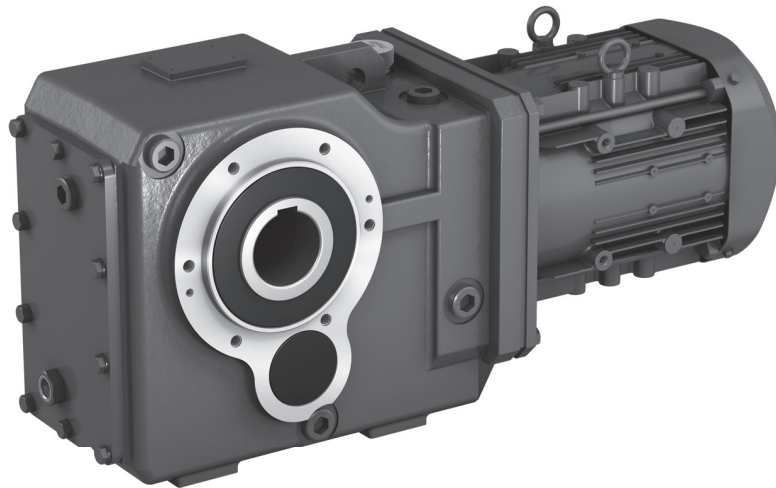


RHYTAX[®] Drive



<<CAUTION>>

- The product should be handled by an experienced and skilled personnel.
- The maintenance manual should be delivered to a customer who uses the product.
- Make sure the maintenance manual stored securely.

Introduction: Safety Precautions


- Carefully read this maintenance manual and all accompanying documents before use (installation, operation, maintenance, inspection, etc.). Thoroughly understand the machine, information about safety, and all precautions for correct operation. Thoroughly understand the machine, information about safety, and all precautions for correct operation. After reading, retain this manual for future reference.
- Pay close attention to the "DANGER" and "CAUTION" warnings regarding safety and proper use.



Improper handling may result in physical damage, serious personal injury and / or death.



Improper handling may result in physical damage and/ or personal injury.

Matters described in  may lead to serious danger depending on the situation.
Be sure to observe important matters described herein.






- Transport, installation, plumbing, wiring, operation, maintenance, and inspections should be performed by trained technicians; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- In the case of maintenance with disassembly of this device, contact the nearest authorized maintenance shop.
- In the case of an explosion proof motor, the work of transportation, installation, plumbing, wiring, operation, maintenance, and inspection should be performed by persons who have knowledge and skill concerning various explosion proof structures, installation of electrical facilities, related laws and regulations, and also principles and functions. otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.
- When the unit is to be used in a system for human transport a protecting device for human safety should be installed to prevent chances of accidents resulting in personal injury or damage to the equipment due to running out of control or falling.
- When the unit is to be used for an elevator or lifter, install a safety protecting device on the elevator side to prevent it from falling; otherwise, personal injury or damage to the equipment due to falling of hoisting equipment.

Introduction: How to Refer to the Maintenance Manual, Table of Contents

This instruction manual is common to the gearmotor and the reducer.

The marks in the table below are used for classification by being attached to top right or top left of each page, so read the applicable parts.

Also, regarding only certain specifications in pages marked **COMMON**, a mark is applied to the text concerned.

Specifications	Common to All Specifications	Gearmotor		Speed Reducer
		Without Brake	With Brake	
Symbol	Common			

Contents

Introduction: Safety Precautions	1
Introduction: Reading the Maintenance Manual, Table of Contents	2
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2. Storage	6
3. Transport	7
4. Installation	8
5. Coupling with Other Machines	9
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7. Operation	38
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11. Warranty	75

1. Receiving Inspection Common

⚠ CAUTION

- Unpack the unit after verifying that it is positioned right side up; otherwise, injury may result. otherwise, injury may result.
- Verify that the unit received is in fact the one you ordered. Installing the wrong unit may result In personal injury or equipment damage.
- Do not remove the nameplate.

Verify the items listed below upon receiving the product. If a nonconformity or problem is found, please contact with your nearest agent, distributor, or sales office.

- [1] Does the information on the nameplate conform to what you ordered?
- [2] Was any part broken during transport?
- [3] Are all bolts and nuts tightened firmly?

1-1 Reading the Nameplates

There are two main types of nameplates: type 1 and type 2. Representative examples are shown below. Please observe them by type.

When contacting the company, please provide [1]. Gearmotor or reducer nomenclature, [2]. Reduction ratio, and [3]. Serial number.

(1) Gearmotor

[1] Gearmotor nomenclature
(see P4)

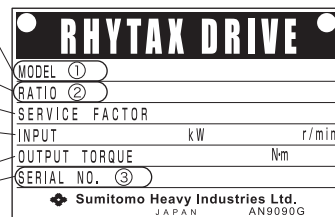
[2] Reduction Ratio

- Service factor

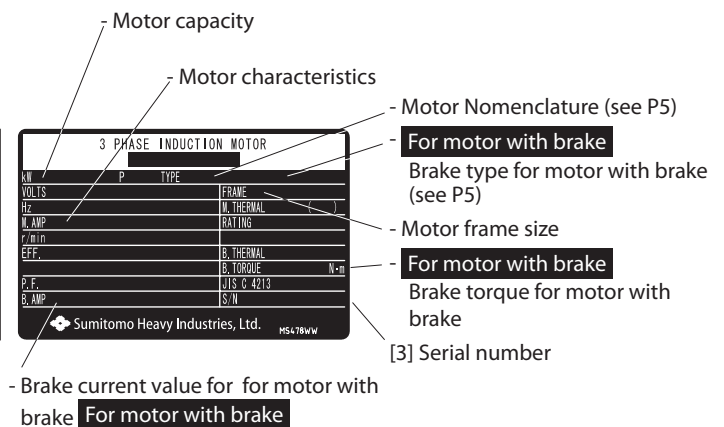
- Input capacitance,
motor speed

- Allowable output torque

[3] Serial number



(Gear Unit Nameplate)



(Motor Unit Nameplate)

Figure 1-1 Gearmotor Nameplate

(2) Speed reducer

[1]Type of speed reducer
(see P4)

[2] Reduction ratio

- Service factor

- Input capacitance, motor speed

- Allowable output torque

[3] Serial number

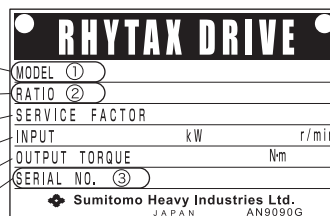


Figure 1-2 Nameplate of Speed Reducer

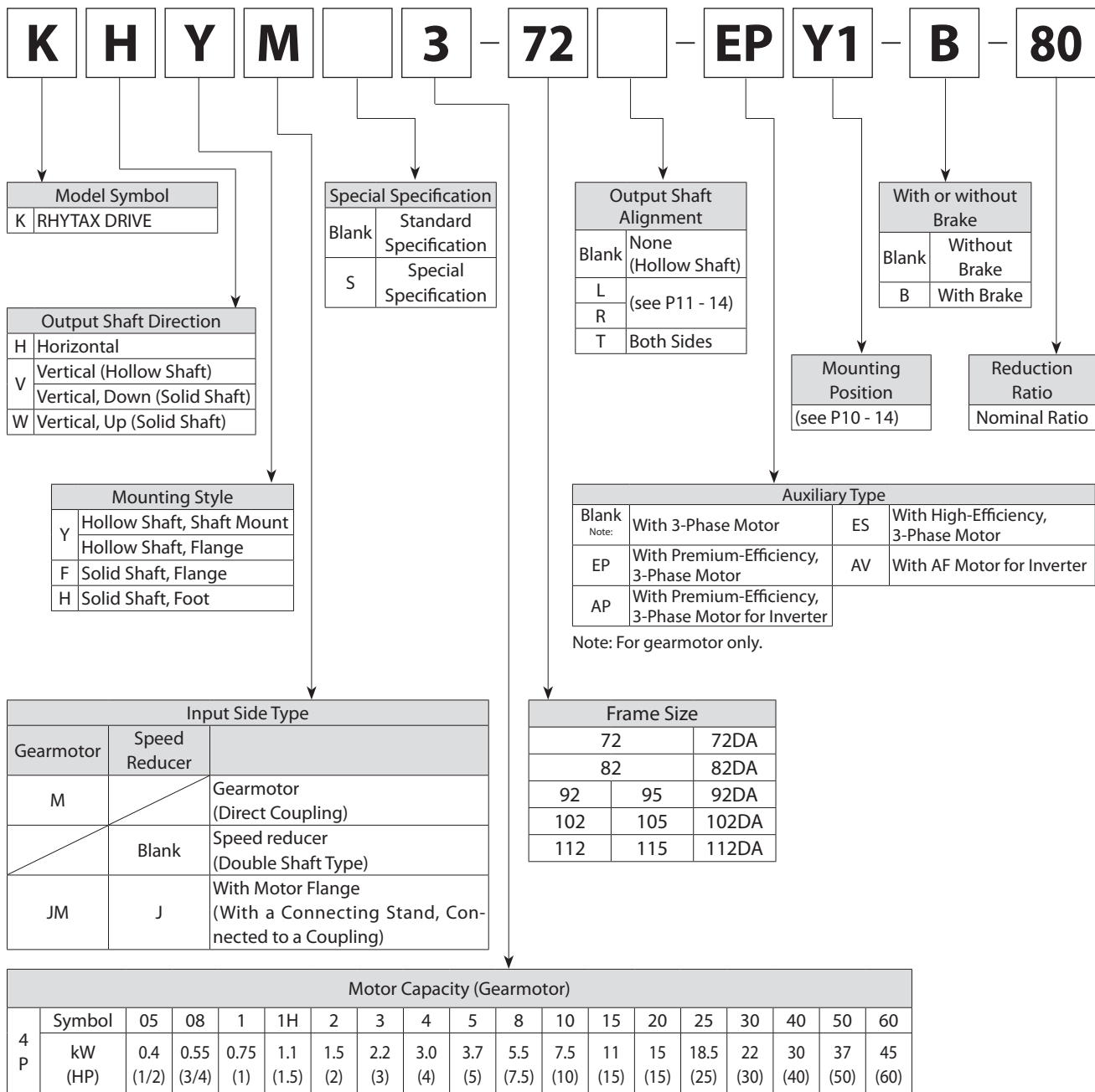
1-2 Lubrication Method

Oil lubrication parts Oil is removed from oil lubrication parts before shipment from our factory. Supply recommended oil before use.
(see P41 - 43)

Common 1. Receiving Inspection

1-3 Gearmotor and Speed Reducer Type Nameplate

Symbol meanings are shown below. Please confirm that the nomenclature matches the order.



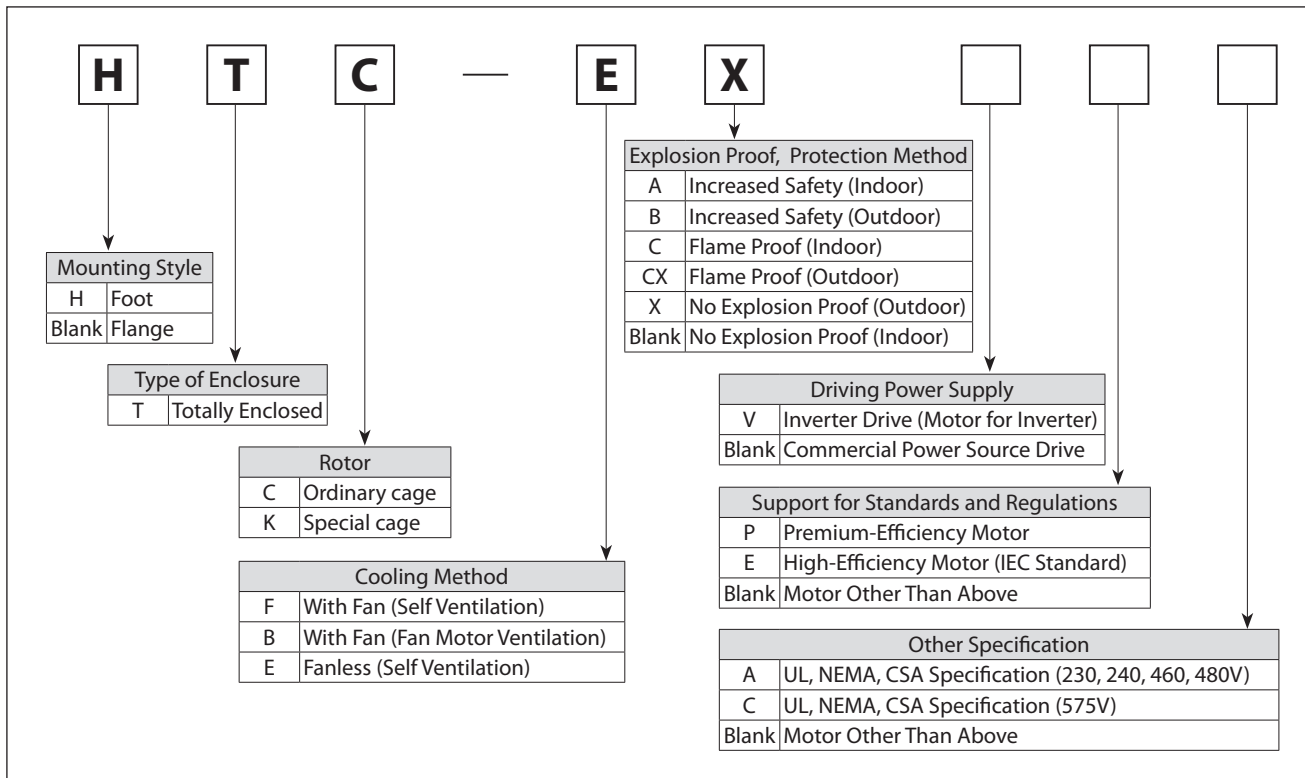
1. Receiving Inspection



1-4 Motor Nomenclature

Symbol meanings are shown below. Please confirm that the nomenclature matches the order.

When using other manufacturer's motor due to motor's specification, follow the operation manual for that motor.



1-5 Brake Type

The relationship between the standard brake type and the motor type and capacity is as follows:

Table 1-1 Brake Type

Brake Type	Motor Capacity (kW)			
	3-Phase Motor	Premium-Efficiency, 3-Phase Motor	AF Motor for Inverter	Premium-Efficiency, 3-Phase Motor for Inverter
FB-05A1	0.4	-	-	-
FB-1D	0.55	-	0.4	-
FB-1E	-	0.75	-	0.75
FB-1HE	-	1.1	-	-
FB-2E	-	1.5	-	1.5
FB-3E	-	2.2	-	2.2
FB-4E	-	3.0	-	-
FB-5E	-	3.7	-	3.7
FB-8E	-	5.5	-	5.5
FB-10E	-	7.5	-	7.5
FB-15E	-	11	-	11
FB-20	-	15	-	15
FB-30	-	18.5 22 30	-	18.5 22 30
ESB-250 (Horizontal type) ESB-250-2 (Vertical type)	-	37 45	30 37	37 45

Note) The brake type may differ from that in Table 1-1 depending on the specifications. Check the nameplate.

If this product is not for immediate use, note the following points when storing it.

2-1 Storage Location

Store the product in the clean and dry indoor.

Do not store outdoors. Store in a location that is free of moisture, dust, extreme temperature changes, corrosive gases, etc.

2-2 Storage Period

- The storage period should be less than 6 months.
- Standard rust prevention specifications
 - External rust prevention Rust prevention oil is applied before shipping from the factory. Once every 6 months after the product is shipped, check the machined surfaces for rusting, and if necessary, apply rust preventive oil once again.
 - Internal rust prevention Rust prevention period: 6 months
Store in an ordinary factory or warehouse in an environment free of moisture, dust, extreme temperature changes, corrosive gases, etc.
- If the equipment is to be exported or stored for at least one year, special rust prevention measures must be taken.
- If the equipment is to be stored for at least 6 months, run it for several minutes under no load, once every 2 to 3 months. Measure and check the insulation resistance of the motor at that time (refer to P21.)

2-3 Using after Storage

- Oil seals are affected by temperature, ultraviolet light and other ambient conditions and can easily degrade. After long storage periods, inspect before operation, and replace any degraded seals with new seals.
- If the equipment is to be stored for at least 2 years, replace the oil seals and replenish the grease immediately before resuming operation.
- At startup, check that there are no unusual noises, vibrations, temperature rises, or other symptoms. For motor with brakes, check that brakes work properly. If any abnormalities are found, immediately contact the nearest authorized maintenance shop.

DANGER

- Do not step under the unit suspended by a crane or other machines for transport; otherwise, injury, or death may result.

CAUTION

- Be careful not to drop the gearmotor or speed reducer during transport.
When a hanging bolt or hole is provided, make sure to use it. After mounting the gearmotor or speed reducer on a system, however, do not hoist the entire system using the hanging bolt or hole; otherwise, the system may be damaged by the falling unit or broken brackets.
- Before hoisting, check the weight with the nameplate, crate, outline drawing, catalog, etc. Never hoist the gearmotor or speed reducer that exceeds load capacity of the crane or other mechanism being used to lift it; otherwise, injury or damage to the equipment and/or lifting device may occur.
- Use a suitable hoisting attachment, check to ensure that the eye bolts and nuts are not loose, and then hoist the product.
- Before installing, moving or transporting the equipment, be sure to drain off the lubricating oil.
If you move the equipment with lubricating oil inside, the lubricating oil may flow out from the oil filler plug.

DANGER

- Do not use the unit in an explosive atmosphere. Use an explosion proof motor in that case; Otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.
- Use an appropriate explosion proof type motor in a danger zone (which is likely to be filled with explosive gas or steam); Otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.
- For inverter driven flame proof motor ,the inverter unit is not explosion proof construction. So be sure to place it in a location where there is no explosive gas. Otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.

CAUTION

- Do not use the products for purposes other than those shown on the nameplate or in the manufacturing specifications; otherwise, electric shock, personal injury, or damage to the equipment may result.
- Do not place inflammables around the gearmotor; otherwise, a fire may occur.
- Do not place any objects that hinder ventilation around the gearmotor or speed reducer; otherwise, cooling effects may be reduced, leading to a fire hazard due to excessive heating.
- Do not step on or hang from the gearmotor or speed reducer; otherwise, injury or damage to the equipment may result.
- Do not touch the shaft end of the products, inside keyways, or the edge of the cooling fan with bare hands; otherwise, injury may result.
- When the unit used in food processing applications which is vulnerable to oil contamination, install an oil pan or other such device to cope with oil leakage due to failure or limited service life; otherwise, oil leakage may damage products.
- Before installing, moving or transporting the equipment, be sure to drain off the lubricating oil. If you move the equipment when it contains lubricating oil, the lubricating oil may flow out from the air bleed plug.

4-1 Location of Installation

Ambient temperature:	-10 to +40°C
Ambient humidity:	85% max.
Altitude:	1000m max.
Ambient atmosphere:	There should be no corrosive gas, explosive gas, or steam. The location should be well ventilated and free from dust.
Location of installation:	Indoor type: Indoor (free from dust or water splash) Outdoor type: Indoor or outdoor (area with little contact with rain water)
Vibration:	1G max.

- Mounting In conditions other than the above requires adherence to optional specifications. Please consult with us.
- Drives built according to special specifications, such as explosion proof, can be used In the specified Mounting environments. However, concerning the connector to the machine used, implement measures based on the Mounting environment.
- Mount In a location that enables easy operation, such as inspection and maintenance.
- Mount on a sufficiently rigid base.

4-2 Mounting Angle

Install the gearmotor or speed reducer so that the output shaft and the motor shaft are horizontal or vertical.
(The mounting direction will depend upon the model, so refer to P4. Also, when you wish to install it obliquely, please contact us.)
Note, however, that if the product is manufactured according to your designated mounting angle, do not use it at any other mounting angle.

Do not remove the eyebolt from the motor. If it is removed for some reason, insert a bolt, etc., into the threaded hole to prevent water from entering the motor.

4-3 Severe Load Conditions

We recommend using mounting bolts of strength at least class 8.8 (as indicated in JISB-1051), for conditions with strong vibrations or frequent start-stop.

⚠ CAUTION

- Check the rotation direction before coupling with its driven machine. Difference in the direction of rotation may cause injury or damage to the equipment.
- Remove the key temporarily attached to the output shaft of the gearmotor or speed reducer, when the shaft is unattached to any other vehicle (i.e.: not loaded);
otherwise the key could fly off, and injury may result.
- Install appropriate protective device around rotating parts; otherwise, injury may result.
- When coupling the gearmotor or speed reducer with other machine, pay attention to the alignment, belt tension, and parallelism of pulleys. Pay attention to the direct coupling accuracy when the unit is directly coupled with another machine. When a belt is used for coupling, adjust the belt tension correctly. Correctly fasten tightening bolts on the pulley and coupling before operation; otherwise, injury or damage to the equipment may result due to scattering fragments.

5-1 Confirming Rotation Direction and Location of Oil Filling/Drain Ports

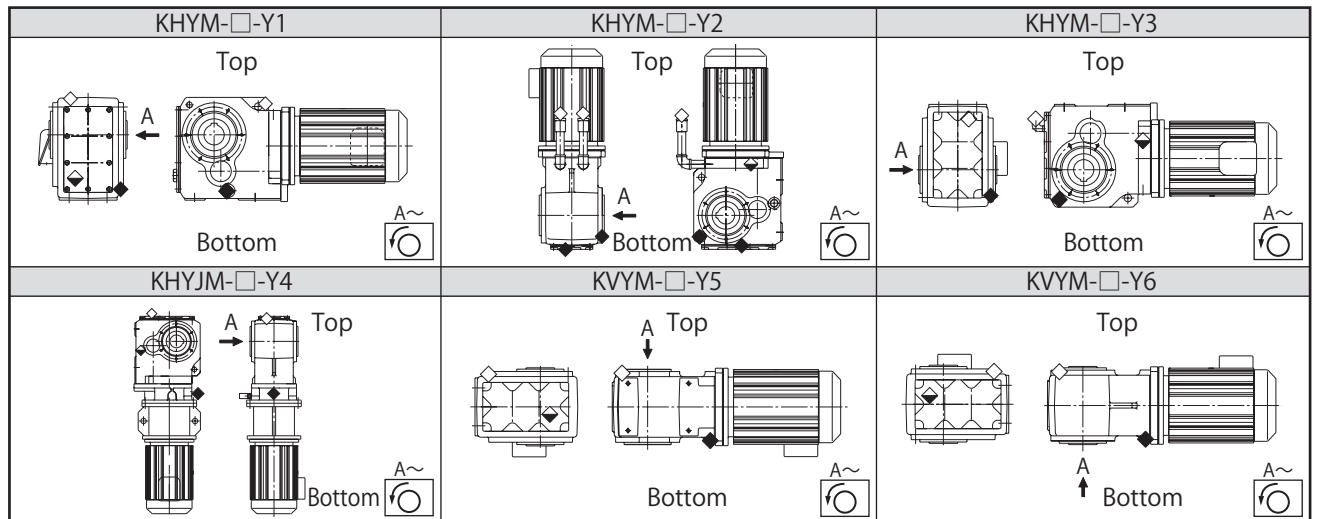
(1) Gearmotor

- Directions of output shaft rotation with wiring shown on P23 - 36 and location of oil filling/drain ports are as shown in P10 - 14.
- When wiring is performed as shown on P23 - 36, the motor shaft rotates to the right as seen from the fan cover side.
- To cause reverse rotation, reverse R and T shown on P23 and P25 - 36.

(2) Speed Reducer

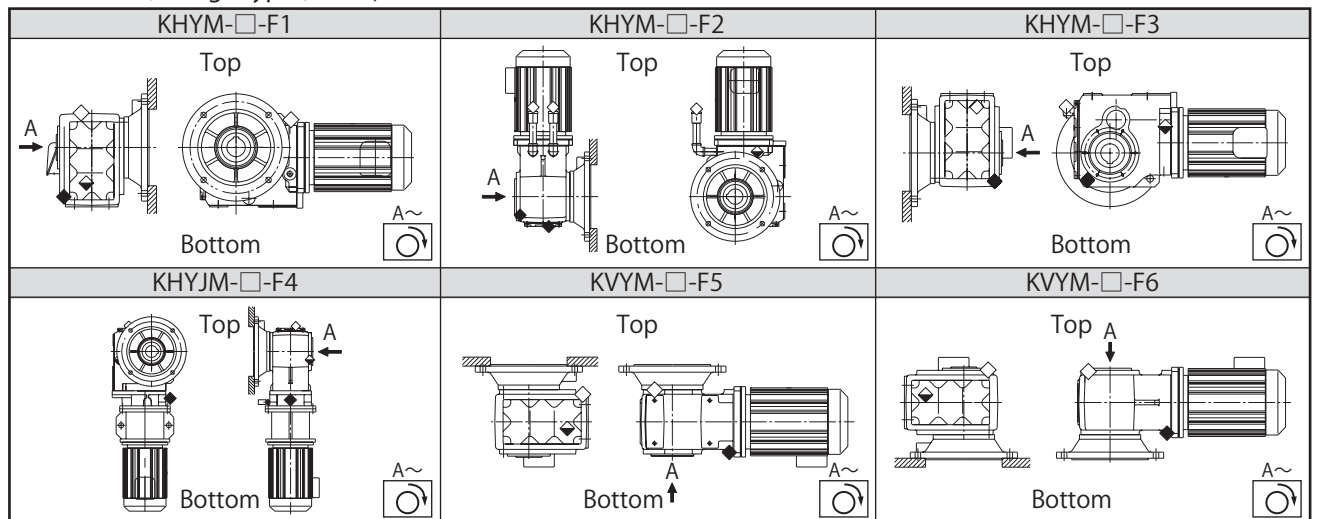
- In the case where the input shaft rotates clockwise, the direction of the output shaft is as the arrow direction shown in P10 to 14. Check it as well as the position of the oil filling/drain ports.

Hollow Shaft, Shaft Mount



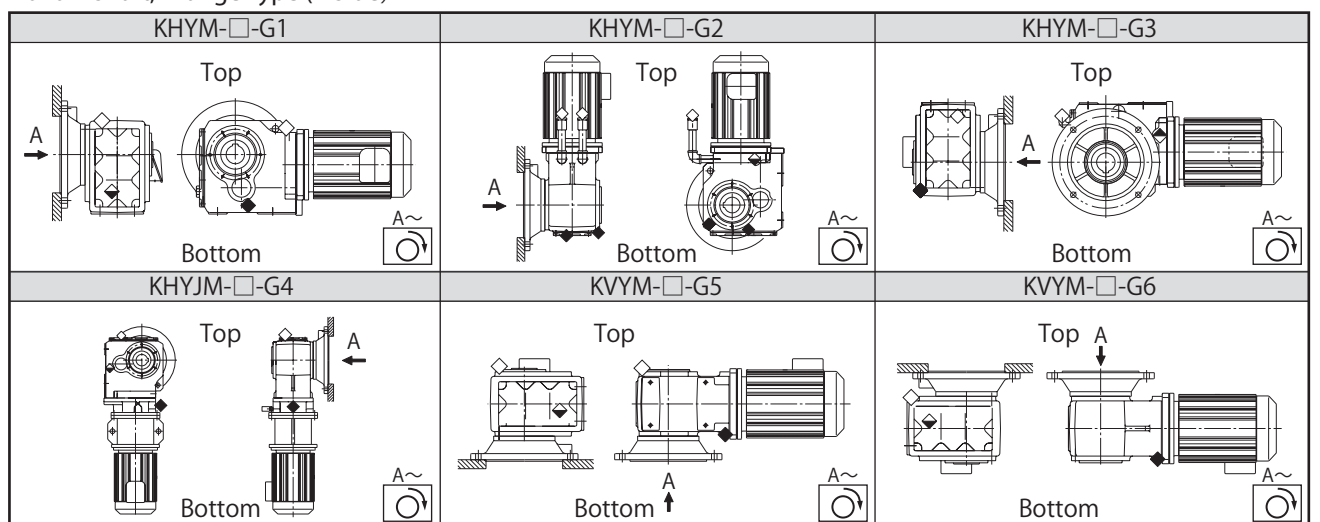
◇ Oil filling port ◆ Oil level ◆ Oil drain port

Hollow Shaft, Flange Type (L Side)



◇ Oil filling port ◆ Oil level ◆ Oil drain port

Hollow Shaft, Flange Type (R Side)

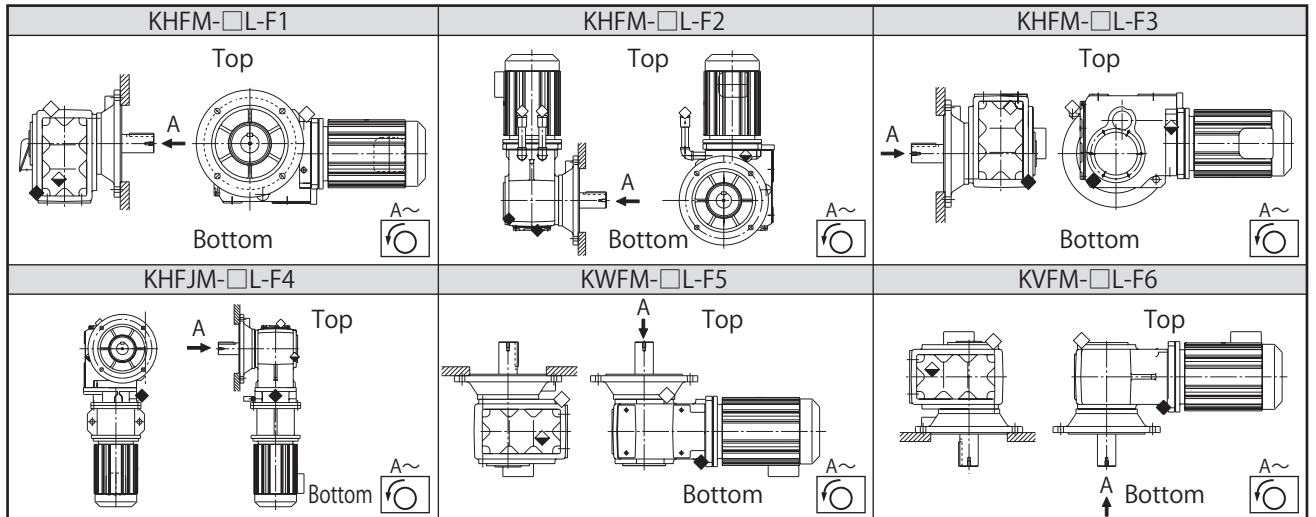


◇ Oil filling port ◆ Oil level ◆ Oil drain port

Figure 5-1 Confirming Rotation Direction and Location of Oil Filling/Drain Ports (Hollow Shaft)

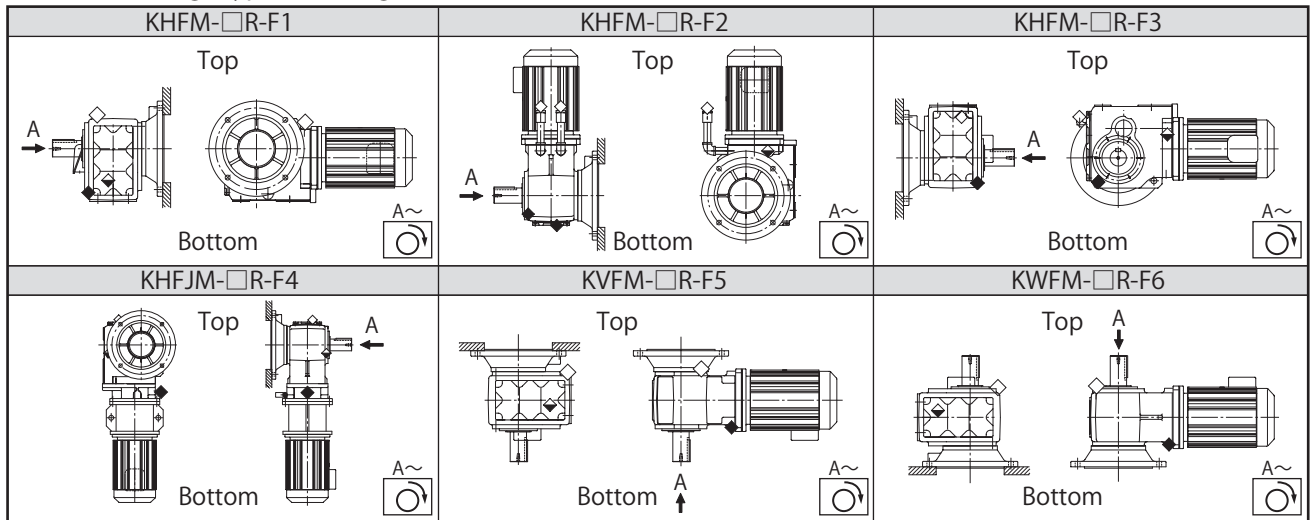
5. Coupling with Other Machines Common

Solid Shaft, Flange Type, Shaft Alignment L (L Side)



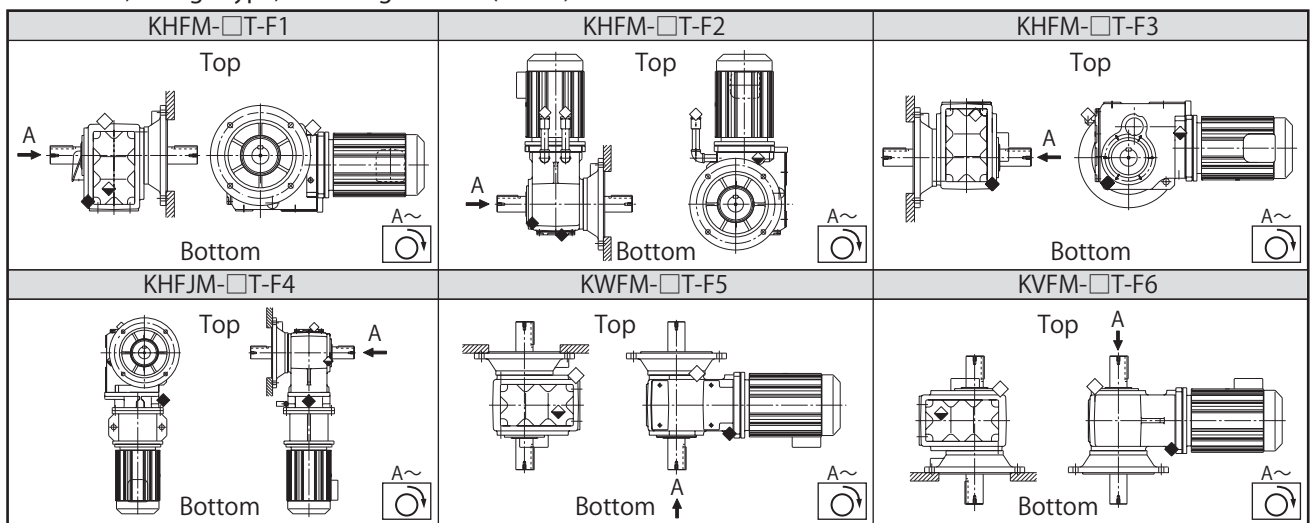
◇ Oil filling port ◆ Oil level ◆ Oil drain port

