Performance Parameters & Limited Warranty

"Seller" and/or "Stearns" refers to Rexnord Industries, LLC (which sells products and services under the Stearns brand) for the entirety of this catalog, warranty, products, and services.

The performance of Stearns brakes, clutches, clutch-brake combinations, solenoids, and controls depends upon the proper application of the product, adequate run in, installation and maintenance procedures, and reasonable care in operation.

All torque values listed in our bulletins are nominal and are subject to the variations normally associated with friction devices. The purchaser should take into consideration all variables shown in the applicable specification sheets. Although our application engineers are available for consultation, final selection and performance assurance on the purchaser's machine is the responsibility of the purchaser. Careful purchaser selection, adequate testing at time of installation, operation and maintenance of all products of the seller are required to obtain effective performance.

Stearns warrants to its purchasers that all its products will be free from defects in material and workmanship at the time of shipment to the purchaser for a period of one (1) year from the date of shipment. All warranty claims must be submitted in writing to Stearns within the warranty period, or shall be deemed waived. As to products or parts thereof which Stearns finds to have been defective at the time of shipment, its sole responsibility hereunder shall be to repair, correct or replace (whichever Stearns deems advisable) such defective products or parts without charge, FOB Stearns factory. In the alternative, Stearns may, at its option, either before or after attempting a different remedy, refund the purchase price upon return of the product or parts.

This warranty shall not apply to any product which has been subjected to misuse: misapplication: neglect (including but not limited to improper maintenance and storage); accident: improper installation; modification (including but not limited to use of other than genuine Stearns replacement parts or attachments); adjustment; or repair.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING THAT OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE, AND OF ANY OTHER OBLIGATION OR LIABILITY ON OUR PART OF ANY KIND OR NATURE WHATSOEVER.

No Stearns representative has any authority to waive, alter, vary or add to the terms hereof without prior approval in writing, to our purchaser, signed by an officer of the seller.

Stearns liability for its products, whether for breach of contract, negligence, strict liability in tort, or otherwise, shall be limited to the repair, correction, or replacement of the products or parts thereof, or to the refund of the purchase price of such products or parts. Stearns will not be liable for any other injury, loss, damage or expense, whether direct or consequential, including but not limited to loss of use, income, profit or production, or increased cost of operation, or spoilage of or damage to material, arising in connection with the sale, installation, use of, inability to use, or the repair or replacement of, or late delivery of, Stearns products.

Any cause of action for breach of the foregoing warranty must be brought within one (1) year from the date the alleged breach occurs.
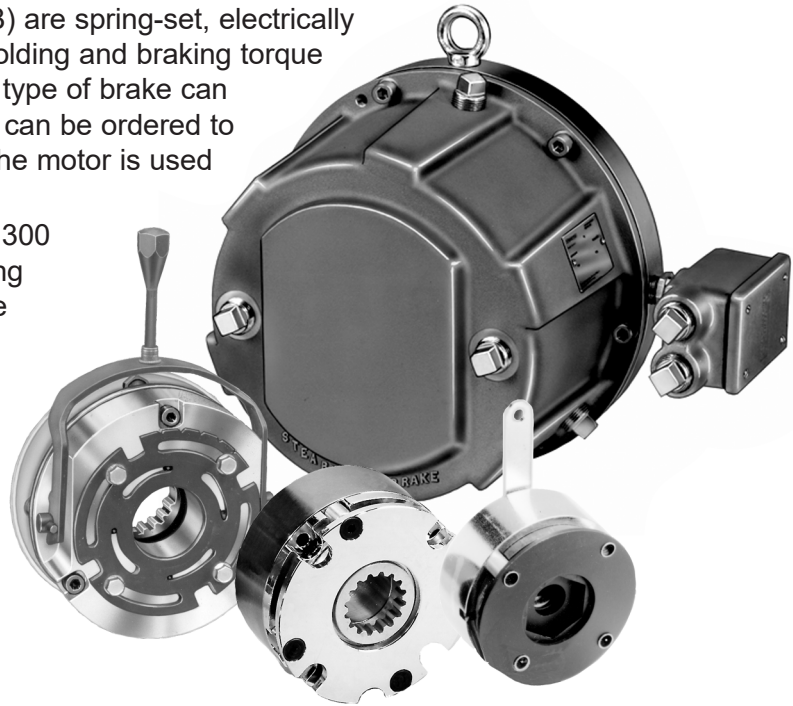
Note on Special Applications:

Stearns products are designed for standard industrial and commercial applications. Operating requirements, environments and required tolerances such as in nuclear and aircraft applications may be beyond the commercial standards of the Stearns Divisions products. Stearns will assume absolutely no responsibility for the use of and/or resale of Stearns products for such applications unless approved in writing in advance by Stearns.

View the most up-to-date terms and conditions at www. regalrexnord.com/terms-and-conditions-of-sale.

Introduction to Armature Actuated Brakes (AAB)

Stearns armature actuated brakes (AAB) are spring-set, electrically released friction devices that develop holding and braking torque in the absence of electrical power. This type of brake can decelerate and hold a rotational load or can be ordered to provide a holding function only, where the motor is used as the dynamic brake.
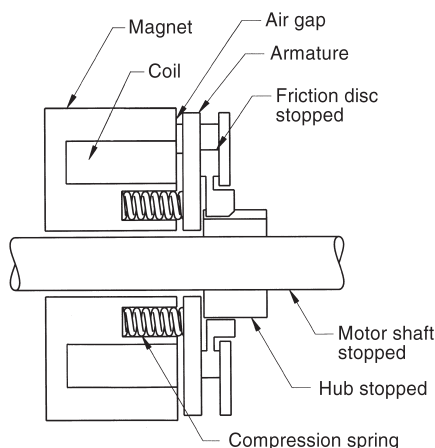
Available sizes range from 3 lb-in up to 300 lb-ft static torque, in a variety of mounting options. A short hub is available for face mounting or to provide for maximum space efficiency. Features include Class H magnet wire coils, corrosion resistance and optional manual release lever. Custom designs and modifications are possible; consult the factory for more information.
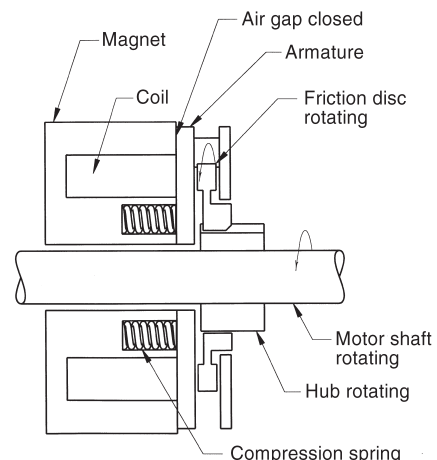
Operating Principle

A hub which is attached to the shaft supports the rotatable friction disc. Brake torque is developed when springs apply a clamping force between the brake armature, friction disc and pressure plate. When electrical power is applied, the armature is pulled by the electromagnetic force in the magnet body assembly which overcomes spring action allowing the friction disc to rotate freely. When electrical power is interrupted, the electromagnetic force is removed and the pressure spring will mechanically force the armature plate to clamp the friction disc between itself and the pressure plate, thereby torque is developed.

Engaged Condition (power off)

Magnet
Air gap
Coil
Armature
Friction disc stopped
Motor shaft stopped
Hub stopped
Compression spring

Disengaged Condition (power on)

Magnet
Air gap closed
Coil
Armature
Friction disc rotating
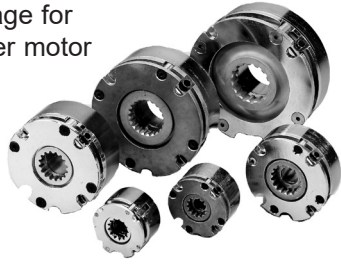Motor shaft rotating
Hub rotating
Compression spring

Armature Actuated Brakes Product Overview

Series 310 & 311

Delivers high torque in a compact package for servo and stepper motor applications.

Sizes ranging from 10 to 400 lb-in, (1.13 to 45.2 Nm) of torque.

Series 320
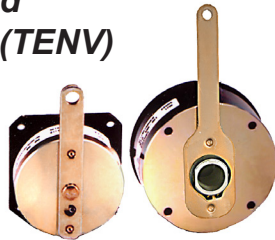
Commercial duty, for small gear motors.

Sizes ranging from 3 to 50 lb-in (.34 to 5.65 Nm) of torque.

Series 321 & Series 322 Totally-Enclosed Non-Ventilated (TENV)

Sizes from 3 to 72 lb-in (.34 to 8.14 Nm) of torque.

Series 321 & Series 322 NEMA C-Face TENV

Direct mounting to 48C and 56C motors.

Sizes from 1.5 to 25 lb-ft (2 to 34 Nm) of torque.

Series 331 & 333

High performance brake for metric/IEC applications.

Direct drop-in for Kebco, Lenze and Binder.

Sizes ranging from 3 to 300 lb-ft, (4 to 400 Nm) of torque.

Series 331 & 333 NEMA C-Face

Adapters for NEMA frame sizes 48C through 405TC/UC.

Enclosed version available in NEMA 48C through 215TC.

Series 350 NEMA C-Face

Pressure plate mounted, IP 56 rating, ideal for portal crane applications.

Torque sizes ranging from 75-300 lb-ft (102-400 Nm).

Series 360

Magnet body mounted brake with IP 56 rating. Ideal for portal crane applications.

Torque sizes ranging from 35-300 lb-ft (47-400 Nm).

Proving Switches & AC Rectifiers

For use with AAB Series 333, 350 and 360.

AAB Modifications
Descriptions & Availability

Armature Actuated Brakes (AAB) Torque Selection

Select the proper torque rating based on horsepower and rpm (speed at the clutch or brake) using the torque selection chart below. Based on 1.4 service factor.

For other service factors and speeds, use the formulas shown below.

Formula for TABLE 1

$$T = \frac{63,025 \times P}{N} \times SF$$

T = Static torque, lb-in.

P = Horsepower, hp

N = Shaft speed at brake, rpm

SF = Service Factor

63,025 = Constant

Formula for TABLE 2

$$T = \frac{5,252 \times P}{N} \times SF$$

T = Static torque, lb-ft.

P = Horsepower, hp

N = Shaft speed at brake, rpm

SF = Service Factor

5,252 = Constant

Caution: Do not use Table 1 to select brakes for overhauling or high inertial loads, or where a stop in specified time or distance is required. For these applications the total inertia of the load and power transmission system must be determined to make a brake selection. Refer to sections on torque and thermal ratings and determination.

NOTE: Series 310 and 311 for holding applications only.

TABLE 1
Series 320, 321 & 322 Static Torque in lb-in. *(Nm)*

Motor hp	rpm									
	600	800	1000	1200	1500	1800	2000	2400	3000	3600
	Static Torque lb-in *(Nm)*									
1/20	18 *(2.03)*	7 *(.79)*	7 *(.79)*	7 *(.79)*	3 *(.34)*	3 *(.34)*	3 *(.34)*	3 *(.34)*	3 *(.34)*	3 *(.34)*
1/12	18 *(2.03)*	18 *(2.03)*	7 *(.79)*	7 *(.79)*	7 *(.79)*	7 *(.79)*	7 *(.79)*	3 *(.34)*	3 *(.34)*	3 *(.34)*
1/8	35 *(3.95)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	7 *(.79)*	7 *(.79)*	7 *(.79)*	7 *(.79)*	3 *(.34)*
1/6	35 *(3.95)*	35 *(3.95)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	7 *(.79)*	7 *(.79)*	7 *(.79)*
1/4	—	35 *(3.95)*	35 *(3.95)*	35 *(3.95)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	7 *(.79)*
1/3	—	—	35 *(3.95)*	35 *(3.95)*	35 *(3.95)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*	18 *(2.03)*
1/2	—	—	—	—	35 *(3.95)*	35 *(3.95)*	35 *(3.95)*	35 *(3.95)*	18 *(2.03)*	18 *(2.03)*
3/4	—	—	—	—	—	—	35 *(3.95)*	35 *(3.95)*	35 *(3.95)*	35 *(3.95)*
1	—	—	—	—	—	—	—	—	—	35 *(3.95)*

TABLE 2
Series 333, 350 & 360 Static Torque in lb-ft. *(Nm)*

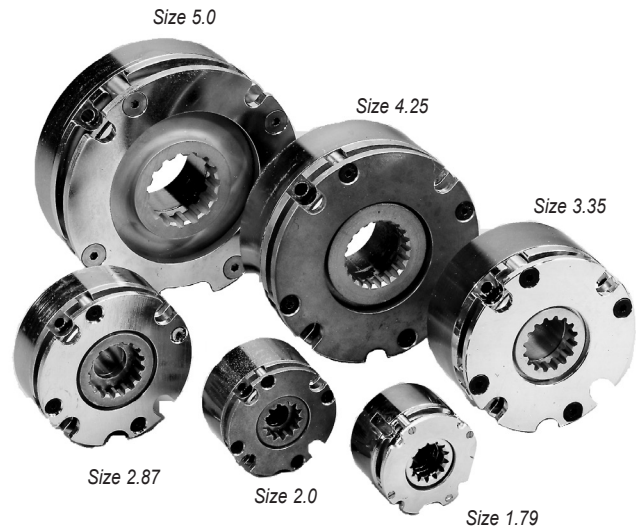| Motor hp *(kw)*	rpm									
	600	800	1000	1200	1500	1800	2000	2400	3000	3600
	Static Torque lb-ft *(Nm)*									
1/3 *(.25)*	6 *(8)*	6 *(8)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*
1/2 *(.37)*	12 *(16)*	6 *(8)*	6 *(8)*	6 *(8)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*
3/4 *(.55)*	12 *(16)*	12 *(16)*	6 *(8)*	6 *(8)*	6 *(8)*	6 *(8)*	3 *(4)*	3 *(4)*	3 *(4)*	3 *(4)*
1 *(.75)*	25 *(34)*	12 *(16)*	12 *(16)*	12 *(16)*	6 *(8)*	6 *(8)*	6 *(8)*	6 *(8)*	6 *(8)*	3 *(4)*
1-1/2 *(1.1)*	25 *(34)*	25 *(34)*	12 *(16)*	12 *(16)*	12 *(16)*	12 *(16)*	6 *(8)*	6 *(8)*	6 *(8)*	6 *(8)*
2 *(1.5)*	25 *(34)*	25 *(34)*	25 *(34)*	25 *(34)*	12 *(16)*	12 *(16)*	12 *(16)*	6 *(8)*	6 *(8)*	6 *(8)*
3 *(2.2)*	45 *(60)*	45 *(60)*	25 *(34)*	25 *(34)*	25 *(34)*	25 *(34)*	12 *(16)*	12 *(16)*	12 *(16)*	12 *(16)*
5 *(3.7)*	60 *(80)*	60 *(80)*	45 *(60)*	45 *(60)*	25 *(34)*	25 *(34)*	25 *(34)*	25 *(34)*	25 *(34)*	12 *(16)*
7-1/2 *(5.6)*	110 *(150)*	110 *(150)*	60 *(80)*	60 *(60)*	45 *(60)*	45 *(60)*	45 *(60)*	25 *(34)*	25 *(34)*	25 *(34)*
10 *(7.5)*	180 *(240)*	110 *(150)*	110 *(150)*	110 *(150)*	60 *(80)*	45 *(60)*	45 *(60)*	45 *(60)*	25 *(34)*	25 *(34)*
15 *(11.2)*	300 *(400)*	180 *(240)*	110 *(150)*	110 *(150)*	110 *(150)*	60 *(80)*	60 *(80)*	60 *(80)*	45 *(60)*	45 *(60)*
20 *(14.9)*	300 *(400)*	180 *(240)*	180 *(240)*	180 *(240)*	110 *(150)*	110 *(150)*	110 *(150)*	60 *(80)*	60 *(80)*	60 *(80)*
25 *(18.6)*	—	300 *(400)*	180 *(240)*	180 *(240)*	180 *(240)*	110 *(150)*	*	*	*	*
30 *(22.4)*	—	300 *(400)*	300 *(400)*	300 *(400)*	180 *(240)*	180 *(240)*	*	*	*	*
40 *(29.8)*	—	—	300 *(400)*	300 *(400)*	300 *(400)*	180 *(240)*	*	*	*	*
50 *(37.3)*	—	—	—	—	300 *(400)*	300 *(400)*	*	*	*	*
60 *(44.7)*	—	—	—	—	300 *(400)*	300 *(400)*	*	*	*	*

* Exceeds maximum speed rating.

Series 310
Mounting Face: Servo Motor

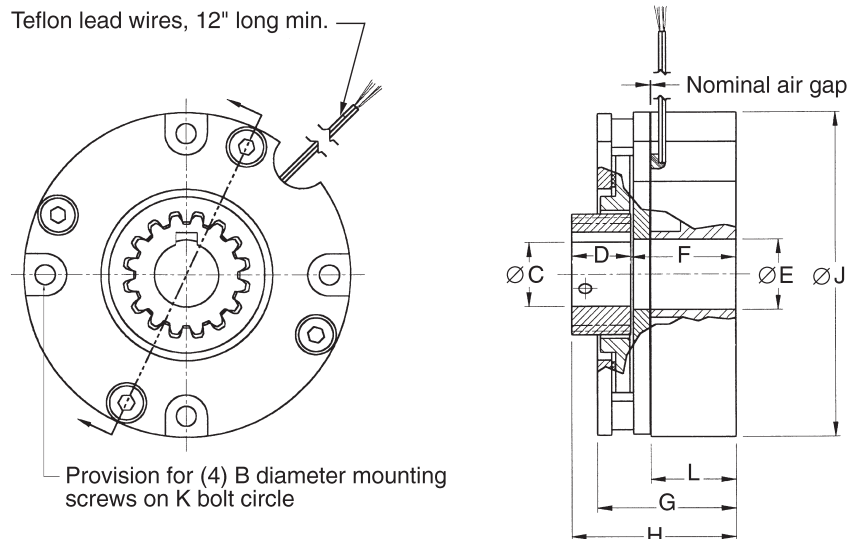**Static Torque:** 10 through 350 lb-in (1.13 to 39.5 Nm)

Installation & Service Instructions: P/N 8-078-888-00

Features

• Spring activated and DC voltage released

• High torque, compact size

• Splined hub for quiet dependable operation

• Corrosion resistant finishes

• Low inertia rotating parts

• Holding applications only

• Standard voltages 24 and 90 Vdc; 115 and 230 Vac

• Available voltages 12, 36, 48 and 180 Vdc

• Coil insulation: Class 180(H)

Size 5.0
Size 4.25
Size 3.35
Size 2.87
Size 2.0
Size 1.79

Option A, Long Hub

Teflon lead wires, 12" long min.

Nominal air gap

ØC D F ØE ØJ

L
G
H

Provision for (4) B diameter mounting screws on K bolt circle

Dimensions in Inches (mm)

| Size | Model Number | Mounting Screw | | ØC Maximum | D Hub Lengths | ØE | Hub Location | G | H Overall | ØJ | L Mounting Screw thru Mag. Body |
		B	K				F				
1.79	310-24010	#2 (M2)	Ø1.640 (41.656)	5/16 (8mm)	.406 (10.31)	.560 (14.22)	.914 (23.22)	1.185 (30.10)	1.320 (33.53)	1.79 (45.47)	.354 (9)
	310-25010						1.06 (26.92)	1.325 (33.66)	1.470 (37.34)		
2.35	310-34010	#6 (M3)	Ø1.770 (44.958)	5/16 (8mm)	.406 (10.31)	.425 (10.80)	.969 (24.62)	1.190 (30.23)	1.375 (34.93)	2.00 (50.80)	.845 (21.5)
2.87	310-44010	#8 (M4)	Ø2.500 (63.500)	5/8 (15mm)	.520 (13.21)	.625 (15.88)	.927 (20.55)	1.220 (30.99)	1.447 (36.75)	2.87 (72.89)	.750 (19)
3.35	310-54010	#10 (M5)	Ø2.913 (73.990)	5/8 (15mm)	.700 (17.78)	1.125 (28.58)	1.213 (30.81)	1.630 (41.40)	1.913 (48.59)	3.35 (85.09)	1.086 (27.6)
4.25	310-64010	1/4 (M6)	Ø3.750 (95.250)	7/8 (22mm)	.700 (17.78)	1.500 (38.10)	1.336 (33.93)	1.752 (44.50)	2.036 (51.7)	4.25 (107.95)	1.085 (27.6)
5.0	310-74010	1/4 (M6)	Ø4.500 (114.300)	15/16 (24mm)	.800 (20.32)	1.750 (44.45)	1.387 (35.23)	1.905 (48.39)	2.187 (55.55)	5.00 (127.00)	1.062 (27)

Series 310 Continued
Mounting Face: Servo Motor

Engineering Specifications

Size	Part Number	Nominal Static Torque		Friction Material Type	Approximate Weight		Electric Power (watts)	Hub and Disc Inertia	
		lb-in	Nm		lbs	kg		lb-in-sec²	kg-cm-sec²
1.79	310-24010-XX-XX	10	1.13	Holding	.5	0.23	13	1.7275E-05	1.9876E-05
	310-25010-XX-XX	13	1.47						
2.0	310-34010-XX-XX	18	2.03	Holding	.7	.32	17	1.6150E-05	1.8582E-05
2.87	310-44010-XX-XX	40	4.52	Holding	1.5	.68	17	1.1150E-04	1.2829E-04
3.35	310-54010-XX-XX	140	15.8	Holding	3	1.36	22	1.6047E-04	1.8464E-04
4.25	310-64010-XX-XX	200	22.5	Holding	4.5	2.04	26	6.4099E-04	7.3751E-04
5.0	310-74010-XX-XX	350	39.5	Holding	6.6	2.99	19	1.9996E-03	2.3007E-03

Ordering Information

310- 2 4 0 1 0 - 0 H - J A

Group "3" Armature Acting Brake

3-10: For AAB-S Models

AAB-S Unit Sizes	Part Number
1.79	2
2.0	3
2.87	4
3.35	5
4.25	6
5.0	7

4=Standard Torque
3= Reduced Torque

Options – **TABLE 3**
Voltages – **TABLE 2**
Hub bore and Keyseat – **TABLE 1**

Character	Options	Available by size
0	standard brake	ALL
H	Quiet operation, plastic carrier disc	1.79, 2.0, 2.87, 3.35*, 4.25*

*With carrier disc option, size 3.35 torque is 50 lb-in holding, and size 4.25 torque is 100 lb-in holding

Numeral or Letter	Options
1	Standard Unit

Numeral	Enclosure
0	None

Table 1: Hub Bores 310-24010-XX-JA

Character to insert	Bore +001/.001	Keyway Size		Bores Available (Size)					
		Width inches	Depth inches	1.79	2.0	2.87	3.35	4.25	5.0
0D	1/4	1/16	1/32	X	X				
0F	5/16	1/16	1/32	X	X				
0H	3/8	3/32	3/64	X	X	X			
0J	1/2	1/8	1/16		X	X			
0L	5/8	3/16	3/32		X	X	X	X	
0N	3/4	3/16	3/32					X	X
0O	7/8	3/16	3/32					X	X
0P	15/16	1/4	1/8						X
	Metric	mm	mm						
06	6	2	1	X	X				
07	7	2	1	X	X				
08	8	2	1	X	X				
09	9	3	1.4			X			
10	10	3	1.4			X			
11	11	4	1.8			X			
12	12	4	1.8			X			
14	14	5	2.3			X	X	X	
15	15	5	2.3			X	X	X	
17	17	5	2.3					X	X
18	18	6	2.8					X	X
19	19	6	2.8					X	X
20	20	6	2.8					X	X
22	22	6	2.8					X	X
23	23	8	3.3						X
24	24	8	3.3						X

NOTE: Non-standard bore sizes available, contact factory.

Table 2: Coil Voltage 310-2401-0H-XA

Character to insert	Voltage	Current Rating in amps					
		1.79	2.0	2.87	3.35	4.25	5.0
C	*12 Vdc	1.01	1.10	1.29	1.82	1.76	1.26
E	24 Vdc	.51	.55	.66	.93	.89	.64
G	*48 Vdc	.27	.29	.35	.46	.54	.40
J	90 Vdc	.13	.14	.16	.23	.22	.16
L	*180 Vdc	.08	.09	.09	.13	.14	.11
N	115 Vac	.11	.16	.16	.17	.25	.17
P	230 Vac	.06	.08	.08	.09	.13	.09

*These voltages are non-standard.

Table 3: Options 310-24010-0H-JX

Character	Options	Available by size
A	Basic Brake, Magnet Body Mounted, Long Hub	1.79, 2.0, 2.87, 3.35* 4.25*, 5.0*

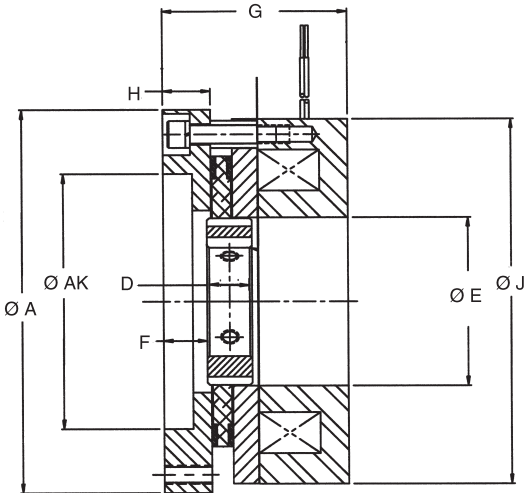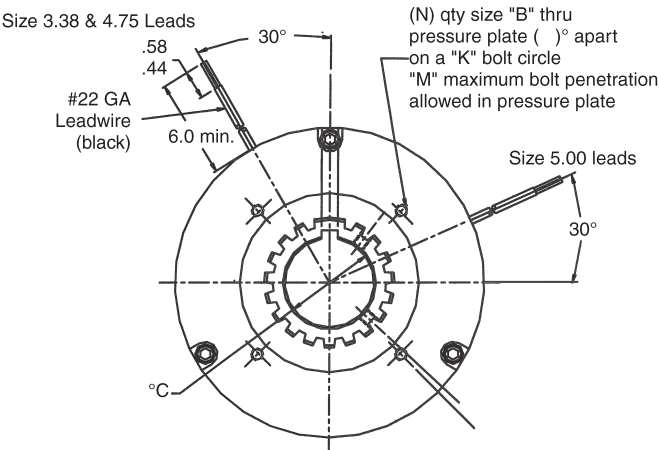*Sizes 3.35, 4.25 and 5.0 have a pass-through hub.

Series 311
Mounting Face: Servo Motor

Static Torque: 75 through 400 lb-in (8.5 to 45.2 Nm)

Installation & Service Instructions: P/N 8-078-888-00

Features

• Spring activated and DC voltage released

• Splined hub for quiet dependable operation

• Corrosion resistant finishes

• Low inertia rotating parts

• Holding applications only

• Standard voltages 24 and 90 Vdc

• Available voltages 12, 36, 48 and 180 Vdc

• Coil insulation: Class 180(H)

Size 3.38 & 4.75 Leads
.58
.44
30°

#22 GA Leadwire (black)
6.0 min.

