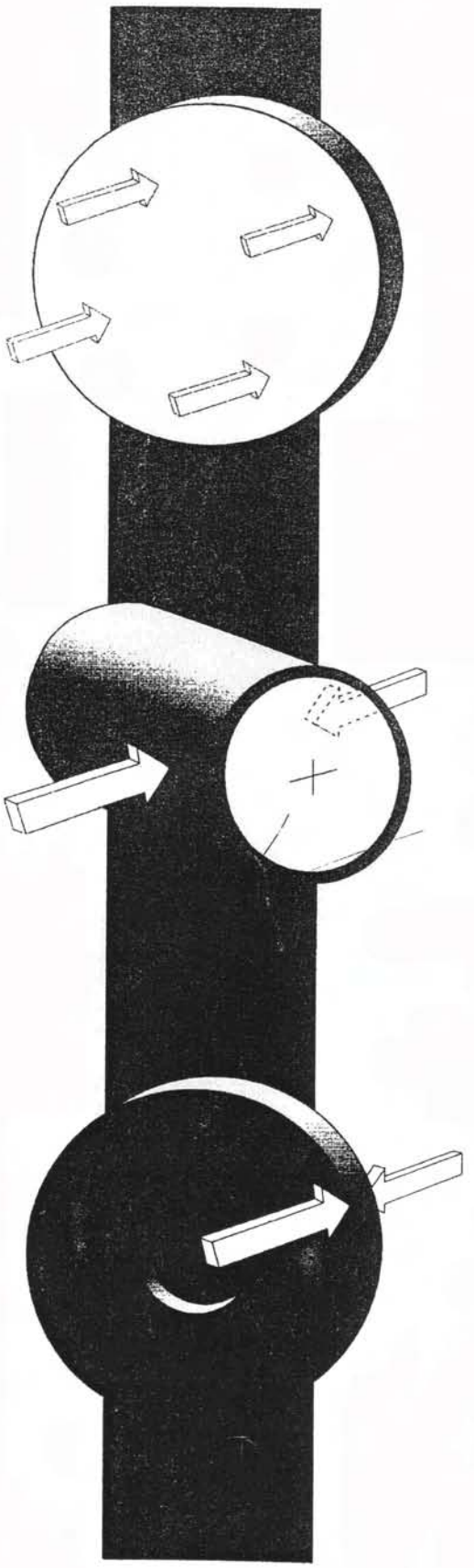

Brake Standards for Mill Motors

AISE
Technical Report No. 11
September 1997

FOREWORD

This document was last published by the Association of Iron and Steel Engineers in September 1972 as Standard No. 11, Brake Standards for Mill Motors. That version was specifically for wheel and shoe brakes.

The 1997 edition of Technical Report No. 11 addresses the entire scope of friction brakes that are spring set and includes shoe, caliper disc and motor mounted plate brakes for crane applications. The standard will continue to expand in the future, and as such will strive to meet the industry's need to establish practical parameters for performance, dimensional interchangeability, maintenance practices and product selection for all mill motor applications.

DISCLAIMER

This report has been prepared by a committee comprised of steel company and equipment design and manufacturing company representatives, the Association of Iron and Steel Engineers and others who considered the technology available at the time of preparation. This report does not represent either minimum acceptable standards or mandatory specifications. In addition, this report is subject to compatibility with all governmental requirements.

The Association of Iron and Steel Engineers in no way mandates or is responsible for use of this report, whether voluntary or pursuant to a mandate of others. The Association of Iron and Steel Engineers and the committee assume and strongly recommend that parties who intend to use this report will examine it thoroughly and will utilize appropriate professional guidance in adapting this report to each particular project.

The use of language in this report that might be construed as mandatory is intended only to preserve the integrity of the report as the committee views it. It is not intended to require strict compliance where not necessitated by safety or operational needs.

Table of Contents

1.0 General

1.1 Scope

Technical Report No. 11 addresses the entire scope of friction brakes which are spring set, including shoe, caliper disc and motor mounted plate brakes.

1.2 Definitions

Caliper Disc Brakes — Use both sides of an exposed rotating disc as the friction surfaces. Friction pads press axially against the disc.

