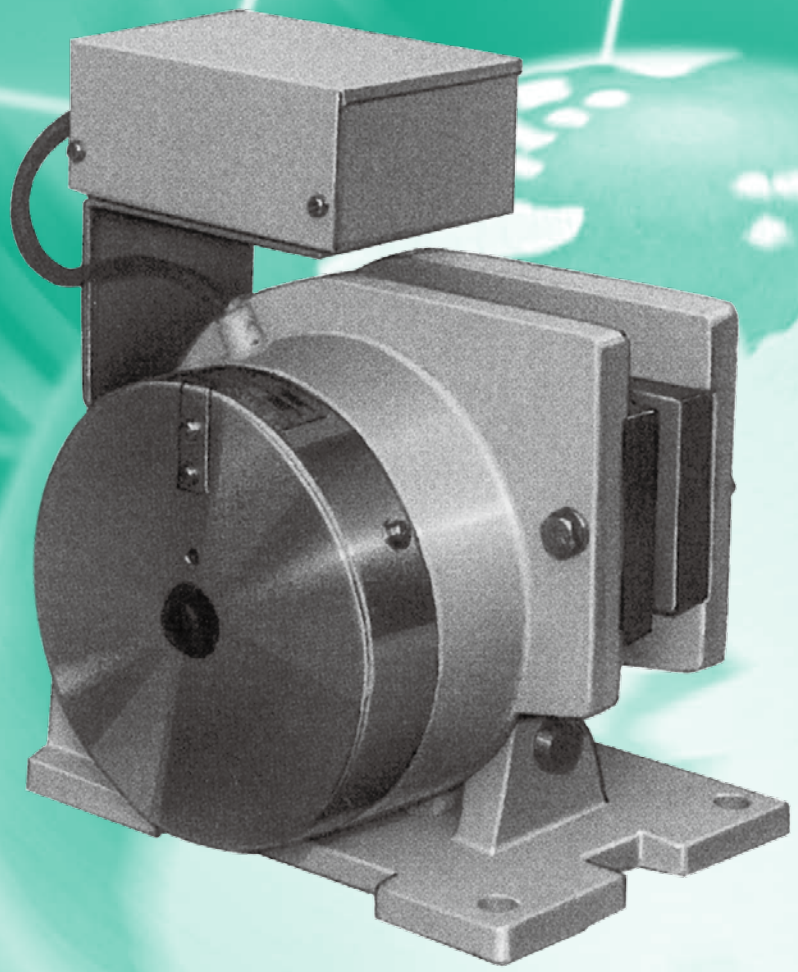
Satuma

No.SC-193

Non-excitation braking
Pad-type disk brakes
AC-operated DC electromagnetic system

Simple structure and easy handling

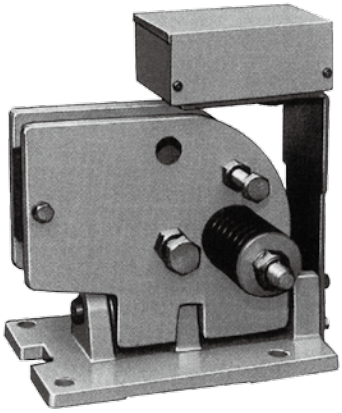


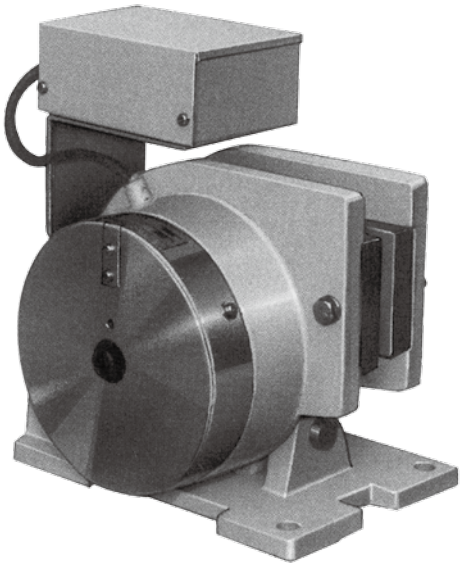
Satuma Electric Mfg. Co., Ltd.