(N) qty size "B" thru pressure plate ( )° apart on a "K" bolt circle "M" maximum bolt penetration allowed in pressure plate

Size 5.00 leads
30°

°C

Ø A
Ø AK   D
F
G
H
Ø E
Ø J

Dimensions in Inches (*mm*)

Size	Model Number	K	N	B	ØA	ØAK	ØC Maximum	D Hub Lengths	ØE	Hub Location F	G	H	ØJ	M
3.38	311-54010	2.500 (63.500)	Qty. 2 (180°) apart	#10-24 UNC	3.375 (85.725)	-	1.125	1.00 (25.4)	1.713 (43.51)	.30 (7.620)	1.999 (50.775)	.383 (9.728)	3.380 (85.852)	.360 (9.144)
4.75	311-64010	3.125 (79.375)	Qty. 4 (90°) apart	#10-32 UNF	4.750 (120.650)	2.750 (69.850)	1.375	.562 (14.27)	2.350 (59.690)	.16 (4.064)	2.310 (58.670)	.493 (12.522)	4.750 (120.65)	.465 (11.811)
5.0	311-74010	4.750 (120.650)	Qty. 6 (60°) apart	1/4-20 UNC	5.250 (133.35)	3.500 (88.900)	1.500	.620 (15.75)	2.312 (58.725)	.60 (15.240)	2.540 (64.516)	.656 (16.662)	5.00 (127.00)	.625 (15.875)

NOTE: Mounting bolt circles, mounting hole thread sizes, and quantity of mounting holes can be changed to meet your requirements. Please contact factory to request mounting dimensions other than those shown here.
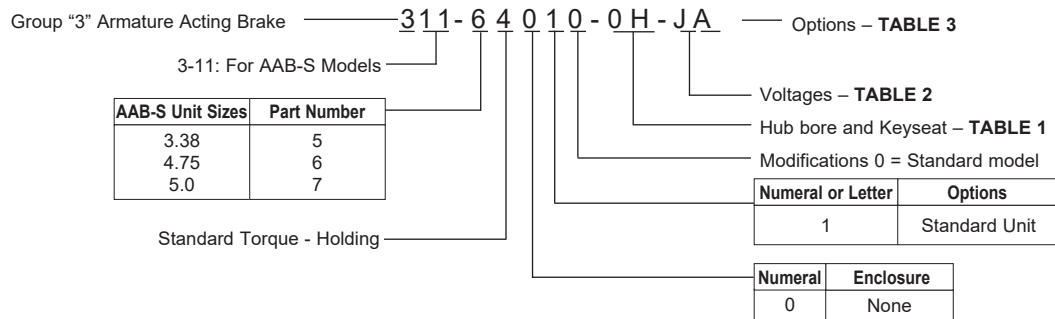
Series 311 Continued
Mounting Face: Servo Motor

Engineering Specifications

Size	Part Number	Nominal Static Torque		Friction Material Type	Approximate Weight		Electric Power (watts)	Hub and Disc Inertia	
		lb-in	*Nm*		lbs	*.35*		lb-in-sec²	kg-cm-sec²
3.38	311-54010-XX-XX	75	*8.5*	holding	2.75	*1.25*	25	5.2 E-04	*5.99E-04*
4.75	311-64010-XX-XX	120	*13.6*	holding	7.00	*3.18*	30	1.48E-03	*1.71E-03*
5.0	311-74010-XX-XX	400	*45.2*	holding	8.75	*3.97*	30	1.87E-03	*2.16E-03*

Ordering Information

Group "3" Armature Acting Brake ——— 3 1 1 - 6 4 0 1 0 - 0 H - J A ——— Options – **TABLE 3**

3-11: For AAB-S Models

AAB-S Unit Sizes	Part Number
3.38	5
4.75	6
5.0	7

Standard Torque - Holding

Voltages – **TABLE 2**

Hub bore and Keyseat – **TABLE 1**

Modifications 0 = Standard model

Numeral or Letter	Options
1	Standard Unit

Numeral	Enclosure
0	None

Table 1: Hub Bores 311-64010-XX-JA

Character to insert	Bore +001/.001	Keyway Size*		Bores Available (Size)		
		Width inches	Depth inches	3.38	4.75	5.0
0B	5/8	3/16	3/32	X	X	
0D	7/8	3/16	3/32	X	X	X
0E	1-1/8	1/4	1/8	X	X	X
0G	1-3/8	1/4	1/8		X	X
0M	1-1/2	1/4	1/8			X
	Metric	*mm*	*mm*			
12	12	4	1.8	X		
14	14	5	2.3	X	X	
15	15	5	2.3	X	X	
17	17	5	2.3	X	X	
18	18	6	2.8	X	X	
19	19	6	2.8	X	X	
20	20	6	2.8	X	X	
22	22	6	2.8	X	X	X
23	23	8	3.3	X	X	X
24	24	8	3.3	X	X	X
25	25	8	3.3	X	X	X
26	26	8	3.3	X	X	X
28	28	8	3.3	X	X	X
30	30	8	3.3		X	X
32	32	10	3.3		X	X
34	34	10	3.3		X	X
35	35	10	3.3			X
36	36	10	3.3			X
38	38	10	3.3			X

NOTE: Non-standard bore sizes available, contact factory.
*Keyseats made to ANSI B17.1 standard.

Table 2: Coil Voltage 311-6401-0H-XA

Character to insert	Voltage
C	*12 Vdc
E	24 Vdc
G	*48 Vdc
J	90 Vdc
L	*180 Vdc

*These voltages are non-standard.

Table 3: Options 311-64010-0H-JX

Character	Options
A	Basic Brake, Endplate Mounted, Long Hub*

*Pass-through hub.

Series 320
Mounting Face: Small Gear Motor

Static Torque: 3 through 50 lb-in / (.34 to 5.65 Nm)

Installation & Service Instructions: P/N 8-078-889-00
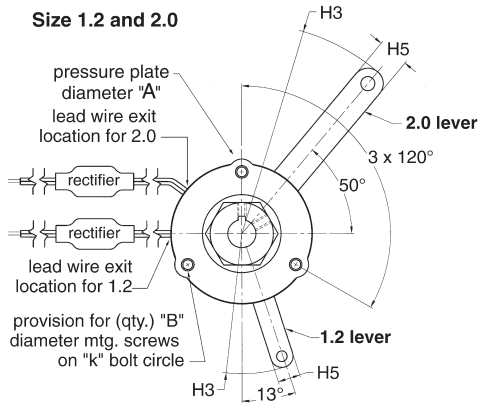
Features
- UR and CUR recognized insulation system, E-125303 and sizes 1.8, 2.8 brakes with internal power supply File E-71115
- Class B temperature rise with Class H mag wire
- Holding (H) or dynamic (D) stopping applications
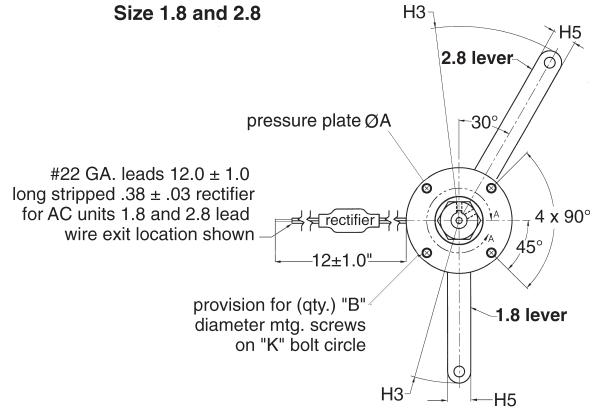- Corrosion resistant

Options
- "Double D" friction discs are available in 3-7 lb-in dynamic and 3-15 lb-in holding brakes. DD shafts fit the brake directly without a brake hub, no shaft keyway cost and simplify assembly.
- Maintained manual release
- Mounting plates
- AC rectifiers - internal or external in-line
- Band seal (not available for 1.2 size)

Maintained manual release option

Shown with and without maintained manual release

Size 1.2 and 2.0

Size 1.8 and 2.8

Option A (magnet body mount, long hub)

Option D (Pressure plate mount, short hub)

1.2 = .090
1.8, 2.0, 2.8=.135

Optional Manual Release Shown

maximum .195 (manual rel.)

Double D Option: flat shaft, no hub break shaft edge .01−.03"

Shaft   D Disc

Brake Size	A	B
1.2	.25 + .05/-.00	.075 max.
1.8	.30 + .13/-.00	.075 max.

Shaft Size	C	D	E
5/16	.052	.105 /.103	.3135 /.3115
3/8	.063	.126 /.124	.376 /.374

Dimensions in Inches (mm)

Size	Model Number	Mounting Screw			Maximum Shaft Length (Manual Release Units)		Hub Location		ØE**	G	H Long Hub	H3	H5	ØJ	D Hub Lengths		ØA
		Qty.	B	K			F	F`							Long	Short	
1.2D 1.2H	3-20-2401G 3-20-2501G	3	Ø.140 #4, (M3)	Ø1.545 (39.243)	.300	(7.62)	.685 (17.40) .860 (21.84)	.015 (.381)	.410 (10.41	.890 (22.60) 1.065 (27.05)	1.065 (27.05) 1.240 (31.50)	2.5 (63.5)	.40 (10.16)	1.77 (44.96)	.38 (9.65)	.19 (4.83)	1.925 (48.90)
1.8D 1.8H	3-20-4401G 3-20-4501G	4	Ø.177 #6 (M3.5)	Ø2.125 (53.975)	.430	(10.92)	.995 (25.27)	.015 (.381)	.450 (11.43)	1.260 (32.00)	1.405 (35.69)	3.775 (95.885)	.55 (10.16)	2.43 (61.72)	.410 (10.41)	.25 (6.35)	2.55 (64.77)
2.0D 2.0H	3-20-5401G 3-20-5501G	3	Ø.145 #6 (M3)	Ø2.220 (56.388)	.430	(10.92)	.933 (23.70)	.015 (.381)	.530 (13.46)	1.190 (30.23)	1.623 (41.22)	3.775 (95.885)	.55 (10.16)	2.50 (63.5)	.69 (17.53)	.31 (7.87)	2.50 (63.50)
2.8D 2.8H	3-20-7401G 3-20-7501G	4	Ø.188 #8 (M4)	Ø2.844 (72.738)	.490	(12.45)	.954 (24.23)	.050* (1.27)	1.10 (27.94)	1.415 (35.94)	1.364 (34.64)	4.5 (95.885)	.55 (10.16)	3.25 (82.55)	.410 (10.41)	*	3.32 (84.33)

*Size 2.8 can be pressure plate mounted using the long hub. The F` dimension shown for size 2.8 is for pressure plate mount using the long hub.
**No thru bore with manual release option.

Series 320 Continued
Mounting Face: Small Gear Motor

Engineering Specifications

Size	Part Number	Nominal Static Torque		Friction Material	Approx Weight		Electric Power	Hub and Disc Inertia	Thermal Capacity	Maximum Bore	
		lb-in	Nm	Type	lbs	kg	(watts)	oz-in-sec²	HP-sec/min	in	mm
1.2D	3-20-2401G-XX-XX	3	.34	Dynamic	.4	.181	7	7.02×10^{-5}	Consult Factory	3/8	9
1.2H[1]	3-20-2501G-XX-XX	5[1]	.56	Holding[1]	.4	.181	9	7.02×10^{-5}		3/8	9
1.8D	3-20-4401G-XX-XX	7	.79	Dynamic	1.1	.499	10	4.8×10^{-4}	.26	1/2[2]	12
1.8H[1]	3-20-4501G-XX-XX	15[1]	1.69	Holding[1]	1.1	.499	10	4.8×10^{-4}		1/2[2]	12
1.8D	3-20-4601G-XX-XX	15	1.69	Dynamic	1.1	.499	10	4.8×10^{-4}		1/2[2]	12
2.0D	3-20-5401G-XX-XX	18	2.03	Dynamic	1.2	.544	12.5	2.23×10^{-3}	.32	1/2	12
2.0H[1]	3-20-5501G-XX-XX	30[1]	3.39	Holding[1]	1.2	.544	12.5	2.23×10^{-3}		1/2	12
2.8D	3-20-7401G-XX-XX	35	3.95	Dynamic	2.0	.91	17	2.3×10^{-3}	.17	1/2[2]	12
2.8H[1]	3-20-7501G-XX-XX	50	5.65	Holding[1]	2.0	.91	17	2.3×10^{-3}		1/2[2]	12

[1] For holding applications only. [2] Set screws located 120° from keyway.

Ordering Information

Group "3" Armature Acting Brake. — 320- 4 4 0 1 G - 0 H - J D — Options – **Table 3**

320 = For AAB-R Models

AAB-R Unit Sizes	Part Number
1.2	2
1.8	4
2.0	5
2.8	7

Voltages – **Table 2**

Hub bore and Keyway – **Table 1**
For Double "D" Bores See **Table 1A**

Character		Nominal Static Torque (lb-in)
Size 1.2	4	3 Dynamic
	5	5 Holding
Size 1.8	4	7 Dynamic
	6	15 Dynamic
	9	9 Dynamic
	5	15 Holding
Size 2.0	4	18 Dynamic
	5	30 Holding
	3	15 Dynamic
	6	25 Holding
	7	7 Dynamic
Size 2.8	4	35 Dynamic
	5	50 Holding

Characters to insert	Modification
E	Brake release indicator (NC)
F	Brake release indicator (NO)
G	Standard - GGA Friction Material
J	CCW manual release rotation
S	Carrier ring friction disc

Numeral or Letter	Options
1	Standard Unit
A-Z	Reserved for Mounting Plates

Numeral	Enclosure
0	None
2	Band seal

Table 1: 320-44010-XX-JD

Characters to insert	Bore	Keyway Size*		Bores Available			
		Width (in.) x Depth (in.)		Mag Body Size			
				1.2	1.8	2.0	2.8
0A	3/16	N/A	N/A	X			
0B	3/16	1/16	1/32	X			
0C	1/4	N/A	N/A	X			
0D	1/4	1/16	1/32	X	X	X	
0E	5/16	N/A	N/A	X			
0F	5/16	1/16	1/32	X	X	X	
0G	3/8	N/A	N/A	X			
0H	3/8	3/32	3/64	X	X	X	
0J	1/2	1/8	1/16	[1]	[1]	[1]	
05	5	2 mm	1 mm	[2]	X	X	X
06	6	2 mm	1 mm	[2]	X	X	X
07	7	2 mm	1 mm	[2]	X	X	X
08	8	2 mm	1 mm	[2]	X	X	X
09	9	3 mm	1.4 mm	[2]	X	X	X
10	10	3 mm	1.4 mm		X	X	X
11	11	4 mm	1.8 mm		X	X	X
12	12	4 mm	1.8 mm		X	X	X

[1] Set screws located 120° from keyway.
[2] Hubs are provided without keyway.
*Keyseats made to ANSI B17.1 standard.

Table 1A: 320-44010-XX-JX
(Double "D" Bores)

Characters to insert	Bore	Bores Available	
		Mag Body Size	
		1.2	1.8H
0F	5/16	X	X
0H	3/8	X	X

NOTE: Can be used up to 15 lb-in for holding.

Table 2: 320-44010-0H-XD
Standard Coil Voltage

Character to Insert	Voltage	Current Rating in Amps			
		Size 1.2	Size 1.8	Size 2.0	Size 2.8
C	12 Vdc	.632	.826	1.04	1.37
E	24 Vdc	.307	.421	.53	.70
G	48 Vdc	.158	.216	.27	.36
J	90 Vdc	.076	.123	.13	.17
K	103 Vdc	.085	.115	.121	.140
L	180 Vdc	.039	.060	.069	.09
N	115 Vac	.085	.115	.140	.140
P	230 Vac	.044	.059	.075	.097
Z	115/230 Vac	.085/.044	.115/.059	.140/.075	.140/.097

NOTE: 65°C maximum ambient temperature for all external in-line rectifiers.

Table 3: Options 320-44010-0H-JX

Characters	Options
A	Basic Brake, Magnet Body Mounted, Long Hub
D*	Basic Brake, Pressure Plate Mounted, Short Hub*
G*	Short Hub, Pressure Plate Mounted with Maintained Manual Release*
H	Long Hub with Maintained Manual Release, Size 2.8 Only
X	Double "D" Friction Disc, 1.2H, 1.2D, 1.8H
Y	Option X with Maintained Manual Release Pressure Plate Mounted

*Short hub not required for size 2.8 pressure plate mount.

NOTE: *Final part number may change due to specifications or options selected or other product design considerations. A number such as a 2, 3, 4 etc., in the 12th position is used to designate a unique brake (custom) and can only be assigned by Stearns Design Engineering Department.*

Modifications are available - see AAB Modification Section.

Series 321 & Series 322 Totally-Enclosed Non-Ventilated (TENV)

Mounting Face: Small Gear Motor

Static Torque: 3 lb-in through 72 lb-in (.34 to 8.14 Nm)

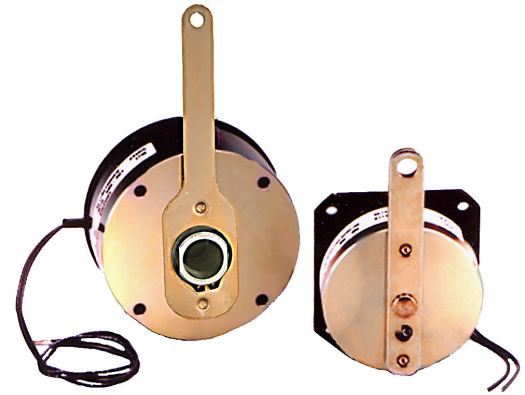***IP Rating:*** 321 Series IP 42; 322 Series IP 54

Installation & Service Instructions: P/N 8-078-901-00

Features
• UR and CUR recognized insulation system - File E-125303; sizes 1.8 and 2.8 brakes and 48C and 56C motor frame brakes with internal power supply File E-71115

• Class B temperature rise with Class H mag wire

• Pressure plate mount

• Direct-acting, quiet operation

Options
• "Double D" friction discs are available in 3-7 lb-in dynamic and 3-15 lb-in holding brakes. DD shafts fit the brake directly without a brake hub, no shaft keyway cost and simplify assembly.

• Maintained manual release lever, or non-maintained pull release

• Through-shaft

• AC rectifiers - internal or external in-line (availability depends on size)
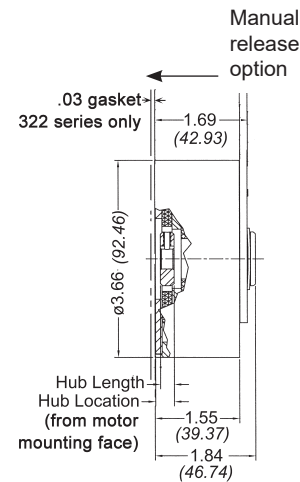
Size 2.8 with thru-shaft and manual release option.

Size 1.8 flange mount with manual release option.

Size 1.2 & 1.8

Size 2.8

Dimensions in Inches (mm)

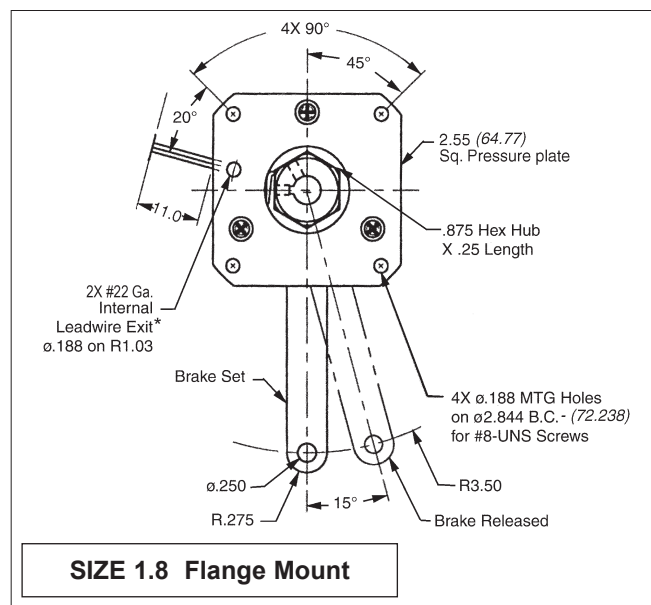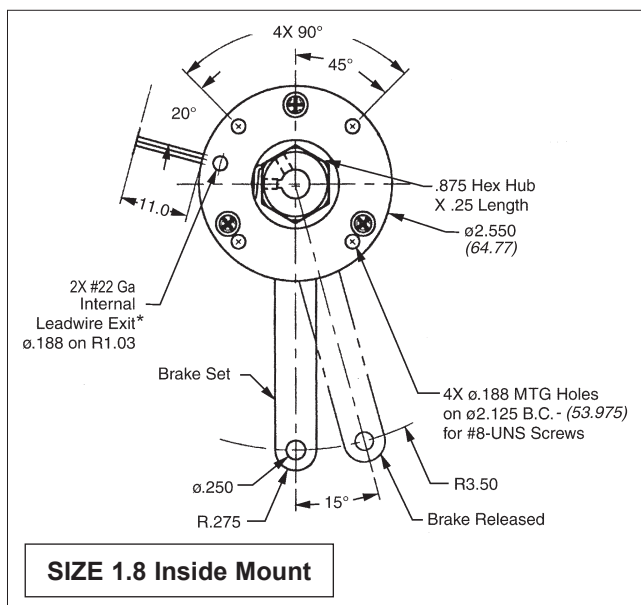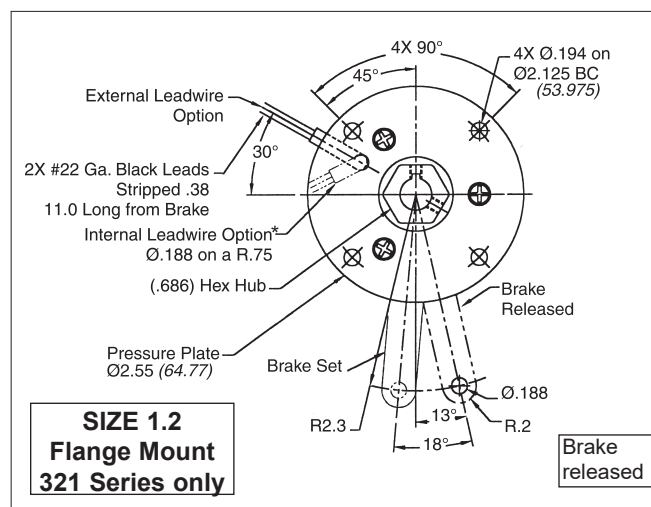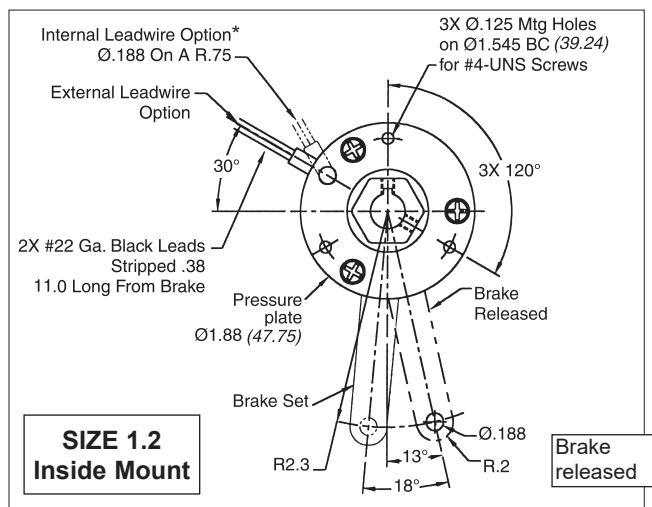| Size	Nominal Static Torque		Basic Model Number	A	H	ØD		Hub Location	Hub Length
	Lb-in	Nm				Series	Mag Body Ø		
1.2 Dynamic	3	.34	3-21-24	.904 (22.962)	.12 (3.05)	321	1.77 (44.96)	.02 (.51)	.19 (4.83)
			3-22-24			322	1.875 (47.625)	.05 (1.27)	
1.2 Holding	5	.56	3-21-25	1.080 (27.432)		321	1.77 (44.96)	.02 (.51)	
			3-22-25			322	1.875 (47.625)	.05 (1.27)	
1.8 Dynamic	7	.79	3-21-44			321		.02 (.51)	
			3-22-44			322		.05 (1.27)	
1.8 Holding	15	1.69	3-21-45	1.296 (32.918)	.12 (3.05)	321	2.50 (63.50)	.02 (.51)	.25 (6.35)
			3-22-45			322		.05 (1.27)	
1.8 Dynamic	15	1.69	3-21-46			321		.02 (.51)	
			3-22-46			322		.05 (1.27)	
2.8 Dynamic	35	3.95	3-21-74	–	–	321	3.66 (92.96)	.100 (2.54)	.25 (6.35)
			3-22-74			322		.125 (3.18)	
2.8 Dynamic	50	5.65	3-21-75	–	–	321	3.66 (92.96)	.100 (2.54)	.25 (6.35)
			3-22-75			322		.125 (3.18)	
2.8 Holding	72	8.14	3-21-77	–	–	321	3.66 (92.96)	.100 (2.54)	.25 (6.35)
			3-22-77			322		.125 (3.18)	

Engineering Specifications

Size	Basic Model Number	Nominal Static Torque Lb-in (Nm)	Approx. Weight		Power (watts)	Hub and Disc inertia (Oz-in-sec²)	Thermal Capacity HP-sec/min	Maximum Bore Size	
			lbs	kg				in	mm
1.2 Dynamic	3-2X-24	3 (.34)	.4	.18	7	7.02 x 10⁻³	Consult Factory	3/8	9
1.2 Holding	3-2X-25	5 (.56)			9				
1.8 Dynamic	3-2X-44	7 (.79)	1.3	.59	10	4.8 x 10⁻⁴	.26	1/2**	12**
1.8 Holding	3-2X-45	15 (1.69)							
1.8 Dynamic	3-2X-46	15 (1.69)							
2.8 Dynamic	3-2X-74	35 (3.95)	2.0	.91	17	2.3 x 10⁻³	.17	1/2	12
2.8 Dynamic	3-2X-75	50 (5.65)	2.0	.91	17	2.3 x 10⁻³		1/2	12
2.8 Holding	3-2X-77	72 (8.14)	2.0	.91	22	2.3 x 10⁻³		1/2	12

**Set screws located 120° from keyway.

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Series 321 & Series 322 TENV Continued

Small Gear Motor

Internal Leadwire Option*
Ø.188 On A R.75

External Leadwire
Option

3X Ø.125 Mtg Holes
on Ø1.545 BC (39.24)
for #4-UNS Screws

30°

3X 120°

2X #22 Ga. Black Leads
Stripped .38
11.0 Long From Brake

Pressure plate
Ø1.88 (47.75)

Brake
Released

Brake Set

R2.3

13°

Ø.188

R.2

18°

Brake released

SIZE 1.2 Inside Mount

4X 90°

45°

4X Ø.194 on
Ø2.125 BC
(53.975)

External Leadwire
Option

30°

2X #22 Ga. Black Leads
Stripped .38
11.0 Long from Brake

Internal Leadwire Option*
Ø.188 on a R.75

(.686) Hex Hub

Pressure Plate
Ø2.55 (64.77)

Brake Set

Brake
Released

Ø.188

R2.3

13°

R.2

18°

Brake released

SIZE 1.2 Flange Mount 321 Series only

4X 90°

45°

20°

11.0

.875 Hex Hub
X .25 Length

ø2.550
(64.77)

2X #22 Ga
Internal
Leadwire Exit*
ø.188 on R1.03

Brake Set

4X ø.188 MTG Holes
on ø2.125 B.C.- (53.975)
for #8-UNS Screws

ø.250

R.275

15°

R3.50

Brake Released

SIZE 1.8 Inside Mount

4X 90°

45°

20°

11.0

2.55 (64.77)
Sq. Pressure plate

.875 Hex Hub
X .25 Length

2X #22 Ga.
Internal
Leadwire Exit*
ø.188 on R1.03

Brake Set

4X ø.188 MTG Holes
on ø2.844 B.C.- (72.238)
for #8-UNS Screws

ø.250

R.275

15°

R3.50

Brake Released

SIZE 1.8 Flange Mount

Brake
Released

15°

R.275

R4.23

ø.25

Brake Set

Manual Release
(Optional)

Star Hub

Internal
Leadwire Exit*
ø.19 ON R1.42

45°

4X 90°

(#22Ga AC)
(#20Ga DC)
Stripped .38
12.0±.5 Long
from Brake

4X ø.188 Mtg. Holes
ON ø2.844 Bolt Circle
for #8 UNS Screws

SIZE 2.8 Inside Mount

Brake Released

15°

R.275

R4.23

ø.25

Brake Set

Manual Release
(Optional)

Star Hub

Internal Leadwire Exit*
Ø.19 on R1.42

(#22Ga AC)
(#20Ga DC)
Stripped .38
12.0±.5 Long
from Brake

3 X 120°

3 X Ø.180 Mtg. Holes
on Ø 2.835 (72 mm) B.C.
for M4 screws

SIZE 2.8 72mm Mount

*Also, the location of the external leads for the 322 series is on the backside of the magnet body - not on the side (as shown in the above drawings) as with the 321 series.
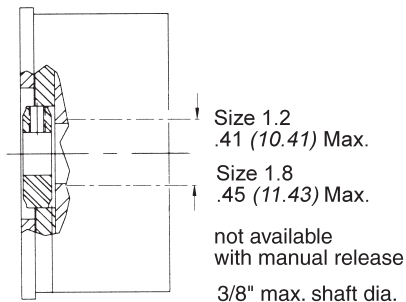
Series 321 & Series 322 TENV Options
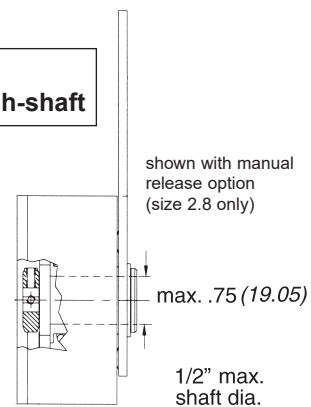## Small Gear Motor

THROUGH-SHAFT

SIZE 1.2 & 1.8
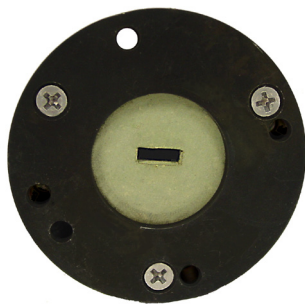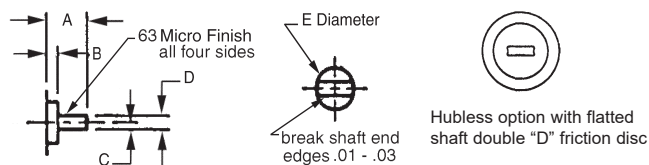**Optional through-shaft - No manual release option**

Size 1.2
.41 *(10.41)* Max.