Electro-Hydraulic or Electro-Mechanical Actuators — Used with either AC or DC motors, with the brake release actuator arranged for connection across a motor or power source.

Heat Checking — Cracking of a friction surface due to a significant temperature gradient resulting from a rapid temperature rise.

Manual Release (NEMA) — A device by which the braking surfaces are manually disengaged without disturbing the torque adjustment

Mounting Arrangements (NEMA)

Type I, Floor-Mounted Horizontal Shaft Brake — A brake which is arranged for floor mounting with the wheel located on a shaft which is approximately parallel to the floor and with the brake actuator located at the side of the brake wheel.

Type I-A, Floor-Mounted Horizontal Shaft Brake — Similar to Type I, except that the brake actuator is located either above or below the brake wheel.

Type II, Wall-Mounted Horizontal Shaft Brake — A brake which is arranged for wall mounting with the wheel located on a shaft which is approximately parallel to the floor and to the wall and with the brake actuator located above or below the brake wheel.

Type III, Ceiling-Mounted Horizontal Shaft Brake — A brake which is arranged for ceiling mounting with the wheel located on a shaft which is approximately parallel to the floor and with the brake actuator located at the side of the brake wheel.

Type IV, Wall-Mounted Vertical Shaft Brake — A brake which is arranged for wall mounting with the wheel located on a shaft which is approximately perpendicular to the floor and with the brake actuator located at the side of the brake wheel.

Motor Mounted Plate Brakes — Are enclosed with full circular contact between friction and brake plates.

Owner's Information Sheet (OIS) — Found in AISE Technical Report No. 6, Specification for Electric Overhead Traveling Cranes for Steel Mill Service.

Parking Brake — A brake that is set after the crane has come to a stop. Primarily used on an outdoor crane to resist movement due to wind.

Release — A term used to describe brake disengagement.

Self Adjusting — A brake which incorporates a mechanism which automatically compensates for lining wear by maintaining a predetermined position relationship between the braking surfaces.

Series Coil Actuated Brakes — Used with DC series motors. The brake release coil is connected in series with the motor power circuit.

Service Brake — A brake used to bring a crane to a complete stop, either with or without the assistance of the motor controls.

Set — A term used to describe brake engagement.

Shoe Brakes — Use the cylindrical outer diameter of the brake wheel as the friction surface. Shoe brakes engage the brake wheel by moving radially inward.

Shunt Coil Actuated Brakes — Used with either DC or AC motors and with the brake release coil arranged for connection across a motor or power source.

Thermal Absorption — Describes the amount of energy that a disc or wheel can absorb while maintaining a steady state temperature at a rated speed and ambient temperature.

Thermal Capacity — Describes the amount of energy that a disc, wheel or plate can absorb, radiate and convect over a given period of time, at a rated speed and known ambient temperature while maintaining a steady state temperature.

2.0 Ratings and Dimensions

2.1

It is the intent of this standard to establish torque ratings and dimensions for shoe and caliper disc brakes when applied to AISE AC and DC mill motors for the purpose of interchangeability.

2.2

The brake and motor combinations listed herein cover the range from 50 to 150% of the 30 minute and 60 minute TENV motor torque ratings. Brake torque ratings will be in accordance with those given below. Ratings are given in Table 1 for 1/2 hour series and 1 hour shunt, 1 hour series and 8 hour shunt coils.

Table 1. Brake Torque Ratings

Brake size (in.)		Torque rating (lb. ft.)		
Drum	Disc	fi hour series 1 hour shunt	1 hour series	8 hour shunt
8	12	100	65	75
10	14	200	130	150
13	17	550	365	400
16	21	1000	650	750
19	24	2000	1300	1500
23	29	4000	2600	3000
N/A	34	6000	3900	4500
30	38	9000	6000	6750

2.3

The torque ratings apply at a "worn" lining condition defined as the point where readjustment is required as recommended by the brake manufacturer.

2.4

Brake mounting tolerances, both horizontal and vertical, shall be ± 1/16 in.

