

CYCLO[®] Drive

Gearmotor

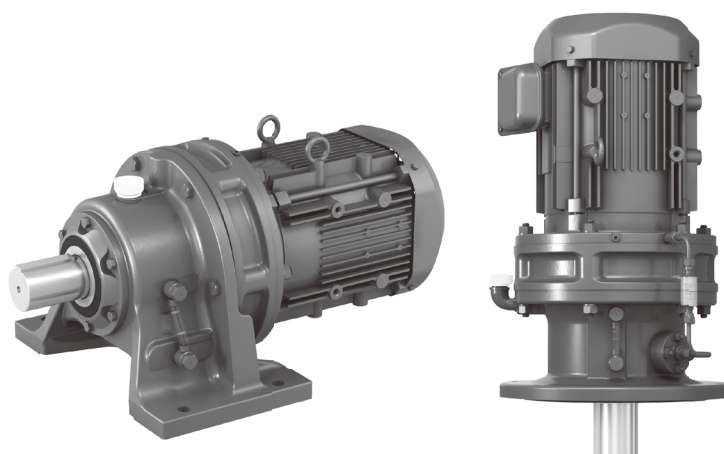
Reducer

CYCLO Drive for Servo Motors

Application Product

CYCLO Drive with Torque Limiter

CYCLO Drive with Special Vertical Base Mount



《CAUTION》

- These Products should be handled, installed and maintained by trained technicians.
Carefully read the maintenance manual before use.
- A copy of this maintenance manual should be sent to the actual user.
- This maintenance manual should be kept by the user for future reference.

Introduction: Safety Precautions

- Carefully read this maintenance manual and all accompanying documents before use (installation, operation, maintenance, inspection, etc.). Use the product after thoroughly understanding 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.



DANGER

- 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, please contact the nearest authorized maintenance shop.
- When using the equipment in conjunction with **explosion proof motor**, a technician with electrical expertise should supervise the transport, installation, plumbing, wiring, operation, maintenance and inspection of the equipment, so as to avoid a potentially hazardous situation that may result in electrical shock, fire, explosion, personal injury and/or damage to the equipment.
- When the unit is to be used in a system for human transport, a protecting device for human safety should be installed to prevent accidents resulting in personal injury, death, 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 falling; otherwise, personal injury, death, or damage to the equipment may result.



CAUTION

Please install loss prevention device such as oil pan to the machine which is vulnerable to oil especially (machine for food processing and machine for clean room, and so on) in case oil or grease leaks; otherwise, the product may fail because of oil leakage.

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

This maintenance manual is common for “gearmotors”, “reducers”, “CYCLO Drive for servo motor” and “the application products CYCLO Drive with Torque Limiter and CYCLO Drive with Vertical Base”.

The symbols shown below appear in the upper right or left corner of each page to indicate the classification. Please read the applicable pages.

On **Common** pages, regarding only specific specification, symbols are applied to indicate the contents about it.

Specifications	Common to All Specifications	Gearmotor		Reducer (Include Drive for Servo Motor)	Application Product
		Without Brake	With Brake		
Mark	Common				Application Product

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Application Product CYCLO Drive with Torque Limiter

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Application Product CYCLO Drive with Vertical Special Base Mount

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⚠ CAUTION

- Unpack the unit after verifying that it is positioned right side up; otherwise, injury may result.
- Verify that the unit received is 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, contact our 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?

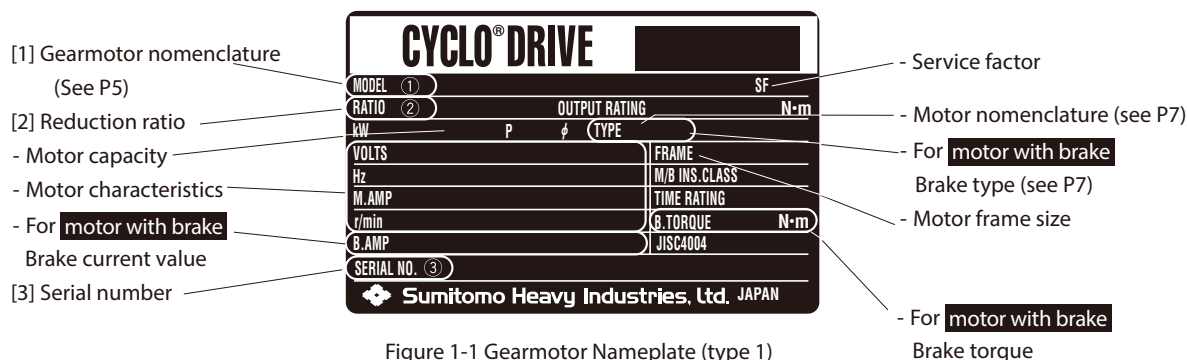
1-1 Reading the Nameplates

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

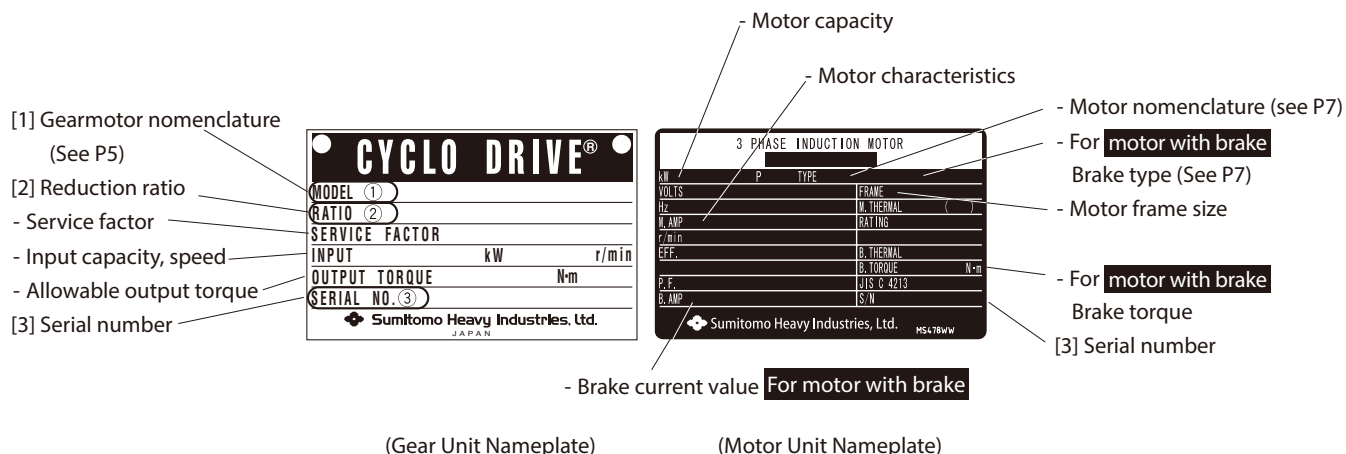
When contacting the company, please provide [1]. Gearmotor or reducer nomenclature, [2]. Reduction ratio, and [3]. Serial number.

(1) For Gearmotor

■ Nameplate Type 1: Gear Unit and Motor Unit are Combined.



■ Nameplate Type 2: Separate Nameplates for Gear Unit and Motor Unit.



(2) For Reducer

■ Nameplate Type 1

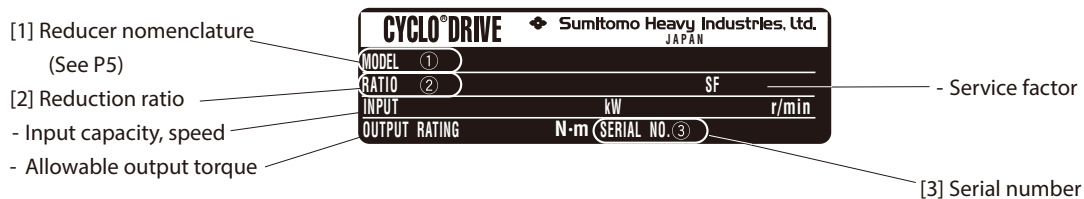


Figure 1-3 Reducer Nameplate (type 1)

■ Nameplate Type 2

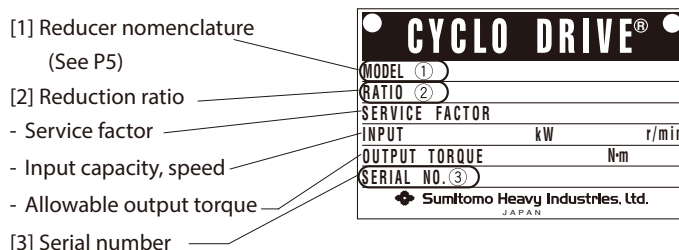


Figure 1-4 Reducer Nameplate (type 2)

(3) For the One Torque Limiter Equipped (motor unit nameplate is the same as in figure 1-2.)

■ Gear Unit Nameplate

Confirm that the preset torque value marked in the gear unit nameplate and the preset torque value marked on the adjustment indicator plate (see P84) are the same as the required specification.

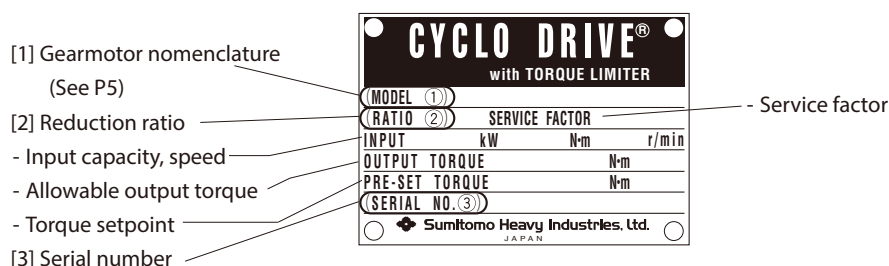


Figure 1-5 Torque Limiter Nameplate (Gear Unit Nameplate)

■ Alarm Torque Nameplate

With 2-point alarm configuration (double safety specification), an alarm torque nameplate is attached near the nameplate in figure 1-5.



Figure 1-6 Torque Limiter Nameplate (Alarm Torque Nameplate)

1-2 Checking Lubrication Method

Refer to “8-2 Confirmation of Lubrication Method” (P37) to confirm the lubrication method.

Oil lubricated machines are shipped without oil. Before operating, make certain to feed the recommended lubricating oil. (See P38–40)

1-3 Gearmotor, Reducer Nomenclature

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

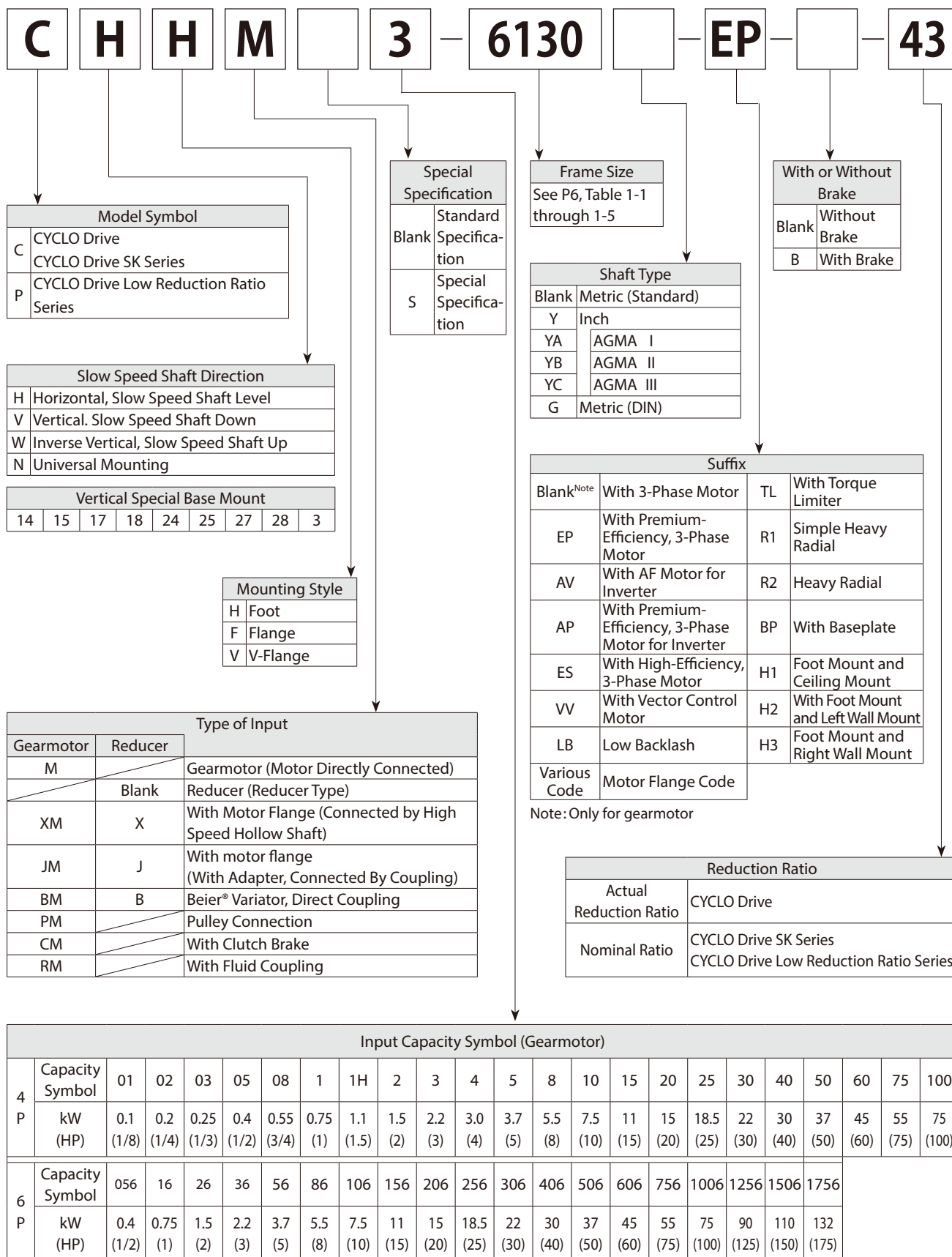


Table 1-1 SK Series Frame Sizes

Frame Size				
6070SK	6080SK	6090SK	6100SK	6110SK
6075SK	6085SK	6095SK	6105SK	6115SK

Table 1-2 Low Reduction Ratio Series Frame Sizes

Frame Size			
6130	6140	6160	6170
6135	6145	6165	6175

Table 1-3 1 Stage Reduction Frame Sizes

Frame Size								
6060	6090	6110	6130	6160 6165 616H	6180	6205	6235	6265
6065	6095	6115	6135		6185			
6070	6100 6105 610H	6120	6140 6145 614H	6170 6175	6190	6215	6245	6275
6075		6125			6195			
6080		612H				6225	6255	
6085								

Table 1-4 2 Stage Reduction Frame Sizes

Frame Size	Second Stage (Output Stage)	First Stage (Input Stage)	Frame Size	Second Stage (Output Stage)	First Stage (Input Stage)	Frame Size	Second Stage (Output Stage)	First Stage (Input Stage)	Frame Size	Second Stage (Output Stage)	First Stage (Input Stage)
6060DA	6060 + 6060		6130DA	6130 + 6075		6165DA	6165 + 6095		6205DA	6205 + 6125	
6065DA	6065 + 6065		6130DB	6130 + 6095		6165DB	6165 + 6105		6205DB	6205 + 6135	
6070DA	6070 + 6065		6130DC	6130 + 6105		6165DC	6165 + 6125		6215DA	6215 + 6135	
6075DA	6075 + 6065		6135DA	6135 + 6075		6170DA	6170 + 6095		6215DB	6215 + 6165	
6090DA	6090 + 6075		6135DB	6135 + 6095		6170DB	6170 + 6105		6225DA	6225 + 6135	
6095DA	6095 + 6075		6135DC	6135 + 6105		6170DC	6170 + 6125		6225DB	6225 + 6175	
6100DA	6100 + 6075		6140DA	6140 + 6075		6175DA	6175 + 6095		6235DA	6235 + 6165	
6105DA	6105 + 6075		6140DB	6140 + 6095		6175DB	6175 + 6105		6235DB	6235 + 6185	
6120DA	6120 + 6075		6140DC	6140 + 6105		6175DC	6175 + 6125		6245DA	6245 + 6165	
6120DB	6120 + 6095		6145DA	6145 + 6075		6180DA	6180 + 6105		6245DB	6245 + 6185	
6125DA	6125 + 6075		6145DB	6145 + 6095		6180DB	6180 + 6135		6255DA	6255 + 6175	
6125DB	6125 + 6095		6145DC	6145 + 6105		6185DA	6185 + 6105		6255DB	6255 + 6195	
			6160DA	6160 + 6095		6185DB	6185 + 6135		6265DA	6265 + 6195	
			6160DB	6160 + 6105		6190DA	6190 + 6125		6275DA	6275 + 6195	
			6160DC	6160 + 6125		6190DB	6190 + 6135				
						6195DA	6195 + 6125				
						6195DB	6195 + 6135				

Table 1-5 3 Stage Reduction Frame Sizes

Frame Size	Third Stage (Output Stage)	Second Stage (Intermediate Stage)	First Stage (Input Stage)	Frame Size	Third Stage (Output Stage)	Second Stage (Intermediate Stage)	First Stage (Input Stage)	Frame Size	Third Stage (Output Stage)	Second Stage (Intermediate Stage)	First Stage (Input Stage)
6060TA	6060 + 6060	6060	6060	6170TA	6170 + 6095	6095	6075	6205TA	6205 + 6125	6125	6075
6065TA	6065 + 6065	6065	6065	6170TB	6170 + 6105	6105	6075	6205TB	6205 + 6125	6125	6095
6070TA	6070 + 6065	6065	6065	6170TC	6170 + 6125	6125	6075	6205TC	6205 + 6135	6135	6075
6075TA	6075 + 6065	6065	6065	6170TD	6170 + 6125	6125	6095	6205TD	6205 + 6135	6135	6095
6090TA	6090 + 6075	6075	6065	6175TA	6175 + 6095	6095	6075	6205TE	6205 + 6135	6135	6105
6095TA	6095 + 6075	6075	6065	6175TB	6175 + 6105	6105	6075	6215TA	6215 + 6135	6135	6075
6100TA	6100 + 6075	6075	6065	6175TC	6175 + 6125	6125	6075	6215TB	6215 + 6135	6135	6095
6105TA	6105 + 6075	6075	6065	6175TD	6175 + 6125	6125	6095	6215TC	6215 + 6135	6135	6105
6120TA	6120 + 6075	6075	6065	6180TA	6180 + 6105	6105	6075	6215TD	6215 + 6165	6165	6095
6120TB	6120 + 6095	6095	6075	6180TB	6180 + 6135	6135	6075	6215TE	6215 + 6165	6165	6105
6125TA	6125 + 6075	6075	6065	6180TC	6180 + 6135	6135	6095	6215TF	6215 + 6165	6165	6125
6125TB	6125 + 6095	6095	6075	6180TD	6180 + 6135	6135	6105	6225TA	6225 + 6135	6135	6075
6130TA	6130 + 6075	6075	6065	6185TA	6185 + 6105	6105	6075	6225TB	6225 + 6135	6135	6095
6130TB	6130 + 6095	6095	6075	6185TB	6185 + 6135	6135	6075	6225TC	6225 + 6135	6135	6105
6130TC	6130 + 6105	6105	6075	6185TC	6185 + 6135	6135	6095	6225TD	6225 + 6175	6175	6095
6135TA	6135 + 6075	6075	6065	6185TD	6185 + 6135	6135	6105	6225TE	6225 + 6175	6175	6105
6135TB	6135 + 6095	6095	6075	6190TA	6190 + 6125	6125	6075	6225TF	6225 + 6175	6175	6125
6135TC	6135 + 6105	6105	6075	6190TB	6190 + 6125	6125	6095	6235TA	6235 + 6165	6165	6095
6140TA	6140 + 6075	6075	6065	6190TC	6190 + 6135	6135	6075	6235TB	6235 + 6165	6165	6105
6140TB	6140 + 6095	6095	6075	6190TD	6190 + 6135	6135	6095	6235TC	6235 + 6165	6165	6125
6140TC	6140 + 6105	6105	6075	6190TE	6190 + 6135	6135	6105	6235TD	6235 + 6185	6185	6105
6145TA	6145 + 6075	6075	6065	6195TA	6195 + 6125	6125	6075	6235TE	6235 + 6185	6185	6135
6145TB	6145 + 6095	6095	6075	6195TB	6195 + 6125	6125	6095	6245TA	6245 + 6165	6165	6095
6145TC	6145 + 6105	6105	6075	6195TC	6195 + 6135	6135	6075	6245TB	6245 + 6165	6165	6105
6160TA	6160 + 6095	6095	6075	6195TD	6195 + 6135	6135	6095	6245TC	6245 + 6165	6165	6125
6160TB	6160 + 6105	6105	6075	6195TE	6195 + 6135	6135	6105	6245TD	6245 + 6185	6185	6105
6160TC	6160 + 6125	6125	6075					6245TE	6245 + 6185	6185	6135
6160TD	6160 + 6125	6125	6095					6255TA	6255 + 6175	6175	6095
6165TA	6165 + 6095	6095	6075					6255TB	6255 + 6175	6175	6105
6165TB	6165 + 6105	6105	6075					6255TC	6255 + 6175	6175	6125
6165TC	6165 + 6125	6125	6075					6255TD	6255 + 6195	6195	6125
6165TD	6165 + 6125	6125	6095					6255TE	6255 + 6195	6195	6135
								6265TA	6265 + 6195	6195	6125
								6265TB	6265 + 6195	6195	6135
								6275TA	6275 + 6195	6195	6125
								6275TB	6275 + 6195	6195	6135

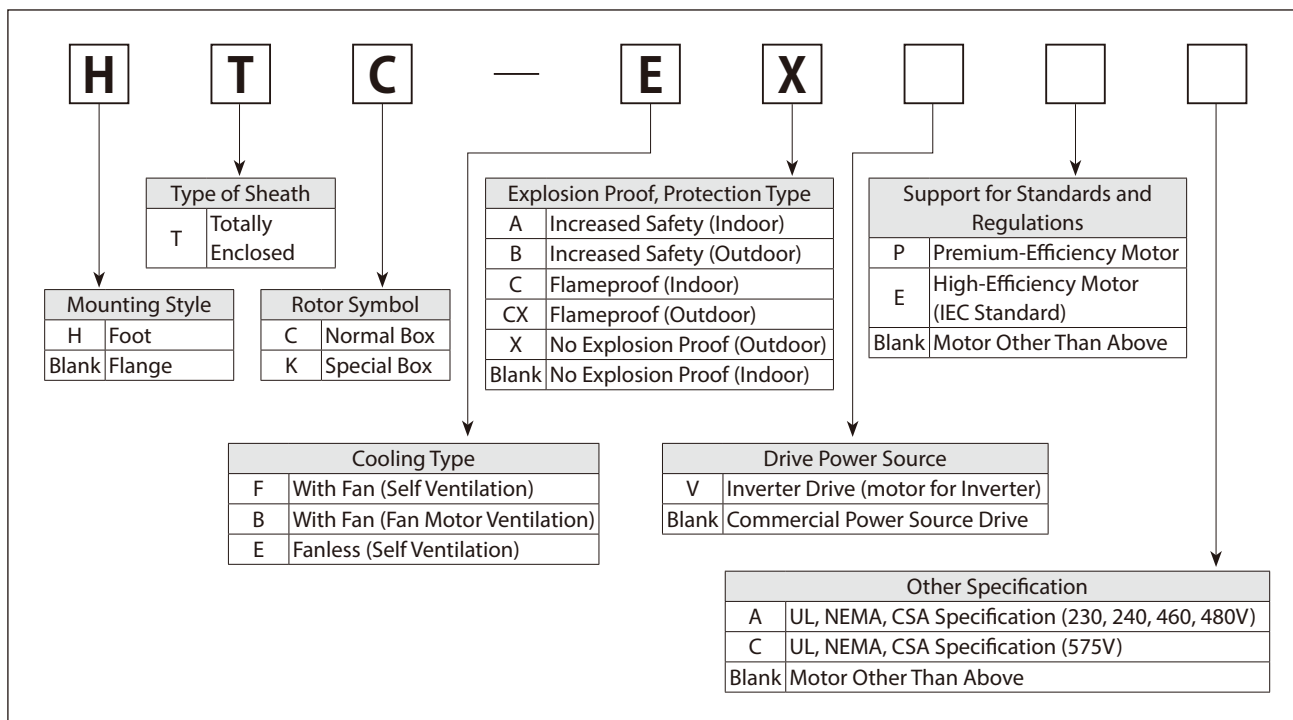
1. Receiving Inspection



1-4 Motor Nomenclature

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

When used with a vector motor, or other manufacturer's motor (There are some models made by other manufacture.), see the relevant operation manual.



1-5 Brake Type

Table 1-6 shows the relationship between standard brake type, motor type, and capacity range.

Table 1-6 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	High-Efficiency, 3-Phase Motor
	4P	4P	6P	4P	6P	4P	4P
FB-01A1	0.1	-	-	-	-	-	-
FB-02A1	0.2 0.25	-	-	0.1	-	-	-
FB-05A1	0.4	-	-	0.2	-	-	0.2
FB-1D	0.55	-	-	0.4	-	-	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	15 18.5 22	-	-	18.5 22 30	-
ESB-250 (Horizontal Type) ESB-250-2 (Vertical Type)	-	37 45	30 37	30 37	18.5 22 30	37 45	-

Note: Depending on the specification, brake type may differ from the types shown in Table 1-6. 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 a clean and dry indoor.

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

2-2 Storage Time

- The storage time should be within the rust prevention time shown below.

- Standard rust prevention specifications

External rust prevention

Rust prevention oil is applied when shipping from the factory. Check the rust conditions to see if any rust is forming on the machined surface every six months after shipment. Reapply the rust prevention oil or any other rust prevention process if necessary.

Internal rust prevention

Lubrication	Grease Lubricated Machines	Oil Lubricated Machines
Rust prevention time	One year	Six months
Storage conditions	Store the product in a general factory or warehouse in an environment free of moisture, dust, extreme temperature changes, corrosive gases, etc.	

- If the product is for export, or if the storage time is longer than one year (grease lubricated) or six months (oil lubricated) adherence to special rust prevention specifications is required. Please consult with us.

- If the storage time is longer than one year, run the product for a few minutes under no load once every two to three months. Measure (see P16) and check the insulation resistance of the motor at that time.

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 it before operation, and replace any degraded seals with new seals.

- If the storage time is longer than two years, replace the oil seal and the grease before starting operation.

- At startup, check that there are no unusual noises, vibrations, temperature rises, or other symptoms. For models with brakes, check that brakes work properly.

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

DANGER

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

CAUTION

- Be careful not to drop the unit.
When a hanging bolt or hole is provided, be sure to use it. After mounting a unit on a machine, do not hoist the entire machine by using the hanging bolt or hole; otherwise, personal injury or damage to the equipment and/ or lifting device may result.
- Before hoisting, refer to the nameplate, crate, outline drawing, catalog, etc. for the weight of the unit. Never hoist a unit that exceeds the load capacity of the crane or other mechanism being used to lift it; otherwise, personal injury or damage to the equipment and/ or lifting device may result.
- When the products are lifted, use suitable lifting parts, and confirm that eye-bolts and nuts are not loose.
- Always drain oil before mounting, moving, and transporting the machine lubricated by oil.
Moving the machine with lubricating oil in may cause oil to escape from the air vent, etc.

DANGER

- Do not use a standard unit in an explosive atmosphere (which is likely to be filled with explosive gas or steam). Under such conditions, an explosion proof motor should be used; otherwise, electric shock, personal injury, explosion fire, or damage to the equipment may result.
- In the case of an **explosion proof motor**, use a motor that has specifications that are appropriate for a dangerous location (a location where gas or volatile vapor is present); otherwise explosion, ignition, electric shock, injury, fire, or equipment damage may result.
- When a **flameproof motor is driven by an inverter**, install an inverter in a place free from explosive gas since the inverter itself is not explosion proof. Otherwise, electric shock, personal injury, explosion fire, or damage to the equipment may result.

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 flammable objects around the gearmotor; otherwise, fire may result.
- Do not place any object around the gearmotor or reducer that will hinder ventilation. Insufficient ventilation can cause excessive heat that may result in burns or fire.
- Do not step on or hang from the gearmotor or reducer; otherwise injury may result.
- Do not touch the shaft end of the gearmotor or reducer, inside keyways, or the edge of the motor cooling fan with bare hands; otherwise, injury may result.
- Please install loss prevention device such as oil pan to the machine which is vulnerable to oil especially (machine for food processing and machine for clean room, and so on) in case oil or grease leaks; otherwise, the product may fail because of oil leakage.
- Always drain oil before mounting, moving, and transporting the model lubricated by oil. Moving the machine with the lubricating oil in may cause oil to escape from the air vent, etc.

4-1 Installation Location

Ambient temperature:	−10 to +40°C
Ambient humidity:	Maximum 85%
Altitude:	Maximum 1,000 m
Atmosphere:	No corrosive or volatile gases, no steam Dust-free, well-ventilated area.
Installation location:	Indoor type: Indoors (area with minimal dust, no contact with water) Outdoor type: Indoors or outdoors (place where are got wet with common rainwater but not direct heavy wind and rain) Vibration: Maximum 1G

- 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 proofing, 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

Table 4-1 Mounting Angle

Grease Lubricated Machines	Long-life grease models (Except SK series)	Free
	Machine types other than the above	Slow speed shaft is horizontal or vertical (depends on nomenclature. See P5. Please consult with us for inclined mounting).
Oil Lubricated Machines		Slow speed shaft is horizontal or vertical (depends on nomenclature. See P5. Please consult with us for inclined mounting).

For machines built for specified mounting angle, only use the specified mounting angle.

Do not remove the motor's eye-bolt. In the rare case that it is removed, insert a bolt or other appropriate material into the screw hole to prevent water or other substances from entering the motor through the screw hole.

For the horizontal slow speed shaft level type (see P5), attach it as shown in the figure below.

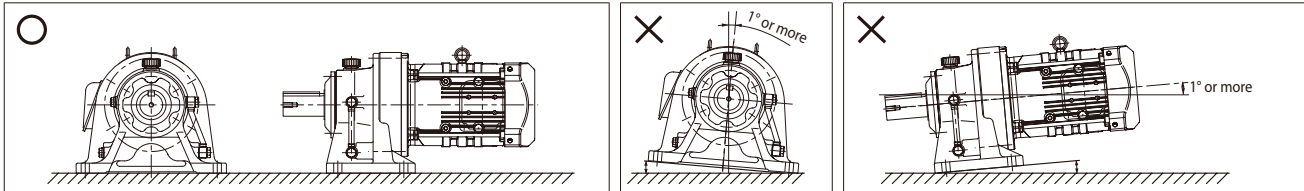


Figure 4-1 Mounting Angle (Example: Foot Mount Type)

4-3 When Load Condition Is Critical

In cases of extreme vibration or frequent startup, it is recommended to use dowell pin for the foot unit, and use a mounting bolt of at least class 8.8 (JIS B 1051) strength.

4-4 Flange Type Assembly Points (Models: CNFM, CHFM, CNF, CHF, etc.)

- [1] Remove the fan cover if there is one installed (reducer frame size of 6160 or more).
- [2] Remove the nut and bolt for ring gear housing. Take care when loosening the nut, as the bolt for ring gear housing may rotate together.
- [3] When the device is shipped, different size of nut from the one for ring gear housing may be assembled between nut for ring gear housing and flanged casing. Remove this nut, as it is used as a spacer for preventing damage to the faces of the nut for ring gear housing and flanged casing, as well as for covering non-threaded portion of bolt for ring gear housing.
- [4] Install the device to the driven machine, and tighten the nut and bolt for ring gear housing with the tightening torque shown in Table 4.2.