Solid Shaft, Flange Type, Shaft Alignment R (L Side)



◇ Oil filling port ◆ Oil level ◆ Oil drain port

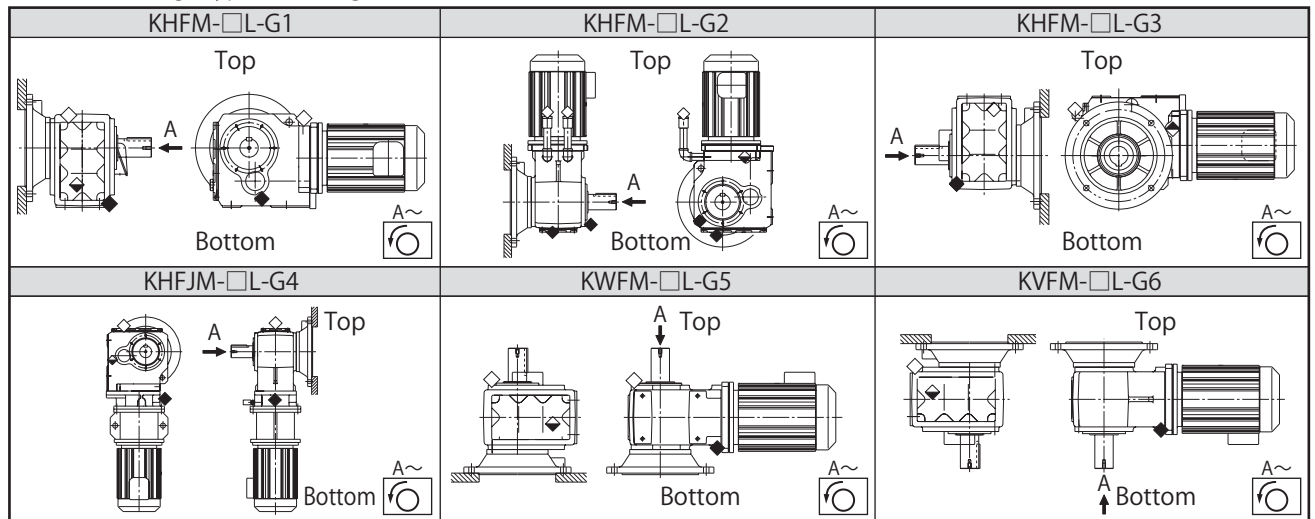
Solid Shaft, Flange Type, Shaft Alignment T (L Side)



◇ Oil filling port ◆ Oil level ◆ Oil drain port

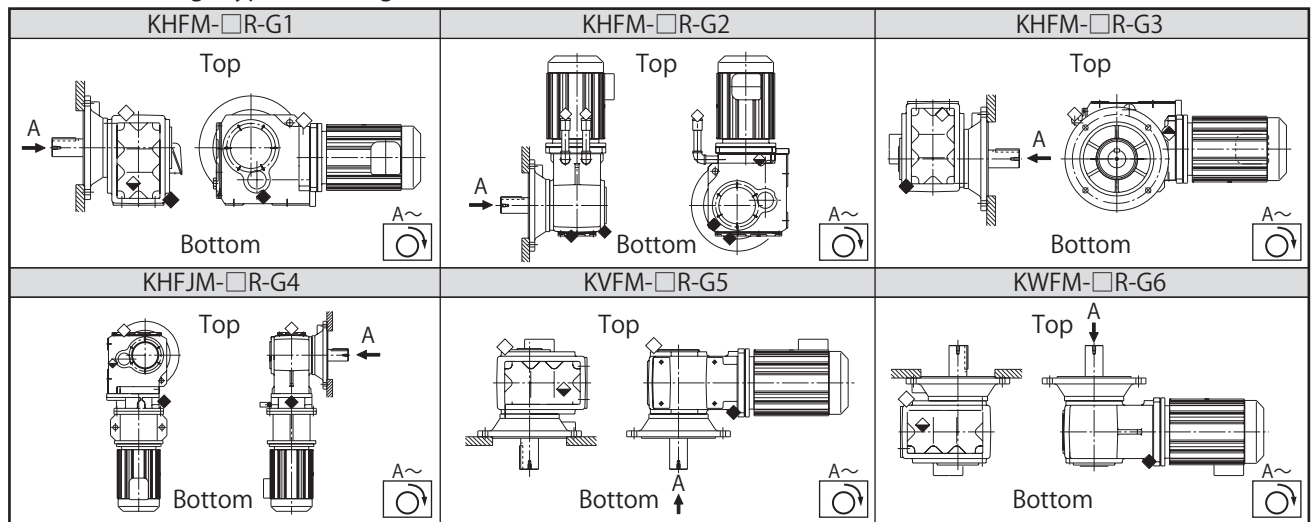
Figure 5-2 Confirming Rotation Direction and Location of Oil Filling/Drain Ports (Solid Shaft, Flange Type, L Side)

Solid Shaft, Flange Type, Shaft Alignment L (R Side)



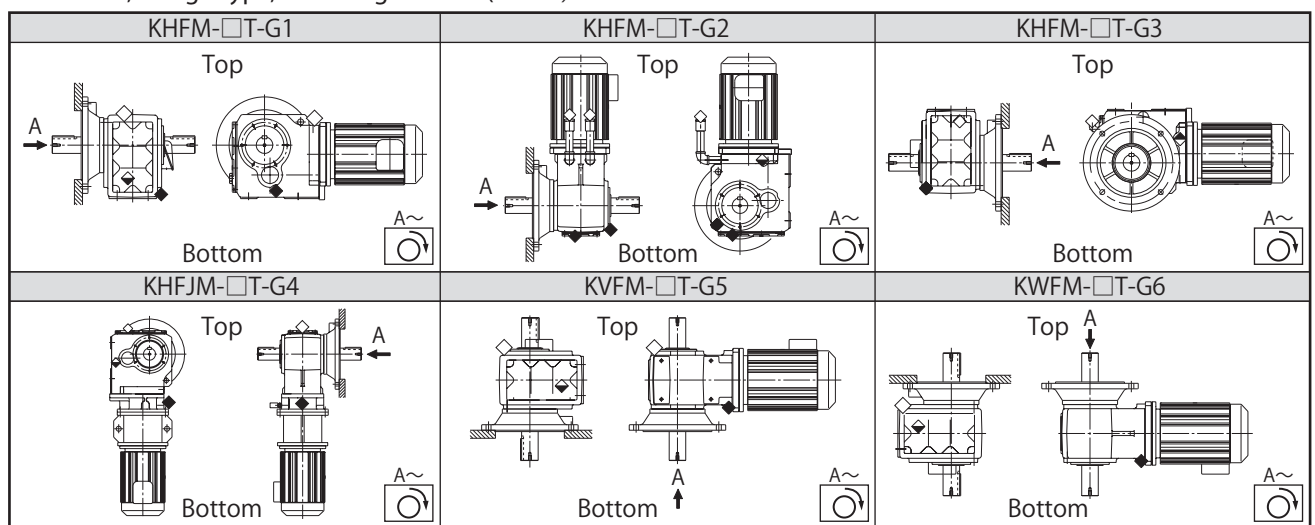
◇ Oil filling port ◆ Oil level ◆ Oil drain port

Solid Shaft, Flange Type, Shaft Alignment R (R Side)



◇ Oil filling port ◆ Oil level ◆ Oil drain port

Solid Shaft, Flange Type, Shaft Alignment T (R Side)

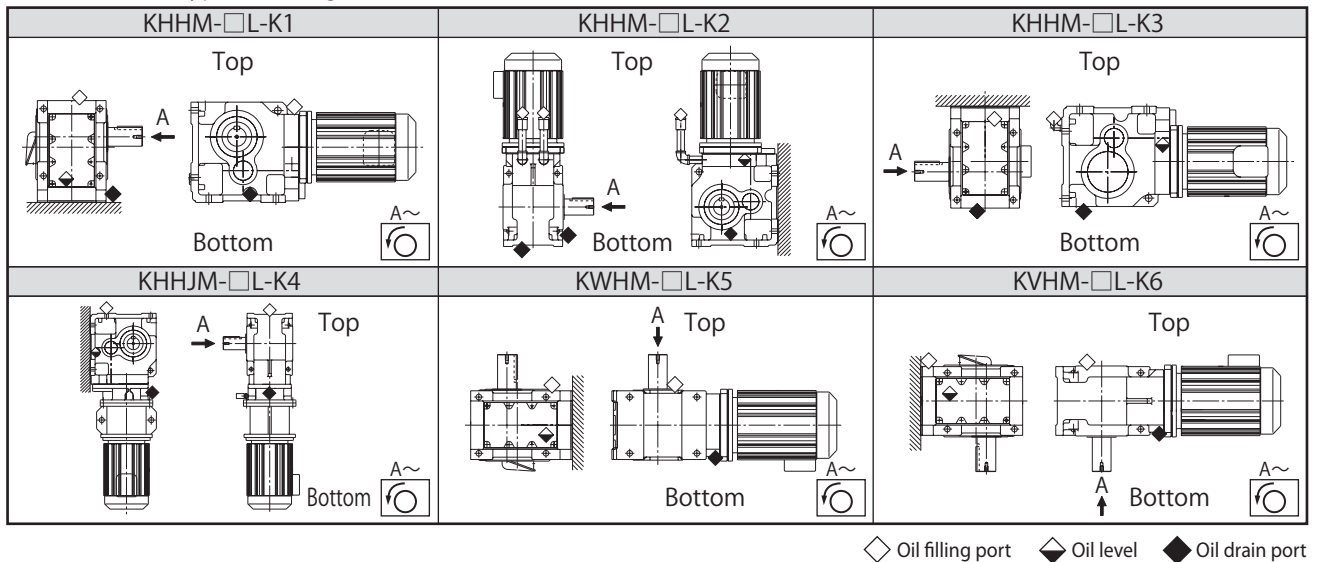


◇ Oil filling port ◆ Oil level ◆ Oil drain port

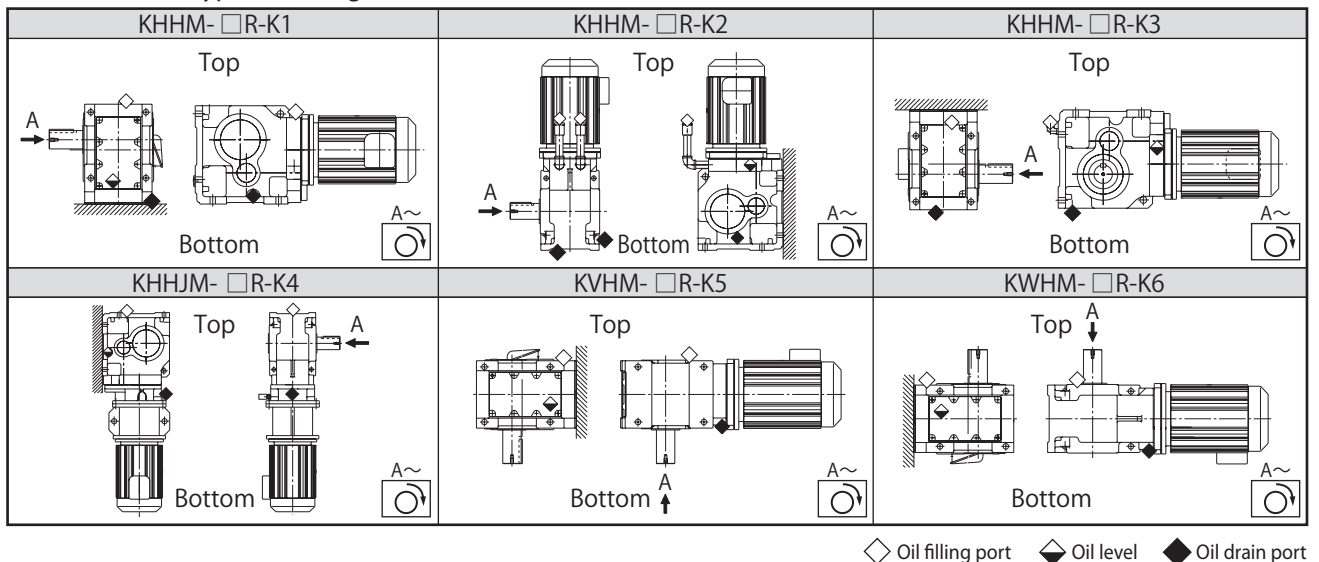
Figure 5-3 Confirming Rotation Direction and Location of Oil Filling/Drain Ports (Solid Shaft, Flange Type R Side)

5. Coupling with Other Machines Common

Solid Shaft, Foot Type, Shaft Alignment L



Solid Shaft, Foot Type, Shaft Alignment R



Solid Shaft, Foot Type, Shaft Alignment T

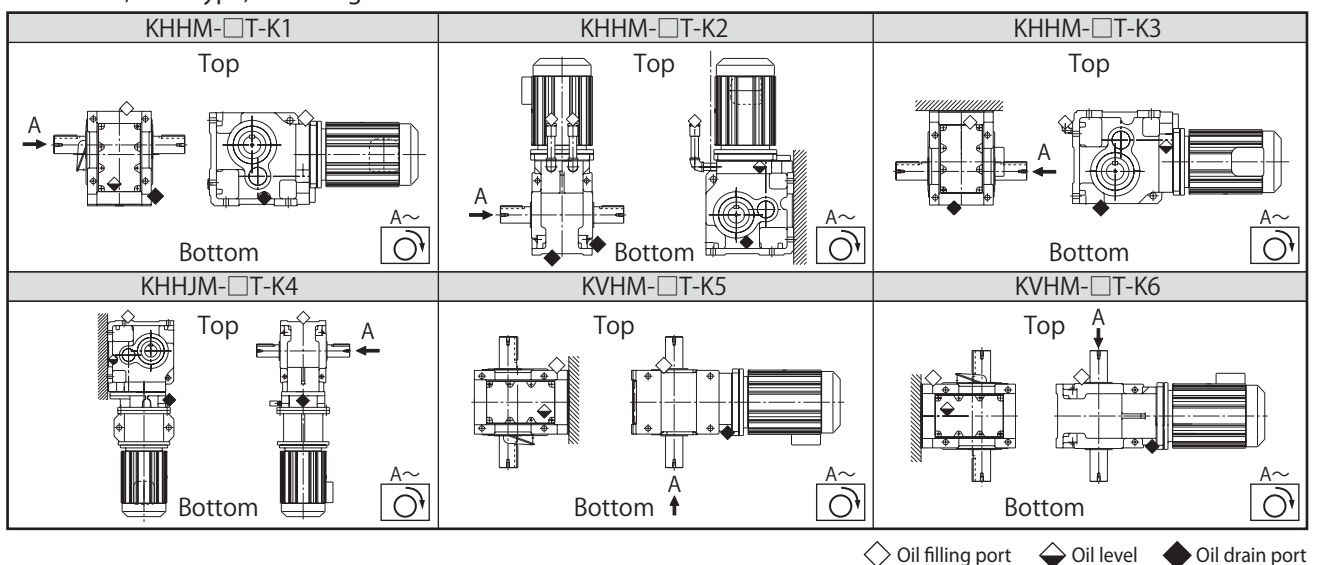


Figure 5-4 Confirming Rotation Direction and Location of Oil Filling/Drain Ports (Solid Shaft, Foot Type)

Solid Shaft, Foot Type (Floor Installed), Shaft Alignment L, R, T

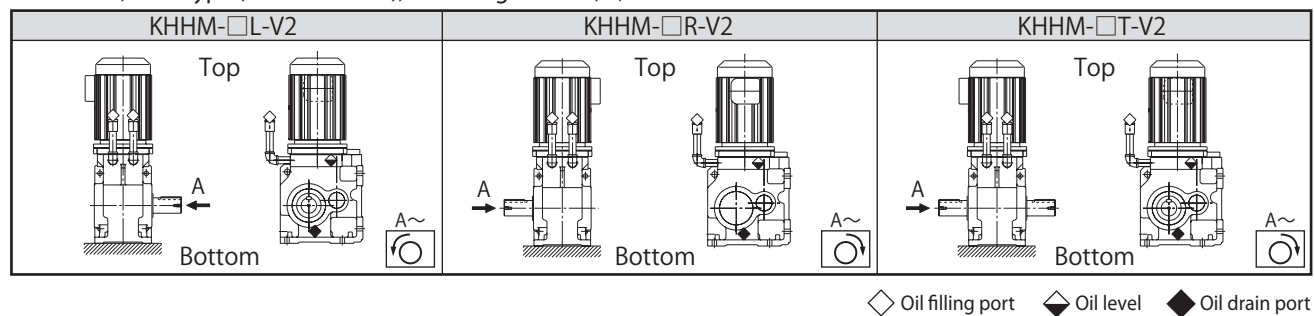


Figure 5-5 Confirming Rotation Direction and Location of Oil Filling/Drain Ports (Solid Shaft, Foot Type, Floor Installed)

5-2 Mounting Connector

- When mounting connector, do not give an impact or excessive axial load to the shaft. Otherwise, the bearing may be damaged or collar may come off.
- shrinkage-fit is recommended.

(1) When Using a Coupling

The alignment accuracy (A, B, X) in figure 5-6 should be no greater than that shown in Table 5-1.

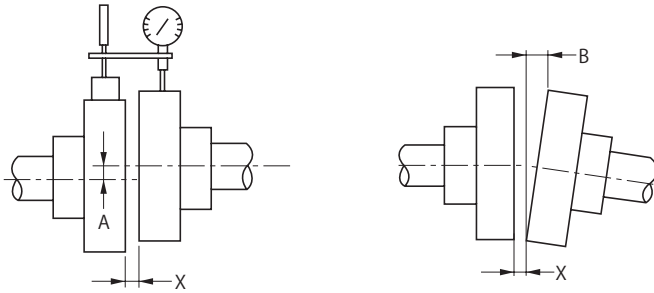


Figure 5-6

Table 5-1 Centering Accuracy of Flexible Coupling

Allowable Tolerance A	0.1mm or manufacturer-specified value Manufacturer-specified value
Dimension B Tolerance	0.1mm or manufacturer-specified value Manufacturer-specified value
X	manufacturer-specified value

(2) When Using Chains, Sprockets, or Gears

- When using a chain, attach so that the chain tension angle is perpendicular to the shaft.
- Refer to the chain catalog or other reference for chain tension.
- Select a sprocket or gear pitch diameter that is at least three times the shaft diameter.
- The working load point of the sprocket or gear should go from the center of the shaft to this product. (See Figure 5-7)

(3) When Using a V Belt

- Over-tightening the V belt will damage the shaft and bearing. Refer to the V belt catalog or other reference for V belt tension.
- The parallelism, eccentricity β of the two pulleys should be within $20'$. (See Figure 5-8)
- When using multiple V belts, use a matched set having the same length.

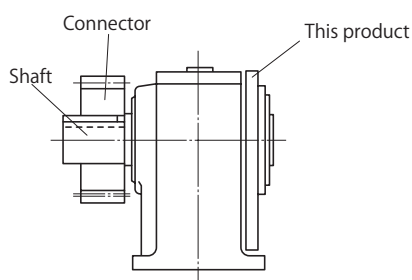


Figure 5-7

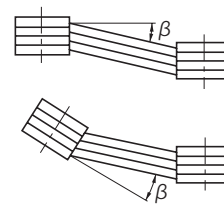


Figure 5-8

5-3 Hollow Shaft, Torque Arm/Flange Mounted

(1) Driven Shaft Length

When mounting the driven shaft onto the hollow shaft, make sure that the insertion length is at or above the "recommended driven shaft length."

Refer to the catalog or consult us for more details.

(2) Mounting on the Driven Shaft

- [1] Apply the molybdenum disulfide grease to the surface of the driven shaft and the hollow shaft bore and insert the product into the driven shaft.
- [2] If the fit is tight, lightly hit the end face of the hollow shaft with a wooden hammer to insert the shaft. When doing so, never hit the case or the oil seal directly. If the fit is particularly tight, use a jig such as the one shown in Figure 5-9 for a smoother insertion.

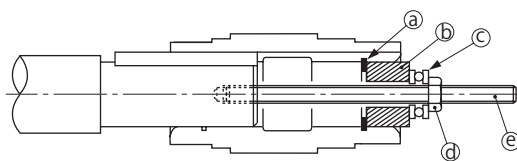


Figure 5-9 Mounting Jig

The hollow shaft is created with a JIS H8 tolerance. The following tolerances are recommended for driven shafts.

- If an impact does not occur when a uniform load is applied: JIS h6 or js6
- If an impact is expected or the overhung load is significant: JIS js6 or k6
- Size of retaining ring (snap ring): JI B 2804 C-ring

(3) Mounting on the Driven Shaft

If you use torque arm for retaining, be sure to fix the product onto the driven shaft.

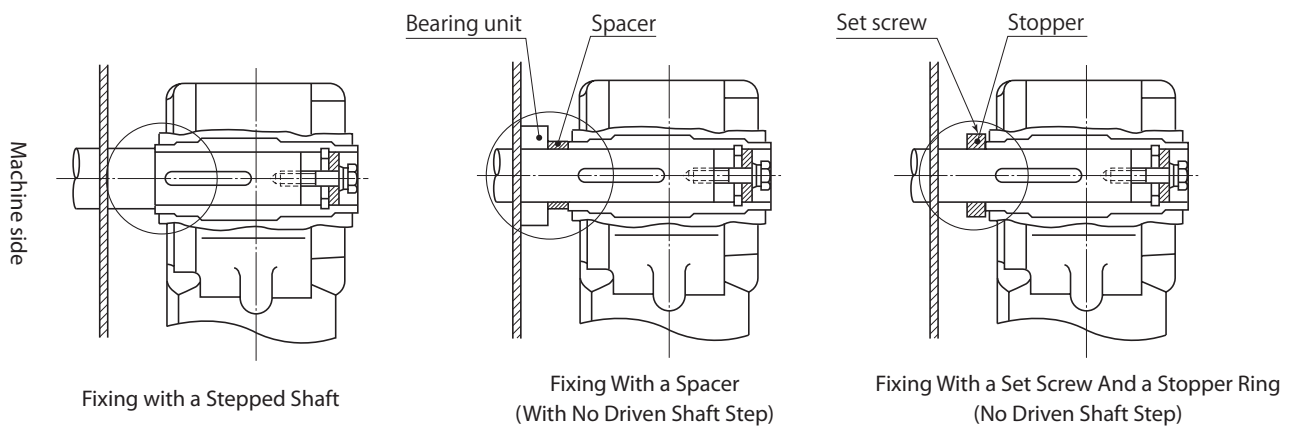


Figure 5-10 Method of Fixing So That the Product Does Not Move to the Machine Side

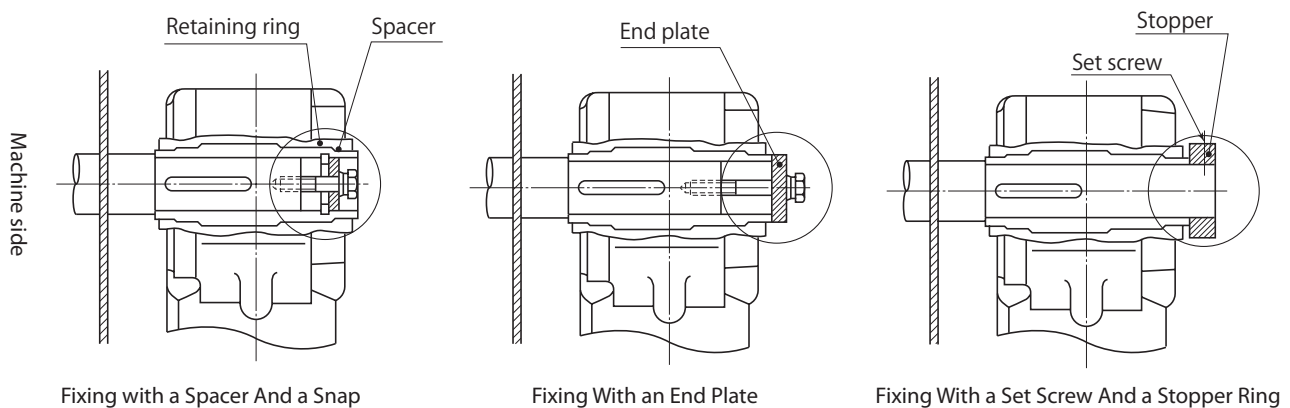


Figure 5-11 Method of Fixing So That the Product Does Not Move in the Opposite Direction of the Machine

- Notes: 1. Jigs and parts for installation or fixing are to be prepared by the customer.
2. Refer to the catalog for recommended sizes.

(4) Mounting Torque Arm (Option)

- (1) Mount the torque arm on the driven shaft machine side of the case.
- (2) Ensure there is some degree of freedom for the torque arm retainer (Figure 5-13, 5-14) so that no excessive force is applied between the product and the driven shaft. (The retainer is to be prepared by the customer.)
- (3) Never fix the torque arm using a retainer bolt.
- (4) If frequent starting and stopping are expected, or for repetitious plugging operations, attach a disk spring (see Fig. 5-12) between the torque arm and the mounting bolt (or spacer) as a buffer material to lessen the impact.
- (5) Use bolts that have a strength class of at least 10.9 (JIS B 1051).
- (6) When installing the torque arm, be sure to lock the bolt.
(Use spring washers, U nuts, or apply locking adhesive.)

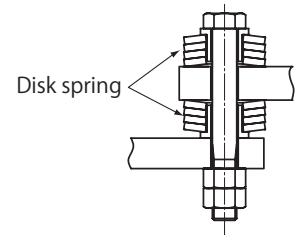


Figure 5-12 Disk Spring

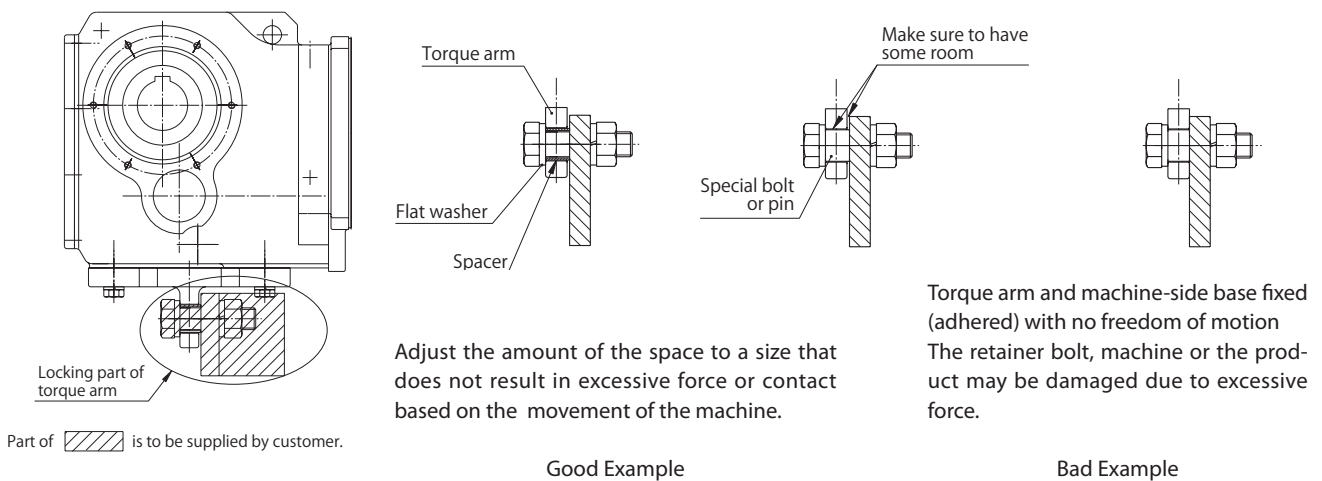


Figure 5-13 Retainer Mounting Examples (Attachment Type Torque Arm)

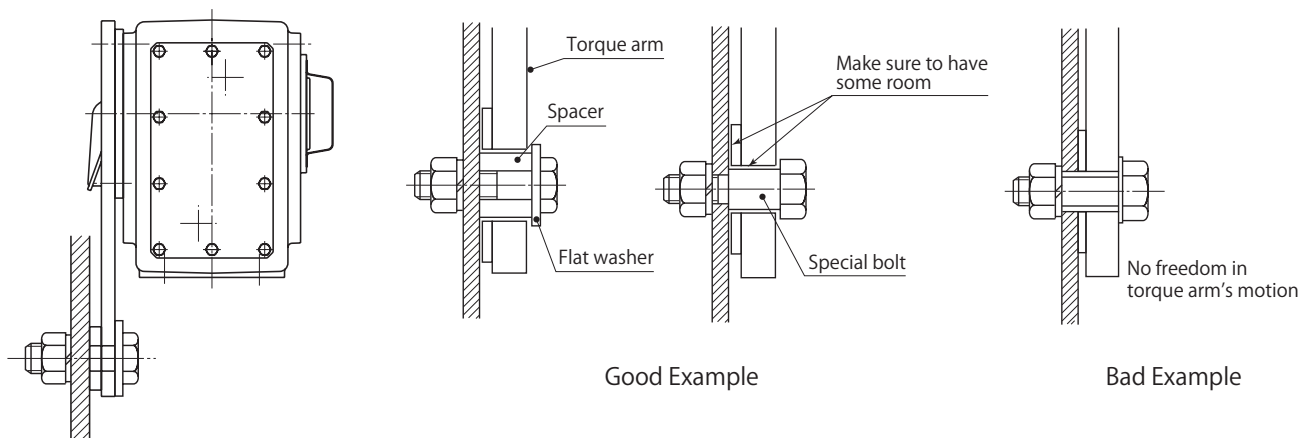


Figure 5-14 Retainer Mounting Examples (Plate Type Torque Arm)

(5) Flange Mounted Option

- [1] Mount the product on the driven shaft machine.
- [2] Assemble the driven shaft on the hollow shaft.
- [3] Assemble the bearing unit onto the driven shaft, and upon confirming that there is no shaft looseness, fix the bearing unit.

Note: Exercise caution to prevent the case from getting twisted relative to the driven shaft and the hollow shaft, which may result in excessive force. Otherwise, the product and shaft bearing unit may be subjected to an unreasonable force, resulting in a damage of internal parts.

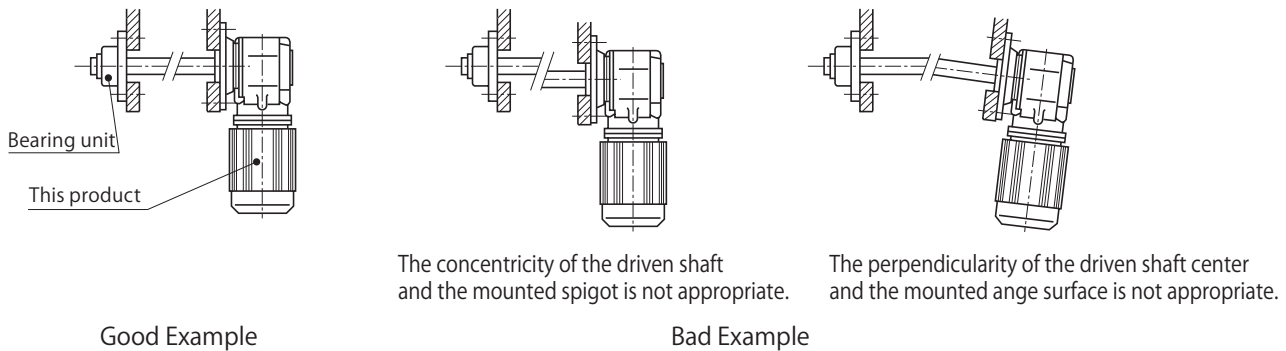


Figure 5-15 Flange Mounted Example

(6) Removing from the Driven Shaft

Be careful not to allow excessive force to apply between the case and the hollow shaft. Use a jig such as the one shown in Figure 5-16 to remove it more smoothly.

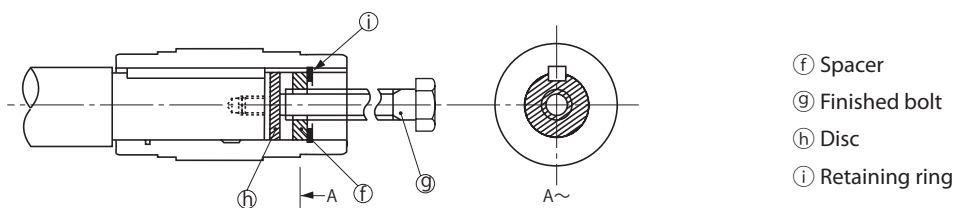


Figure 5-16 Removal of Jig

- Notes: 1. The removal jig and parts are to be prepared by the customer.
 2. Refer to the catalog for recommended sizes.

5-4 Hollow Shaft, Shrink Disc Mounted

(1) Mounting Shrink Disc (Option)

A shrink disc is installed on the product before shipment, with its face for clamping bolt coated with grease. Therefore you can install as-is.

- (1) If an object is lodged between both plates while the equipment is being transported, you can dislodge it by slackening all of the bolts.
- (2) When you wish to remove a shrink disc that you had used previously, and then reuse it, 1) disassemble and wash it, 2) coat the sliding cone, fastener bolts, and the face touching the bolt head with molybdenum disulfide grease.
- (3) Completely degrease the boss holes and also the shafts touching them.
- (4) Slide the shrink disc over the hollow shaft. Do not tighten the fastener bolts until the driven shaft enters the hollow shaft.
- (5) Slide the driven shaft or this product, and insert the driven shaft into the hollow shaft.
- (6) When tightening the bolts, take care to ensure that the faces of both plates are parallel to each other. In this case, it is recommended that you use a spanner with a short handle.
- (7) Check that the shrink disc has been set correctly, and then tightening the fastener bolts with spanner of proper length.
While maintaining both plates uniformly in sequence, tighten the fastener bolts in the clockwise direction (not in diagonally opposite pairs.) In this case, it is recommended that you tighten each bolt 30° in one turn.
- (8) After the shrink disc has been tightened, be sure to use a torque wrench to obtain the tightening torque indicated in Table 5-2.
- (9) Finally, check if both plates are parallel to each other.

Table 5-2 Fastener Bolts

Strength Class (JIS B 1051)	10.9	
Size	M8	M10
Tightening Torque (N·m)	29.4	57.8

Note: Do not operate the gearmotor or speed reducer until the shrink disc has been installed by following the above procedure. The contacting parts of the hollow shaft and the driven shaft are not lubricated, so if you rotate the motor when it has been installed using an incorrect method, the shaft is liable to become damaged or scuffed.