2.5

CAUTION: Single caliper disc brakes cause a reaction load on the shaft of the equipment. Due consideration should be given to over-hung loads.

2.6

CAUTION: Consideration should be given to all components of the drive to determine the applied brake torque value. Excessive applied braking torque can cause drive component damage.

2.7

CAUTION: Due consideration should be given to the maximum rotating speed in each installation. Not all wheels and discs of any given size have the same allowable maximum rotating speed.

3.0 Applications

3.1 Crane and Hoist

3.1.1 Hoist Brakes

Each hoist on a crane shall be equipped with at least one spring-set magnetic brake. Where a single brake is used it shall be mounted on the outboard end of the motor speed pinion shaft, the end of which shall have a taper fit for the brake wheel or disc of the same dimensions as that on the motor shaft.

All hoists handling hot metal shall be equipped with more than one brake. Other hoists shall be equipped with multiple brakes if specified on the Owner's Information Sheet (OIS). Unless otherwise specified, these brakes shall be mounted on the outboard ends of additional motor speed pinion shafts if available on multi-motor drives. If these additional shafts are not available, additional brakes shall be mounted on motor shafts opposite the drive ends. When all motor speed pinion shafts and motor shafts have been supplied with one brake each, additional brakes may be mounted to other drive train shafts as required.

Brake sizes shall be as recommended by the brake manufacturer for the service, but in no case shall the summation of all brake ratings in percent of hoist full load hoisting torque at the points of brake application be less than the following:

a) 150% when only one brake is used.
b) 150% when multiple brakes are used and the hoist is not used to handle hot metal; failure of any one brake shall not reduce total braking torque below 100%.
c) 175% for hoists handling hot metal; failure of any one brake shall not reduce total braking torque below 125%.

For example, if two brakes are used, each must be rated 100% of the total full load hoisting torque (125% each for hot metal). If three brakes are used, each must be rated 50% (62.5% each for hot metal). If four brakes are used, each must be rated 37.5% (43.75% each for hot metal). In each of these cases, the failure of one brake does not cause the remaining braking torque to fall below the required minimum.

On multiple motor hoists that are arranged for operation under emergency conditions with one or more motors bypassed, brakes in operation during emergency bypass operation shall provide braking torque in accordance with this Section.

3.1.2 Trolley Brakes

3.1.2.1 Operator's Cab on Bridge (Fixed or Movable)

Trolleys with anti-friction bearings shall be provided with a mechanical drag brake, a spring-set magnetic brake or a remote controlled service brake, or as specified on the OIS.

The drag brake shall be installed on the trolley motor shaft and shall be of sufficient capacity to

prevent the trolley from drifting. The magnetic brake shall have a torque rating of not less than 50% of the trolley motor 60-minute rated torque and be adjustable so that its torque can be decreased by 50%. The remote controlled service brake shall have a capacity as outlined in Section 3.1.3. The brake shall be arranged to set whenever power is removed from the motor unless otherwise specified on the OIS.

3.1.2.2 Operator's Cab on Trolley

A trolley brake shall be provided as described for bridge brakes in Section 3.1.3 or as otherwise specified.

3.1.2.3 Floor, Pulpit or Remote Operated Cranes

The requirements for trolley brakes shall be the same as specified in Section 3.1.2.1.

3.1.3 Bridge Brakes

Service brakes shall have sufficient thermal capacity and torque range to stop the bridge within a distance not to exceed a length in feet equal to 10% of the full load speed in fpm (e.g.100 fpm x 1 min. x 10% = 10ft.) when traveling at full speed at full load, or to stop the bridge from full load top running speed to zero speed at a deceleration rate for the drive as specified on the OIS. In either case, the deceleration rate should be selected so that wheel slippage does not occur under minimum wheel load conditions. The thermal capacity shall be adequate for the number of stops per hr as specified on the OIS.

When foot-operated, the stroke of the brake foot pedal shall not be more than 8 inches nor require an applied force of more than 70 lbs. to stop the bridge as described. The lever shall be designed and positioned so that it will not interfere with the necessary movements of the operator's legs or feet while operating the crane.