- Disassembly prevention nuts are installed at 2 locations of the bolt for ring gear housing (opposing angles) to prevent disassembly of the reducer in case the bolt for ring gear housing is removed. Do not remove the disassembly prevention nuts. Removing them may result in the flanged casing, ring gear housing, internal cover, motor and other parts disassembling and falling off, and may cause injury.
- Using only the disassembly prevention nuts with the nut for ring gear housing removed does not generate a sufficient level of torque. Do not use only the disassembly prevention nuts for ring gear housing for long periods of time, move them excessively or subject them to shock. Lubricant or grease may leak if there gaps develop between any of the mating faces.
- Tightening the nut for ring gear housing changes the axial force of the disassembly prevention nuts, and may result in them coming loose. To remove the CYCLO Drive after temporarily assembling the device to the driven machine, check that the disassembly prevention nuts have not become loose.

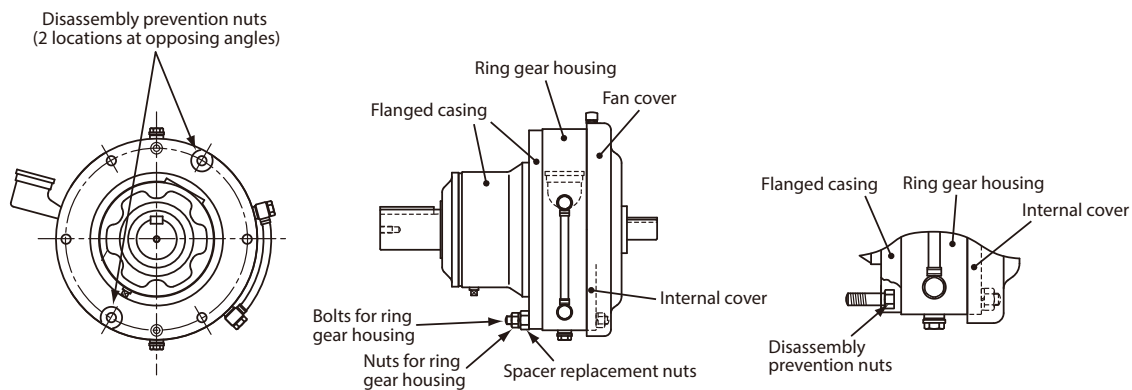


Figure 4-2 Construction Drawings

Table 4-2 Tightening Torque for Nuts and Bolts for Ring Gear Housing

Frame Size		Size	Tightening Torque (N·m)
1 Stage	2 Stage		
606□	606□DA	M6	11
607□	607□DA		
608□	-		
609□	609□DA	M8	25
610□	610□DA		
611□	-		
612□	612□DA, 612□DB	M10	55
613□	613□DA, 613□DB, 613□DC		
614□	614□DA, 614□DB, 614□DC		
616□	616□DA, 616□DB, 616□DC	M12	96

Frame Size		Size	Tightening Torque (N·m)
1 Stage	2 Stage		
617□	617□DA, 617□DB, 617□DC	M12	96
618□	618□DA, 618□DB		
619□	619□DA, 619□DB		
6205	6205DA, 6205DB	M16	219
6215	6215DA, 6215DB	M18	298
6225	6225DA, 6225DB	M20	475
6235	6235DA, 6235DB		
6245	6245DA, 6245DB		
6255	6255DA, 6255DB	M24	794
6265	6265DA	M30	1590

Note: 1. The symbol □ in frame size can be "0" or "5."

2. If a nut and bolt are prepared by the customer, a tightening torque that suits the nut and bolt should be used.

3. The position of the disassembly prevention nuts and the shape of each part depend on the frame size.

4-5 Keyless Shaft Motor Assembly Points (Connected by High Speed Hollow Shaft for Servo Motors)

- [1] Remove oil, dirt, and other contaminants from the motor shaft and inside of the CYCLO Drive high speed shaft. (The inner surface of the high speed shaft is treated with rust prevention oil before shipping.)
- [2] Position the reducer on a platform so that the slow speed shaft is on the bottom.
- [3] Align the high speed shaft with the notch on the clamp ring.
- [4] Remove the adapter plate cap and insert a hexagonal wrench through the setting hole into the hexagon socket head bolt in the clamp ring. Next, insert the motor shaft into the high speed shaft.
- [5] When assembling the motor and CYCLO Drive, make sure that the centers of both shafts are aligned. Do not force the assembly if the shafts are slanted or misaligned.
- [6] Fasten the motor and adapter plate by using the motor mounting bolt. Tighten them after confirming that the motor spigot is certainly inserted into the adapter plate spigot. If the bolt is tightened when the spigot is not inserted, uneven tightening will result in damage to the internal bearing and other components.
- [7] Tighten the clamp ring hexagon socket head bolt to the torque shown in Table 4-3.
- [8] After operating at low speed, increase the tightening torque as shown in Table 4-3.
- [9] Attach the adapter plate cap that had been removed.

Table 4-3 Tightening Torque for the Clamp Ring Hexagon Socket Head Bolt

Bolt Size	M4	M5	M6	M8	M10	M12
Tightening Torque (N·m)	4.3	5.5	9.6	23	46	79

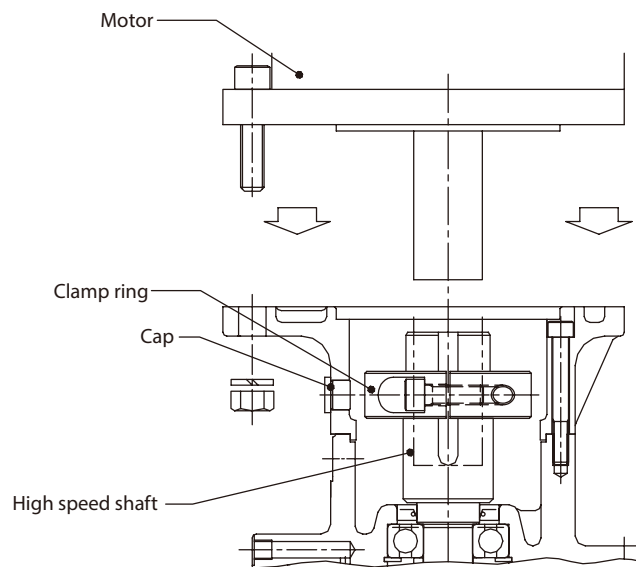


Figure 4-2 Assembly Diagram

4-6 Keyed Shaft Motor Assembly Points (Connected by High Speed Hollow Shaft for Servo Motor or General Flange Motor)

- [1] Remove oil, dirt, and other contaminants from the motor shaft and inside of the CYCLO Drive high speed shaft. (The inner surface of the high speed shaft is treated with rust prevention oil before shipping.)
- [2] Align the motor shaft key with the high speed hollow shaft keyway. (Keyway dimensions conform to JIS B 1301-1996 (ISO) "Keys and Their Corresponding Keyways: Parallel keys (Normal Type)").
- [3] Coat the motor shaft with molybdenum disulfide grease to prevent fretting.
- [4] Depending on the motor combination, a spacer for preventing the key from falling out may be shipped separately. Before assembly, insert the spacer deep into the hole in the high speed shaft. Operation with uninserted spacer could result in the key falling out and damaging the shaft.
- [5] When assembling the motor and CYCLO Drive, make sure that the centers of both shafts are aligned. Do not force the assembly if the shafts are slanted, misaligned, or if the key is partially engaged.
- [6] Fasten the motor and adapter plate (internal cover) using the motor mounting bolt. Tighten after confirming that the motor spigot is securely inserted into the adapter plate (internal cover) spigot. If the bolt is tightened when the spigot is not inserted, uneven tightening will result in damage to the internal bearing and other components.

⚠ CAUTION

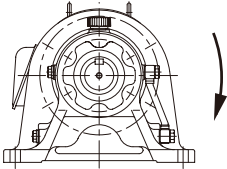
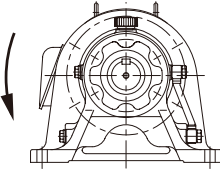
- Confirm the rotation direction before coupling the unit with the driven machine. Incorrect rotation direction may cause personal injury or damage to the equipment.
- When operating the product alone (uncoupled), remove the key that is temporarily attached to the slow speed shaft; otherwise the key could fly off, and injury may result.
- Cover rotating parts; otherwise, injury may result.
- When coupling the product with another machine, check that the centering, the belt tension and parallelism of the pulleys are within the specified limits. When the unit is directly coupled with another machine, check that the direct coupling accuracy is within the specified limits. When a belt is used for coupling the unit with another machine, check the belt tension. Correctly tighten bolts on the pulley and coupling before operation; otherwise there is a risk of injury due to scattering the broken pieces or of damage to the products.

5-1 Checking Rotational Direction

(1) For Gearmotor

Table 5-1 shows the direction of slow speed shaft rotation when wiring is performed as on P18–31.

Table 5-1 Slow Speed Shaft Rotation Direction (Gearmotor)

When wiring is performed as shown on P18–31, the motor shaft rotates to the right as seen from the anti-load side. In the following diagrams, arrows show the direction of slow speed shaft rotation in this case.		
Gear Unit Construction	1 Stage Reduction – 3 Stage Reduction	2 Stage Reduction SK Series Low Reduction Ratio Series
Slow speed shaft rotation direction (Seen from load side)		

Note :To cause reverse rotation, reverse R and T on P18 and P20–27.

(2) For Reducer

Table 5-2 Slow Speed Shaft Rotation Direction (Reducer)

Gear Unit Construction	1 Stage Reduction – 3 Stage Reduction	2 Stage Reduction SK Series
Slow speed shaft rotation direction	Rotates in opposite direction as the high speed shaft.	Rotates in same direction as the high speed shaft.

Note :For the SK series, “SK” is appended to frame sizes.

For the low reduction ratio series, “P” is prepended to nomenclature.

5-2 Mounting Connector

- When mounting Connector, do not apply impact or excessive axial load to the shaft. The bearing could be damaged, or the collar could come off.
- Shrinkage fit is recommend.

(1) When Using a Coupling

The alignment accuracy (A, B, X) in figure 5-1 should be no greater than that shown in Table 5-3.

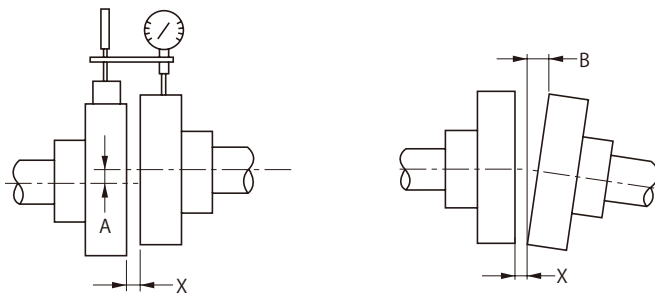


Figure 5-1

Table 5-3 Alignment Precision for Flexible Coupling

Allowable Dimensional Error for A	0.1 mm or manufacturer-specified value
Allowable Dimensional Error for B	0.1 mm or manufacturer-specified value
Dimension for X	manufacturer-specified value

(2) When Using Chains, Sprockets, or Gears

- When using a chain, attach it so that the chain tension angle is perpendicular to the shaft.
- Refer to the chain catalog or other reference for chain tension.
- The pitch circle of the sprocket and gear shall be more than three times of the shaft diameter.
- The load point of the sprocket or gear should be nearer to the product than to center of the shaft. (See figure 5-2)

(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 between the two pulleys should be within $20'$. (See figure 5-3)
- When using multiple V belts, use a matched set having the same circumferential length.

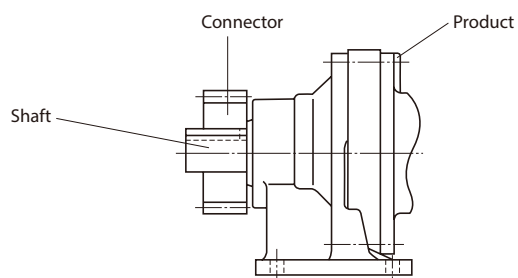


Figure 5-2

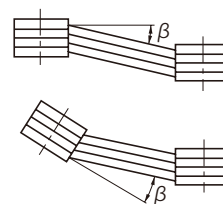


Figure 5-3



When using a vector motor, or other manufacturer's motor (There are some models made by other manufacture.), follow the operation manual for that motor.

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; 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.
- The lead-in condition of an **explosion proof motor** shall conform to the facility's regulations, electrical codes, and explosion proofing standard, as well as the maintenance manual; otherwise, electric shock, personal injury, explosion, fire or damage to the equipment may result.

CAUTION

- When wiring, follow the facility's regulations and electrical codes; otherwise, burning, electric shock, injury, or fire may result.
- 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, in order to prevent burning, electric shock, injury, and fire.
- Never 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 such as when the cable is long in the 400V class, 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.
- When using a **motor with brake**, do not turn on connection power to the brake coil when the motor is stopped. Otherwise coil burnout fire, may result. Also, mistaken wiring could damage the rectifier.
- When using an **explosion proof motor driven by an inverter**, use one inverter for one motor. Use the approved inverter for the motor.
- When measuring the insulation resistance of an **explosion proof motor**, confirm that there is no gas or explosive vapor in the vicinity, in order to prevent possible 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, ambient temperature conditions for standard units with and without brakes must be -10 to 40°C. (Manufacture with 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 be no 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. Wiring

6-1 Removing and Attaching the Resin Terminal Box Cover

3-phase motor 4P: 0.1–0.4kW, high-efficiency, 3-phase motor 4P: 0.2kW, AF motor for inverter: 0.1–0.2kW

(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.

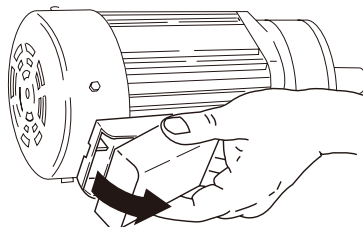


Figure 6-1

6-2 Measuring Insulation Resistance

When measuring insulation resistance, always disconnect the control board 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 time test voltage is applied. However, normally, it must be above the values in Table 6-1.

Table 6-1 Values for Insulation Resistance

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

Reference: JEC -2100 provides the following equation.

$$R \geq \frac{\text{Rated Voltage (V)}}{\text{Rated output power (kW)} + 1,000} \text{ (M}\Omega\text{)}$$
$$R \geq \frac{\text{Rated Voltage (V)} + (\text{RPM}/3)}{\text{Rated output power (kW)} + 2,000} + 0.5 \text{ (M}\Omega\text{)}$$

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 proofing.
- Use an overload protection device designed to handle currents that exceed the rated current on the nameplate.
- For **Increased safety motor**, use an overload protection device capable of protecting the locked rotor current on the nameplate within the allowable locking time.

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.

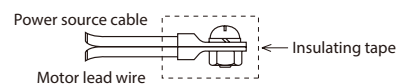


Figure 6-2



6-5 Motor Wiring

This page shows the page numbers for motor wiring diagrams.

Table 6-2 Without Brake

Motor Type		Number of Poles	Capacity (kW)	Number of Lead Wires	Page	
					Direct Input from Commercial Power Source	Inverter Drive
3-Phase Motor	Standard	4P	0.1–0.55	3	P18	P19
		4/8P	All	6	P18	-
	Increased safety, explosion proof	4P	0.1–7.5 11–55	3 6	P18	-
		6P	7.5 11–55	3 6	P18	-
	Flameproof	4P	0.1–22 30–37	3 6	P18	-
		4P	0.75–3.7 5.5–55	3 6	P18	-
Premium-Efficiency, 3-Phase Motor	Standard	4P	0.75–3.7 5.5–55	3 6	P18	P19
		6P	15–55	6	P18	P19
	Increased safety, explosion proof	4P	0.75–3.7 5.5–22	3 6	P18	-
AF Motor for Inverter	Standard	4P	0.1–0.4 30–45	3 11	-	P19
		6P	18.5–45	11	-	P19
	Flameproof	4P	0.2–15 22 30–55	3 6 11	-	P19
Premium-Efficiency, 3-Phase Motor for Inverter		4P	0.75–3.7 5.5–55	3 6	-	P19
High-Efficiency, 3-Phase Motor		4P	0.2–0.4	3	P18	P19

Table 6-3 With Brake

Motor Type	Number of Poles	Capacity (kW)	Brakes	Number of Lead Wires	Page						
					One-Direction Rotation	Plugging Rotation	Inverter Drive				
3-Phase Motor	4P	0.1	FB-01A1	5	P20	P24	P28				
		0.2 0.25	FB-02A1								
		0.4	FB-05A1								
		0.55	FB-1D								
Premium-Efficiency, 3-Phase Motor	4P	0.75	FB-1E	5	P20	P24	P28				
		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	P21	P25	P29				
		7.5	FB-10E								
		11	FB-15E								
		15	FB-20								
	6P	18.5 22 30	FB-30	8	P22	P26	P29				
		37 45	ESB-250 ESB-250-2								
		15 18.5 22	FB-30					8	P22 P23	P26 P27	P29 P30
		30 37	ESB-250 ESB-250-2								
AF Motor for Inverter	4P	0.1	FB-02A1	5	-	-	P28				
		0.2	FB-05A1								
		0.4	FB-1D								
		30 37	ESB-250 ESB-250-2	13			P31				
	6P	18.5 22 30	ESB-250 ESB-250-2	13			P31				
Premium-Efficiency, 3-Phase Motor for Inverter	4P	0.75	FB-1E	5	-	-	P28				
		1.5	FB-2E								
		2.2	FB-3E								
		3.7	FB-5E								
		5.5	FB-8E	8			P29				
		7.5	FB-10E								
		11	FB-15E								
		15	FB-20								
		18.5 22 30	FB-30								
		37 45	ESB-250 ESB-250-2					P30			
High-Efficiency, 3-Phase Motor	4P	0.2	FB-05A1	5	P20	P24	P28				
		0.4	FB-1D								

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

2. For motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.



6. Wiring

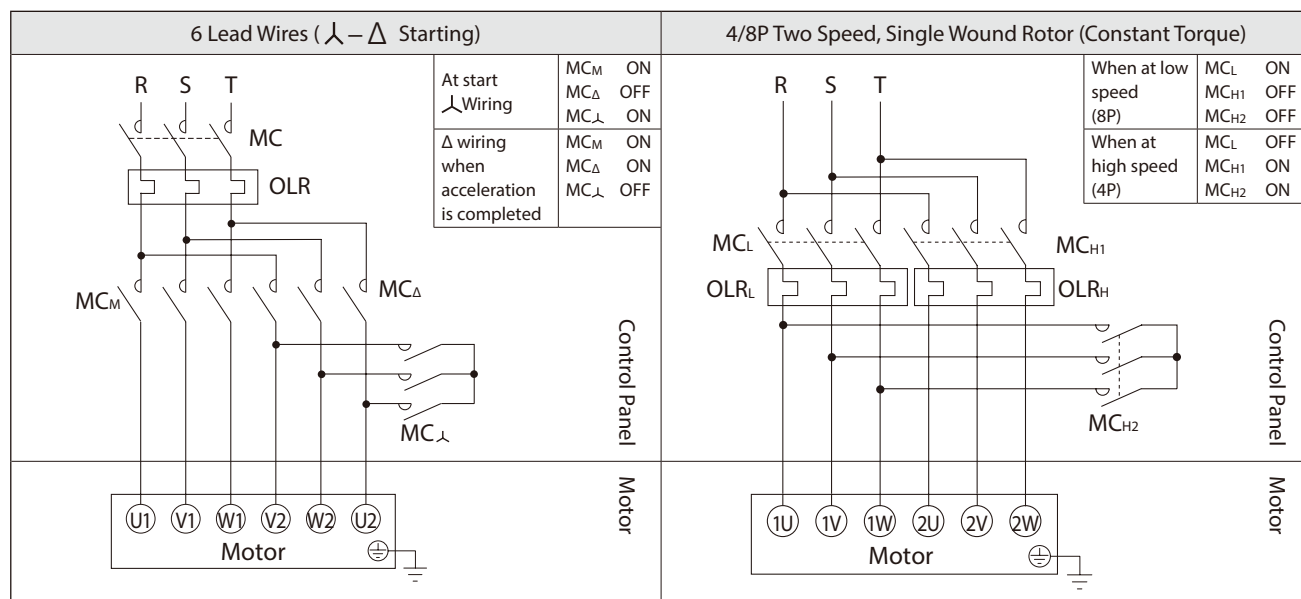
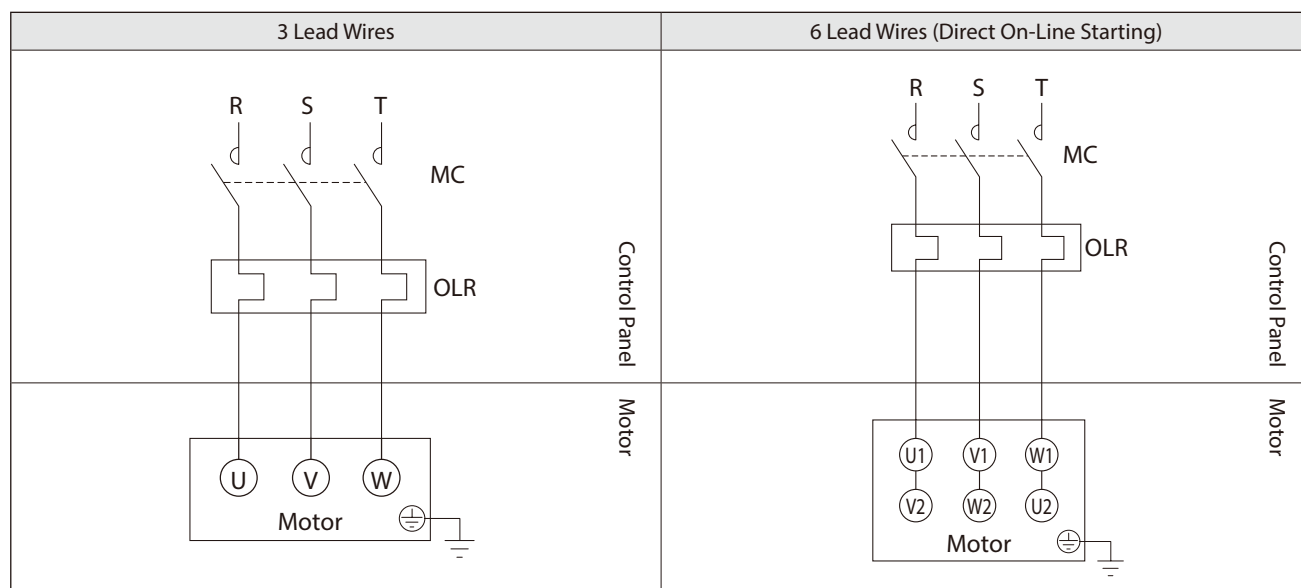
In this section, motor wiring, standard specification for terminals, and symbols of lead wires are shown.

■ Without Brake. 3-Phase Power Source

3-Phase Motor

Premium-Efficiency, 3-Phase Motor

High-Efficiency, 3-Phase Motor



MC: Electromagnetic contactor

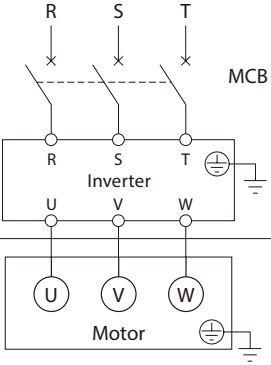
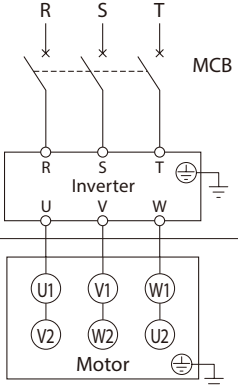
OLR: Overload protection device or electronic thermal relay

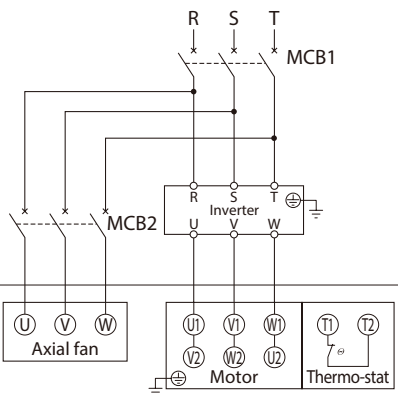
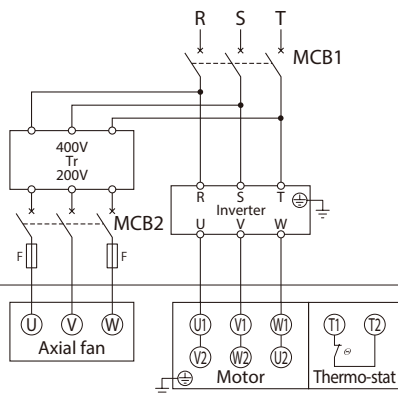
Customer needs to prepare.

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

■ Without Brake Inverter Drive

3-Phase Motor
Premium-Efficiency, 3-Phase Motor
AF Motor for Inverter
Premium-Efficiency, 3-Phase Motor for Inverter
High-Efficiency, 3-Phase Motor

3 Lead Wires		6 Lead Wires	
	Control Panel		Control Panel

11 Lead Wires	
AF Motor for Inverter With Axial Fan	
Indoor 200V Class Outdoor 200V Class, 400V Class Flameproof Type	Indoor 400V Class
	

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.

In the case of **motor with axial fan (totally enclosed, fan motor ventilation type)** , note the following items.

- Also connect a power source to the axial fan.
- For an indoor 400V class (except flameproof type), the axial fan power source voltage will be 200V class. For the motor with special specifications, specifications may differ from the above. Check the manufacturing specifications.
- Connect the fan so that it rotates in the same direction as that shown on the nameplate for direction of rotation.
(Normally, the air from the fan will blow in a direction from the anti-load side to the load side.)
- When the motor is shut down for a long period, also shut down the axial fan motor.
- Wire the mounted thermostat.
- Thermostat specification: Terminal symbols: T1, T2 and P1, P2 Operating function: Normal close (b contact point)
 Operating temperature: 135°C (for thermal class 155 (F)) Maximum current: DC 24V, 18A; AC 230V, 13A



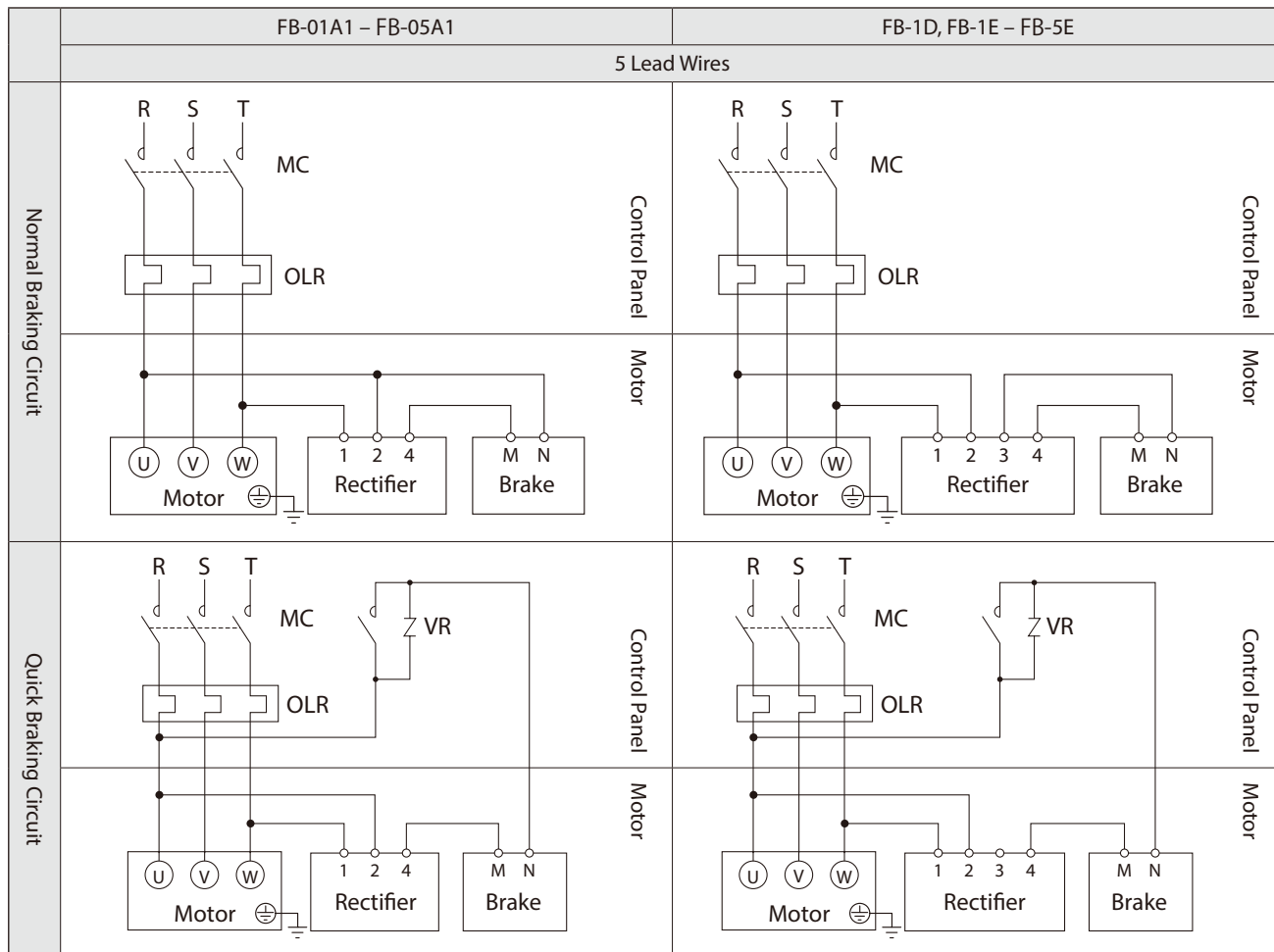
6. Wiring

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

3-Phase Motor

Premium-Efficiency, 3-Phase Motor

High-Efficiency, 3-Phase Motor



MC: Electromagnetic contactor

OLR: Overload protection device or electronic thermal relay

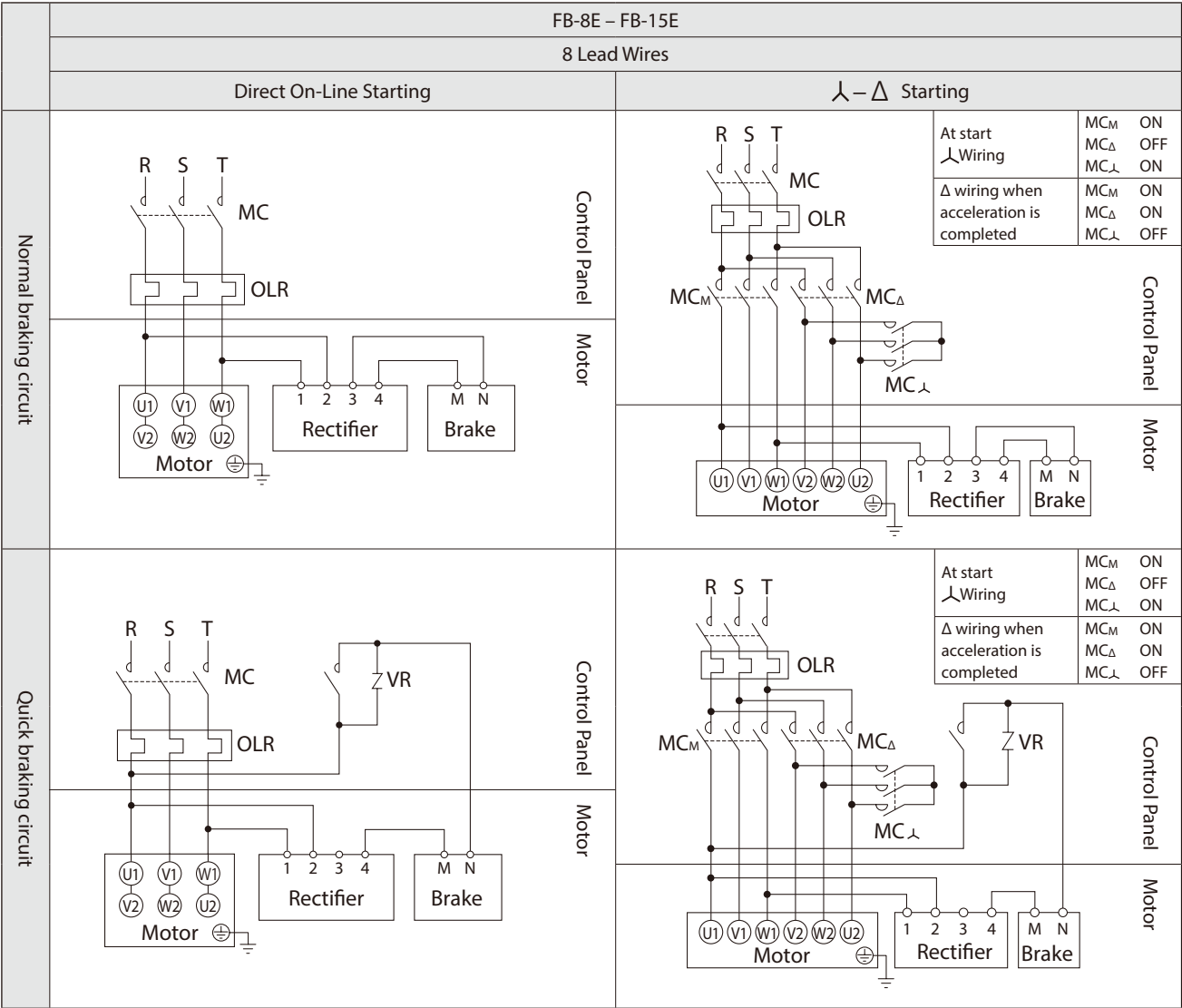
VR: Varistor (for protecting contact points, rectifier, etc.)