AC-operated DC electromagnetic type

Pad-type disk brakes

The AC-operated DC electromagnetic pad-type disk brakes is an off brake that delivers stable braking performance with excellent features, including easy maintenance and low noise. This high-performance brake was newly developed for applications such as braking for traversing and traveling of cranes, braking of carriages and roller conveyers, etc., and for maintenance purposes. It is becoming more popular than conventional drum-type brakes.





Features

- Simple structure, compact, and lightweight
  Since the mechanism generating braking force integrates magnets and a braking spring on the side face of the disk rotor, this ensures a simple, compact, and lightweight structure.
  The brake is thus extremely easy to install, maintain and handle.

- Stable braking force
  Compared to drum-type brakes, the disk brake has a large heat-dissipation area, ensuring a large braking workload. This allows stable braking performance from low to high rotation speeds.

- Small shock and low braking noise
  Since the stroke of the movable part of the magnet is small, shock generated when braking and opening is minimized, and the braking noise is also low.

- Shortened maintenance time
  Adopting a dry bushing decreases lubrication work.

Rating

Brake type	Type PB3: Brake for traversing and traveling of cranes, carriages, and for roller conveyers (not usable for hoisting.) Type PL3: Brake for retaining: To prevent swinging of cranes (not usable for hoisting)
Installation method	Standard specification/floor installation type[Note 1], Special specifications/wall-mount type (axis: perpendicular)　Types V and Z, wall-mount type (axis: horizontal): type K
Actuation	Off brake
Ambient temperature	−10 ～ +40℃
Protective structure of operation unit	Simple dustproof type (Main body: Unprotected type)
Insulation class of operation unit	Class F insulation
Rated voltage and frequency	200/220 V − 50/60Hz or 400/440V − 50/60Hz[Note 2]
Permissible voltage fluctuation	−15 ～ +10%
Usage rate of operation unit and actuating cycle (for braking)	100%, 400 cycle/hour
Time rating (for maintenance)	Continuous
Coating color	Munsell 7.5BG6/1.5

Note 1　Mountable to both sides, provided that the inclination from the horizontal shaft is up to ±45°. (See "Mounting direction" on page 5)
Note 2　200- and 400 V-class brakes can be used by changing the terminal connections. (See “Connection diagram” on page 5.)

Specifications

Brake for braking (Disk rotor is optionally available.)

Brake type	PB3−3	PB3−6	PB3−12
Rated braking torque (N・m)	15～30	30～60	60～120
Permissible braking workload (J/min)	20,000	32,000	49,000
Permissible maximum braking workload (J)	129,000	192,000	287,000
Permissible braking rotational speed (min^{-1})	2300	1800	1600
Suction time of brake (s) [Note 3]	0.15	0.25	0.30
Detachment time of brake (s) [Note 3]	0.30	0.35	0.45
Standard disk rotor dimensions, Outer diameter×thickness (mm) [Note4, Note5]	250×12	300×12	350×12
Moment of inertia of the disk rotor (kg・m^2)	0.038	0.075	0.14
Mass: Main body/disk rotor (kg)	14/7	24/12	40/18

Note 3　The operating time is the value at the rated braking torque and specified stroke.
Note 4　The disk rotor is made of gray cast iron (FC250.)
Note 5　Applicable by special processing, provided that the disk-rotor thickness ranges from 10 to 15 mm (PB3-12: 10 to 20 mm.)