Brakes on all outdoor cranes, and others if specified, shall be provided with a spring-set parking feature and also be arranged to set on loss of power. The torque capability of the brakes shall be sufficient to statically hold the bridge against the external loads as specified.

3.1.3.1 Operator's Cab on Bridge

Each bridge drive shall be equipped with a foot-operated hydraulic or electrical adjustable torque service brake or brakes sized in accordance with Section 3.1.3.

3.1.3.2 Operator's Cab on Trolley

Each bridge drive shall be equipped with a brake or brakes having a spring-set parking feature, and also be arranged to set on loss of power. The brake shall be sized in accordance with Section 3.1.3. This type of brake system is usable on drives where motor braking is used for routine stopping.

In addition, when motor braking is not used by the operator for routine stops, one of the available remote controlled brake systems which will provide service braking similar to cab-on-bridge cranes should be specified on the OIS. Several functions may be combined in a single brake.

3.1.3.3 Floor, Pulpit or Remote Controlled Cranes

The requirements for bridge brakes shall be the same as specified in Section 3.1.3.

4.0 Maintenance, Inspection and Repair

4.1 Maintenance

In order to assure proper equipment operation, a periodic maintenance program should be established. Maintenance instructions should be obtained from the manufacturer for incorporation into this program.

4.1.1

A well planned and executed preventive maintenance program is essential to the satisfactory operation of brakes. The program should be established at the time the equipment is installed. All manufacturer's instructional literature and renewal parts information should be reviewed and retained in a location readily accessible for reference during maintenance of the equipment.

4.1.2

A schedule should be established for routine preventive maintenance at intervals selected on the basis of severity of duty and environment. The schedule should be adjusted if later experience indicates the need.

4.1.3

A specific checklist of routine preventive maintenance requirements is recommended, as well as a logbook to record the maintenance history as it is performed. The entry should indicate the date maintenance was performed; observations;

description of repairs or modifications and reasons for them; and identity of person(s) who performed the maintenance.

4.1.4

The user should establish a schedule to test for the following:

a) The brake operated properly and freely.
b) The brake can stop and hold the rated load.

4.2 Inspection

4.2.1

Brakes should be inspected to see that magnet gaps and torque spring settings are correct.

4.2.2

The brake should be operated to verify that the brake linings are released from the wheel or disc. Linings should be examined for wear and should be replaced if it is determined that new linings are needed. Refer to Table 2 for the minimum brake lining thickness for DC shoe brakes or follow the manufacturer's recommendations.

4.2.3

Electrical connections and mechanical joints should be inspected for proper tightness; in particular, the hardware securing the wheel to the motor shaft and the brake mounting bolts.

4.2.4

Remove dirt and dust from the brake paying particular attention to the armature gap which tends to collect magnetic particles.

4.2.5

The brake wheel or disc should be examined for unusual scoring, overheating, cracking, or wear, to determine the need for replacement or machining. Replace the wheel in accordance with the minimum wheel diameter specification after machining given in Table 2 or the manufacturer's recommendation.

4.2.6

The condition of wear surfaces, bearings and bushings should be checked along with the overall mechanical and electrical integrity of the complete braking system.

4.3 Repair

4.3.1

If the equipment condition indicates need for adjustment, repair, or replacement, the manufacturer's instruction manual should be followed carefully. The level of field repair recommended by the manufacturer should be followed. If more extensive repair is needed the item should be replaced.

4.3.2

Caution should be followed when using equivalent replacement parts from sources other than the original equipment manufacturer. Some apparent equivalent replacement parts may not be suitable for use because the original part may have to meet unique specifications to insure safety and proper performance. Use only replacement parts meeting or exceeding the specifications of the original equipment manufacturer.

Table 2. Minimum Wheel Diameter and Shoe Brake Lining Thickness

Wheel Diameter (in.)	Max RPM	Min. Wheel Diameter (in.)*	Lining Thickness (in.)**	
			Riveted***	Bonded
8	5000	7.94	0.010	0.106
10	4000	9.92	0.010	0.020
13	3300	12.90	0.010	0.026
16	2600	15.87	0.015	0.032
19	2300	18.87	0.015	0.038
23	1900	22.87	0.015	0.046
30	1600	29.87	0.015	0.060

* Minimum after remachining
** Minimum permissible prior to replacement
*** Above rivet head at amximum wear point

4.3.3

If partial disassembly of the mechanism is necessary, the manufacturer's instructions should be followed for disassembly, reassembly, and any required adjustment or lubrication. Upon reassembly the brake should be checked for freedom of motion and functional operation. Alignment and settings should be checked and verified.