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 1-6 on P7.
- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P35 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 P32.
- For 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.

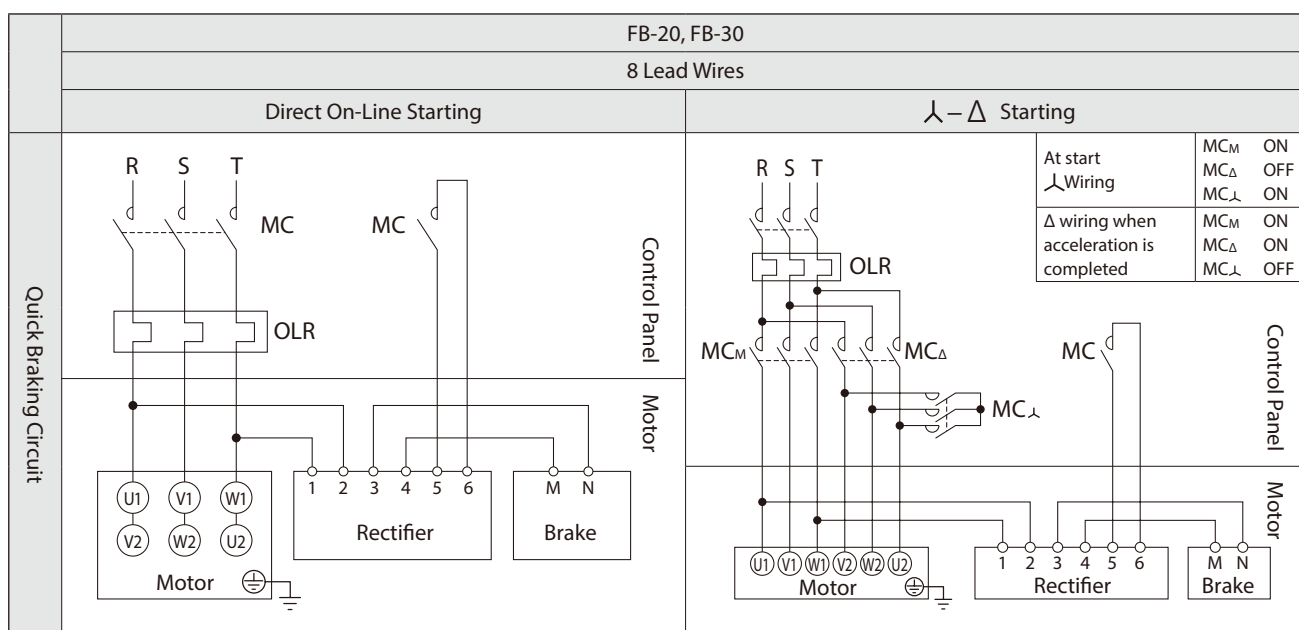
- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-6 on P7.
- Brake action delay time is different between normal and quick braking circuits.
 Table 7-2 on P35 shows action 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 P32.
- For quick braking circuits, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.



6. Wiring

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

Premium-Efficiency, 3-Phase Motor



MC: Electromagnetic contactor

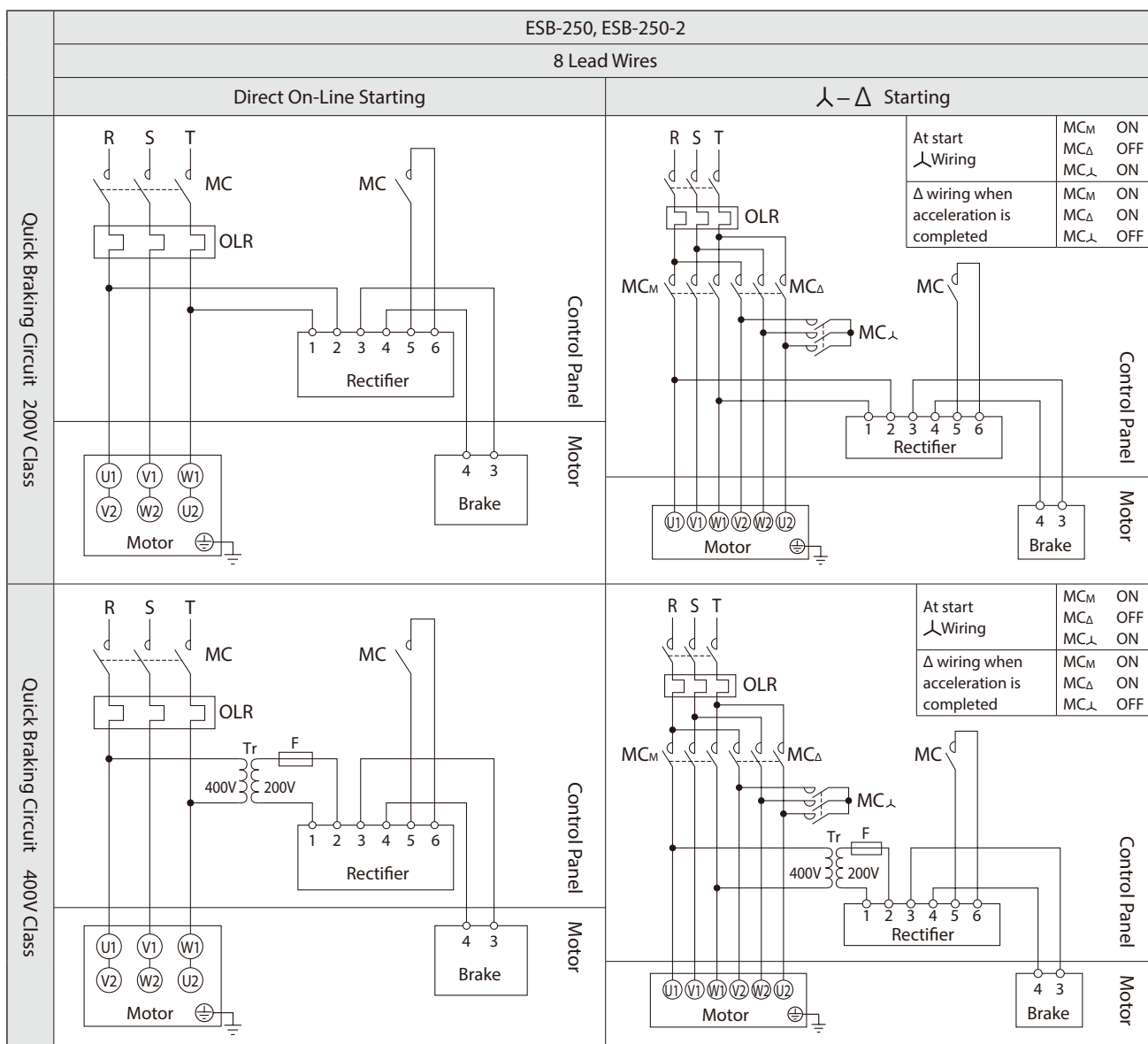
OLR: Overload protection device or electronic thermal relay

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 1-6 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P32.
- For quick braking circuits, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.
- The motor is shipped with a short circuit plate connected between 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 1-6 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P32.
- For quick braking circuits, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.
- Rectifiers are external to the main unit. Rectifiers are made for indoor use. Install in an area where they will not contact with water, etc.
- The brake unit is for 200V class. For 400V class power sources, prepare a 400V/200V transformer.



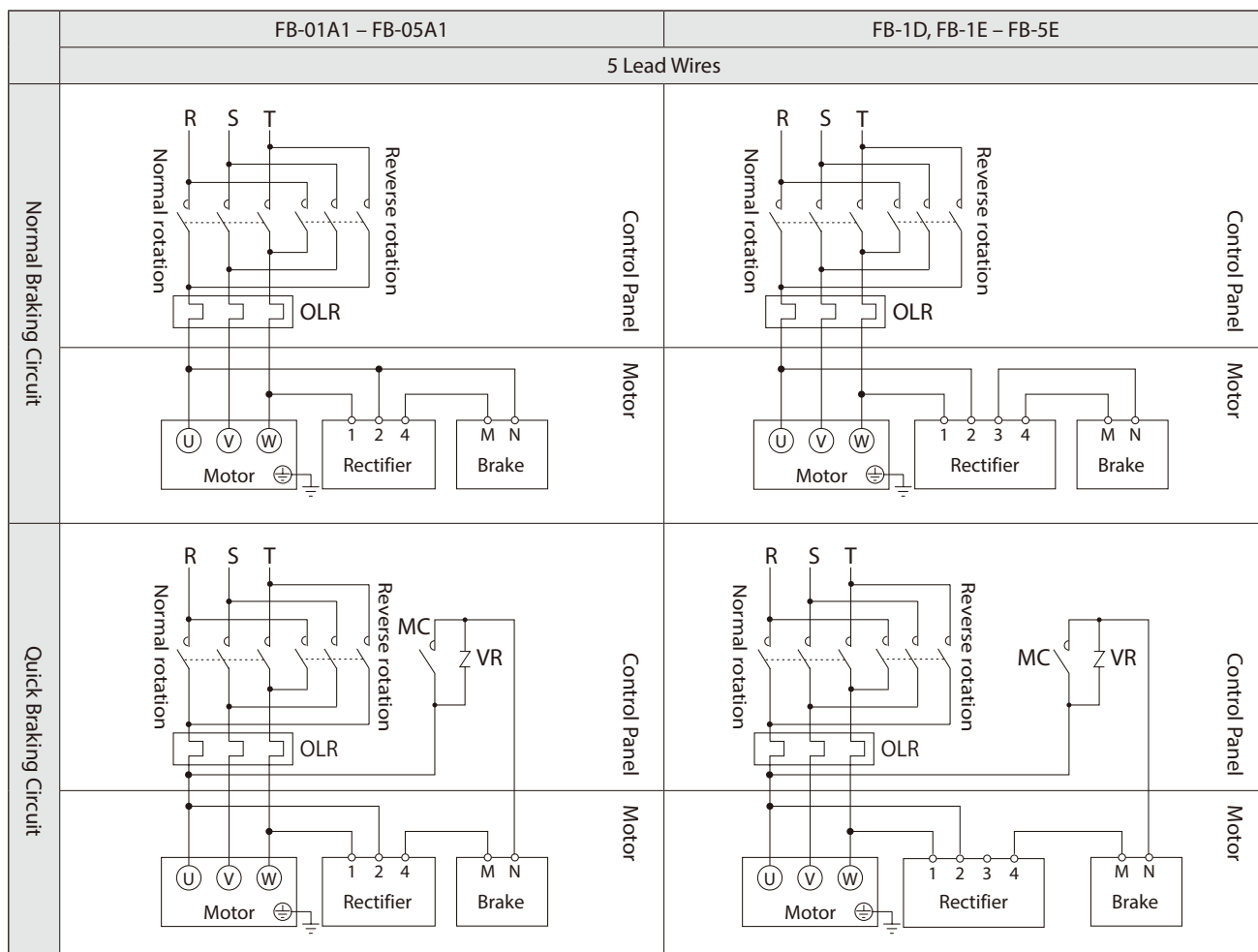
6. Wiring

■ With Brake. 3-Phase Motor. Plugging Operation

3-Phase Motor

Premium-Efficiency, 3-Phase Motor

High-Efficiency, 3-Phase Motor



Electromagnetic contactor for normal and reverse rotation

MC: Electromagnetic contactor

OLR: Overload protection device or electronic thermal relay

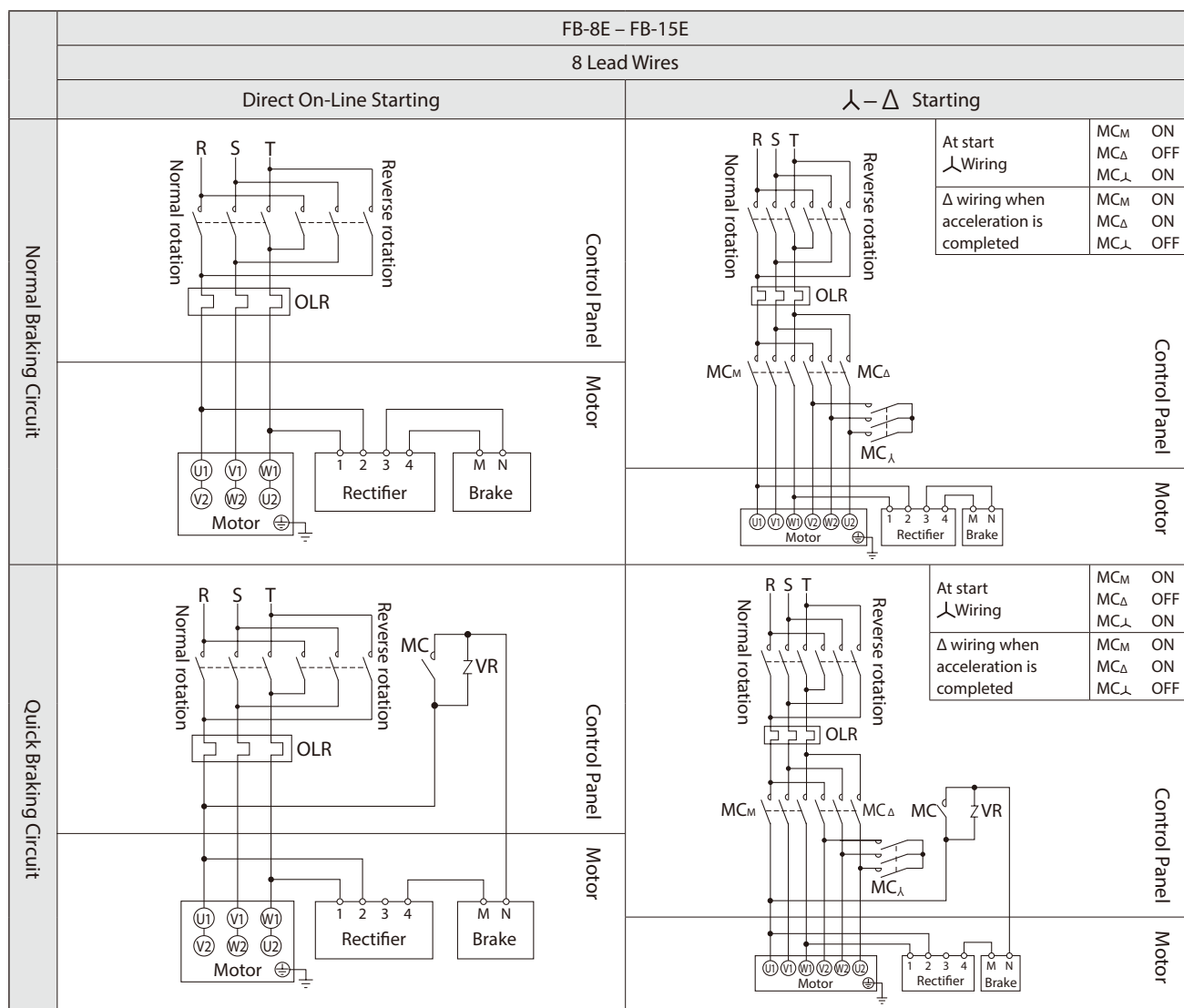
VR: Varistor (for protecting contact points, rectifier, etc.)

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 1-6 on P7.
- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P35 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 P32.
- For plugging operations using a quick- braking circuit, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.

■ With Brake. 3-Phase Motor. 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.

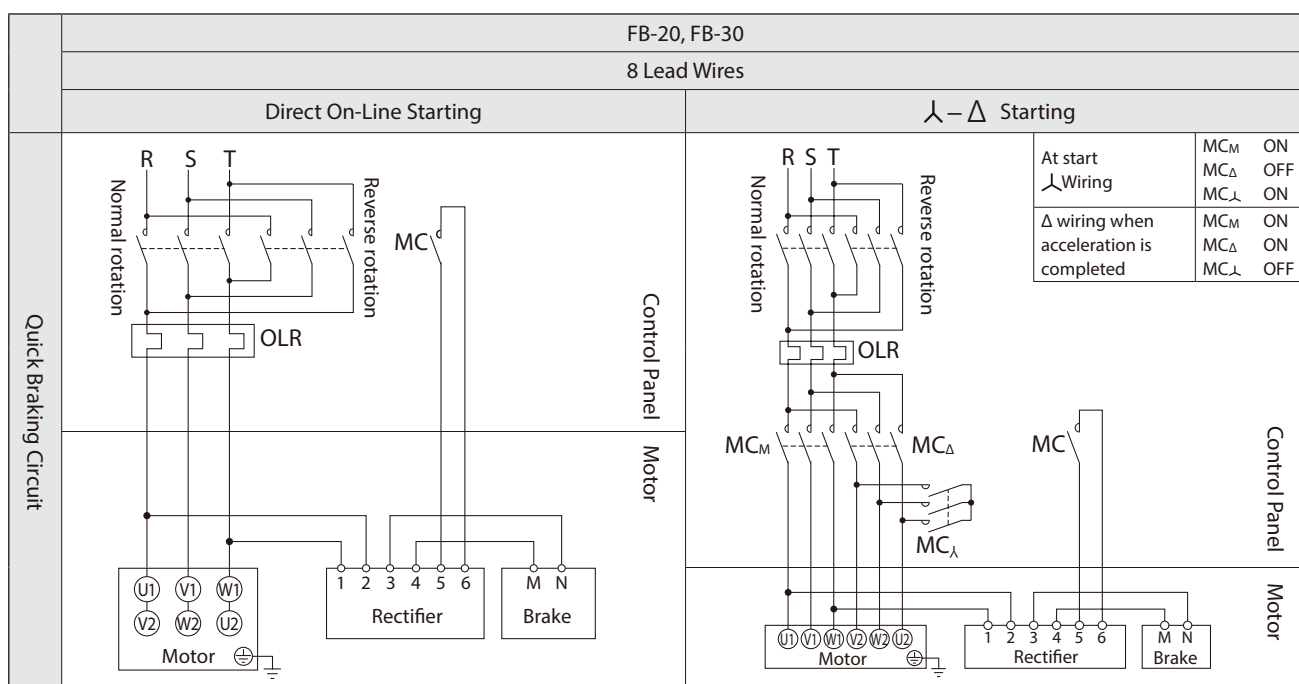
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- Use a quick braking circuit when a phase-advancing capacitor is mounted.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table 6-4 on P32.
- For plugging operations using a quick braking circuit, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.



6. Wiring

■ With Brake. 3-Phase Motor. Plugging Operation

Premium-Efficiency, 3-Phase Motor



Electromagnetic contactor for normal and reverse rotation

MC: Electromagnetic contactor

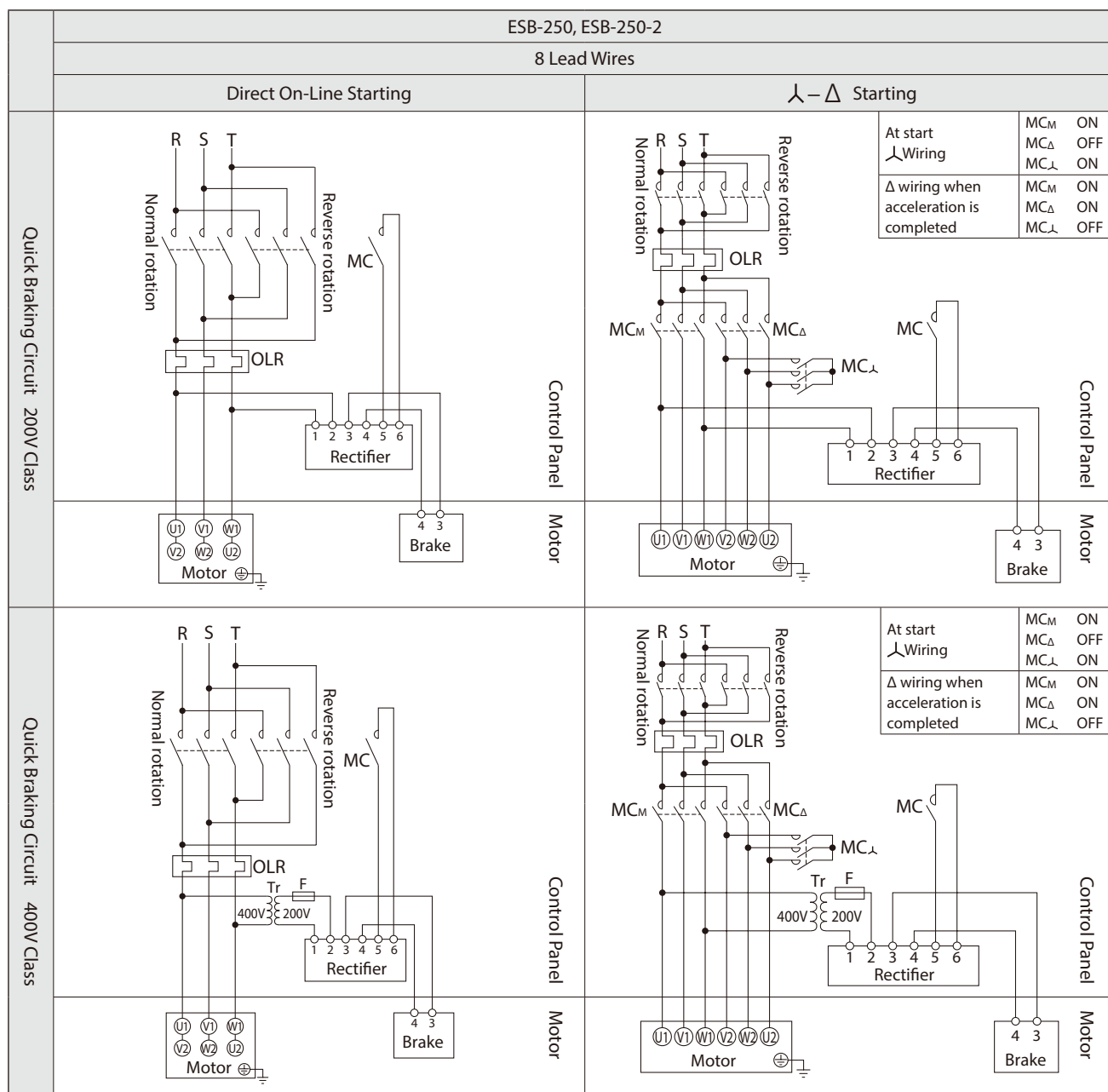
OLR: Overload protection device or electronic thermal relay

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 1-6 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P32.
- The motor is shipped with a short circuit plate connected between terminals 5 and 6. Remove the short circuit plate when wiring.
- For plugging operations, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.

■ With Brake. 3-Phase Motor. 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 1-6 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P32.
- 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.
- The brake unit is for 200V class. For 400V class power sources, prepare a 400V/200V transformer.
- For plugging operations, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.



6. Wiring

■ With Brake Inverter Drive

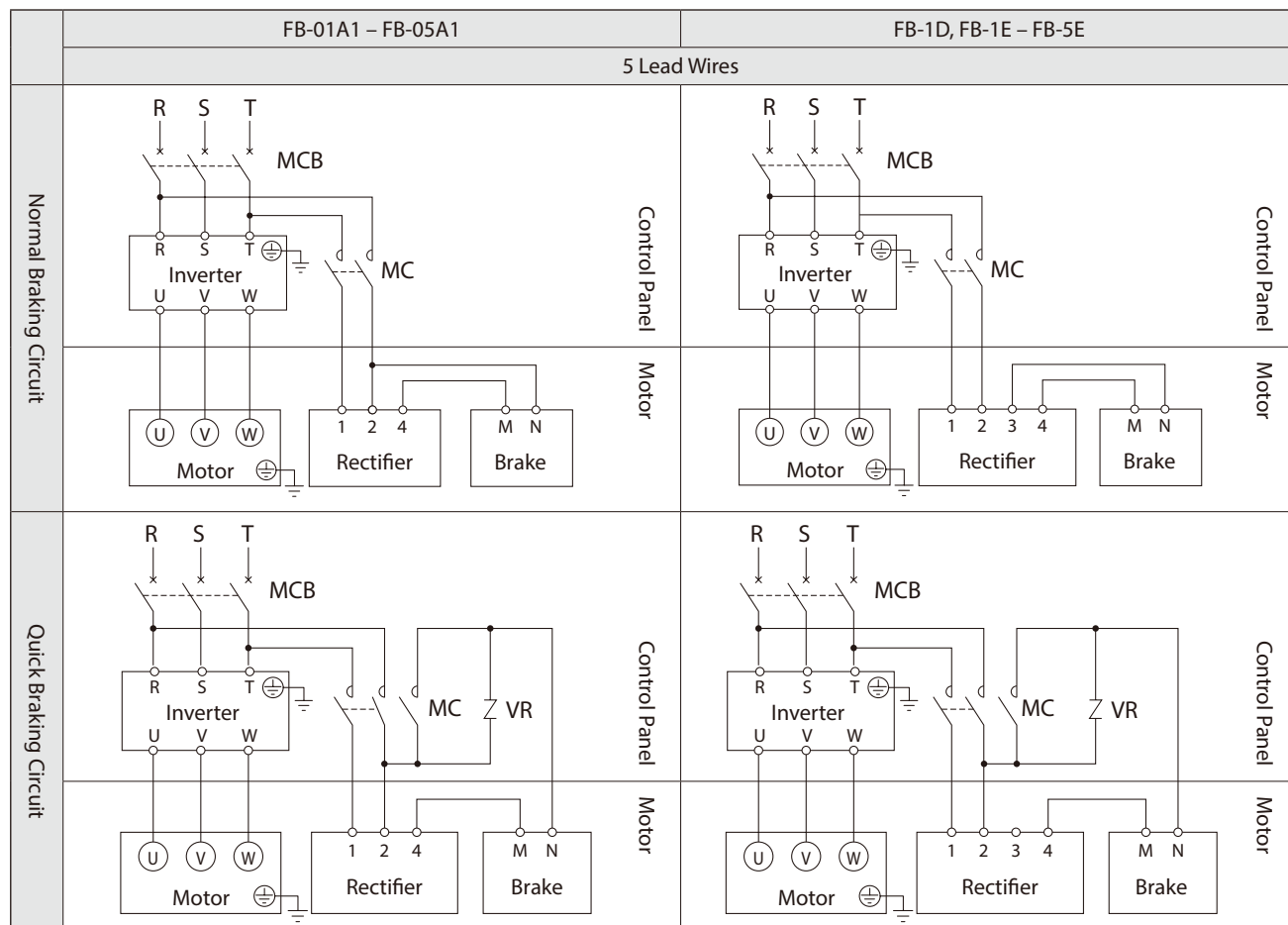
3-Phase Motor

Premium-Efficiency, 3-Phase Motor

AF Motor for Inverter

Premium-Efficiency, 3-Phase Motor for Inverter

High-Efficiency, 3-Phase Motor



MC: Electromagnetic contactor

MCB: Breaker for wiring

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

Customer needs to prepare.

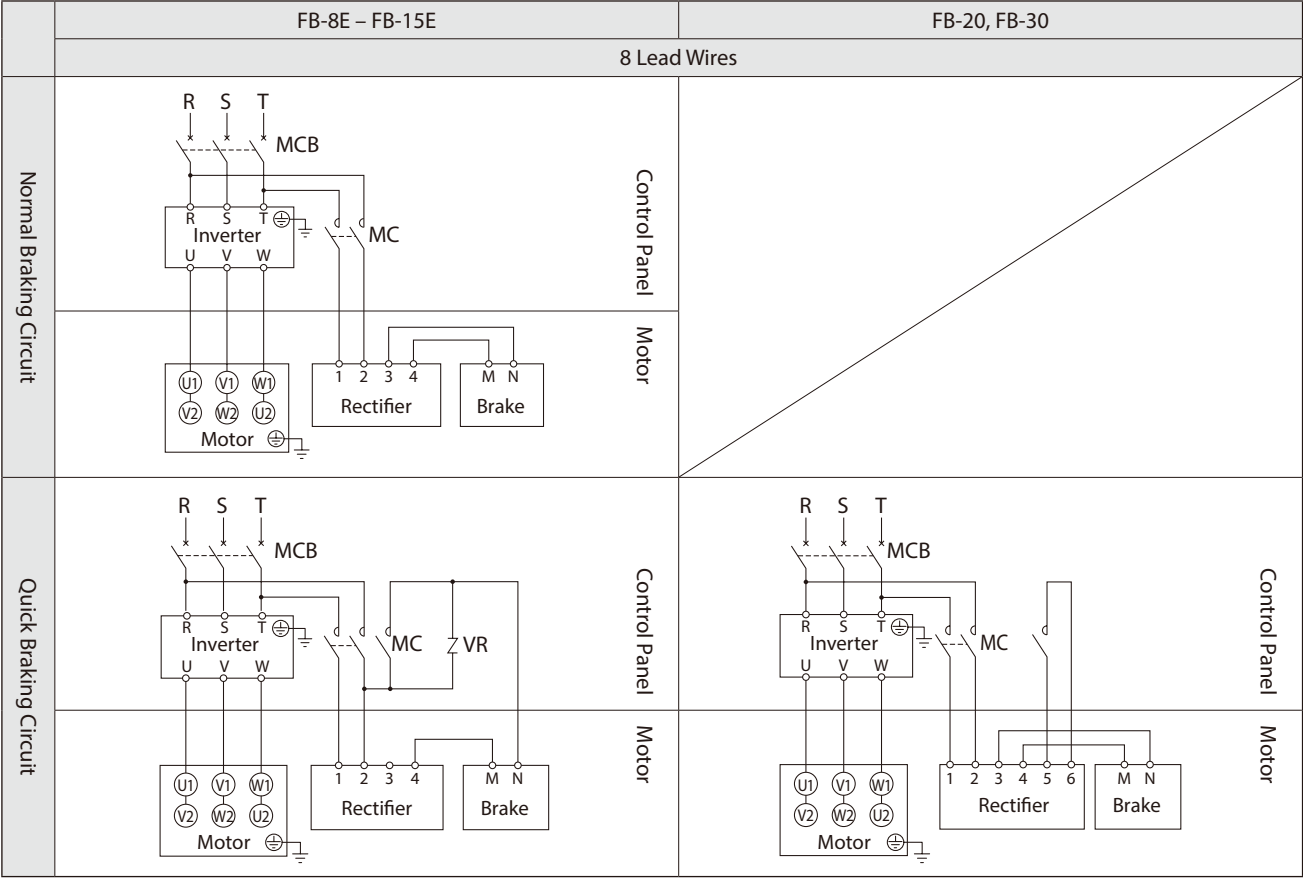
- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-6 on P7.
- The motor must be insulated to inverter-drive a 400V class 3-phase motor/high-efficiency, 3-phase motor.
- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P35 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 P32.