(2) Removing Shrink Disc

- (1) Remove the shrink disc in the reverse sequence to the mounting procedure.
- (2) To prevent both plates from tilting on the sliding cone, slacken the bolts in sequence a little at a time.
- (3) If both plates are not parallel to each other, do not attempt to remove the bolts. Both plates are likely to suddenly fly off the sliding cone. For this reason, gently slacken all of the bolts, then insert a wedge between the two plates so that they are parallel.

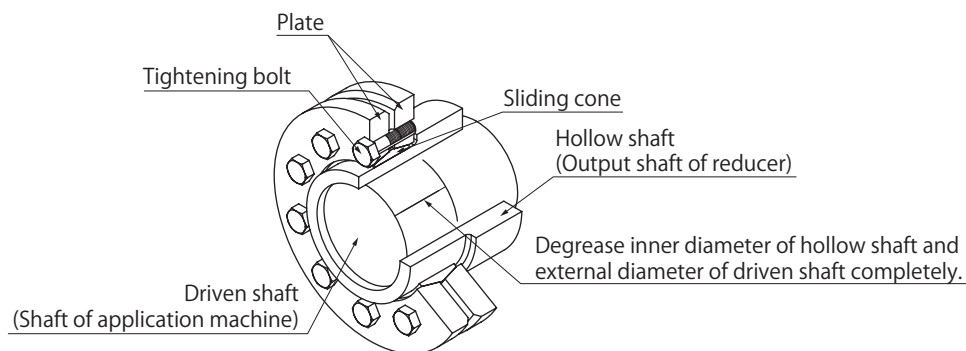


Figure 5-17 Shrink Disc Structure

When using other manufacturer's motor (another manufacturer's motor could conceivably be used depending upon the specifications of the motor), refer to the instruction manual for the motor concerned.

This manual shows wiring for motors with Japanese standard specifications. Please consult with us for motors with overseas specifications.

DANGER

- Do not handle the unit when cables are energized. Be sure to turn off the power when working on the unit; otherwise, electric shock may result.
- Connect a power cable to the unit according to the diagram shown inside the terminal box or in the maintenance manual; otherwise, electric shock or fire may result.
- Do not forcibly bend, pull, or clamp the power cable and lead wires; otherwise, electric shock or fire may result.
- Correctly ground the grounding bolt; otherwise, electric shock may result.
- In the case of explosion proof motor, draw lead wire with following the facility's regulations, electrical codes, and explosion proofing standard. otherwise, electric shock, injury, fire, or damage to the equipment may result.

CAUTION

- When wiring, follow the facility's regulations and electrical codes, in order to prevent burning, electric shock, injury, and fire.
- The motor is not equipped with a protection device. However, it is compulsory to install an overload protector according to facility electrical codes. It is recommended to install other protective devices (earth leakage breaker, etc.), in addition to an overload protector to prevent burning, electric shock, injury, and fire.
- Do not touch the terminals when measuring insulation resistance; otherwise, electric shock may result.
- When using a star-delta starter, select one with an electromagnetic switch on the primary side (3-contact point type); otherwise, fire may result.
- Voltage PWM inverters that use IGBT generate high-voltage surges at the motor terminals, which may degrade the insulation on the motor windings. Especially when using long 400V cable, a surge voltage over 1300V occurs. Therefore, in this case, install an LCR filter, AC reactor, etc. between the inverter and motor to inhibit the surge voltage.
- For motor with brake, do not energize the brake coil when the motor is stopped. Otherwise coil burnout fire may result. Also, mistaken wiring could damage the rectifier.
- When measuring the insulation resistance of explosion proof motor, confirm that there is no gas or explosive vapor in the vicinity, in order to prevent explosion or ignition.
- If ambient temperature exceeds 60°C, place the rectifier in a location where the temperature is 60°C or less. In this case, always protect the entire rectifier with a cover. However, standard ambient temperature conditions for units with and without brakes is -10 to +40°C. (Manufacturing with a special specification is required for operation in an environment where ambient temperature exceeds 40°C.)
- Long cables cause large voltage drops. Select cables with appropriate diameter so that the voltage drop will not be greater than 2%.
- After wiring outdoor types and explosion proof types, check that terminal box mounting bolts are not loose, and correctly attach the terminal box cover.

6-1 Removing and Attaching the Resin Terminal Box Cover

3-phase motor: 0.4 kW

(1) Removal

As shown in Figure 6-1, to remove the cover, grab the sides of the terminal box, and pull it toward you.

(2) Attachment

Push the terminal box cover from above the terminal box case until it snaps shut.

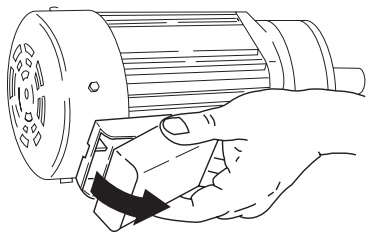


Figure 6-1

6-2 Measuring Insulation Resistance

When measuring insulation resistance, always disconnect the control panel and measure the motor alone.

Measure insulation resistance before wiring. Insulation resistance (R) is changed by a number of factors, including motor output, voltage, type of insulation, winding temperature, moisture, degree of fouling, time used, and amount of applied voltage for test. However, normally, it must be above the values in Table 6-1.

Table 6-1 Values for Insulation Resistance

Motor Voltage	Megohmmeter Voltage	Insulation Resistance (R)
Low-voltage electric motors of no more than 600V	500V	1 MΩ or more

Reference: JEC-2100 contains the following equation.

$$R \geq \frac{\text{Rated Voltage (V)}}{\text{Rated output power (kW)} + 1,000} \quad (\text{M}\Omega)$$

$$R \geq \frac{\text{Rated Voltage (V)} + (\text{RPM}/3)}{\text{Rated output power (kW)} + 2,000} + 0.5 \quad (\text{M}\Omega)$$

Low insulation resistance is a sign that there is an insulation failure. Do not apply power. Consult an accredited maintenance shop.

6-3 Coordination of System Protection

- use a wiring breaker for short circuit protection.
- use an overload protection device designed to handle currents that exceed the rated current on the nameplate.
- For increased safety motors, use an overload protection device designed to handle currents that exceed the rated current on the nameplate.

6-4 Connecting the Power Cable

Connect the power cable and motor lead wire by clasping in a pressure connection terminal as shown in Figure 6-2.

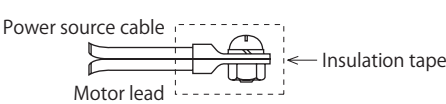


Figure 6-2

6-5 Motor Wiring

Showing page number having motor wiring diagrams.

Table 6-2 Without Brake

Motor Type		Capacity (kW)	Number of Lead Wires	Page	
				Direct Input from Commercial Power Source	Inverter Drive
3-Phase Motor	Standard	0.4 - 0.55	3	P23	P24
	Increased safety	0.4 - 7.5 11 - 45	3 6	P23	-
Premium-Efficiency, 3-Phase Motor	Standard	0.75 - 3.7 5.5 - 45	3 6	P23	P24
	Increased safety	0.75 - 3.7 5.5 - 22	3 6	P23	-
AF Motor for Inverter		0.4 30 - 37	3 11	-	P24
Normal Braking Circuit for Inverter Circuit Premium-Efficiency, 3-Phase Motor		0.75 - 3.7 5.5 - 45	3 6	-	P24

Table 6-3 With Brake

Motor Type	Capacity (kW)	Brake Type	Number of Lead Wires	Page		
				One-Direction Rotation	Plugging Rotation	Inverter Drive
3-Phase Motor	0.4	FB-05A1	5	P25	P29	P33
	0.55	FB-1D				
Premium-Efficiency, 3-Phase Motor	0.75	FB-1E	5	P25	P29	P33
	1.1	FB-1HE				
	1.5	FB-2E				
	2.2	FB-3E				
	3.0	FB-4E				
	3.7	FB-5E				
	5.5	FB-8E	8	P26	P30	P34
	7.5	FB-10E				
	11	FB-15E				
	15	FB-20		P27	P31	
	18.5 22 30	FB-30				
	37 45	ESB-250 ESB-250-2		P28	P32	P35
AF Motor for Inverter	0.4	FB-1D	5	-	-	P33
	30 37	ESB-250 ESB-250-2	13			P36
Normal Braking Circuit for Inverter Circuit Premium-Efficiency, 3-Phase Motor	0.75	FB-1E	5	-	-	P33
	1.5	FB-2E				
	2.2	FB-3E				
	3.7	FB-5E				
	5.5	FB-8E	8			P34
	7.5	FB-10E				
	11	FB-15E				
	15	FB-20				
	18.5 22 30	FB-30				
37 45	ESB-250 ESB-250-2	P35				

Note 1. Brake type may differ depending on specification. Check the nameplate.

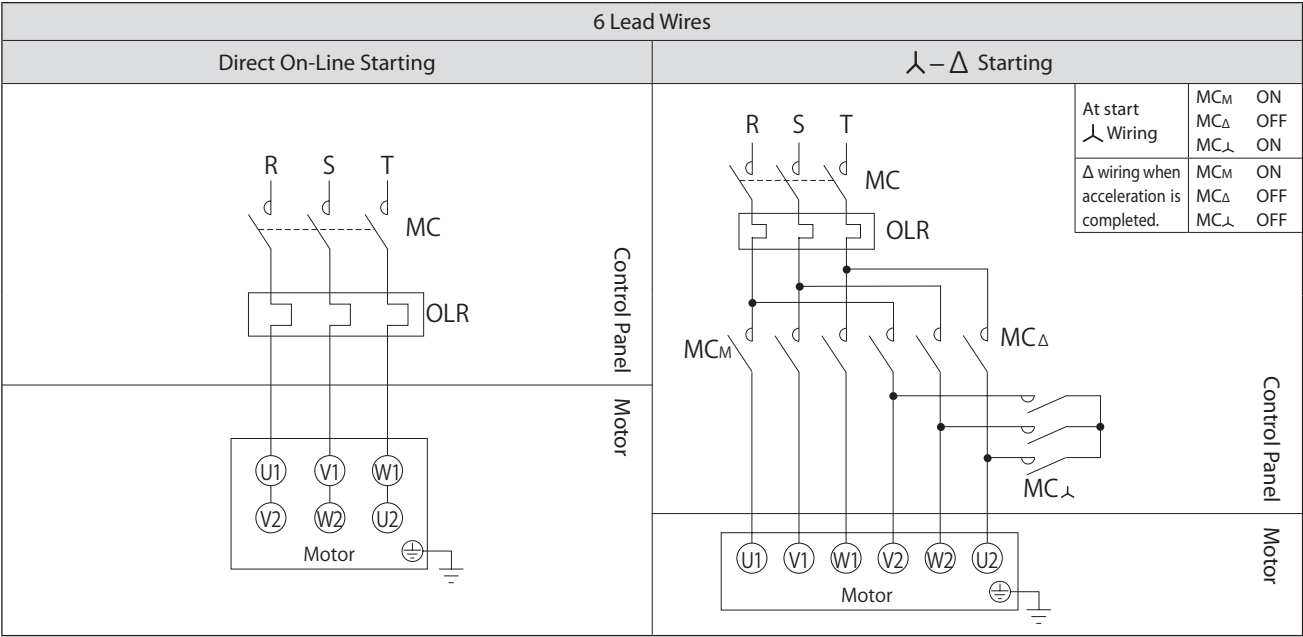
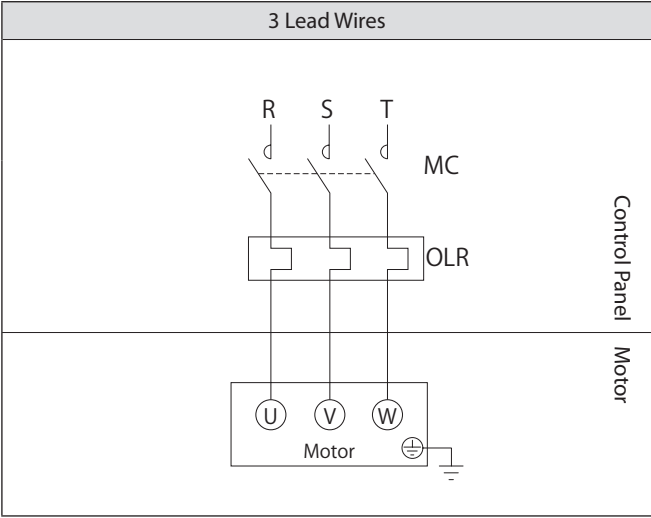
2. These diagrams above are for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.

These diagrams indicate the standard specifications of the motor wiring and also the symbols for the terminals and lead wires.

■ Without Brake. 3-Phase Power Source

3-Phase Motor

Premium-Efficiency, 3-Phase Motor



MC : Electromagnetic contactor
OLR : Overload protection device or electronic thermal relay

Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.



6. Wiring

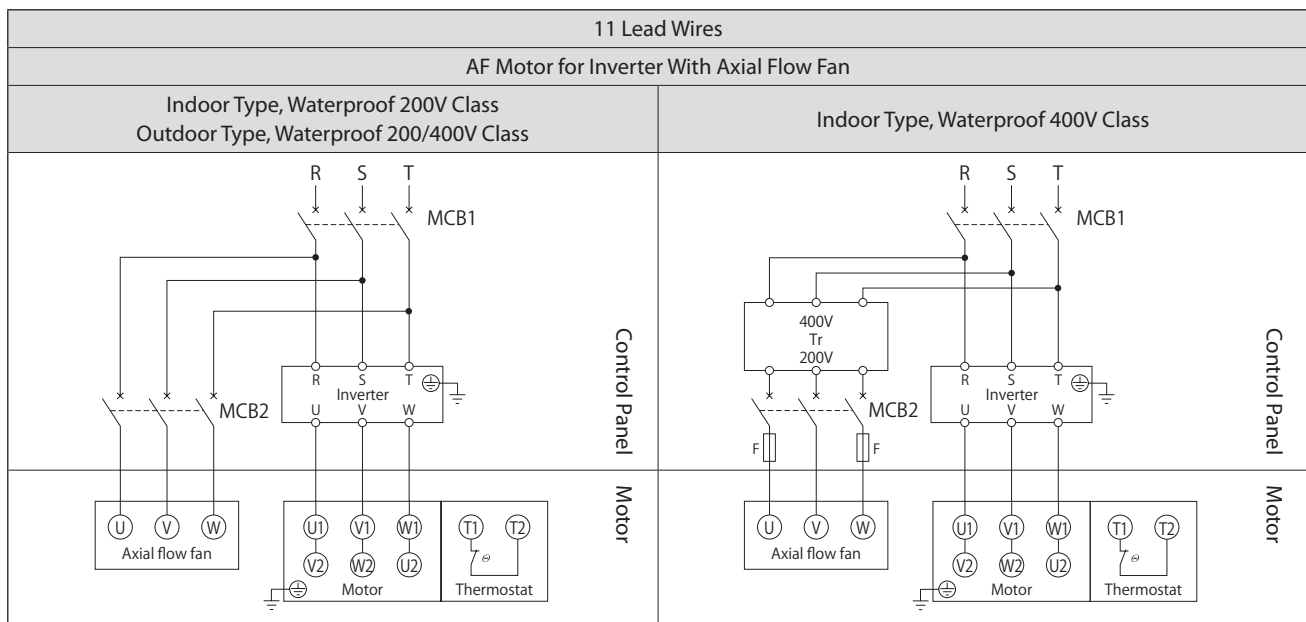
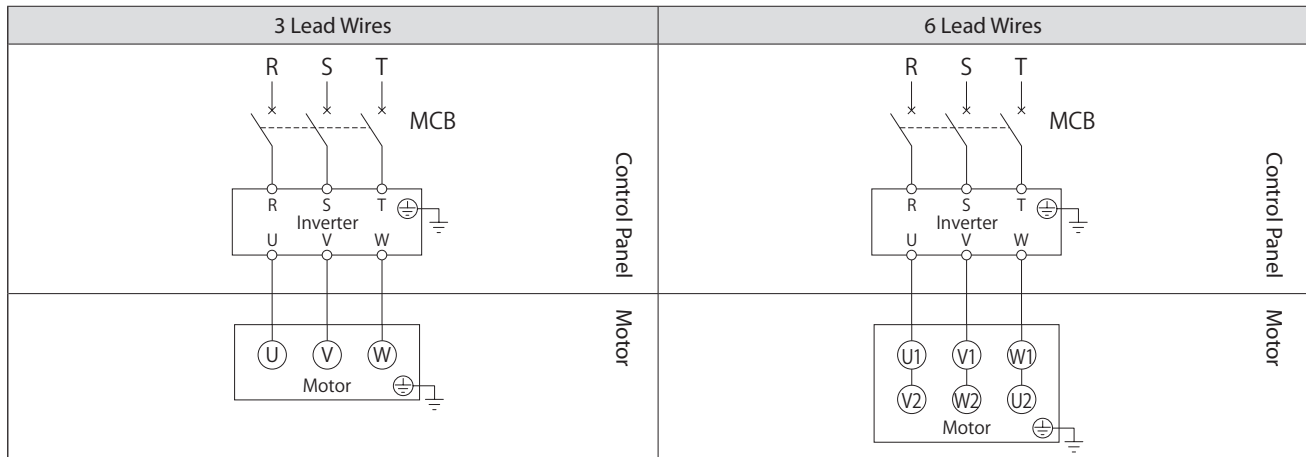
■ Without Brake, Inverter Drive

3-phase motor

Premium-efficiency, 3-phase motor

AF motor for inverter

Premium-efficiency, 3-phase motor for inverter



MCB : Breaker for wiring

Tr : Transformer capacity 250 – 600VA, secondary voltage 200 – 220V

F : Fuse 3 – 5A

customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- When using inverter for 400v class 3-phase motor / high-efficiency 3-phase motor, the motor must be insulated.

For AF motor for inverter with axial flow fan (fully enclosed ventilation type) , note the following points.

- Connect electric power to an axial fan as well.
- In the case of 400 V class indoor equipment, the power source voltage for the axial fan is 200 V. In the case of special specifications, the actual product may sometimes differ from the above drawing, so check the manufacturing specifications.
- Connect the fan so that it rotates in the direction indicated on the nameplate.
(When the fan is operating normally, it should blow cooling air from the non-load side to the load side.)
- When leaving the motor stopped for a long period, leave the axial fan motor stopped as well.
- As thermostat is installed to the motor, wiring to it.
- Specifications of the thermostat

Terminal codes: T1, T2 or P1, P2

Working temperature: 135°C (For heat resistance class 155 (F))

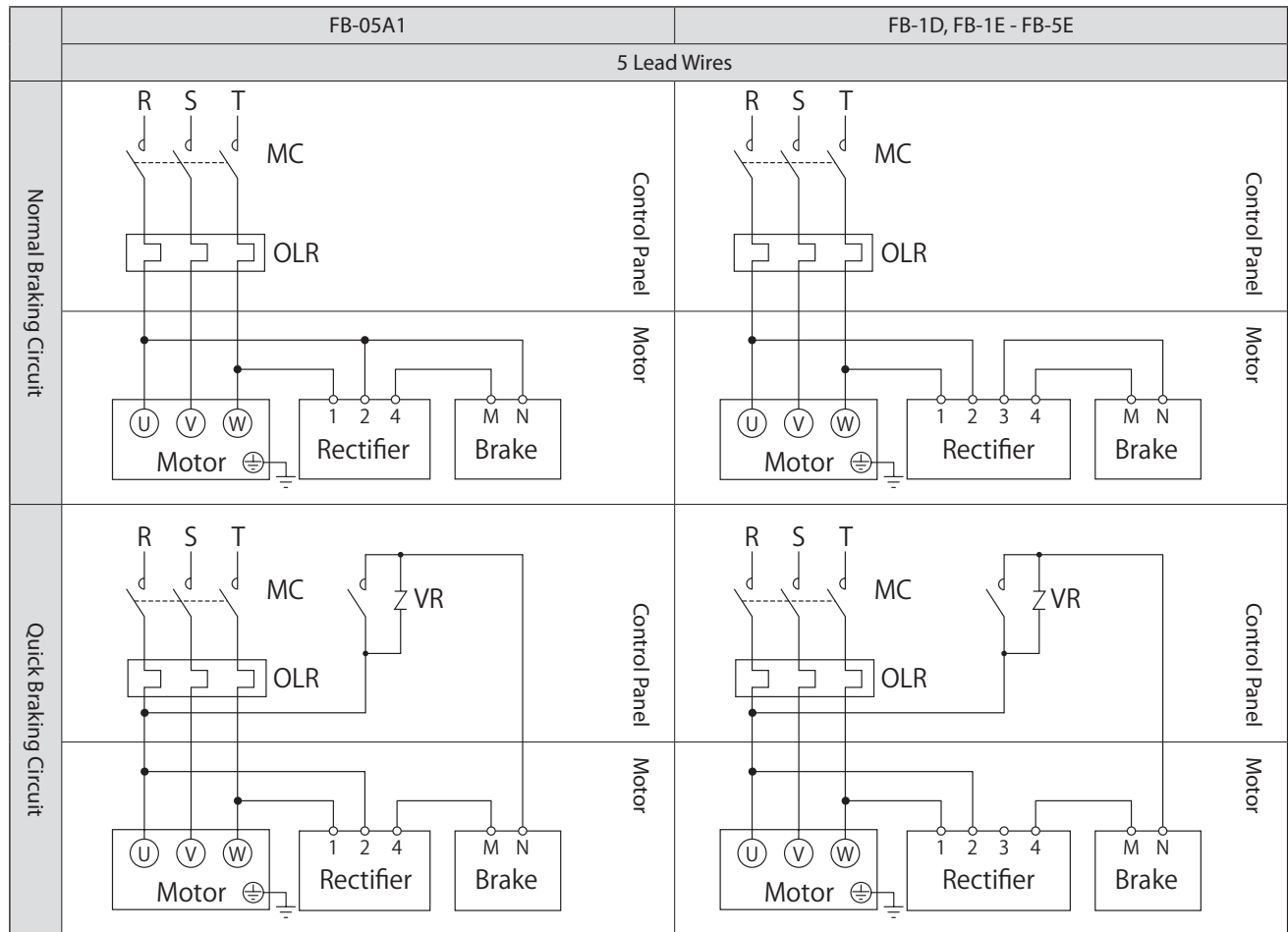
Operation function: Normally closed (b contact)

Max current: 24 VDC 18 A, 230 VAC 13 A

■ With Brake, 3-Phase Power Source, Operates Rotating in One Direction

3-phase motor

Premium-efficiency, 3-phase motor



MC : Electromagnetic contactor

OLR : Overload protection device or electronic thermal relay

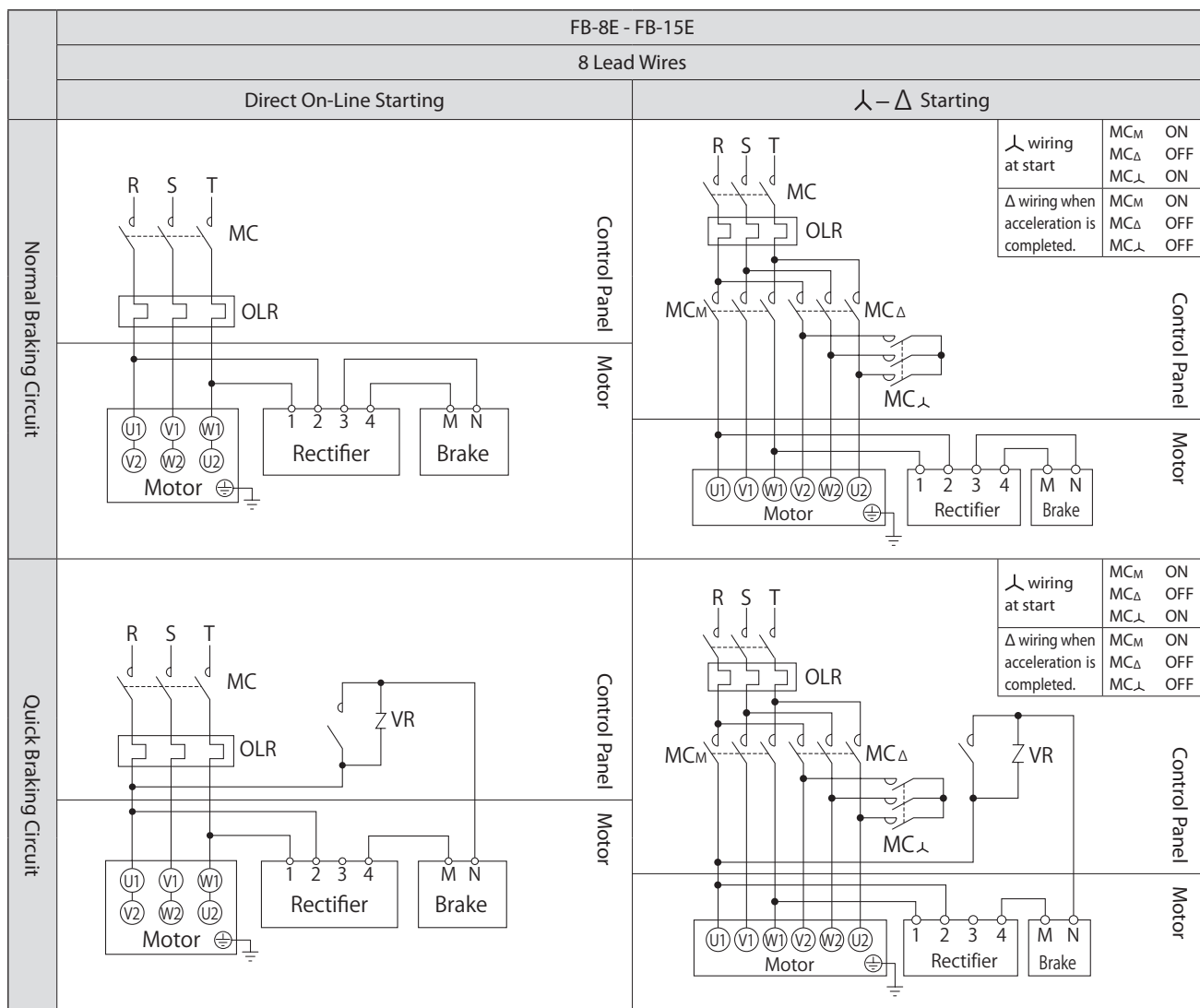
VR : Varistor (for protecting contact points, rectifier, etc.)

Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P39 shows action delay time. Choose the circuit that matches work requirements.
- Use a quick braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit When a phase-advancing capacitor is mounted.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table 6-4 on P37.
- In the case of quick braking circuits, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.

■ With Brake, 3-Phase Power Source, Operates Rotating in One Direction

Premium-efficiency, 3-phase motor



MC : Electromagnetic contactor

OLR : Overload protection device or electronic thermal relay

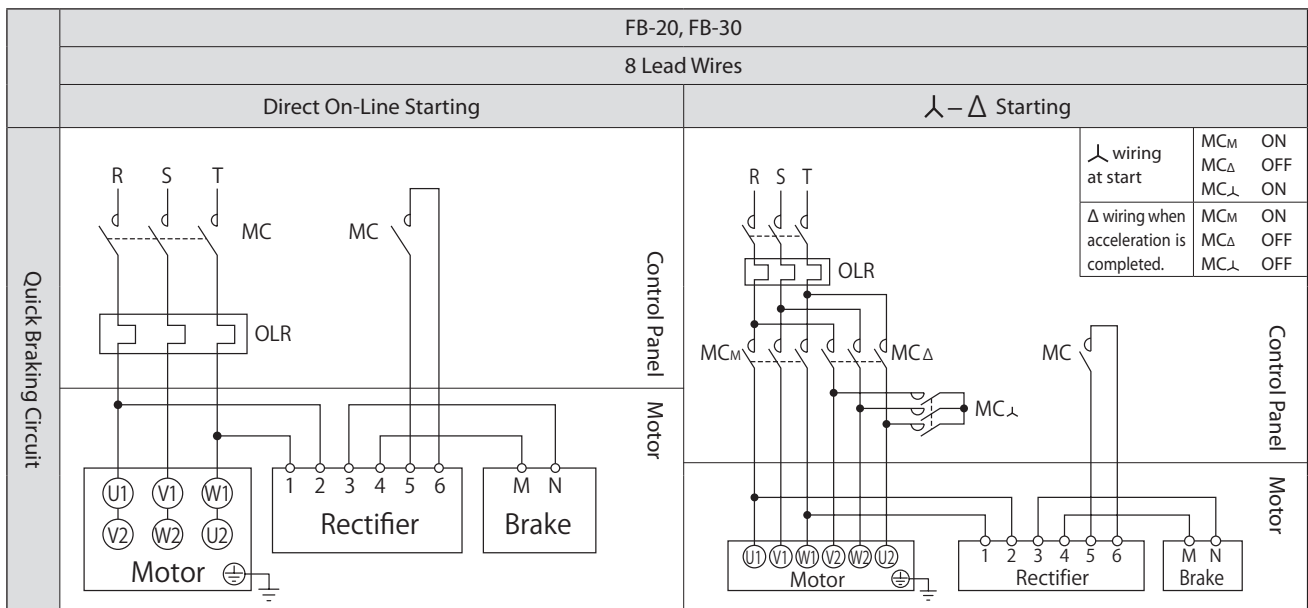
VR : Varistor (for protecting contact points, rectifier, etc.)

Customer needs to prepare.

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- Use a quick braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit When a phase-advancing capacitor is mounted.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table 6-4 on P37.
- In the case of quick braking circuits, interlock brake circuit's electromagnetic contactor with the motor's electromagnetic contactor.

■ With Brake, 3-Phase Power Source, Rotating in One Direction

Premium-efficiency, 3-phase motor



MC : Electromagnetic contactor

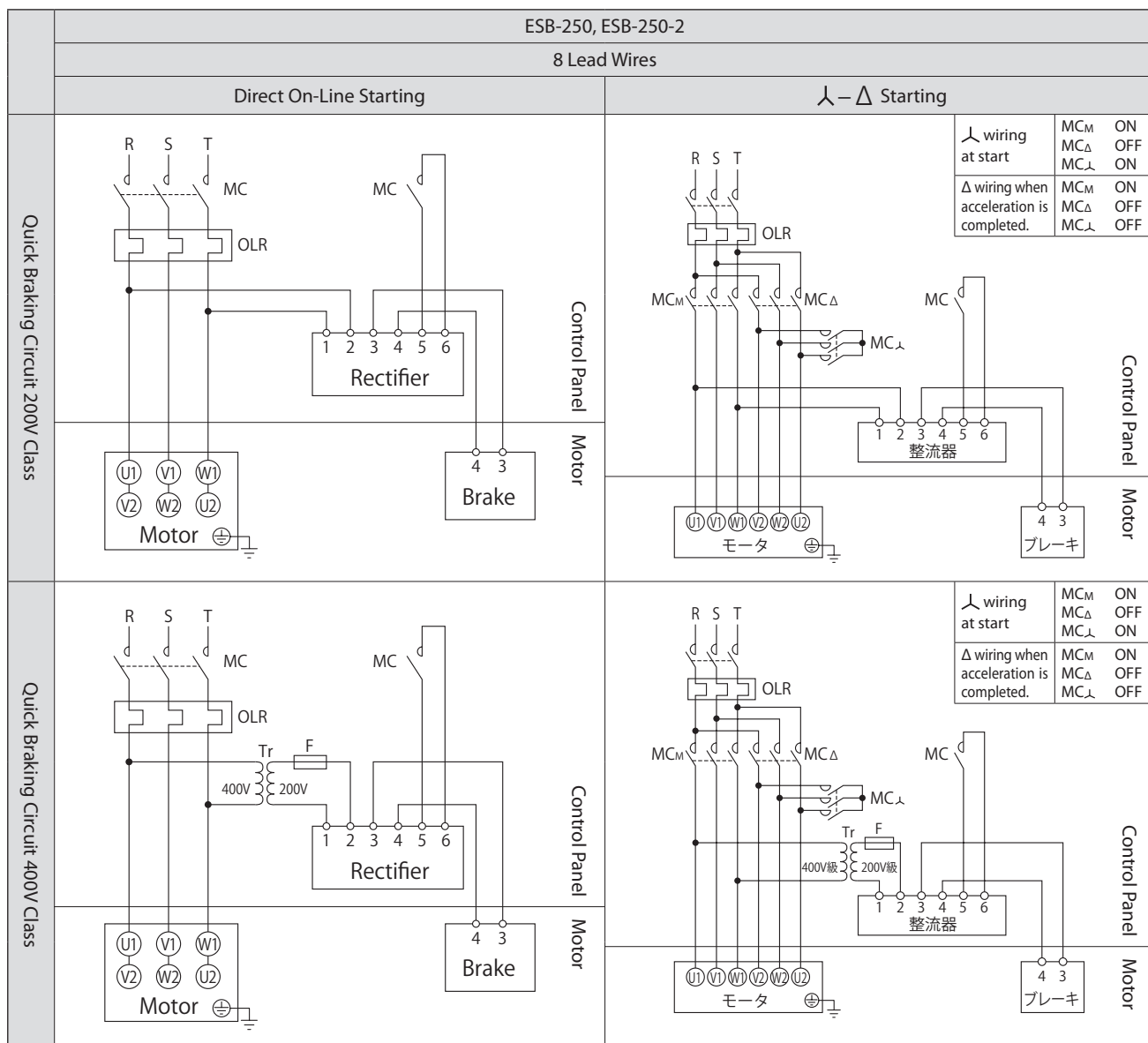
OLR : Overload protection device or electronic thermal relay

Customer to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P37.
- In the case of quick braking circuits, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.
- Shipped with a short circuit plate connecting rectifier terminals 5 and 6. Remove the short circuit plate when wiring.