Size 1.8
.45 *(11.43)* Max.

not available
with manual release

3/8" max. shaft dia.

SIZE 2.8
Optional through-shaft

shown with manual
release option
(size 2.8 only)

max. .75 *(19.05)*

1/2" max.
shaft dia.

DOUBLE - D DISC

Double "D" Option

A
B
63 Micro Finish
all four sides
D
E Diameter
C

break shaft end
edges .01 - .03

Hubless option with flatted
shaft double "D" friction disc

Brake Size	A	B
1.2	.25 + .05/-.00	.075 max.
1.8	.30 + .13/-.00	.075 max

Shaft Size	C	D	E
5/16	.052	.105 /.103	.3135 /.3115
3/8	.063	.126 /.124	.376 /.374

NOTE: Contact factory for Double "D" disc on brakes greater than 7 lb-in nominal static torque

AC RECTIFIER

*External In-line
(as shown)*

or

Internal

6.4
1.300
6.4
0.5 Max.

0.6 Max.
Rectifier

2 #22G leads stripped .38

Internal rectifier is available
only on the 1.8 and 2.8 models.
external in-line rectifier is a
standard option only on the 1.2
model.

NON-MAINTAINED MANUAL RELEASE

Pull for momentary
brake release

BRAKE RELEASE INDICATOR

A mechanical switch which is activated by
the manual release lever, and can be used to
disconnect power in case of accidental start-up
when the brake is manually released.

Series 321 & Series 322 TENV Continued
Small Gear Motor

Size	321 Series Model External leads Mounting		322 Series Model External Leads Mounting	
	Inside***	Flange	Inside***	Flange
1.2 Dynamic	3-21-2401G	3-21-2403G	3-22-2401G	N/A**
1.2 Holding	3-21-2501G	3-21-2503G	3-22-2501G	N/A**
1.8 Dynamic	3-21-4401G	3-21-440DG	3-22-4401G	3-22-440DG
1.8 Holding	3-21-4501G	3-21-450DG	3-22-4501G	3-22-450DG
1.8 Dynamic	3-21-4601G	3-21-460DG	3-22-4601G	3-22-460DG
2.8 Dynamic	3-21-7401K	N/A**	3-22-7401K	N/A**
2.8 Dynamic	3-21-7501K	N/A**	3-22-7501K	N/A**
2.8 Holding	3-21-7701K	N/A**	3-22-7701K	N/A**
	72 mm mount		**72 mm mount**	
2.8 Dynamic	3-21-740MK	N/A**	3-22-740MK	N/A**
2.8 Holding	3-21-750MK	N/A**	3-22-750MK	N/A**

**N/A = Not available.

***Mounting bolt circle inside (less than) the outside diameter of magnet body. (BC dimensions shown on AAB 320 Series page).

Ordering Information

Group "3" Armature Actuated Brakes — **3-2X- X X X X X - XX- X X** — Options – **Table 3**
Series = 321 or 322 — Voltages – **Table 2**
Hub Bore and Keyway – **Table 1**
For Double "D" Bores See **Table 1A**

Character	Size
2	1.2
4	1.8
7	2.8

Size	Static Torque (lb-in)	Numeral
1.2	3 Dynamic	4
1.2	5 Holding	5
1.8	7 Dynamic	4
1.8	15 Holding	5
1.8	15 Dynamic	6
2.8	35 Dynamic	4
2.8	50 Dynamic	5
2.8	72 Holding	7

Numeral or Letter	Description	Series
0	Standard Brake External Lead Location	321, 322
A	Internal Lead Location*	321 or 322
6	External leads Thru-Shaft	321
C	Internal Leads* Thru-Shaft	321

Character	Modification
E	Brake release indicator (NC)
F	Brake release indicator (NO)
G	Standard - GGA Friction Material
J	CCW manual release rotation
K	"Star" hub and GGA disc size 2.8
S	Carrier ring friction disc size 1.8

Numeral or Letter	Mounting	Brake Size		
		1.2	1.8	2.8
1	Inside Mount	x	x	x
D	Flange Mount 2.844" Mounting Bolt Circle	x	x	
3	Flange Mount 2.125" Mounting Bolt Circle	x		
M	Body Mount 72 mm Mounting Bolt Circle			x

Table 1: Bore Size

Characters to Insert	Bore	Keyway Size* Width (in.) x Depth (in.)		Bores Available Mag Body Size		
		Width (in.)	Depth (in.)	1.2	1.8	2.8
0A	3/16	no keyway		x		
0B	3/16	1/16	1/32		x	
0C	1/4	no keyway		x		
0D	1/4	1/16	1/32		x	x
0E	5/16	no keyway		x		
0F	5/16	1/16	1/32		x	x
0G	3/8	no keyway		x		
0H	3/8	3/32	3/64		x	x
0J	1/2	1/8	1/16		①	x
05	5	2 mm	1 mm	②	x	x
06	6	2 mm	1 mm	②	x	x
07	7	2 mm	1 mm	②	x	x
08	8	2 mm	1 mm	②	x	x
09	9	3 mm	1.4 mm	②	x	x

①Set screws located 120° from keyway.
②Hubs are provided without keyway.
*Keyseats made to ANSI B17.1 standard.

Table 1A:
(Double "D" Bores)

Characters to Insert	Bore
0F	5/16
0H	3/8

NOTE: Contact factory for Double "D" disc on brakes greater than 7 lb-in nominal static torque. Can be used up to 15 lb-in holding.

Table 3: Options

Characters to Insert	Options
D	Short Hub pressure plate mounted
G	Short Hub with Maintained Manual Release
X	Double "D" Friction Disc
Y	Option X with Maintained Manual Release

Manual release and thru bore size 2.8 only.

Table 2: Standard Coil Voltage

Character to Insert	Voltage	Current Rating in Amps		
		Size 1.2	Size 1.8	Size 2.8
C	12 Vdc	.632	.826	1.37
E	24 Vdc	.307	.421	.70
G	48 Vdc	.158	.216	.36
J	90 Vdc	.076	.123	.17
K	103 Vdc	.090	.115	.150
L	180 Vdc	.051	.060	.090
T*	115 Vac Internal Rectifier	N/A	.115	.168*
U*	230 Vac Internal Rectifier	N/A	.059	.086*
V	115 Vac external in-line QuickSet	.090	.115	.168
W	230 Vac external in-line QuickSet	.044	.059	.086
Z	115/230 Vac external in-line	.090	.115	.168

*Internal rectifier not available on size 2.8 brake with 72mm bolt circle and 1.2 brake.

NOTE: Other voltages available, contact factory.

NOTE: 65°C maximum ambient temperature for all external in-line rectifiers.

NOTE: Final part number may change due to specifications or options selected or other product design considerations. A number such as a 2, 3, 4 etc., in the 12th position is used to designate a unique brake (custom) and can only be assigned by Stearns Design Engineering Department.

Modifications are available - see AAB Modification Section.

Series 321 & Series 322 Totally-Enclosed Non-Ventilated (TENV)
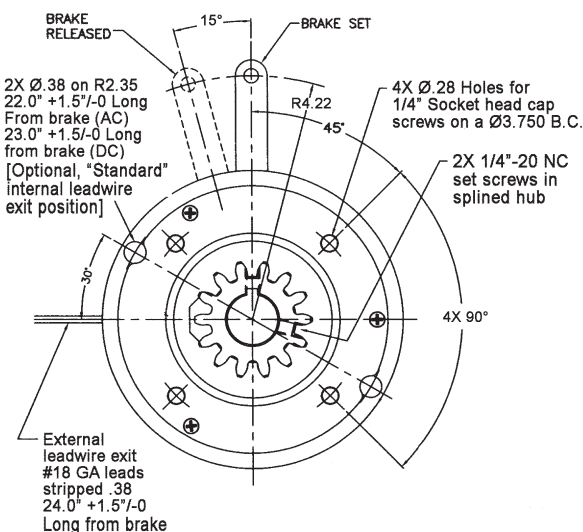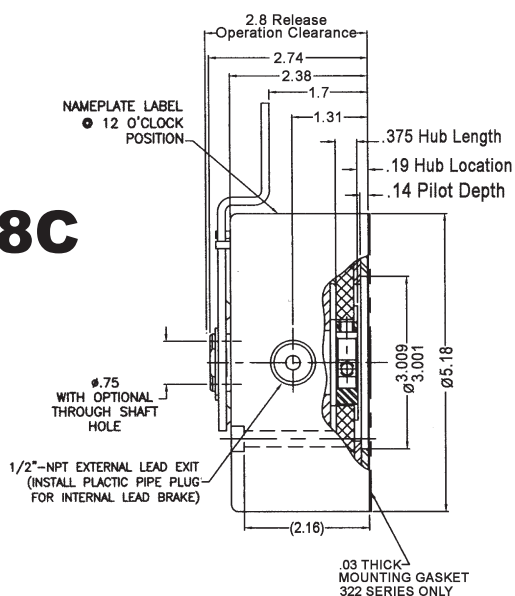## Mounting Face: NEMA 48 & 56C

Features

• IP Rating: Series 321 is IP 42; Series 322 is IP 54

• Out-of-box torque - no burnishing required

• Class B temperature rise with class H mag wire

• Brake housing integrated with mag body creating a heat exchanger that keeps the brake coil cool

• Field replaceable coil

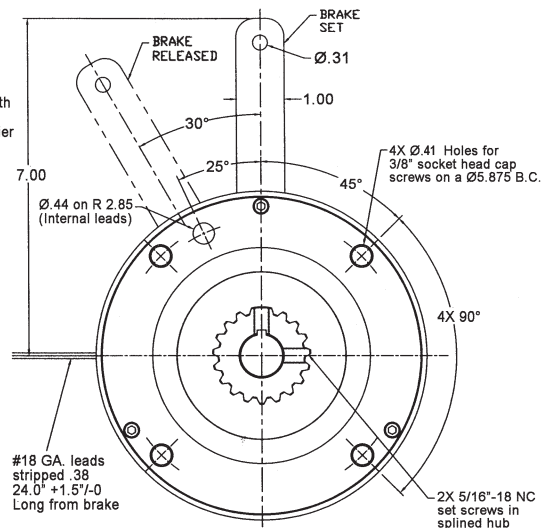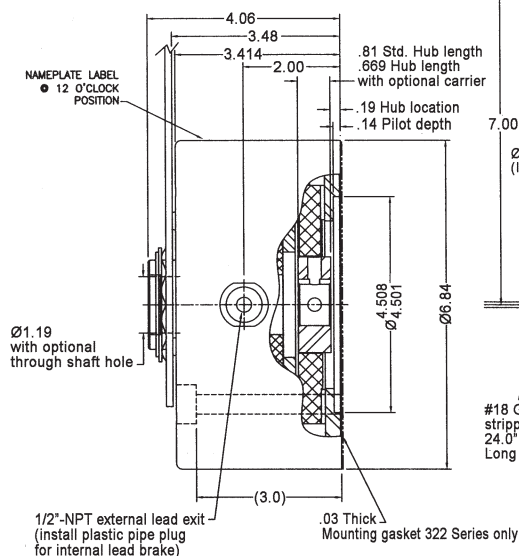• Splined hub and friction disc

• High cycling

Options

• Internal rectifier

• Quick-set rectifiers - for fast response time even when wired directly across motor

• Maintained manual release

• Brake release indicator switch

• Single point torque adjustment- to 50% of nameplate torque

• Through-shaft

• Conduit box

• Quiet armature actuations

• Carrier ring friction disc

48C

2.8 Release Operation Clearance
2.74
2.38
1.7
1.31

NAMEPLATE LABEL @ 12 O'CLOCK POSITION

.375 Hub Length
.19 Hub Location
.14 Pilot Depth

Ø3.009 / 3.001
Ø5.18

Ø.75 WITH OPTIONAL THROUGH SHAFT HOLE

1/2"-NPT EXTERNAL LEAD EXIT (INSTALL PLASTIC PIPE PLUG FOR INTERNAL LEAD BRAKE)

(2.16)

.03 THICK MOUNTING GASKET 322 SERIES ONLY

BRAKE RELEASED   15°   BRAKE SET

2X Ø.38 on R2.35 22.0" +1.5"/-0 Long From brake (AC) 23.0" +1.5"/-0 Long from brake (DC) [Optional, "Standard" internal leadwire exit position]

R4.22
45°

4X Ø.28 Holes for 1/4" Socket head cap screws on a Ø3.750 B.C.

2X 1/4"-20 NC set screws in splined hub

4X 90°

30°

External leadwire exit #18 GA leads stripped .38 24.0" +1.5"/-0 Long from brake

56C

4.06
3.48
3.414
2.00

NAMEPLATE LABEL @ 12 O'CLOCK POSITION

.81 Std. Hub length
.669 Hub length with optional carrier
.19 Hub location
.14 Pilot depth

Ø4.508 / 4.501
Ø6.84

Ø1.19 with optional through shaft hole

1/2"-NPT external lead exit (install plastic pipe plug for internal lead brake)

(3.0)

.03 Thick Mounting gasket 322 Series only

BRAKE SET
Ø.31
1.00

BRAKE RELEASED

7.00

30°
25°
45°

Ø.44 on R 2.85 (Internal leads)

4X Ø.41 Holes for 3/8" socket head cap screws on a Ø5.875 B.C.

4X 90°

#18 GA. leads stripped .38 24.0" +1.5"/-0 Long from brake

2X 5/16"-18 NC set screws in splined hub

Engineering Specifications

Motor Frame	321 Series Model Number	Nominal Static Torque Lb-ft (Nm)	322 Series Model Number	Approx. Weight lbs	Approx. Weight kg	Power (watts)	Hub and Disc inertia (Oz-in-sec²)
48C	3-21-83XF	1.5 (2)	3-22-83XF	9.5	4.3	20	1.2 x 10⁻²
	3-21-84XF	3 (4)	3-22-84XF				
	3-21-85XF	6 (8)	3-22-85XF				
	3-21-86XF	8.3 (11)	3-22-86XF				
56C	3-21-93XG	3 (4)	3-22-93XG	23	10.4	31	15.5 x 10⁻²
	3-21-94XG	6 (8)	3-22-94XG				
	3-21-95XG	10 (14)	3-22-95XG				
	3-21-96XG	15 (20)	3-22-96XG				
	3-21-98XG	25 (34)	3-22-98XG				

Note: Available as standard or with manual release.

Ordering Information

Group "3" Armature Actuated Brakes — 3-2X- X X X X 0 - XX- X X — Options – **Table 3**

Series = 321 or 322 — Voltages – **Table 2**

Hub Bore and Keyway – **Table 1**

Character	NEMA frame
8	48C
9	56C

Options = 8th digit	Modification Description
0	Standard brake
S	Carrier ring friction disc

Mounting = 7th digit	NEMA frame size
F	48C
G	56C

48C

Torque = 5th digit	Nominal Static Torque Lb-ft (Nm)
3	1.5 (2)
4	3 (4)
5	6 (8)
6	8.3 (11)

56C

Torque = 5th digit	Nominal Static Torque Lb-ft (Nm)
3	3 (4)
4	6 (8)
5	10 (14)
6	15 (20)
8	25 (34)

Lead location & options = 6th digit	Description
0	External leads
6	External leads & through shaft
A	Internal leads

Table 1: Bore Sizes

Character to insert	Bore	Keyway	Bores Available
0B	5/8	3/16 x 3/32	48C & 56C
0D	7/8	3/16 x 3/32	56C only
0K	1/2	1/8 x 1/16	48C

Other bore sizes available.

Table 2: Standard Coil Voltage

Character to Insert	Voltage	Current Rating in Amps 48C	Current Rating in Amps 56C
C	12 Vdc	1.47	2.44
E	24 Vdc	.75	1.26
G	48 Vdc	.38	.647
J	90 Vdc	.23	.393
R	460 Vac Half Wave Internal	.50	.50
V	115 Vac Internal QuickSet	.25	.40
W	230 Vac Internal QuickSet	.25	.40

Other voltages available.

Table 3: Options

Characters to Insert	Options
D	Standard Brake
G	With Maintained Manual Release

NOTE: *Final part number may change due to specifications or options selected or other product design considerations. A number such as a 2, 3, 4 etc., in the 12ᵗʰ position is used to designate a unique brake (custom) and can only be assigned by Stearns Design Engineering Department.*

Modifications are available - see AAB Modification Section.

Series 33X

Direct replacement for European brakes: Kebco, Lenze & Binder*

Features

• Direct acting
• Torque 3 through 300 lb-ft (4 to 400 Nm)
• UL recognized Class H coil insulation system to US standards (UR)
• Spring-set and DC voltage released - AC rectifiers optional
• Series 333 torque adjustable
• Pre-adjusted air gap for easy assembly
• Corrosion resistance
• Spline hub for quiet dependable operation
• Metric and US customary bore sizes

Options

• See AC rectifiers section for specifications (full and half wave)
• Band seal (boot)
• Tach/encoder mounting
• Manual release - non-maintained or maintained
• Shaft seal
• Mounting flange
• Electronic brake release indicator switch

Product Overview

331 Series

Basic brake without the torque adjust option.

Available in torque ratings from 3 to 300 lb-ft (4 to 400 Nm).

Manual release optional, can be provided with non-maintained release lever or maintained release bolts.

Metric mount; also can be ordered with C-face adapter or as the C-face enclosed version, and as severe duty.

333 Series

Static torque from 3 to 300 lb-ft, with nine different sizes ranging from 72mm bolt circle up to 278 mm bolt circle.

Torque can be adjusted down to approximately 50% of the nameplate torque rating.

Shown here with optional non-maintained manual release lever; other options include boot (band seal), end cap plug, through-shaft seal, and many more listed in the AAB modification section.

33X Series with NEMA C-Face Adapter

Series 331 or Series 333 can be provided with a C-face adapter for motor frames from 48C through 404/405TC, TSC, UC, USC.

All other available modifications for the 33X Series can be ordered for this brake.

33X Series with NEMA C-Face Adapter & Enclosed Housing

Series 33X with a C-face adapter and a brake housing. Order as an IP 43 rating with or without external manual release:

33B Series for brake without torque adjust
33C Series for brake with torque adjust

OR IP 54 rating with the option of internal maintained manual release:

33H Series for brake without torque adjust
33J Series for brake with torque adjust

Also Available.....

330 Series

Magnet body is not machined for a manual release option. See ordering information for the 33X Series brakes.

33X Severe Duty

Any of the 33X Series can be ordered as severe duty, appropriate for high-cycle rate applications. See ordering information for the 33X series brakes.
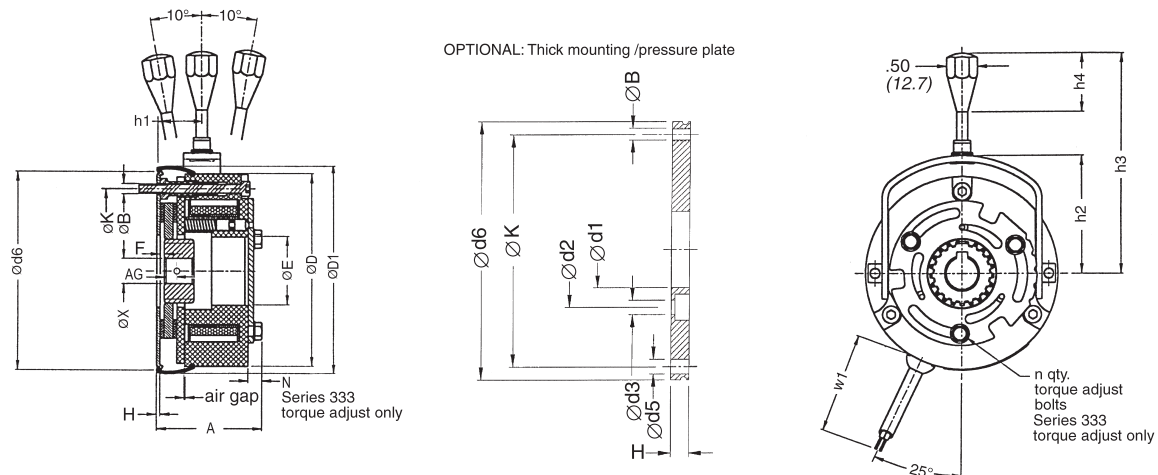
332 Series

Basic brake with the torque adjust option, and the magnet body not machined for the manual release option. See ordering information for the 33X series brakes.

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Series 331 (Without Torque Adjust) & Series 333 (Torque Adjustable)
Mounting Face: IEC/Metric 72, 90, 112, 132, 145, 170, 196 & 278

OPTIONAL: Thick mounting /pressure plate

Dimensions: Sizes 72 thru 170

Size	Basic Model Number	Torque lb-ft (Nm)	Ø D1 Max	ØB	Ø X Min. Bore	Ø X Max. Bore	C Hub length	ØE	F Recommended Hub Location	AG Set screw location English bores only	A Thick Plate	A Thin Plate	A No Plate	H Thick Plate	H Thin Plate	Ø D	ØK	N 333 Series only	n torque adjust bolts 333 series only
72	33X-14010	3 (4)	3.56 90.4	3 x M4	3/8 9*	9/16 15	0.709 18	1.183 30	0.070 1.78	.355 9.02	2.016 51.20	1.838 46.68	1.780 45.20	0.236 6	0.058 1.47	3.346 85	2.835 72	0.257 6.52	3
90	33X-24010	6 (8)	4.48 113.8	3 x M5	1/2 9*	3/4 16, 20**	0.787 20	1.183 30	0.070 1.78	.394 10.01	2.275 57.78	2.057 52.24	1.999 50.77	0.276 7	0.058 1.47	4.016 102	3.543 90	0.257 6.52	4
112	33X-34010	12 (16)	5.39 136.9	3 x M6	5/8 10*	7/8 22, 24**	0.787 20	1.262 32	0.105 2.67	.393 9.98	2.771 70.38	2.475 62.86	2.417 61.38	0.354 9	0.058 1.47	5.000 127	4.409 112	0.287 7.29	3
132	33X-44010	25 (32)	6.19 157.2	3 x M6	7/8 14*	1-1/8 25, 28**	0.984 25	1.380 35	0.105 2.67	.492 12.50	3.001 76.23	2.705 68.71	2.647 67.23	0.354 9	0.058 1.47	5.787 147	5.197 132	0.327 8.30	4
145	33X-54010	45 (60)	6.81 173	3 x M8	7/8 14*	1-1/8 30, 34**	1.181 30	1.577 40	0.130 3.30	.590 14.99	3.696 93.88	3.321 84.35	3.263 82.88	0.433 11	0.058 1.47	6.457 164	5.709 145	0.366 9.30	4
170	33X-64010	60 (80)	7.80 198	3 x M8	1-1/8 15*	1-3/8 35, 38**	1.181 30	1.852 47	0.133 3.38	.590 14.99	3.781 96.04	3.406 86.51	3.348 85.04	0.433 11	0.058 1.47	7.480 190	6.693 170	0.380 9.65	4

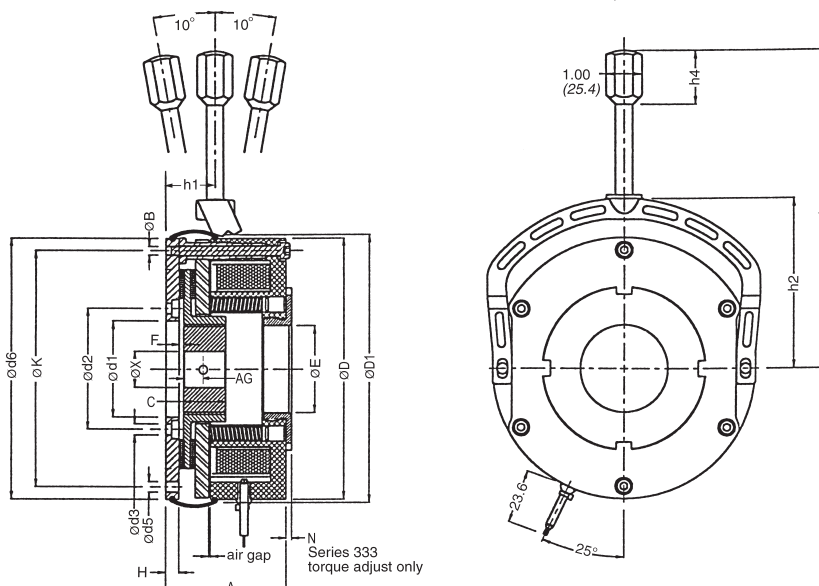| Size	Basic Model Number	Ø d1	Ø d2	Ø d3	Ø d5	Ø d6	h1 Thick Plate	h1 Thin Plate	h1 No Plate	h2 ①	h3 ①	h4	w1
72	33X-14010	0.787 20	1.181 30	0.177 4.5	0.177 4.5	3.268 83	0.905 23	0.727 18.47	0.669 17	2.05 52.1	3.85 97.8	1.00 25.4	17.5 444.5
90	33X-24010	1.181 30	1.772 45	0.217 5.5	0.217 5.5	3.937 100	0.985 25	0.767 19.48	0.709 18	2.33 59.2	4.52 114.8	1.00 25.4	17.5 444.5
112	33X-34010	1.575 40	2.205 56	0.261 6.6	0.261 6.6	4.921 125	1.338 34	1.042 26.47	0.984 25	2.96 75.2	5.08 129.0	.950 24.13	17.5 444.5
132	33X-44010	1.772 45	2.441 62	0.261 6.6	0.261 6.6	5.709 145	1.200 31	0.924 23.47	0.866 22	3.35 85.1	5.47 138.9	.950 24.13	17.5 444.5
145	33X-54010	2.165 55	2.913 74	0.354 9	0.354 9	6.299 160	1.575 40	1.200 30.48	1.142 29	3.95 100.3	6.90 175.3	1.25 31.9	17.5 444.5
170	33X-64010	2.559 65	3.307 84	0.354 9	0.354 9	7.283 185	1.338 34	1.042 26.47	0.984 25	4.69 119.1	7.73 196.3	1.25 31.9	23.6 600

* Without keyway pilot bore.