- 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 1-6 on P7.

- Brake action delay time is different between normal and quick braking circuits.
Table 7-2 on P35 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 P32.

- Use FB-20, FB-30 with quick braking circuits.

- FB-20, FB-30 are shipped with a short circuit plate connected between 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.

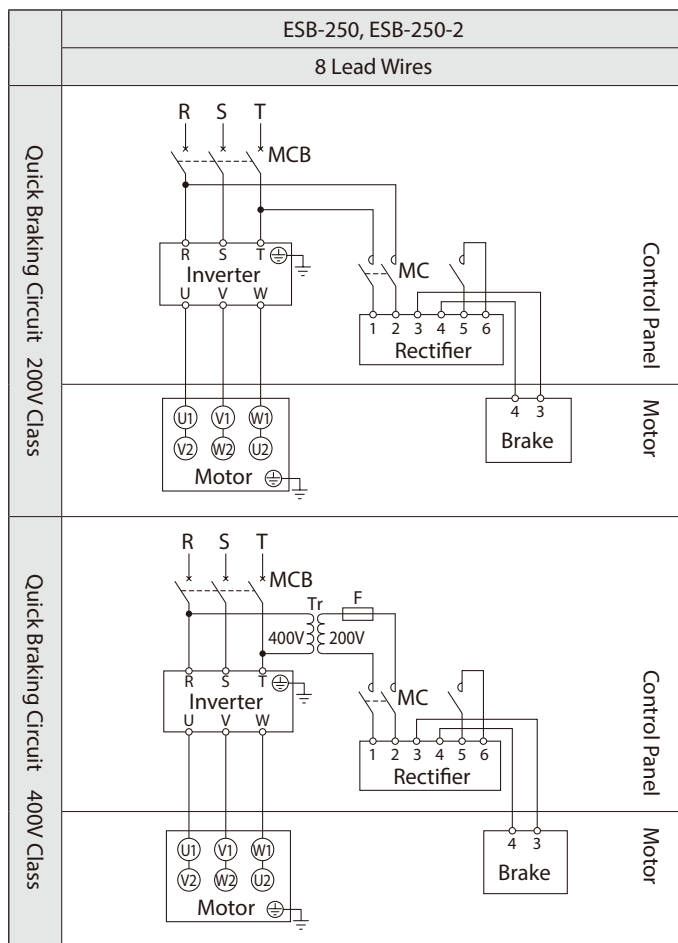


6. Wiring

■ 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

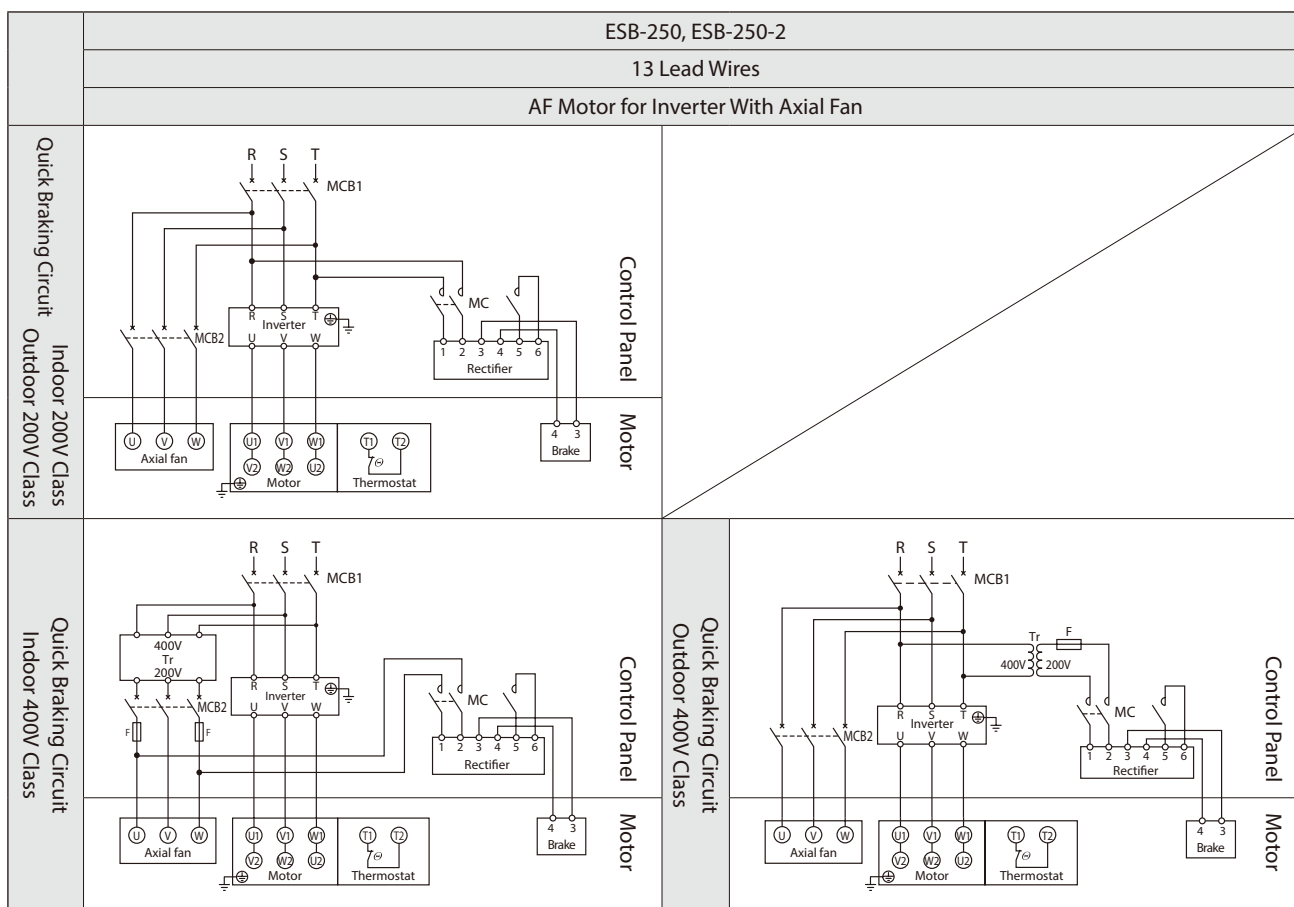
Customer needs to prepare.

- 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 1-6 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P32.
- 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.
- The 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 1-6 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P32.
- Rectifiers are external to the main unit. Rectifiers are made for indoor use. Install in an area where they will not contact with water, etc.
- The 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.

In the case of **motor with axial fan (totally enclosed, fan motor ventilation type)**, note the following items.

- Also connect a power source to the axial fan.
- For an indoor 400V class, the axial fan power source voltage will be 200V class.
- For special specifications, specifications may differ from the above. Check the manufacturing specifications.
- Connect the fan so that it rotates in the same direction as that shown on the nameplate for direction of rotation.
(Normally, the air from the fan will blow in a direction from the anti-load side to the load side.)
- When the motor is shut down for a long period, also shut down the axial fan motor.
- Wire the mounted thermostat.
- Thermostat specification: Terminal symbols: T1, T2 and P1, P2
Operating temperature: 135°C (for thermal class 155 (F))
- Operating function: Normal close (b contact point)
Maximum current: DC 24V, 18A; AC 230V, 13A

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 the brake power source secondary side contact points; otherwise, contact points might not be protected.
- For information on using an alternating current electromagnetic contactor for 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)

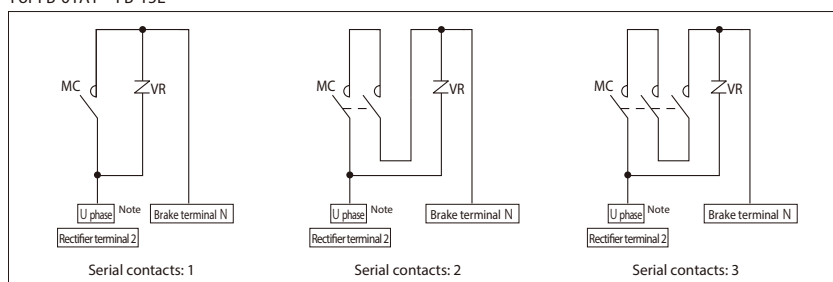
Table 6-4 Nomenclature for Parts Recommended When Using a Quick Braking Circuit (When Using an Alternating Current Electromagnetic Contactor).

AC Voltage	Brakes	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 Nomenclature	Maximum Allowable Circuit Voltage	Varistor Voltage	Power Rating		
200V 220V	FB-01A1	SC-05	Serial contact points: 1 (0.7A)	S-N11 or S-N12	Serial contact points: 1 (1.2A)	DC 110V	Minimum 0.4A	TND07V-471KB00AAA0	AC300V	470V (423–517V)	0.25 W	
	FB-02A1						Minimum 0.5A					0.4 W
	FB-05A1						Minimum 0.7A					
	FB-1D						SC-05	Serial contact points: 2 (3.0A)			S-N11 or S-N12	Serial contact points: 2 (3.0A)
	FB-1E	TND20V-471KB00AAA0	1.0 W									
	FB-1HE			Minimum 1.5A								
	FB-2E				Minimum 3.0A							
	FB-3E	SC-05	Serial contact points: 3 (4.0A)				S-N18	Serial contact points: 3 (5.0A)			Minimum 5.5A	
	FB-4E											
	FB-5E											
	FB-8E			SC-5-1	Serial contact points: 3 (10A)						S-N20 or S-N21	Serial contact points: 3 (10A)
	FB-10E											
	FB-15E											
	FB-20											
FB-30												
ESB-250												
ESB-250-2												
400V 440V	FB-01A1	SC-05	Serial contact points: 1 (0.25A)	S-N11 or S-N12	Serial contact points: 2 (0.5A)	DC 220V	Minimum 0.2A	TND10V-821KB00AAA0	AC510V	820V (738–902V)	0.4 W	
	FB-02A1	SC-05	Serial contact points: 2 (0.4A)				Minimum 0.3A					0.6 W
	FB-05A1											
	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			1.0 W	
	FB-1E						TND20V-821KB00AAA0					
	FB-1HE											Minimum 1.0A
	FB-2E							Minimum 1.5A				
	FB-3E						Minimum 3.0A					
	FB-4E										Minimum 2.5A	
	FB-5E											
	FB-8E	-	-	S-N18	Serial contact points: 3 (2.0A)							
	FB-10E											
	FB-15E											
	FB-20											
FB-30												

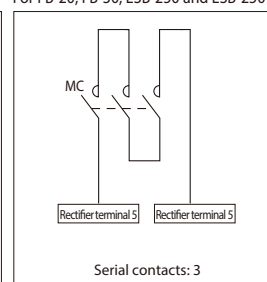
- This recommended contactor nomenclature is for Fuji Electric FA Components & Systems Co., Ltd. and Mitsubishi Electric Corporation contactors. Products from other manufacturers are also allowable if they have equivalent capabilities.
- Recommended contactor contact point capacity indicates the case where durability regarding electronic opening and closing (service life) is approximately 2 million times (for FB-30, ESB-250 and 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 contactors 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, FB-30, ESB-250 and ESB-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-01A1 – FB-15E



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



Note : For inverter drives, connect to the R phase (power source side).



6-7 Wiring for Motorized Trochoid Pump Motor

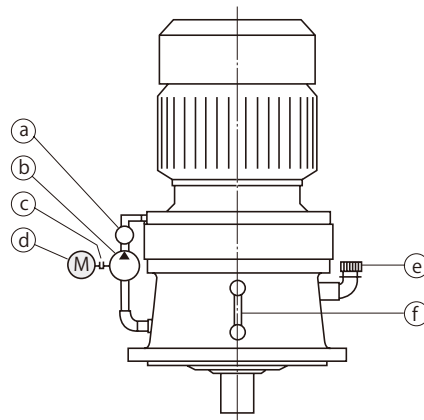
⚠ CAUTION

- When lubricating with a motorized trochoid pump, always start the motorized trochoid pump before starting the main motor. Abnormal temperature rise, seizure, and other damage to the device may occur.

- (1) **Vertical frame, size 6275, 6275DA** : They use a motorized trochoid pump with independent lubrication. Therefore the pump needs a separate power source. (See Table 6-5, figure 6-4)
- (2) For motorized trochoid pump wiring, see figure 6-5. Wire R-U, S-V, T-W. The pump motor rotates in the specified direction. (For Japanese domestic standard specifications. Consult with us for special specification, such as overseas specifications and motors not manufactured by Sumitomo.)
- (3) Between the motor for the motorized trochoid pump and main motor, equip the interlock that satisfies the following two functions. (See figure 6-5)
 - [1] Start time: When the motorized trochoid pump are not activated, the main motor does not activate as well.
 - [2] While running: When for any reason the motorized trochoid pump stops, the main motor stops.
- (4) To ensure good lubricating conditions, start the motorized trochoid pump at least 30 seconds before the main motor starts.

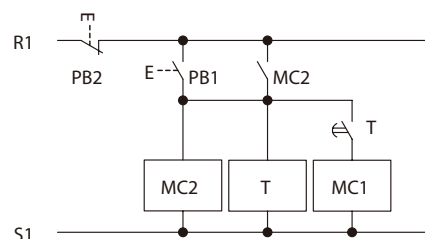
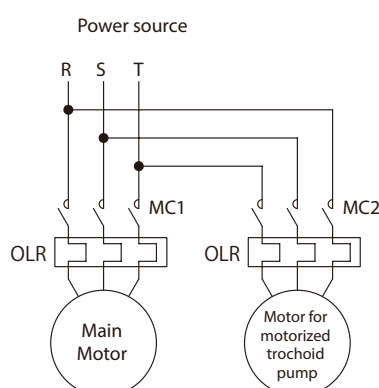
Table 6-5 Motorized Trochoid Pump Specifications

Type			Motorized Trochoid Pump						Remarks
Frame size		Reduction ratio	Pump nomenclature	Pump motor	50 Hz region		60 Hz region		(1) Motorized trochoid pumps manufactured by Nippon Oil Pump Co., Ltd. are used as standard equipment. (2) The motorized trochoid pump is equipped with a release valve as standard (set pressure 0.29 MPa).
					Discharge volume (L/min)	Maximum pressure (MPa)	Discharge volume (L/min)	Maximum pressure (MPa)	
Vertical	6275	Total reduction ratio	TOP-216HB-VB-3	0.75kW 4P	24.0	0.78	28.8	0.49	
	6275DA	Total reduction ratio	TOP-204HB-VB-3	0.4kW 4P	6.0	1.57	7.2	1.13	



a	Flow sight
b	Motorized trochoid pump
c	Coupling
d	Motor (for trochoid pump)
e	Filler plug
f	Oil gauge

Figure 6-4 Structural Diagram of Machine With Motorized Trochoid Pump



- MC1: Electromagnetic contactor (Main motor)
 MC2: Electromagnetic contactor (Motor for motorized trochoid pump)
 PB1: Push button switch (Start)
 PB2: Push button switch (Stop)
 T: Timer (30 or more seconds)

Figure 6-5 Motorized Trochoid Pump Circuit Diagram



7. Operation

DANGER

- Do not approach or touch rotating parts (slow speed 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; otherwise, restoration 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, in order to prevent electric shock.
- 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 products; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- The products becomes very hot during operation. Touching the unit may result in burns.
- Do not loosen the oil filler plug during operation; otherwise, hot, splashing lubricant may cause burns.
- If any abnormality occurs during operation, stop operation immediately; otherwise, electric shock, personal injury, or fire may result.
- Do not operate the unit under more than rated load; otherwise, personal injury, or damage to the equipment may result.

7-1 Items to Check Before Operation

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?
- Does the oil level in an oil-lubricated model reach the top red line of the oil gauge when the unit is at rest?

After confirming these items, operate without a load and gradually apply a load. Check the items shown in Table 7-1.

7-2 Items to Check During Operation

Table 7-1 Items to Check During Operation

Does abnormal sound or vibration generate?	- 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?	- Does the voltage rise or drop substantially? - Is the ambient temperature too high? - Does the current value to the gearmotor exceed the rated current shown on the nameplate?
Is the oil signal active? (When the lubrication is of the plunger pump type.)	- If the ball in the oil signal is not moving up or down, there may be a lubrication problem.

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 standard specification brake types, 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 Activation Delay Time (s)		
	3-Phase Motor	Premium Efficiency, 3-Phase Motor		AF Motor for Inverter		Premium-Efficiency, 3-Phase Motor for Inverter	High-Efficiency, 3-Phase Motor	Brake Torque (Dynamic Friction Torque) (N·m)	Normal Braking Circuit (Simultaneous Turn-Off Circuit)	Normal Braking Circuit for Inverter (Simultaneous Turn-Off Circuit)	Quick Braking Circuit
	4P	4P	6P	4P	6P	4P	4P				
FB-01A1	0.1	—	—	—	—	—	—	1.0	0.15 – 0.2	0.08 – 0.12	0.015 – 0.02
FB-02A1	0.2 0.25	—	—	0.1	—	—	—	2.0			
FB-05A1	0.4	—	—	0.2	—	—	0.2	4.0	0.1 – 0.15	0.03 – 0.07	0.01 – 0.015
FB-1D	0.55	—	—	0.4	—	—	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	—	—	15	—	—	—	—	220	—	—	0.03 – 0.11
	—	18.5	18.5	—	—	18.5	—	190			
	—	22	22	—	—	22	—	220			
	—	30	—	—	—	30	—	200			
ESB-250 (Horizontal)	—	—	—	30	18.5	—	—	Horizontal 212 Vertical 195	—	—	0.065
	—	37	—	37	22	37	—	Horizontal 266 Vertical 244			
ESB-250-2 (Vertical)	—	45	30	—	30	45	—	Horizontal 320 Vertical 292			
	—	—	37	—	—	—	—	Horizontal 372 Vertical 390			
	—	—	—	—	—	—	—	—			
	—	—	—	—	—	—	—	—			

Note: 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 (slow speed shaft, etc.) during maintenance or the inspection with operating the unit; otherwise, loose clothing may become caught in these rotating parts and cause serious injury or death.
- For **explosion proof motors**, customers must not disassemble or modify; otherwise, explosion, ignition, electric shock, or damage to the equipment may result.
- For **explosion proof motors**, the lead-in condition 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, electric shock, or damage to the equipment 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 products; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- The products becomes very hot during operation. Touching the unit with bare hands may result in serious burns.
- 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); otherwise loose clothing may become caught in these rotating parts and cause serious injury or death.
- When any abnormality happens, observe the condition based on maintenance manual. Do not operate the unit until the cause is detected and repaired.
- Change lubricant according to the maintenance manual instructions. Be sure to use factory recommended lubricant.
- When install, move, or transport oil lubricated model, be sure to remove lubricating oil from it. Moving machine with lubricating oil in may cause oil to discharge from the air vent, etc.
- Do not change lubricant during operation or immediately after stopping operation; otherwise, burns may result.
- Supply/discharge grease to/from the motor bearing according to the maintenance manual instructions. Avoid contact with rotating parts; otherwise, injury 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 products lubricant as general industrial waste.
- When measuring the insulation resistance of an **explosion proof motors**, confirm that there is no gas or other vaporized explosive substance around the unit 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 inspections 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? Has there been a sudden rise? (Temperature rises during operation will differ according to model and type. However the difference between the gear unit surface temperature and the ambient temperature should be approximately 60°C. (For frame size 6060 – 6125, and SK series , approximately 40°C.) In this case, there is no particular problem if fluctuation is slight.
Oil level (Oil lubricated machines)	At rest	Is the oil level below the red line at the top of the oil gauge when the machine is at rest? If the oil level is below the top red mark when the machine is at rest, fill up lubricating oil to the mark. Do not add while the machine is running.
	While running	Is the oil level significantly different compared to the level when the lubrication state is stable? The bottom red mark is an auxiliary mark serving as a guideline to check oil level while the machine is running.
	Trochoid pump type	Are the oil signal and flow gauge working properly? Not working properly is a sign of improper reducer lubrication, due to factors including insufficient oil, pump damage and plugged pipes. In this case, immediately stop the machine and inspect it.
Lubricant contamination		Is the lubricating oil contaminated? To check oil contamination, extracting oil while the machine stops and using the oil gauge are effective. If the oil gauge is contaminated, promptly change it.
Oil, grease leaks		Are oil or grease 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 abnormality is discovered during the daily inspection, take measures in accordance with "9. Troubleshooting" (P73, 74). If these actions do not solve the issue, immediately contact the nearest authorized maintenance shop.

8-2 Confirmation of Lubrication Method

Please look for the relevant items and make certain to do maintenance. Lack of maintenance is a source of trouble.

- Check Table 8-2 for the lubrication method applied by the gear unit of the model used.
- Table 8-3 lists the maintenance method by lubrication method.

Table 8-2 Standard Lubrication Methods for Gear Units by Type (When Driven at Standard Input Speed)

SK series	Frame Size	607□SK	608□SK	609□SK	610□SK	611□SK																
	Horizontal	Long-life grease																				
	Vertical																					

Low reduction ratio series	Frame Size	613□	614□	616□	617□																
	Horizontal	Oil Bath																			
	Vertical																				

1 Stage	Frame Size	606□	607□	608□	609□	610□	611□	612□	613□	614□	616□	617□	618□	619□	6205	6215	6225	6235	6245	6255	6265	6275
	Horizontal	Long-life grease							Oil Bath													
	Vertical								Oil Bath		Plunger pump (forced lubrication)											

2 Stage	Frame Size	606□DA	607□DA	609□DA	610□DA	612□DA 612□DB	613□DA	613□DB 613□DC	614□DA	614□DB 614□DC	616□DA 616□DB	617□DA 617□DB	618□DA									
	Horizontal	Long-life grease							Grease													
	Vertical																					
	Frame Size	616□DC	617□DC	618□DB	619□DA 619□DB	6205DA 6205DB	6215DA 6215DB	6225DA 6225DB	6235DA 6235DB	6245DA 6245DB	6255DA 6255DB	6265DA	6275DA									
	Horizontal	Oil Bath																				
	Vertical	Reduction ratio	– 473	– 841	– 1015	– 2065	– 1849	– 2537														
		Plunger pump (forced lubrication)																				
		Reduction ratio	493 –	1003 –	1247 –	2537 –	2065 –	3045 –														
		Grease																				

3 Stage	Frame Size	606□TA	607□TA	609□TA	610□TA	612□TA 612□TB	Frame Sizes Not Listed to the Left															
	Horizontal	Long-life grease							Grease													
	Vertical																					

- Note: 1.  Indicates universal mounting direction.
2.  Indicates independent lubrication using a trochoid pump. See “6-7 Wiring for Motorized Trochoid Pump Motor” (P33)
3. The symbol □ in frame size can be “0”, “5” or “H”.
4. For underlined frame sizes, the horizontal chain flight sludge collector specification is set to oil lubrication.
5. If input speed is not standard, consult with us.

Table 8-3 Maintenance Manual Pages that can be Referenced Regarding Lubrication Maintenance

	Lubrication Method			Oiling, Greasing at Time of Purchase, Prior to Operation	Location of Information on Maintenance Technique			
					Oil, Grease Change, Replenish Intervals	Recommended Lubricating Oil, Grease	Oil Fill Quantity Grease Supply Quantity	Oil Fill and Drain Procedures Grease Supply and Discharge Procedures
Gear unit	Oil lubrication	Oil Bath	Self-lubricating	Required	8-3 (1) P38	8-3 (2) P38	8-3 (3) P39	8-3 (4), (5) P39, 40
		Plunger system	forced lubrication					
		Trochoid system	Independent lubrication					
	Grease lubrication	Long-life grease	Self-lubricating	Not required	8-4 (1) P41	8-4 (2) P41	8-4 (3) P42	8-4 (4) P43
		Other than long-life grease						
Motor bearing unit	Grease lubrication	—	Self-lubricating	Not required	8-6 (1) P44	8-6 (2) P45	8-6 (1) P44	8-6 (3) P45

Note: For plunger pump type (forced lubrication) models, in the case that the slow speed shaft does not rotate continuously (example: the slow speed shaft only rotates 90° or less), consult with us. As Figure 10-2 on P75 shows, plunger pump [40] is driven by cam [47] on the slow speed shaft unit. If the machine is not driven at a continuous standard input speed, consideration to change the amount of lubrication oil for reducer is needed.

8-3 Oil Supply and Oil Change for Oil Lubricated Gear Units

(1) Oil Change Interval

Table 8-4 Lubricating Oil Inspection and Change Intervals

	Change Interval		Operating Condition
Oil supply	Time of purchase		—
Oil change	First time	After 500 hours or 6 months, whichever comes first.	—
	2nd. and subsequent times	Every 5,000 hours, or every year, whichever comes first.	Indoors, etc. at 0 to 35 °C
		Every 2,500 hours, or every 6 months, whichever comes first.	Outdoors or hot locations, etc., where 0 to 35 °C cannot be maintained.

- Oil degrades more rapidly when ambient temperature is high or changes radically, and when corrosive gases are present. In such cases confer with the lubricating oil manufacturer.

(2) Recommended Lubricating Oil

Always use lubricating oils recommended by Sumitomo Heavy Industries as shown in Table 8-5.

Table 8-5 Recommended Lubricating Oils (Equivalent to SP Type Industrial High-Pressure Gear Oil or JIS K2219)

Ambient Temperature °C	COSMO	ENEOS	IDEMITSU	Shell	Mobil		Gulf	CALTEX	bp
-10 to 5	COSMO GEAR SE 68	—	Daphne Super Gear Oil 68	Shell Omala S2 G 68	—	Mobilgear 600 XP 68	Gulf EP Lubricant HD 68	—	Energol GR-XP 68
0 to 35	COSMO GEAR SE 100, 150	BONNOC TS 150	Daphne Super Gear Oil 100, 150	Shell Omala S2 G 100, 150	Spartan EP 150	Mobilgear 600 XP 100, 150	Gulf EP Lubricant HD 100, 150	Meropa 100, 150	Energol GR-XP 100, 150
30 to 50	COSMO GEAR SE 220 - 460	BONNOC TS 220 - 460	Daphne Super Gear Oil 220 - 460	Shell Omala S2 G 220 - 460	Spartan EP 220 - 460	Mobilgear 600 XP 220 - 460	Gulf EP Lubricant HD 220 - 460	Meropa 220 - 460	Energol GR-XP 220 - 460

[1] When using in winter or where the ambient temperature is relatively low, use an oil with low viscosity shown in the table below.

[2] For allowable lubricating oil viscosity see Table 8-6. Use within this required viscosity range.

Table 8-6 Allowable Oil Lubricant Viscosity

Minimum Allowable Viscosity	For oil temperature during operation, minimum 15mm ² /S.		Viscosity that will obtain required film strength under load.
Maximum Allowable Viscosity	Oil bath lubricated models	Maximum 4,300mm ² /S	Viscosity at which Cyclo Drive can start
	Forced lubricated models	Maximum 2,200mm ² /S	Viscosity at which the plunger pump and motorized trochoid pump can start.

[3] For a smooth startup use oil with a pour point at least 5°C below ambient temperature.

[4] If operating temperature changes widely, use a high viscosity index oil that meets requirements [2] and [3].

[5] If regularly operating outside the ambient temperature range of 0 to 40°C, some parts of the mechanism may need to be changed, and lubricating oil might need to be preheated, or cooled. Please consult with us.

(3) Oil Fill Quantity

Table 8-7, 8-8 provides approximate oil fill quantities. There are individual differences in actual quantities due to difference in each structure. Make sure to check that the oil level reaches the top red line on the oil gauge, because the oil quantity may be more or less than requirement even if the oil is filled according to Table 8-7, 8-8.

Table 8-7 Approximate Oil Fill Quantity (L)

Low reduction ratio series	Frame Size	613□	614□	616□	617□	1 Stage	Frame Size	613□	614□	616□	617□	618□	619□	6205	6215	6225	6235	6245	6255	6265	6275
	Horizontal	0.7	0.7	1.4	1.9		Horizontal	0.7	0.7	1.4	1.9	2.5	4.0	5.5	8.5	10	15	16	21	29	56
	Vertical	1.0	1.0	2.3	4.3		Vertical	1.1	1.1	1.0	1.9	2.0	2.7	5.7	7.5	10	12	15	35	43	(60)
2 Stage	Frame Size	616 □ DC	617 □ DC	618 □ DB	619 □ DA	619 □ DB	6205DA 6205DB	6215DA 6215DB	6225DA 6225DB	6235DA 6235DB	6245DA 6245DB	6255DA 6255DB	6265DA	6275DA							
	Horizontal	1.5	2.4	3.5	5.8	6.0	6.0	10	11	17	18	23	32	60							
	Vertical	1.0	1.9	2.0	2.7	2.7	11	14	18	23	29	42	51	(60)							

Table 8-8 Oil Fill Quantity (L) for Horizontal Chain Flight Sludge Collector Specification

2 Stage Reduction	Frame Size	613 □ DB	613 □ DC	614 □ DB	614 □ DC	616 □ DA	616 □ DB	617 □ DA	617 □ DB	618 □ DA
	Horizontal	0.8	0.8	0.8	0.8	1.5	1.5	2.4	2.4	3.0

Note: 1. The symbol □ in frame size can be "O", "5" or "H".

2. Depending on the reduction ratio, 2 stage reduction, vertical type will require grease.

3. () is for a motorized trochoid pump

4. Horizontal type indicates the following nomenclature: PHHM, CHH, CHHM, CHHX, CHHXM, CHHJ, CHHJM. Vertical type indicates the following nomenclature: PVVM, CVV, CVVM, CVVX, CVVXM, CVVJ, CVVJM.

For other nomenclature and mounting directions that are outside standard specification, see the specification documents.

(4) Oil Fill Procedure

■ Oil Fill Procedure for Horizontal Type

- [1] Remove the filler plug.
- [2] Pour oil into the oil filler port, keeping an eye on the oil gauge to check the oil level.
- [3] Confirm that the oil level is up to the top red line on the oil gauge.
- [4] Replace the filler plug.