■ With Brake, 3-Phase Power Source, Operates Rotating in One Direction

Premium-efficiency, 3-phase motor



MC : Electromagnetic contactor

OLR : Overload protection device or electronic thermal relay

Tr : Transformer capacity 250 – 600VA, secondary voltage 200 – 220V

F : Fuse 3 – 5A

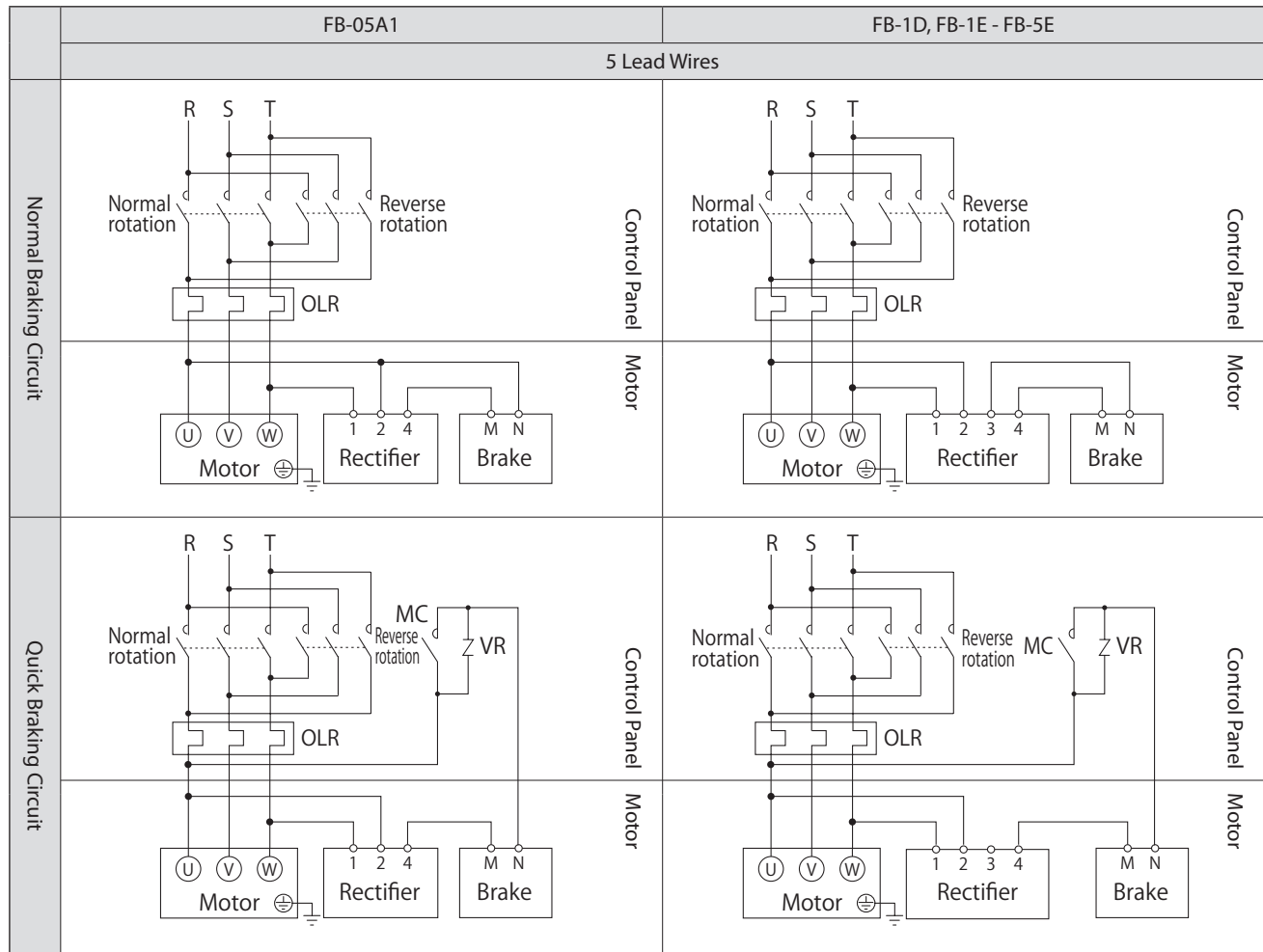
Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P37.
- In the case of quick braking circuits, interlock brake circuit's electromagnetic contactor with the motor's electromagnetic contactor. Rectifiers are external to the main unit. Rectifiers are made for indoor use. Install in an area where they will not come into contact with water, etc.
- Brake unit is for 200V class. For 400V class power sources, prepare a 400V/200V transformer.

■ With Brake, 3-Phase Power Source, Plugging Operation

3-phase motor

Premium-efficiency, 3-phase motor



Electromagnetic contactor for normal and reverse rotation

MC : Electromagnetic contactor

OLR : Overload protection device or electronic thermal relay

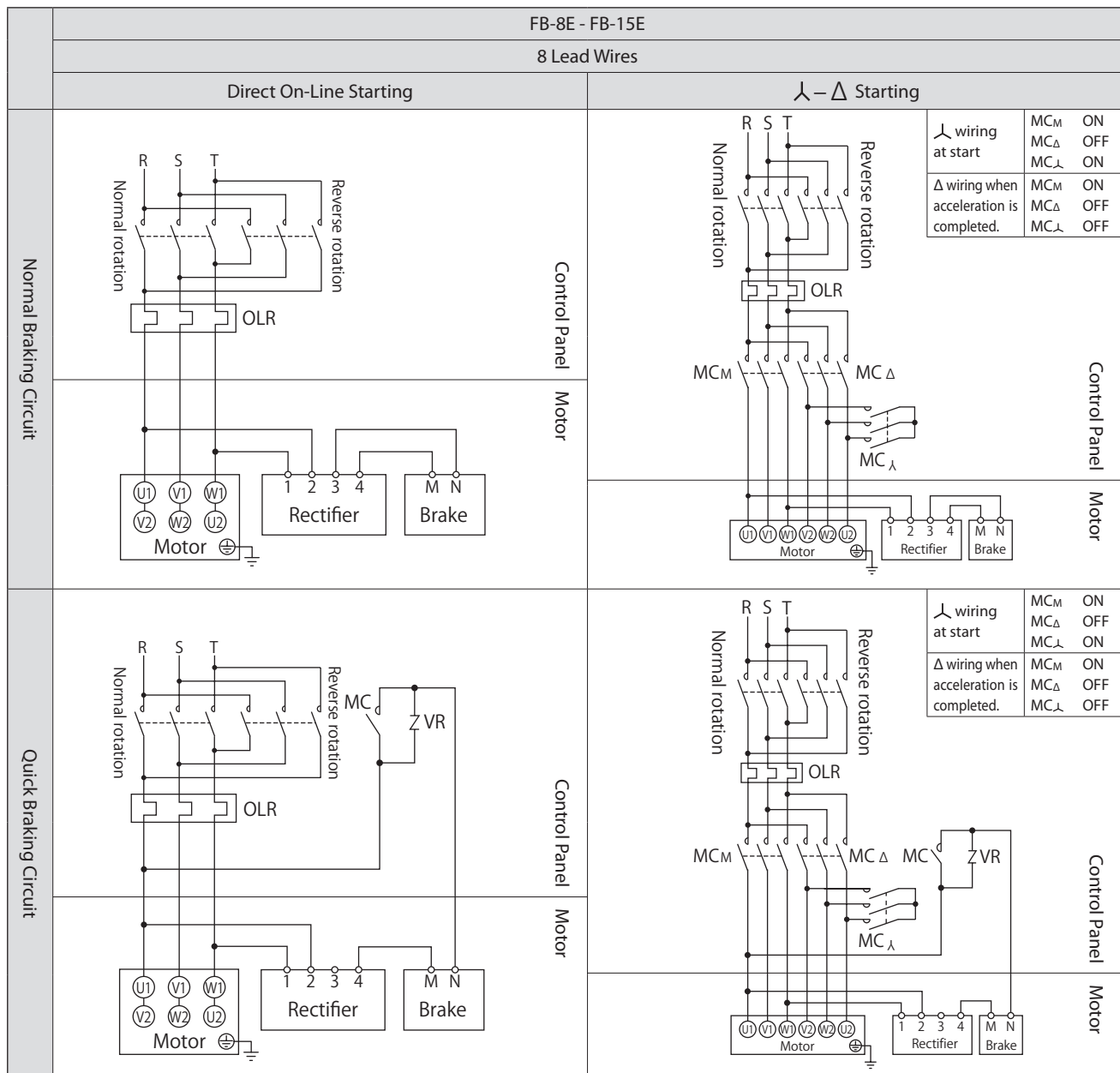
VR : Varistor (for protecting contact points, rectifier, etc.)

Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P39 shows action delay time. Choose the circuit that matches work requirements.
- Use a quick braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit When a phase-advancing capacitor is mounted.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table 6-4 on P37.
- For plugging operations using a quick braking circuit, interlock the brake circuit's electromagnetic contactors with the motor's normal and reverse rotation electromagnetic contactors.

■ With Brake, 3-Phase Power Source, Plugging Operation

Premium-efficiency, 3-phase motor



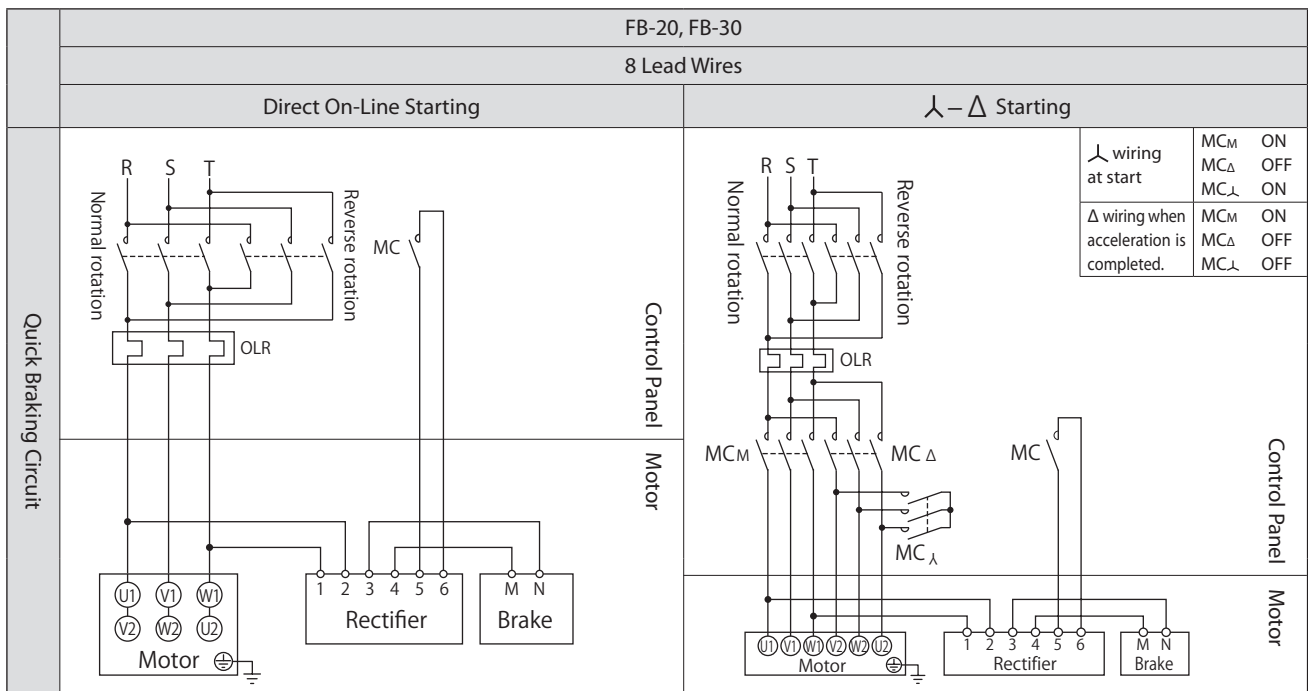
Electromagnetic contactor for normal and reverse rotation
 MC : Electromagnetic contactor
 OLR : Overload protection device or electronic thermal relay
 VR : Varistor (for protecting contact points, rectifier, etc.)

Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Brake action delay time is different between normal and quick braking circuits.
 Table 7-2 on P39 shows action delay time. Choose the circuit that matches work requirements.
- Use a quick braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit When a phase-advancing capacitor is mounted.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table 6-4 on P37.
- For plugging operations using a quick braking circuit, interlock the brake circuit's electromagnetic contactors with the motor's normal and reverse rotation electromagnetic contactors.

■ With Bbrake, 3-Phase Power Source, Plugging Operation

Premium-efficiency, 3-phase motor



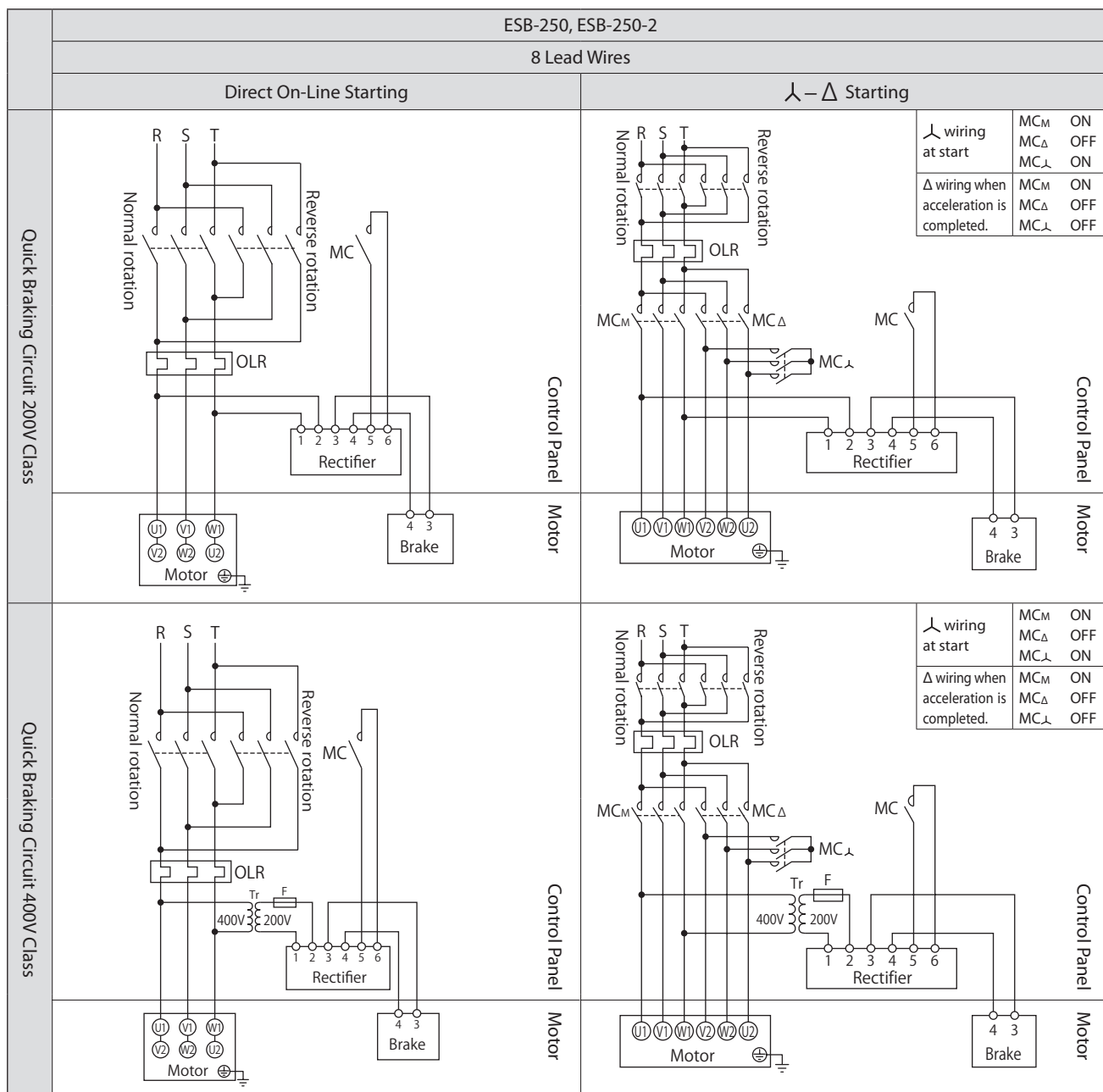
Electromagnetic contactor for normal and reverse rotation
 MC : Electromagnetic contactor
 OLR : Overload protection device or electronic thermal relay

— Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P37.
- Shipped with a short circuit plate connecting rectifier terminals 5 and 6. Remove the short circuit plate when wiring.
- Interlock the brake circuit's electromagnetic contactor with the motor's electromagnetic contactor.

■ With Brake, 3-Phase Power Source, Plugging Operation

Premium-efficiency, 3-phase motor



Electromagnetic contactor for normal and reverse rotation

MC : Electromagnetic contactor

OLR : Overload protection device or electronic thermal relay

Tr : Transformer capacity 250 – 600VA, secondary voltage 200 – 220V

F : Fuse 3 – 5A

Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.

- For brake types, see Table 1-1 on P5.

- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P37.

Rectifiers are external to the main unit. Rectifiers are made for indoor use. Install in an area where they will not come into contact with water, etc.

- Brake unit is for 200V class. For 400V class power sources, prepare a 400V/200V transformer.

- Interlock the brake circuit's electromagnetic contactor with the motor's electromagnetic contactor.

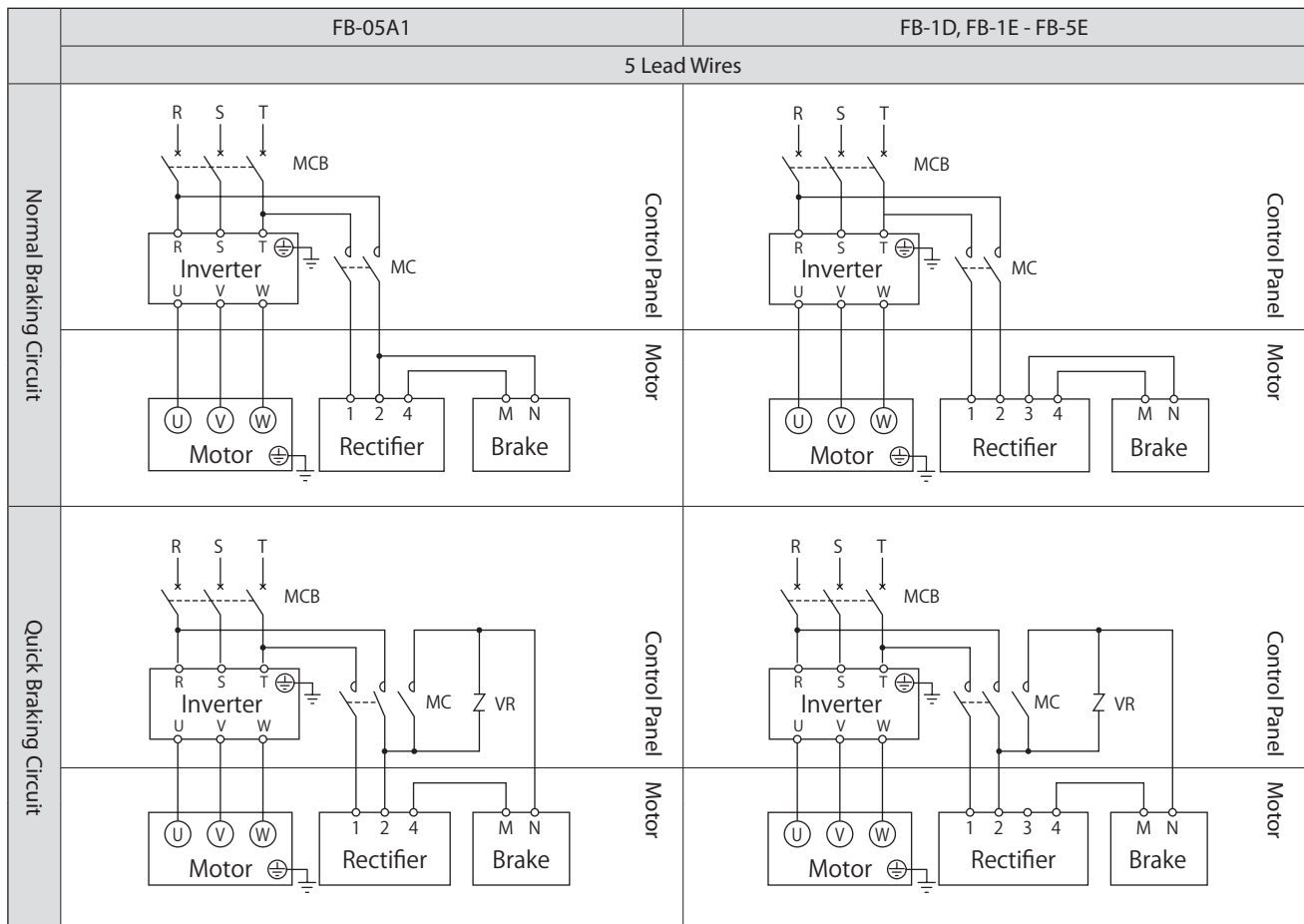
■ With Brake, Inverter Drive

3-phase motor

Premium-efficiency, 3-phase motor

AF motor for inverter

Premium-efficiency, 3-phase motor for inverter



MC : Electromagnetic contactor

MCB : Breaker for wiring

VR : Varistor (for protecting contact points, rectifier, etc.)

Customer needs to prepare.

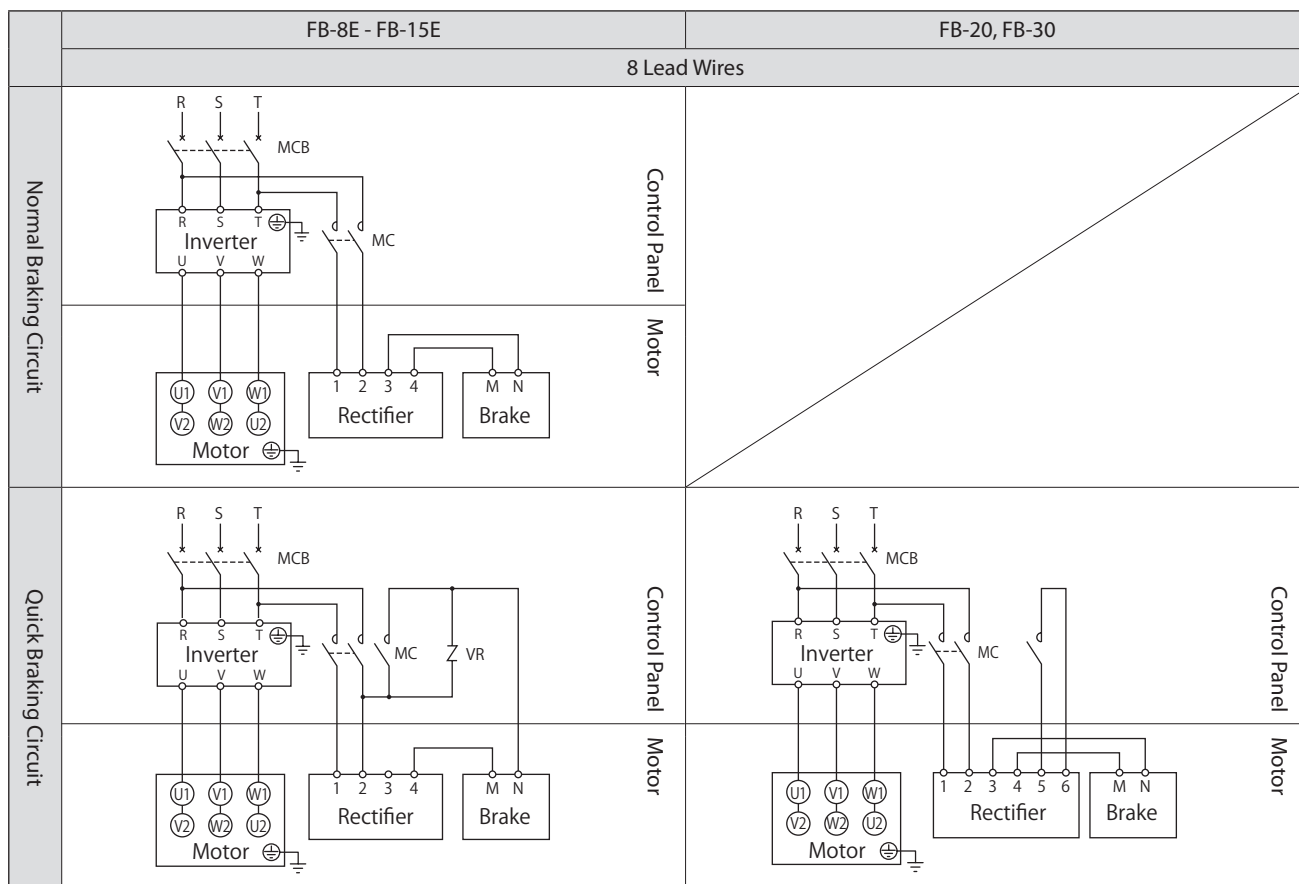
- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- When using inverter for 400v class 3-phase motor / high-efficiency 3-phase motor, the motor must be insulated.
- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P39 shows action delay time. Choose the circuit that matches work requirements.
- Use a quick braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit When a phase-advancing capacitor is mounted.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table 6-4 on P37.

- Always use the inverter's power source side for the brake power source.
- Match the opening and closing of the brake circuit's electromagnetic contactor to the timing of the inverter control.

■ With Brake, Inverter Drive

Premium-efficiency, 3-phase motor

Premium-efficiency, 3-phase motor for inverter



MC : Electromagnetic contactor

MCB : Breaker for wiring

VR : Varistor (for protecting contact points, rectifier, etc.)

Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P39 shows action delay time. Choose the circuit that matches work requirements.
- Use a quick braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit When a phase-advancing capacitor is mounted.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table 6-4 on P37.

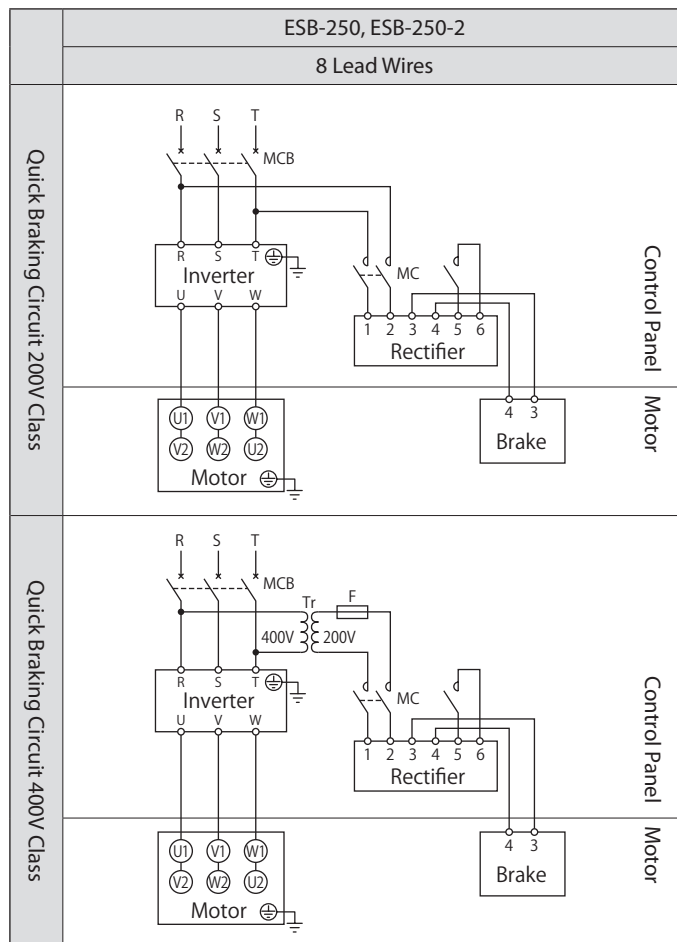
- Use with a quick braking circuit for FB-20 or FB-30.
- FB-20, 30 are shipped with a short circuit plate connecting terminals 5 and 6. Remove the short circuit plate when wiring.

- Always use the inverter's power source side for the brake power source.
- Match the opening and closing of the brake circuit's electromagnetic contactor to the timing of the inverter control.

■ With Brake, Inverter Drive

Premium-efficiency, 3-phase motor

Premium-efficiency, 3-phase motor for inverter



MC : Electromagnetic contactor

MCB : Breaker for wiring

Tr : Transformer capacity 250 – 600VA, secondary voltage 200 – 220V

F : Fuse 3 – 5A

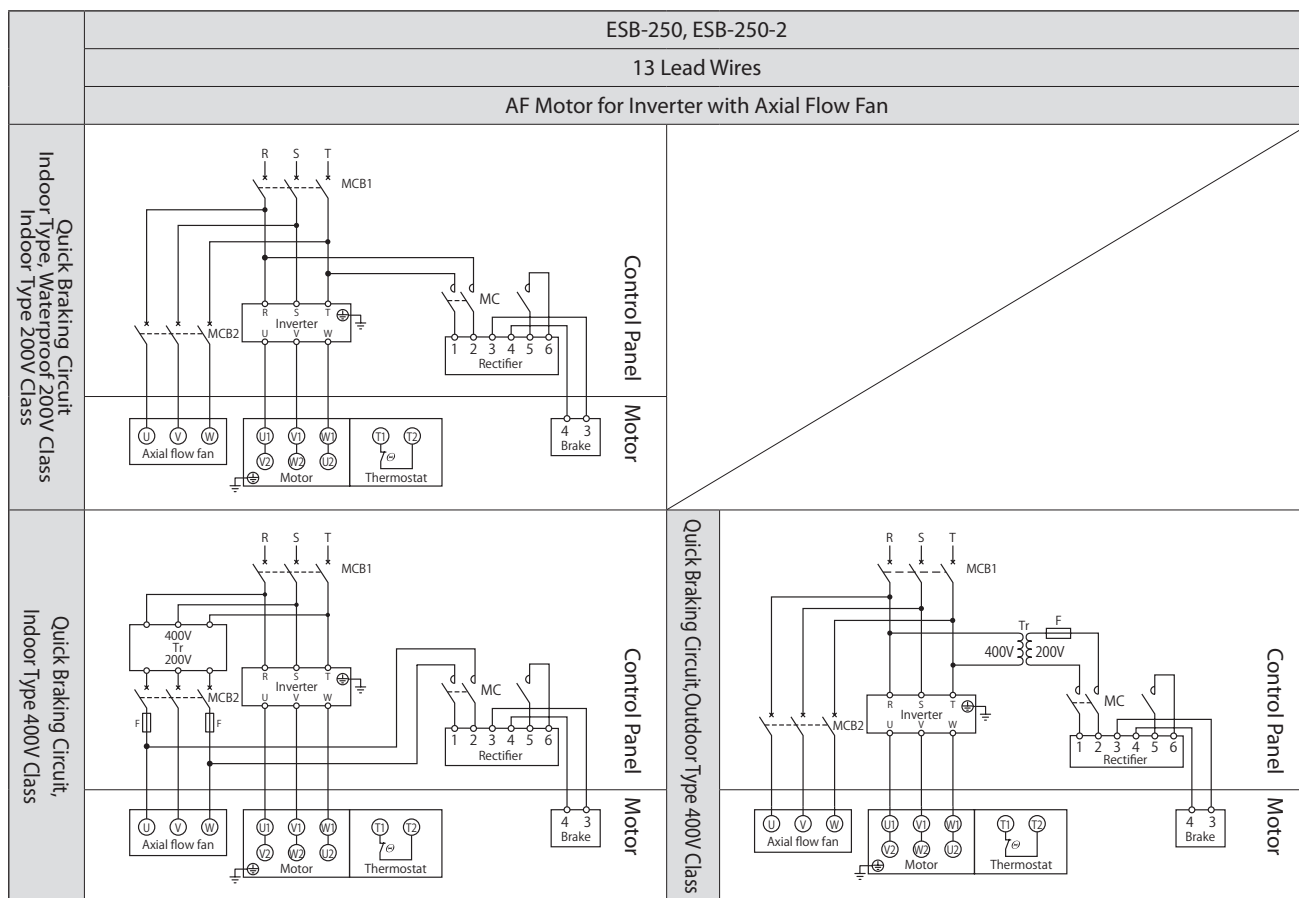
Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P37. Rectifiers are external to the main unit. Rectifiers are made for indoor use. Install in an area where they will not come into contact with water, etc.
- Brake unit is for 200V class. For 400V class power sources, prepare a 400V/200V transformer.

- Always use the inverter's power source side for the brake power source.
- Match the opening and closing of the brake circuit's electromagnetic contactor to the timing of the inverter control.

■ With Brake, Inverter Drive

AF motor for inverter



MC : Electromagnetic contactor

MCB : Breaker for wiring

Tr : Transformer capacity 250 – 600VA, secondary voltage 200 – 220V

F : Fuse 3 – 5A

Customer needs to prepare.

- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-1 on P5.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P37. Rectifiers are external to the main unit. Rectifiers are made for indoor use. Install in an area where they will not come into contact with water, etc.
- Brake unit is for 200V class. For 400V class power sources, prepare a 400V/200V transformer.

- Always use the inverter's power source side for the brake power source.
- Match the opening and closing of the brake circuit's electromagnetic contactor to the timing of the inverter control.

For AF motor for inverter with axial flow fan (fully enclosed separate ventilate type), note the following points.

- Connect electric power to an axial fan as well.
- In the case of 400 V class indoor equipment, the power source voltage for the axial fan is 200 V.
- In the case of special specifications, the actual product may sometimes differ from the above drawing, so check the manufacturing specifications.
- Connect the fan so that it rotates in the direction indicated on the nameplate.
(When the fan is operating normally, it should blow cooling air from the non-load side to the load side.)
- When leaving the motor stopped for a long period, leave the axial fan motor stopped as well.
- A thermostat has been installed, so connect the wiring to it.
- Specifications of the thermostat

Terminal codes: T1, T2 or P1, P2

Working temperature: 135°C (For heat resistance class 155 (F))

Operation function: Normally closed (b contact)

Max current: 24 VDC 18 A, 230 VAC 13 A

6-6 Points to Note When Using a Quick Braking Circuit

When using brakes with quick braking circuits, take note of the following items.

- Connect a varistor (protection element) to protect the quick braking circuit contact points from surge Voltage generated by the brake action.
- Wire the quick braking circuit contact points to secondary side contacts of the brake power source. If not, contact points might not be protected.
- For information on using an alternating current electromagnetic contactor as contact points for quick braking circuits, see Table 6-4.

If multiple contact points are required, note the following issues.

- Connect electromagnetic contactor contact points in serial. (See Figure 6-3)
- Connect the varistor (VR) as close to the unit as possible. (See Figure 6-3)

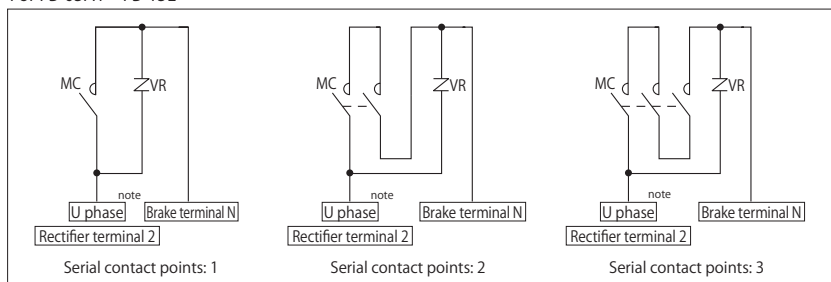
Table 6-4 Nomenclature for Parts Recommended When Using a Quick Braking Circuit (When Using an Alternating Current Electromagnetic Contactor).