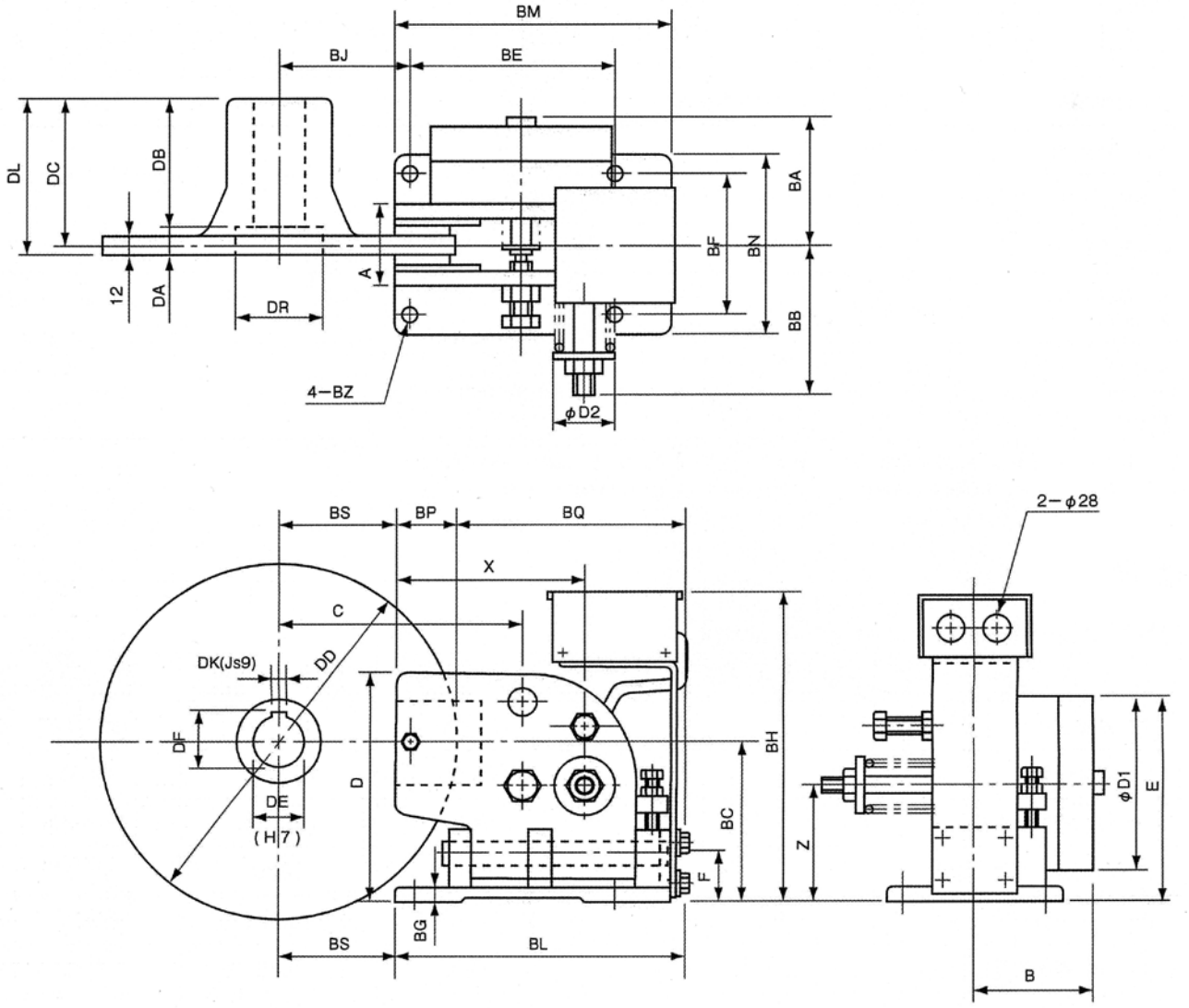
Brake for retaining (Disk rotor is optionally available.)

Brake type	PL3−5	PL3−10	PL3−20
Rated torque (N・m)	50	100	200
Standard disk rotor dimensions, Outer diameter×thickness (mm)[Note6, Note7]	250×12	300×12	350×12
Mass: Main body/disk rotor (kg)	14/7	24/12	40/18

Note 6　The disk rotor is made of gray cast iron (FC250.)
Note 7　Applicable by special processing, provided that the disk-rotor thickness ranges from 10 to 15 mm (PL3-20: 10 to 20 mm.)