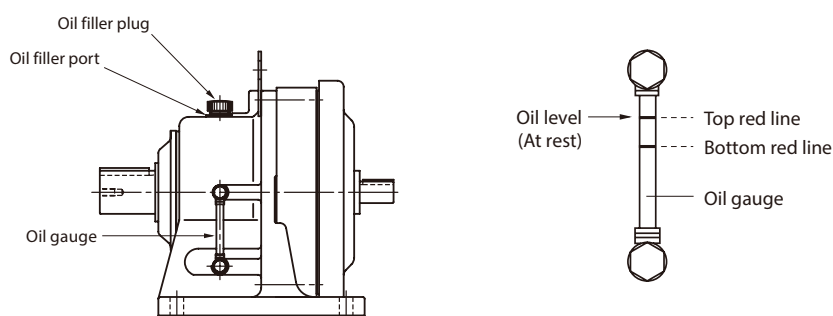


Figure 8-1 Horizontal Types

Oil Fill Procedure for Vertical Type

- [1] Remove the filler plug. For **models other than frame size 6255, 6265**, remove the air vent plug to release air.
- [2] Pour oil into the oil filler port, keeping an eye on the oil gauge to check the oil level.
- [3] Confirm that the oil level is up to the top red line on the oil gauge.
- [4] For **models other than frame size 6255, 6265** wrap the air vent plug with sealing tape and install it.
- [5] Replace the filler plug.

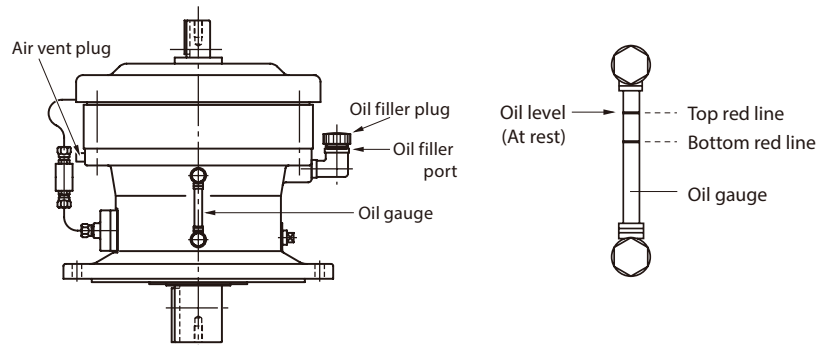


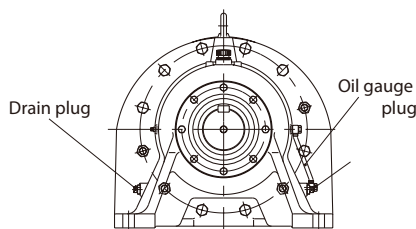
Figure 8-2 Vertical Types

- Only fill oil when the machine is stopped.
- It will take some time for high-viscosity oil to reach a uniform level. Be careful not to fill with too much oil. (If oil is filled above the top red line, churning heat may raise the temperature.)
- Use the lower red line of the oil gauge as a guideline for the oil level while the machine is running. (The oil level may drop below the bottom red line immediately after the machine starts. It will return when oil viscosity drops as the machine runs. Therefore, this is not a problem.)
- For daily oil level management see Table 8-1 on P36.

(5) Draining Procedures

To drain the oil, remove the oil drain plug and the the plug at the bottom of the oil gauge.

Horizontal types



Vertical types

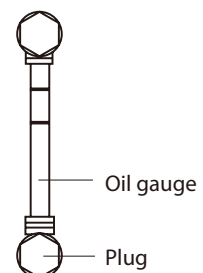
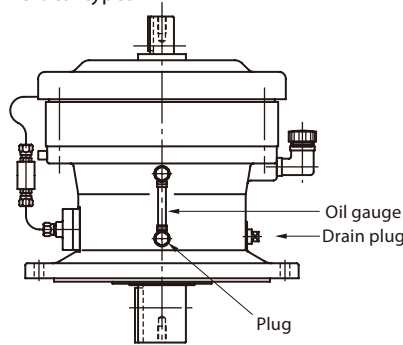


Figure 8-3 Draining Oil

(6) Long Term Inactivity

Table 8-9 Long Term Inactivity

Period of Inactivity	Approximately 1 month	Before resting the machine, change to new oil and run the machine for a few minutes.
	1 month or more	Before resting the machine, flush, fill with rust preventing oil and run for a few minutes under no load.

When resuming operation after a long period of inactivity, change to new oil because the existing oil may degrade.

8-4 Grease Replenishment for Grease Gear Unit Models

(1) Grease Replenishment Intervals

Table 8-10 Grease Replenishment Intervals

Type	Grease Replenishment and Change Intervals
Long-life grease lubricated models	Although these models use long-life grease and can run for a long time without replenishment, maintenance with disassembly after approximately 20,000 hours or 3 to 5 years will increase lifetime.
Other models than Long-life grease lubricated ones	Replenish as shown in Table 8-11. Maintenance with disassembly after approximately 20,000 hours or 3 to 5 years will increase lifetime.

Table 8-11 Grease Replenishment Intervals (Except Long-Life Grease Lubricated Models)

Operation Time	Replenishment Interval	Remarks
Less than 10 hours per day	Once every 3 – 6 months	Shorten the replenishment interval when the operating conditions are severe or the frame size is large.
10 – 24 hours per day	Once every 500 – 1,000 hours	

(2) Recommended Grease (Grease Used When Shipped)

Table 8-12 Recommended Grease (Grease Used When Shipped)

	Type		Manufacturer	Description	Ambient Temperature °C
[1]	SK series	Long-life grease lubricated models	Shell	Shell Alvania EP Grease R000	-10 to 40
[2]	1 Stage Reduction	Long-life grease lubricated models	NIPPECO	BEN10-No.2	-10 to 50
			Mobil	UNIREX N2	
[3]	2 Stage Reduction	Models that are not lubricated with long-life grease	COSMO	COSMO GREASE DYNAMAX SH No.2	
			Mobil	UNIREX N2	
[4]	3 Stage Reduction	The following frame sizes when inverter- driven 613 □ DA, 613 □ DB, 613 □ DC, 614 □ DA, 614 □ DB, 614 □ DC, 616 □ DA, 616 □ DB, 617 □ DA, 617 □ DB, 618 □ DA	NIPPECO	BEN10-No.2	
			Mobil	UNIREX N2	

- The symbol □ in frame size can be "0" or "5".
- Only use grease listed in Table 8-12.
- The maintenance method will differ according to product although the same grease is used.
- When regularly used in an ambient temperature outside the 0 to 40°C range, some specifications will differ. Please consult with us.

(3) Grease Replenishment Quantity

These tables show grease replenishment quantities. Replenish by using the value in the tables as a guideline.

Table 8-13 Grease Replenishment Quantity (Guidelines)

Upper Row: Frame size
Lower Row: Replenishment
Quantity (g)

SK Series

607 □ SK	608 □ SK	609 □ SK	610 □ SK	611 □ SK
Long-life grease lubricated models. Replenishment is not required.				

1 Stage Reduction

606 □	607 □	608 □	609 □	610 □	611 □	612 □
Long-life grease lubricated models. Replenishment is not required.						

2 Stage Reduction

606 □ DA	607 □ DA	609 □ DA	610 □ DA	612 □ DA	612 □ DB			
Long-life grease lubricated models. Replenishment is not required.								
613 □ DA	613 □ DB	613 □ DC	614 □ DA	614 □ DB	614 □ DC	616 □ DA	616 □ DB	616 □ DC
8.5 – 12.5	20 – 30	40 – 60	8.5 – 12.5	20 – 30	40 – 60	20 – 30	40 – 60	85 – 125
617 □ DA	617 □ DB	617 □ DC	618 □ DA	618 □ DB	619 □ DA	619 □ DB		
20 – 30	40 – 60	85 – 125	40 – 60	150 – 225	110 – 165	150 – 225		
6205DA	6205DB	6215DA	6215DB	6225DA	6225DB	6235DA	6235DB	
110 – 165	150 – 225	150 – 225	250 – 375	150 – 225	335 – 500	250 – 375	370 – 550	
6245DA	6245DB	6255DA	6255DB	6265DA				
250 – 375	370 – 550	335 – 500	500 – 750	500 – 750				

3 Stage Reduction

606 □ TA	607 □ TA	609 □ TA	610 □ TA	612 □ TA	612 □ TB				
Long-life grease lubricated models. Replenishment is not required.									
613 □ TA	613 □ TB	613 □ TC	614 □ TA	614 □ TB	614 □ TC	616 □ TA	616 □ TB	616 □ TC	616 □ TD
8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	20 – 30
617 □ TA	617 □ TB	617 □ TC	617 □ TD	618 □ TA	618 □ TB	618 □ TC	618 □ TD	619 □ TA	619 □ TB
8.5 – 12.5	8.5 – 12.5	8.5 – 12.5	30 – 45	8.5 – 12.5	8.5 – 12.5	20 – 30	40 – 60	8.5 – 12.5	20 – 30
619 □ TC	619 □ TD	619 □ TE	6205TA	6205TB	6205TC	6205TD	6205TE	6215TA	6215TB
8.5 – 12.5	20 – 30	40 – 60	8.5 – 12.5	20 – 30	8.5 – 12.5	20 – 30	40 – 60	8.5 – 12.5	20 – 30
6215TC	6215TD	6215TE	6215TF	6225TA	6225TB	6225TC	6225TD	6225TE	6225TF
40 – 60	20 – 30	40 – 60	85 – 125	8.5 – 12.5	20 – 30	40 – 60	20 – 30	40 – 60	85 – 125
6235TA	6235TB	6235TC	6235TD	6235TE	6245TA	6245TB	6245TC	6245TD	6245TE
20 – 30	40 – 60	85 – 125	40 – 60	150 – 225	20 – 30	40 – 60	85 – 125	40 – 60	150 – 225
6255TA	6255TB	6255TC	6255TD	6255TE	6265TA	6265TB	6275TA	6275TB	
20 – 30	40 – 60	85 – 125	85 – 125	150 – 225	85 – 125	150 – 225	85 – 125	150 – 225	

- The symbol □ in frame size can be "0", "5" or "H".
- When changing grease, consult with us for filling quantity for each unit.

(4) Procedures for Filling and Discharging

Grease replenishment procedure for grease lubricated models (excluding long-life grease lubricated models)

- [1] Remove the grease discharge plug from the flanged casing.
- [2] Use a grease gun to replenish through the grease fittings of the internal cover or the motor flange bracket. Use the quantities of grease shown on P42, Table 8-13 as guidelines. If a grease fitting has a metal cap, remove the cap before replenishing. After replenishing, attach the metal cap.
- [3] Replace the grease discharge plug.

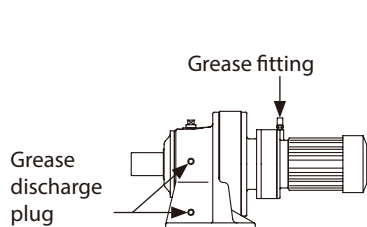


Table 8-4 Location of Grease Fill and Discharge Port
(Example: Horizontal, Gearmotor, 2 Stage Reduction)

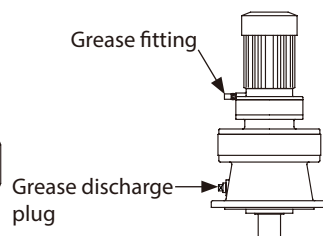


Table 8-5 Location of Grease Fill and Discharge Port
(Example: Vertical, Gearmotor, 2 Stage Reduction)

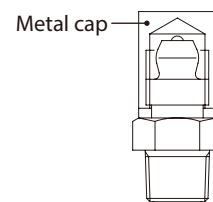


Table 8-6 Grease Fitting with Metal Cap

- Supply grease while the machine is running to improve grease distribution.
- In addition to being used for discharging grease, the grease discharge plug also functions as a pressure vent when replenishing grease. Make certain to remove when replenishing.
- Replenish grease slowly.
- Replenishing more than the quantity shown in Table 8-13 may cause agitation heat, which raises the temperature, and may cause grease to leak into the motor unit.
- Grease may leak out of the grease fitting after starting the machine. In such a case replace the grease fitting with one that has a metal cap.
- Be careful when handling the metal cap for the grease fitting as dropping it from a high place is dangerous.
- Contact the nearest authorized maintenance shop concerning changing all of the grease in a grease lubricated model.

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 increase 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) 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. Because sliding surfaces for oil seals are made of carbon steel, take periodic rust prevention measures not to spread rust on them by applying rustproof oil and so on, if there are exposed surfaces of steel. Please consult with the nearest maintenance shop for the replacement of oil seal or V-ring.
- If stop and start are frequent, mounting bolts (or nuts) and ring gear housing fastening bolts (or nuts) may come loose. Periodically check for looseness as this is a source of miss-alignment, oil leakages, and load unbalance.



8. Daily Inspection and Maintenance

8-6 Motor Bearing Maintenance

Bearing type and maintenance technique will vary according to motor frame size. When maintaining, confirm the bearing type by referring to the nameplate and Table 8-14.

When using a vector motor, other manufacturer's motor (There are some models made by other manufacture.), refer to the operation manual for that motor.

Table 8-14 Bearing Types

Bearing Type	- Specified Motor (Frame Size)		Remarks
	Load Side	Anti-Load Side	
Sealed bearing	- Motor frame size 160 and smaller - Motor frame size 180 and larger at the same time Cyclo frame size 6225 and smaller	All motors except the following.	Not constructed for filling or draining grease
Open bearing	- Motor frame size 180 and larger at the same time Cyclo frame size 6235 and larger	- Motor frame size F-200L (increased safety), at the same time Cyclo frame size 6255 and 6265	With grease fitting and grease discharge plug

(1) Sealed Bearing Maintenance

Although it will depend on operation conditions, maintenance with disassembly after approximately 20,000 hours or 3 to 5 years will increase lifetime.

Contact the nearest authorized maintenance shop regarding maintenance with disassembly.

(2) Open Bearing Maintenance

Check the bearing number on the nameplate, and replenish grease in accordance with with Table 8-15.

Table 8-15 Open Bearing Grease Replenishment Intervals and Replenishment Quantity

Bearing Number	Replenishment Quantity (g)	Grease Replenishment Interval (Interval (h) for Speeds (r/min))					
		720 r/min	870 r/min	980 r/min	1165 r/min	1450 r/min	1750 r/min
NU314	40	4000	3500	3000	2500	1500	1000
NU315	45	4000	3000	3000	2000	1500	1000
NU316	50	4000	3000	2500	2000	1500	1000
NU317	55	3500	3000	2500	2000	1500	1000
NU318	60	3500	2500	2500	2000	1000	1000
21312	30	1500	1000	1000	800	-	-

- The replenishment quantity is the quantity to insert at each interval.
- Even in the case of intermittent operation, replenish grease approximately every 3 years.
- If the machine is rested for a long time, replenish grease immediately after resuming operation.

(3) Recommended Grease for Open Bearings

Table 8-16 Recommended Grease

Ambient temperature °C	Open Bearing	
	Thermal class 130 (B)	Thermal class 155 (F)
	Mobil	Shell
-10 to 40	UNIREX N2	Shell Stamina Grease RL2

Avoid using grease other than that listed in Table 8-16.



(4) Procedures for Filling and Discharging Grease for Open Bearings

See construction diagram 8-7.

[1] Remove the discharge port plug, and discharge the old grease. While the machine is running, replenish with new grease through the grease fitting.

(Grease change will be incomplete if replenishing is done while the machine is stopped.)

[2] Run the machine for approximately 10 minutes after the grease is inserted. Then fasten the discharge port plug.

- Overfilling could cause the bearing to overheat, grease to leak and other problems. Be careful.
- Do not think that it is allowable to replenish with a large quantity to extend the replenishment interval.
- Please maintain the machine properly. Neglecting replenishment when resuming operation, or periodic replenishment when the machine is operating could lead to abnormal wear, bearing noise, bearing burnout, and other problems.

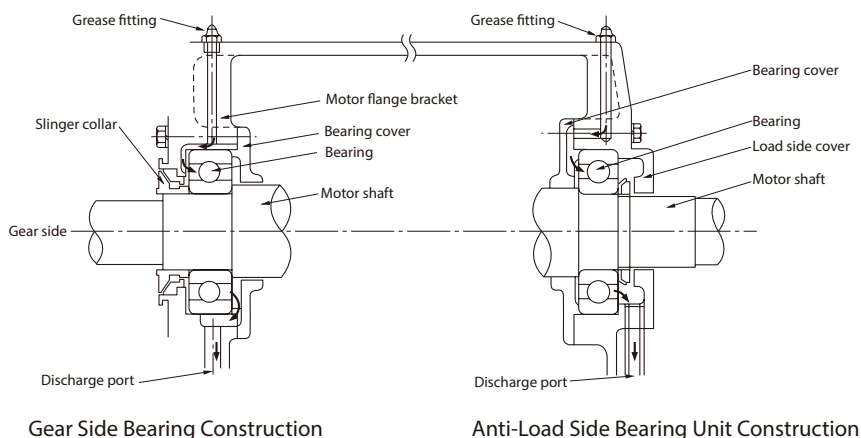


Figure 8-7 Open Bearing Unit Construction



8. Daily Inspection and Maintenance

8-7 Brake Maintenance and Inspection

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.
- When using the product for lifting, do not release the brake while an object 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 bring water or oils in contact with 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 become 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 moment of inertia 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 (power-off 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, adjust the gap.
- In FB-1E – FB-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 so 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 brake noise will increase and the brake will not function properly if the shock absorber is damaged or falls out.

Table 8-17 Pages Containing Information on Brake Construction and Gap Inspection and Adjustment

Brake type	Indoor	Outdoor
FB-01A1, FB-02A1, FB-05A1	P47	P58
FB-1D	P48	P59
FB-1E	P49	P60
FB-1HE, FB-2E	P50	P61
FB-3E, FB-4E	P51	P62
FB-5E, FB-8E	P52	P63
FB-10E, FB-15E	P53	P64
FB-20	P54	P65
FB-30	P55	P66
ESB-250, ESB-250-2	P56	P67

Please refer to P69 for the way to remove and attach one-touch release lever.

■ FB-01A1, FB-02A1, FB-05A1 (Indoor Type)

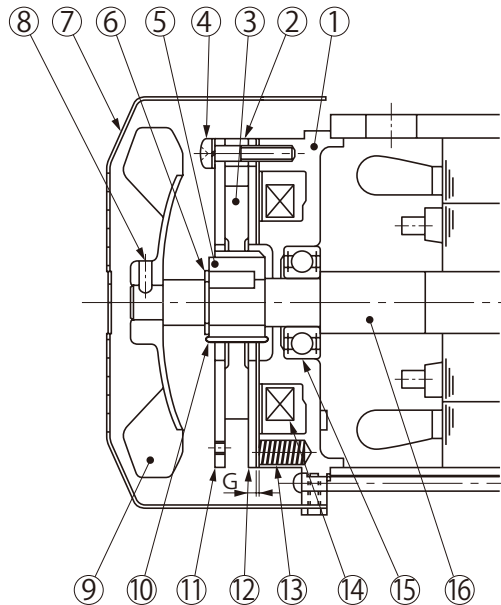


Figure 8-8

Code	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

Note: FB-01A1 does not come with [8][9].

- 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] counterclockwise, 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 to a torque of 0.3 – 0.5 N·m.

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

■ FB-1D (Indoor Type)

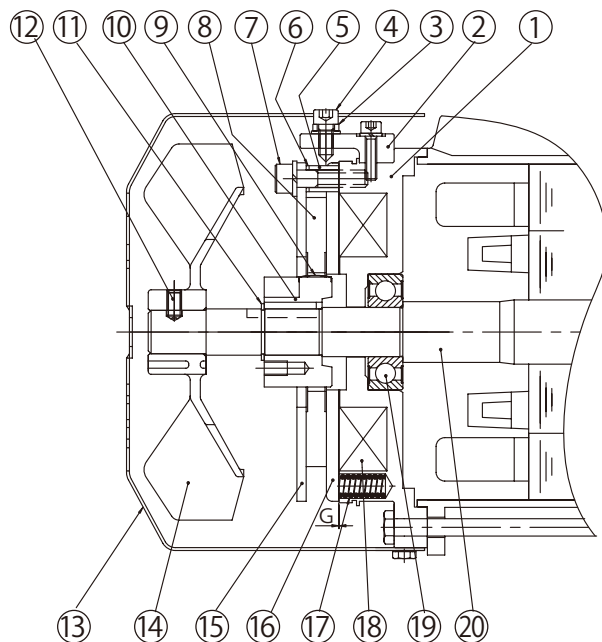


Figure 8-9

Code	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

- 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.
(Gap adjustment shim thickness is approximately 0.2 – 0.25 mm. Adjustment cannot be made at a lower value.)

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 fall 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 to 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)

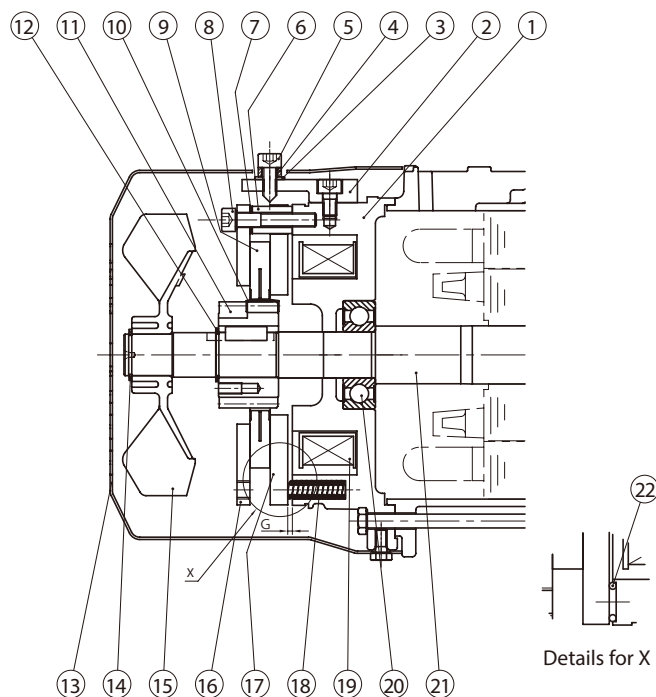


Figure 8-10

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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

- 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.

(Gap adjustment shim thickness is approximately 0.2 – 0.25 mm. Adjustment cannot be made at a lower value.)

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] make certain not to fall the gap adjustment shims [7] or 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)

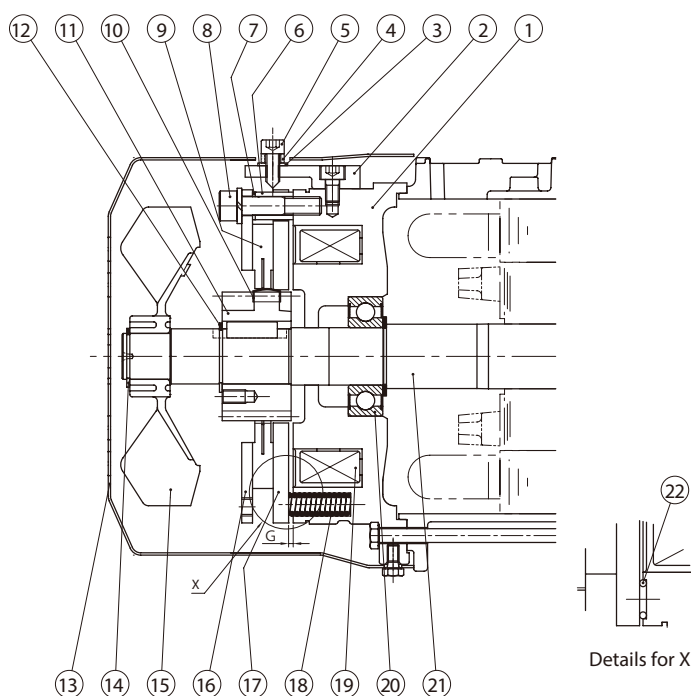


Figure 8-11

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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

- 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.

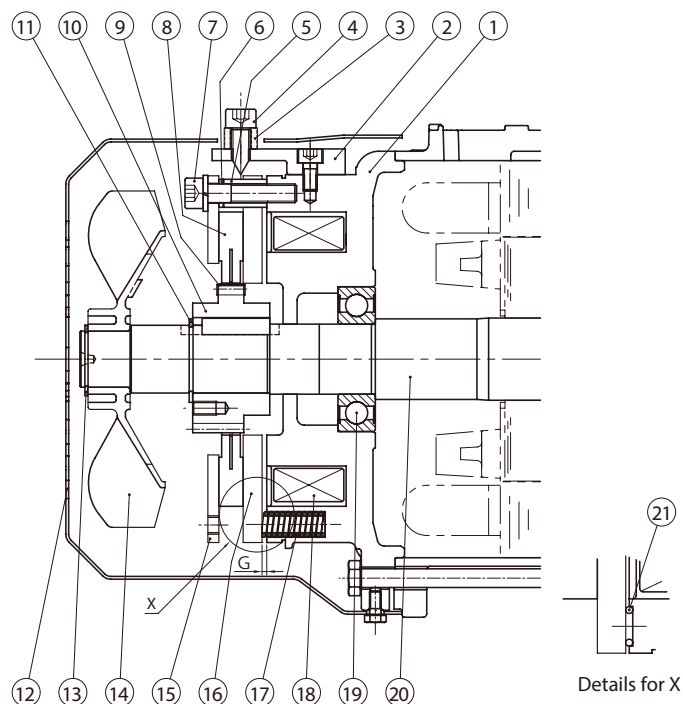
(Gap adjustment shim thickness is approximately 0.35 – 0.45 mm. Adjustment cannot be made at a lower value.)

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] make certain not to fall the gap adjustment shims [7] or the shock absorber [22].
- (5) The gap adjustment shims [7] have a thickness of 0.35 – 0.45 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-3E, FB-4E (Indoor Type)



Code	Part Name
1	Stationary core
2	Brake release
3	Manual release prevention 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 8-12

- 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.

(Gap adjustment shim thickness is approximately 0.45 – 0.55 mm. Adjustment cannot be made at a lower value.)

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] make certain not to fall the gap adjustment shims [6] or 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 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].



8. Daily Inspection and Maintenance

■ FB-5E, FB-8E (Indoor Type)

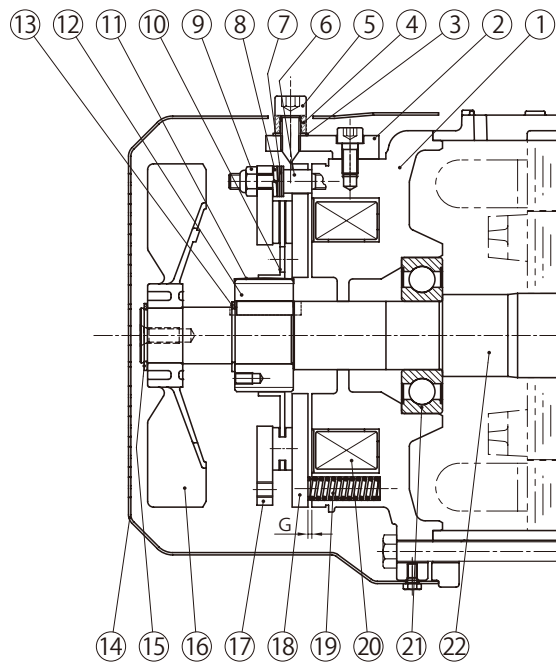


Figure 8-13

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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)

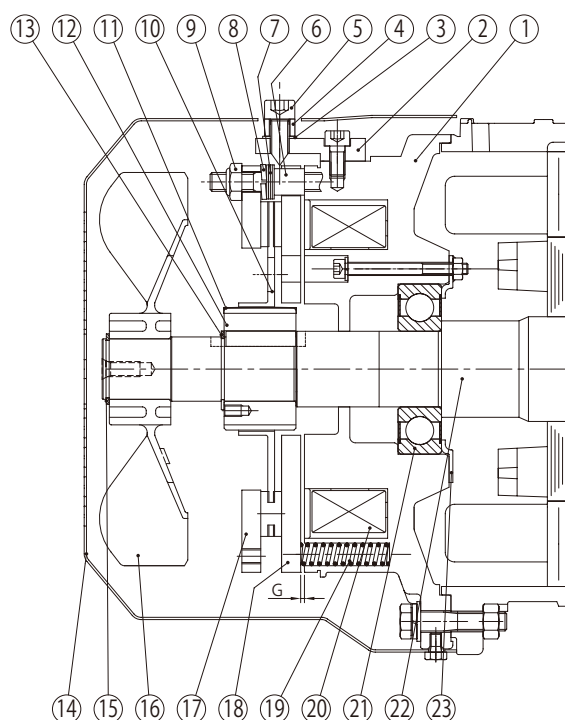


Figure 8-14

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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 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)

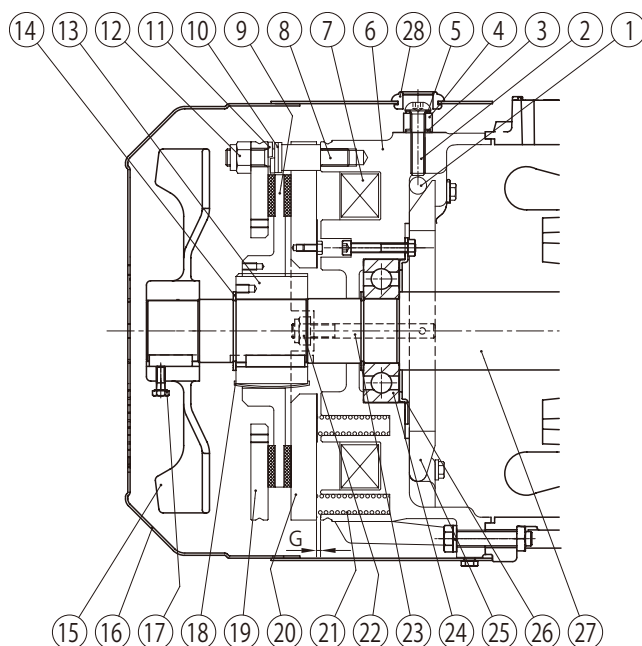


Figure 8-15

Code	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release prevention 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)

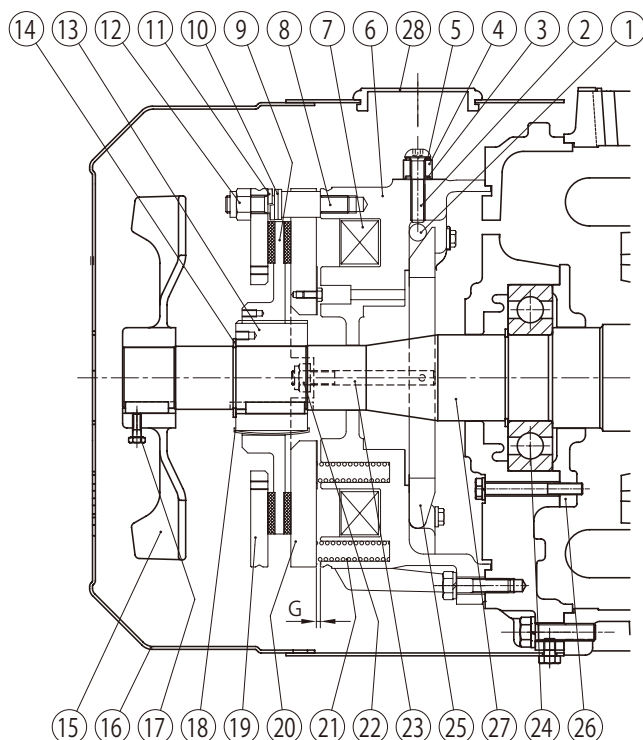


Figure 8-16

Code	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release prevention 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].