AC Voltage	Brake Type	Recommended Contactor Nomenclature				Recommended Contactor Contact Point Capacity (DC-13 Class)	Recommended Varistor (For Protecting Contactor Contact Points)										
		Made by Fuji Electric FA Components & Systems Co., Ltd.		Made by Mitsubishi Electric Corporation			Varistor Type	Maximum Allowable Circuit Voltage	Varistor Voltage	Power Rating							
200V 220V	FB-05A1	SC-05	Serial contact points: 1 (0.7A)	S-N11 or S-N12	Serial contact points: 1 (1.2A)	DC 110V	Minimum 0.5A	TND07V-471KB00AAA0	AC300V	470V (423 - 517V)	0.25W						
	FB-1D						Minimum 0.7A	TND10V-471KB00AAA0			0.4W						
	FB-1E																
	FB-1HE	SC-05	Serial contact points: 2 (3.0A)	S-N11 or S-N12	Serial contact points: 2 (3.0A)		Minimum 1.5A	TND14V-471KB00AAA0			0.6W						
	FB-2E																
	FB-3E						SC-05					Serial contact points: 3 (4.0A)	S-N18	Serial contact points: 3 (5.0A)	Minimum 3.0A	TND20V-471KB00AAA0	1.0W
	FB-4E																
	FB-5E	SC-5-1	Serial contact points: 3 (10A)	S-N20 or S-N21	Serial contact points: 3 (10A)		Minimum 5.5A										
	FB-8E																
	FB-10E						Minimum 4.5A										
	FB-15E																
	FB-20																
FB-30																	
ESB-250 ESB-250-2																	
400V 440V	FB-05A1	SC-05	Serial contact points: 2 (0.4A)	S-N11 or S-N12	Serial contact points: 2 (0.5A)	DC 220V	Minimum 0.3A	TND10V-821KB00AAA0	AC510V	820V (738 - 902V)	0.4W						
	FB-1D	SC-05	Serial contact points: 3 (2.0A)	S-N11 or S-N12	Serial contact points: 3 (2.0A)		Minimum 0.5A	TND14V-821KB00AAA0			0.6W						
	FB-1E																
	FB-1HE						S-N11 or S-N12	Serial contact points: 3 (2.0A)			Minimum 1.0A	TND20V-821KB00AAA0	1.0W				
	FB-2E																
	FB-3E			S-N18	Serial contact points: 3 (2.0A)		Minimum 1.5A										
	FB-4E																
	FB-5E	-	-	S-N20 or S-N21	Serial contact points: 3 (4.0A)		Minimum 3.0A										
	FB-8E																
	FB-10E						Minimum 2.5A										
	FB-15E																
	FB-20																
FB-30																	

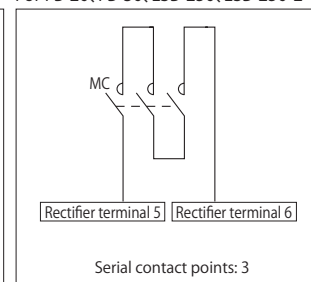
- This recommended contactor nomenclature is for Fuji electric FA Components & Systems Co., Ltd. and Mitsubishi electric Corporation contactors. products from other manufacturers are Also allowable If they have equivalent capabilities.
- Recommended contactor contact point capacity indicates the case where durability regarding electronic opening and closing (service life) is approximately 2 million times (for FB-30, ESB-250, ESB-250-2 approximately 1 million times).
- Of the recommended contactors, the Mitsubishi Electric Corporation S-N11 has one auxiliary contact point; the S-N18 has none. Please note that these 2 contactors are not usable when two or more auxiliary contact points are required for inverter drive and so on. (Other connectors in Table 6-4 have two or more auxiliary contact points.)
- This recommended varistor nomenclature is for Nippon Chemi-Con Corporation varistors. Products from other manufacturers are also allowable if they have equivalent capabilities.
- In the FB-20, 30, ESB-250 and 250-2, a varistor for protecting the connector contact points is built in to the rectifier.

Figure 6-3 Examples of Contact Point Connections with Quick Braking Circuits

For FB-05A1~FB-15E



For FB-20, FB-30, ESB-250, ESB-250-2



For inverter drives, connect to the L1 phase or R phase (power source side).

⚠ DANGER

- Do not approach or touch rotating parts (output shaft, etc.) during operation; otherwise loose clothing may become caught in these rotating parts and cause serious injury or death.
- When the power supply is interrupted, be sure to turn off the power switch. Unexpected resumption of power may cause electric shock, personal injury, or damage to the equipment.
- Do not operate the unit with the terminal box Cover removed. Return the terminal box Cover to the original position after maintenance, otherwise, electric shock may result.
- Do not operate the machine while the brake is released by the manual brake release bolt; otherwise, falling, going out of control, or damage to the equipment may result.

⚠ CAUTION

- Do not put fingers or foreign objects into the opening of the product; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- The gearmotor or reducer becomes very hot during operation. Be careful not to touch with hands or body. Otherwise, burns may result.
- Do not loosen the oil filler plug while the gearmotor or speed reducer is operating. Otherwise, hot oil may fly out, resulting in a burn.
- If any abnormality occurs during operation, stop operation immediately; otherwise, electric shock, personal injury, or fire may result.
- Do not operate the unit in excess of the load rating; otherwise, personal injury, or damage to the equipment may result.

7-1 Items to Check Before Operation

- Oil is removed from oil lubrication parts before shipment from our factory. Supply recommended oil before use. (See P41 - 43)
- Grease is filled before shipment from the factory.

After installation and wiring are completed, check the following items before operating.

- is the wiring correct?
- is the unit properly coupled with the driven machine?
- are Mounting bolts tightened firmly?
- is the direction of rotation as required?
- In the case of the oil lubricating part, is the oil level at the center of the oil gauge (Fig. 7-1) when the gearmotor or reducer is stopped?

Upon completing the above checks, run in the motor under no load, and gradually apply a load to it. At this time, check the items in Table 7-1.

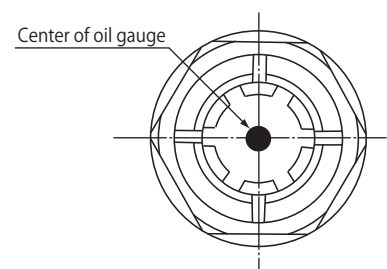


Figure 7-1 Oil Gauge

- Notes: 1. Even if you align the oil level with the center of the oil gauge, the oil level may sometimes fall when the gearmotor or reducer is stopped, due to air leakage from the inside while it is running. For this reason, be sure to check the oil level after a test run. If the oil level is too low, replenish the lubricating oil.
2. Before checking the oil level, wait for a while after stopping the gearmotor or reducer. You cannot check the oil level either during operation or immediately after the end of operation.

7-2 Items to Check During Operation

Table 7-1 Items to Check During Operation

Does abnormal sound or vibration generate?	<ul style="list-style-type: none"> - Is the housing deformed because the installation surface is not flat? - Is Insufficient rigidity of the installation base generating resonance? - Is the shaft center aligned with the driven machine? - Is the vibration of the driven machine transmitted to the gearmotor or reducer?
Is the surface temperature abnormally high?	<ul style="list-style-type: none"> - Does the voltage rise or drop substantially? - Is the ambient temperature too high? - Does the current flowing to the gearmotor exceed the rated current shown on the nameplate?

If any abnormalities are found, immediately stop operation and contact the nearest authorized maintenance shop.

7-3 Brake Torque and Activation Delay Time

The table below shows brake types with standard specification, their brake torque, and their relationship to brake activation delay time.

Table 7-2 Brake Torque and Activation Delay Time

Brake Type	Motor Capacity (kW)				Brake Torque (Dynamic Friction Torque) (N·m)	Brake Activation Delay Time (sec)		
	3-Phase Motor	Premium-Efficiency, 3-Phase Motor	AF Motor for Inverter	Premium-Efficiency, 3-Phase Motor for Inverter		Normal Braking Circuit (Simultaneous Turn-Off Circuit)	Normal Braking Circuit for Inverter Normal Braking Circuit (Separate Turnoff Circuit)	Quick Braking Circuit
FB-05A1	0.4	—	0.2	—	4.0	0.1 - 0.15	0.03 - 0.07	0.01 - 0.015
FB-1D	0.55	—	0.4	—	7.5	0.2 - 0.3	0.1 - 0.15	0.01 - 0.02
FB-1E	—	0.75	—	0.75	7.5	0.25 - 0.45	0.15 - 0.25	0.01 - 0.03
FB-1HE	—	1.1	—	—	11	0.45 - 0.65	0.25 - 0.35	
FB-2E	—	1.5	—	1.5	15	0.35 - 0.55	0.15 - 0.25	
FB-3E	—	2.2	—	2.2	22	0.75 - 0.95	0.4 - 0.5	0.02 - 0.04
FB-4E	—	3.0	—	—	30	0.65 - 0.85	0.3 - 0.4	
FB-5E	—	3.7	—	3.7	40	1.1 - 1.3	0.4 - 0.5	
FB-8E	—	5.5	—	5.5	55	1.0 - 1.2	0.3 - 0.4	
FB-10E	—	7.5	—	7.5	80	1.8 - 2.0	0.6 - 0.7	
FB-15E	—	11	—	11	110	1.6 - 1.8	0.5 - 0.6	
FB-20	—	15	—	15	150	—	—	0.06 - 0.14
FB-30	—	18.5	—	18.5	190	—	—	0.03 - 0.11
	—	22	—	22	220			
	—	30	—	30	200			
ESB-250 (Horizontal type) ESB-250-2 (Vertical type)	—	—	30	—	Horizontal	212	—	0.065
					Vertical	195		
	—	37	37	37	Horizontal	266		
					Vertical	244		
	—	45	—	45	Horizontal	320		
					Vertical	292		

Notes: 1. Brake type may differ depending on specification. Check the nameplate.

2. Brake torque will change according to operating environment, operating conditions, the condition of the friction surface, etc. In particular, brake torque may not be at the prescribed level for initial operation, and after a long period of inactivity. In such a case turn the brake on and off under as light load as possible to contact the brake's friction surfaces.

3. Brake activation delay time will change according to the brake's wiring circuit. Select the optimum circuit for the application.

⚠ DANGER

- Do not handle the unit when cables are energized. Be sure to turn off the power when working on the unit; otherwise, electric shock may result.
- Do not approach or touch any rotating parts (output shaft, etc.) while conducting maintenance during operation or the inspection of the unit, loose clothing may become caught in these rotating parts and cause serious injury or death.
- In the case of **explosion proof motor**, customers must not disassemble or modify; otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.
- In the case of **explosion proof motor**, The lead-in condition of explosion proof motor shall conform to the facility's regulations, electrical codes, and explosion proofing standard, as well as the maintenance manual; Additionally, do not open the terminal box cover while operating. Otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.
- Do not operate the machine while the brake is released by the manual brake release bolt; otherwise, falling, going out of control, or damage to the equipment may result.


⚠ CAUTION

- Do not put fingers or foreign objects into the opening of the gearmotor or reducer; otherwise, electric shock, injury, fire, or damage to the equipment may result.
 - The gearmotor or reducer becomes very hot during operation. Do not touch the product with bare hands. Otherwise, burns may result.
 - Do not touch the terminals when measuring insulation resistance; otherwise, electric shock may result.
 - Do not operate the unit without a safety cover (removed during inspection) to shield rotating parts; otherwise loose clothing may become caught in these rotating parts and cause serious injury or death.
 - Promptly observe and repair any abnormalities during operation according to instructions in this maintenance manual. Do not operate until the cause of the abnormality is understood, and the abnormality is repaired.
 - When replacing the lubricating oil, follow the instructions in this manual. Be sure to use our recommended type of oil.
 - Before installing, moving or transporting the equipment, be sure to drain off the lubricating oil. If you move the equipment with lubricating oil is inside it, the lubricating oil may flow out from the oil filler plug.
 - Do not replace the lubricating oil either during operation or immediately after the end of operation. Otherwise, burns may result.
 - Do not operate damaged gearmotors or reducers; otherwise, injury, fire, or damage to the equipment may result.
 - We cannot assume any responsibility for damage or injury resulting from an unauthorized modification by a customer, as it is outside the scope of the warranty.
 - Dispose of the product or lubricating oil as general industrial waste.
 - In the case of **explosion proof motor**, When measuring the insulation resistance of explosion proof motor, confirm that there is no gas or explosive vapor in the vicinity, in order to prevent explosion or ignition.
 - Changing brake linings requires experience. Consult with the nearest authorized maintenance shop.
- Brake torque will change with operation environment and conditions, the condition of the friction surface, and other factors. In particular, brake torque may not be at the prescribed level for initial operation, and after a long period of inactivity. In such a case turn the brake on and off under as light load as possible to contact the brake's friction surfaces.

8-1 Daily Inspection

Make certain to carry out daily inspection in accordance with Table 8-1. Lack of inspections is a source of trouble.

Table 8-1 Daily Inspection

Inspection Item	Inspection Detail
Current value 	Is the current no greater than the rated value shown on the nameplate?
Noise	Are there unusual noises, or are there extreme changes in the noises?
Vibration	Is there abnormally large vibration? Are there extreme changes?
Surface temperature	Is surface temperature unusually high? Are there extreme changes? (Temperature rises during operation will differ according to model and type. However, in case the difference between the gear unit surface temperature and the environment temperature is approximately 60°C, there is no particular trouble if fluctuation is slight.
Oil level (Oil lubrication parts)	- Is the oil level at the center of the oil gauge when the gearmotor or reducer is stopped?
Contamination of the lubricating oil	Is the lubricating oil contaminated? You can check the lubricating oil for contamination not only by sampling the oil when the gearmotor or reducer is stopped, but also by using the oil gauge. If the oil gauge is found to be contaminated, replace the oil gauge quickly.
Oil or grease leaks	Is grease or oil leaking from the gear unit? Are the oil seal sliding surfaces corroded?
Mounting bolts	Are the mounting bolts loose?
Chain, V-belt	Are the chain or V-belt loose?

- If any problems are found in a daily inspection, follow "9. Troubleshooting" (on P71 and 72) to take appropriate actions. If these actions do not solve the issue, immediately contact the nearest authorized maintenance shop.

8. Daily Inspection and Maintenance Common

8-2 Checking lubrication Method

Refer to the section concerned in this manual and be sure to carry out maintenance. lack of maintenance is a source of trouble.

(1) Standard lubrication method (when the motor is being driven at the standard input rotational speed)

Confirm the lubricating method used in the gear section of the model that you are using in Table 8-2.

Table 8-5 shows the sections where the maintenance method is indicated, for each lubricating method.

Table 8-2 Standard Lubrication Method

Frame Size	Lubrication
72, 82, 92, 95, 102, 112, 115	Oil bath lubrication
72DA, 82DA, 92DA, 102DA, 112DA	Output part: oil bath type lubrication; Input part (CYCLO reducer): Long-life grease lubrication

Note: The output shaft bearing is filled with grease.

8-3 Oil Supply and Change for Oil Lubrication Parts

(1) Oil change interval

Table 8-3 Oil Inspection and Change Interval

	Change Interval		Duration of Operation
Oil supply	At the time of purchase		—
Oil change	First time	After 500 hours or 6 months whichever comes earlier	—
	Second time and after	After 5,000 hours or a year whichever comes earlier	0 – 35°C indoors, etc.
		After 2,500 hours or 6 months whichever comes earlier	Outdoors, or other high temperature location that cannot be maintained within 0 – 35°C

- If the ambient temperature is high, or changes abruptly, and also there is corrosive gas in the vicinity, the rate of deterioration of the oil will increase. In this case, consult with the manufacturer of the lubricating oil.

(2) Recommended Oil

Make sure to use the recommended oil shown in Table 8-4.

Table 8-4 Recommended Lubricants (Equivalent to SP type industrial high-pressure gear oil or JIS K2219)

Ambient Temperature °C	COSMO	ENEOS	IDEMITSU	Shell	Mobil		Gulf	CALTEX	bp
-10 – 25	COSMOGEAR SE 150	BONNOC TS 150	Daphne Super Gear Oil 150	Shell Omala S2 G 150	Spartan EP 150	Mobilgear 600 XP 150	Gulf EP Lubricant HD 150	Meropa 150	Energol GR-XP 150
10 – 40	COSMO GEAR SE 220	BONNOC TS 220	Daphne Super Gear Oil 220	Shell Omala S2 G 220	Spartan EP 220	Mobilgear 600 XP 220	Gulf EP Lubricant HD 220	Meropa 220	Energol GR-XP 220
30 – 50	COSMO GEAR SE 320	BONNOC TS 320	Daphne Super Gear Oil 320	Shell Omala S2 G 320	Spartan EP 320	Mobilgear 600 XP 320	Gulf EP Lubricant HD 320	Meropa 320	Energol GR-XP 320

(3) Amount of oil

Table 8-5 shows approximate quantity of necessary oil. There are differences in the actual oil feed quantity among machines because of the difference in structure and so on. Even if the feed quantity of lubricating oil is the same as that indicated in Table 8-5, the actual quantity of oil in the product may be excessive or insufficient. For this reason, be sure to confirm that the oil level corresponds to the center position of the oil gauge.

Table 8-5 Approximate Quantity of Oil (L)

Hollow Shaft Mount, Solid Shaft, Flange Type

Frame Size	Mounting Position					
	Y1	Y2	Y3	Y4	Y5	Y6
	F1	F2	F3	F4	F5	F6
	G1	G2	G3	G4	G5	G6
72, 72DA	1.9	8.3	5.7	4.8	3.3	5.7
82, 82DA	3.4	11.5	7.6	6.8	4.7	7.8
92, 95, 92DA	4.1	15.8	10.2	7.9	5.9	11.1
102, 105, 102DA	6.7	23.0	14.9	14.2	9.1	14.9
112, 115, 112DA	9.5	33.2	21.0	16.8	12.2	19.2

Solid Shaft, Foot Type

Frame Size	Mounting Position					
	K1	K2 V2	K3	K4	K5	K6
72, 72DA	2.1	7.6	5.0	4.5	2.8	5.4
82, 82DA	3.2	10.7	6.8	5.9	4.0	7.4
92, 95, 92DA	4.1	14.1	9.1	6.8	5.1	9.7
102, 105, 102DA	6.7	22.2	14.3	12.9	8.6	15.3
112, 115, 112DA	8.6	29.6	18.5	15.0	10.7	20.4

(4) Procedure for Oil Feed and Discharge

- Oil Feed Procedure

- (1) Remove the oil filler plug.
- (2) With checking the oil level on the oil gauge, add oil from the oil filling port.
- (3) Confirm that the oil level corresponds to the center position of the oil gauge.
- (4) Install the oil filler plug.

- Oil Discharge Procedure

Remove the plug of the oil drain port and discharge the oil.

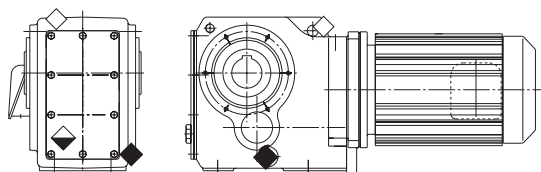
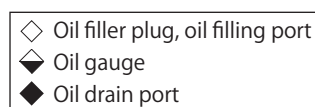
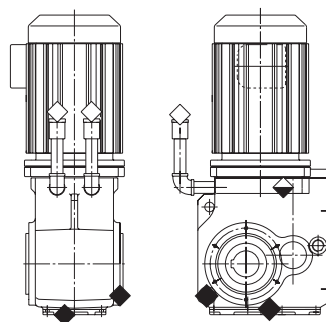
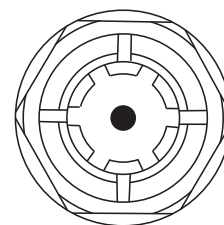
Figure 8-1 Locations of Oil Filling/Drain Ports
(E.g.: KHYM-Y1)Figure 8-2 Locations of Oil Filling/Drain Ports
(E.g.: KHYM-Y2)

Figure 8-3 Oil Gauge

For the locations of oil filling/drain ports other than the above, see P10 to 14.

- Ensure that the gearmotor or reducer is stopped before feeding oil to it.
- If the viscosity of the oil is high, it may take time for the oil level to become uniform. Take care not to add an excessive quantity of oil.
- Add oil until it reaches the center of the oil gauge.
- Before checking the oil level, wait for a while after stopping the gearmotor or reducer. You cannot check the oil level either during operation or immediately after the end of operation.
- For the daily control method of oil level, see Table 8-1 on P40.

(5) Long-Period Stoppage

Table 8-6 Long-Period Stoppage

Period of stoppage	About one month	Replace the old oil with new one, then operate the gearmotor or reducer for several minutes, and stop it.
	One month or more	Perform flushing, then add rust preventive oil, run the gearmotor or reducer in a no-load condition for several minutes, and stop it.

When re-starting the gearmotor or reducer after a long-period stoppage, be sure to replace the oil with fresh one. This is because the previously used oil may have deteriorated.

8-4 Grease Lubrication (Input Part: CYCLO Reducer)

As the gearmotor and reducer is filled with long-life grease, you can use it for a long period without replenishing the grease.

8-5 Main Unit Maintenance

- Although it will depend on operation conditions, maintenance with disassembly after approximately 20,000 hours or 3 to 5 years will extend product lifetime.
Contact the nearest authorized maintenance shop regarding maintenance with disassembly.
- Oil seals have a lifetime. During long use natural degradation and frictional wear will reduce effectiveness. Reducer operating conditions and ambient environment will cause lifetime to widely vary. Given normal operation, (uniform load, running 10 hours per day, normal temperature) as a guideline it is recommended to change them every 1 to 3 years. If the sliding surfaces of oil seals or V-rings show signs of wear or corrosion, replace them with new ones. The sliding surface of an oil seal is made of carbon steel, so in order to prevent rust forming on it, if there are parts of the oil seal that are exposed to the outside, periodically take steps to prevent rusting by coating the oil seal with rust preventive oil. About replacing oil seal and V-ring, please consult with nearest authorized maintenance shop.
- If stop and start are frequent, mounting bolts (or nuts) may come loose. Periodically check for looseness as this is a source of misalignment, oil leakages, and load unbalance.

8-6 Motor Bearing Maintenance

- The Sumitomo standard motor is a sealed type bearing (not constructed for filling or draining grease) is used.
- When using other manufacturer's motor due to motor's specification, follow the operation manual for that motor.
- Although it will depend on operation conditions, maintenance with disassembly after approximately 20,000 hours or 3 to 5 years will further increase lifetime.
- Contact the nearest authorized maintenance shop regarding maintenance with disassembly.

8-7 Brake Maintenance and Inspection

DANGER

- Do not handle the unit when cables are enregized. Be sure to turn off the power when working on the unit; otherwise, electric shock may result.
- When using for lifting, do not release the brake while a load is suspended; otherwise it could fall, causing an accident.
- Do not operate the machine while the brake is released by the manual brake release bolt; otherwise, falling, going out of control, or damage to the equipment may result.
- Before operation turn power on and off to check brake action; otherwise falling or running out of control could occur.
- Do not let water or oil touch the brake. the brake. Brake torque degradation could cause falling or running out of control.

CAUTION

- After gap inspection and adjustment do not operate with the fan cover removed; otherwise loose clothing may became caught in these rotating parts and cause serious injury or death.
- Changing brake linings requires experience. Consult with the nearest authorized maintenance shop.

Given normal operation conditions, brake mechanical lifetime is quite long at 2 million times (1 million times for FB-30, ESB-250 and ESB-250-2). These conditions include the moment of inertia for the load being no greater than the one for the brakemotor. However, please periodically inspect the brake gap (G). The brake lining wears after long hours of running time, making it impossible for the brake to release. When 2 million times is exceeded (1 million times for FB-30, ESB-250 and ESB-250-2), wear and damage to mechanical parts may cause dropping or overdrive problems.

8-8 Brake Construction and Gap Inspection and Adjustment

- The brake is spring activated (off brake type).
- The brake lining wears after long hours of operating the brake, making it impossible for the brake to release. Therefore please periodically inspect the brake gap (G).
- If on inspection the gap is close to the limit value, adjust the gap.
- In FB-1E - 4E a shock absorber is inserted between the stationary core and the armature plate to reduce the noise that results from the braking action.

When inspecting, be careful that the gap gauge, other measuring tool or anything else does not damage the shock absorber or cause it to fall out.

There is danger that if the shock absorber is damaged or falls out, brake noise will increase and the brake will not function properly.

Table 8-7 Pages Containing Information on Brake Construction and Gap Inspection and Adjustment

Brake Type	Indoor	Outdoor
FB-05A1	P45	P56
FB-1D	P46	P57
FB-1E	P47	P58
FB-1HE, FB-2E	P48	P59
FB-3E, FB-4E	P49	P60
FB-5E, FB-8E	P50	P61
FB-10E, FB-15E	P51	P62
FB-20	P52	P63
FB-30	P53	P64
ESB-250, ESB-250-2	P54	P65

Note: Please refer to P67 for the way to remove and install One-Touch Release lever.

■ FB-05A1 (Indoor Type)

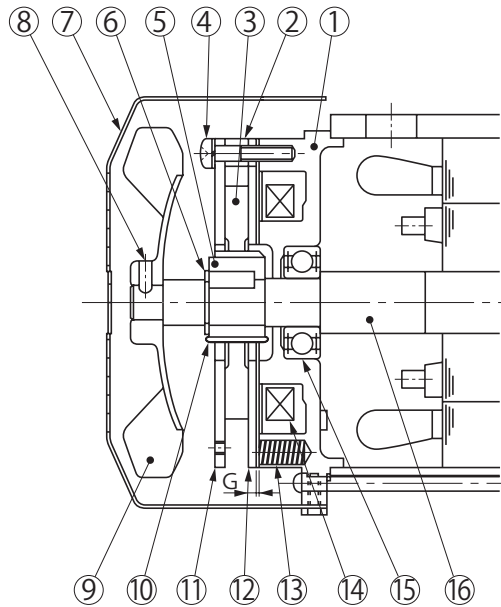


Figure 8-4

Part Number	Part Name
1	Stationary core
2	Spacer
3	Brake lining
4	Attachment bolt
5	Boss
6	Shaft-retaining C-ring
7	Cover
8	Fan set screw
9	Fan
10	Leaf spring
11	Fixed plate
12	Armature plate
13	Spring
14	Electromagnetic coil
15	Bearing
16	Motor shaft

- Gap Inspection

- (1) Remove the cover [7].
- (2) Insert a gap gauge between the stationary core [1] and the armature plate [12] and measure the gap. Measure in 3 locations around the circumference.
- (3) Adjustment is required if the gap value is near the limit.

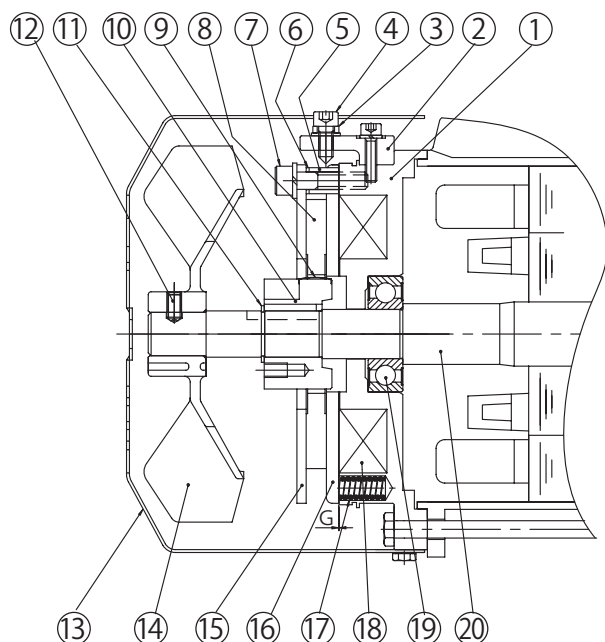
Gap Value G (mm)	
Required value (original value)	Limit value
0.2 - 0.35	0.5

- Gap Adjustment

- (1) Remove the cover [7].
- (2) Loosen the fan set screw [8] and remove the fan [9].
- (3) Slightly loosen the attachment bolts [4] and rotate the fixed plate [11] counter clockwise, as far as it will go. Then tighten the attachment bolts [4]. After tightening, measure the gap (G) and check to see if the gap value is between the required value and the limit. (This operation will reduce the gap by 0.3 mm.)
- (4) Turn the power on and off to check brake action.
- (5) Attach the fan [9] and cover [7]. Use a fan set screw [8] coated with Three Bond TB2365 (Sumitomo part number EW444WW-01), and tighten with a torque of 0.3 – 0.5 N·m.

Note: If the optional brake release bolt is installed, disassemble the brake after removing the release bolt.

■ FB-1D (Indoor Type)



Part Number	Part Name
1	Stationary core
2	Brake release
3	Manual release protection spacer
4	Brake release bolt
5	Spacer
6	Gap adjusting shims
7	Attachment bolt
8	Brake lining
9	Leaf spring
10	Boss
11	Shaft-retaining C-ring
12	Fan set screw
13	Cover
14	Fan
15	Fixed plate
16	Armature plate
17	Spring
18	Electromagnetic coil
19	Bearing
20	Motor shaft

Figure 8-5

- Gap Inspection

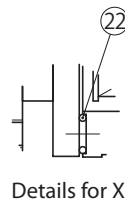
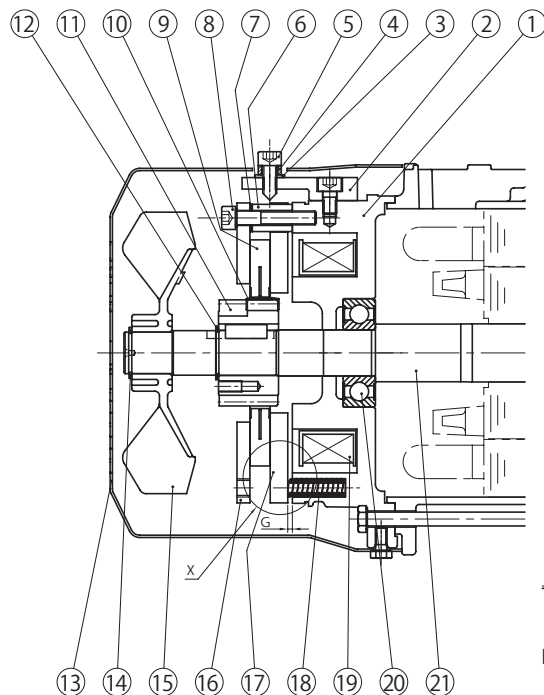
- (1) Remove the brake release bolt [4] and the manual release prevention spacer [3].
- (2) Remove the cover [13].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [16] and measure the gap. Measure in 3 locations around the circumference.
- (4) Adjustment is required if the gap value is near the limit.
(You cannot adjust the thickness of the gap adjustment shims to about 0.2 to 0.25 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.3 - 0.4	0.6

- Gap Adjustment

- (1) Remove the brake release bolt [4] and the manual release prevention spacer [3].
- (2) Remove the cover [13].
- (3) Remove the fan set screw [12] and remove the fan [14].
- (4) Loosen the attachment bolts [7] and remove the spacers [5], gap adjustment shims [6], attachment bolts [7] and fixed plate [15] as a set. When removing the attachment bolts [7] make certain not to omit the gap adjustment shims [6].
- (5) The gap adjustment shims [6] have a thickness of 0.2 - 0.25 mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [5], gap adjustment shims [6], attachment bolts [7] and the fixed plate [15] as a set.
- (6) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (7) Turn the power on and off to check brake action.
- (8) Attach the fan [14], fan set screw [12] and cover [13]. Use a fan set screw [12] coated with Three Bond TB2365 (Sumitomo part number EW445WW-01), and tighten with a torque of 0.85 - 1.05 N·m. Finally, attach the brake release bolt [4] and the manual release prevention spacer [3].

■ FB-1E (Indoor Type)



Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Spacer
7	Gap adjusting shims
8	Attachment bolt
9	Brake lining
10	Leaf spring
11	Boss
12	Shaft-retaining C-ring
13	Cover
14	Shaft-retaining C-ring
15	Fan
16	Fixed plate
17	Armature plate
18	Spring
19	Electromagnetic coil
20	Ball bearings
21	Motor shaft
22	Shock absorber

Figure 8-6

- Gap Inspection

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [17] and measure the gap. Measure in 3 locations around the circumference.
- (4) Adjustment is required if the gap value is near the limit.

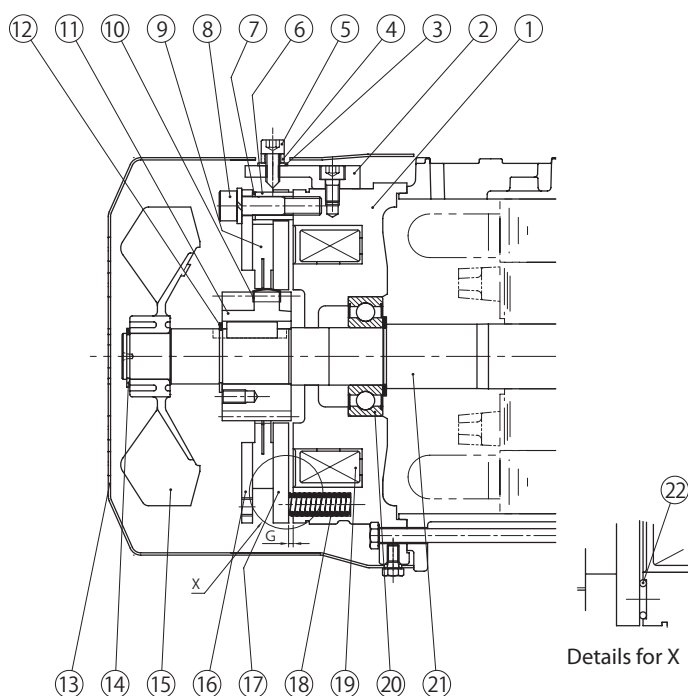
(You cannot adjust the thickness of the gap adjustment shims to about 0.2 to 0.25 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.25 - 0.35	0.6

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Remove the shaft-retaining C-ring [14], and remove the fan [15].
- (4) Loosen the attachment bolts [8] and remove the spacers [6], gap adjustment shims [7], attachment bolts [8] and fixed plate [16] as a set. When removing the attachment bolts [8] only, make sure not to fall the gap adjustment shims [7] and the shock absorber [22].
- (5) The gap adjustment shims [7] have a thickness of 0.2 – 0.25 mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [6], gap adjustment shims [7], attachment bolts [8] and the fixed plate [16] as a set.
- (6) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (7) Turn the power on and off to check brake action.
- (8) Attach the fan [15], shaft-retaining C-ring [14] and cover [13].
- (9) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].