Table 3. Dimensions for Type FC Face Mounted Disc Brakes

(Used in conjunction with Fig. 1 below.) Reprinted with permission from National Electrical Manufacturers Association.

Type FC Face Mounting Dimensions								Brake Data		
		FBF Hole							Area for Leads	
Frame Designation	FAJ Bolt Circle	Number	Tap Size	Min. Depth	FBD Outside Diameter of Face	FAK Outside Diameter of Pilot	FBB Depth of Pilot	Size	Diameter	DP Radial Location
*56C										
143TFC,145TFC	5.875	4	3/8–16	0.56	6.50 Nom	4.50	0.16 Max	A	0.41	2.81
182TFC,184TFC	5.875	4	3/8–16	.056	6.50 Nom	4.50	0.16 Max	A	0.41	2.81
213TFC,215TFC	7.250	4	1/2–13	0.75	9.00 Min	8.50	0.25 Min	B	0.62	3.81
254TFC,256TFC	7.250	4	1/2–13	0.75	10.00 Min	8.50	0.25 Min	B	0.62	3.81
284TFC,286TFC	9.000	4	1/2–13	0.75	11.25 Min	10.50	0.25 Min	C	0.62	4.50
324TFC,326TFC	0.56	4	5/8–11	0.94	14.00 Min	12.50	0.25 Min	D	0.62	5.25