8. Daily Inspection and Maintenance

■ ESB-250, ESB-250-2 (Indoor Type)

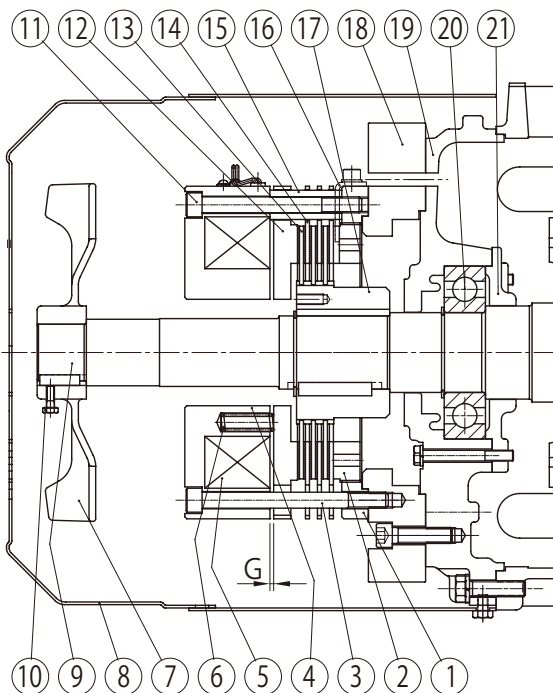


Figure 8-17

Code	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

Note: 1. Motor configuration differs for fan motor ventilation type.

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

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 – 1.2 s
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 s or less: 8 cycles/min
	Constant When on-time exceeds 1.2 s: 30 cycles/min
Allowable ambient temperature	- 20°C to 60°C

■ Accessory Rectifier (DC power supply unit) Model HD-110M3

Outline drawing

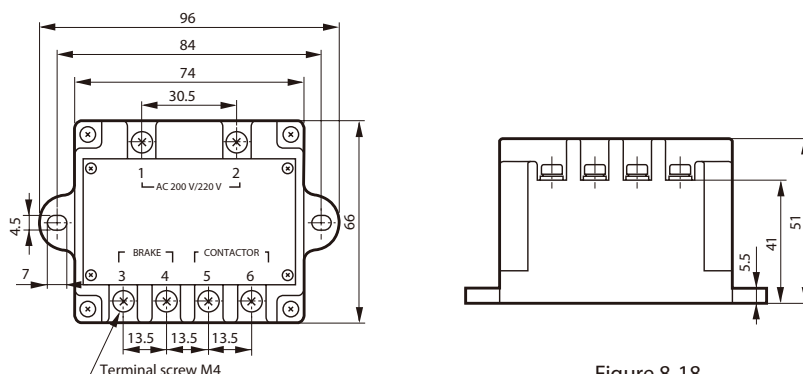
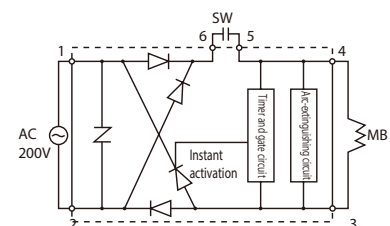


Figure 8-18

Internal circuit (diagram)



Note: 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 cover [8].
- (2) Insert a gap gauge between the field [4] and 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 P72.
- (2) Loosen the stopper [16] on the periphery of the center ring [1], and remove it. This will free the gap adjusting screws [2].
(See Figure 8-19)
- (3) Insert the gap adjusting bar (customer to prepare an angle plate. See Figure 8-21) from between the outer disc [14] and the center ring [1] into a hole for a gap adjusting screw [2].
Rotating to the left as seen from the field [4] side, will narrow the gap. (See Figure 8-20)
- (4) Six attachment bolts [3] and 6 lock bolts [11] alternately pass through the space between the outer disc [14] and the center ring [1]. Rotating the gap adjusting bar will contact 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.

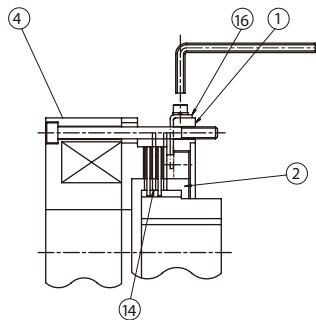


Figure 8-19

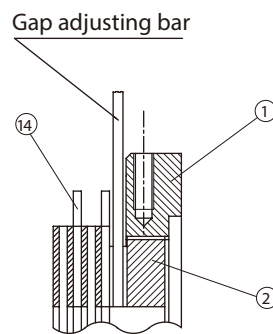


Figure 8-20

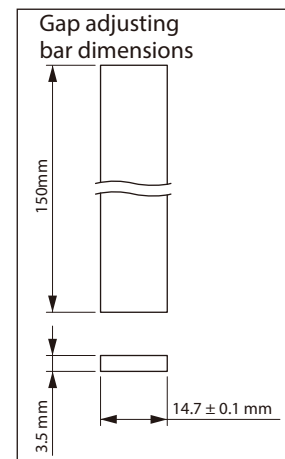


Figure 8-21

■ FB-01A1, FB-02A1, FB-05A1 (Outdoor Type)

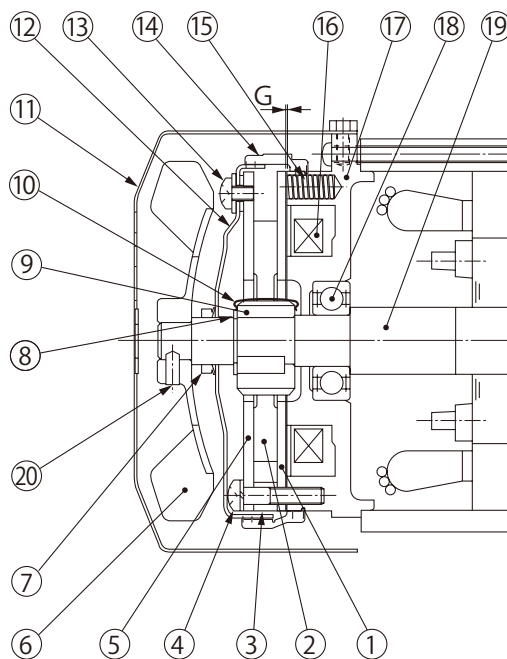


Figure 8-22

Code	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

Note: FB-01A1 does not come with [6][7][20].

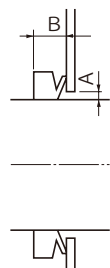
- Gap Inspection

- (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] 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 the release bolt.) Attach the waterproof seal [14] so that its protrusion fits snugly around the entire circumference of the groove for the stationary core [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 the lip contact 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 to a torque of 0.3 – 0.5 N·m.



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

■ FB-1D (Outdoor Type)

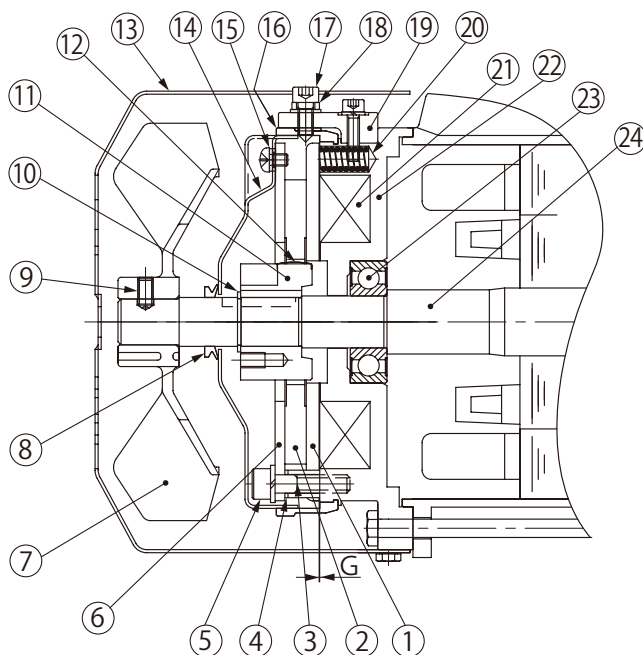


Figure 8-23

Code	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.
(Gap adjustment shim thickness is approximately 0.2 – 0.25 mm. Adjustment cannot be made at a lower value.)

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 adjusting shims [4], attachment bolts [5], fixed plate [6] as a set. When removing the attachment bolts [5] make certain not to fall the gap adjustment shims [4].
- (9) The gap adjusting 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 it and the required value.
- (11) Attach the waterproof cover [14] 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 uniform.
- (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 groove for the stationary core [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 the lip contact 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 to a torque of 0.85 – 1.05 N·m. Finally, attach the brake release bolt [17] and the manual release prevention spacer [18].



■ FB-1E (Outdoor Type)

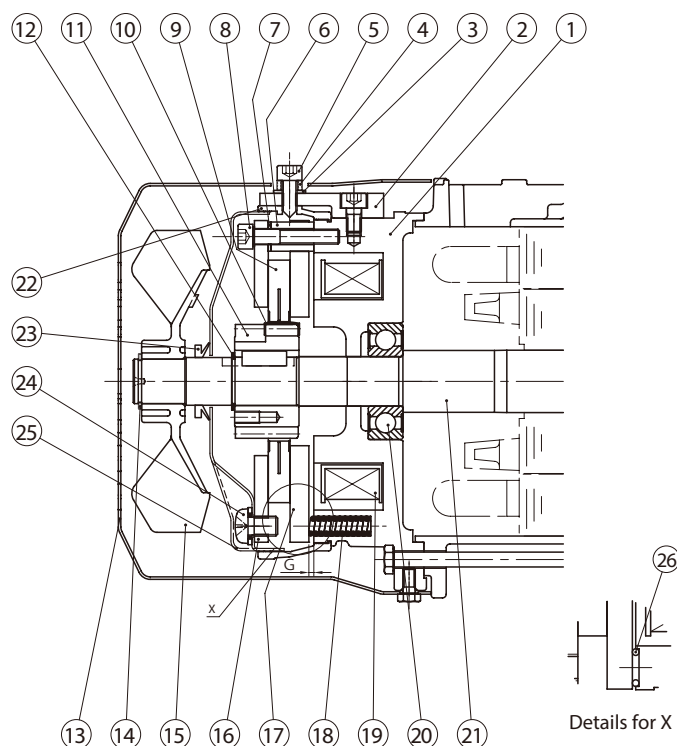


Figure 8-24

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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

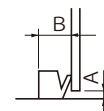
- Gap Inspection

- (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.
(Gap adjustment shim thickness is approximately 0.2 – 0.25 mm. Adjustment cannot be made at a lower value.)

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] make certain not to omit the gap adjustment shims [7] or 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 it and the required value.
- (10) Attach the waterproof cover [25] using the waterproof cover 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 uniform.
- (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 brake release bolt with the position of the release bolt [5]. Attach the waterproof seal [22] so that its protrusion fits snugly around the entire circumference of the groove for the stationary core [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 the lip contact 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)

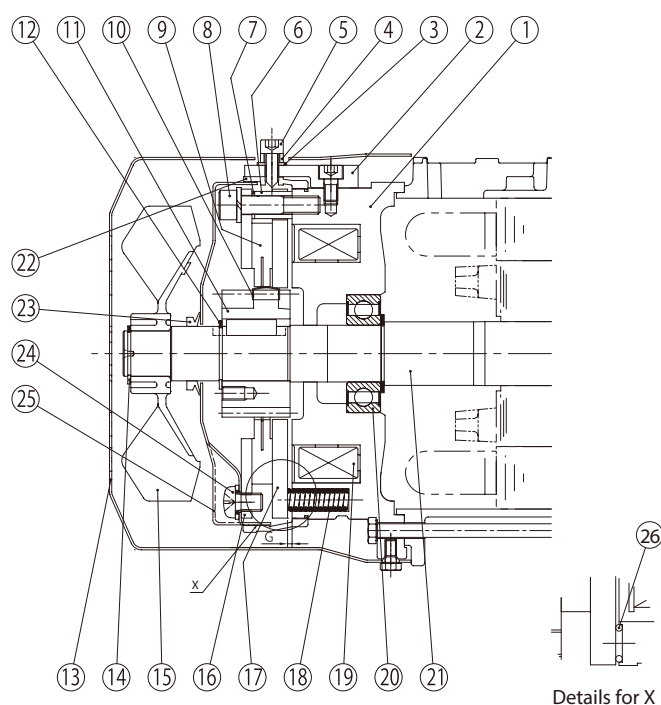


Figure 8-25

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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

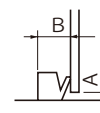
- Gap Inspection

- Remove the brake release bolt [5] and the manual release prevention spacer [4].
- Remove the cover [13].
- Remove the shaft-retaining C-ring [14], and remove the fan [15].
- Remove the brake release [2] (2 locations) and remove the waterproof seal [22].
- 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.
- Adjustment is required if the gap value is near the limit.
(Gap adjustment shim thickness is approximately 0.35 – 0.45 mm. Adjustment cannot be made at a lower value.)

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

- Gap Adjustment

- Remove the brake release bolt [5] and the manual release prevention spacer [4].
- Remove the cover [13].
- Remove the shaft-retaining C-ring [14], and remove the fan [15].
- Pull off the V-ring [23].
- Remove the brake release [2] (2 locations) and remove the waterproof seal [22].
- Remove the waterproof cover attachment bolts [24], and remove the waterproof cover [25].
- 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] make certain not to omit the gap adjustment shims [7] or the shock absorber [26].
- The gap adjustment shims [7] have a thickness of 0.35 – 0.45 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.
- Check the gap G, and readjust the shims if there is a large difference between it and the required value.
- Attach the waterproof cover [25] using the waterproof cover 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 uniform.
- Clean the surface of the waterproof seal [22] to remove impurities.
- 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 brake release bolt with the position of the release bolt [5]. Attach the waterproof seal [22] so that its protrusion fits snugly around the entire circumference of the groove for the stationary core [1]. (Be careful that the waterproof seal [22] does not meander. Otherwise water could leak in.)
- Turn the power on and off to check brake action.
- Attach the V-ring [23]. Wipe off the lip and surface near the lip of the V-ring [23], lightly coat the the lip contact surface with grease, and attach. Observe the attaching dimension (B=6mm).
- Attach the fan [15], shaft-retaining C-ring [14] and cover [13].
- Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].



■ FB-3E, FB-4E (Outdoor Type)

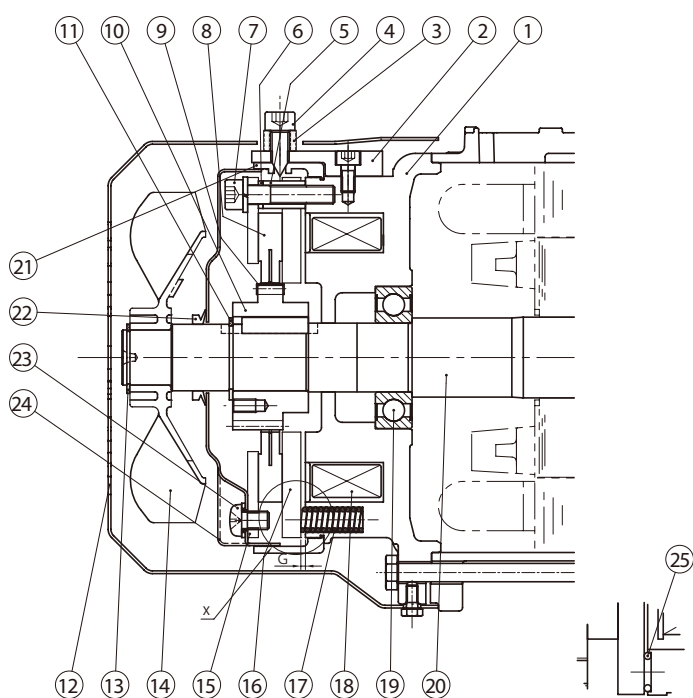


Figure 8-26

Details for X

Code	Part Name
1	Stationary core
2	Brake release
3	Manual release prevention 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

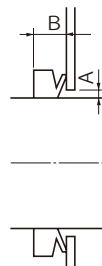
- Gap Inspection

- (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.
(Gap adjustment shim thickness is approximately 0.45 – 0.55 mm. Adjustment cannot be made at a lower value.)

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] make certain not to omit the gap adjustment shims [6] or 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 fixed plate [15] as a set.
- (9) Check the gap G, and readjust the shims if there is a large difference between it and the required value.
- (10) Attach the waterproof cover [24] using the waterproof cover 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 uniform.
- (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]. Align the hole in the waterproof seal [21] for the brake release bolt with the position of the release bolt [4]. Attach the waterproof seal [21] so that its protrusion fits snugly around the entire circumference of the groove for the stationary core [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 the lip contact 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)

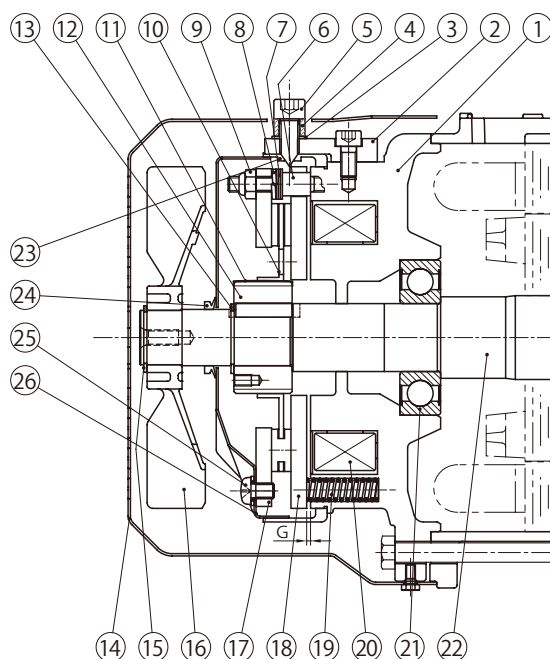


Figure 8-27

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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

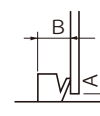
- Gap Inspection

- (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 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 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 the gap is large, and adjustments are not possible, decrease the number of adjustment washers [7]. There are 3 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] using the waterproof cover 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 uniform.
- (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]. Align the hole in the waterproof seal [23] for the brake release bolt with the position of the release bolt [5]. Next, attach along the machined surfaces around the stationary core [1]. Be careful so 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 the lip contact 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-10E, FB-15E (Outdoor Type)

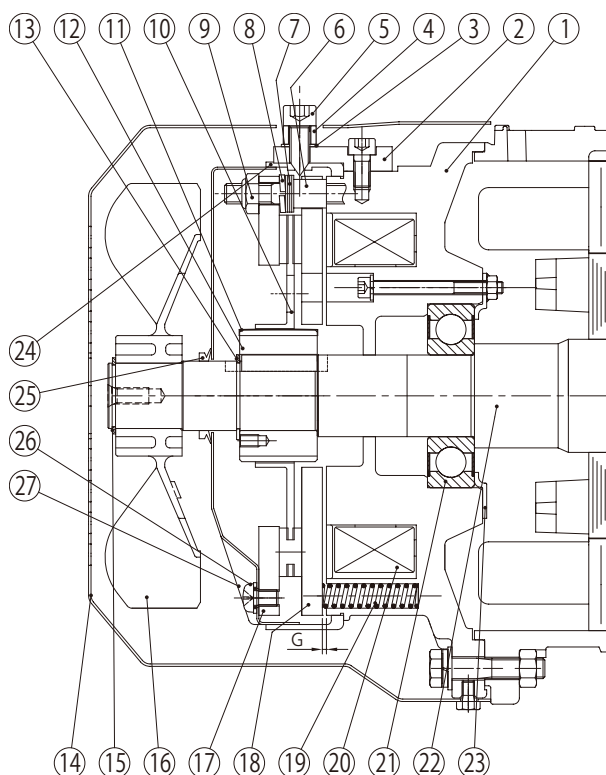


Figure 8-28

Code	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention 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 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 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 the gap is large, and adjustments are not possible, decrease the number of adjustment washers [7]. There are 3 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] using the waterproof cover attachment bolts [26]. At this time align the cutout area on the side of the waterproof cover [27] with position of 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 uniform.
- (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]. Align the hole in the waterproof seal [24] for the brake release bolt with the position of the release bolt [5]. Next, attach along the machined surfaces around the stationary core [1]. Be careful so 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 the lip contact 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)

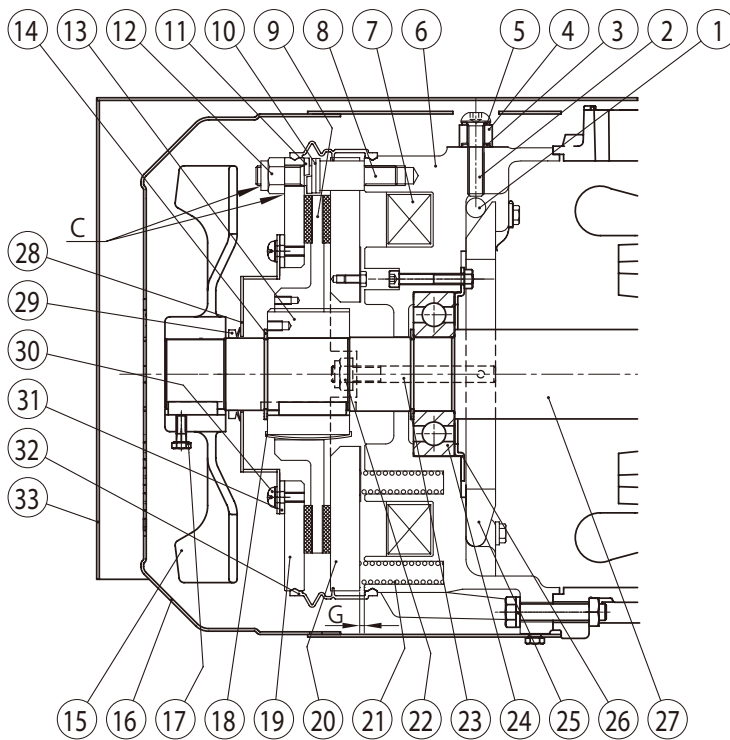


Figure 8-29

Code	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release prevention 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

Note: The shape of the outdoor cover [33] differs for vertical type specification.

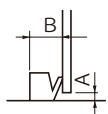
- Gap Inspection

- Remove the outdoor cover [33] and the cover [16].
- Loosen the fan set screw [17] and remove the fan [15].
- Remove the waterproof seal [32].
- Insert a gap gauge between the stationary core [6] and the armature plate [12], and measure the gap. Measure in 3 locations around the circumference.
- Adjustment is required if the gap value is near the limit.

- Gap Adjustment

- Remove the outdoor cover [33] and the cover [16].
- Loosen the fan set screw [17] and remove the fan [15].
- Pull off the V-ring [29].
- Remove the waterproof seal [32].
- 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.
- Turn the power on and off to check brake action.
- Attach the waterproof cover [28] so that the gap (A) between its hole and the motor shaft [27] is nearly uniform. (Only when the waterproof cover [28] has been removed)
- Clean the surface of the waterproof seal [32] to remove impurities.
- As shown in the construction diagram, install the waterproof seal [32] between the stationary core [6] and the fixed plate [19]. (Be careful so that the waterproof seal [32] does not meander. Otherwise water could leak in.)
- Attach the V-ring [29]. Wipe off the lip and surface near the lip of V-ring [29], lightly coat the the lip contact surface with grease, and attach. Observe the attaching dimension (B=7mm).
- Thoroughly coat the gap (C) between the gap adjusting nuts [12], the stud bolts [8] and the fixed plate [19] with waterproof adhesive (Three Bond 1102).
- Attach the fan [15], 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)

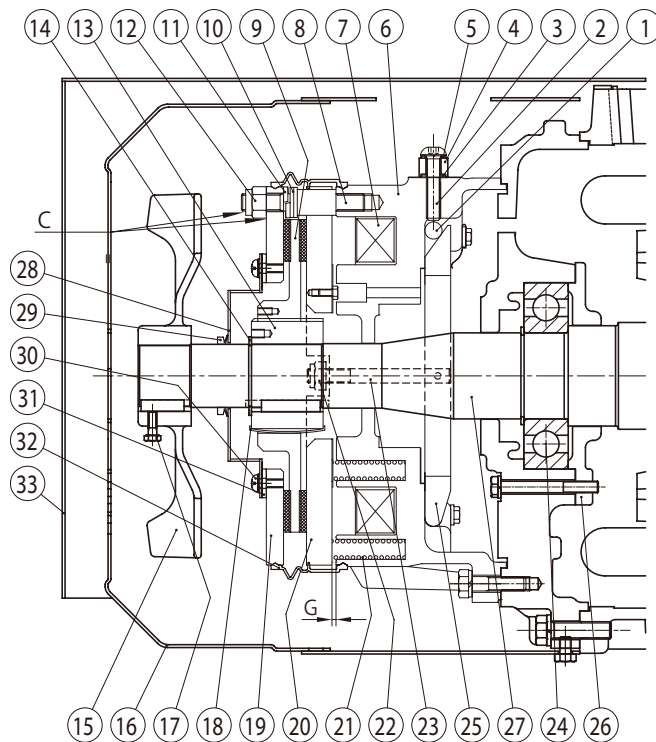


Figure 8-30

Code	Part Name
1	Roller
2	Brake release bolt
3	Rubber packing
4	Manual release prevention 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

Note: The shape of the outdoor cover [33] differs for vertical type specification.

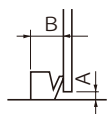
- Gap Inspection

- Remove the outdoor cover [33] and the cover [16].
- Loosen the fan set screw [17] and remove the fan [15].
- Remove the waterproof seal [32].
- 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.
- Adjustment is required if the gap value is near the limit.

- Gap Adjustment

- Remove the outdoor cover [33] and the cover [16].
- Loosen the fan set screw [17] and remove the fan [15].
- Pull off the V-ring [29].
- Remove the waterproof seal [32].
- 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.
- Turn the power on and off to check brake action.
- Attach the waterproof cover [28] so that the gap (A) between its hole and the motor shaft [27] is nearly uniform. (Only when the waterproof cover [28] has been removed)
- Clean the surface of the waterproof seal [32] to remove impurities.
- As shown in the construction diagram, install the waterproof seal [32] between the stationary core [6] and the fixed plate [19]. (Be careful so that the waterproof seal [32] does not meander. Otherwise water could leak in.)
- Attach the V-ring [29]. Wipe off the lip and surface near the lip of V-ring [29], lightly coat the the lip contact surface with grease, and attach. Observe the attaching dimension (B=7mm).
- Thoroughly coat the gap (C) between the gap adjusting nuts [12], the stud bolts [8] and the fixed plate [19] with waterproof adhesive (Three Bond 1102).
- Attach the fan [15], 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)

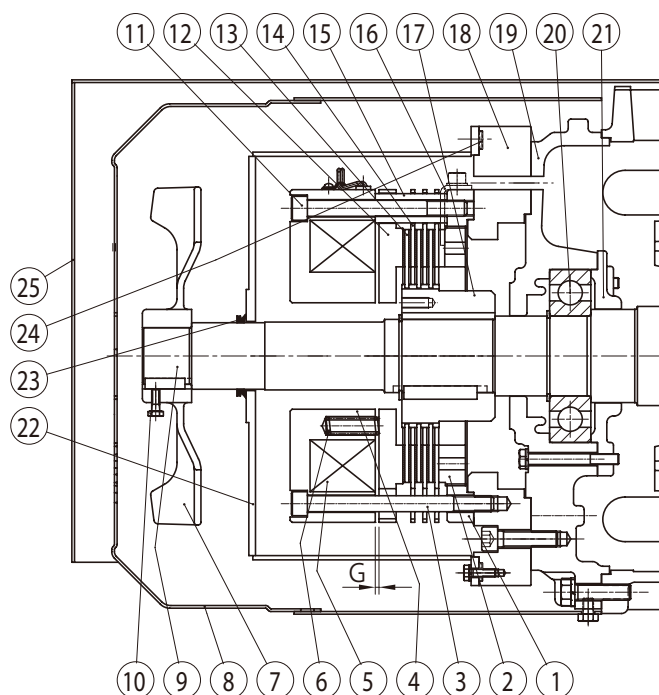


Figure 8-31

Code	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

Note: 1. Motor configuration differs for fan motor ventilation type.

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

3. The outdoor cover [25] for ESB-250-2 (the vertical types) 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 – 1.2 s
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 s or less: 8 cycles/min Constant When on-time exceeds 1.2 s: 30 cycles/min
Allowable ambient temperature	-20°C to 60°C

■ Accessory Rectifier (DC power supply unit)

Model HD-110M3

Outline drawing

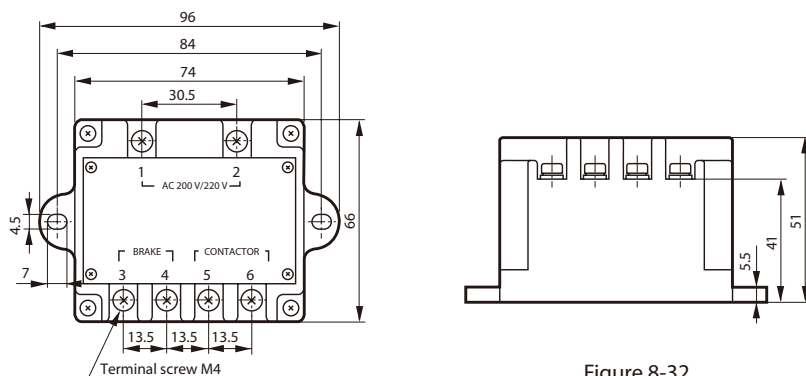
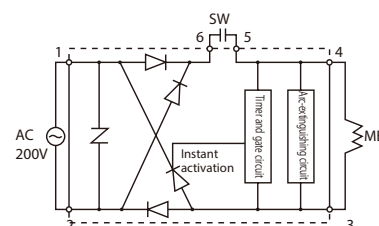


Figure 8-32

Internal circuit (diagram)



Note: 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.



8. Daily Inspection and Maintenance

- 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 following the procedure on P72.
- (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 8-33)
- (3) Insert the gap adjusting bar (customer to prepare an angle plate. See Figure 8-35) from between the outer disc [14] and the center ring [1] into a hole for a gap adjusting screw [2].
Rotating to the left as seen from the field [4] side, will narrow the gap. (See Figure 8-34)
- (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 adjusting bar will contact 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.