■ FB-1HE, FB-2E (Indoor Type)



Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Spacer
7	Gap adjusting shims
8	Attachment bolt
9	Brake lining
10	Leaf spring
11	Boss
12	Shaft-retaining C-ring
13	Cover
14	Shaft-retaining C-ring
15	Fan
16	Fixed plate
17	Armature plate
18	Spring
19	Electromagnetic coil
20	Ball bearings
21	Motor shaft
22	Shock absorber

Figure 8-7

- Gap Inspection

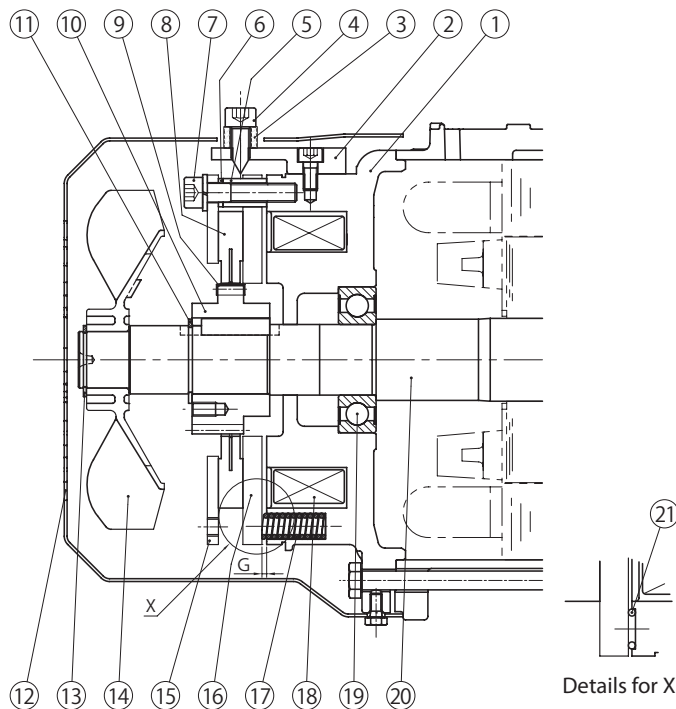
- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [17] and measure the gap. Measure in 3 locations around the circumference.
- (4) Adjustment is required if the gap value is near the limit.
(You cannot adjust the thickness of the gap adjustment shims to about 0.35 to 0.45 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.25 - 0.35	0.75

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Remove the shaft-retaining C-ring [14], and remove the fan [15].
- (4) Loosen the attachment bolts [8] and remove the spacers [6], gap adjustment shims [7], attachment bolts [8] and fixed plate [16] as a set. When removing the attachment bolts [8] only, make sure not to fall the gap adjustment shims [7] and the shock absorber [22].
- (5) The gap adjustment shims [7] have a thickness of 0.35 – 0.45mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [6], gap adjustment shims [7], attachment bolts [8] and the fixed plate [16] as a set.
- (6) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (7) Turn the power on and off to check brake action.
- (8) Attach the fan [15], shaft-retaining C-ring [14] and cover [13].
- (9) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].

■ FB-3E, FB-4E (Indoor Type)



Part Number	Part Name
1	Stationary core
2	Brake release
3	Manual release protection spacer
4	Brake release bolt
5	Spacer
6	Gap adjusting shims
7	Attachment bolt
8	Brake lining
9	Leaf spring
10	Boss
11	Shaft-retaining C-ring
12	Cover
13	Shaft-retaining C-ring
14	Fan
15	Fixed plate
16	Armature plate
17	Spring
18	Electromagnetic coil
19	Ball bearings
20	Motor shaft
21	Shock absorber

Figure 8-8

- Gap Inspection

- (1) Remove the brake release bolt [4] and the manual release prevention spacer [3].
- (2) Remove the cover [12].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [16] and measure the gap. Measure in 3 locations around the circumference.
- (4) Adjustment is required if the gap value is near the limit.
(You cannot adjust the thickness of the gap adjustment shims to about 0.45 to 0.55 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.25 - 0.35	0.85

- Gap Adjustment

- (1) Remove the brake release bolt [4] and the manual release prevention spacer [3].
- (2) Remove the cover [12].
- (3) Remove the shaft-retaining C-ring [13] and the fan [14].
- (4) Loosen the attachment bolts [7] and remove the spacers [5], gap adjustment shims [6], attachment bolts [7] and fixed plate [15] as a set. When removing the attachment bolts [7] only, make sure not to fall the gap adjustment shims [6] and the shock absorber [21].
- (5) The gap adjustment shims [6] have a thickness of 0.45 – 0.55 mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [5], gap adjustment shims [6], attachment bolts [7] and the fixed plate [15] as a set.
- (6) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (7) Turn the power on and off to check brake action.
- (8) Attach the fan [14], shaft-retaining C-ring [13] and cover [12].
- (9) Finally, attach the brake release bolt [4] and the manual release prevention spacer [3].

■ FB-5E, FB-8E (Indoor Type)

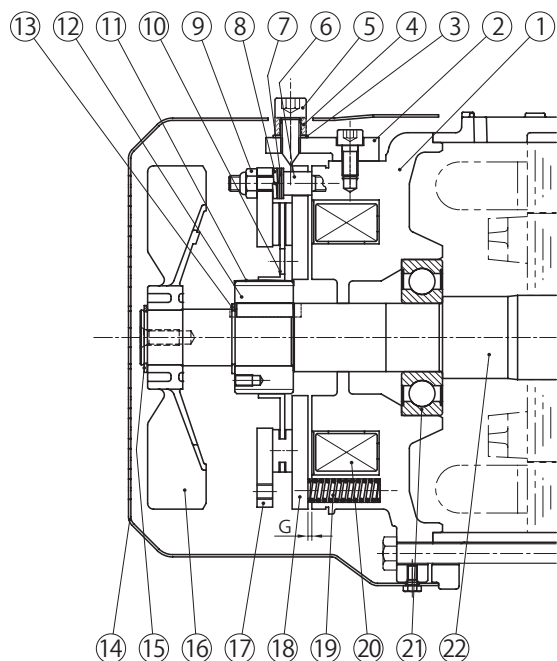


Figure 8-9

Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting nut
10	Brake lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft

- Gap Inspection

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [18] and measure the gap. Measure in 3 locations around the circumference.
- (4) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.35 - 0.45	1.0

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [18] and rotate to the right the gap adjusting nuts [9] that are attached to ends of the stud bolts [6]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [7]. There are 3 gap adjusting nuts [9]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (4) Turn the power on and off to check brake action.
- (5) Attach the cover [14].
- (6) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].

■ FB-10E, FB-15E (Indoor Type)

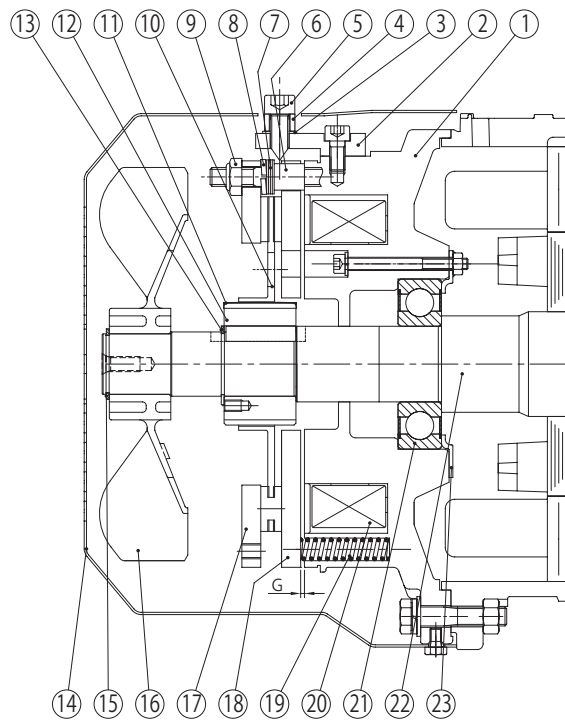


Figure 8-10

Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting nut
10	Brake lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft
23	Bearing cover

- Gap Inspection

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [18] and measure the gap. Measure in 3 locations around the circumference.
- (4) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.35 - 0.45	1.2

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Insert a gap gauge between the stationary core [1] and the armature plate [18] and rotate to the right the gap adjusting nuts [9] that are attached to ends of the stud bolts [6]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [7]. There are 3 gap adjusting nuts [9]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (4) Turn the power on and off to check brake action.
- (5) Attach the cover [14].
- (6) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].

■ FB-20 (Indoor Type)

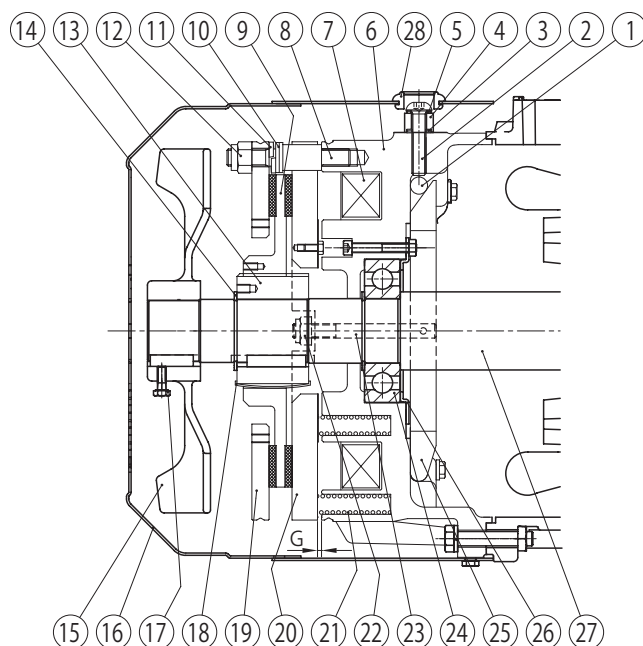


Figure 8-11

Part Number	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release protection spacer
5	Seal washer
6	Stationary core
7	Electromagnetic coil
8	Stud bolt
9	Brake lining
10	Adjusting washer
11	Spring washer
12	Gap adjusting nut
13	Boss
14	Shaft-retaining C-ring
15	Fan
16	Cover
17	Fan set screw
18	Leaf spring
19	Fixed plate
20	Armature plate
21	Spring
22	Nut
23	Tap-end stud
24	Ball bearings
25	Release lever
26	Bearing cover
27	Motor shaft
28	Grommet

- Gap Inspection

- (1) Remove the grommet [28] and cover [16].
- (2) Insert a gap gauge between the stationary core [6] and the armature plate [20] and measure the gap. Measure in 3 locations around the circumference.
- (3) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.6 - 0.7	1.5

- Gap Adjustment

- (1) Remove the grommet [28] and cover [16].
- (2) Insert a gap gauge between the stationary core [6] and the armature plate [20] and rotate to the right the gap adjusting nuts [12] that are attached to ends of the stud bolts [8]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [10]. There are 3 gap adjusting nuts [12]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (3) Turn the power on and off to check brake action.
- (4) Attach the cover [16] and grommet [28].

■ FB-30 (Indoor Type)

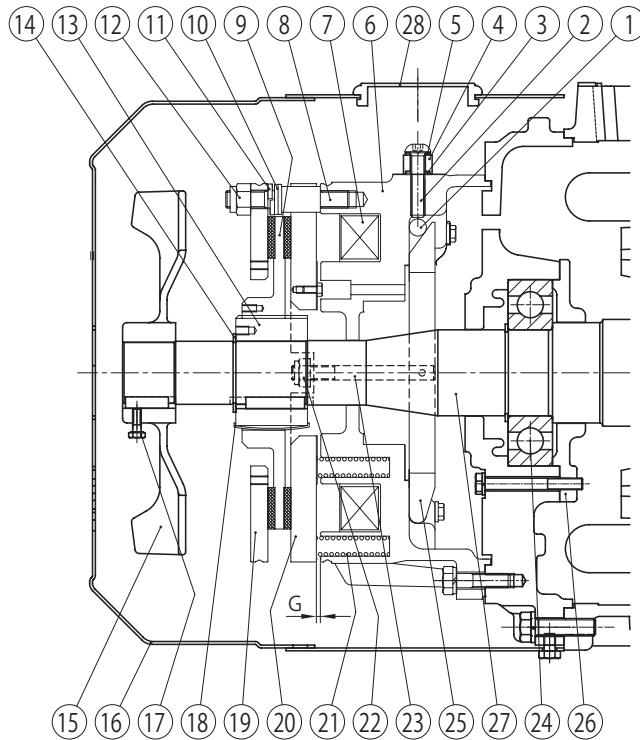


Figure 8-12

Part Number	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release protection spacer
5	Seal washer
6	Stationary core
7	Electromagnetic coil
8	Stud bolt
9	Brake lining
10	Adjusting washer
11	Spring washer
12	Gap adjusting nut
13	Boss
14	Shaft-retaining C-ring
15	Fan
16	Cover
17	Fan set screw
18	Leaf spring
19	Fixed plate
20	Armature plate
21	Spring
22	Nut
23	Tap-end stud
24	Ball bearings
25	Release lever
26	Bearing cover
27	Motor shaft
28	Grommet

- Gap Inspection

- (1) Remove the grommet [28] and cover [16].
- (2) Insert a gap gauge between the stationary core [6] and the armature plate [20] and measure the gap. Measure in 3 locations around the circumference.
- (3) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.6 - 0.7	1.5

- Gap Adjustment

- (1) Remove the grommet [28] and cover [16].
- (2) Insert a gap gauge between the stationary core [6] and the armature plate [20] and rotate to the right the gap adjusting nuts [12] that are attached to ends of the stud bolts [8]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [10]. There are 3 gap adjusting nuts [12]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (3) Turn the power on and off to check brake action.
- (4) Attach the cover [16] and grommet [28].

■ ESB-250, ESB-250-2 (Indoor Type)

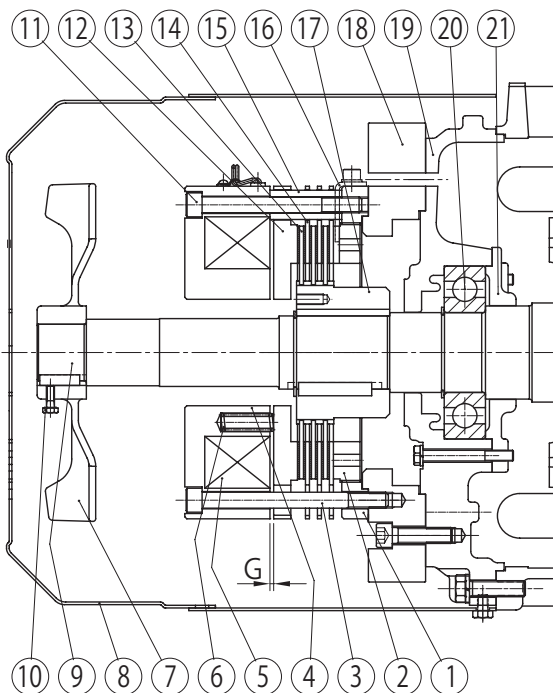


Figure 8-13

Part Number	Part Name
1	Center ring
2	Gap adjusting screw
3	Attachment bolt
4	Field
5	Brake coil
6	Actuating spring
7	Fan
8	Cover
9	Motor shaft
10	Fan set screw
11	Lock bolt
12	Armature
13	Inner disc
14	Outer disc
15	Spacer bush
16	Stopper
17	Hub
18	Brake adapter plate
19	Opposite drive end cover
20	Opposite drive end bearing
21	Opposite drive end bearing cover

Notes: 1. The motor for separately ventilated type has a different shape.

2. There are 3 of [13][14] for ESB-250 (horizontal type), and 2 for ESB-250-2 (vertical type).

Items	Specifications
Rated input voltage	AC200/220V 50/60Hz
Maximum input voltage	AC240V 50/60Hz
Minimum input voltage	AC170V 50/60Hz
Standard output voltage	Instantaneous voltage DC180V (for AC200V input)
	Steady voltage DC90V (for AC200V input)
Maximum output current	DC1.8A (Steady output)
Over excitation time	0.4 - 1.2s
Insulation resistance	100MΩ or larger (When measured with 1000V megohmmeter)
Insulation withstand voltage	AC2000V for one time or more
Maximum frequency	Inching (When on-time 1.2 sec or less): 8 cycles/min
	Steady (When on-time exceeds 1.2 sec): 30 cycles/min
Allowable ambient temperature	-20°C to 60°C

■ Accessory Rectifier (DC Power Supply Unit) Model HD-110M3

Outline Drawing

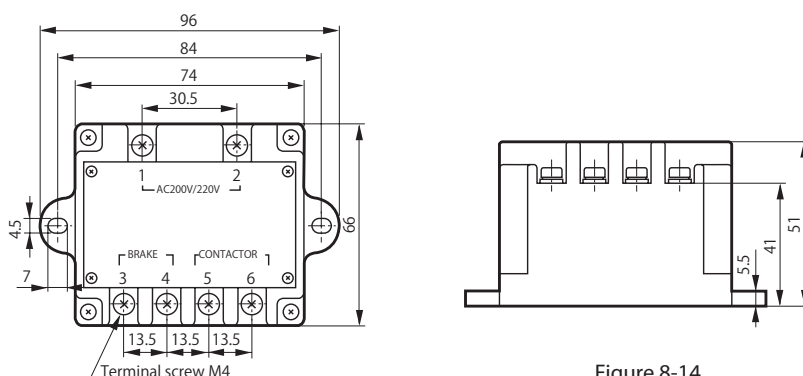
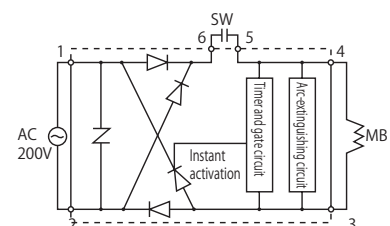


Figure 8-14

Internal Circuit (Diagram)



Notes: 1. Model HD-110M3 is an indoor model. Take care to avoid water, etc.

2. Transformer is necessary for operation with 400V class power source. Secondary voltage is 200 – 220V.

- Gap Inspection

- (1) Remove the cover [8].
- (2) Insert a gap gauge between the field [4] and the armature [12] and measure the gap. Measure in 4 locations around the circumference.
- (3) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.7	2.0

- Gap Adjustment

- (1) Manually release the brake following the procedure on P70.
- (2) Loosen the stopper [16] on the periphery of the center ring [1], and remove. This will free the gap adjusting screws [2].
(See Figure 8-15)
- (3) Insert a gap adjustment bar (An angle plate should be prepared by customer. See Figure 8-17) into the groove of adjustment screw
(2) between the outer disk [14] and the center ring [1].
Rotating to the left as seen from the field [4] side, will narrow the gap. (See Figure 8-16)
- (4) Six attachment bolts [3] and lock bolts [11] alternately pass through the space between the outer disc [14] and the center ring [1].
Rotating the gap adjustment bar will make the bar touch these bolts. There are 8 equally distributed holes for gap adjusting screws [2]. Adjust the gap G to the required value by repeating (3) each time the gap adjusting bar contacts a bolt.
- (5) Select the point where hole and screw hole are closest to the required gap and attach the stopper [16] there.
- (6) After returning the manual brake release to its original state, turn power on and off to check brake action.
- (7) Attach the fan [7] and cover [8]. At this time coat the fan set screw [10] with Three Bond TB2365.

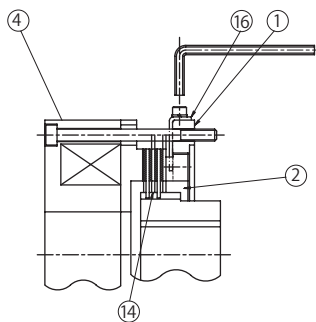


Figure 8-15

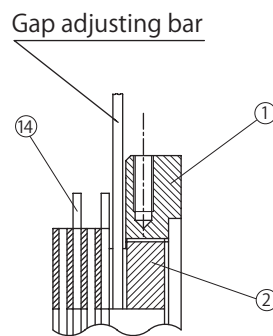


Figure 8-16

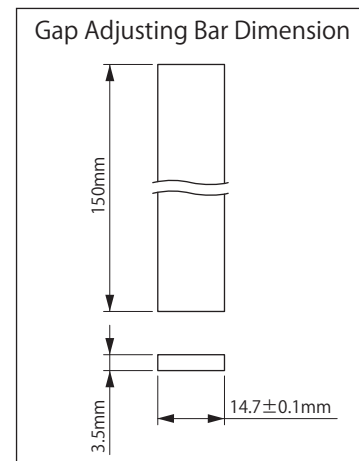


Figure 8-17

■ FB-05A1 (Outdoor Type)

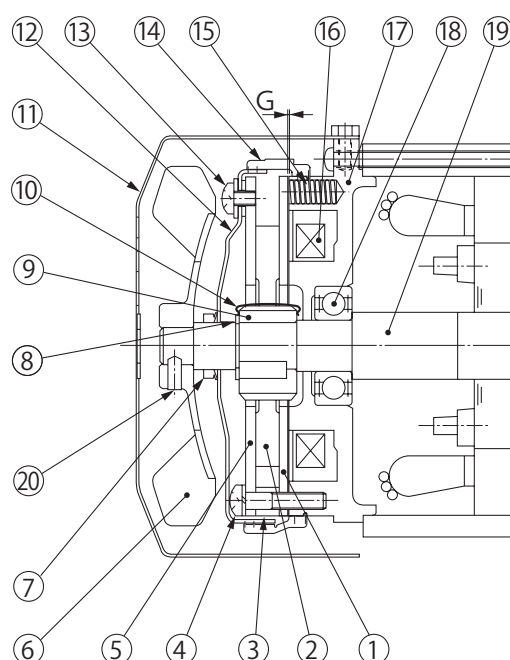


Figure 8-18

Part Number	Part Name
1	Armature plate
2	Brake lining
3	Spacer
4	Attachment bolt
5	Fixed plate
6	Fan
7	V-ring
8	Shaft-retaining C-ring
9	Boss
10	Leaf spring
11	Cover
12	Waterproof cover
13	Waterproof cover attachment bolts
14	Waterproof seal
15	Spring
16	Electromagnetic coil
17	Stationary core
18	Bearing
19	Motor shaft
20	Fan set screw

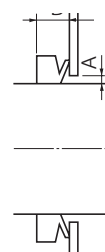
- Gap Inspection

- (1) Remove the cover [11].
- (2) Loosen the fan set screw [20] and remove the fan [6].
- (3) Remove the waterproof seal [14].
- (4) Insert a gap gauge between the stationary core [17] and the armature plate [1] and measure the gap. Measure in 3 locations around the circumference.
- (5) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.2 - 0.35	0.5

- Gap Adjustment

- (1) Remove the cover [11].
- (2) Loosen the fan set screw [20] and remove the fan [6].
- (3) Remove the waterproof seal [14].
- (4) Pull off the V-ring [7].
- (5) Remove the waterproof cover attachment bolts [13], and remove the waterproof cover [12].
- (6) Slightly loosen the attachment bolts [4] and rotate the fixed plate [5] counter clockwise, as far as it will go. Then tighten the attachment bolts [4]. After tightening, measure the gap (G) and check to see if the gap value is between the required value and the limit. (This operation will reduce the gap by 0.3 mm.)
- (7) Attach the waterproof cover [12] by using the attachment bolts [13]. Attach the waterproof cover [12] so that the gap (A) between its hole and the motor shaft [19] is nearly uniform around the circumference.
- (8) Clean the surface of the waterproof seal [14] to remove impurities.
- (9) As shown in the construction diagram, install the waterproof seal [14] between the stationary core [17] and the waterproof cover [12]. Insert the waterproof seal [14] with its arrow mark pointing toward the load side. Align the hole in the waterproof seal [14] for the release bolt with the position of release bolt. Attach the waterproof seal [14] so that its protrusion fits snugly around the entire circumference of the stationary core's groove [17]. Otherwise water could leak in.
- (10) Turn the power on and off to check brake action.
- (11) Attach the V-ring [7]. Wipe off the lip and surface near the lip of the V-ring [7], lightly coat the lip surface with grease and attach. Observe the attaching dimension (B = 4.5mm).
- (12) Attach the fan [7] and cover [11]. Use a fan set screw [20] coated with Three Bond TB2365 (Sumitomo part number EW444WW-01), and tighten with a torque of 0.3 – 0.5 N·m.



Note: If the optional brake release bolt is installed, disassemble the brake after removing the release bolt.

■ FB-1D (Outdoor Type)

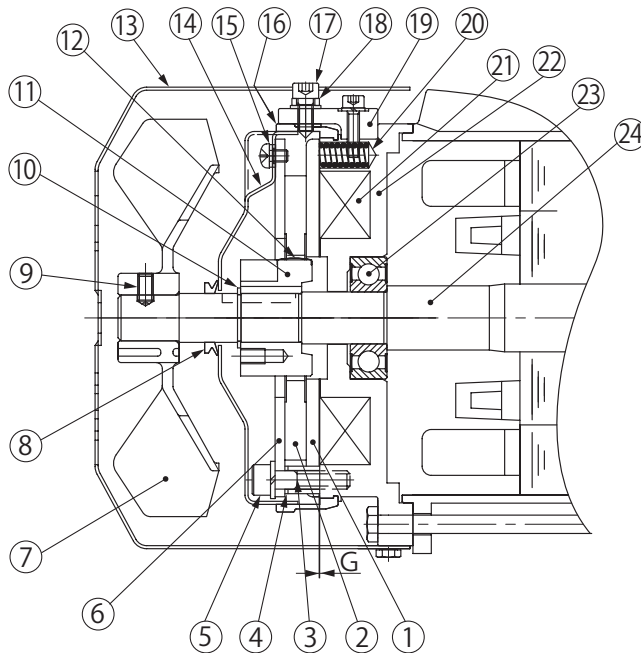


Figure 8-19

Part Number	Part Name
1	Armature plate
2	Brake lining
3	Spacer
4	Gap adjusting shims
5	Attachment bolt
6	Fixed plate
7	Fan
8	V-ring
9	Fan set screw
10	Shaft-retaining C-ring
11	Boss
12	Leaf spring
13	Cover
14	Waterproof cover
15	Waterproof cover attachment bolts
16	Waterproof seal
17	Brake release bolt
18	Manual release protection spacer
19	Brake release
20	Spring
21	Electromagnetic coil
22	Stationary core
23	Bearing
24	Motor shaft

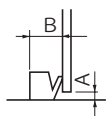
- Gap Inspection

- (1) Remove the brake release bolt [17] and the manual release prevention spacer [18].
- (2) Remove the cover [13].
- (3) Loosen the fan set screw [9] and remove the fan [7].
- (4) Remove the brake release [19]. (2 Places)
- (5) Remove the waterproof seal [16].
- (6) Insert a gap gauge between the stationary core [22] and the armature plate [1] and measure the gap. Measure in 3 locations around the circumference.
- (7) Adjustment is required if the gap value is near the limit.
(You cannot adjust the thickness of the gap adjustment shims to about 0.2 to 0.25 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.3 - 0.4	0.6

- Gap Adjustment

- (1) Remove the brake release bolt [17] and the manual release prevention spacer [18].
- (2) Remove the cover [13].
- (3) Loosen the fan set screw [9] and remove the fan [7].
- (4) Pull off the V-ring [8].
- (5) Remove the brake release [19]. (2 Places)
- (6) Remove the waterproof seal [16].
- (7) Remove the waterproof cover attachment bolts [15], and remove the waterproof cover [14].
- (8) Loosen the attachment bolts [5] and remove the spacers [3], gap adjustment shims [4], attachment bolts [5] and fixed plate [6] as a set. When removing the attachment bolts only, make sure not to fall the gap adjustment shims [4].
- (9) The gap adjustment shims [4] have a thickness of 0.2 – 0.25 mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [3], gap adjustment shims [4], attachment bolts [5] and the fixed plate [6] as a set.
- (10) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (11) Attach the waterproof cover [14] by using the attachment bolts [15]. Attach the waterproof cover [14] so that the gap (A) between its hole and the motor shaft [24] is nearly the same.
- (12) Clean the surface of the waterproof seal [16] to remove impurities.
- (13) As shown in the construction diagram, install the waterproof seal [16] between the stationary core [22] and the waterproof cover [14]. Then attach the brake release [19]. Insert the waterproof seal [16] with its arrow mark pointing toward the load side. Align the hole in the waterproof seal [16] for the release bolt with the position of release bolt [17]. Attach the waterproof seal [16] so that its protrusion fits snugly around the entire circumference of the stationary core's groove [22]. Otherwise water could leak in.
- (14) Turn the power on and off to check brake action.
- (15) Attach the V-ring [8]. Wipe off the lip and surface near the lip of V-ring [8], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B=4.5mm).
- (16) Attach the fan [7] and cover [13]. Use a fan set screw [9] coated with Three Bond TB2365 (Sumitomo part number EW445WW-01), and tighten with a torque of 0.85 – 1.05N•m. Finally, attach the brake release bolt [17] and the manual release prevention spacer [18].



■ FB-1E (Outdoor Type)

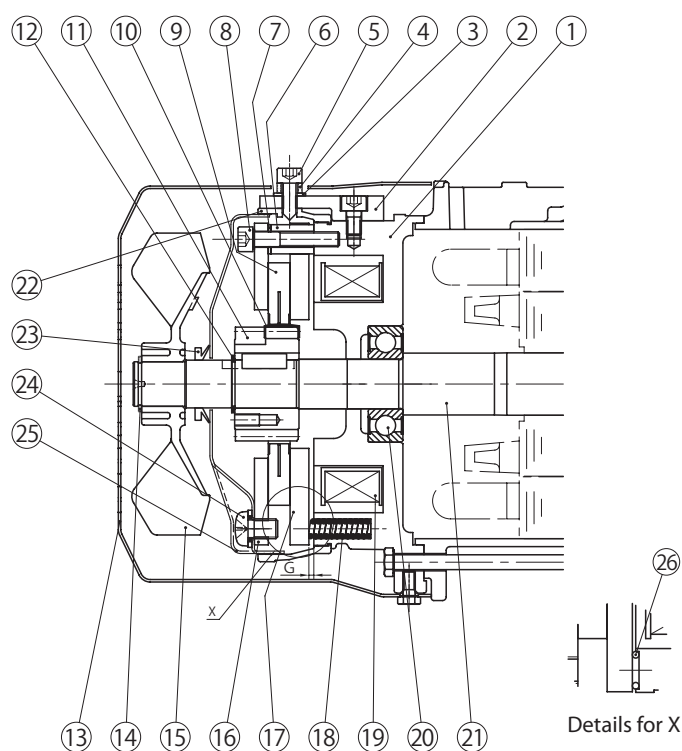


Figure 8-20

Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Spacer
7	Gap adjusting shims
8	Attachment bolt
9	Brake lining
10	Leaf spring
11	Boss
12	Shaft-retaining C-ring
13	Cover
14	Shaft-retaining C-ring
15	Fan
16	Fixed plate
17	Armature plate
18	Spring
19	Electromagnetic coil
20	Ball bearings
21	Motor shaft
22	Waterproof seal
23	V-ring
24	Waterproof cover attachment bolts
25	Waterproof cover
26	Shock absorber

- Gap Inspection

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Remove the shaft-retaining C-ring [14], and remove the fan [15].
- (4) Remove the brake release [2] (2 locations) and remove the waterproof seal [22].
- (5) Insert a gap gauge between the stationary core [1] and the armature plate [17] and measure the gap. Measure in 3 locations around the circumference.
- (6) Adjustment is required if the gap value is near the limit.
(You cannot adjust the thickness of the gap adjustment shims to about 0.2 to 0.25 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.25 - 0.35	0.6

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Remove the shaft-retaining C-ring [14], and remove the fan [15].
- (4) Pull off the V-ring [23].
- (5) Remove the brake release [2] (2 locations) and remove the waterproof seal [22].
- (6) Remove the waterproof cover attachment bolts [24], and remove the waterproof cover [25].
- (7) Loosen the attachment bolts [8] and remove the spacers [6], gap adjustment shims [7], attachment bolts [8] and fixed plate [16] as a set. When removing the attachment bolts [8] only, make sure not to fall the gap adjustment shims [7] and the shock absorber [26].
- (8) The gap adjustment shims [7] have a thickness of 0.2 – 0.25 mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [6], gap adjustment shims [7], attachment bolts [8] and the fixed plate [16] as a set.
- (9) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (10) Attach the waterproof cover [25] using the attachment bolts [24]. At this time align the cutout area on the side of the waterproof cover [25] with the brake release bolt [5]. Attach the waterproof cover [25] so that the gap (A) between its hole and the motor shaft [21] is nearly the same.
- (11) Clean the surface of the waterproof seal [22] to remove impurities.
- (12) As shown in the construction diagram, install the waterproof seal [22] between the stationary core [1] and the waterproof cover [25]. Then attach the brake release [2]. Insert the waterproof seal [22] with its arrow mark pointing toward the load side. Align the hole in the waterproof seal [22] for the release bolt with the position of release bolt [5]. Attach the waterproof seal [22] so that its protrusion fits snugly around the entire circumference of the stationary core's groove [1]. (Be careful that the waterproof seal [22] does not meander. Otherwise water could leak in.) Otherwise water could leak in.)
- (13) Turn the power on and off to check brake action.
- (14) Attach the V-ring [23]. Wipe off the lip and surface near the lip of the V-ring [23], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B = 6mm).
- (15) Attach the fan [15], shaft-retaining C-ring [14] and cover [13].
- (16) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].