* Mounting dimensions not standardized

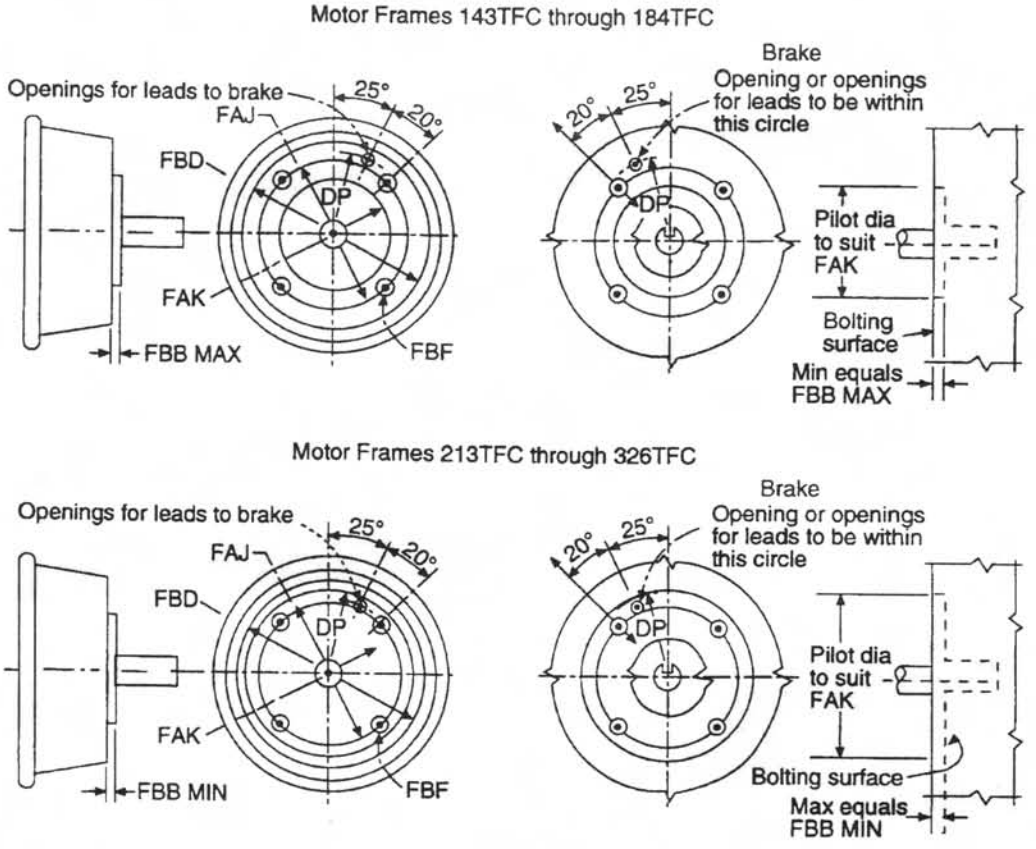

Fig. 1 Face-mounted disc brake configuration. Refer to Table 3 to determine actual dimensions for the applicable motor frame designation

Table 4. Standardized mounting by motor frame size for wheel and disc brakes.

(Used in conjunction with Fig. 2 and Fig. 3.)

Wheel Dia. (in.)	Disc Dia. (in.)	Motor Frame	Wheel Dimensions (in.)		Common Dimensions (in.)		Disc Dimensions (in.)		Mounting Dimensions (in.)					
D	D1	Size	C	F	E	O	D3	T	A	B	H	J	Z	M
8	12	602/802	3.25	2.63	3.00	4.00	6.50	0.50	3.25	2.88	0.69	7.00	8.25	7.63
		603/803		2.13	3.50								9.00	8.50
		604/804											9.50	9.00
		606/806		1.63	4.00									10.00
		AC1/AC2		2.63	3.00								9.63	
		AC4											10.13	
		AC8		1.63	4.00								10.63	
10	14	602/802	3.75	3.13	3.00	4.25	6.50	0.50	4.00	3.13	0.69	8.38	8.50	7.63
		603/803		2.63	3.50								9.25	8.50
		604/804											9.75	9.00
		606/806		2.13	4.00									10.00
		608/808		1.63	4.50								9.88	11.25
		AC1/AC2		3.13	3.00									
		AC4											10.38	
		AC8		2.13	4.00								10.88	
		AC12											11.63	
13	17	603/803	5.75	4.38	3.50	5.00	9.00	0.75	5.75	4.50	0.81	9 .88	10.00	8.50
		604/804											10.50	9.00
		606/806		3.88	4.00									10.00
		608/808		3.75	4.50	5.38							11.00	11.25
		610/810											11.63	12.25
		612/812		3.25	5.00								12.13	13.38
		614/814											13.13	14.75
		AC8		3.88	4.00	5.00							11.63	
		AC12											12.38	
		AC18		3.75	4.50	5.38							14.69	
		AC25/AC30		3.25	5.00								15.81	
16	21	606/806	6.75	5.88	4.00	6.50	9.00	0.75	7.50	5.38	1.06	12.13	12.00	10.00
		608/808		5.38	4.50								12.13	11.25
		610/810											12.75	12.25
		612/812		4.88	5.00								13.25	13.38
		614/814											14.25	14.75
		616/816		4.38	5.50								15.50	16.00
		AC18		5.38	4.50								15.47	
		AC25/AC30		4.88	5.00								16.94	
		AC40/AC50											18.50	
19	24	608/808	8.75	7.38	4.50	7.50	12.00	1.00	9.25	6.50	1.06	13.25	13.13	11.25
		610/810											13.75	12.25
		612/812		6.88	5.00								14.25	13.38
		614/814											15.25	14.75
		616/816		6.38	5.50								16.50	16.00
		618/818		5.88	6.00								16.00	17.75
		620/820		5.13	6.75									20.88
		AC25/AC30		6.88	5.00								17.31	14.50
		AC40/AC50											19.50	
23	29	612/812	11.25	8.88	5.00	8.25	14.00	1.00	11.75	8.00	1.31	15.88	15.00	13.38
		614/814											16.00	14.75
		616/816		8.38	5.50								17.25	16.00
		618/818			6.00	8.75								17.75
		620/820		8.63	6.75	9.75							18.25	20.88
		622/822		8.13	7.25								17.50	23.00
		624/824		6.13	9.25								18.25	24.00
		AC25/AC30		8.88	5.00	8.25							18.69	
		AC40/AC50											20.25	
N/A	34	614/814			5.00	10.25	16.00	1.50	13.25	8.75	1.56	19.00	17.25	14.75
		616/816			5.50								18.50	16.00
		618/818			6.00								18.00	17.75
		620/820			6.75									20.88
		622/822			7.25	10.75							17.75	23.00
		624/824			9.25								18.50	24.00
30	38	616/816	14.25	11.88	5.50	10.25	20.00	1.50	15.00	9.50	1.56	20.75	19.25	16.00
		618/818		11.38	6.00								18.75	17.75
		620/820		10.63	6.75									20.88
		622/822			7.25	10.75							18.50	23.00
		624/824		8.63	9.25								19.25	24.00