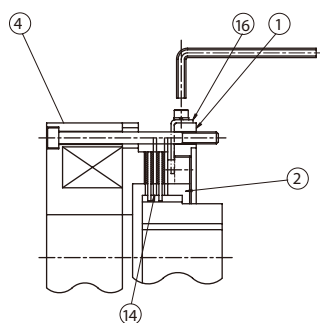


Figure 8-33

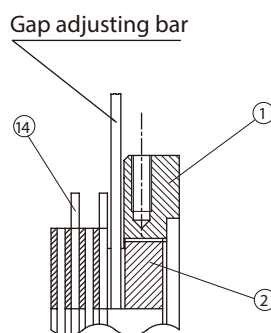


Figure 8-34

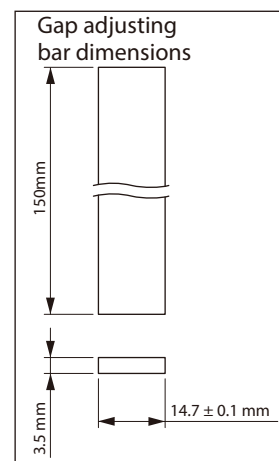


Figure 8-35

8-9 Removing and Installing One-Touch Release Lever

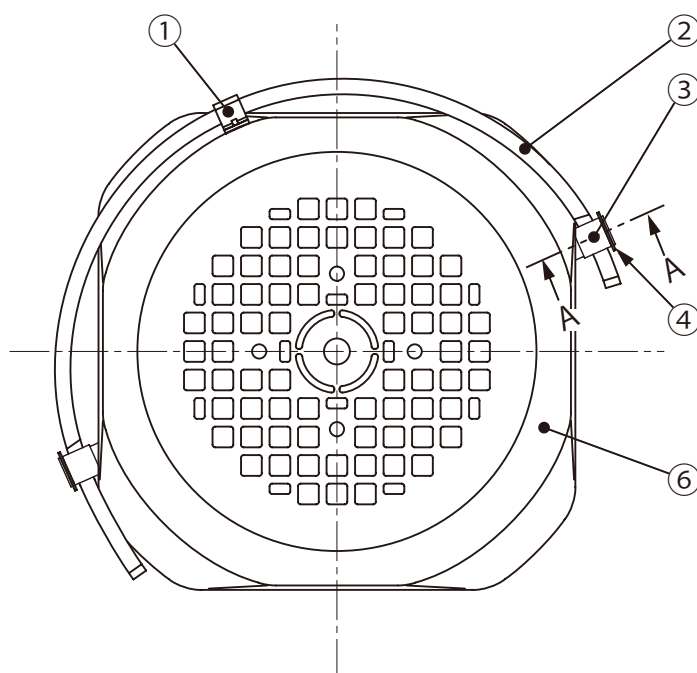
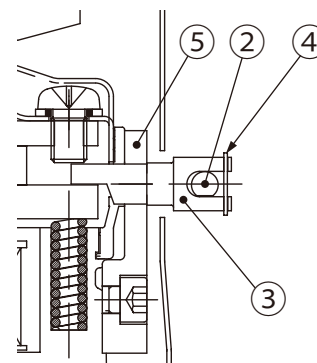


Figure 8-36

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. Daily Inspection and Maintenance

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-01A1, FB-02A1, FB-05A1), ESB-250, ESB-250-2

When the thickness of brake lining (FB brake) or inner disc (ESB-250) reaches the use limit thickness in Table 8-18

(2) FB-01A1, FB-02A1, FB-05A1

When after gap adjustment the brake gap still reaches the limit (see P47, P58)

Table 8-18 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-01A1, FB-02A1, FB-05A1		7.0	-	-	-
FB-1D				6.0	
FB-1E		8.8		7.8	
FB-1HE, FB-2E		9.0		8.0	
FB-3E, FB-4E		10.4		8.4	
FB-5E, FB-8E		10	-	6.0	-
FB-10E, FB-15E		11		7.0	
FB-20, FB-30		16		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 case, turn motor and brake power on and off under as lightest load as possible to rub the brake lining and the inner disc friction surfaces.
- When changing the brake lining and the inner disc, change the boss and leaf springs (for FB-5E – FB-15E, FB-20, FB-30, include the gap adjusting nuts) as a set.
- After 2 million or more cycles of operation, (for FB-30, ESB-250 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 or the inner disc has not reached the usable thickness limit.
- Check the following items concerning the condition of each mechanical part.
 - Are the material of linings split or chipped?
 - Is there any peeling or gap between the material of lining and the disc?
 - Does the spline unit of the brake lining and the inner disc exhibit any cracking, chipping, or stepped wear?
 - Is there any stepped wear on the surfaces around the stud bolts or armature plate?
- Change the brake lining and the inner disc, even if it has not reached the usable thickness limit, if 10 or more years have elapsed since the manufacturing date and the brake is used outdoors or in a high-humidity environment, or 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. Contact the nearest authorized maintenance shop about 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 periodic rust prevention measures.

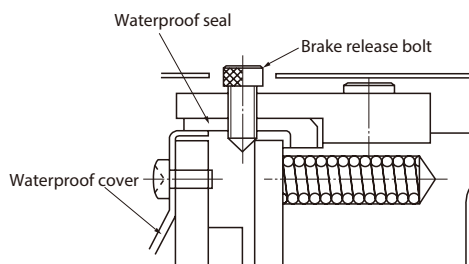
8-12 Manually Releasing the Brake

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

■ FB Brakes (excluding FB-20, FB-30) (FB-01A1 – FB-05A1 are options)

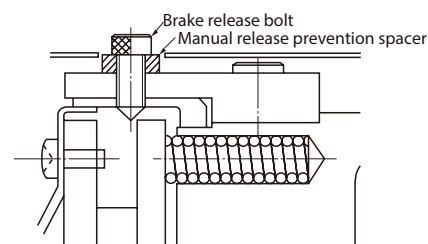
- (1) First remove the brake release bolts from the 2 opposing angles and remove the release prevention spacers. Reinsert the bolts and rotate with a hexagonal wrench to release the brake. Be careful not to over rotate the brake release bolts. (Rotate the brake release bolts while checking if the brake is released.) (See Figures 8-37, 8-38)
- (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 8-38)
- (3) This table shows brake release bolt sizes.

Brake Type	Bolt Size
FB-01A1, FB-02A1, FB-05A1 FB-1D	M5
FB-1E, FB-1HE, FB-2E	M6
FB-3E, FB-4E	M8
FB-5E, FB-8E, FB-10E, FB-15E	M10



When released

Figure 8-37



When operating

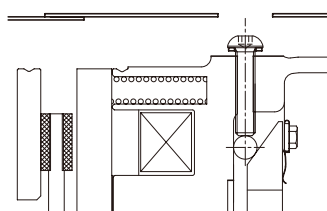
Figure 8-38

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

■ FB-20, FB-30

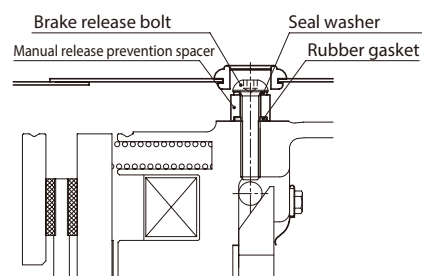
- (1) In the case of outdoor types, remove the lid on the window part of the outdoor cover [33]. Remove the grommet [28] (indoor type), remove the brake release bolt [2] by using a hexagonal wrench (for an M8 hole bolt), and remove the rubber gasket [3] and the manual release prevention spacer [4]. The 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 if the brake is released.) (See Figure 8-39)
- (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 8-40) 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 8-39



When operating

Figure 8-40



8. Daily Inspection and Maintenance

■ ESB-250, ESB-250-2

- (1) In the case of outdoor types, remove outdoor cover [25]. Remove the cover [8], fan [7], and brake cover [22] (outdoor type).
- (2) Insert M12×65 hexagon socket head bolts (customer needs to prepare) 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. Using a hexagonal wrench equally tighten the bolts 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.

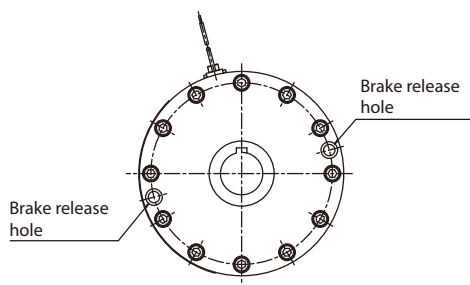


Figure 8-41

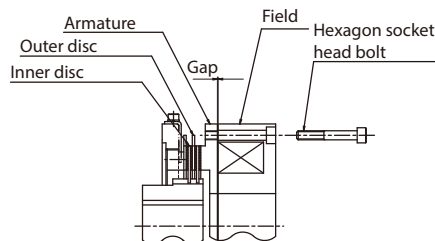


Figure 8-42

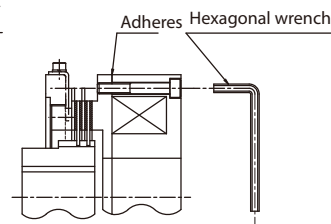


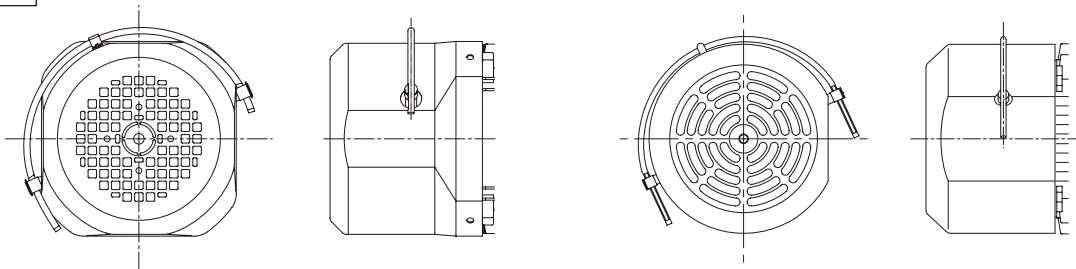
Figure 8-43

■ One-Touch Release Lever Method (Optional on all FB brakes except FB-20, FB-30)

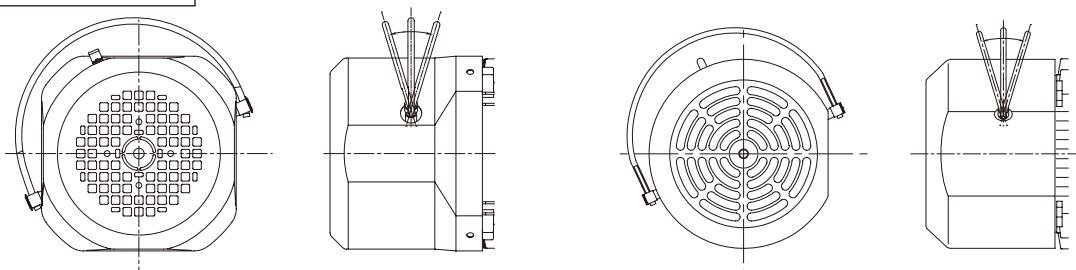
- (1) To release the brake, pull the release lever out of the holder, and push it toward the load or anti-load side (Refer to figure 8-44).
(Some specifications do not allow pushing the release lever toward the load side.)
Be careful not to push the lever too far. Pushing the lever too far could damage the brake.
(Push the release lever while checking 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: The brake is released while the lever is tilted by a hand, and it works when the lever is released the hold.

When operating



When brake is manually released



Premium efficiency motor

Other than premium efficiency motor

Figure 8-44

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 operating	Fix the problem and recover.
			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 authorized maintenance shop.
			Incorrect brake gap adjustment	Re-adjust brake gap. (See P47 – 68)
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 without a load	When a load is applied	The switch overheats	Insufficient switch capacity	Replace with specified switch.
			Overload	Decrease the load to the specified value.
		Fuse tripping	Insufficient fuse capacity	Replace with specified fuse.
			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
	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 overload, etc.	Confer with authorized maintenance shop.
Oil leakage	Blot or drip of a small amount of oil or grease at seal section of high speed or slow speed shaft		Grease applied to the oil seal seeps out at an early stage.	Wipe off around the oil seal, and observe.
	Leakage of oil or grease from high speed or slow speed shaft section		Damaged oil seal or possibly damaged shaft (or collar)	Confer with authorized maintenance shop.
	Leakage of oil/grease from the contact surfaces of ring gear housing and flanged casing, etc.		Loose fastener bolts	Tighten fastener bolts correctly.
	Leakage of oil/grease into motor		Damage to oil seals, or slinger collar	Confer with authorized maintenance shop.
			Excessive oil supply	Remove oil.

Table 9-2 Troubleshooting

Problem		Cause	Correction
Abnormal sound Excessive vibration		Dust and foreign matter in bearings, or damaged bearings	Confer with authorized maintenance shop.
		Reducer parts grinding on foreign matter	Confer with authorized maintenance shop.
		Reducer parts are damaged	Confer 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 installation base	Reinforce the installation base to increase rigidity.
		Nonalignment of shaft with driven machine	Align the shaft centers.
		Transmission of vibration from the driven machine	Individually operate the products to check the source of the sound.
		With torque limiter, makes chattering sound	
Abnormal motor sounds		Foreign objects have entered	Confer with authorized maintenance shop.
		Bearing damage	Confer with authorized maintenance shop.
		Improper brake gap adjustment	Adjust the brake gap. (See P47 – 68)
		Brake lining or inner disc wear	Request brake lining or inner disc replacement from an authorized maintenance shop.
		Brake unit electromagnetic coil burnout	Confer with authorized maintenance shop.
		Rectifier damage	Confer with authorized maintenance shop.
		Leaf spring in the brake boss unit has come off or is damaged	Confer 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 P20 – 29)
		Foreign objects in brake lining or inner disc unit, oil adhesion	Request cleaning from authorized maintenance shop.
		Brake lining or inner disc wear	Adjust the brake gap. Request brake lining or 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.
	Tripping Inverter	Overcurrent shut-off	Sudden speed changes
Extreme load fluctuation			Decrease load fluctuation.
Overcurrent due to ground fault		Ground fault on out 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 Gear Unit Construction Drawings (1 Stage Reduction, 2 Stage Reduction)

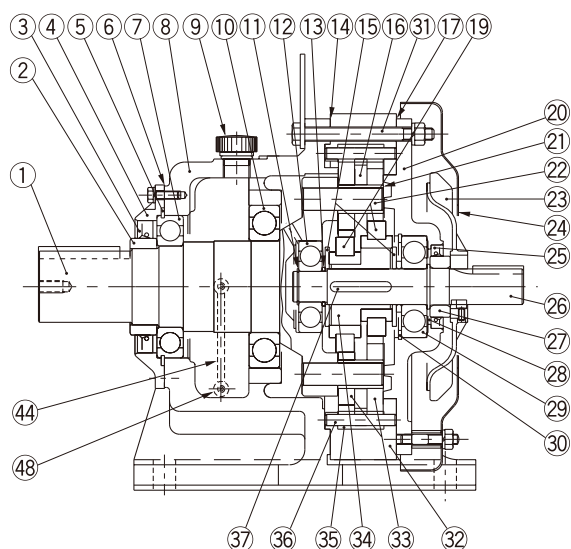


Figure 10-1 Type CHH (Horizontal, Reducer),
1 Stage Reduction (Example: Frame size 6175)

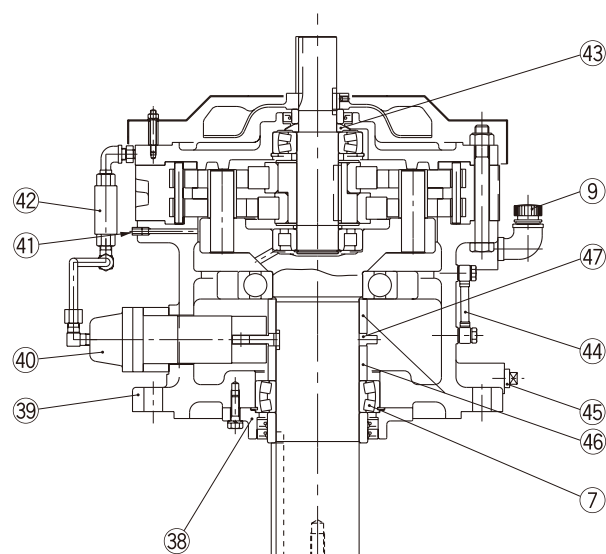


Figure 10-2 Type CVV (Vertical, Reducer),
1 Stage Reduction (Example: Frame size 6225)

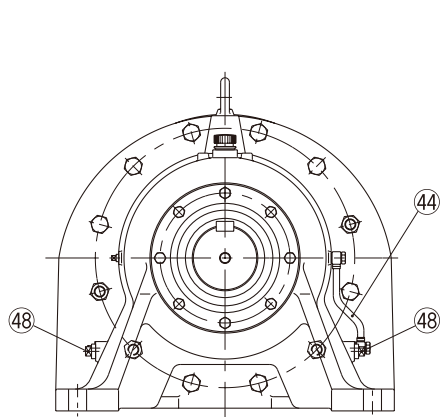


Figure 10-3 Type CHHM (Horizontal, Gearmotor),
1 Stage Reduction (Example: Frame size 6225)

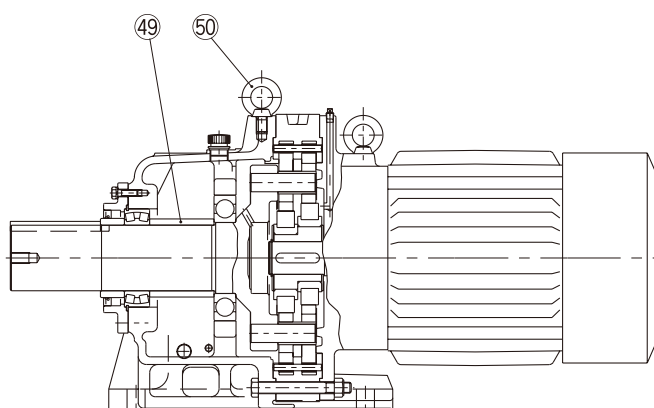


Figure 10-4 Type CNHM (Horizontal, Gearmotor),
1 Stage Reduction (Example: Frame size 6095)

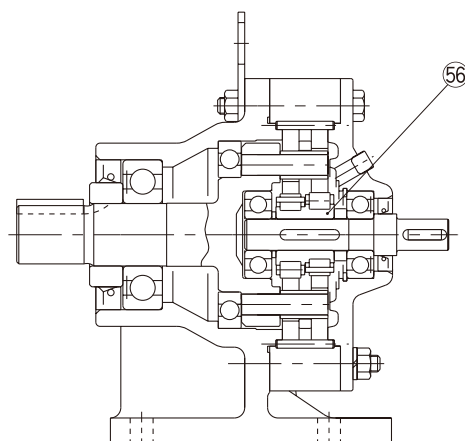


Figure 10-5 Type CNH (Horizontal, Reducer),
1 Stage Reduction (Example: Frame size 6105)

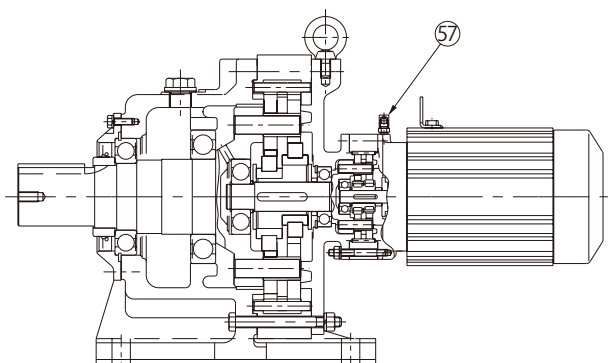


Figure 10-6 Type CHHM (Horizontal, Gearmotor),
2 Stage Reduction (Example: Frame size 6185DA)

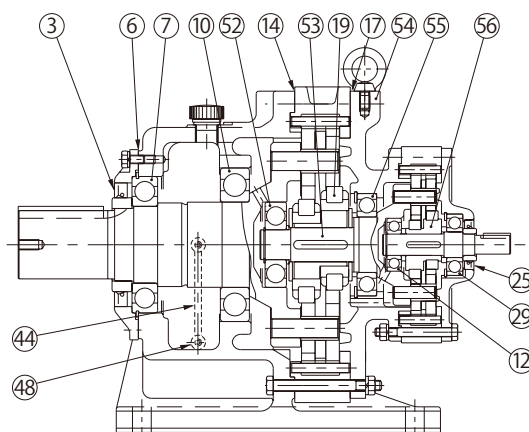


Figure 10-7 Type CHH (Horizontal, Reducer),
2 Stage Reduction (Example: Frame size 6185DB)

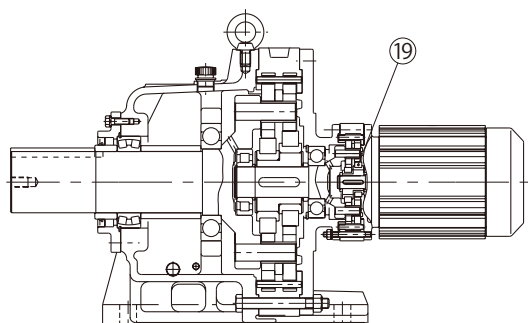


Figure 10-8 Type CHHM (Horizontal, Gearmotor),
2 Stage Reduction (Example: Frame size 6225DB)

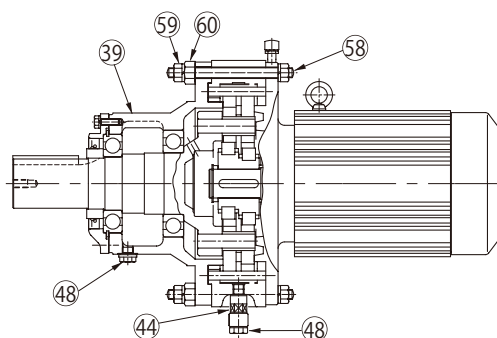


Figure 10-9 Type CHFM (Horizontal, Gearmotor),
1 Stage Reduction (Example: Frame size 6165)

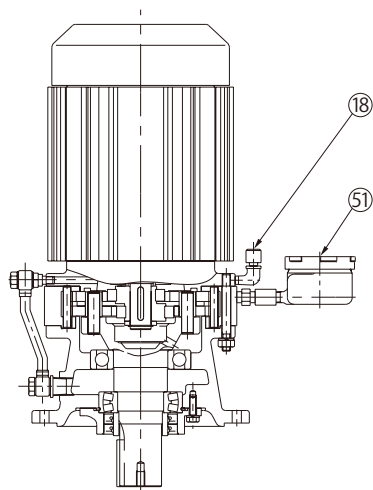


Figure 10-10 Type CVVM (Vertical, Gearmotor),
1 Stage Reduction (Example: Frame size 6145)

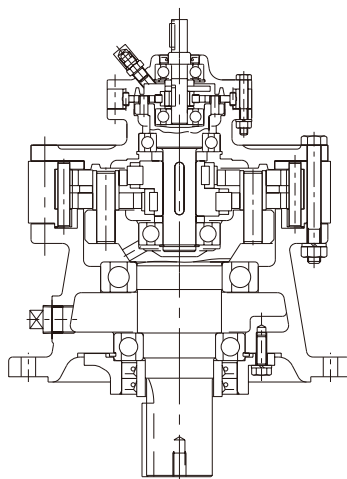


Figure 10-11 Type CVV (Vertical, Reducer),
2 Stage Reduction
(Example: Frame size 6135DA)

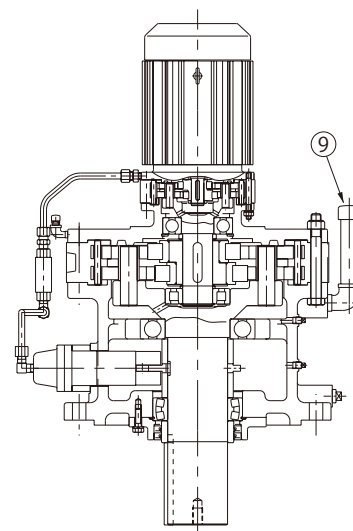


Figure 10-12 Type CVVM (Vertical, Gearmotor),
2 Stage Reduction
(Example: Frame size 6225DA)

Table 10-1 Gear Unit, Principal Parts 1 Stage Reduction, 2 Stage Reduction

Code	Part Name	Code	Part Name	Code	Part Name	Code	Part Name	Code	Part Name
1	Slow speed shaft (Output shaft)	13	Spacer ring	25	Oil seal	37	Parallel key	49	Spacer ring
2	Collar	14	Gasket B	26	High speed shaft	38	Gland	50	Eye-bolt
3	Oil seal	15	End plate	27	Collar	39	Flanged casing	51	Oil fill cup
4	Slow speed end cap	16	Spacer ring	28	Spacer ring	40	Plunger pump	52	Intermediate shaft bearing A
5	Retaining ring	17	Gasket C	29	High speed shaft bearing B	41	Air vent plug	53	Intermediate shaft
6	Gasket A	18	Air vent plug	30	Retaining ring for opening	42	Oil signal	54	Intermediate cover
7	Slow speed shaft bearing A	19	Bearing for eccentric	31	Upper bolt	43	Oil slinger	55	Intermediate shaft bearing B
8	Horizontal casing	20	Internal cover	32	Ring gear housing	44	Oil gauge	56	Eccentric cam (double)
9	Oil filter plug	21	Slow speed shaft roller	33	Cycloid disc	45	Plug (Oil drain port)	57	Grease fitting (with cap)
10	Slow speed shaft bearing B	22	Slow speed shaft pin	34	Eccentric	46	Spacer ring	58	Bolts for ring gear housing (Flange type)
11	Retaining ring for shaft	23	Cooling fan	35	Ring gear roller	47	Cam	59	Disassembly prevention nut (Flange type)
12	High speed shaft bearing A	24	Fan cover	36	Ring gear pin	48	Plug (Oil drain port)	60	Spacer replacement nut (Flange type)

10-2 Gear Unit Construction Drawings (3 Stage Reduction)

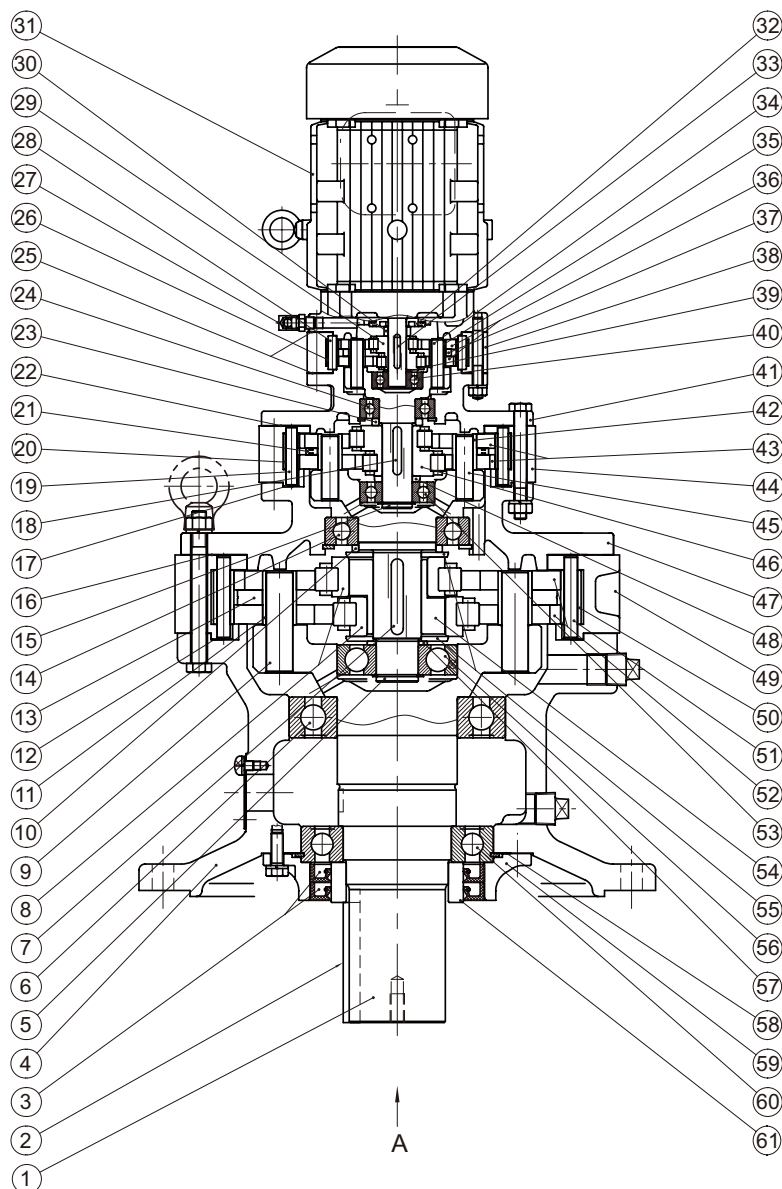


Figure 10-13 Type CVVM (Vertical, Gearmotor),
3 Stage Reduction (Example: Frame size 6185TD)

Table 10-2 Gear Unit, Principal Parts
(3 Stage Reduction)

Code	Part Name
1	Slow speed shaft (Output shaft)
2	Key
3	Oil seal
4	Flanged casing
5	Intermediate shaft
6	Ball bearing
7	Key
8	Roller bearing
9	Slow speed shaft pin
10	Spacer ring
11	Slow speed shaft roller
12	Gasket B
13	Spacer ring
14	Ball bearing
15	Intermediate shaft
16	Gasket C
17	Gasket B
18	Key
19	Ring gear pin
20	Ring gear roller
21	Spacer ring
22	Gasket C
23	Spacer ring
24	Ball bearing
25	Gasket B.C
26	Ring gear roller
27	Grease fitting (with cap)
28	Ring gear pin
29	Eccentric cam
30	Spacer ring
31	Motor
32	Slinger
33	Key
34	Slow speed shaft pin
35	Slow speed shaft roller
36	Cycloid disc
37	Spacer ring
38	Ring gear housing
39	Spacer ring
40	Ball bearing
41	Intermediate cover
42	Slow speed shaft roller
43	Cycloid disc
44	Ring gear housing
45	Slow speed shaft pin
46	Eccentric cam
47	Intermediate cover
48	Spacer ring
49	Ring gear housing
50	Ring gear roller
51	Ring gear pin
52	Cycloid disc
53	Ball bearing
54	Eccentric
55	End plate
56	Ball bearing
57	Spacer ring
58	Gasket A
59	Gland
60	Ball bearing
61	Collar

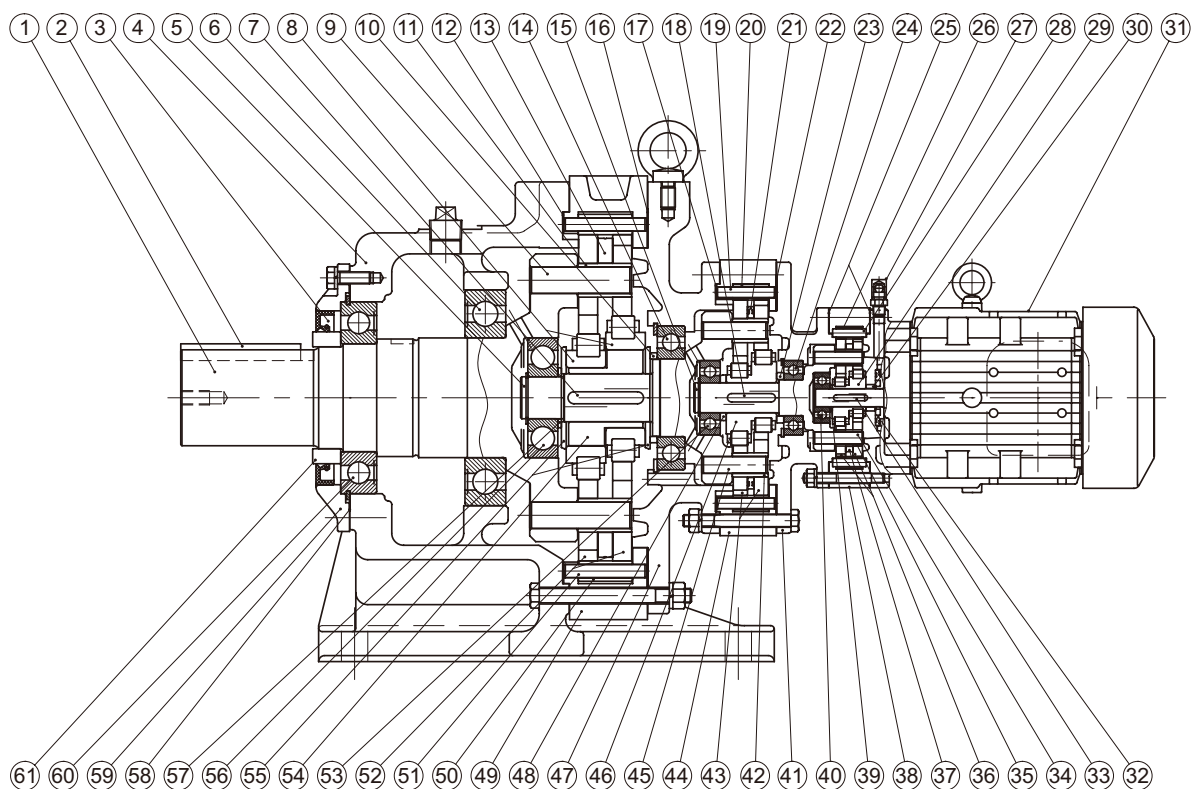


Figure 10-14 Type CHHM (Horizontal, Gearmotor),
3 Stage Reduction (Example: Frame size 6185TD)