■ FB-1HE, FB-2E (Outdoor Type)

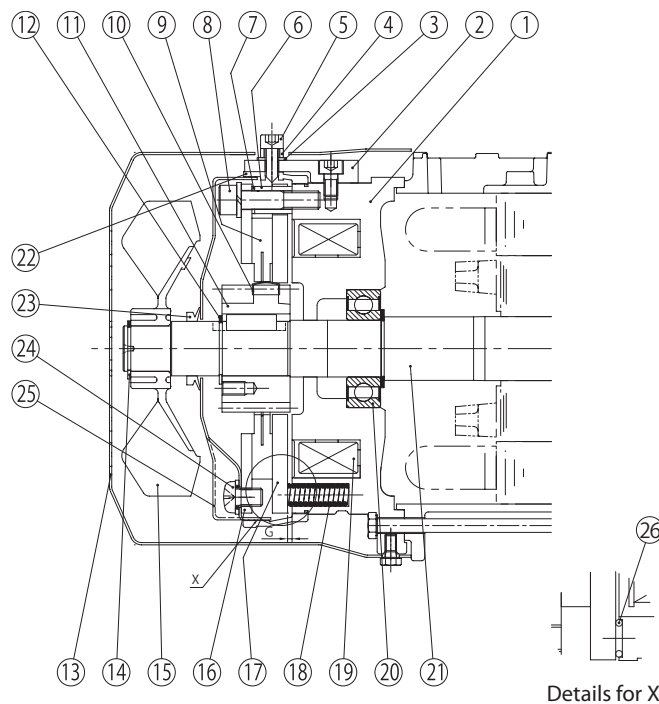


Figure 8-21

Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Spacer
7	Gap adjusting shims
8	Attachment bolt
9	Brake lining
10	Leaf spring
11	Boss
12	Shaft-retaining C-ring
13	Cover
14	Shaft-retaining C-ring
15	Fan
16	Fixed plate
17	Armature plate
18	Spring
19	Electromagnetic coil
20	Ball bearings
21	Motor shaft
22	Waterproof seal
23	V-ring
24	Waterproof cover attachment bolts
25	Waterproof cover
26	Shock absorber

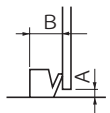
- Gap Inspection

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Remove the shaft-retaining C-ring [14], and remove the fan [15].
- (4) Remove the brake release [2] (2 locations) and remove the waterproof seal [22].
- (5) Insert a gap gauge between the stationary core [1] and the armature plate [17] and measure the gap. Measure in 3 locations around the circumference.
- (6) Adjustment is required if the gap value is near the limit.
(You cannot adjust the thickness of the gap adjustment shims to about 0.35 to 0.45 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.25 - 0.35	0.75

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [13].
- (3) Remove the shaft-retaining C-ring [14], and remove the fan [15].
- (4) Pull off the V-ring [23].
- (5) Remove the brake release [2] (2 locations) and remove the waterproof seal [22].
- (6) Remove the waterproof cover attachment bolts [24], and remove the waterproof cover [25].
- (7) Loosen the attachment bolts [8] and remove the spacers [6], gap adjustment shims [7], attachment bolts [8] and fixed plate [16] as a set. When removing the attachment bolts [8] only, make sure not to fall the gap adjustment shims [7] and the shock absorber [26].
- (8) The gap adjustment shims [7] have a thickness of 0.35 – 0.45mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [6], gap adjustment shims [7], attachment bolts [8] and the fixed plate [16] as a set.
- (9) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (10) Attach the waterproof cover [25] using the attachment bolts [24]. At this time align the cutout area on the side of the waterproof cover [25] with the brake release bolt [5]. Attach the waterproof cover [25] so that the gap (A) between its hole and the motor shaft [21] is nearly the same.
- (11) Clean the surface of the waterproof seal [22] to remove impurities.
- (12) As shown in the construction diagram, install the waterproof seal [22] between the stationary core [1] and the waterproof cover [25]. Then attach the brake release [2]. Insert the waterproof seal [22] with its arrow mark pointing toward the load side. Align the hole in the waterproof seal [22] for the release bolt with the position of release bolt [5]. Attach the waterproof seal [22] so that its protrusion fits snugly around the entire circumference of the stationary core's groove [1]. (Be careful that the waterproof seal [22] does not meander. Otherwise water could leak in.)
- (13) Turn the power on and off to check brake action.
- (14) Attach the V-ring [23]. Wipe off the lip and surface near the lip of the V-ring [23], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B = 6mm).
- (15) Attach the fan [15], shaft-retaining C-ring [14] and cover [13].
- (16) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].



■ FB-3E, FB-4E (Outdoor Type)

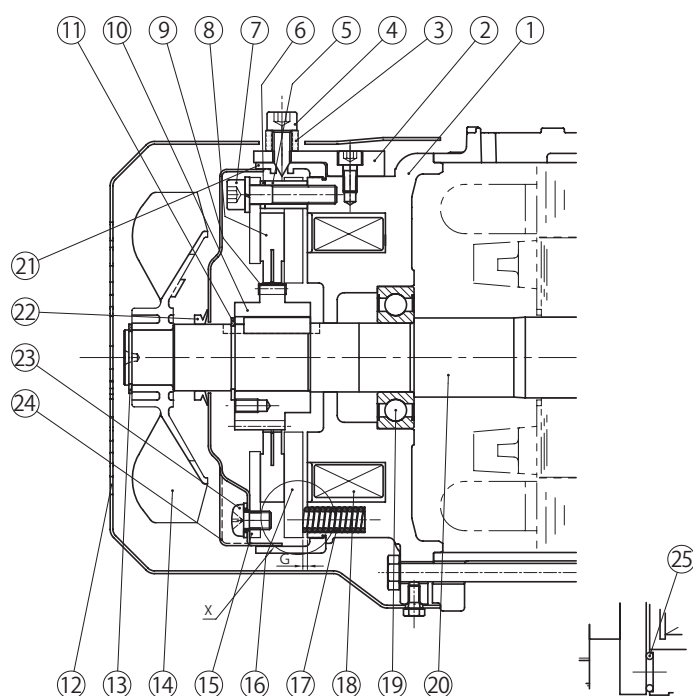


Figure 8-22

Details for X

Part Number	Part Name
1	Stationary core
2	Brake release
3	Manual release protection spacer
4	Brake release bolt
5	Spacer
6	Gap adjusting shims
7	Attachment bolt
8	Brake lining
9	Leaf spring
10	Boss
11	Shaft-retaining C-ring
12	Cover
13	Shaft-retaining C-ring
14	Fan
15	Fixed plate
16	Armature plate
17	Spring
18	Electromagnetic coil
19	Ball bearings
20	Motor shaft
21	Waterproof seal
22	V-ring
23	Waterproof cover attachment bolts
24	Waterproof cover
25	Shock absorber

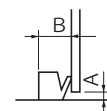
- Gap Inspection

- (1) Remove the brake release bolt [4] and the manual release prevention spacer [5].
- (2) Remove the cover [12].
- (3) Remove the shaft-retaining C-ring [13] and the fan [14].
- (4) Remove the brake release [2] (2 locations) and remove the waterproof seal [21].
- (5) Insert a gap gauge between the stationary core [1] and the armature plate [16] and measure the gap. Measure in 3 locations around the circumference.
- (6) Adjustment is required if the gap value is near the limit.
(You cannot adjust the thickness of the gap adjustment shims to about 0.45 to 0.55 or less.)

Gap Value G (mm)	
Required value (original value)	Limit value
0.25 - 0.35	0.85

- Gap Adjustment

- (1) Remove the brake release bolt [4] and the manual release prevention spacer [5].
- (2) Remove the cover [12].
- (3) Remove the shaft-retaining C-ring [13] and the fan [14].
- (4) Pull off the V-ring [22].
- (5) Remove the brake release [2] (2 locations) and remove the waterproof seal [21].
- (6) Remove the waterproof cover attachment bolts [23], and remove the waterproof cover [24].
- (7) Loosen the attachment bolts [7] and remove the spacers [5], gap adjustment shims [6], attachment bolts [7] and fixed plate [15] as a set. When removing the attachment bolts [7] only, make sure not to fall the gap adjustment shims [6] and the shock absorber [25].
- (8) The gap adjustment shims [6] have a thickness of 0.45 – 0.55 mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [5], gap adjustment shims [6], attachment bolts [7] and the fixed plate [15] as a set.
- (9) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (10) Attach the waterproof cover [24] using the attachment bolts [23]. At this time align the cutout area on the side of the waterproof cover [24] with the brake release bolt [4]. Attach the waterproof cover [24] so that the gap (A) between its hole and the motor shaft [20] is nearly the same.
- (11) Clean the surface of the waterproof seal [21] to remove impurities.
- (12) As shown in the construction diagram, install the waterproof seal [21] between the stationary core [1] and the waterproof cover [24]. Then attach the brake release [2]. At this time align the hole in the waterproof seal [21] for the release bolt with the position of release bolt [4]. Attach the waterproof seal [21] so that its protrusion fits snugly around the entire circumference of the stationary core's groove [1]. (Be careful that the waterproof seal [21] does not meander. Otherwise water could leak in.)
- (13) Turn the power on and off to check brake action.
- (14) Attach the V-ring [22]. Wipe off the lip and surface near the lip of the V-ring [22], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B = 6mm).
- (15) Attach the fan [14], shaft-retaining C-ring [13] and cover [12].
- (16) Finally, attach the brake release bolt [4] and the manual release prevention spacer [3].



■ FB-5E, FB-8E (Outdoor Type)

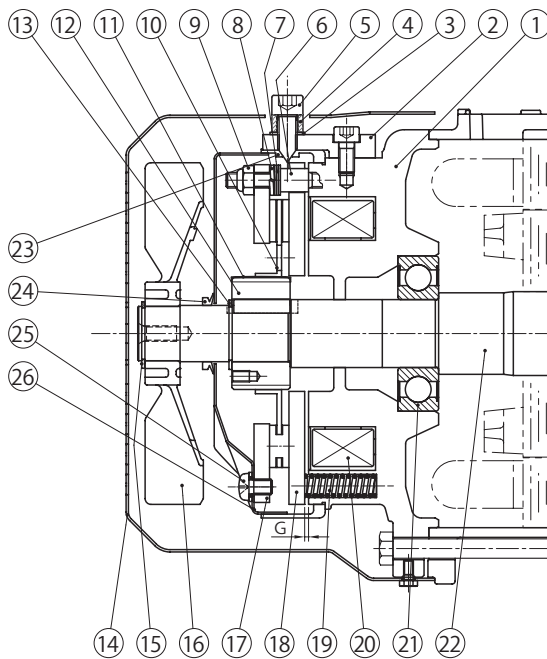


Figure 8-23

Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting nut
10	Brake lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft
23	Waterproof seal
24	V-ring
25	Waterproof cover attachment bolts
26	Waterproof cover

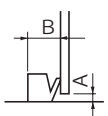
- Gap Inspection

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Remove the shaft-retaining C-ring [15], and remove the fan [16].
- (4) Remove the brake release [2] (2 locations) and remove the waterproof seal [23].
- (5) Insert a gap gauge between the stationary core [1] and the armature plate [18] and measure the gap. Measure in 3 locations around the circumference.
- (6) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.35 - 0.45	1.0

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Remove the shaft-retaining C-ring [15], and remove the fan [16].
- (4) Pull off the V-ring [24].
- (5) Remove the brake release [2] (2 locations) and remove the waterproof seal [23].
- (6) Remove the waterproof cover attachment bolts [25], and remove the waterproof cover [26].
- (7) Insert a gap gauge between the stationary core [1] and the armature plate [18] and rotate to the right the gap adjusting nuts [9] that are attached to ends of the stud bolts [6]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [7]. There are 3 gap adjusting nuts [9]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (8) Attach the waterproof cover [26] by using the attachment bolts [25]. At this time, align the cutout area on the side of the waterproof cover [26] with the brake release bolt [5]. Attach the waterproof cover [26] so that the gap (A) between its hole and the motor shaft [22] is nearly the same.
- (9) Clean the surface of the waterproof seal [23] to remove impurities.
- (10) As shown in the construction diagram, install the waterproof seal [23] between the stationary core [1] and the waterproof cover [26]. Then attach the brake release [2]. At this time, align the hole in the waterproof seal [23] for the release bolt with the position of release bolt [5]. Then attach the brake release along the machined surfaces around the stationary core [1]. (Be careful that the waterproof seal [23] does not meander. Otherwise water could leak in.)
- (11) Turn the power on and off to check brake action.
- (12) Attach the V-ring [24]. Wipe off the lip and surface near the lip of the V-ring [24], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B = 6mm).
- (13) Attach the fan [16], shaft-retaining C-ring [15] and cover [14].
- (14) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].



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■ FB-10E, FB-15E (Outdoor Type)

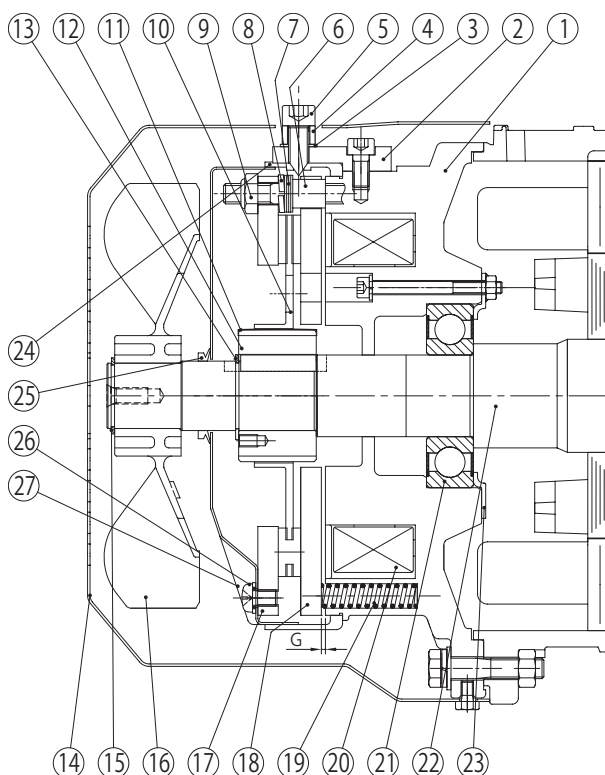


Figure 8-24

Part Number	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release protection spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting nut
10	Brake lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft
23	Bearing cover
24	Waterproof seal
25	V-ring
26	Waterproof cover attachment bolts
27	Waterproof cover

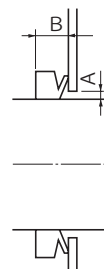
- Gap Inspection

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Remove the shaft-retaining C-ring [15], and remove the fan [16].
- (4) Remove the brake release [2] (2 locations) and remove the waterproof seal [24].
- (5) Insert a gap gauge between the stationary core [1] and the armature plate [18] and measure the gap. Measure in 3 locations around the circumference.
- (6) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.35 - 0.45	1.2

- Gap Adjustment

- (1) Remove the brake release bolt [5] and the manual release prevention spacer [4].
- (2) Remove the cover [14].
- (3) Remove the shaft-retaining C-ring [15], and remove the fan [16].
- (4) Pull off the V-ring [25].
- (5) Remove the brake release [2] (2 locations) and remove the waterproof seal [24].
- (6) Remove the waterproof cover attachment bolts [26], and remove the waterproof cover [27].
- (7) Insert a gap gauge between the stationary core [1] and the armature plate [18] and rotate to the right the gap adjusting nuts [9] that are attached to ends of the stud bolts [6]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [7]. There are 3 gap adjusting nuts [9]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (8) Attach the waterproof cover [27] by using the attachment bolts [26]. At this time, align the cutout area on the side of the waterproof cover [27] with the brake release bolt [5]. Attach the waterproof cover [27] so that the gap (A) between its hole and the motor shaft [22] is nearly the same.
- (9) Clean the surface of the waterproof seal [24] to remove impurities.
- (10) As shown in the construction diagram install the waterproof seal [24] between the stationary core [1] and the waterproof cover [27]. Then attach the brake release [2]. At this time align the hole in the waterproof seal [24] for the release bolt with the position of release bolt [5]. Then attach brake release along the machined surfaces around the stationary core [1]. (Be careful that the waterproof seal [24] does not meander. Otherwise water could leak in.)
- (11) Turn the power on and off to check brake action.
- (12) Attach the V-ring [24]. Wipe off the lip and surface near the lip of the V-ring [25], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B = 6mm).
- (13) Attach the fan [16], shaft-retaining C-ring [15] and cover [14].
- (14) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].



■ FB-20 (Outdoor Type)

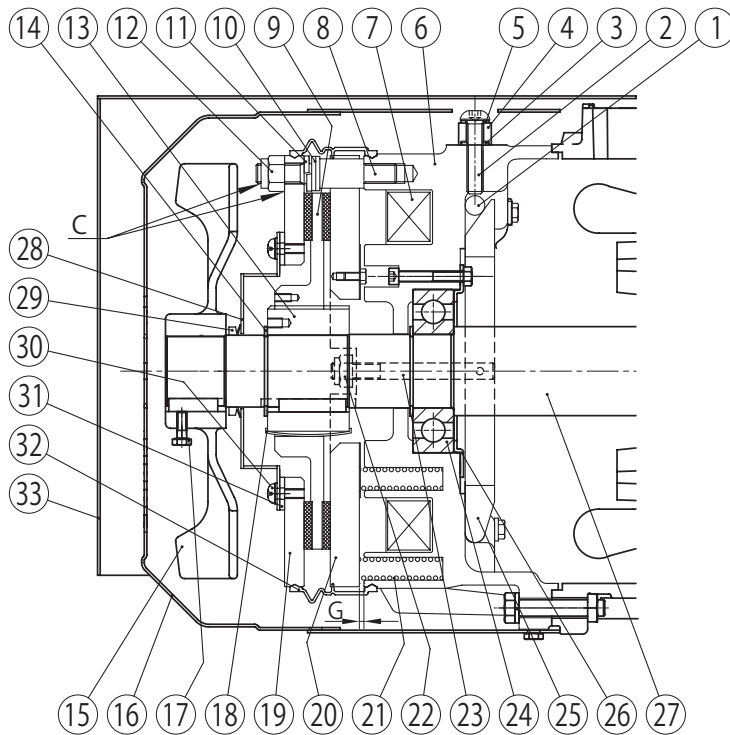


Figure 8-25

Part Number	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release protection spacer
5	Seal washer
6	Stationary core
7	Electromagnetic coil
8	Stud bolt
9	Brake lining
10	Adjusting washer
11	Spring washer
12	Gap adjusting nut
13	Boss
14	Shaft-retaining C-ring
15	Fan
16	Cover
17	Fan set screw
18	Leaf spring
19	Fixed plate
20	Armature plate
21	Spring
22	Nut
23	Tap-end stud
24	Ball bearings
25	Release lever
26	Bearing cover
27	Motor shaft
28	Waterproof cover
29	V-ring
30	Waterproof cover attachment bolts
31	Waterproof cover gasket
32	Waterproof seal
33	Outdoor cover

- Gap Inspection

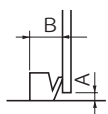
- (1) Remove the outdoor cover [33] and the cover [16].
- (2) Loosen the fan set screw [17] and remove the fan [15].
- (3) Remove the waterproof seal [32].
- (4) Insert a gap gauge between the stationary core [6] and the armature plate [20] and measure the gap. Measure in 3 locations around the circumference.
- (5) Adjustment is required if the gap value is near the limit.

Note: The outdoor cover [33] for the vertical types has a different shape.

- Gap Adjustment

- (1) Remove the outdoor cover [33] and the cover [16].
- (2) Loosen the fan set screw [17] and remove the fan [15].
- (3) Pull off the V-ring [29].
- (4) Remove the waterproof seal [32].
- (5) Insert a gap gauge between the stationary core [6] and the armature plate [20] and rotate to the right the gap adjusting nuts [12] that are attached to ends of the stud bolts [8]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [10]. There are 3 gap adjusting nuts [12]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (6) Turn the power on and off to check brake action.
- (7) Attach the waterproof cover [26] so that the gap (A) between its hole and the motor shaft [27] is nearly the same around the entire circumference. (Only when the waterproof cover [26] has been removed)
- (8) Clean the surface of the waterproof seal [32] to remove impurities.
- (9) As shown in the construction diagram, install the waterproof seal [32] between the stationary core [6] and the fixed plate [19]. (Be careful that the waterproof seal [32] does not meander. Otherwise water could leak in.)
- (10) Attach the V-ring [29]. Wipe off the lip and surface near the lip of the V-ring [29], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B = 7mm).
- (11) Thoroughly coat the gap (C) (the gap between adjusting nuts [12] and the stud bolts [8], and the gap between stud [8] bolts and the fixed plate [19].) with waterproof adhesive (Three Bond 1102).
- (12) Attach the fan [15] and cover [16] and outdoor cover [33].

Gap Value G (mm)	
Required value (original value)	Limit value
0.6 - 0.7	1.5



■ FB-30 (Outdoor Type)

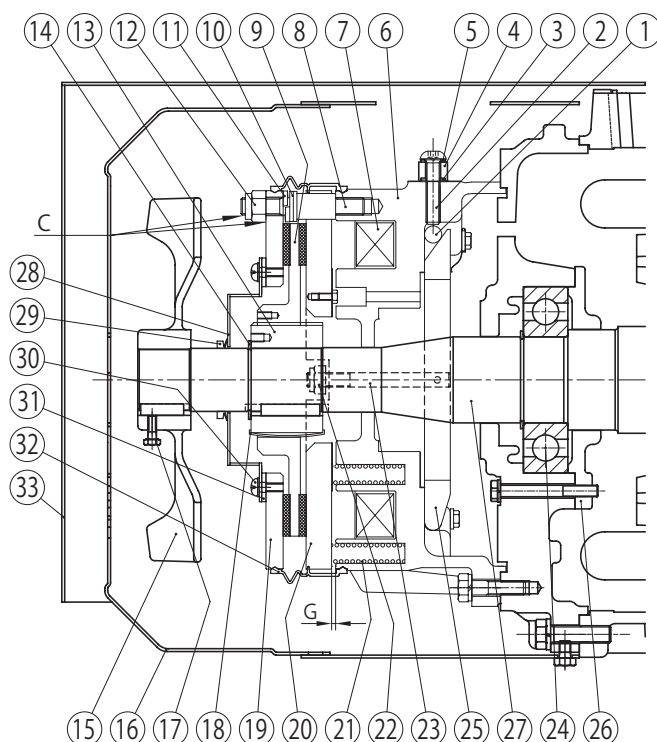


Figure 8-26

Part Number	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release protection spacer
5	Seal washer
6	Stationary core
7	Electromagnetic coil
8	Stud bolt
9	Brake lining
10	Adjusting washer
11	Spring washer
12	Gap adjusting nut
13	Boss
14	Shaft-retaining C-ring
15	Fan
16	Cover
17	Fan set screw
18	Leaf spring
19	Fixed plate
20	Armature plate
21	Spring
22	Nut
23	Tap-end stud
24	Ball bearings
25	Release lever
26	Bearing cover
27	Motor shaft
28	Waterproof cover
29	V-ring
30	Waterproof cover attachment bolts
31	Waterproof cover gasket
32	Waterproof seal
33	Outdoor cover

- Gap Inspection

- (1) Remove the outdoor cover [33] and the cover [16].
- (2) Loosen the fan set screw [17] and remove the fan [15].
- (3) Remove the waterproof seal [32].
- (4) Insert a gap gauge between the stationary core [6] and the armature plate [20] and measure the gap. Measure in 3 locations around the circumference.
- (5) Adjustment is required if the gap value is near the limit.

Note: The outdoor cover [33] for the vertical types has a different shape.

- Gap Adjustment

- (1) Remove the outdoor cover [33] and the cover [16].
- (2) Loosen the fan set screw [17] and remove the fan [15].
- (3) Pull off the V-ring [29].
- (4) Remove the waterproof seal [32].
- (5) Insert a gap gauge between the stationary core [6] and the armature plate [20] and rotate to the right the gap adjusting nuts [12] that are attached to ends of the stud bolts [8]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [10]. There are 3 gap adjusting nuts [12]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (6) Turn the power on and off to check brake action.
- (7) Attach the waterproof cover [26] so that the gap (A) between its hole and the motor shaft [27] is nearly uniform. (Only when the waterproof cover [26] has been removed)
- (8) Clean the surface of the waterproof seal [32] to remove impurities.
- (9) As shown in the construction diagram, install the waterproof seal [32] between the stationary core [6] and the fixed plate [19]. (Be careful that the waterproof seal [32] does not meander. Otherwise water could leak in.)
- (10) Attach the V-ring [29]. Wipe off the lip and surface near the lip of the V-ring [29], lightly coat the lip surface with grease, and attach. Observe the attaching dimension (B = 7mm).
- (11) Thoroughly coat the gap (C) (the gap between adjusting nuts [12] and the stud bolts [8], and the gap between stud [8] bolts and the fixed plate [19].) with waterproof adhesive (Three Bond 1102).
- (12) Attach the fan [15] and cover [16] and outdoor cover [33].

Gap Value G (mm)	
Required value (original value)	Limit value
0.6 - 0.7	1.5



■ ESB-250, ESB-250-2 (Outdoor Type)

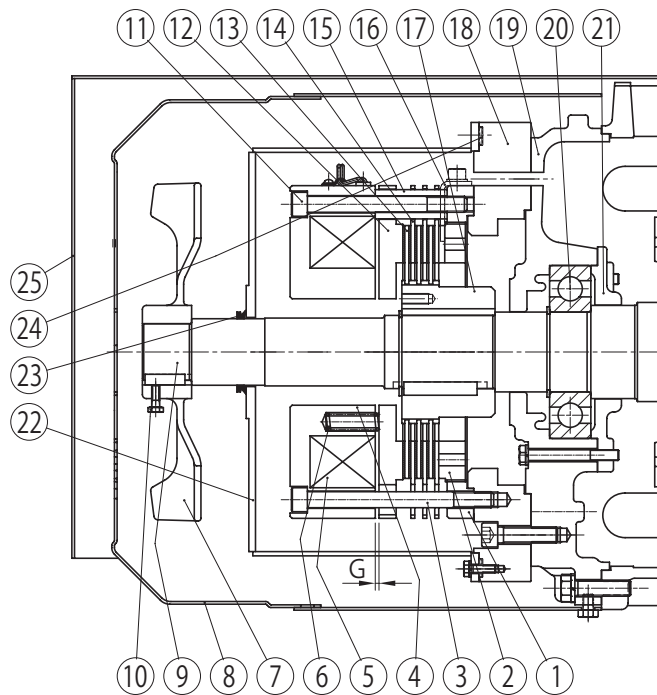


Figure 8-27

Part Number	Part Name
1	Center ring
2	Gap adjusting screw
3	Attachment bolt
4	Field
5	Brake coil
6	Actuating spring
7	Fan
8	Cover
9	Motor shaft
10	Fan set screw
11	Lock bolt
12	Armature
13	Inner disc
14	Outer disc
15	Spacer bush
16	Stopper
17	Hub
18	Brake adapter plate
19	Opposite drive end cover
20	Opposite drive end bearing
21	Opposite drive end bearing cover
22	Brake cover
23	V-ring
24	Brake cover gasket
25	Outdoor cover

- Notes: 1. The motor for separately ventilated type has a different shape.
2. There are 3 of [13][14] for ESB-250 (horizontal type), and 2 for ESB-250-2 (vertical type).
3. The outdoor cover [25] for ESB-250-2 (vertical type) has a different shape.

Items	Specifications
Rated input voltage	AC200/220V 50/60Hz
Maximum input voltage	AC240V 50/60Hz
Minimum input voltage	AC170V 50/60Hz
Standard output voltage	Instantaneous voltage DC180V (for AC200V input)
	Steady voltage DC90V (for AC200V input)
Maximum output current	DC1.8A (Steady output)
Over excitation time	0.4 - 1.2s
Insulation resistance	100MΩ or larger (When measured with 1000V megohmmeter)
Insulation withstand voltage	AC2000V for one time or more
Maximum frequency	Inching (When on-time 1.2 sec or less): 8 cycles/min
	Steady (When on-time exceeds 1.2 sec): 30 cycles/min
Allowable ambient temperature	-20°C to 60°C

■ Accessory Rectifier (DC Power Supply Unit) Model HD-110M3

Outline Drawing

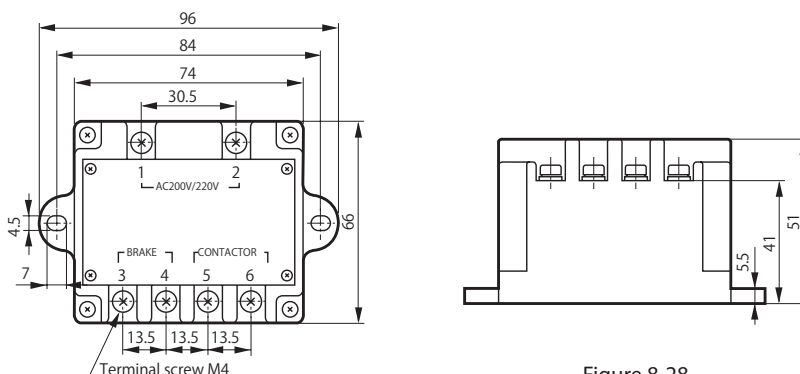
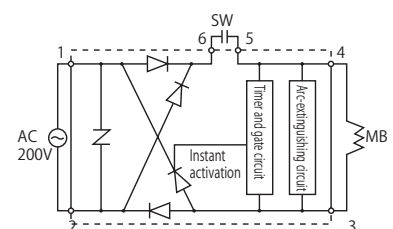


Figure 8-28

Internal Circuit (Diagram)



Notes: 1. Model HD-110M3 is an indoor model. Take care to avoid water, etc.

2. Transformer is necessary for operation with 400V class power source. Secondary voltage is 200 – 220V.

- Gap Inspection

- (1) Remove the outdoor cover [25] and the cover [8].
- (2) Loosen the fan set screw [10] and remove the fan [7].
- (3) Pull off the V-ring [23] and remove the brake cover [22].
- (4) Insert a gap gauge between the field [4] and the armature [12] and measure the gap. Measure in 4 locations around the circumference.
- (5) Adjustment is required if the gap value is near the limit.

Gap Value G (mm)	
Required value (original value)	Limit value
0.7	2.0

- Gap Adjustment

- (1) Manually release the brake with following the procedure on P70.
- (2) Loosen the stopper [16] on the periphery of the center ring [1], and remove. This will free the gap adjusting screws [2].
(See Figure 8-29)
- (3) Insert a gap adjustment bar (An angle plate should be prepared by customer. See Figure 8-31) into the groove of adjustment screw [2] between the outer disk (14) and the center ring (1)
Rotating the gap adjusting bar to the left as seen from the field [4] side, will narrow the gap. (See Figure 8-30)
- (4) Six attachment bolts [3] and lock bolts [11] alternately pass through the space between the outer disc [14] and the center ring [1].
Rotating the gap adjustment bar will make the bar touch these bolts. There are 8 equally distributed holes for gap adjusting screws [2]. Adjust the gap G to the required value by repeating (3) each time the gap adjusting bar contacts a bolt.
- (5) Select the point where hole and screw hole are closest to the required gap and attach the stopper [16] there.
- (6) After returning the manual brake release to its original state, turn power on and off to check brake action.
- (7) Attach the brake cover [22], V-ring [23], fan [7], fan set screw [10], cover [8] and outdoor cover [25]. At this time coat the fan set screw [10] with Three Bond TB2365.

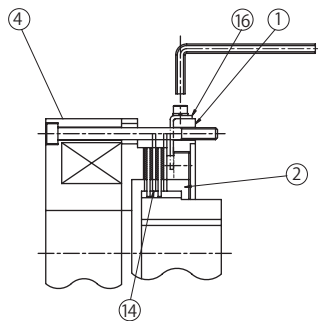


Figure 8-29

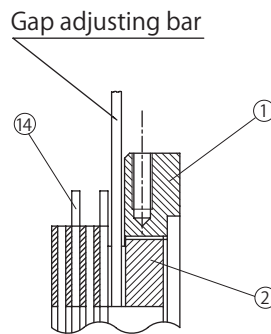


Figure 8-30

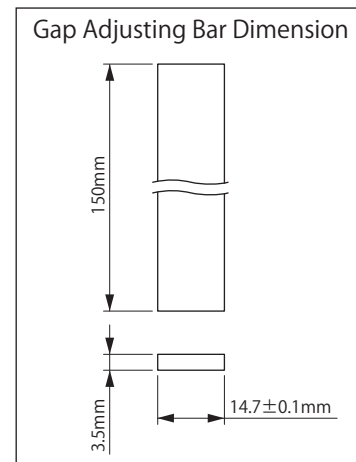


Figure 8-31

8-9 Removing and Installing One-Touch Release Lever

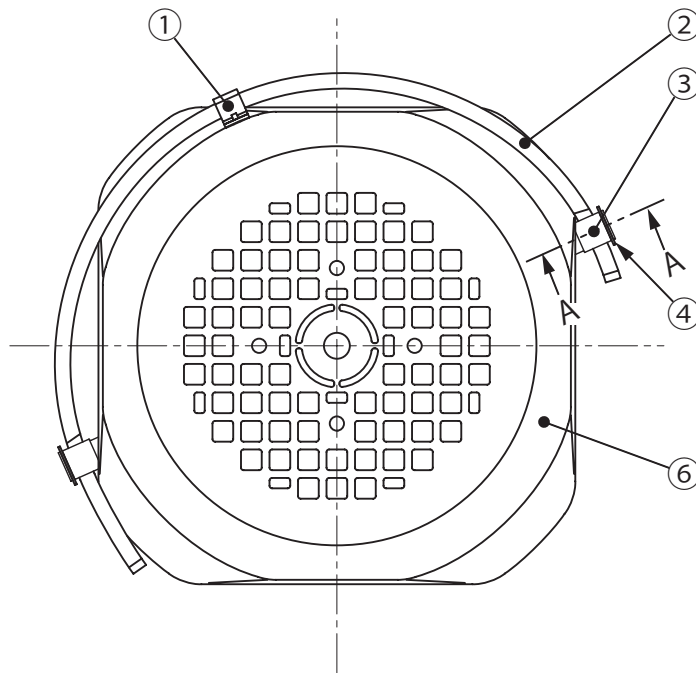
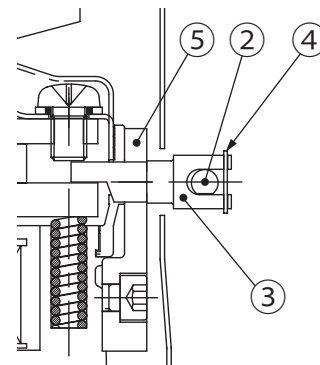


Figure 8-32

Part Number	Part Name
1	Holder
2	Release lever
3	Release pin
4	Retaining ring
5	Brake release
6	Fan cover



A-A

- Removing One-Touch Release Lever

- (1) Removing retaining ring [4] (E-retaining ring or shaft retaining C-ring) in 2 locations.
- (2) Remove release lever [2] from holder [1].
- (3) Expand release lever [2] to the outside from each side of the lever in turn, removing it from release pin [3]. (Do not expand the release lever overly).
- (4) Remove release pin [3].
- (5) Remove fan cover [6].

- Installing One-Touch Release Lever

- (1) Attach fan cover [6].
- (2) Insert release pin [3] into brake release [5] with preventing pin to drop.
- (3) Attach release lever [2] to U-hole of release pin [3] by extending release lever [2] to the outside from each side of the lever in turn.
- (4) Attach retaining ring [4].
- (5) Check that brake is released by pushing release lever [2].
- (6) Fix release lever [2] to holder [1].

8-10 Changing the Brake Lining and Inner Disc

If the following conditions occur, ask the nearest authorized maintenance shop to exchange the brake linings and inner discs with new ones.