External dimensions and structure

External dimensions (mm)



External dimensions (mm)

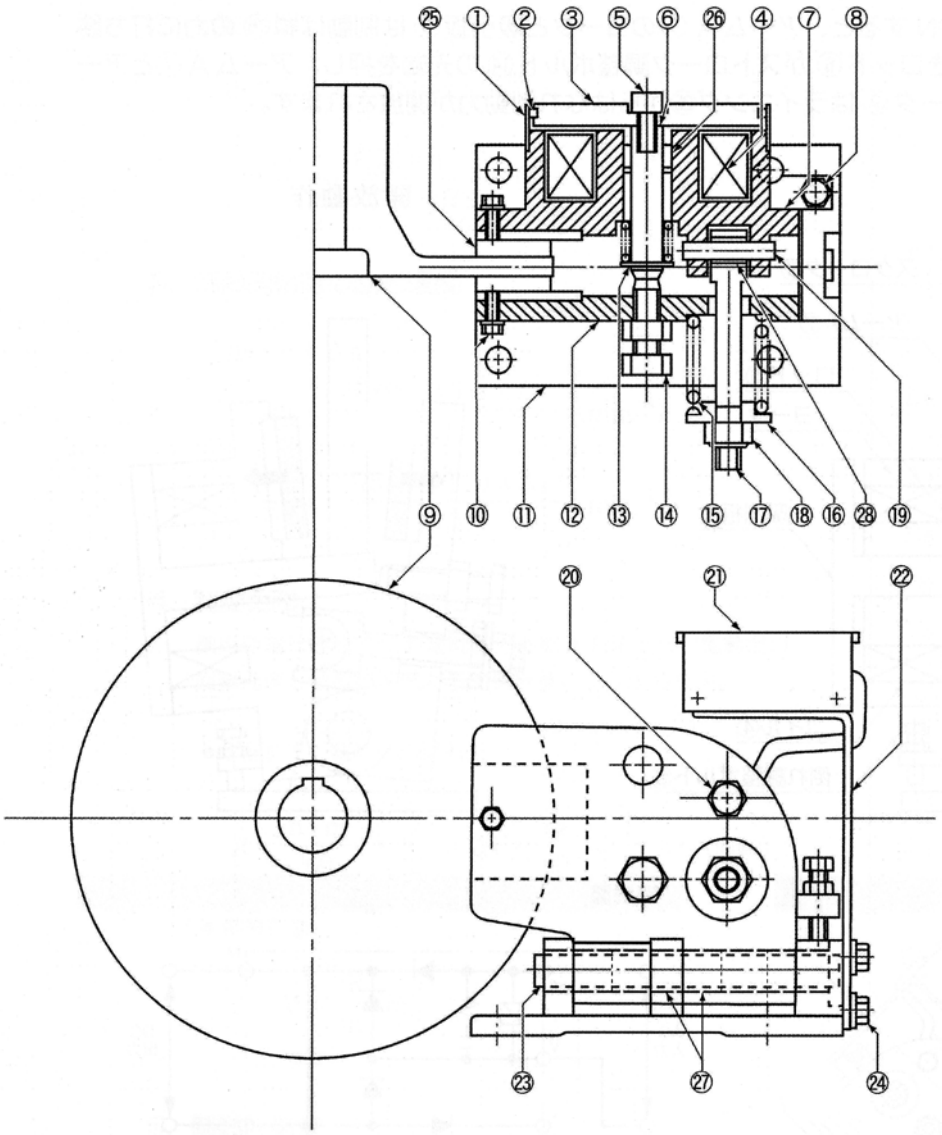
Brake type		Brake main body (mm)														
For braking	For retaining	BE	BF	BJ	BM	BN	BC	BA	BB	BG	BH	BL	BP	BQ	BS	BZ
PB3−3	PL3−5	135	100	95	185	130	112	95	105	10	230	195	40	155	85	10
PB3−6	PL3−10	165	120	115	225	150	132	110	130	12	260	235	50	185	100	12
PB3−12	PL3−20	195	140	130	270	180	160	130	145	15	300	285	65	220	110	15

Note8: For axis diameters and key dimensions (tolerance) other than those listed above, items with unprocessed axial diameter (DE) are available. Please process them to the desired dimensions yourself.