** Keyway to DIN 6885/3 - standard metric keyway DIN 6885/1.

① Size 132: "h2" and "h3" dimensions, contact factory. May vary .09 inch. For verification of manual release dimensions, contact factory.

Engineering Specifications: Sizes 72 thru 170

Size Bolt Circle (mm)	Part Number	Nominal Static Torque lb-ft (Nm)	Inertia (Wk²) lb-ft²	Inertia (Wk²) Kgm² x 10⁻⁴	Approx Weight lbs (Kg)	Max RPM	Power (Watts)	Thermal Capacity Hp-Sec/Min
72	33X-14010-XX-XX	3 (4)	.002	.84	2.28 (1.03)	3600	24	2
90	33X-24010-XX-XX	6 (8)	.003	1.26	4 (1.81)	3600	29	3
112	33X-34010-XX-XX	12 (16)	.005	2.10	6.78 (3.07)	3600	32	4
132	33X-44010-XX-XX	25 (32)	.011	4.62	11.42 (5.18)	3600	49	6
145	33X-54010-XX-XX	45 (60)	.019	7.98	14.45 (6.55)	3600	62	12
170	33X-64010-XX-XX	60 (80)	.041	17.22	22.6 (10.25)	3600	76	13

Series 331 (Without Torque Adjust) & Series 333 (Torque Adjustable) Continued
IEC/Metric Frame

Dimensions: Sizes 196 thru 278

Size	Basic Model Number	Torque lb-ft (Nm)	ØD1 Max	ØB	ØX Min. Bore	ØX Max. Bore	C Hub length	ØE	F Recommended Hub Location	AG Set screw location English bores only	A Pressure Plate	A No Plate	H Pressure Plate	H No Plate	ØD	ØK	N 333 Series only Min.	N 333 Series only Max.
196	33X-74020	110 (149)	8.94 227	6 x M8	1-3/8 20*	1-5/8 45, 48**	1.378 35	2.836 72	0.174 4.42	.689 17.50	3.902 99.11	3.469 88.11	0.433 11	0	8.543 217	7.717 196	0.187 4.75	0.479 12.17
230	33X-84020	180 (240)	10.38 263.6	6 x M10	1-5/8 25*	1-7/8 45, 50**	1.575 40	2.836 72	0.216 5.49	.790 20.07	4.352 110.54	3.927 99.75	0.433 11	0	10.000 254	9.055 230	0.340 8.64	0.740 18.80
278	33X-94020	300 (400)	12.43 315.7	6 x M10	1-7/8 25*	2-1/8 70	1.969 50	2.836 72	0.216 5.49	.985 25.02	4.915 124.84	4.438 112.73	0.492 12.5	0	12.047 306	10.945 278	0.340 8.64	0.730 18.54

Size	Basic Model Number	Ød1	Ød2	Ød3	Ød5	Ød6	h1 Pressure Plate	h1 No Plate	h2	h3	h4
196	33X-74020	3.125 79.4	3.937 100	0.354 9	0.354 9	8.543 217	1.575 40	1.142 29	5.51 140	10.43 265	1.75 44.5
230	33X-84020	3.86 98	4.724 120	0.433 11	0.433 11	10.00 254	1.850 47	1.417 36	5.34 161	11.26 286	1.75 44.5
278	33X-94020	4.724 120	5.906 150	0.433 11	0.433 11	11.654 296	2.205 56	1.772 45	7.36 187	13.34 339	1.71 43.4

* Without keyway pilot bore.

** Keyway to DIN 6885/3 - standard metric keyway DIN 6885/1.

Engineering Specifications: Sizes 196 thru 278

Size Bolt Circle (mm)	Part Number	Nominal Static Torque lb-ft (Nm)	Inertia (Wk²) lb-ft²	Inertia (Wk²) Kgm² x 10⁻⁴	Approx Weight lbs (Kg)	Max RPM	Power (Watts)	Thermal Capacity Hp-Sec/Min
196	33X-74020-XX-XX	110 (150)	.066	27.72	50.00 (22.7)	1800	84	22
230	33X-84020-XX-XX	180 (240)	.163	68.46	47.00 (21.3)	1800	102	28
278	33X-94020-XX-XX	300 (400)	.401	168.42	75.00 (34.0)	1800	112	30

Series 331 & Series 333
Mounting Face: NEMA 48 & 56C, NEMA 145, 182 & 256TC, NEMA 324, 326, 365, 404 & 405TC, TSC, UC & USC

Dimensions

Model Number	Size	NEMA Frame	Ø A	Ø AJ	Ø AK	B	Ø D	E	G	H	HL	Hub Length	H1	H3	J	L	Internal Lead Hole Location
3-3X-140F0	72	48C	.28	3.75	3.0	1/4	5.50	.19	2.07	.50	.54	.709	1.22	3.85	3.35	.257	(2) @ 60°/180° apart
3-3X-240F0	90*	48C	.28	3.75	3.0	1/4	5.50	.19	2.30	.50	.55	.787	1.25	4.52	3.96	.257	(2) @ 60°/180° apart
3-3X-240G0	90	56C	.41	5.875	4.50	3/8	6.83	.19	2.48	.68	.73	.787	1.43	4.52	3.96	.257	(2) @ 25°/180° apart
3-3X-340G0	112	56C, 145TC	.41	5.875	4.50	3/8	6.83	.19	2.86	.68	.74	.787	1.72	5.08	4.97	.287	(2) @ 25°/180° apart
3-3X-440G0	132	56C, 145TC	.41	5.875	4.50	3/8	6.83	.19	3.05	.68	.74	.984	1.59	5.47	5.79	.327	(2) @ 25°/180° apart
3-3X-440H0	132	182-256TC △	.56	7.25	8.50	1/2	9.25	.19	3.37	1.00	.81	.984	1.91	5.47	5.79	.327	(1) @ 25°
3-3X-540G0	145*	145TC	.41	5.875	4.50	3/8	6.83	.19	3.63	.68	.92	1.181	1.87	6.90	6.45	.366	(2) @ 25°/180° apart
3-3X-540H0	145	182-256TC △	.56	7.25	8.50	1/2	9.25	.19	3.95	1.00	.94	1.181	2.19	6.90	6.45	.366	(1) @ 25°
3-3X-640H0	170*	182-256TC △	.56	7.25	8.50	1/2	9.25	.19	4.03	1.00	.94	1.181	2.04	7.73	7.47	.380	(1) @ 15°
3-3X-740H0	196	182-256TC	.53	7.25	8.50	1/2	8.90	.19	5.0	1.30	1.50	1.378	2.14	10.43	8.54	**	None
3-3X-740K0	196	324/326TC-404/405TC	.66	11.0	12.50	5/8	13.25	.19	5.38	1.50	1.67	1.378	2.69	10.43	8.54	**	(2) @ 25°***
3-3X-840H0	230*	182-256TC △	.53	7.25	8.50	1/2	10.00	.19	5.62	1.00	1.22	1.58	2.42	11.26	10.00	**	None
3-3X-840K0	230	324/326TC-404/405TC	.66	11.0	12.50	5/8	13.25	.19	6.10	1.50	1.72	1.58	2.94	11.26	10.00	**	(2) @ 25°***
3-3X-940K0	278*	324/326TC-404/405TC	.66	11.0	12.50	5/8	13.25	.19	6.75	1.60	1.82	1.97	3.38	13.34	12.05	**	(2) @ 25°***

*On these sizes, the brake diameter is larger than the adapter mounting/bolt circle.

***On each side of the 12:00 position (the location of second hole is not shown on above drawing).

△ Frame shaft size may require derate of a larger brake. Confirm hub bore.

**L min. & max: size 196 = .187 min. & .479 max. size 230/278 = .340 min. & .730 max.

Engineering Specifications

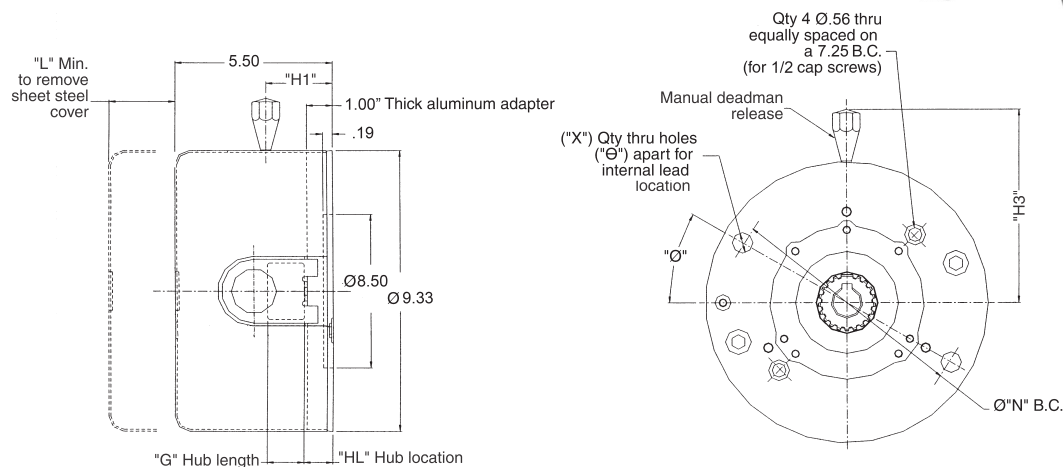| Model Number	Size	Nominal Static Torque		NEMA Frame Size △	Approximate Weight	
		Lb-Ft	Nm		Lbs	Kg
3-3X-140F0-XX-XX	72	3	4	48C	2.76	1.25
3-3X-240F0-XX-XX	90	6	8	48C	4.48	2.03
3-3X-240G0-XX-XX	90	6	8	56C	5.24	2.38
3-3X-340G0-XX-XX	112	12	16	56C	8.02	3.64
3-3X-440G0-XX-XX	132	25	32	56C	14.00	6.36
3-3X-440H0-XX-XX	132	25	32	182TC-256TC	17.52	7.95
3-3X-540G0-XX-XX	145	45	60	56C	16.14	7.32
3-3X-540H0-XX-XX	145	45	60	182TC-256TC	20.55	9.32
3-3X-640H0-XX-XX	170	60	80	182TC-256TC	35.00	15.89
3-3X-740H0-XX-XX	196	110	150	182TC-256TC	55.00	25.00
3-3X-740K0-XX-XX	196	110	150	324-365/404-405TC/TSC/UC/USC	72.30	32.79
3-3X-840H0-XX-XX	230	180	240	182TC-256TC	65.55	29.76
3-3X-840K0-XX-XX	230	180	240	324-365/404-405TC/TSC/UC/USC	88.30	40.05
3-3X-940K0-XX-XX	278	300	400	324-365/404-405TC/TSC/UC/USC	140.00	63.50

Series 331 & Series 333
Mounting Face: NEMA 182 & 256TC
with Brake Housing
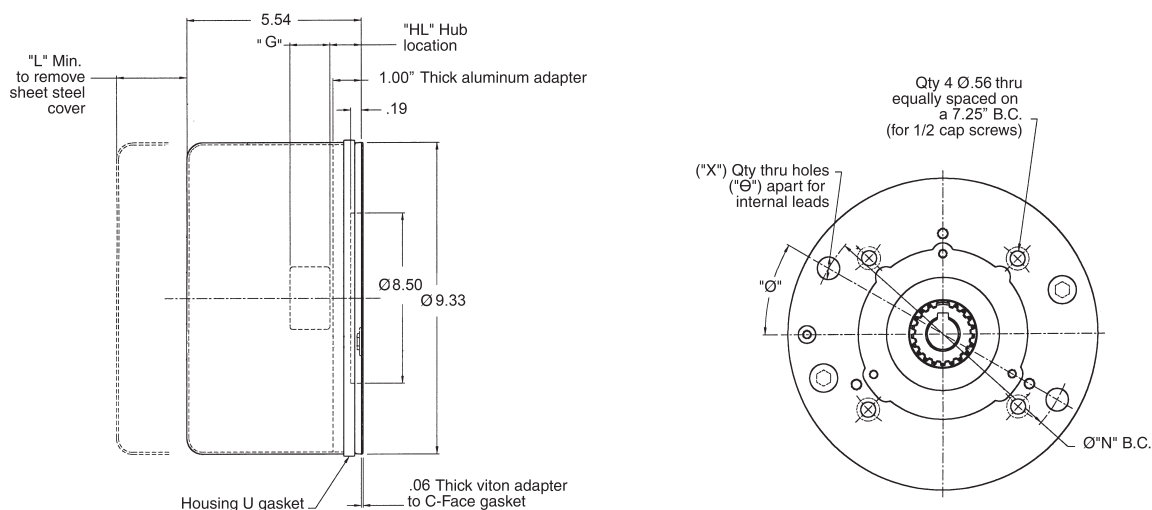
Outline Drawing for IP 43

"L" Min. to remove sheet steel cover

5.50

"H1"

1.00" Thick aluminum adapter

.19

Ø8.50
Ø9.33

"G" Hub length

"HL" Hub location

Qty 4 Ø.56 thru equally spaced on a 7.25 B.C. (for 1/2 cap screws)

Manual deadman release

("X") Qty thru holes ("Θ") apart for internal lead location

"H3"

"Ø"

Ø"N" B.C.

IP 43 Dimensions

Model Number	Size	Nominal Static Torque Lb-Ft (Nm)	NEMA Frame*	HL	G	H1	H3	L	Internal lead location X, Ø and O on "N" Bolt circle	Approximate Weight Lbs (Kg)
33X-441H0	132	25 (32)	182TC-256TC	1.16	.984	1.94	6.35	2.88	(1) @ 65° on R3.81	20.14 (9.1)
33X-541H0	145	45 (60)	182TC-256TC	1.19	1.181	2.22	6.90	3.50	(1) @ 65° on R3.81	23.17 (10.5)

For sizes 196 through 278 with C-face and housing, see Series 350 or Series 360.

Outline Drawing for IP 54 (No manual release/optional internal manual release)

5.54

"HL" Hub location

"G"

1.00" Thick aluminum adapter

.19

"L" Min. to remove sheet steel cover

Ø8.50
Ø9.33

Housing U gasket

.06 Thick viton adapter to C-Face gasket

Qty 4 Ø.56 thru equally spaced on a 7.25" B.C. (for 1/2 cap screws)

("X") Qty thru holes ("Θ") apart for internal leads

"Ø"

Ø"N" B.C.

IP 54 Dimensions

Model Number	Size	Nominal Static Torque Lb-Ft (Nm)	NEMA Frame*	HL	G	L	Internal lead location X, Ø and O on N B.C.	Approximate Weight Lbs (Kg)
33X-444H0	132	25 (32)	182TC-256TC	1.16	.984	2.88	(1) @ 65° on R3.81	25 (11.35)
33X-544H0	145	45 (60)	182TC-256TC	1.19	1.181	3.50	(1) @ 65° on R3.81	29 (13.16)
33X-644H0	170	60 (80)	182TC-256TC	1.19	1.181	3.50	(1) @ 65° on R3.81	36 (16.34)

*For NEMA 48C and 56C mounting, see AAB 321 and 322 NEMA C-face section.

Series 331 & Series 333 Continued
IEC/Metric & NEMA Frames

Ordering Information

Group "3" Armature Acting Brake — 333- 4 4 1 1 0 - O D - K C

Metric Mount

Options **Table 3**
Voltages - **Table 2**
Hub bore and keyseat - **Table 1**

Numeral	Description
0	No torque adjust, mag body not machined for manual release
1	No torque adjust
2	With torque adjust, mag body not machined for manual release
3	With torque adjust
B	Housing with conduit hole, no torque adjust (Size 72 - 145)
C	Housing with conduit hole, with torque adjust
H	IP 54 housing, no torque adjust (Size 72 - 170)
J	IP 54 housing, with torque adjust (Size 72 - 170)

Numeral	Modifications
0	Standard

Numeral	AAB-E Unit Sizes
1	72
2	90
3	112
4	132
5	145
6	170
7	196
8	230
9	278

Numeral	Description
2	Reduced torque with air gap shim
3	Reduced torque (severe duty- long life)
4	Standard
5	Size 90 Only; 8.34 lb-ft holding applications only
6	Std torque with air gap shim

Numeral	Mounting Style
0	Less pressure plate
1	Thin pressure plate (Size 72 - 170 only)
2	Thick pressure plate
F	NEMA 48C (Size 72 & 90)
G	NEMA 56C (Size 90, 132, & 112)
H	NEMA 180/210/250 TC (Size 132, 145, 170, 196 & 230)
J	NEMA 280 TC/UC (Size 196)
K	NEMA 320/360/400 TC/UC (Size 196, 230, 278)

Numeral	Enclosure
0	Standard
1	Seal (boot) kit thru bore
2	Seal (boot) and end cap plug
3	Seal (boot) and through-shaft seal
4	IP54 rating

Table 1 - Hub Bores 333-14010-XX-EA

NOTE: See dimensions for C-face brake motor systems section for recommended minimum bore size by torque.

Bore (in)	Character to insert	Keyway Size* Width (in)	Keyway Size* Depth (in)	Brake Size 1 / 72	2 / 90	3 / 112	4 / 132	5 / 145	6 / 170	7 / 196	8 / 230	9 / 278
3/8	0V	3/32	3/64	std								
1/2	0K	1/8	1/16	std	std							
9/16	0N	1/8	1/16	non std	non std							
5/8	0B	3/16	3/32		std	std	non std					
3/4	0C	3/16	3/32		non std	non std	non std					
7/8	0D	3/16	3/32			std	std	std	non std			
1	0L	1/4	1/8			non std	std	std	non std			
1-1/8	0E	1/4	1/8				std	std	std	non std		
1-1/4	0F	1/4	1/8					non std	non std			
1-3/8	0G	5/16	5/32					std	std	non std	non std	
1-1/2	0M	3/8	3/16						std	non std	non std	
1-5/8	0H	3/8	3/16						std	std	non std	
1-3/4	0I	3/8	3/16							std	non std	
1-7/8	0J	1/2	1/4								std	std
2	0L	1/2	1/4									non std
2-1/8	0N	1/2	1/4									std

Metric		Width (mm)	Depth (mm)	Metric Bores Supplied Without Set Screws, circlip recommended								
11	11	4	1.8	std	non std							
14	14	5	2.3	std	std	std	non std	non std				
15	15	5	2.3	non std	std	std	non std	non std	non std			
16	16	5	2.3		non std	non std	non std	non std	non std			
20	20	6	2.8		std**	std	non std	non std	non std	non std**		
22	22	6	2.8			std**	non std	non std	non std	non std		
24	24	8	3.3				std	non std	non std	non std		
25	25	8	3.3				std	non std	std	non std	non std**	non std**
28	28	8	3.3				non std**	non std	std	non std	non std	non std
30	30	8	3.3					std	std	std	std	std
34	34	10	3.3				std**	non std	non std	non std	non std	non std
35	35	10	3.3						non std	std	std	std
38	38	10	3.3					std**	std	std	non std	
40	40	12	3.3						std	std	std	
42	42	12	3.3						non std	std	non std	
45	45	14	3.8						non std	std	non std	
48	48	14	3.8						std**	non std	non std	
49	49	14	3.8							non std	non std	
50	50	14	3.8							std**	std	
55	55	16	4.3								std	
60	60	18	4.4								std	
70	70	20	4.9								std	

*Standard U.S. Keyseats made to ANSI B17.1 standard. Standard metric Keyseat DIN 6885/1.

** Keyseat to DIN 6885/3.

Table 2 - STD Coil Voltage 333-14010-14-XA

Character to insert	Coil Voltage	Current Rating in Amps 1 / 72	2 / 90	3 / 112	4 / 132	5 / 145	6 / 170	7 / 196	8 / 230	9 / 278
B	414/432 Vdc	0.06	0.07	0.09	0.12	0.16	0.22	0.25	0.26	0.29
C	12 Vdc	2.13	2.66	2.27	3.50	3.90	5.60	6.40	8.30	N/A
E	24 Vdc	1.10	1.28	1.16	1.80	1.84	2.80	3.30	4.27	3.85
J	90 Vdc	0.28	0.32	0.29	0.45	0.72	0.70	0.82	1.05	1.19
K	103 Vdc	0.21	0.24	0.33	0.51	0.53	0.80	0.75	0.96	1.08
L	180 Vdc	0.15	0.17	0.15	0.23	0.38	0.36	0.42	0.54	0.61
M	205 Vdc	0.11	0.12	0.17	0.27	0.27	0.41	0.38	0.49	0.56
S	258 Vdc	0.09	0.10	0.14	0.21	0.23	0.33	0.34	0.40	0.44
N*	115 Vac	0.21	0.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P*	230 Vac	0.11	0.12	0.17	.27	N/A	N/A	N/A	N/A	N/A
V**	115 Vac quickset	0.21	0.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
W**	230 Vac quickset	0.11	0.12	0.17	N/A	N/A	N/A	N/A	N/A	N/A

*In-line rectifier. Consult factory for pricing.

**In-line quickset rectifier. Consult factory for pricing.

Contact factory for non-standard coils.
Add the following for non-std. coil voltage.
- Sizes 72 through 112 = Consult factory for pricing.
- Sizes 132 through 170 = Consult factory for pricing.
- Sizes 196 through 278 = Consult factory for pricing.
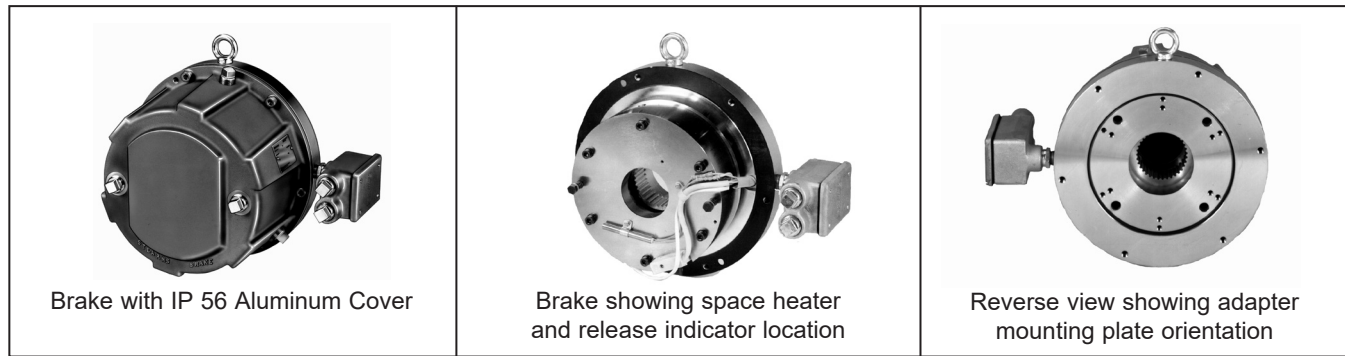For separate AC rectifiers, see AC rectifier section.

Table 3 - Options 333-14010-14-EX

Character to insert	Description/Options
A	Basic brake
C	Option A with non-maintained release
J	Steel hub w/manual release (for press-fit applications)
K	Steel hub, no manual release
L	Internal manual release, non-maintained
R	Maintained manual release (bolts)

Modifications are available - see AAB Modification section.

Series 350 Pressure Plate Mounted

Mounting Face: NEMA 182, 284 & 324TC, 256, 286 & 405TSC

Brake with IP 56 Aluminum Cover

Brake showing space heater and release indicator location

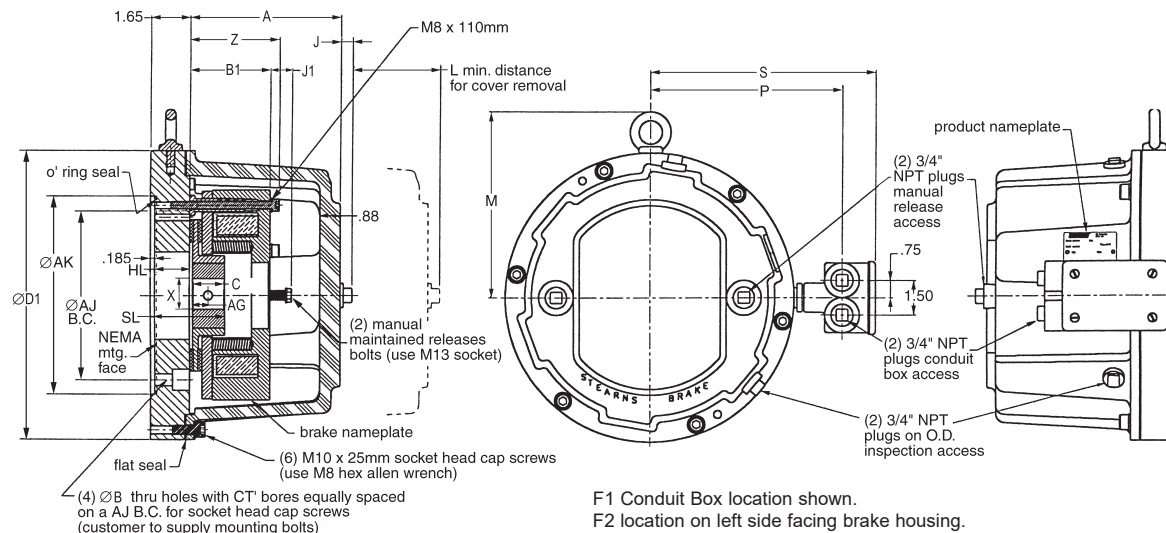Reverse view showing adapter mounting plate orientation

Features

- Torque: 75 - 300 lb-ft (102 to 400 Nm)
- Installation Instructions & Parts List: P/N 8-078-895-00
- Universal mounting
- Class 180(H) insulation
- Maintained manual release
- Corrosion resistance (stainless steel external hardware)
- IP 56 protection (available in ductile cast iron or aluminum cover)

- ABS and CE certification
- Simple wear adjustment with access hole for air gap inspection
- Metric and US Customary bore sizes
- C-Face mounting - various adapter plates available for 182TC through 405TSC frame mounting
- Splined hub for quiet dependable operation

Options

- See AC rectifier section
- Tach/encoder mounting
- Space heater 115, 230 or 460 Vac
- Thru-shaft
- Conduit box- specify F1 or F2 location (F1 location shown)

F1 Conduit Box location shown.
F2 location on left side facing brake housing.