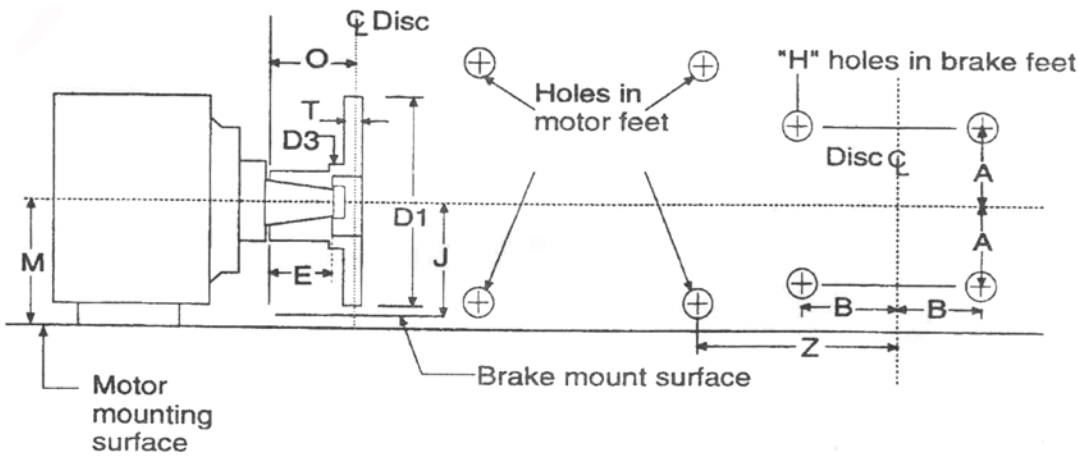

Fig. 2 Disc brake configuration. Refer to Table 4 to determine actual dimensions for the applicable frame size.

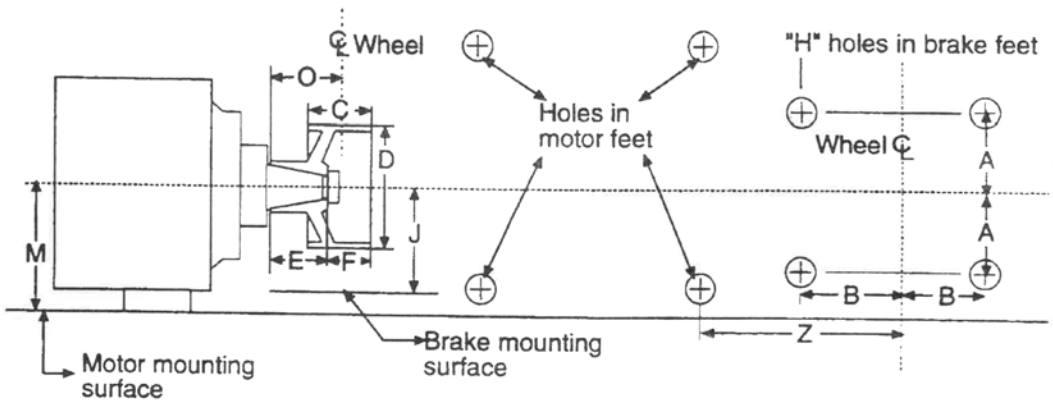

Fig. 3 Wheel and shoe brake configuration. Refer to Table 4 to determine actual dimensions for the applicable frame size.

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