Structural drawing of disk brake

This disk brake has a simple structure, with only one pin unit as the supporting point.

- Major parts include a brake base, arm A which integrates a DC electromagnet, and arm B.
- The electromagnetic coil is fastened by MEW Resin (epoxy resin), increasing the insulation performance.
- Since a bolt for opening the manual brake is provided, the brake can be opened easily.
- There are three adjustment parts: adjustment of the gap on both sides of the lining, magnet stroke adjustment, and braking torque (brake spring) adjustment.
  In particular, the braking torque is easily adjustable because the braking spring is installed outside.



	Name
①	Cover
②	Packing
③	Suction disk
④	Coil
⑤	Suction disk mounting bolt
⑥	Rod
⑦	Arm A
⑧	Tilt adjustment bolt
⑨	Disk rotor (option)
⑩	Lining mounting bolt
⑪	Brake base
⑫	Arm B
⑬	Suction disk returning spring
⑭	Stroke adjustment bolt
⑮	Braking spring
⑯	Spring holder
⑰	Braking spring adjustment bolt
⑱	Braking spring adjustment nut
⑲	Connecting pin (with bushing)
⑳	Manual release bolt
㉑	Control box
㉒	Bracket
㉓	Connecting pin (with bushing)
㉔	Bracket mounting bolt
㉕	Lining (pad)
㉖	Dry bushing
㉗	Dry bushing
㉘	Dry bushing

												Disk rotor (option)									
	A	B	C	D	E	F	⌀D1	X	Z	⌀D2	Mass	DD	DA	DB	DC	DL	DR	DE	DF	DK	Mass
	58	90	170	162	150	32	135	125	82	35	14kg	250	20	82	96	102	50	32	35.3	10	7kg
	68	104	205	192	175	42	155	155	97	49	24kg	300	8	112	114	120	70	42	45.3	12	12kg
	86	121	235	230	210	50	190	185	115	63	40kg	350	23	112	129	135	85	48	51.8	14	18kg
																		55	59.3	16	

Description of operation

• Braking operation

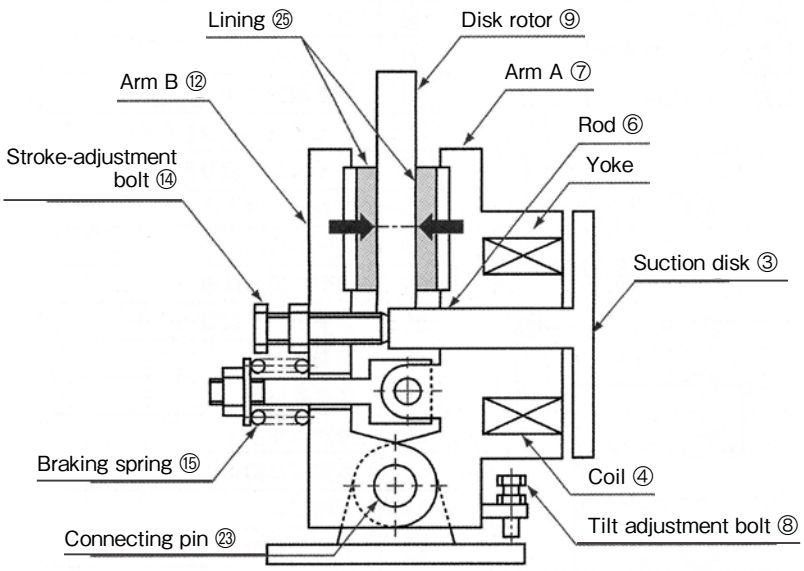
When the current of the DC electromagnetic coil ④ is set to OFF, arms A ⑦ and B ⑫ move toward each other by the braking spring ⑮ with the connecting pin ㉓ used as a supporting point.