Dimensions

Size	NEMA Frame	ØB	Torque lb-ft	Torque Nm	ØAJ	ØAK	Mount Bolt	X Min. Bore in	X Min. Bore mm	X Max. Bore in	X Max. Bore mm	Ø D1**	Ø D1***	B1	Z	L	M	S	P	J1	A**	A***	J	C Hub length	HL Hub Location	AG set screw location
7	196	182TC-256TSC	.53	75	102	7.250	8.500	1/2"-13	1.375	20	1.625	48*	12.38	15.75	3.57	3.97	4.6	8.00	9.68	8.25	.93	6.47	6.73	.50	1.378	1.63	.689 / 17.50
7	196	182TC-256TSC	.53	110	150	7.250	8.500	1/2"-13	1.375	20	1.625	48*	12.38	15.75	3.57	3.97	4.6	8.00	9.68	8.25	.93	6.47	6.73	.50	1.378	1.63	.689 / 17.50
7	196	284TC-286TSC	.53	110	150	9.000	10.500	1/2"-13	1.375	20	1.625	48*	12.38	15.75	3.57	3.97	4.6	8.00	9.68	8.25	.93	6.47	6.73	.50	1.378	1.63	.689 / 17.50
7	196	324TC-405TSC	.66	110	150	11.000	12.500	5/8"-18	1.375	20	1.625	48*	15.75	15.75	3.57	3.97	4.6	9.63	11.38	9.94	.93	6.73	6.73	.50	1.378	1.63	.689 / 17.50
8	230	284TC-286TSC	.53	180	240	9.000	10.500	1/2"-13	1.625	25	1.875	50*	15.75	15.75	4.00	4.46	5.0	9.63	11.38	9.94	.93	6.73	6.73	.25	1.575	1.63	.790 / 20.07
8	230	324TC-405TSC	.66	180	240	11.000	12.500	5/8"-11	1.625	25	1.875	50*	15.75	15.75	4.00	4.46	5.0	9.63	11.38	9.94	.93	6.73	6.73	.25	1.575	1.63	.790 / 20.07
9	278	324TC-405TSC	.66	300	400	11.000	12.500	5/8"-11	1.875	25	2.125	70	15.75	15.75	4.00	5.08	5.0	9.63	11.38	9.94	.97	6.73	6.73	.25	1.969	1.63	.985 / 25.02

*Key to DIN 6885/3p9-standard metric keyway DIN 6885/1.
D1** & A** for aluminum cover.
D1*** & A*** for ductile iron cover.

Component Materials:

- Adapter plate - steel (zinc plate)
- Splined hub - steel (zinc plate)
- Splined carrier - aluminum

- Armature - steel (zinc plate)
- Magnet body - steel (zinc plate)
- Hardware - steel (corrosion resistant plating or stainless)

- Cover: Size 196 - 182T thru 286TS NEMA - Aluminum (anodized) (additional paint optional) Size 196 - 324T thru 405TS NEMA - Cast Iron (primed) (additional paint optional)

- Size 230 - 284T thru 405TS NEMA - Cast Iron (primed) (additional paint optional)
- Size 278 - 324T thru 405TS NEMA - Cast Iron (primed) (additional paint optional)

Series 350 Pressure Plate Mounted Continued
NEMA Frame
Specifications

Size	NEMA Frame	Nominal Static Torque		Part Number		Weight/lbs		Max RPM	Thermal Capacity Hp-Sec/Min
		lb-ft	*Nm*	Ductile Cast Iron	Aluminum Cover	Ductile Iron	Aluminum		
196	182TC-256TSC	75	*102*	351-734HX-XX-XX	355-734HX-XX-XX	–	103	1800	22
196	182TC-256TSC	110	*150*	351-744HX-XX-XX	355-744HX-XX-XX	–	103	1800	22
196	284TC-286TSC	110	*150*	351-744JX-XX-XX	355-744JX-XX-XX	–	103	1800	22
196	324TC-405TSC	110	*150*	351-744KX-XX-XX	355-744KX-XX-XX	134	128	1800	22
230	284TC-286TSC	180	*240*	351-844JX-XX-XX	355-844JX-XX-XX	208	178	1800	28
230	324TC-405TSC	180	*240*	351-844KX-XX-XX	355-844KX-XX-XX	208	178	1800	28
278	324TC-405TSC	300	*400*	351-944KX-XX-XX	355-944KX-XX-XX	219	189	1800	30

Ordering Information

Part number example: **355- 7 4 4 J C O M E A**

Group "3" Armature Acting Brake (Direct acting with a DC Coil)

Mounting Design	
Numeral	Design
5	Pressure Plate Mount

Numeral	Brake Cover Type
1	Ductile Iron
5	Aluminum

Numeral/Alpha	Magnet Body Size	Torque lb-ft
7	196	110
8	230	180
9	278	300

Torque/Modification	
3	Reduced Torque
4	Standard Torque

Numeral	IP Rating
H	IP66 conduit box* with terminal strip
M	IP66 conduit box*

*Specify F1 or F2 location for conduit box modification in quote request.

Options **Table 3**

Voltages - **Table 2**

Hub bore and keyset - **Table 1**

Additional Options	
Standard Brake	0
Space Heater 115	1
Space Heater 230	2
Space Heater 460	3
Brake release indicator NO/NC	4
Brake release indicator NO/NC Space Heater 115	5
Brake release indicator NO/NC Space Heater 230	6
Brake release indicator NO/NC Space Heater 460	7

Mounting	
NEMA 180/210/250 C-face	H
NEMA 280 C-face	J
NEMA 320/400 C-face	K
NEMA 440 C-face Mt*	L
NEMA 500 C-face Mt*	M
IEC 132 C-face Mt*	S
IEC 160 C-face Mt*	T
IEC 132 D-face Mt*	U
IEC 160 D-face Mt*	V
IEC 180 D-face Mt*	W
IEC 200 D-face Mt*	X
IEC 225 D-face Mt*	Y

*Contact factory for pricing on these mounting options.

Table 3 - Additional Options

No manual release	A
Maintained release (standard)	R

NOTE: *Final part number may change due to specifications or options selected or other product design considerations. A number such as a 2, 3, 4 etc., in the 12th position is used to designate a unique brake (custom) and can only be assigned by Stearns Design Engineering Department.*

Modifications are available - see AAB Modification Section.

Table 1 - Hub Bores

NOTE: See Dimensions for C-Face AC Brake Motor Systems for recommended minimum bore sizes by torque.

Character to insert	Bore	Keyway Size* Width (in.)	Depth (in.)	Bores Available Unit Size 196	230	278
0G	1.375	5/16	5/32	X		
0M	1.500	3/8	3/16	X		
0H	1.625	3/8	3/16	X	X	
0I	1.750	3/8	3/16		X	
0J	1.875	1/2	1/4		X	X
0L	2.000	1/2	1/4			X
0N	2.125	1/2	1/4			X
Metric	*Bore*	*Width*	*Depth*	*196*	*230*	*278*
20	20	—	—	X		
30	30	8	3.3	X		X
35	35	10	3.3	X	X	
38	38	10	3.3	X	X	
40	40	12	3.3	X	X	X
42	42	12	3.3	X	X	
45	45	14	3.8	X	X	X
48	48	14	3.8	X		
50	50**	14	3.8**		X	
50	50	14	3.8			X
55	55	16	4.3			X
60	60	18	4.4			X
70	70	20	4.9			X

Table 2 - Coil Voltage

Character to Insert	Coil Voltage	Current Rating 7 196	8 230	9 278
E	24 Vdc	3.30	4.27	3.85
J	90 Vdc	.82	1.05	1.19
K	103 Vdc	.75	.96	1.08
L	180 Vdc	.42	.54	.61
M	205 Vdc	.38	.49	.56
B	414/432 Vdc	.24	.26	.28

Other voltages available - consult factory
For AC rectifiers, see AC rectifier section.

*Standard U.S. keyseats made to ANSI B17.1 standard. Standard metric keyseat DIN 6885/1.

**Keyseat to DIN 6885/3.

Series 360 Magnet Body Mounted

Mounting Face: IEC 170, 196, 230 & 278

Features

- IP 56 rating
- Installation Instructions & Parts List: P/N 8-078-898-00
- Universal mounting
- Internal maintained manual release
- ABS and CE Certification
- Brake gaskets are captive (o-ring), so parts are not lost during maintenance
- Stainless steel nameplate (exterior)
- Modular brake assembly. Install and remove brake without having to readjust air gaps.
- Class 180(H) insulation

Options

- See AC rectifier section
- Tach/encoder mounting
- Space heater
- Electronic brake release indicator
- Electronic wear indicator
- Thru-shaft
- External non-maintained/maintained manual release
- IP 66 conduit box mounted on adapter plate. Wiring is not disturbed when brake housing is removed.

Shown with optional conduit box

Reverse view showing adapter mounting plate orientation

Brake showing space heater and release indicator location

F1 Conduit Box location shown.
F2 location on left side facing brake housing.

Dimensions

Size		Model	NEMA Frame	Torque		ØB	Ø AJ	Ø AK	Mount Bolt	Ø D1	E	B1	Z	L	h2	h3	S	P	A	HL Hub Location	C Hub Length	S.S. Location
				lb-ft	Nm																	
6	170	36X-6	182-256TC	35	47		7.25	8.50		10.38	.185						9.54	7.09	6.70			
6	170	36X-6	182-256TC	60	80	.53	7.25	8.50	1/2"-13	10.38	.185	3.57	3.94	3.8	6.00	16.1	9.54	7.09	6.70	.19	4.64	1.63
6	170	36X-6	284-286TC	60	80		9.00	10.50		10.76	.190						10.25	7.81	6.90			
7	196	36X-7	182-256TC	110	149	.53	7.25	8.50	1/2"-13	11.81	.185	3.72	4.12	4.3	6.70	16.6	10.25	7.81	6.90	.19	4.70	1.75
7	196	36X-7	284-286TC	110	149	.53	9.00	10.50														
8	230	36X-8	284-286TC	180	240	.53	9.00	10.50	1/2"-13	13.63	.190	4.45	4.94	5.2	8.25	17.9	11.19	10.94	8.27	.19	5.20	2.12
8	230	36X-8	324TC-405TSC	180	240	.69	11.00	12.50	5/8"-11													
9	278	36X-9	324TC-405TSC	300	400	.69	11.00	12.50	5/8"-11	15.68	.190	5.12	5.60	5.8	9.20	18.8	12.19	11.94	9.69	.19	5.82	2.12
9	278	36X-9	444-445TC	300	400	.69	14.00	16.00		16.56							12.63	12.38				

Note: Dimensions for estimating purposes only.

Component Materials for 361-X Series:

- Adapter plate - steel (zinc phosphate, prime & paint)
- Splined hub - steel (zinc plate)
- Armature - steel (normalized)
- Pressure Plate - steel (normalized)
- Magnet body - steel (zinc plated)
- Housing - ductile iron (primed & painted):
- Hardware - steel (corrosion resistant plated or stainless)

Series 360 Magnet Body Mounted Continued
IEC Frame

Specifications

Size	NEMA Frame	Nominal Static Torque lb-ft	Nominal Static Torque Nm	Model Number	Thermal Capacity Hp-Sec/Min	Approx weight lbs.
170	182-256TC	35	47	3-61-634H0	14	101
170	182-256TC	60	80	3-61-644H0		
170	284-286TC	60	80	3-61-644J0		
196	182-256TC	75	102	3-61-734H0	20	120
196	182-256TC	110	150	3-61-744H0		
196	284-286TC	110	150	3-61-744J0		
230	284-286TC	180	240	3-61-844J0	26	176
230	324TC/364-365TC	180	240	3-61-844K0		
278	324TC/364-365TC	300	400	3-61-944K0	28	280
278	444TC	300	400	3-61-944L0		

Ordering Information

Part number example: 3 6 1 - 7 4 4 J C O M E S

Group "3" Armature Acting Brake
(Direct acting with a DC Coil)

Mounting Design
Numeral	Design
6	Magnet Body Mount

Brake Cover Type
Numeral	Brake Cover Type
1	Ductile Iron

Numeral/ Alpha	Magnet Body Size	Torque lb-ft
6	170	60
7	196	110
8	230	180
9	278	300

Torque/Modification
Numeral	
3	Reduced Torque
4	Standard Torque

IP Rating
Numeral	IP Rating
4	IP56 (standard)
H	IP66 conduit box* with terminal strip
M	IP66 conduit box*

*Specify F1 or F2 location for conduit box modification in quote request.

Options **Table 3**

Voltages - **Table 2**

Hub bore and keyset - **Table 1**

Additional Options
Additional Options	
Standard Brake	0
Space Heater 115	1
Space Heater 230	2
Space Heater 460	3
Brake release indicator Switch NO/NC	4
Brake release indicator NO/NC Space Heater 115	5
Brake release indicator NO/NC Space Heater 230	6
Brake release indicator NO/NC Space Heater 460	7
Wear indicator NO NO	A
Wear indicator NO/NC Space Heater 115	B
Wear indicator NO/NC Space Heater 230	C
Wear indicator NO/NC Space Heater 460	D

Mounting/Size
Mounting/Size	
NEMA 180/210/250 C-face	H
NEMA 280 C-face	J
NEMA 320/400 C-face	K
NEMA 440 C-face Mt*	L
NEMA 500 C-face Mt*	M
IEC 132 C-face Mt*	S
IEC 160 C-face Mt*	T
IEC 132 D-face Mt*	U
IEC 160 D-face Mt*	V
IEC 180 D-face Mt*	W
IEC 200 D-face Mt*	X
IEC 225 D-face Mt*	Y

*Contact factory for pricing on these mounting options.

Table 1 - Hub Bores
NOTE: See dimensions for C-face AC brake motor systems for recommended minimum bore sizes by torque.

Character to insert	Bore	Keyway Size* Width (in.)	Keyway Size* Depth (in.)	Bores Available Unit Size 170	196	230	278
0E	1.125	1/4	1/8	X			
0F	1.250	1/4	1/8	X			
0G	1.375	5/16	5/32	X	X		
0M	1.500	3/8	3/16	X	X		
0H	1.625	3/8	3/16	X	X	X	
0I	1.750	3/8	3/16		X	X	
0J	1.875	1/2	1/4		X	X	X
0L	2.000	1/2	1/4			X	X
0N	2.125	1/2	1/4				X
0R	2.375	5/8	5/16				X
Metric	**Bore**	**Width**	**Depth**	**170**	**196**	**230**	**278**
30	30	8	3.3	X	X		
35	35	10	3.3	X	X	X	
38	38	10	3.3	X	X	X	
40	40	12	3.3	X	X	X	X
42	42	12	3.3		X	X	
45	45	14	3.8		X	X	X
48	48	14	3.8		X	X	X
50	50	14	3.8			X	X
55	55	16	4.3				X
60	60	18	4.4				X

*Standard U.S. keyseats made to ANSI B17.1 standard. Metric keyseats to DIN 6885/1.

Table 2 - Coil Voltage

Character to Insert	Coil Voltage	Current Rating 6 170	7 196	8 230	9 278
E	24 Vdc	2.80	4.27	3.85	3.85
J	90 Vdc	.70	1.05	1.19	1.19
K	103 Vdc	.80	.96	1.08	1.08
L	180 Vdc	.36	.54	.61	.61
M	205 Vdc	.41	.49	.56	.56
S	258 Vdc	.33	.34	.40	.44
B	414/432 Vdc	.22	.26	.28	.28

Other voltages available - consult factory.
For AC rectifiers, see AC rectifier section.

Table 3 - Additional Options
Standard - Internal Maintained Manual Release	R
External Non-Maintained (deadman) and Maintained Manual Release	S

NOTE: Final part number may change due to specifications or options selected or other product design considerations. A number such as a 2, 3, 4 etc., in the 12th position is used to designate a unique brake (custom) and can only be assigned by Stearns Design Engineering Department.

Modifications are available - see AAB Modification Section.

AC Rectifiers for Use with Armature Actuated Brakes

For brake response times with and without AC rectifiers, see technical data section.

Product Overview

Full Wave

A rectifier in which both positive and negative half-cycles of the incoming (AC) signal are rectified to produce a unidirectional (DC) current through the load. The DC output voltage of a full wave rectifier is $V_{DC} = .90 V_{AC}$ Maximum operating voltage is +10% of nominal, frequency 50/60 Hz, maximum ambient temperature range of -40°C to 65°C.

Input **Output**

Half Wave

A rectifier in which only alternate half-cycles of the incoming (AC) signal are rectified to produce a unidirectional (DC) current through the load. The DC output voltage of a half wave rectifier is $V_{DC} = .45 V_{AC}$. Maximum operating voltage is +10% of nominal, frequency 50/60 Hz, maximum ambient temperature range of -40°C to 65°C.

Input **Output**

Combination Full & Half Wave

Provides option of utilizing either full or half wave rectification. Maximum operating voltage is +10% of nominal, frequency 50/60 Hz. Maximum ambient temperature range is -40°C to 65°C.

TOR-AC Full & Half Wave

Provides coil turn off nearly as fast as DC side switching. Includes line filter for AC drive applications or whenever electrical filtering is required to protect the rectifier from high-frequency electrical line pulses. Must be switched on/off by a switch in an AC lead of the TOR-AC. Maximum operating voltage +10% of nominal, frequency 50/60 Hz. Maximum ambient temperature range is -40°C to 65°C.

QuickSet

A rectifier that provides a quick brake response time even when the rectifier is permanently wired across the windings of an AC motor. The QuickSet Rectifier detects the decaying, motor generated voltage that occurs when power is removed from the motor circuit, and interrupts brake coil current in response. QuickSet Rectifiers can be specified full wave or half wave.
Operating voltage is ±10% of nominal, frequency 50/60 Hz.
Maximum ambient temperature range is -40°C to 65°C.

QuickSet/QuickRelease

A rectifier that provides a timed, full wave rectified "over-excitation" brake release function, followed by continuous, half wave rectified brake released "holding" function, when used in conjunction with an appropriate brake coil voltage rating.

USED AS WATTSAVER: Provides a timed, full wave rectified brake release function, followed by continuous, half wave rectified brake released "wattsaver" function, when used in conjunction with an appropriate brake coil voltage rating. The Wattsaver serves to reduce the electrical power consumption and dissipation of the brake in the released state. Operating voltage is ±10% of nominal, frequency 50/60 Hz. Maximum ambient temperature varies by part number - see information by part number on following pages.

Input **Output**

Bi-Phase Rectifiers

A rectifier that is typically used in single phase, reversing, permanent split capacitor (PSC) motor applications. A single phase, reversing, PSC motor typically has two windings of equivalent resistance. The winding which serves as the main winding is connected directly across the power line, the winding which serves as the auxiliary winding is connected in series with a run capacitor across the power line. The direction of rotation is reversed by interchanging the function of the two windings. The Bi-Phase Rectifier provides the same voltage to the brake coil regardless of the direction of rotation of the motor. The Bi-Phase Rectifier has five leads and comes in standard response and QuickSet versions. Bi-Phase Rectifiers are application specific. Please contact factory for more information.
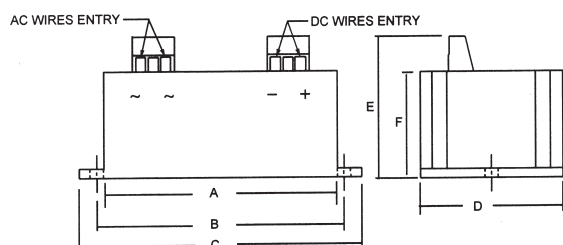
AC Rectifiers Selection

115 Vac Input Voltage

**At 50 Vdc coil voltage, this rectifier can be used on brake sizes 72-112. At 103 Vdc coil voltage, this rectifier can be used on brake sizes 72-196. At all other listed coil voltages, this rectifier can be used on any brakes size.

Full Wave

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
72-196	412029101K	115	103	K or J	ac or dc side or connect across motor terminals	ac leads dc terminal block	.8
ALL	412029201K	115	103	K or J	ac or dc side or connect across motor terminals	ac terminal block dc terminal block	1.6
ALL	412029203K	115	103	K or J	ac or dc side or connect across motor terminals	ac leads dc leads	1.6

Combination Full & Half Wave

Brake Sizes	Part Number	AC Input	DC Output	Brake Coil Voltage/Letter Designation		Switching	Connection	Max Current (amps)
**	412049101K	115/230 460/575	50/103 207/259 414/517	50 Vdc = G 207 Vdc = M 414 Vdc = B	103 Vdc = K 259 Vdc = S 517 Vdc = A	ac or dc side or connect across motor terminals	ac terminal block dc terminal block	.8

Quick Set/Quick Release or 103 Vdc Wattsaver

Brake Sizes	Part Number	AC Input	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
72-112	412019611K	115	103 Vdc over-excitation	G	ac side only or connect across motor terminals	ac terminal block dc terminal block	2.0
			50 Vdc Sustaining				1.0

230 Vac Input Voltage

**At 50 Vdc coil voltage, this rectifier can be used on brake sizes 72-112. At 103 Vdc coil voltage, this rectifier can be used on brake sizes 72-196. At all other listed coil voltages, this rectifier can be used on any brakes size.

Full Wave

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
ALL	412029101K	230	207	M	ac or dc side or connect across motor terminals	ac leads dc terminal block	.8
ALL	412029201K	230	207	M	ac or dc side or connect across motor terminals	ac terminal block dc terminal block	1.6
ALL	412029203K	230	207	M	ac or dc side or connect across motor terminals	ac leads dc leads	1.6

Combination Full & Half Wave

Brake Sizes	Part Number	AC Input	DC Output	Brake Coil Voltage/Letter Designation		Switching	Connection	Max Current (amps)
**	412049101K	115/230 460/575	50/103 207/259 414/517	50 Vdc = G 207 Vdc = M 414 Vdc = B	103 Vdc = K 259 Vdc = S 517 Vdc = A	ac or dc side or connect across motor terminals	ac terminal block dc terminal block	.8

TOR-AC Rectifier with Line Filter, Full Wave

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
ALL	412029401K 412029402K	230	207	M	ac side only	Terminals Leadwires	.6

QuickSet

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
ALL	412029601K	230	207	M	NONE-connect across motor terminals	ac terminal block dc terminal block	.6

QuickSet/QuickRelease or 205 Vdc Wattsaver

Brake Sizes	Part Number	Max Ambient Temp	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
72-230	412029301K	65°C	230	207 Vdc over-excitation	K or J	ac side only or connect across motor terminals	ac terminal block dc terminal block	2.0
				103 Vdc sustaining				1.0

AC Rectifiers Selection

460 Vac Input Voltage

**At 50 Vdc coil voltage, this rectifier can be used on brake sizes 72-112. At 103 Vdc coil voltage, this rectifier can be used on brake sizes 72-196. At all other listed coil voltages, this rectifier can be used on any brakes size.

Half Wave

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
ALL	412049301K	400	180	L	ac or dc side or connect across motor terminals	ac terminal block dc terminal block	.8
		460	207	M			

Combination Full & Half Wave

Brake Sizes	Part Number	AC Input	DC Output	Brake Coil Voltage/ Letter Designation	Switching	Connection	Max Current (amps)
**	412049101K	115/230 207/259 460/575	50/103 207/259 414/517	50 Vdc = G 103 Vdc = K 207 Vdc = M 259 Vdc = S 414 Vdc = B 517 Vdc = A	ac or dc side or connect across motor terminals	ac terminal block dc terminal block	.8

TOR-AC with Line Filter

Brake Sizes	Part Number	AC Input	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
ALL	412049404K	460	414	B / Full	ac side only	Terminals	0.3
ALL	412049405K	460	414	B / Full	ac side only	Leadwires	0.3
ALL	412049411K	460	207	M / Half	ac side only	Terminals	0.3
ALL	412049412K	460	207	M / Half	ac side only	Leadwires	0.3
ALL	412049413K	460	207	M / Half	ac side only	Terminals	0.6
ALL	412049414K	460	207	M / Half	ac side only	Leadwires	0.6

QuickSet

Brake Sizes	Part Number	AC Input	DC Output	Brake Coil Voltage/ Letter Designation	Switching	Connection	Max Current (amps)
ALL	412049801K	460	414	B Fullwave	NONE-connect across motor terminals	ac terminal block dc terminal block	.3
ALL	412049811K	460	207	M Halfwave	NONE-connect across motor terminals	ac terminal block dc terminal block	.6

QuickSet/QuickRelease or 414 Vdc Wattsaver

Brake Sizes	Part Number	Max Ambient Temp	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/ Letter Designation	Switching	Connection	Max Current (amps)
72-230	412049601K	45°C	460	414 Vdc over-excitation	M	ac side only or connect across motor terminals	ac terminal block dc terminal block	1.0
				207 Vdc sustaining				0.5

575 Vac Input Voltage

**At 50 Vdc coil voltage, this rectifier can be used on brake sizes 72-112. At 103 Vdc coil voltage, this rectifier can be used on brake sizes 72-196. At all other listed coil voltages, this rectifier can be used on any brakes size.