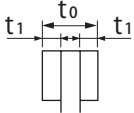
(1) FB Brakes (excluding FB-05A1), ESB-250, ESB-250-2

When the thickness of brake lining (FB brake) or inner disc (ESB-250, ESB-250-2) reaches the use limit thickness in Table 8-8

(2) FB-05A1

When the brake gap still reaches the limit after the gap adjustment (see P45 and P56)

Table 8-8 Brake Lining, Inner Disc Dimensions

Brake Type	Brake Lining Inner Disc Dimension Drawing	Original Thickness		Usable Thickness Limit	
		T ₀ (mm)	T ₁ (mm)	T ₀ (mm)	T ₁ (mm)
FB-05A1		7.0	—	—	—
FB-1D		8.8		6.0	
FB-1E		9.0		7.8	
FB-1HE FB-2E		10.4		8.0	
FB-3E FB-4E		10		8.4	
FB-5E FB-8E		11		6.0	
FB-10E FB-15E		16		7.0	
FB-20 FB-30				12	
ESB-250 ESB-250-2		6.0	1.5	3.6	0.3

- Brake torque may not be at the prescribed level during initial operation. In such a case turn the brake on and off under as light load as possible to contact the brake's friction surfaces.
- When changing the brake lining, replace the boss and leaf springs (for FB-5E – FB-15E, FB-20, FB-30, the gap adjusting nuts are included) as a set.
- After 2 million or more cycles of operation, (for FB-30, ESB-250 and ESB-250-2 1 million cycles or more), or after 10 years or more have passed since shipment from the factory, inspect to check whether continued operation is possible, even if the lining is not at the usable thickness limit.
- Check the following items concerning the condition of each mechanical part.
 - Are the linings split or chipped?
 - Is there any peeling or gap between the lining and the disc?
 - Does the brake lining or the spline of the inner disc exhibit cracking, chipping, or stepped wear?
 - Is there any stepped wear on the surfaces around the stud bolts or armature plate?
- Change the brake lining, even if it has not reached the usable thickness limit, in following cases. (1) if 10 or more years have elapsed since the manufacturing date, (2) the brake is used outdoors or in a high-humidity environment, (3) if it is stored or rested for a long period of time.

8-11 Changing the V-Ring and Waterproof Seal (Outdoor Type)

V-rings and waterproof seals degrade over the years, losing their waterproofing abilities. As a guideline contact the nearest authorized maintenance shop every 3 years. If the sliding surfaces of oil seals or V-rings show signs of wear or corrosion, replace them with new ones. Sliding surfaces are made of carbon steel, so rain water, condensation and other factors could cause rust to form and spread. Because this could lead to oil seal damage, take on-going rust prevention measures.

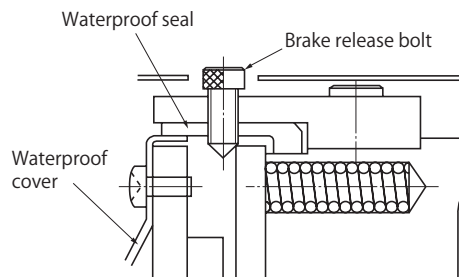
8-12 Manually Releasing the Brake

To manually release the brake with its power off, operate the brake release mechanism as shown below.

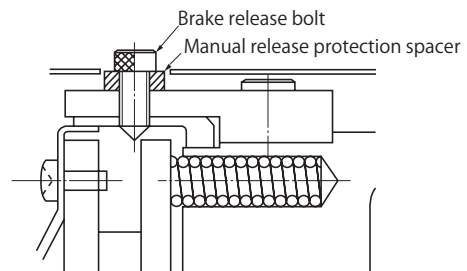
■ FB Brakes (excluding FB-20 and FB-30) (FB-05A1 is an option)

- (1) First, remove the brake release bolts from the 2 opposing angles and remove the release prevention spacers. Reinsert the bolts and rotate them with a hexagonal wrench to release the brake. Be careful not to over rotate the brake release bolts. (Rotate the brake release bolts while checking to see if the brake is released.) (See Figures 8-33, 8-34)
- (2) After releasing the brake, to return it to its original condition, for safety, return the manual release prevention spacers that were removed in (1) to their original positions. (See Figure 8-34)
- (3) This table shows brake release bolt sizes.

Brake Type	Bolt Size
FB-05A1, FB-1D	M5
FB-1E - FB-2E	M6
FB-3E - FB-4E	M8
FB-5E - FB-15E	M10



When Released
Figure 8-33



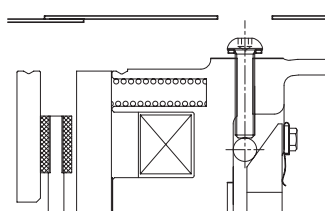
When Operating
Figure 8-34

Note: Indoor types do not come with waterproof seals or waterproof covers.

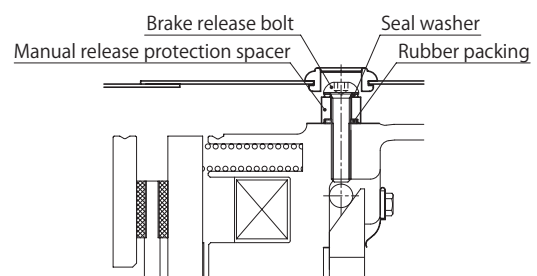
■ FB-20, FB-30

- (1) In the case of outdoor types, remove the lid on the window part of the outdoor cover [33]. Remove the grommet [28] (indoor type), remove the brake release bolt [2] by using a hexagonal wrench (for an M8 hole bolt), and remove the rubber gasket [3] and the manual release prevention spacer [4]. The brake will release when you again rotate the bolt by using the hexagonal wrench. Be careful not to over rotate the brake release bolt. (Rotate the brake release bolt [2] while checking to see if the brake is released.) (See Figure 8-35)
- (2) After releasing the brake, to return it to its original condition, for safety, return the manual release prevention spacer and the rubber gasket [3] that were removed in (1) to their original positions, and firmly tighten the brake release bolt [2]. (See Figure 8-36) Next, re-attach the grommet [28] (indoor type) in its original state. In the case of outdoor types, attach the lid on the window part of the outdoor cover [33] as it was before.

- Note that if the rubber gasket [3] and the seal washer [5] for the brake release bolt [2] unit are not attached when returning to the original state, dust-proofing and waterproofing capabilities will be lost. Also, firmly tighten the brake release bolt [2]. Otherwise waterproofing capability may be lost. Also make certain to return the grommet [28] (indoor type) or outdoor cover [33] window lid (outdoor type) to their original states.
- If the machine is operated when the brake release bolt has not been returned to its original position, in the worst case it is possible that the manual release would function before maximum gap is obtained, and the brake would cease to function. Therefore, make certain to always operate with the manual release prevention spacer attached.



When Released
Figure 8-35



When Operating
Figure 8-36

■ FB-250, ESB-250-2

- (1) In the case of outdoor types, remove the outdoor cover [25]. Remove the cover [8], fan [7] and brake cover [22] (Outdoor Type).
- (2) Insert M12×65 hexagon socket head bolts (prepared by customer) through the manual releasing holes, to the field. (Note that if the hexagon socket head bolts are too long, they will hit the outer disc and deform it.)
- (3) There are two manual release holes at opposing angles. By using a hexagonal wrench, tighten the bolts equally in turn in turn.
- (4) To release the brake, tighten the bolts until the armature and field stick together.
- (5) After returning the brake to its original state, attach the brake cover [22] (outdoor type), fan [7], and cover [8].

At this time coat the fan set screw [10] with Three Bond TB2365.

In the case of outdoor types, attach the outdoor cover as it was before.

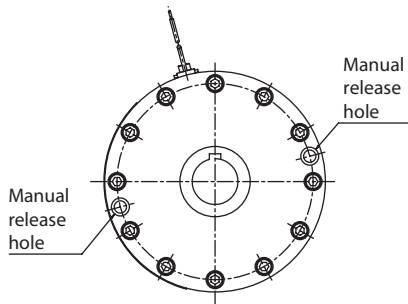


Figure 8-37

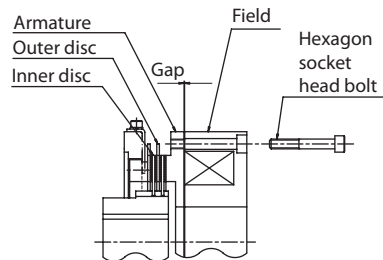


Figure 8-38

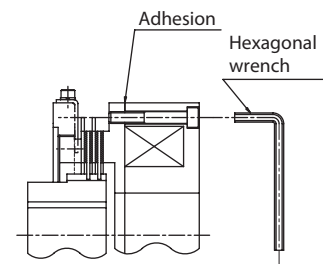


Figure 8-39

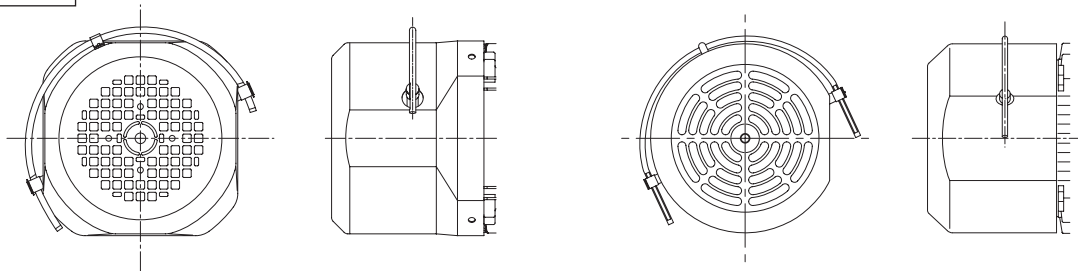
■ One-Touch Release Lever Type (Excluding FB-20, FB-30. FB-05A1 is optional)

All you need to do to release the brake is push the release lever over. (See Figure 8-40)

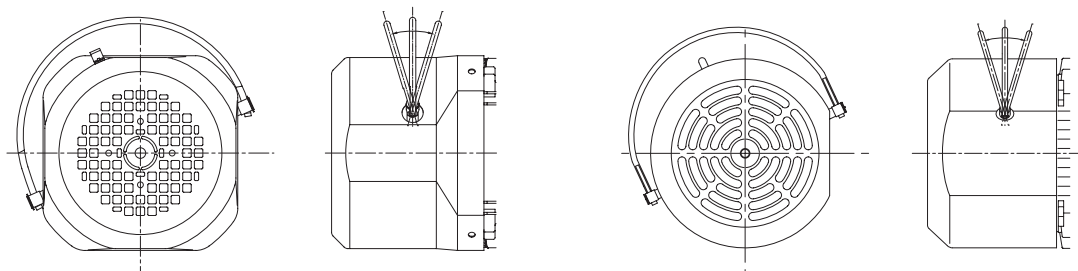
- (1) To release the brake, pull the release lever out of the holder, and push it toward the load or anti-load side.
(Some specifications do not allow pushing the release lever toward the load side.)
Be careful not to push the lever too far. Pushing the lever too far could damage the brake.
(Push the release lever while checking to see if the brake is released.)
- (2) When operating the motor, make certain to return the lever to its original position and set it inside the holder. Start operation after confirming that the brake operates properly.

Note: While the lever is held down, the brake remains released. When the lever is released, the brake is applied.

When Operating



When Brake is Manually Released



Premium-Efficiency Motor

Other than Premium-Efficiency Motor

Figure 8-40

9. Troubleshooting **Common**

If any abnormal condition occurs, refer to Table 9-1, 9-2 and promptly take appropriate measures.

If these actions do not solve the issue, immediately contact the nearest authorized maintenance shop.

Table 9-1 Troubleshooting

Problem			Cause	Correction
The motor will not operate under no load			Power failure	Contact the electric power company.
			Defective electric circuit	Check the circuit.
			Blown fuse	Replace the fuse.
			Protective device is engaged	Fix the problem and re-operate.
			Load locking	Check the load and safety device.
			Poor switch contact	Adjust the contact unit.
			Motor stator coil disconnect	Confer with authorized maintenance shop.
			Bearing damage	Confer with authorized maintenance shop.
			3-phase is functioning as single-phase	Check the power supply with a voltmeter. Check the motor, transformer coil, contactor, fuse, etc. and repair or replace them.
			Friction surface of brake is corroded	Request brake cleaning from an authorized maintenance shop.
			Incorrect brake gap adjustment	Re-adjust brake gap. (See P45 - 66.)
The motor rotates without a load but the slow speed shaft does not rotate.			Damage to gear unit due to overloading of gears, etc.	Confer with authorized maintenance shop.
The slow speed shaft turns with no load	When a load is applied	The switch overheats	Insufficient switch capacity	Replace with a specified switch.
			Overload	Decrease the load to the specified value.
		Fuse tripping	Insufficient fuse capacity	Replace with a specified switch.
			Overload	Decrease the load to the specified value.
		The speed will not increase and the motor is overheating.	Voltage drop	Contact the electric power company.
			Overload	Decrease the load to the specified value.
			Short-circuited motor stator coil	Confer with authorized maintenance shop.
		It stops.	The key is not inserted	Insert key.
			Bearing burnout	Confer with authorized maintenance shop.
			Poor adjustment of protection device	Adjust the protection device.
	The motor runs in the reverse direction.	Wiring error	Change the connection.	
		Fuse tripping	The lead wire is short circuited.	Confer with authorized maintenance shop.
			Poor contact between motor and starter	Make good connection.
Excessive temperature rise			Overload	Decrease the load to the specified value.
			Voltage drop or rise	Contact the electric power company.
			The ambient temperature is high	Improve the ventilation method.
			Damaged bearing	Confer with authorized maintenance shop.
			Abnormal wear of reducer parts due to over-load, etc.	Confer with authorized maintenance shop.
Oil leakage	Oil and fat blot or drip from the seal section of input / output shaft.		Grease applied to the oil seal seeps out at first.	Wipe off around the oil seal, and observe.
	Oil/grease leaks from the contact surfaces of frame and outside cover.		Damaged oil seal or damaged shaft (or collar)	Confer with authorized maintenance shop.
	Leakage of oil and grease from the mating faces of the casing, etc.		Loose fastener bolts	Tighten fastener bolts correctly.
	Oil/grease leaks into motor.		Damaged oil seal or oil thrower	Consult with authorized maintenance shop.
			Excessive oil/grease supply	Remove excess oil/grease.

Table 9-2 Troubleshooting

Problem		Cause	Correction
Abnormal sound Excessive vibration		Dust and foreign matter in bearings, or damaged bearings	Consult with authorized maintenance shop.
		Reducer parts grinding on foreign matter	Consult with authorized maintenance shop.
		Reducer parts are damaged	Consult with authorized maintenance shop.
		Warping of housing because the installation surface is not flat	Make the installation base flat or make adjustment using liners, etc.
		Resonance due to insufficient rigidity of the installation base	Reinforce the installation base to increase rigidity.
		Nonalignment of the center of axle with driven machine	Align the center of axle.
		Transmission of vibration from the driven machine	Individually operate the product to check the source of the sound.
Abnormal motor sounds		Foreign objects have entered	Consult with authorized maintenance shop.
		Bearing damage	Consult with authorized maintenance shop.
		Improper brake gap adjustment	Adjust the brake gap. (See P45 - 66.)
		Wear of the brake lining or inner disc	Request brake lining and inner disc replacement from an authorized maintenance shop.
		Brake unit electromagnetic coil burnout	Consult with authorized maintenance shop.
		Rectifier damage	Consult with authorized maintenance shop.
		A leaf spring in the brake boss unit has come off or is damaged.	Consult with authorized maintenance shop.
Brake is ineffective	Does not activate	Forgot to restore the brake release bolt to its original position	Restore the release bolt.
		Improper adjustment after disassembly	Request authorized maintenance shop to re-adjust.
	Slips (Braking takes a long time)	Not using the quick braking circuit	Change to quick braking circuit. (See P25 - 34.)
		Foreign objects or oil adhesion in brake lining unit and inner disc	Request cleaning from authorized maintenance shop.
		Wear of the brake lining or inner disc	Adjust the brake gap. Request brake lining and inner disc replacement from an authorized maintenance shop.
		Brake gap not uniform	Adjust the brake gap.
		Overload	Decrease the load to the specified value.
		Brake release bolt not sufficiently restored	Restore the release bolt.
Inverter Tripping Inverter	Overcurrent shut-off	Sudden speed changes	Increase the time for speed changes.
		Extreme load fluctuation	Decrease load fluctuation.
	Overcurrent due to ground fault	Ground fault on output side	Take measures to prevent ground fault.
	Direct current overcurrent	Short on output side	Take measures to prevent short. Inspect wiring.
	Regenerative overvoltage shut-off	Sudden speed reduction	Increase the time for speed reduction. Decrease brake frequency.
	Thermal operation	Overload	Decrease the load to the specified value.

10-1 Construction

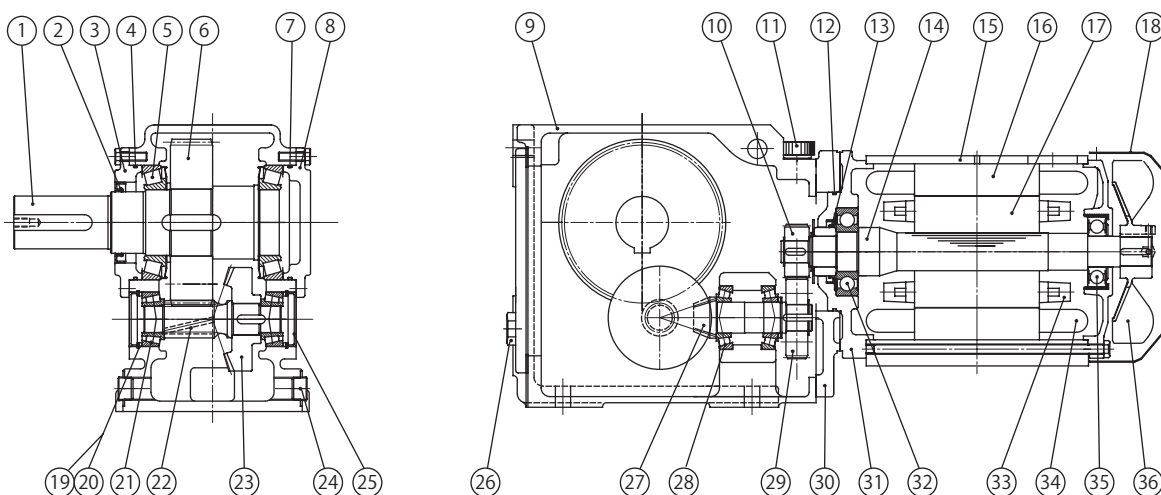


Figure 10-1 KHHM Type (Gearmotor) (E.g.: Frame Size 72R-K1)

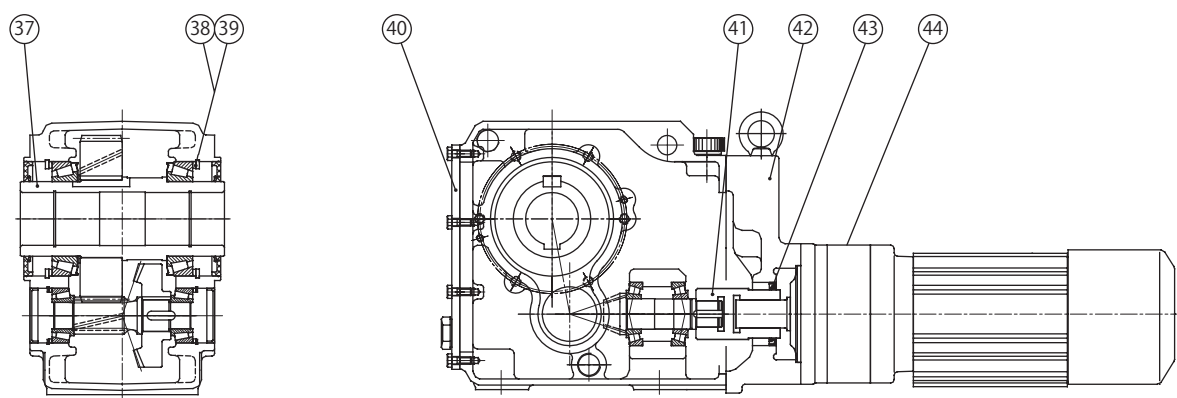


Figure 10-2 KHYM Type (Gearmotor) (E.g.: Frame Size 72DA-Y1)

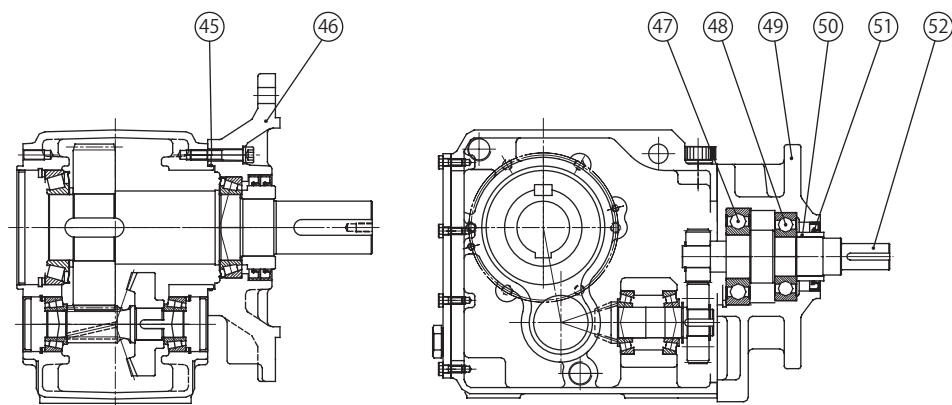


Figure 10-3 KHF Type (Reducer) (E.g.: Frame Size 72L-F1)

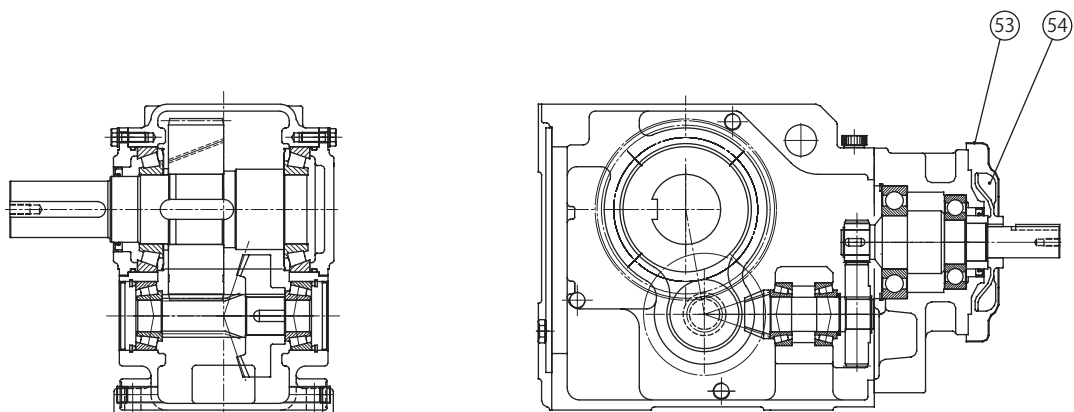


Figure 10-4 KHH Type (Reducer) (E.g.: Frame Size 115R-K1)

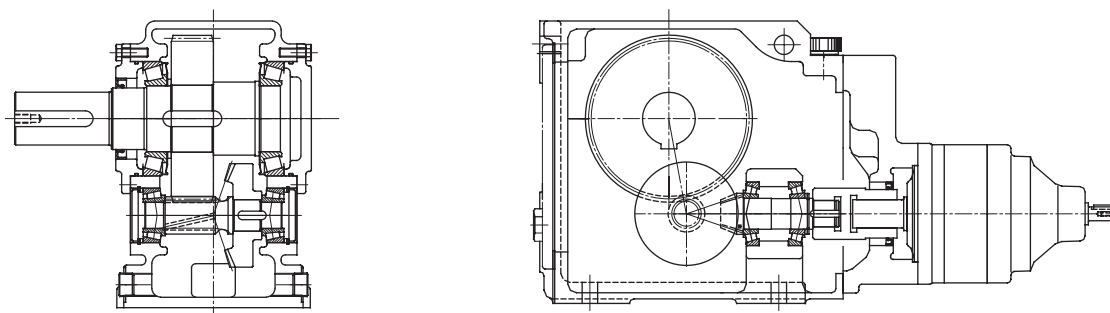


Figure 10-5 KHH Type (Reducer) (E.g.: Frame Size 72DAR-K1)

Table10-1 Principal Parts

Part Number	Part Name	Part Number	Part Name	Part Number	Part Name	Part Number	Part Name
1	Output Shaft	15	Motor frame	29	Gear (first stage)	43	Oil seal
2	Oil seal	16	Stationary core	30	Joint plate	44	CYCLO reducer
3	Output side cover (1)	17	Rotor core	31	Motor joint cover	45	O-ring
4	O-ring	18	Fan cover	32	Bearing	46	Flange
5	Bearing	19	Snap ring for C-type hole	33	Rotor conductor	47	Bearing
6	Gear (third stage)	20	Spacer	34	Stationary coil	48	Bearing
7	O-ring	21	Bearing	35	Bearing	49	Input shaft cover
8	Output side cover (2)	22	Pinion (third stage)	36	Fan	50	Collar
9	Casing	23	Bevel gear	37	Hollow shaft	51	Oil seal
10	Pinion (first stage)	24	Oil drain plug	38	Snap ring for C-type hole	52	Input shaft
11	Oil filler plug	25	Seal cap	39	Spacer	53	Fan cover
12	O-ring	26	Oil gauge	40	Casing cover	54	Fan
13	Oil seal	27	Bevel pinion	41	Coupling bush		
14	Motor shaft	28	Bearing	42	Coupling cover		

The scope of warranty of our delivered products is limited only to what we manufactured.

Warranty (period and description)

Period	The warranty period applies only to new products and represents 18 months after the shipment or 12 months after the actual operation, whichever is shorter.
Description	<p>If the product failed within the warranty period, in the case where mounting is done properly, connection and maintenance & administration are followed according to the maintenance manual, and the product is properly run based on the specification on the catalog or under conditions agreed between us, we will repair or provide an alternative product at our discretion for free of charge, except the exclusions below</p> <p>However, as far as the product is connected with customers' other devices, we will not indemnify those expenses on dismounting from/mounting on the devices, etc. and other associated construction expenses, transportation expenses and opportunity loss and operation loss the customers suffered from, and other indirect damages.</p>
Exclusion from the warranty	<p>The following items will be excluded from the warranty:</p> <ol style="list-style-type: none"> 1. A breakdown resulting from defects in the mounting of the product and connection with other devices, etc. 2. A breakdown resulting from insufficient maintenance & administration and improper handling of the product, including a case that the product is not stored according to our defined storage manual. 3. A breakdown resulting from operation which does not fall within our specification and other operation conditions and use status we hardly can know or a failure caused by the use of lubricant which we do not recommended. 4. A breakdown resulting from defects, special specification, etc of device prepared and connected by customer. 5. A breakdown resulting from modification or reconstruction of the product. 6. A breakdown resulting from defects in parts supplied or specified by customers. 7. A breakdown caused by inevitable force including earthquake, fire, flood disaster, salt damage, gas damage, and lightning strike, etc. 8. Warranty of natural wear and tear, abrasion, and deterioration of consumable parts such as a bearing and oil seal, etc. under normal usage. 9. A breakdown caused for reasons not attributable to each of the above item.

Worldwide Locations

U.S.A Sumitomo Machinery Corporation of America (SMA) 1453 Cornwall Blvd. Chesapeake, VA 23323, U.S.A. TEL (1)757-485-3355 FAX (1)757-485-7490	Austria Sumitomo (SHI) Cyclo Drive Germany GmbH (SCG) SCG Branch Austria Office Gruentalerstraße 30A, 4020 Linz, Austria TEL (43)732-330958 FAX (43)732-331978	Korea Sumitomo (SHI) Cyclo Drive Korea, Ltd. (SCK) Room #913, Royal Bldg, Saemun-ro 5 gil 19, Jongro-gu, Seoul, Korea 03173 TEL (82)2-730-0151 FAX (82)2-730-0156
Canada SM Cyclo of Canada, Ltd. (SMC) 1453 Cornwall Road, Oakville, Canada ON L6J 7T5 TEL (1)905-469-1050 FAX (1)905-469-1055	Belgium Hansen Industrial Transmissions NV (HIT) Leonardo da Vincilaan 1, Edegem, Belgium TEL (32)34-50-12-11 FAX (32)34-50-12-20	Taiwan Tatung SM-Cyclo Co., Ltd. (TSC) 22 Chungshan N. Road 3rd., Sec. Taipei, Taiwan 104, R.O.C. TEL (886)2-2595-7275 FAX (886)2-2595-5594
Mexico SM Cyclo de Mexico, S.A. de C.V. (SMME) Av. Desarrollo 541, Col. Finsa, Guadalupe, Nuevo León, México, CP67132 TEL (52)81-8144-5130 FAX (52)81-8144-5130	France SM-Cyclo France SAS (SMFR) 8 Avenue Christian Doppler, 77700 Serris, France TEL (33)164171717 FAX (33)164171718	Singapore Sumitomo (SHI) Cyclo Drive Asia Pacific Pte. Ltd. (SCA) 15 Kwong Min Road, Singapore 628718 TEL (65)6591-7800 FAX (65)6863-4238
Brazil Sumitomo Industrias Pesadas do Brasil Ltda. (SHIB) Rodovia do Acucar (SP-075) Km 26 Itu, Sao Paulo, Brasil TEL (55)11-4886-1000 FAX (55)11-4886-1000	Italy SM-Cyclo Italy Srl (SMIT) Via dell' Artigianato 23, 20010 Cornaredo (MI), Italy TEL (39)293-481101 FAX (39)293-481103	Philippines Sumitomo (SHI) Cyclo Drive Asia Pacific Pte. Ltd. Philippines Branch Office (SMPH) C4 & C5 Buildings Granville Industrial Complex, Carmona, Cavite 4116, Philippines TEL (63)2-584-4921 FAX (63)2-584-4922
Chile SM-Cyclo de Chile Ltda. (SMCH) Camino Lo Echevers 550, Bodegas 5 y 6, Quilicura, Región Metropolitana, Chile TEL (56)2-892-7000 FAX (56)2-892-7001	Spain SM-Cyclo Iberia, S.L.U. (SMIB) C/Gran Vía Nº 63 Bis, Planta 1, Departamento 1B 48011 Bilbao–Vizcaya, Spain TEL (34)9448-05389 FAX (34)9448-01550	Vietnam SM-Cyclo (Vietnam) Co., Ltd. (SMVN) Factory 2B, Lot K1-2-5, Road No. 2-3-5A, Le Minh Xuan Industrial Park, Binh Chanh Dist., HCMC, Vietnam TEL (84)8-3766-3709 FAX (84)8-3766-3710
Argentina SM-Cyclo de Argentina S.A. (SMAR) Ing Delpini 2230, B1615KGB Grand Bourg, Malvinas Argentinas, Buenos Aires, Argentina TEL (54)3327-45-4095 FAX (54)3327-45-4099	United Kingdom SM-Cyclo UK Ltd. (SMUK) Unit 29, Bergen Way, Sutton Fields Industrial Estate, Kingston upon Hull, HU7 0YQ, East Yorkshire, United Kingdom TEL (44)1482-790340 FAX (44)1482-790321	Malaysia SM-Cyclo (Malaysia) Sdn. Bhd. (SMMA) No.7C, Jalan Anggerik Mokara 31/56, Kota Kemuning, Seksyen 31, 40460 Shah Alam, Selangor Darul Ehsan, Malaysia TEL (60)3-5121-0455 FAX (60)3-5121-0578
Guatemala SM Cyclo de Guatemala Ensambladora, Ltda. (SMGT) Parque Industrial Unisur, 0 Calle B 19-50 Zona 3, Bodega D-1 Delta Bárcenas en Villa Nueva, Guatemala TEL (502)6648-0500 FAX (502)6631-9171	Turkey SM Cyclo Turkey Güç Aktarım Sis. Tic. Ltd. Sti. (SMTR) Barbaros Mh. Çiğdem Sk. Ağaoğlu, Office Mrk. No:1 Kat:4 D.18 Ataşehir, İstanbul, Turkey TEL (90)216-250-6069 FAX (90)216-250-5556	Indonesia PT. SM-Cyclo Indonesia (SMID) Jalan Sungkai Blok F 25 No. 09 K, Delta Silicon III, Lippo Cikarang, Bekasi 17530, Indonesia TEL (62)21-2961-2100 FAX (62)21-2961-2211
Colombia SM Cyclo Colombia, S.A.S. (SMCO) Parque Industrial Celta, Km 7.0 Autopista Medellín, Costado Occidental, Funza, Cundinamarca, Colombia TEL (57)1-826-9766	India Sumi-Cyclo Drive India Private Limited (SDI) Gat No. 186, Raison Industrial Park, Alandi Markal Road, Fulgaon-Pune, Maharashtra, India TEL (91)96-0774-5353	Thailand SM-Cyclo (Thailand) Co., Ltd. (SMTH) 195 Empire Tower, Unit 2103-4, 21st Floor, South Sathorn Road, Yannawa, Sathorn, Bangkok 10120, Thailand TEL (66)2670-0998 FAX (66)2670-0999
Peru SM Cyclo de Perú, S.A.C (SMPE) Jr. Monte Rosa 255, Oficina 702, Lima, Santiago de Surco, Perú TEL (51)1-713-0342 FAX (51)1-715-0223	China Sumitomo (SHI) Cyclo Drive Shanghai, Ltd. (SCS) 11F, SMEG Plaza, No. 1386 Hongqiao Road, Changning District, Shanghai, China 200336 TEL (86)21-3462-7877 FAX (86)21-3462-7922	Australia Sumitomo (SHI) Hansen Australia Pty. Ltd. (SHAU) 181 Power St, Glendenning, NSW 2761, Australia TEL (61)2-9208-3000 FAX (61)2-9208-3050
Germany Sumitomo (SHI) Cyclo Drive Germany GmbH (SCG) Cyclostraße 92, 85229 Markt Indersdorf, Germany TEL (49)8136-66-0 FAX (49)8136-5771	Hong Kong SM-Cyclo of Hong Kong Co., Ltd. (SMHK) Room 19, 28th Floor, Metropole Square, No.2 On Yiu Street, Shatin, New Territories, Hong Kong TEL (852)2460-1881 FAX (852)2460-1882	Japan Sumitomo Heavy Industries, Ltd. (SHI) ThinkPark Tower, 1-1 Osaki 2-chome, Shinagawa-ku, Tokyo 141-6025, Japan TEL (81)3-6737-2511 FAX (81)3-6866-5160