Consequently the lining ㉕ fastened to arms A ⑦ and B ⑫ presses down the disk rotor ⑨, thus generating braking force.

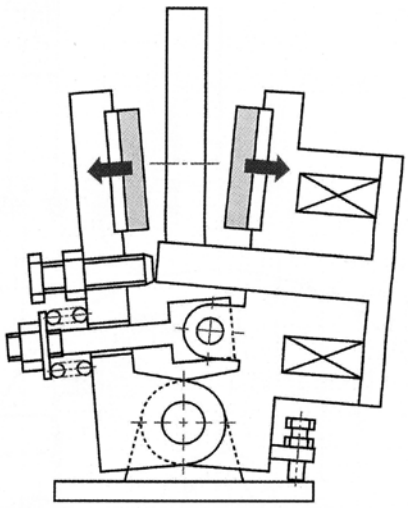
• Releasing operation

When the current of the DC electromagnetic coil ④ is set to ON, the yoke and suction disk ③ of arm A ⑦ exceed the force of the braking spring ⑮, and are attracted to each other. At this time, the rod ⑥ presses the tip of the stroke-adjustment bolt ⑭, arms A ⑦ and B ⑫ detach, and the disk rotor ⑨ detaches from the lining ㉕, discharging the braking force.

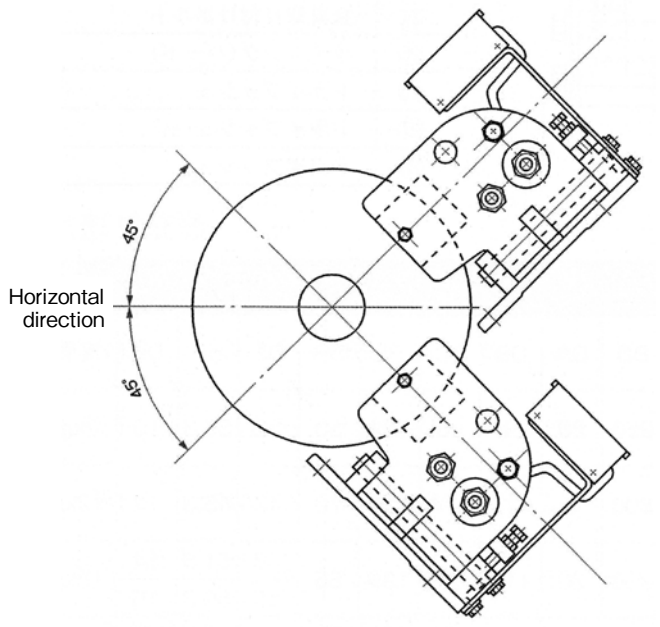
Braking operation



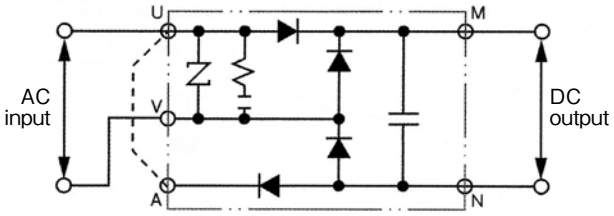
Releasing operation



Mounting direction



Connection diagram



When the AC input voltage is 200 V class, connect U-A.
When it is 400 V class, connection is unnecessary

General expressions used for brake calculations

1. Braking torque Note 9

$$T_B = \frac{9550 \times kW}{n} \times F \quad (\mathrm{N \cdot m})$$

$$T_B' = \frac{974 \times kW}{n} \times F \quad (\mathrm{kgf \cdot m})$$

2. Braking time

$$t_B = \frac{J \times n}{9.55 \times (T_B \pm T_L)} \quad (\mathrm{s})$$

$$= \frac{GD^2 \times n}{375 \times (T_B' \pm T_L')} \quad (\mathrm{s})$$

3. Rotation speed at start of braking

$$n_B = n + \Delta n$$

$$= n + \frac{9.55 \times (\pm T_L) \times \Delta t}{J} \quad (\mathrm{min^{-1}})$$

$$= n + \frac{375 \times (\pm T_L') \times \Delta t}{GD^2} \quad (\mathrm{min^{-1}})$$

4. Braking distance

To determine the braking distance, calculate the rotation volume of the motor up to stop, and perform a proportional calculation based on the motor-rotation speed and the speed of the load.