Half Wave

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/Letter Designation	Switching	Connection	Max Current (amps)
ALL	412059101K UL E71115	400	180	L	ac side only or connect across motor terminals	ac leads dc terminal block	.8
		575	259	S			
ALL	412059103K	400	180	L	ac side only or connect across motor terminals	ac leads dc leads	.8
		575	259	S			

Combination Full & Half Wave

Brake Sizes	Part Number	AC Input	DC Output	Brake Coil Voltage/ Letter Designation	Switching	Connection	Max Current (amps)
**	412049101K	115/230 207/259 460/575	50/103 207/259 414/517	50 Vdc = G 103 Vdc = K 207 Vdc = M 259 Vdc = S 414 Vdc = B 517 Vdc = A	ac or dc side or connect across motor terminals	ac terminal block dc terminal block	.8

QuickSet

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/ Letter Designation	Switching	Connection	Max Current (amps)
ALL	412059811K	575	258	S	NONE-connect across motor terminals	ac terminal block dc terminal block	.6

TOR-AC with Line Filter - Half Wave

Brake Sizes	Part Number	AC Input 50/60 Hz	DC Output	Brake Coil Voltage/ Letter Designation	Switching	Connection	Max Current (amps)
ALL	412059411K	575	259	S	ac side only	terminals	.6
	412059412K					leadwires	

AC Rectifiers Continued

Rectifier Dimensions

Tape Mount

Part Number	Length	Width	Ht	Connection	
				AC	DC
4-1-20291-01K	1.4	0.6	1.0	Leadwire, 7" long	Terminal
4-1-20292-01K	1.38	1.06	0.94	Terminal	Terminal
4-1-20292-03K	1.38	1.06	0.9	Leadwire, 2.5" long	Leadwire, 2.5" long
4-1-20491-01K	2.25	1.25	1.0	Terminal	Terminal
4-1-20591-03K	1.4	0.75	0.9	Leadwire, 7" long	Leadwire, 7" long
4-1-20591-01K	1.4	0.75	1.0	Leadwire, 7" long	Terminal

Terminal location or connection may differ from sketch
Flange or Tape Mount

Part Number	A	B	C	D	E	F
4-1-20293-01K	4.6	5	5.5	3.3	2.03	1.25
4-1-20294-01K	3	3.5	4	2	2	1.5
4-1-20296-01K	3	3.5	4	3	2	1.5
4-1-20493-01K	2	2.5	3	1.5	1.6	1
4-1-20494-04K	3	3.5	4	2	2	1.5
4-1-20494-11K	3	3.5	4	2	2	1.5
4-1-20494-13K	3	3.5	4	2	2	1.5
4-1-20496-01K	4.6	5	5.5	3.3	2	1.25
4-1-20498-01K	3	3.5	4	3	2	1.5
4-1-20498-11K	2	2.38	2.6	2	2.1	1.3
4-1-20594-11K	3	3.5	4	2	2	1.5
4-1-20598-11K	2	2.38	2.6	2	2.1	1.3
4-1-20196-11K	4.6	5	5.5	3.3	2.03	1.25

Part Number	A	B	C	D	E	F	Mount
4-1-20494-01K	2.3			1.32	6	0.86	Tape
4-1-20294-02K	3	3.5	4	2	6	1.5	Flange
4-1-20494-05K	3	3.5	4	2	6	1.5	Flange
4-1-20494-12K	3	3.5	4	2	6	1.5	Flange
4-1-20494-14K	3	3.5	4	2	6	1.5	Flange
4-1-20594-12K	3	3.5	4	2	6	1.5	Flange

Wiring Diagrams/Switching

For brake response times with/without AC rectifiers, see set and release times.

AC Side Switching

Rectifier module

Brake coil

DC Side Switching

Rectifier module

Brake coil

Use DC side switching with the following Rectifiers ONLY: 4-1-20291-01K, 4-1-20292-01K, 4-1-20292-03K, 4-1-20493-01K, 4-1-20491-01K

Connected Across Motor Terminals (No switching)

Rectifier module

Brake coil

Armature Actuated Brake Modifications

Series 320, 321 & 322

Modification	Series	Brake Size		
Maintained Manual Release				
	320/321/322	1.2 1.8 2.0 2.8		
Non-Maintained Manual Release				
	320/321/322	1.2 1.8 2.0 2.8		
Brake Manual Release Indicator Switch				
Manual release engaged	320/321/322	ALL		
AC Rectifiers, In-Line				
	310/320/321/322	ALL (Except Quick Set) Quick Set		
AC Rectifiers, Internal	320/321/322	1.8 and 2.8		
Encoder Mount				
	310/320/321/322 tapped holes in magnet body for tether mount			
Through-Shaft				
	320	See catalog pg.		
	321/322	ALL (through-shaft combined with manual release only available on size 2.8)		
Mounting Plates				
	320/321/322	**Size**	**Bolt Circle**	
		1.2	2.5/2.62"	
		1.8, 2.8	3.5"	
		1.8, 2.8	3.5", 2.5" register	
		2.0	2.844"	
Double "D" Disc				
	320/321/322	1.2, 1.8, and 2.0 Contact factory for Double "D" disc on brakes rated greater than 7 lb-in		
Carrier Ring Disc	320/321/322	1.8		

Armature Actuated Brake Modifications

Series 333, 350 & 360

Modification	Series	Brake Size
Maintained Manual Release		
	333	ALL
Manual Release Access Plugs	350/360	ALL
Non-Maintained Manual Release		
333 **360**	333	ALL
	360	ALL
Electronic Wear Indicator Switch	333/350/360	ALL
AC Rectifiers, In-Line	333	size 72-90 115 Vac size 72-112 230 Vac
AC Rectifiers, Separate	333/350/360	ALL
Conduit Box		
	333/350/360	ALL
	350/360 with IP67 conduit box	ALL

Armature Actuated Brake Modifications

Series 333, 350 & 360

Modification	Series	Brake Size
Band Seal (Boot)		
	333	ALL
End Cap Plug		
	333	ALL
Space Heater		
	333/350/360	ALL
Tach Machining		
	333 tapped holes in magnet body for tether mount	ALL
	350/360 Machining on brake housing	ALL
Through-Shaft		
	333 through-shaft seal in magnet body	ALL
	350/360 through-shaft hole in housing with shaft seal	ALL

Technical Data
SAB Motor Frame Adapter Dimensions
Selection

To select an adapter for a specific brake, refer to the motor frame adapter tables as shown in the brake series sections of this catalog. After selecting the adapter stock number, refer to the Tables below for dimensions.

All adapters are constructed with an opening for internal lead wire connection, corresponding to the NEMA standard location for the motor frame size.

Screws for mounting adapter to motor must be provided by customer. Socket head cap screws are supplied for mounting brake to adapter.

Motor Side   **Brake Side**

Dimensions for estimating only. For installation purposes, request certified prints.

Brake Series	Torque (lb-ft)	Adapter Stock Number	Dimensions in Inches (Dimensions in Millimeters)											Add'l Shaft Length Req'd
			A	AH	AJ	AK	AL	B	BF	BK Hole	D	F	L	
56,000	1.5 - 6	5-55-5041-00	1.25 (31.75)	5.88 (149.22)	7.25 (184.15)	8.500 8.502 (215.900) (215.951)	4.497 4.500 (114.325) (114.275)	9.00 (228.60)	.50 (12.70)	3/8 - 16 x 1/2 deep	4.00 (101.60)	.19 (4.76)	.12 (3.18)	.94 (23.88)
65,300*		5-55-5046-00												
56,000 and 56,800*	10 - 25	5-55-5043-00												
87,000 and 87,800*	6 - 105	5-55-7046-00	1.06 (26.99)	7.25 (184.15)	11.00 (279.40)	12.501 12.504 (317.525) (317.602)	8.499 8.497 (215.875) (215.849)	13.00 (330.20)	.62 (15.88)	1/2 - 13 through	4.12 (104.78)	.19 (4.76)	.38 (9.52)	.87 (22.10)
87,300		5-55-7054-00												
87,000 and 87,800*	6 - 105	5-55-7055-00	1.00 (25.40)		9.00 (228.60)	10.500 10.502 (266.700) (266.751)	8.499 8.497 (215.875) (215.849)	11.00 (279.40)	**		6.25 (158.75)		.25 (6.35)	.81 (20.57)
87,300*		5-55-7045-00												
87,000, 87,800* and 87,300*	6 - 105	5-55-7043-00	.75 (19.05)	7.25 (184.15)	5.88 (149.35)	4.502 4.507 (114.35) (114.48)	8.499 8.497 (215.875) (215.849)	8.75 (222.25)	.62 (15.75)	1/2 - 13 through	4.00 (101.60)	.19 (4.76)	.25 (6.35)	.56 (14.23)
81,000	125 - 130	5-55-2045-00	1.06 (26.99)	11.00 (279.40)	14.00 (355.60)	16.002 16.005 (406.451) (406.527)	12.499 12.496 (317.475) (317.398)	16.50 (419.10)	.62 (15.88)	5/8 - 11 through	9.75 (247.65)	.19 (4.76)	.25 (6.35)	.87 (22.10)
81,000	125 - 230	5-55-2041-00	1.12 (28.58)	11.00 (279.40)	7.25 (184.15)	8.500 8.502 (215.900) (215.951)	12.499 12.496 (317.475) (317.398)	12.499 12.496 (317.475) (317.398)	.50 (12.70)	5/8 -11 through	6.00 (152.40)	.19 (4.76)	---	.93 (23.62)
81,000		5-55-2043-00			9.00 (228.60)	10.500 10.502 (266.700) (266.751)					7.75 (196.85)			.93 (23.62)
82,000 and 82,300*	125 - 440	5-55-2046-00	1.94 (49.21)	11.00 (279.40)	14.00 (355.60)	16.002 16.005 (406.451) (406.527)	12.499 12.496 (317.475) (317.398)	16.50 (419.10)	.62 (15.88)	5/8 - 11 x 1 deep	9.50 (241.30)	.19 (4.76)	.25 (6.35)	1.75 (44.45)
82,000 and 82,300*		5-55-2042-00	1.38 (34.92)		7.25 (184.15)	8.500 8.502 (215.900) (215.951)		13.25 (336.55)	.50 (12.70)	5/8 -11 through	6.00 (152.40)			1.19 (30.23)
82,000 and 82,300*		5-55-2044-00	1.38 (34.92)		9.00 (228.60)	10.500 10.502 (266.700) (266.751)		13.25 (336.55)			7.75 (196.85)			1.19 (30.23)
86,000	500 - 1000	5-55-6041-00	1.56 (38.69)	14.00 (355.60)	11.00 (379.40)	12.500 12.504 (317.500) (317.602)	16.000 15.995 (406.400) (406.273)	16.19 (441.16)	.62 (15.88)	5/8 - 11 x 3/4 deep	8.62 (219.08)	.19 (4.76)	.25 (6.35)	1.37 (34.80)

* 1/2-13 flat head screws are supplied with adapter.

** When adding an adapter to a hazardous location brake, refer to the "mounting requirements" on the product page for the recommended brake series for accommodating adapters.

Foot Mounting Kits

Brake Side

Kits include the foot mounting bracket and hardware to fit the BF mounting holes.

Dimensions for estimating only. For installation purposes, request certified prints.

Brake Series	Torque	Foot Mounting Kit Number	Dimensions in Inches (Dimensions in Millimeters)																		Wgt lbs.
			A	AJ	AK	B	BB	BF No.	BF Thd.	C	D	E	FA	FB	G	H	J	K	L	M No.	
56,000	1.5-25	5-55-5023-00	7.00 (177.80)	5.88 (149.22)	4.499 4.498 (114.275 / 114.249)	2.38 (60.32)	.12 (3.18)	2	3/8-16	6.50 (165.10)	3.50 (88.90)	2.88 (73.02)	1.50 (38.10)	–	.38 (9.52)	.41 (10.32)	1.50 (38.10)	.50 (12.70)	2.50 (63.50)	2	4.5
87,000	6-125	5-55-7021-00	8.62 (219.08)	7.25 (184.15)	8.499 8.498 (215.875 / 215.849)	3.00 (76.20)	.25 (6.35)	4	1/2-13	8.62 (218.95)	5.00 (127.00)	3.56 (90.49)	2.00 (50.80)	–	.38 (9.52)	.53 (13.49)	1.62 (41.28)	.56 (14.29)	5.75 (146.05	2	7
81,000	125-230	5-55-2022-00	15.50 (393.70)	11.00 (279.40)	12.499 12.498 (317.475 / 317.449)	7.00 (177.80)	.25 (6.35)	4	5/8-11	13.25 (336.55)	8.50 (215.90)	6.88 (174.62)	2.00 (50.80)	4.00 (101.60)	.62 (15.88)	.69 (17.46)	3.00 (76.20)	.88 (22.22)	9.00 (228.60)	4	40
82,000	125-550																				
86,000	500-1000	5-55-6021-00	18.25 (463.55)	14.00 (355.60)	16.000 15.995 (406.400 / 406.273)	8.00 (203.20)	.22 (5.56)	4	5/8-11	17.00 (431.80)	10.88 (276.22)	6.38 (161.92)	3.38 (85.72)	3.00 (76.20)	1.00 (25.40)	.81 (20.64)	4.12 (104.78)	1.22 (30.96)	8.50 (215.90)	4	75

Dimensions for C-Face Brake Motor Systems

Brakes Externally Wired to Motor
C-face motor with double shaft extension.

Stearns disc brakes are designed to mount on standard C-face motors having the same dimensions and tolerances on the accessory end as on the drive end. They also mount on foot mounting brackets and machine mounting faces having the same mounting dimensions and tolerances. Some motor accessory end C-face may differ from the drive end.

Accessory End   Drive End

Dimensions for frames where AJ is greater than AK

Drive End Dimensions (Inches)

Frame Designation	AJ	AK	BB Min.	BF Hole			U	AH	Keyseat			Base to Centerline D
				Number	Tap Size	Bolt Penetration Allowance			R	ES Min.	S	
42C	3.750	3.000	0.16	4	1/4-20	. . .	0.375	1.312	0.328	. . .	flat	2.62
48C	3.750	3.000	0.16	4	1/4-20	. . .	0.500	1.69	0.453	. . .	flat	3.00
56C	5.875	4.500	0.16	4	3/8-16	. . .	0.625	2.06	0.517	1.41	0.188	3.50
143TC and 145TC	5.875	4.500	0.16	4	3/8-16	0.56	0.875	2.12	0.771	1.41	0.188	3.50
182TC and 184TC	7.250	8.500	0.25	4	1/2-13	0.75	1.125	2.62	0.986	1.78	0.250	4.50
182TCH and 184TCH	5.875	4.500	0.16	4	3/8-16	0.56	1.125	2.62	0.986	1.78	0.250	4.50
213TC and 215TC	7.250	8.500	0.25	4	1/2-13	0.75	1.375	3.12	1.201	2.41	0.312	5.25
254TC and 256TC	7.250	8.500	0.25	4	1/2-13	0.75	1.625	3.75	1.416	2.91	0.375	6.25
284TC and 286TC	9.000	10.500	0.25	4	1/2-13	0.75	1.875	4.38	1.591	3.28	0.500	7.00
284TSC and 286TSC	9.000	10.500	0.25	4	1/2-13	0.75	1.625	3.00	1.416	1.91	0.375	7.00
324TC and 326TC	11.000	12.500	0.25	4	5/8-11	0.94	2.125	5.00	1.845	3.91	0.500	8.00
324TSC and 326TSC	11.000	12.500	0.25	4	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	8.00
364TC and 365TC	11.000	12.500	0.25	8	5/8-11	0.94	2.375	5.62	2.021	4.28	0.625	9.00
364TSC and 365TSC	11.000	12.500	0.25	8	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	9.00
404TC and 405TC	11.000	12.500	0.25	8	5/8-11	0.94	2.875	7.00	2.450	5.65	0.750	10.00
404TSC and 405TSC	11.000	12.500	0.25	8	5/8-11	0.94	2.125	4.00	1.845	2.78	0.500	10.00
444TC and 445TC	14.000	16.000	0.25	8	5/8-11	0.94	3.375	8.25	2.880	6.91	0.875	11.00
444TSC and 445TSC	14.000	16.000	0.25	8	5/8-11	0.94	2.375	4.50	2.021	3.03	0.625	11.00
500 Frame Series	14.500	16.500	0.25	4	5/8-11	0.94	. . .	. . .	. . .	. . .	. . .	12.50

Tolerances (Inches)

AK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

AK Dimension	Tolerance on AK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

Shaft Extension Diameters

Shaft Diameter	Tolerances	
	Plus	Minus
0.2500 to 1.5000, inclusive	0.000	0.0005
Over 1.5000 to 6.500, inclusive	0.000	0.001

Width of Shaft Extension Keyseats

Width of Keyseat	Tolerances	
	Plus	Minus
0.188 to 0.750, inclusive	0.002	0.000
Over 0.750 to 1.500, inclusive	0.003	0.000

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Dimensions for C-Face AC Brake Motor Systems Continued

Accessory End

FC face mounting for accessories, including brakes, on the end opposite the drive end of motor. Some motor accessory end C-face may differ from the drive end. Confirm shaft diameter and bolt circle before ordering.

143TFC to 184TFC Frames, Inclusive

213TFC to 326TFC Frames, Inclusive

Dimensions (Inches)

Frame Designation	FAJ	FAK	FBD Max.	FBF Hole			Hole for Accessory Leads	
				Number	Tap Size	Bolt Penetration Allowance	DP	Diameter
143TFC and 145TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
182TFC and 184TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
213TFC and 215TFC	7.250	8.500	9.00	4	1/2-13	0.75	3.81	0.62
254TFC and 256TFC	7.250	8.500	10.00	4	1/2-13	0.75	3.81	0.62
284TFC and 286TFC	9.000	10.500	11.25	4	1/2-13	0.75	4.50	0.62
324TFC and 326TFC	11.000	12.500	14.00	4	5/8-11	0.94	5.25	0.62

NOTE: Standards have not been developed for the shaft extension diameter and length, and keyseat dimensions.

Tolerances* (Inches)

FAK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

FAK Dimension	Tolerance on FAK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

* Tolerance requirement on 56,X00 and 87,000 Series brake kits is .015 T.I.R. (total indicated runout shaft to motor register face).

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Stearns Recommended Minimum Shaft Diameter by Torque

Minimum recommended shaft size considers a keyed C1045 steel shaft under *dynamic* use in a typical spring set brake application.

Torque ft-lb	Minimum Shaft (inches)
0.50	0.250
0.75	0.250
1.5	0.375
3	0.500
6	0.500
10	0.625
15	0.750
25	0.875
35	1.000
50	1.125

Torque ft-lb	Minimum Shaft (inches)
75	1.250
105	1.375
125	1.375
175	1.625
230	1.750
330	2.000
440	2.125
500	2.375
750	2.500
1000	2.750

Torque Nm	Minimum Shaft (mm)
4 Nm	ø10 mm
8 Nm	ø13 mm
16 Nm	ø16 mm
32 Nm	ø20 mm
60 Nm	ø25 mm
80 Nm	ø28 mm
150 Nm	ø34 mm
240 Nm	ø39 mm
400 Nm	ø47 mm

Set & Release Times

The models listed below were tested for typical set and release times. Times listed below are defined as follows:

T1 = Total set time to 80% of rated static torque

T2 = Release time, measured as the time from when the power is applied to the brake to the time that the solenoid plunger or armature is fully seated.

NOTE: Times will vary with the motor used, and brakes tested with factory-set air gap. The times shown should be used as a guide only.

SAB T1/T2 Time in Milliseconds

Series	Static Torque lb-ft	Coil Size	Coil Strength	T1 AC	T2 AC
56,000	1 1/2 – 25	4	3	25	14
87,000	10,15, 25,50	5 & 6	3	53	21
87,000	35,75,105	8	3	50	25
81,000 82,000	All	9	3	58	31

Brake and motor are switched separately.
All brakes tested in horizontal position.
Coil is energized for >24 hours before testing.
Ambient temperature 70°F at time of test.

AAB Series 333 Times in Milliseconds

Size	Applied Voltage/Type of Switching	T1	T2
72	DC side switching	23	35
	230 Vac/ac side switching/full wave	103	39
	460 Vac/ac side switching/half wave	98	34
90	DC side switching	19	73
	230 Vac/ac side switching/full wave	113	72
	460 Vac/ac side switching/half wave	114	73
	230 Vac connected across motor full wave	357	72
	230 Vac connected across motor /quickset	42	72
112	DC side switching	155	39
	230 Vac/ac side switching/full wave	547	43
	460 Vac/ac side switching/half wave	501	54
132	DC side switching	119	100
	230 Vac/ac side switching/full wave	833	101
	460 Vac/ac side switching/half wave	803	106
145	DC side switching	185	186
	230 Vac/ac side switching/full wave	999	192
	460 Vac/ac side switching/half wave	1007	209
	230 Vac connected across motor full wave	1689	192
	230 Vac connected across motor /quickset	368	192
	460 Vac/ac side switching/half wave/With air gap shim	629	223
170	DC side switching	129	163
	230 Vac/ac side switching/full wave	1130	174
	460 Vac/ac side switching/half wave	1140	175
196	DC side switching	96	263
	230 Vac/ac side switching/full wave	920	264
	460 Vac/ac side switching/half wave	957	274
230	DC side switching	131	264
	230 Vac/ac side switching/full wave	1299	236
	460 Vac/ac side switching/half wave	1303	276
	Tor-Ac 230 Vac/ac side switching/full wave	169	295
	Tor-Ac 230 Vac/ac side switching/full wave/ With air gap shim	122	327
	230 Vac connected across motor quickset/ quickrelease/with air gap shim	122	145
278	DC side switching	182	388
	230 Vac/ac side switching/full wave	1807	389
	460 Vac/ac side switching/half wave	1689	366

AAB Series 310/311/320/321
Times in Milliseconds

Series	310 DC Side Switching					
Size	1.79	2.0	2.87	3.35	4.25	5.0
T1	3	6	9	14	13	22
T2	20	43	48	110	120	195
Series	311 DC Side Switching					
Size	3.38	4.75	5.0			
T1	43	48	96			
T2	12	74	35			
Series	320 DC Side Switching					
Size	1.2	1.8	2.0	2.8		
T1	14	43	16	27		
T2	24	26	35	34		
Series	320 Full wave rectifier/AC Side Switching					
Size	1.2	1.8	2.0	2.8		
T1	31	97	52	78		
T2	27	29	40	42		
Series	321 DC Side Switching			321 AC Side Switching		
Size	1.2	1.8	2.8	1.2	1.8	2.8
T1	13	16	20	45	77	131
T2	18	27	49	16	25	26

Conversions

English-Metric Conversion Factors

Multiply the base unit by the factor shown to obtain the desired conversion.

Measurement	Base Unit	Factor	Conversion
Length	inch, in *(millimeter, mm)*	25.4 .03937	*(millimeter, mm)* inch, in
Torque	pound-feet, lb-ft *(newton-meter, Nm)*	1.355818 .73756	*(newton-feet, Nm)* pound-feet, lb-ft
	pound-inch, lb-in *(newton-meter, Nm)*	.113 8.85	*(newton-meter, Nm)* pound-inch, lb-in
	ounce-inch, oz-in *(newton-meter, Nm)*	.007062 141.611	*(newton-meter, Nm)* ounce-inch, oz-in
Moment of Inertia	pound-feet squared, lb-ft² *(kilogram-meter squared, kgm²)*	.04214 23.73	*(kilogram-meter squared, kgm²)* pound-feet squared, lb-ft²
Kinetic Energy	foot-pound, ft-lb *(joule, J)*	1.355818 .73756	*(joule, J)* foot-pound, ft-lb
Weight	pound, lb *(kilogram, kg)*	.453592 2.20462	*(kilogram, kg)* pound, lb
Horsepower (English)	horsepower, hp *(kilowatt, kW)*	.7457 1.341	*(kilowatt, Kw)* horsepower, hp
Thermal Capacity	horsepower-seconds per minute, hp-sec/min *(watts, W)*	12.42854 .08046	*(watts W)* horsepower-seconds per minute, hp-sec/min
Temperature	degrees Fahrenheit,°F *(degrees Celsius, °C)*	$(°F - 32) \times 5/9$ $(°C \times 9/5) + 32$	*(degrees Celsius, °C)* degrees Fahrenheit, °F

English-English Conversion Factors for Thermal Capacity

Base Unit	Multiply by	To Obtain
horsepower	60.0	hp-sec/min
ft-lb/sec	.109	hp-sec/min
ft-lb/min	.0018	hp-sec/min
in-lb/sec	.009	hp-sec/min
in-lb/min	.00015	hp-sec/min

Decimal Equivalents of Fractions

Decimal Equivalent (Inches) 2-Place	3-Place	Fraction (Inches)	Decimal Equivalent (Inches) 2-Place	3-Place	Fraction (Inches)	Decimal Equivalent (Inches) 2-Place	3-Place	Fraction (Inches)
.02	.016	1/64	.39	.391	25/64	.77	.766	49/64
.03	.031	1/32	.41	.406	13/32	.78	.781	25/32
.05	.047	3/64	.42	.422	27/64	.80	.797	51/64
.06	.062	1/16	.44	.438	7/16	.81	.812	13/16
.08	.078	5/64	.45	.453	29/64	.83	.828	53/64
.09	.094	3/32	.47	.469	15/32	.84	.844	27/32
.11	.109	7/64	.48	.484	31/64	.86	.859	55/64
.12	.125	1/8	.50	.500	1/2	.88	.875	7/8
.14	.141	9/64	.52	.516	33/64	.89	.891	57/64
.16	.156	5/32	.53	.531	17/32	.91	.906	29/32
.17	.172	11/64	.55	.547	35/64	.92	.922	59/64
.19	.188	3/16	.56	.562	9/16	.94	.938	15/16
.20	.203	13/64	.58	.578	37/64	.95	.958	61/64
.22	.219	7/32	.59	.594	19/32	.97	.969	31/32
.23	.234	15/64	.61	.609	39/64	.98	.984	63/64
.25	.250	1/4	.62	.625	5/8	1.00	1.000	1
.27	.266	17/64	.64	.641	41/64			
.28	.281	9/32	.66	.656	21/32			
.30	.297	19/64	.67	.672	43/64			
.31	.312	5/16	.69	.688	11/16			
.33	.328	21/64	.70	.703	45/64			
.34	.344	11/32	.72	.719	23/32			
.36	.359	23/64	.73	.734	47/64			
.38	.375	3/8	.75	.750	3/4			

Application Engineering

Introduction

Information and guidelines provided in the application section are intended for general selection and application of spring set brakes. Unusual operating environments, loading or other undefined factors may affect the proper application of the product. Stearns application services are available to assist in proper selection or to review applications where the specifier may have questions.

A spring set brake is used to stop and hold a rotating shaft. Generally the brake is mounted to an electric motor, but can also be mounted to gear reducers, hoists, machinery or utilize a foot mount kit.

The brake should be located on the high speed shaft of a power transmission system. This permits a brake with the lowest possible torque to be selected for the system.

Spring set disc brakes use friction to stop (dynamic torque) and hold (static torque) a load. Energy of the motor rotor and moving load is converted to thermal energy (heat) in the brake during deceleration. The brakes are power released, spring applied. No electrical current is required to maintain the spring set condition.

The system designer will need to consider the mount surface and match the brake to the load and application. Factors include: brake torque, stopping time, deceleration rate, load weight and speed, location and environment. Brake thermal ratings, electrical requirements and environmental factors are discussed in separate sections.

Electrical Considerations

Solenoid actuated brakes (SAB) are available with standard motor voltages, frequencies and Class B or H coil insulation. Most models can be furnished with either single or dual voltage coils. Coils in most models are field replaceable.

Inrush and holding amperage information is published for the common coil voltages and factory available for other voltages or frequencies. Amperage information for specific coil sizes is provided for selection of wire size and circuit protection at brake installation. Fixed voltage - 50/60 Hz dual frequency coils are available in many models.

All SAB AC coils are single phase and can be wired to either single or three phase motors without modifications. All solenoid coils have a voltage range of +/- 10% of the rated nameplate voltage at the rated frequency. Instantaneous rated voltage must be supplied to the coil to insure proper solenoid pull in and maximum coil cycle rate. The plunger rapidly seats in the solenoid and the amperage requirements drops to a holding amperage value.

Instantaneous voltage must be supplied to the coil to insure proper solenoid pull-in and maximum coil cycle rate.

Since Stearns SABs require low current to maintain the brake in the released position, the response time to set the brake *can* be affected by EMF voltages generated by the motor windings. It may be necessary to isolate the brake coil from the motor winding.

The solenoid coil cycle rate limits the engagements per minute of a static or holding duty brake. Brake thermal performance, discussed in another section, limits engagements per minute in dynamic applications.

Class B insulation is standard in most SAB models, class H coil insulation is optional and is recommended for environments above 104°F (40°C), or rapid cycling applications.

Armature actuated brakes (AAB) are available in standard DC voltages. Available AC rectification is listed in the catalog section. Wattage information is provided in the catalog pages. Unlike solenoid actuated brakes, armature actuated brakes do not have inrush amperage. Coil and armature reaction time and resulting torque response time information is available. Like SAB, mechanical reaction time depends on typical application factors including load, speed and position.

Electrical response time and profiles are unique to the SAB and AAB. Reaction time requirements should be considered when selecting or interchanging brakes.

All Stearns brake coils are rated for continuous duty and can be energized continually without overheating. The coil heating effect is greatest at coil engagement due to engaging, pull in or inrush amperage.

Temperature limits as established by UL controls standards are:

Class A insulation   221°F (105°C)
Class B insulation   266°F (130°C)
Class H insulation   356°F (180°C).

Types of Applications

In order to simplify the selection of a disc brake, loads can be classified into two categories, non-overhauling and overhauling.

Loads are classified as non overhauling, if (1) no components of the connected equipment or external material undergo a change of height, such as would occur in hoisting, elevating or lowering a load, and (2) there is only rotary motion in a horizontal plane. For example, a loaded conveyor operating in a horizontal plane would be typical of a non-overhauling load.

If the same conveyor were transporting material to a lower level, it would be classified as an overhauling load. The external material or load undergoes a change in height, with the weight of the load attempting to force the conveyor to run faster than its design speed or to overhaul.

Non-overhauling loads require braking torque only to stop the load and will remain at rest due to system friction. Overhauling loads, such as a crane hoist, have two torque requirements. The first requirement is the braking torque required to *stop* the load, and the second requirement is the torque required to *hold* the load at rest. The sum of these requirements is considered when selecting a brake for an overhauling load.

Alignment

Requirements per NEMA:

Permissible ECCENTRICITY of mounting rabbet (AK dimension):

42C to 286TC frames inclusive is 0.004" total indicator reading. 324TC to 505TC frames inclusive is 0.007" total indicator reading.

Face Runout:

42C to 286TC frames inclusive is 0.004" total indicator reading.

If a customer furnishes a face on the machine for brake mounting, the same tolerances apply. Floor mounted brakes must be carefully aligned within 0.005" for concentricity and angular alignment. Use of dowels to insure permanent alignment is recommended.

In offset brake mount locations such as fan covers, cowls or jack shafting, proper mount rigidity and bearing support must be provided. Spring set frictional brakes characteristically have a rapid stop during torque application which may affect the mount surface or contribute to shaft deflection.

Printed installation information is published and available on all Stearns spring set brakes.

Determining Brake Torque

Torque Ratings

Brake torque ratings are normally expressed as nominal static torque. That is, the torque required to begin rotation of the brake from a static, engaged condition. This value is to be distinguished from dynamic torque, which is the retarding torque required to stop a linear, rotating or overhauling load.

As a general rule, a brake's dynamic torque is approximately 80% of the static torque rating of the brake for stopping time up to one second. Longer stopping time will produce additional brake heat and possible fading (reduction) of dynamic torque. The required dynamic torque must be converted to a static torque value before selecting a brake, using the relationship:

$$T_S = \frac{T_d}{0.8}$$

Where, T_S = Static torque, lb-ft

T_d = Dynamic torque, lb-ft

0.8 = Constant (derating factor)

All Stearns brakes are factory burnished and adjusted to produce no less than rated nominal static torque. Burnishing is the initial wear-in and mating of the rotating friction discs with the stationary metallic friction surfaces of the brake.

Although brakes are factory burnished and adjusted, variations in torque may occur if components are mixed when disassembling and reassembling the brake during installation. Further burnishing may be necessary after installation. Friction material will burnish under normal load conditions. Brakes used as holding only duty require friction material burnishing at or before installation to insure adequate torque.

When friction discs are replaced, the brake must be burnished again in order to produce its rated holding torque.

System Friction
The friction and rolling resistance in a power transmission system is usually neglected when selecting a brake. With the use of anti-friction bearings in the system, friction and rolling resistance is usually low enough to neglect. Friction within the system will assist the brake in stopping the load. If it is desired to consider it, subtract the frictional torque from the braking torque necessary to decelerate and stop the load. Friction and rolling resistance are neglected in the examples presented in this guide.

Non-overhauling Loads
There are two methods for determining brake torque for non-overhauling loads. The first method is to size the brake to the torque of the motor. The second is to select a brake on the basis of the total system or load inertia to be stopped.

Selecting Brake Torque from the Motor Data
Motor full-load torque based or nameplate horsepower and speed can be used to select a brake. This is the most common method of selecting a brake torque rating due to its simplicity.

This method is normally used for simple rotary and linear inertial loads. Brake torque is usually expressed as a percent of the full load torque of the motor. Generally this figure is not less than 100% of the motor's full load torque. Often a larger service factor is considered. Refer to Selection of Service Factor.

The required brake torque may be calculated from the formula:

$$T_S = \frac{5{,}252 \times P}{N} \times SF$$

Where, T_S = Static brake torque, lb-ft

P = Motor horsepower, hp

N = Motor full load speed, rpm

SF = Service factor

5,252 = Constant

Match the brake torque to the hp used in the application. When an oversized motor hp has been selected, brake torque based on the motor hp may be excessive for the actual end use.

Nameplate torque represents a nominal static torque. Torque will vary based on combinations of factors including cycle rate, environment, wear, disc burnish and flatness. Spring set brakes provide a rapid stop and hold and are generally not used in repeat positioning applications.

Selection of Service Factor (SF)
A service factor is applied to the basic drive torque calculation. The SF compensates for any tolerance variation, data inaccuracy, unplanned transient torque and potential variations of the friction disc.

When using the basic equation: T= (hp x 5252) / rpm with non-overhauling loads, a service factor of 1.2 to 1.4 is typical. Overhauling loads with unknown factors such as reductions may use a service factor of 1.4 to 1.8.

Spring set brakes combined with variable frequency drives use service factors ranging from 1.0 to 2.0 (2.0 for holding duty only) depending on the system design. These holding duty brakes must be wired to a separate dedicated power supply.

Occasionally, a brake with a torque rating less than the motor full load torque or with a service factor less than 1.0 is selected. These holding or soft stop applications must be evaluated by the end user or system designer to insure adequate sizing and thermal capacity.

Typically a brake rated 125% of the motor full load torque, or with a 1.25 service factor, provides a stop in approximately the same time as that required for the motor to accelerate the load to full load speed.

Occasionally a motor is oversized or undersized for the load or application. In these situations, the load inertia and desired stopping time calculations should be used rather than relying on the service factor method alone.

Service factor selection can be based on motor performance curves. Motor rotor and load inertia should be considered in this selection process. Depending on the motor design (NEMA A, B, C and D), rpm and horsepower, the maximum torque is either the starting or breakdown torque. A NEMA design B, 3 phase, squirrel cage design motor at breakdown torque produces a minimum of 250% the full load torque. A service factor of 2.5 would be selected. Typical service factors depending on NEMA motor design are: NEMA design A or B: 1.75 to 3.0, NEMA design C: 1.75 to 3.0 and NEMA design D: not less than 2.75.

A brake with an excessive service factor may result in system component damage, an unreasonably rapid stop or loss of load control. A SF above 2.0 is not recommended without evaluation by the end user or system designer.

Example 1: Select brake torque from motor horsepower and speed.

Given: Motor power (P) - 5 hp

Motor speed (N) - 1,750 rpm

Service factor (SF) - 1.4

$$T = \frac{5{,}252 \times P}{N} \times SF$$

$$= \frac{5{,}252 \times 5}{1{,}750} \times 1.4$$

T = 21 lb-ft

A brake having a standard rating of 25 lb-ft nominal static torque would be selected.

Example 2 illustrates selection of a brake to provide proper static torque to hold a load if dynamic braking were used to stop the load.

Example 2: Select a brake to hold a load in position after some other method, such as dynamic braking of the motor, has stopped all rotation.

Given: Weight of load (W) - 5 lb

Drum radius (R) - 2 ft

Service factor (SF) - 1.4

The static holding torque is determined by the weight of the load applied at the drum radius. A service factor is applied to ensure sufficient holding torque is available in the brake.

$$T_S = F \times R \times SF$$
$$= 5 \times 2 \times 1.4$$
$$T_S = 14 \text{ lb-ft}$$

Sizing the Brake to the Inertial Load

For applications where the load data is known, where high inertial loads exist, or where a stop in a specified time or distance is required, the brake should be selected on the basis of the total inertia to be retarded. The total system inertia, reflected to the brake shaft speed, would be:

$$Wk_T^2 = Wk_B^2 + Wk_M^2 + Wk_L^2$$

Where: Wk_T^2 = Total inertia reflected to the brake, lb-ft^2

Wk_B^2 = Inertia of brake, lb-ft^2

Wk_M^2 = Inertia of motor rotor, lb-ft^2

Wk_L^2 = Equivalent inertia of load reflected to brake shaft, lb-ft^2

Other significant system inertias, including speed reducers, shafting, pulleys and drums, should also be considered in determining the total inertia the brake would stop.

If any component in the system has a rotational speed different than the rotational speed of the brake, or any linear moving loads are present, such as a conveyor load, their equivalent inertia in terms of rotary inertia at the brake rotational speed must be determined. The following formulas are applicable:

Rotary Motion:

$$\text{Equivalent } Wk_B^2 = Wk_L^2 \left(\frac{N_L}{N_B}\right)^2$$

Where,

Equivalent Wk_B^2 = Inertia of rotating load reflected to brake shaft, lb-ft^2

Wk_L^2 = Inertia of rotating load, lb-ft^2

N_L = Shaft speed at load, rpm

N_B = Shaft speed at brake, rpm

Horizontal Linear Motion

$$\text{Equivalent } Wk_W^2 = W\left(\frac{V}{2\pi\,N_B}\right)^2$$

Where,

Equivalent Wk_W^2 = Equivalent inertia of linear moving load reflected to brake shaft, lb-ft^2

W = Weight of linear moving load, lb

V = Linear velocity of load, ft/min

N_B = Shaft speed at brake, rpm

Once the total system inertia is calculated, the required average dynamic braking torque can be calculated using the formula:

$$T_d = \frac{Wk_T^2 \times N_B}{308 \times t}$$

Where, T_d = Average dynamic braking torque, lb-ft

Wk_T^2 = Total inertia reflected to brake, lb-ft^2

N_B = Shaft speed at brake, rpm

t = Desired stopping time, sec

308 = Constant

The calculated dynamic torque is converted to the static torque rating using the relationship:

$$T_s = \frac{T_D}{0.8}$$

Where, T_s = Brake static torque, lb-ft

T_d = System dynamic torque, lb-ft

Examples 3, 4, 5 and 6 illustrate how brake torque is determined for non-overhauling loads where rotary or horizontal linear motion is to be stopped.

Example 3: Select a brake to stop a rotating flywheel in a specified time.

Given, Motor speed (N_M) - 1,750 rpm

Motor inertia (Wk_M^2) - 0.075 lb-ft^2

Flywheel inertia (Wk_{FW}^2) - 4 lb-ft^2

Brake inertia (Wk_B^2) - 0.042 lb-ft^2

Required stopping time (t) - 1 sec

First determine the total inertia to be stopped,

$$Wk_T^2 = Wk_M^2 + Wk_{FW}^2 + Wk_B^2$$
$$= 0.075 + 4 + 0.042$$
$$Wk_T^2 = 4.117 \text{ lb-ft}^2$$

The dynamic braking torque required to stop the total inertia in 1 second is,

$$T_d = \frac{Wk_T^2 \times N_{BM}}{308 \times t}$$
$$= \frac{4.117 \times 1,750}{308 \times 1}$$
$$T_d = 23.4 \text{ lb-ft}$$

Converting T_d to static torque

$$T_s = \frac{T_d}{0.8}$$
$$= \frac{23.4}{0.8}$$
$$T_s = 29.3 \text{ lb-ft}$$

A brake having a standard static torque rating of 35 lb-ft would be selected. Since a brake with more torque than necessary to stop the flywheel in 1 second is selected, the stopping time would be,

$$t = \frac{Wk_T^2 \times N_{BM}}{308 \times T_d}$$
$$= \frac{Wk_T^2 \times N_{BM}}{308 \times (0.8\ T_S)}$$
$$\frac{4.117 \times 1,750}{308 \times (0.8 \times 35)}$$
$$t = 0.84 \text{ sec}$$

See section on stopping time and thermal information.

Example 4: Select a brake to stop a rotating flywheel, driven through a gear reducer, in a specified time.

Given: Motor speed (N_M) - 1,800 rpm

Motor inertia (Wk_M^2) - 0.075 lb-ft^2

Gear reduction (GR) - 20:1

Gear reducer inertia at high speed shaft (Wk_{GR}^2) - 0.025 lb-ft^2

Flywheel inertia (Wk_{FW}^2) - 20 lb-ft^2

Required stopping time (t) - 0.25 sec

First, determine rotating speed of flywheel (N_{FW})

$$N_{FW} = \frac{N_{BM}}{GR}$$

$$= \frac{1,800}{20}$$

$$N_{FW} = 90 \text{ rpm}$$

Next, the inertia of the flywheel must be reflected back to the motor brake shaft.

$$Wk_b^2 = Wk_{FW}^2 \left(\frac{N_{FW}}{N_M}\right)^2$$

$$= 20 \left(\frac{90}{1,800}\right)^2$$

$$Wk_b^2 = 0.05 \text{ lb-ft}^2$$

Determining the total Wk^2,

$$Wk_T^2 = Wk_M^2 + Wk_{GR}^2 + Wk_b^2$$

$$= 0.075 + 0.025 + 0.05$$

$$Wk_T^2 = 0.15 \text{ lb-ft}^2$$

The required dynamic torque to stop the flywheel in 0.25 seconds can now be determined.

$$T_d = \frac{Wk_T^2 \times N_{BM}}{308 \times t}$$

$$T_d = \frac{0.15 \times 1,800}{308 \times 0.25}$$

$$T_d = 3.5 \text{ lb-ft}$$

Converting dynamic torque to static torque,

$$T_s = \frac{T_d}{0.8}$$

$$= \frac{3.5}{0.8}$$

$$T_s = 4.4 \text{ lb-ft}$$

A brake having a standard static torque rating of 6 lb-ft would be selected. Since a brake with more torque than necessary to stop the flywheel in 0.25 seconds is selected, the stopping time would be,

$$t = \frac{Wk_T^2 \times N_M}{308 \times T_d}$$

$$= \frac{Wk_T^2 \times N_M}{308 \times (0.8 \times T_s)}$$

$$= \frac{0.15 \times 1,800}{308 \times (0.8 \times 6)}$$

$$t = 0.18 \text{ sec}$$

See section on stopping time and thermal information.

Example 5: Select a brake to stop a load on a horizontal belt conveyor in a specified time.

Given:

Conveyor pulley speed (N_p) - 32 rpm

Weight of load (W) - 30 lb

Conveyor pulley and belt inertia (Wk_p^2) - 4.0 lb-ft^2

Conveyor pulley diameter (d_p) - 1 ft

Required stopping time (t) - 0.25 sec

First, convert the rotational pulley speed to linear belt speed (V_B).

$$V_B = \pi d_p N_p$$

$$= \pi \times 1 \times 32$$

$$V_B = 100.5 \text{ ft/min}$$

Next, determine inertia of load.

$$Wk_W^2 = W \left(\frac{V_B}{2\pi \times N_p}\right)^2$$

$$= 30 \left(\frac{100.5}{2\pi \times 32}\right)^2$$

$$Wk_W^2 = 7.5 \text{ ft-lb}^2$$

Then, determine total inertial load.

$$Wk_T^2 = Wk_W^2 + Wk_p^2$$

$$= 7.5 + 4.0$$

$$Wk_T^2 = 11.5 \text{ lb-ft}^2$$

The required dynamic torque to stop the conveyor load in 0.25 seconds can now be determined.

$$T_d = \frac{Wk_T^2 \times N_p}{308 \times t}$$

$$T_d = \frac{11.5 \times 32}{308 \times 0.25}$$

$$T_d = 4.8 \text{ lb-ft}$$

Converting dynamic torque to static torque,

$$T_s = \frac{T_d}{0.8}$$

$$= \frac{4.8}{0.8}$$

$$T_s = 6 \text{ lb-ft}$$

A brake having a standard static torque rating of 6 lb-ft would be selected. See thermal information.

Example 6: Select a brake to stop a trolley crane and its load in a specified time. Brake mounted on wheel axle.

Given:

Weight of crane (W_C) - 2,000 lb

Weight of load (W_L) - 100 lb

Trolley velocity (v) - 3 ft/sec or 180 ft/min

Radius of trolley wheel (r) - 0.75 ft

Required stopping time (t) - 2 sec

The dynamic braking torque required to stop the trolley crane and load can be determined by one of two methods. The first method is to determine the equivalent inertia of the linearly moving crane and load, then calculate the dynamic braking torque. The second method is to determine the dynamic braking torque directly.

Using the first method, the total weight to be stopped is determined first.

$$W_T = W_L + W_C$$
$$= 100 + 2,000$$
$$W_T = 2,100 \text{ lb}$$

Next, the rotational speed of the axle (N_B) is calculated.

$$N_B = \frac{V}{2\pi\,r}$$
$$= \frac{180}{2 \times \pi \times 0.75}$$
$$N_B = 38.2 \text{ rpm}$$

Then, the equivalent inertia of the linearly moving crane and load is determined.

$$Wk_T^2 = W_T\left(\frac{V}{2\pi\,N_B}\right)^2$$
$$= 2,100\left(\frac{180}{2\pi\,38.2}\right)^2$$
$$Wk_T^2 = 1,181 \text{ lb-ft}^2$$

Finally, the dynamic braking torque required to stop the total inertia in 2 seconds is,

$$T_d = \frac{Wk_T^2 \times N_B}{308 \times t}$$
$$= \frac{1,181 \times 38.2}{308 \times 2}$$
$$T_d = 73 \text{ lb-ft}$$

Using the second method, the dynamic braking torque required to stop the crane and load in 2 seconds can be calculated directly using the formula,

$$T_d = \frac{W_T{}^V}{gt} \times r$$

Where, T_d = Average dynamic braking torque, lb-ft

W_t = Total weight of linear moving load, lb

v = Linear velocity of load, ft/sec

g = Gravitational acceleration constant, 32.2 ft/sec^2

t = Desired stopping time, sec

r = Length of the moment arm (wheel radius), ft

or, for this example,

$$T_d = \frac{2,100 \times 3}{32.2 \times 2} \times .75$$
$$T_d = 73 \text{ lb-ft}$$

For both methods above, the required dynamic braking torque is converted to static torque,

$$T_s = \frac{T_d}{0.8}$$
$$= \frac{73}{0.8}$$
$$T_s = 91 \text{ lb-ft}$$

A smaller brake could be mounted on the high speed shaft in place of the higher torque on the low speed shaft.

A brake having a standard static torque rating of 105 lb-ft is selected. Since a brake with more torque than necessary to stop the load in 2 seconds is selected, the stopping time would be,

$$T = \frac{W_T{}^V}{gT_d} \times r$$
$$= \frac{W_T{}^V}{g \times (0.8 \times T_s)} \times r$$
$$= \frac{2,100 \times 3}{32.2 \times (0.8 \times 105)} \times 0.75$$
$$t = 1.8 \text{ sec}$$

See section on stopping time and cycle rates, thermal selection. Stops should be under 2 seconds. Longer stops require application test.

Overhauling Loads

Applications with a descending load, such as power lowered crane, hoist or elevator loads, require a brake with sufficient torque to both *stop* the load, and *hold* it at rest. Overhauling loads having been brought to rest still invite motion of the load due to the effect of gravity. Therefore, brake torque must be larger than the overhauling torque in order to stop and hold the load. If brake torque is equal to or less than the overhauling torque, there is no net torque available for stopping a descending load.

First, the total system inertia reflected to the brake shaft speed must be calculated.

Second, the average dynamic torque required to decelerate the descending load in the required time is calculated with the formula:

$$T_d = \frac{Wk_T^2 \times N_B}{308 \times t}$$

Where, T_d = Average dynamic braking torque, lb-ft

Wk_T^2 = Total inertia reflected to brake, lb-ft^2

N_B = Shaft speed at brake, rpm. Consider motor slip when descending.

t = Desired stopping time, sec

Third, the overhauling torque reflected to the brake shaft is determined by the formula:

$$T_o = W \times R \times \frac{N_L}{N_B}$$

Where, T_o = Overhauling dynamic torque of load reflected to brake shaft, lb-ft

W = Weight of overhauling load, lb

R = Radius of hoist or elevator drum, ft

N_L = Rotating speed of drum, rpm

N_B = Rotating speed at brake, rpm

Or alternately, the dynamic torque to overcome the overhauling load can be calculated with the formula:

$$T_o = \frac{0.158 \times W \times V}{N_B}$$

Where, T_o = Overhauling dynamic torque of load reflected to brake shaft, lb-ft

W = Weight of overhauling load, lb

V = Linear velocity of descending load, ft/min

N_B = Shaft speed at brake, rpm

0.158 = Constant

Next, the total dynamic torque required to stop and hold the overhauling load is the sum of the two calculated dynamic torques:

$$T_t = T_d + T_o$$

Finally, the dynamic torque must be converted to static brake torque to select a brake:

$$T_S = \frac{T_d}{0.8}$$

Where, T_S = Brake static torque, lb-ft

T_t = System dynamic torque, lb-ft

If the total inertia of the system and overhauling load cannot be accurately determined, a brake rated at 180% the motor full load torque should be selected. Refer to selection of service factor. The motor starting torque may permit a heavier than rated load to be lifted; the brake must stop the load when descending.

Examples 7, 8 and 9 illustrate how brake torque would be determined for overhauling loads. In these examples brakes are selected using the system data rather than sizing them to the motor. Refer to the section on thermal calculations to determine cycle rate.

Consider motor slip in calculation. An 1800 rpm motor with 10% slip would operate at 1,620 rpm when the load is ascending and 1,980 rpm when descending. Motor rpm, armature inertia and load position will affect stop time. Brakes on overhauling loads should be wired through a dedicated relay.

Example 7: Select a brake to stop an overhauling load in a specified time.

Given: Cable speed (V) - 667 ft/min

Weight of load (W) - 100 lb

Drum diameter (D) - 0.25 ft

Drum inertia (Wk_D^2) - 5 lb-ft²

Required stopping time (t) -1 sec

First, determine brakemotor shaft speed (N_B).

$$NB = \frac{V}{\pi D}$$

$$= \frac{667}{\pi \times 0.25}$$

$$NB = 849 \text{ rpm}$$

Then, determine the equivalent inertia of the overhauling load.

$$Wk_I^2 = W\left(\frac{V}{2\pi N_B}\right)^2$$

$$= 100\left(\frac{667}{2\pi \times 849}\right)^2$$

$$Wk_I^2 = 1.56 \text{ lb-ft}^2$$

Therefore, the total inertia at the brake is,

$$Wk_I^2 = Wk_D^2 + Wk_I^2$$

$$= 5 + 1.56$$

$$Wk_I^2 = 6.56 \text{ lb-ft}^2$$

Now, the dynamic torque required to decelerate the load and drum in the required time is calculated.

$$T_d = Wk_I^2 \times N_B$$

$$= \frac{6.56 \times 850}{308 \times 1}$$

$$T_d = 18.1 \text{ lb-ft}$$

Next, calculate the dynamic torque required to overcome the overhauling load.

$$T_O = W \times R$$

$$= 100 \times \frac{0.25}{2}$$

$$T_O = 12.5 \text{ lb-ft}$$

The total dynamic torque to stop and hold the overhauling load is the sum of the two calculated dynamic torques.

$$T_t = T_d + T_O$$

$$= 18.1 + 12.5$$

$$T_t = 30.6 \text{ lb-ft}$$

Dynamic torque is then converted to static torque.

$$T_s = \frac{T_t}{0.8}$$

$$= \frac{30.6}{0.8}$$

$$T_s = 38.3 \text{ lb-ft}$$

A brake having a standard torque rating of 50 lb-ft is selected based on expected stop time. Since a brake with more torque than necessary to stop the load in 1 second is selected, the stopping time would be,

$$t = \frac{WK_I^2 \times N}{308 \times T_d}$$

where, $T_s = \frac{T_t}{0.8}$

$$= \frac{T_d + T_O}{0.8}$$

or, $T_d = 0.8 T_s - T_O$

$$= (0.8)(50) - 12.5$$

$$T_d = 27.5 \text{ lb-ft}$$

therefore, $t = \frac{6.56 \times 850}{308 \times 27.5}$

$$t = 0.7 \text{ sec}$$

Wire the brake through a dedicated relay on overhauling loads where stop time or distance is critical. See section on stopping time.

Example 8: Select a brake to stop an overhauling load driven through gear reducer in a specified time.

Given: Motor speed (N_M) - 1,150 rpm

Motor inertia (WK_M^2) - 0.65 lb-ft²

Gear reduction (GR) - 300:1

Drum diameter (D) - 1.58 ft

Weight of load (W) - 4,940 lb

Drum inertia (WK_D^2) - 600 lb-ft²

Required stopping time (t) - 0.5 sec

First, calculate all inertial loads reflected to the brake motor shaft.

The rotational speed of the drum is,

$$N_D = \frac{N_M}{GR}$$

$$= \frac{1,150}{300}$$

$$N_D = 3.83 \text{ rpm}$$

From this, the cable speed can be determined.

$$V = N_D \times \pi D$$

$$= 3.83 \times \pi \times 1.58$$

$$V = 19.0 \text{ ft/min}$$

The equivalent inertia of the load reflected to the brake motor shaft is,

$$Wk_I^2 = W\left(\frac{V}{2\pi N_{BM}}\right)^2$$

$$= 4,940\left(\frac{19.0}{2\pi \, 1,150}\right)^2$$

$$Wk_I^2 = 0.034 \text{ lb-ft}^2$$

The equivalent inertia of the drum at the brake motor shaft speed is,

$$Wk_d^2 = Wk_D^2\left(\frac{N_D}{N_{BM}}\right)^2$$

$$= 600\left(\frac{3.83}{1,150}\right)^2$$

Finally, the total inertia the brake will retard is,

$$Wk_T^2 = Wk_M^2 + Wk_I^2 + Wk_d^2$$

$$Wk_T^d = .0067 \text{ lb-ft}^2$$

$$Wk_T^2 = 0.691 \text{ lb-ft}^2$$

The dynamic torque required to decelerate the total inertia is,

$$T_d = \frac{Wk_T^2 \times N_{BM}}{308 \times t}$$

$$= \frac{0.691 \times 1,150}{308 \times 0.5}$$

$$T_d = 5.16 \text{ lb-ft}^2$$

Now, calculate the dynamic torque to overcome the overhauling load.

$$T_O = W \times R = W \times \tfrac{1}{2}D$$

$$= 4,940 \times \frac{1.58}{2}$$

$$T_O = 3,903 \text{ lb-ft}$$

Which reflected to the brake motor shaft becomes,

$$T_m = \frac{T_O}{GR}$$

$$= \frac{3,903}{300}$$

$$T_m = 13.0 \text{ lb-ft}$$

Then, the total dynamic torque to stop and hold the overhauling load is the sum of the two calculated dynamic torques.

$$T_t = T_d + T_m$$

$$= 5.16 + 13.0$$

$$T_t = 18.16 \text{ lb-ft}$$

Dynamic torque is then converted to static torque.

$$T_S = \frac{T_t}{0.8}$$

$$= \frac{18.16}{0.8}$$

$$T_S = 22.7 \text{ lb-ft}$$

A brake having a standard torque rating of 25 lb-ft is selected.