・Rotation volume of the motor up to stop

$$R = \frac{n + n_B}{60} \times \frac{1}{2} \times \Delta t + \frac{n_B}{60} \times \frac{1}{2} \times t_B \quad (\mathrm{Rotation})$$

・Braking distance

$$S = V \times \frac{R}{n} \quad (\mathrm{m})$$

5. Braking workload

・Braking workload for an operation

$$A_B = \frac{J \times n^2}{183} \times \frac{T_B}{T_B \pm T_L} \quad (\mathrm{J})$$

$$A_B' = \frac{GD^2 \times n^2}{7160} \times \frac{T_B'}{T_B' \pm T_L'} \quad (\mathrm{kgf \cdot m})$$

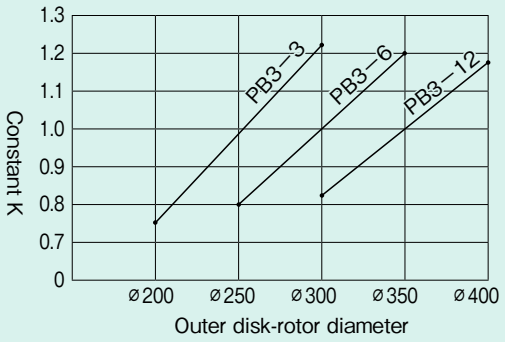
・Braking workload per minute

$$E_B = A_B \times Z \quad (\mathrm{J/min})$$

$$E_B' = A_B' \times Z \quad (\mathrm{kgf \cdot m/min})$$

T_B : Braking torque (N·m)
T_B' : Braking torque (kgf·m)
kW : Motor output (kW)
n : Motor-rotation speed ($\mathrm{min^{-1}}$)
F : Constant related to load conditions and stopping time
Traversing and traveling 1.0～0.7
J : Total moment of inertia converted to brake shaft ($\mathrm{kg \cdot m^2}$)
$GD^2 = 4\mathrm{J}$…Balance wheel effect ($\mathrm{kgf \cdot m^2}$)
t_B : Braking time (s)
T_L : Load torque (N·m)
T_L' : Load torque (kgf·m)
Value converted into brake shaft
Code − represents the direction reverse to brake torque (lowering)
Code + represents the same direction as brake torque (hoisting)
Δn : Change in motor-rotation speed due to dead time ($\mathrm{min^{-1}}$)
Δt : Dead time up to start of braking operation (s)
n_B : Rotation speed at the start of braking operation ($\mathrm{min^{-1}}$)
R : Rotation volume of motor up to stop (rotation)
S : Braking distance (m)
V : Speed of load (m/min)
Z : Braking frequency (cycle/minute)
A_B : Braking workload per operation (J)
A_B' : Braking workload per operation (kgf·m)
E_B : Braking workload per minute (J/min)
E_B' : Braking workload per minute (kgf·m/min)

Note 9 : When using a disk rotor with external diameters other than the standard diameter (material: FC250), determine the braking torque using the following expression:
TB=K × (Rated braking torque of the standard disk rotor)



When ordering and making an inquiry

Please inform us of the following:

1. Application: Crane type, classification (traversing, traveling), usage rate, Rating of operations (cycle/hour), moment of inertia of the load
2. Operation environment: Indoor/outdoor use, ambient temperature
3. Brake type and Diskrotor diameter
4. Motor rating: Output/load hour rate, voltage, frequency (availability of inverter control regenerative braking)
5. Braking torque
6. Operation power supply: voltage, frequency
7. Special accessory (as applicable) : disk rotor, etc.
8. Spare parts

Safety precautions
Be sure to read the "Instruction Manual" or equivalent carefully before using the brake.

Contact for inquiries:

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