Example 9: Select a brake to stop and hold a load on an inclined plane (skip hoist).

Given: Motor data
Power (P) - 7½ hp
Speed (N_M) - 1,165 rpm
Rotor inertia (WK_M^2) - 1.4 lb-ft^2

Gear reducer data:

Reduction (G_R) - 110:1
Inertia at input shaft
(Wk_R^2) - 0.2 lb-ft^2

Drum data
Diameter (D_D) - 1.5 ft
Inertia (Wk_D^2) - 75 lb-ft^2

Pulley data
Diameter (D_P) - 1.5 ft
Inertia (Wk_P^2) - 20 lb-ft^2
Bucket weight (W_B) - 700 lb
Maximum weight of load
(W_L) - 4,000 lb
Slope of track (B) -52.7°

Required stopping time (t) -1 sec

The bucket is full when ascending the track and is empty when descending. When selecting a brake the most severe condition would be a fully loaded bucket backed down the hoist track. In normal operation the descending bucket would be empty. In this example, the brake is selected for the most severe condition.

The total torque to stop and hold the bucket and load when descending is the sum of (a) the torque to decelerate the total inertia and (b) the torque required to hold the loaded bucket.

First, calculate all inertial loads reflected to the brake motor shaft. The rotational speed of the drum is:

$$N_D = \frac{N_M}{GR}$$

$$= \frac{1,165}{110}$$

$$N_D = 10.6 \text{ rpm}$$

From this the cable speed can be determined:

$$V = N_D \times \pi D_D$$

$$= 10.6 \times \pi \times 1.5$$

$$V = 50 \text{ ft/min}$$

The equivalent inertia of the loaded bucket reflected to the brake motor shaft is,

$$Wk_I^2 = W\left(\frac{V}{2\pi N_M}\right)^2$$

$$= 4,700\left(\frac{50}{2\pi \times 1,165}\right)^2$$

$$Wk_I^2 = 0.219 \text{ lb-ft}^2$$

Next, the inertia of the pulley and drum are reflected to the brake motor shaft speed so the total inertia at the brake can be determined.
Since the diameters of the pulley and drum are the same, 1.5 ft, their rotational speeds would be the same, 10.6 rpm.

The inertia of the pulley reflected to the brake motor shaft is,

$$Wk_P^2 = Wk_P^2\left(\frac{N_D}{N_M}\right)^2 = Wk_P^2\left(\frac{1}{GR}\right)^2$$

$$= 20 \times \left(\frac{1}{110}\right)^2$$

$$Wk_P^2 = 0.0017 \text{ lb-ft}^2$$

The inertia of the drum reflected to the brake motor shaft is,

$$Wk_d^2 = Wk_D^2\left(\frac{N_D}{N_M}\right)^2 = Wk_D^2\left(\frac{1}{GR}\right)^2$$

$$= 75 \times \left(\frac{1}{110}\right)^2$$

$$Wk_d^2 = 0.0062 \text{ lb-ft}^2$$

The total inertia to be stopped is,

$$Wk_T^2 = Wk_I^2 + Wk_P^2 + Wk_d^2 + Wk_R^2 + Wk_M^2$$

$$= 0.219 + 0.0017 + 0.0062 + 0.2 + 1.4$$

$$Wk_T^2 = 1.827 \text{ lb-ft}$$

Then, the dynamic torque required to bring the descending bucket and load to rest is,

$$T_d = \frac{Wk_T^2 \times N_M}{308 \times T_d}$$

$$T_d = \frac{1.827 \times 1,165}{308 \times 1}$$

The additional dynamic torque required to hold the overhauling load would be determined by the unbalanced component of the force acting along the plane of the hoist track, $W_T \sin B$, and the length of the moment arm which is the drum radius (R_D). $W_T \sin B$ is the force necessary to retard downward motion of the loaded hoist bucket.

$$T_O = W_T \sin B \times R_D$$
$$= W_T \sin B \times \tfrac{1}{2} D_D$$
$$= 4{,}700 \times \sin 52.7^\circ \times \tfrac{1}{2}(1.5)$$
$$= 4{,}700 \times 0.7955 \times 0.75$$
$$T_O = 2{,}804 \text{ lb-ft}$$

Which reflected to the brake motor shaft becomes,

$$T_m = \frac{T_O}{GR}$$
$$= \frac{2{,}804}{110}$$
$$T_m = 25.5 \text{ lb-ft}$$

Then, the total dynamic torque to stop and hold the descending bucket and load is the sum of the two calculated dynamic torques.

$$T_t = T_d + T_m$$
$$= 6.9 + 25.5$$
$$T_t = 32.4 \text{ lb-ft}$$

Converting to static torque,

$$T_S = \frac{T_t}{0.8}$$
$$= \frac{32.4}{0.8}$$
$$T_S = 40.5 \text{ lb-ft}$$

A brake having a standard torque rating of 50 lb-ft is selected. Since a brake with more torque than necessary to stop the load in 1 second is selected, the stopping time would be,

$$t = \frac{W_T^2 \times N_M}{308 \times T_d}$$

Where, $T_S = \dfrac{T_t}{0.8}$

$$= \frac{T_d + T_m}{0.8}$$

or, $T_d = 0.8 T_S - T_m$

$$= (0.8)(50) - 25.5$$
$$T_d = 14.5 \text{ lb-ft}$$

therefore,

$$t = \frac{1.827 \times 1{,}165}{308 \times 14.5}$$
$$t = 0.48 \text{ sec}$$

See section on stopping time.

Stopping Time & Deceleration Rate

In the formulas used to determine dynamic torque, stopping time or "t" in seconds is a desired or assumed value selected on the requirements of the application. For optimum brake performance, a stopping or braking time of 1 second or less is desirable. Stop times between 2 and 3 seconds require test. *A brake of insufficient torque rating will lengthen the stopping time. This may result in overheating of the brake to a point where torque falls appreciably. The friction material could carbonize, glaze, or fail.*

After determining the braking torque required by a system, it may be necessary to recalculate the stopping time based on the actual brake size selected to insure that stopping time falls within the 0 to 2 second range. Any formula, where the stopping time is a variable, may be rewritten to solve for the new stopping time. For instance, the dynamic torque equation may be transposed as follows:

$$T_d = \frac{Wk_f^2 \times N_B}{308 \times t}$$

or, $\quad t = \dfrac{Wk_f^2 \times N_B}{308 \times (0.8 \times T_S)}$

Where, t = Stopping time, sec

Wk_f^2 = Total inertia reflected to brake, lb-ft^2

N_B = Shaft speed at brake, rpm

T_S = Nominal static torque rating of brake, lb-ft

T_d = Dynamic braking torque ($0.8 \times T_S$), lb-ft

0.8 = Constant (derating factor)

308 = Constant

Brakes are rated in static torque. This value is converted to dynamic torque, as done in the above equation, when stopping time is calculated. That is,

$$T_d = 0.8 \times T_S$$

Where, T_d = Dynamic braking torque, lb-ft

T_S = Nominal static torque rating of brake, lb-ft

The approximate number of revolutions the brake shaft makes when stopping is:

$$\text{Revolutions to stop} = \frac{t \times N_B}{120}$$

Where, t = Stopping time, sec

N_B = Shaft speed at brake, rpm

120 = Constant

The average rate of deceleration when braking a linearly moving load to rest can be calculated using the stopping time determined by the above formula and the initial linear velocity of the load.

$$a = -\frac{V_i}{t}$$

Where, a = Deceleration, ft/sec^2

V_i = Initial linear velocity of load, ft/sec

t = Stopping time, sec

RPM Considerations

The maximum allowable rotational speed of the brake should not be exceeded in braking. Maximum brake rpm as listed in the catalog is intended to limit stopping time to 2 seconds or less and insure friction disc stability. Brakes are not dynamically balanced because of the low brake inertia.

Determining Required Thermal Capacity

Thermal Ratings

When a brake stops a load, it converts mechanical energy to thermal energy or heat. The heat is absorbed by components of the brake. This heat is then dissipated by the brake. The ability of a given brake to absorb and dissipate heat without exceeding temperature limitations is known as thermal capacity.
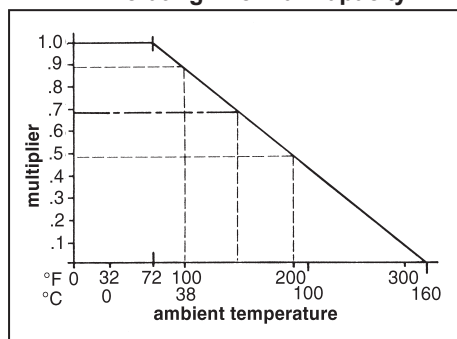
There are two categories of thermal capacity for a brake. The first is the *maximum* energy the brake can absorb in one stop, generally referred to as a "crash" or "emergency" stop. The second is the heat dissipation capability of the brake when it is cycled frequently. *To achieve optimum brake performance, the thermal rating should not be exceeded. They are specified for a predetermined maximum temperature rise of the brake friction material.*

The ability of a brake to absorb and dissipate heat is determined by many factors, including the design of the brake, the ambient temperature, brake enclosure, position of the brake, the surface that the brake is mounted to, and the altitude.

The rating for a given brake is the maximum allowable. Longer brake life results when the brake has more thermal capacity than a power transmission requires. Much shorter life or brake failure will result when the thermal capacity rating is exceeded. Ratings are determined at an ambient temperature of 72°F (22°C), with the brake in a horizontal position, with a stopping time of 1 second or less, and with no external heat source such as a motor.

Ambient temperature will limit the thermal capacity of a brake. Temperatures above 72°F (22°C) require derating of the thermal capacity rating. For example, at 150°F, thermal capacity is reduced approximately 30% (see Derating Thermal Capacity Chart).

CHART: Derating Thermal Capacity

A temperature range of 20°F (-7°C) to 104°F (40°C) is acceptable in most brake applications. Above 104°F also consider Class H coil insulation.

Thermal capacity ratings are determined with enclosures on the brake. Other customer furnished covers or cowls may affect a brake's thermal capacity. The effect on thermal capacity should be evaluated. In some cases, thermal capacity may be increased by use of air or liquid cooling. However, provisions must be made to prevent contaminating the brake internally.

Brakes with brass stationary discs are derated 25%.

The mounting position of a brake will also affect thermal capacity. The specified ratings are for brakes mounted in a horizontal position with the solenoid plunger above the solenoid. For brakes mounted in a vertical position, or 15° or more from horizontal, the thermal capacity decreases due to friction disc drag. Brakes are modified for vertical operation to minimize the drag. 2- and 3- disc brakes are derated 25%, 4-disc brakes are derated 33%. 4- and 5-disc brakes are not recommended for vertical use.

Thermal capacity ratings are established without external sources of heat increasing the brake temperature. The surface that a brake is mounted to, such as an electric

motor or gear reducer, will limit the heat dissipation capability or thermal capacity of a brake. These sources of heat should be evaluated when determining the thermal requirements of the system for which the brake is selected.

High altitudes may also affect a brake's thermal capacity. Stearns brakes will operate to 10,000 ft above sea level at 72°F (22°C) ambient temperature. At 104°F (40°C) ambient temperature, altitude and temperature adjustments occur. Refer to NEMA MG1-1993 section 14 for additional information.

CHART: Altitude & Thermal Capacity

Maximum Energy Absorption

The thermal capacity of a brake is limited by the maximum energy it can absorb in one stop. This factor is important when stopping extremely high inertial loads at infrequent intervals. Such use of a brake requires extensive cooling time before it can be operated again.

The energy a brake is required to absorb in one stop by a given power transmission system is determined by the formulas below. *The calculated energy of the system should not exceed the maximum kinetic energy rating of the brake. System energy exceeding the brake's maximum rating may result in overheating of the brake to a point where torque falls appreciably. The friction material of the brake could glaze, carbonize or fail.*

In the case of linear loads, the energy that the brake must absorb is kinetic energy. It is determined by the formula:

$$KE_I = \frac{W_v^2}{2g}$$

KE_I = Kinetic energy of linear moving load, lb-ft

W = Weight of load, lb

v = Linear velocity of load, ft/sec

g = Gravitational acceleration constant, 32.2 ft/sec^2

In the case of rotational loads, the energy that the brake must absorb is also kinetic energy. It is determined by the formula:

$$KE_r = \frac{Wk_r^2 \times N_B^2}{5875}$$

Where, KE_r = Kinetic energy of linear load, lb-ft

Wk_r^2 = Inertia of the rotating load reflected to brake shaft, lb-ft^2

N_B = Shaft speed at brake, rpm

5875 = Constant

In the case of overhauling loads, both the kinetic energy of the linear and rotating loads and the potential energy transformed into kinetic energy by the change in height or position must be considered when determining the total energy that the brake must absorb. The potential energy transformed to kinetic energy is determined by the formula:

$$PE = W_s$$

Where, PE = Change in potential energy, ft-lb

W = Weight of overhauling load, lb

s = Distance load travels, ft

Thus, the total energy to be absorbed by a brake stopping an overhauling load is:

$$E_T = KE_I + KE_r + PE$$

Example 10 illustrates how energy absorption for Example 8 would be determined for one stop.

Example 10: Determine the total energy absorbed by a brake in one stop.

In Example 8, the calculation for total energy to be absorbed would be as follows.

First, calculate the kinetic energy of the linear load. The load weight was 4,940 lb and the velocity is 19 ft/min or 0.317 ft/sec. The kinetic energy is:

$$KE_I = \frac{W_v^2}{2g}$$
$$= \frac{4,940 \times 0.317^2}{2 \times 32.2}$$

KE_I = 7.71 ft-lb

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Next, calculate the kinetic energy for the rotational load. The motor inertia is 0.65 lb-ft^2 and the drum inertia reflected to the brake shaft speed is 0.0067 lb-ft^2. The total rotational inertia at the brake motor shaft is,

$$Wk_r^2 = Wk_M^2 + Wk_d^2$$

$$= 0.65 + 0.0067$$

$$Wk_r^2 = 0.6567 \text{ lb-ft}^2$$

And the kinetic energy of the rotating components is,

$$KE_r = \frac{Wk_r^2 \times N_B^2}{5,875}$$

$$= \frac{0.6567 \times 1,150^2}{5,875}$$

$$KE_I = 147.8 \text{ ft-lb}$$

Now, calculate the potential energy converted to kinetic energy due to the change in position of the load while descending. A descending load is the most severe case since potential energy is transformed to kinetic energy that the brake must absorb. A 25 lb-ft brake was selected in Example 8. The 25 lb-ft static torque rating is converted to dynamic torque,

$$T_t = T_S \times 0.8$$

$$= 25 \times 0.8$$

$$T_t = 20 \text{ lb-ft}$$

Of this torque, 13.0 lb-ft is required to overcome the overhauling load as determined in Example 8. The dynamic torque available to decelerate the load is,

$$T_d = T_t - T_m$$

$$= 20 - 13$$

$$T_d = 7 \text{ lb-ft}$$

The stopping time resulting from this dynamic torque is,

$$t = \frac{Wk_r^2 \times N_M}{308 \times T_d}$$

$$= \frac{0.691 \times 1,150}{308 \times 7}$$

$$t = 0.369 \text{ sec}$$

Where, $Wk_r^2 = 0.690$ lb-ft^2 is the total

inertia the brake is to retard as determined in Example 8. With the load traveling at 19.0 ft/min or 0.317 ft/sec, the distance it will travel is,

$$s = \tfrac{1}{2} vt$$

$$= \tfrac{1}{2} \times 0.317 \times 0.369$$

$$s = 0.059 \text{ lb-ft}$$

Wire the brake through a dedicated relay on overhauling loads where stop time or distance is critical. The potential energy transformed to kinetic energy in this distance would be,

$$PE = W_s$$

$$= 4,940 \times 0.059$$

$$PE = 291 \text{ ft-lb}$$

Thus, the total energy to be absorbed by the brake would be,

$$E_T = KE_I + KE_r + PE$$

$$= 7.71 + 147.8 + 291$$

$$E_T = 447 \text{ lb-ft}$$

The 25 lb-ft brake selected in Example 8 should be capable of absorbing 447 ft-lb of energy. The brake's maximum kinetic energy absorption rating should exceed this value.

Motor slip and test loads (150% of load) should be considered both in sizing and thermal calculations.

Brakes overheated in testing will require inspection before using in the standard application.

Heat Dissipation in Cyclic Applications

In general, a brake will repetitively stop a load at the duty cycle that a standard electric motor can repetitively start the load. A brake's thermal capacity is based upon the heat it can absorb and dissipate while cycling. The thermal capacity ratings for brakes are listed in the specification tables for specific brake models.

The energy that a brake is required to absorb and dissipate by a given power transmission system is determined from the total inertia of the load and system, the rotating or linear speed of the load, and the number of times the load is to be stopped in a given time period. The rate of energy dissipation is expressed in horsepower seconds per minute (hp-sec/min). Other common units for energy rates, such as foot pounds per second (ft-lb/sec), can be converted to hp-sec/min using the conversion factors given in the technical data section.

Refer to the Thermal Capacity Chart for use above 104°F *(40°C)* ambient temperature.

For applications demanding optimum brake performance, such as high inertial loads and frequent stops, the rate of energy dissipation required by the system is determined using the following formulas. *The calculated rate of energy dissipation should not exceed the thermal capacity of the brake. Thermal dissipation*

requirements exceeding the brake's rating may result in overheating of the brake to a point where torque falls appreciably. The friction material of the brake could glaze, carbonize or fail.

For rotating or linear loads, the rate at which a brake is required to absorb and dissipate heat when frequently cycled is determined by the relationship:

$$TC = \frac{Wk_T^2 \times N_B^2 \times n}{3.2 \times 10^6}$$

Where, TC = Thermal capacity required for rotating or linear loads hp-sec/min

Wk_T^2 = Total system inertia reflected to brake, lb-ft^2

N_B = Shaft speed at brake, rpm

n = Number of stops per minute, not less than 1

3.2×10^6 = Constant

The rotating speed enters the formula as a squared function. Therefore, thermal requirements are of particular significance in systems where the brake will be operated at high speeds.

$$TC = \frac{E_T \times n}{550}$$

Where, TC = Thermal capacity required for overhauling loads hp-sec/min

E_T = Total energy brake absorbs, ft-lb

n = Number of stops per minute, not less than 1

550 = Constant

For overhauling loads, the rate at which a brake is required to absorb and dissipate heat when frequently cycled is determined by the relationship:

Example 11 illustrates how the required thermal capacity would be determined for Example 4.

Example 11: Determine the thermal capacity required to stop a rotating load frequently.

Referring back to Example 4, the flywheel will be stopped 20 times per minute. The required thermal capacity of the 6 lb-ft brake selected in this example is determined as follows.

The total inertial load the brake is to retard is 0.15 lb-ft^2. The shaft speed of the brake motor is 1,800 rpm. Therefore, the required thermal capacity is,

$$TC = \frac{Wk_T^2 \times N_M^2 \times n}{3.2 \times 10^6}$$

$$= \frac{0.15 \times 1,800^2 \times 20}{3.2 \times 10^6}$$

$$TC = 3.0 \text{ hp-sec/min}$$

The 6 lb-ft brake selected in Example 4 should have a thermal capacity rating equal to or greater than 3.0 hp-sec/min.

A brake with greater thermal capacity will result in greater wear life.

If productivity is to be improved in Example 4 by increasing the cycle rate, the maximum number of stops per minute is determined by the rated thermal capacity of the brake. If the 6 lb-ft brake selected in Example 4 has rated thermal capacity of 9 hp-sec/min, the maximum permissible stops per minute would be determined by transposing the above formula to,

$$n_{max} = \frac{TC_{rated} \times (3.2 \times 10^6)}{Wk_f^2 \times N_M^2}$$

$$= \frac{9 \times (3.2 \times 10^6)}{0.15 \times 1,800^2}$$

$$n_{max} = 59 \text{ stops/min}$$

So, the brake could be operated up to 36 times per minute without exceeding its ability to absorb and dissipate the heat generated by the frequent stops and meet the maximum solenoid cycle rating. *Cycle rate cannot exceed the solenoid cycle rate appearing in the catalog.*

Electrical Considerations

Please see Super-Mod® dimensional data section.

Environmental Considerations

Brakes with standard open enclosures when mounted on NEMA C-face motors are drip-proof, except where a manual release lever has a clearance opening in the housing. The standard enclosure is commonly used on open, drip-proof and enclosed motors operating indoors or in protected outdoor environments.

NEMA 4, IP 54 is available on most brake models and are commonly used for outdoor installations, or where there are moist, abrasive or dusty environments. Standard and severe duty NEMA 4 enclosures are available in some brake series.

Brakes of various styles and materials for above or below deck on ships and dockside installation are available. The materials are usually specified by the ship designers or Navy specification MIL-B-16392C. Brakes are also available to meet MIL-E-17807B for shipboard weapon and cargo elevators. Refer to Marine, Maritime and Navy catalog pages.

Brakes Listed by Underwriters Laboratories, Inc. are available for use in hazardous locations, including Class I, Groups C and D; and Class II, Groups E, F and G. Motor-mounted, hazardous-location electric disc brakes are listed only when mounted to a Listed hazardous-location motor of the same Class and Group at the motor manufacturer's facility, and where the combination has been accepted by UL. This procedure completes the hazardous duty assembly of the brake. However, foot-mounted hazardous-location disc brakes that are Listed are also available for coupling to a motor, and may be installed by anyone.

Hazardous-location brakes are *not* gasketed unless indicated in the brake description. The enclosure prevents flame propagation to the outside atmosphere through controlled clearances. Protection from weather and washdowns must be provided. If the brake is used in a high humidity or low temperature environment, internal electric heaters should be used.

Standard ambient temperature range for brake operation is from 20°F *(-7°C)* to 104°F *(40°C)*. Refer to Thermal Ratings section for brake operation at higher ambient temperatures. Heaters may be available for brake operation at low ambient temperatures and high humidity environments. Ductile iron construction and heaters are recommended for prolonged cold climate use.

Conclusion

The spring-set, electrically released disc brake is an important accessory to electric motors used in cycling and holding operations. It is available in a wide variety of enclosures. In most applications, a brake requires no additional wiring, controls or auxiliary electrical equipment. It is simple to maintain since the replaceable items, the friction discs, can be easily changed.

Many spring-set motor brakes are equipped with features such as simple wear adjustment to provide optimum friction disc life, visual wear indicator, torque adjustment and manual release. Featured on some types of brakes is automatic adjustment to compensate for friction disc wear. This feature eliminates the need for periodic adjustment and is advantageous in remote or inaccessible locations. Not all of the brakes on the market provide all of these features, but there are many Stearns motor brakes offering these features.

Care should be exercised in properly selecting a brake giving due consideration to torque as well as environment and thermal requirements. On applications where all the pertinent information is not available, selection must be based on previous experience of the designer and user, as well as the brake manufacturer, and should be confirmed by tests under actual operating conditions. If the brake is selected with reasonable allowances made for extremes in operating conditions, it will perform its task with little attention or maintenance.

Formulas

The following formulas cover the basic calculations used in brake application engineering.

Required	Given	Formula
Full load motor torque (T_{flmt}), lb-ft	Horsepower (P), hp Shaft speed (N), rpm 5252 = Constant	$T_{flmt} = \dfrac{5252 \times P}{N}$
Average dynamic braking torque (T_d), lb-ft	Total inertia reflected to brake (Wk^2), lb-ft^2 Shaft speed at brake (N), rpm Desired stopping time (t), seconds 308 = Constant	$T_d = \dfrac{Wk^2 \times N}{308 \times T}$
Static torque (T), lb-ft	Force (F), lb Pulley or drum radius, (R), ft	$T = F \times R$
Overhauling dynamic torque reflected to brake shaft (T_o), lb-ft	Weight of overhauling load (W), lb Linear velocity of descending load (V), ft/min Shaft speed at brake (N), rpm 0.158 = Constant	$T_o = \dfrac{0.158 \times W \times V}{N}$.
Static torque of brake (T_s), lb-ft (General Guideline)	Dynamic braking torque required (T_d), lb-ft 0.8 = Constant (derating factor)	$T_s = \dfrac{Td}{0.8}$
Inertia of rotating load reflected to brake shaft (Wk_b^2), lb-ft^2	Inertia of rotating load (Wk_L^2), lb-ft^2 Shaft speed at load (N_L), rpm Shaft speed at brake (N_B), rpm	Equivalent $Wk_b^2 = Wk_L^2 \left(\dfrac{N_L}{N_B}\right)^2$
Equivalent inertia of linear moving load reflected to brake shaft (Wk_w^2), lb-ft^2	Weight of linear moving load (W), lb Linear velocity of load (V), ft/min Shaft speed at brake (N_B), rpm 2 = Constant	Equivalent $Wk_w^2 = W \left(\dfrac{V}{2\pi N_B}\right)^2$
Kinetic energy of rotating load, (KE_r), ft-lb	Inertia of rotating load reflected to brake shaft (Wk_b^2), lb-ft^2 Shaft speed at brake (N_B), rpm 5875 = Constant	$KE_r = \dfrac{Wk_b^2 \times N_B^2}{5875}$
Kinetic energy of linear moving load (KE_I), ft-lb	Weight of load (W), lb Linear velocity of load (v), ft/sec g = Gravitational acceleration constant, 32.2 ft/sec^2	$KE_I = \dfrac{Wv^2}{2g}$
Change in potential energy (PE), ft-lb	Weight of overhauling load (W), lb Distance load travels (s), ft	$PE = Ws$
Total energy absorbed by brake (E_T), ft-lb	Total linear kinetic energy, (KE_L), ft-lb Total rotary kinetic energy (KE_R), ft-lb Potential energy converted to kinetic energy (PE), ft-lb	$E_T = KE_L + KE_R + PE$
Thermal capacity required for rotational or linear moving loads (TC), hp-sec/min	Total system inertia reflected to brake shaft (Wk_T^2), lb-ft^2 Shaft speed at brake (N_B), rpm Number of stops per minute (n), not less than one 3.2 x 10^6 = Constant	$TC = \dfrac{Wk_T^2 \times N_B^2 \times n}{3.2 \times 10^6}$
Thermal capacity required for overhauling loads (TC), hp-sec/min	Total energy brake absorbs (E_T), ft-lb Number of stops per minute (n), not less than one 550 = Constant	$TC = \dfrac{E_T \times n}{550}$
Linear velocity, ft/min	N = rpm Diameter (D), ft	$V = N\pi D$