Table 10-3 Gear Unit, Principal Parts (3 Stage Reduction)

Code	Part Name	Code	Part Name	Code	Part Name
1	Slow speed shaft (Output shaft)	21	Spacer ring	41	Intermediate cover
2	Key	22	Gasket C	42	Slow speed shaft roller
3	Oil seal	23	Spacer ring	43	Cycloid disc
4	Horizontal casing	24	Ball bearing	44	Ring gear housing
5	Intermediate shaft	25	Gasket B.C	45	Slow speed shaft pin
6	Ball bearing	26	Ring gear roller	46	Eccentric cam
7	Key	27	Grease fitting (with cap)	47	Intermediate cover
8	Roller bearing	28	Ring gear pin	48	Spacer ring
9	Slow speed shaft pin	29	Eccentric cam	49	Ring gear housing
10	Spacer ring	30	Spacer ring	50	Ring gear roller
11	Slow speed shaft roller	31	Motor	51	Ring gear pin
12	Gasket B	32	Slinger	52	Cycloid disc
13	Spacer ring	33	Key	53	Ball bearing
14	Ball bearing	34	Slow speed shaft pin	54	Eccentric
15	Intermediate shaft	35	Slow speed shaft roller	55	End plate
16	Gasket C	36	Cycloid disc	56	Ball bearing
17	Gasket B	37	Spacer ring	57	Spacer ring
18	Key	38	Ring gear housing	58	Gasket A
19	Ring gear pin	39	Spacer ring	59	Cover
20	Ring gear roller	40	Ball bearing	60	Ball bearing
				61	Collar

10-3 Gear Unit Construction Drawings (SK Series)

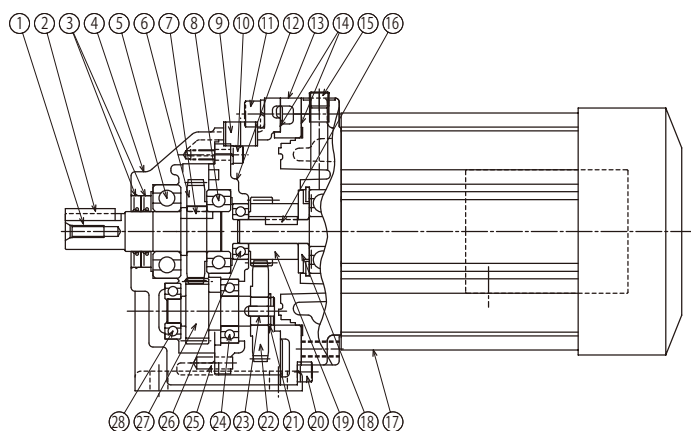


Figure 10-15 Type CHHM (6000SK Series Horizontal, Gearmotor)
(Example: Frame size 6075SK)

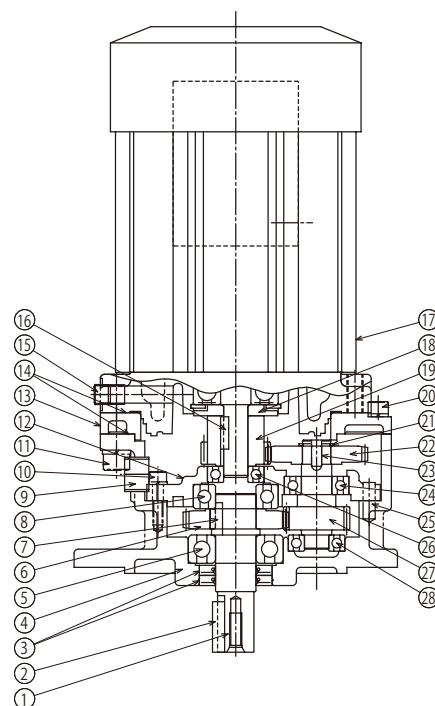


Figure 10-16 Type CVVM (6000SK Series Vertical, Gearmotor)
(Example: Frame size 6075SK)

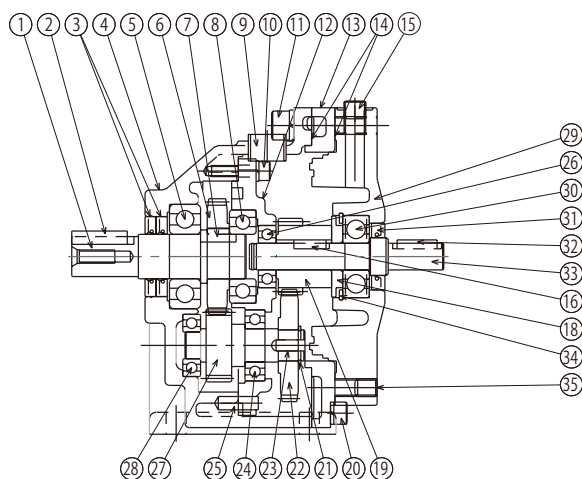


Figure 10-17 Type CHH (6000SK Series Horizontal, Reducer)
(Example: Frame size 6075SK)

Table 10-4 Gear Unit, Principal Parts (SK Series)

Code	Part Name	Code	Part Name	Code	Part Name
1	Slow speed shaft (Output shaft)	13	Adaptor plate	25	Pin
2	Key	14	Liquid gasket	26	High speed shaft bearing A
3	Oil seal	15	Plug	27	Second stage pinion (Mid speed shaft)
4	Horizontal casing	16	Key	28	Mid speed shaft bearing A
5	Slow speed shaft bearing A	17	Motor	29	Internal cover
6	Second stage gear	18	Slinger	30	High speed shaft bearing B
7	Key	19	First stage pinion	31	Oil seal
8	Slow speed shaft bearing B	20	Hexagon socket head bolt	32	Key
9	Plug	21	Snap ring	33	High speed shaft
10	Hexagon socket head bolt	22	First stage gear	34	Snap ring
11	Hexagon socket head bolt	23	Key	35	Hexagon socket head bolt
12	Bearing plate	24	Mid speed shaft bearing B		

10-4 Gear Unit Construction Drawings (Low Reduction Ratio Series)

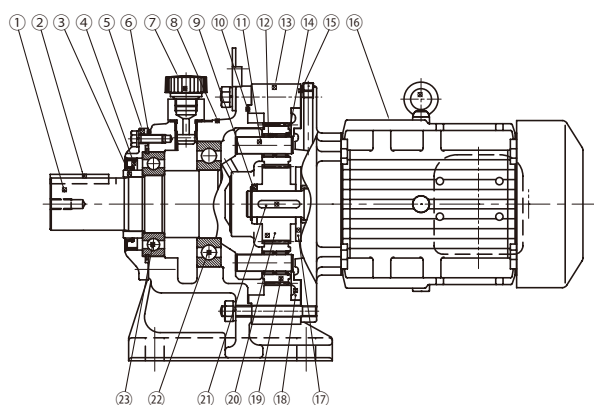


Figure 10-18 Type PHHM (Horizontal, Gearmotor)
(Example: Frame size 6135)

Table 10-5 Gear Unit, Principal Parts (Low Reduction Ratio Series)

Code	Part Name	Code	Part Name
1	Slow speed shaft (Output shaft)	13	Internal gear
2	Key	14	Retaining ring for opening
3	Collar	15	Gasket C
4	Oil seal	16	Motor
5	Cover	17	Slinger
6	Gasket A	18	Support plate
7	Filler plug	19	Planetary gear
8	Horizontal casing	20	Sun gear
9	Spacer ring	21	Key
10	Gasket B	22	Ball bearing
11	Slow speed shaft pin	23	Ball bearing
12	Roller bearing		



10. Construction Drawings

10-5 Motor Unit Construction Drawing

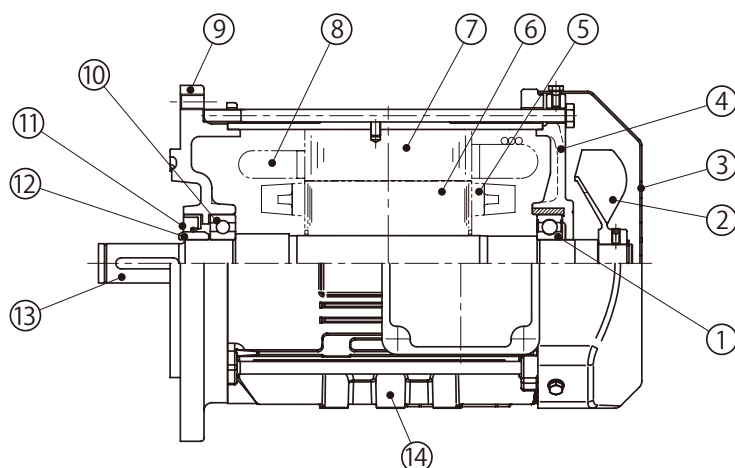


Figure 10-19 Direct-coupled motor for CYCLO Drive (Sealed bearing, oil seal structure)
(Example: N-100L 2.2kW 4P)

Table10-6 Principal Parts of Motor

Code	Parts Name
1	Anti-load side motor shaft bearing
2	Fan
3	Fan cover
4	Anti-load side cover
5	Rotor conductor
6	Rotor core
7	Stator core
8	Stator windings
9	Motor flange bracket
10	Load side motor shaft bearing
11	Oil seal
12	Oil seal collar
13	Motor shaft
14	Frame

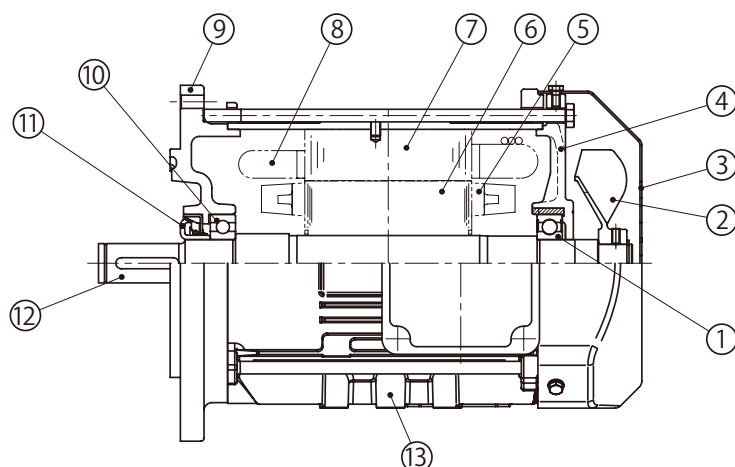


Figure 10-20 Direct-coupled motor for CYCLO Drive (Sealed bearing, Slinger collar structure)
(Example: N-100L 2.2kW 4P)

Table10-7 Principal Parts of Motor

Code	Parts Name
1	Anti-load side motor shaft bearing
2	Fan
3	Fan cover
4	Anti-load side cover
5	Rotor conductor
6	Rotor core
7	Stator core
8	Stator windings
9	Motor flange bracket
10	Load side motor shaft bearing
11	Slinger collar
12	Motor shaft
13	Frame

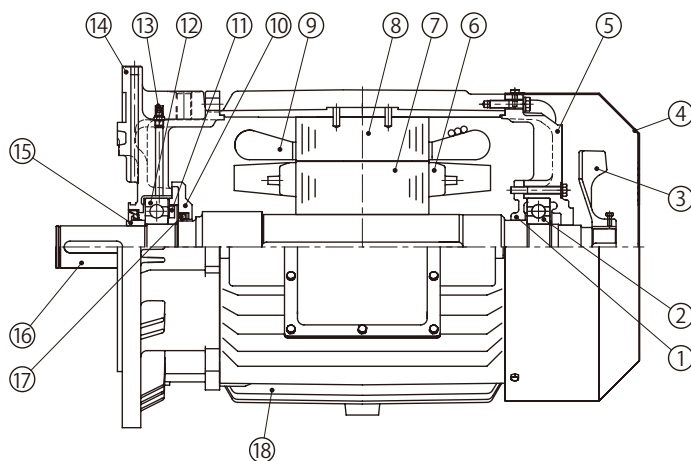


Figure 10-21 Direct-coupled motor for CYCLO Drive (Open bearing structure)
(Example: N-200LS 30kW 6P)

Table10-8 Principal Parts of Motor

Code	Parts Name
1	Bearing cover
2	Anti-load side motor shaft bearing
3	Fan
4	Fan cover
5	Anti-load side cover
6	Rotor conductor
7	Rotor core
8	Stator core
9	Stator windings
10	Bearing cover
11	Oil drain collar
12	Load side motor shaft bearing
13	Grease fitting
14	Motor flange bracket
15	Slinger collar
16	Motor shaft
17	Oil seal
18	Frame

Application Product

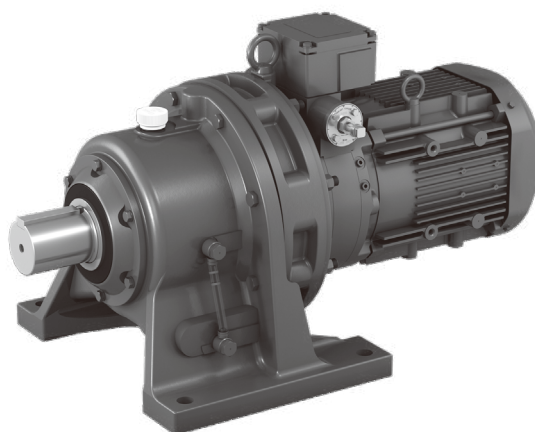
CYCLO[®] Drive with Torque Limiter

This manual covers the torque limiter unit.

For information on handling the reducer unit and the motor unit see P1 – 80.

Contents

11. Wiring	82
12. Adjusting Preset Torque	84
13. Daily Inspection and Maintenance	85
14. Torque Indicator	86
15. Construction Drawings	87



⚠ DANGER

- Do not handle the unit when cables are energized. Be sure to turn off the power when performing operations on the unit; otherwise, electric shock may result.
- Connect a power cable to the unit in accordance with 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.

⚠ CAUTION

- When wiring, follow the facility's regulations and electrical codes to prevent burns, electric shocks, injuries, and fire.

11-1 Wiring for a Spring-Loaded Limit Switch**(1) Limit Switch Type (1-Point Signal, 2-Point Signal, 3-Point Signal)**

- When the preset torque is reached, the dog activates the limit switch, which outputs a signal.
- Depending on manufacturing specifications 1 – 3 point signal output is available.

(Types that have 1 – 3 limit switches.)

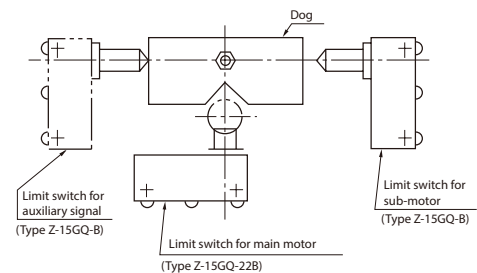


Figure 11-1 Limit Switch

(2) Limit Switch Wiring

- [1] Remove the terminal cover on the terminal box, pass the cable through the cable gland for marine use and connect it to the limit switch terminals.
- [2] Of the three lead wires, connect as follows:
 - For contact point a, terminal symbols C (COMMON) and NO (NORMALLY OPEN)
 - For contact point b, terminal symbols C (COMMON) and NC (NORMALLY CLOSED)
- [3] Make wiring within the terminal box. The construction of the terminal box makes wiring there be possible.
- [4] The limit switch may activate at startup if startup torque exceeds preset torque (when shock occurs at startup, the motor is equipped with a brake, etc.). In this case, install a motor timer to disable the limit switch until the load torque becomes less than the preset torque.

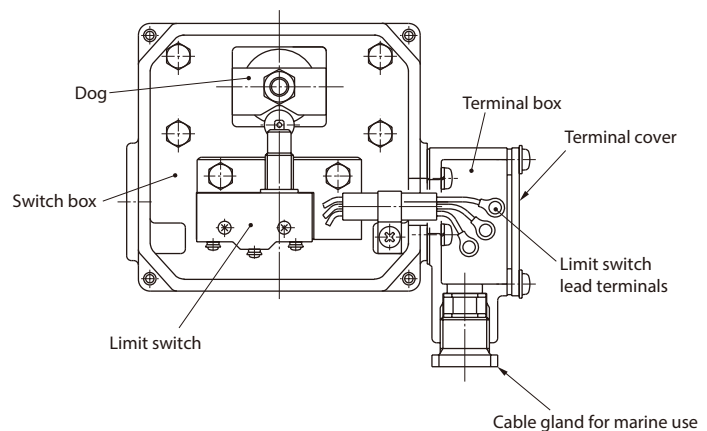


Figure 11-2 Terminal Box-Switch Box

Note: 1. For 2-point signal systems, there are two terminal boxes; for 3-point signal systems, there are three terminal boxes.

2. The cable gland for marine use conforms to JIS F 8801 (for boxes) and 15-b.

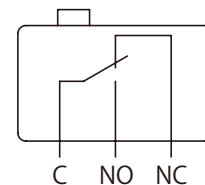


Figure 11-3 Type of Contact (1c)

- To prevent moisture from entering the cable port, seal openings with sealant (for example, putty).
- Do not move the position of the limit switch, or the torque limiter; otherwise, torque limiter does not work properly because preset torque was changed.

(3) Limit Switch Specifications

Table 11-1 Model

Products of OMRON Corporation.

Signal	Rotation Direction	Right or Left	Reversible Direction
Main motor OFF		Z-15GQ22-B (1 piece)	
Submotor or alarm ON		Z-15GQ-B (1 piece)	Z-15GQ-B (2 pieces)
Auxiliary signal		Z-15GQ-B (1 piece)	Please consult with us.

Table 11-2 Rating

Rated Voltage (V)	Noninductive Load (A)				Inductive Load (A)			
	Resistance Load		Lamp Load		Inductive Load		Motor Load	
	Normally Closed Circuit	Normally Open Circuit	Normally Closed Circuit	Normally Open Circuit	Normally Closed Circuit	Normally Open Circuit	Normally Closed Circuit	Normally Open Circuit
AC 125	15		3	1.5	15		5	2.5
	250	15	2.5	1.25	15		3	1.5
	500	10	1.5	0.75	6		1.5	0.75
DC 8	15		3	1.5	15		5	2.5
	14	15	3	1.5	10		5	2.5
	30	6	3	1.5	5		5	2.5
	125	0.5	0.5	0.5	0.05		0.05	0.05
	250	0.25	0.25	0.25	0.03		0.03	0.03

Table 11-3 Contact Point Specification

Inrush Current	Normally Closed Circuit	Normally Open Circuit
	Max. 30A	Max. 15A

Note: 1. Values shown in the table indicate steady-state current.

2. An inductive load is a power factor of 0.4 (AC) or more, or a time constant of 7 ms (DC) or less.

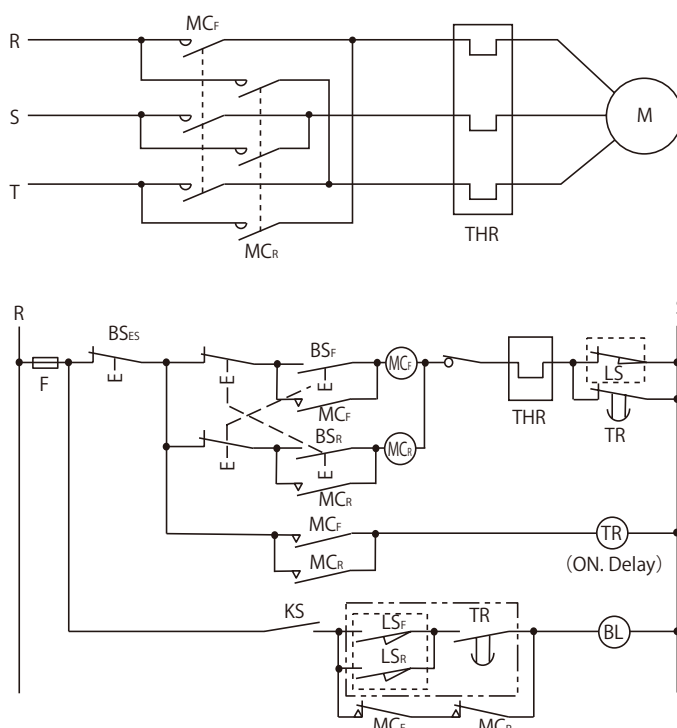
3. A lamp load is a load with an inrush current 10 times as high.

4. A motor load is a load with inrush current 6 times as high.

5. Working ambient temperature: General type -25 to 80°C (no ice)

Working ambient humidity: General type 35 to 85%RH (no condensation)

(4) Example of How to Connect a Spring-Loaded Limit Switch (2-Point Signal, Dual Safety, Reversible Rotation)



M Motor

MC_F ... Electromagnetic switch for forward motor rotation

MC_R ... Electromagnetic switch for reverse motor rotation

BS_F ... Pushbutton switch for forward rotation

BS_R ... Pushbutton switch for reverse rotation

BS_{ES} ... Pushbutton switch for stopping

THR ... Thermal relay

LS..... Limit switch (for forward, reverse and stop)

LS_F ... Limit switch (for forward alarm)

LS_R ... Limit switch (for reverse alarm)

KS ... Knife switch

TR ... Motor timer

F Fuse

BL ... Alarm

Note: 1. Limit switches LS, LS_F and LS_R surrounded by [] are built-in on CYCLO Drive with torque limiter. Other devices should be supplied by customer.

2. If there is an overload, LS_F (LS_R) and LS operate in order.

3. Devices within are [] not required for 1-point signals.

⚠ CAUTION

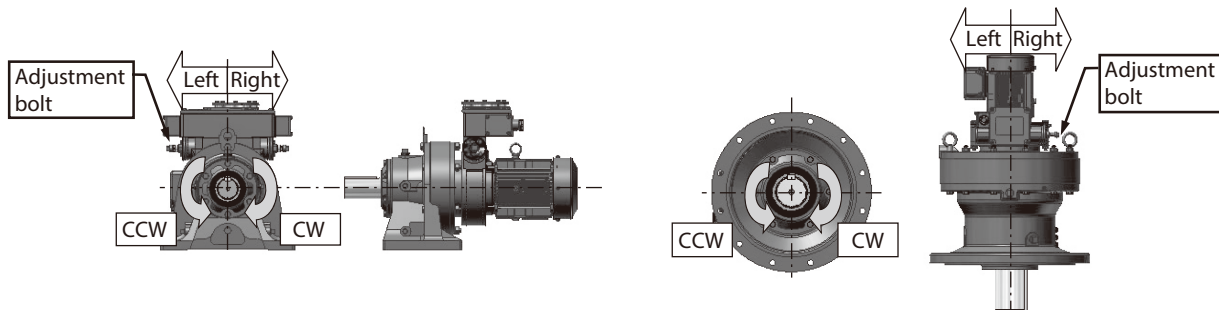
- Increasing the preset torque will cause the torque limiter to function at a torque value that exceeds the initial setpoint. Damage to the machine may occur.

12-1 Adjusting Preset Torque for the Spring-Loaded Limit Switch Model

Preset torque is possible to be adjusted in the range of $\pm 25\%$ value which was set at the factory shipment.

Table 12-1 Propriety to Adjust Preset Torque and Position of Adjusting Bolt

Output Signals	Torque Indicator	Rotational Direction of Slow Speed Shaft	Side of Adjustment Bolt			Adjustment of Preset Torque
			1 Stage Reduction	2 Stage Reduction	3 Stage Reduction	
1 & 2	Without Type A (Indicated load ratio: 60 - 100% or 50 - 100%)	CW	Left	Right	Right	OK
		CCW	Right	Left	Left	
		Both	Both	Both	Both	
	Type B (Indicated load ratio: 0 - 100%)	CW	Both	Both	Both	NG
		CCW	Both	Both	Both	
		Both	Both	Both	Both	



- The preset torque is shown at the center of the adjusting scale plate [1] in the figure below. Torque values indicated by T1 and T2 are positioned at $\pm 150^\circ$ from the center. Use T1 and T2 as points of reference when changing the preset torque.
- When it is necessary to increase or decrease the original preset torque, use the adjustment bolt [2]. Adjust torque within a range of $\pm 25\%$ of the preset torque. Overscaling T1 and T2 is permitted within $\pm 25\%$. However, do not make adjustment in excess of the maximum preset torque. (See the selection table in the catalog.)
- An index [4] is stamped in the cut on the side of the threaded section of the adjustment bolt [2]. The index [4] is aligned with the end face of the case cover [3] when the mark [5] on the adjusting bolt [2] is located at the position of the preset torque on the adjusting scale plate [1]. Make fine adjustments by using this alignment as a base. If the adjustment bolt is too tight or too loose, first reset the adjustment bolt to align the index [4] with the end face of the case cover [3]. Then make adjustments.

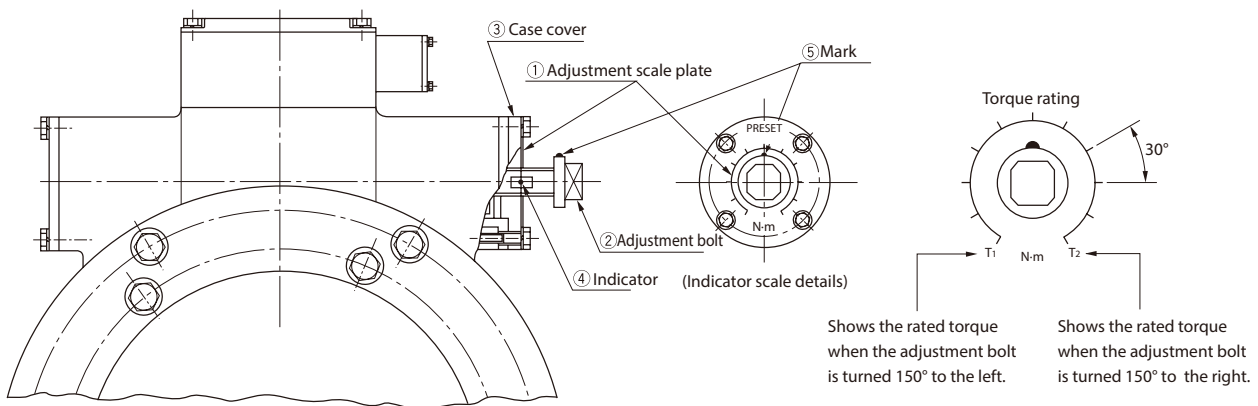


Figure 12-1 Adjusting Preset Torque

Note: 1. For the reversible rotation specification, an adjustment bolt and adjustment scale plate will be located on both sides.

2. In the case of the B-type torque indicator (indicating a load factor of 0 - 100%), it is not possible to adjust the preset torque.

13-1 Torque Limiter, Daily Check

Open the switch box and check every time that oil is replenished or changed.

(1) Limit Switch

- Use a tester to see if the limit switch activates normally.
- If it is possible to run the device, force the limit switch to activate while the machine is running to determine whether the torque limiter works properly.

(2) Dog

- Check to determine whether the nut that secures the dog is loose.
- If it is possible to run the device, confirm that, on startup, the dog moves from its stopped condition.

(3) Oil leakage

- Check whether oil has leaked into the switch box.
- If oil leaks in, the limit switch may not activate, preventing the torque limiter from working.

- Do not move the position of the limit switch because moving it will change the preset torque value. This will prevent the torque limiter from working properly.
- A load test is performed and preset torque is adjusted when the device is shipped from the factory.
If the customer disassembles and reassembles the device, the preset torque could change, causing the torque limiter to stop working properly. This is a source of damage to the device. Therefore, if disassembly or reassembly is required, contact the nearest accredited maintenance shop.

13-2 Lubricating Vertical Type, Frame Sizes 6130, 6135, 6140, 6145

(1) Lubrication and Maintenance

Vertical CYCLO Drives with Torque Limiter, frame sizes 6130, 6135, 6140, 6145 are grease lubricated.

(For lubrication for other than the vertical type, frame sizes 6130, 6135, 6140, 6145, see P36 – 45.)

Table 13-1 Grease Replenishment Intervals

Operation Time	Replenishment Interval	Remarks
Less than 10 hours a day	Once every 3 – 6 months	In the case of severe operating conditions, shorten the replenishment period. Maintenance with disassembly after approximately 20,000 hours or three to five years will increase lifetime.
10 – 24 hours a day	Once every 500 – 1,000 hours	

Table 13-2 Recommended Grease (Grease Used when Shipped)

Manufacturer	Description	Ambient Temperature °C
Cosmo	COSMO GREASE DYNAMAX SH No.2	-10 to 50
Mobil	UNIREX N2	

Note: 1. Only use grease listed in Table 13-2.

2. When regularly used in an ambient temperature outside the 0 to 40°C range, some specifications will differ. Please consult us.

Table 13-3 Grease Replenishment Quantity (Guidelines)

Frame Size	Replenishment Quantity (g)
6130, 6135, 6140, 6145	150

(2) Procedures for Filling and Discharging

- [1] Remove the grease discharge plug from the flanged casing.
- [2] Use a grease gun to replenish through the grease fittings for the internal cover and the motor flange bracket, using the quantities of grease shown in Table 13-3 as guidelines.
- [3] Replace the grease discharge plug.

- Grease while the machine is running to improve grease distribution.
- In addition to being used for discharging grease, the grease discharge plug also functions as a pressure vent when replenishing grease. Make certain to remove when replenishing.
- Replenish grease slowly.
- Replenishing more than the quantity shown in Table 13-3 may cause agitation heat, which raises the temperature, and may cause grease to leak into the motor unit.

14-1 Torque Indicator

(1) Checking the Torque Indicator

- The torque indicator is performed zero point adjustment, and the preset torque is adjusted before shipment.
After the reducer has been connected to equipment, if zero is not indicated when the reducer is at rest, it is possible that a small load is already being applied to the output shaft. Do not readjust to the zero point.
- The relationship between the direction of pointer deflection and slow speed shaft rotation (seen from the slow speed shaft side) is shown below.
1 stage reduction type: pointer opposite direction of the slow speed shaft
2, 3 stage reduction types: pointer in the same direction as the slow speed shaft
- The indicator scale displays the load factor, with 100% being the preset torque. Accuracy is within $\pm 10\%$ of the overall load range.

(2) A-Type Torque Indicator

The A-type torque indicator displays load factors of 60 – 100% (depending on the combination of preset torque and reduction ratio, it displays 50 – 100%).

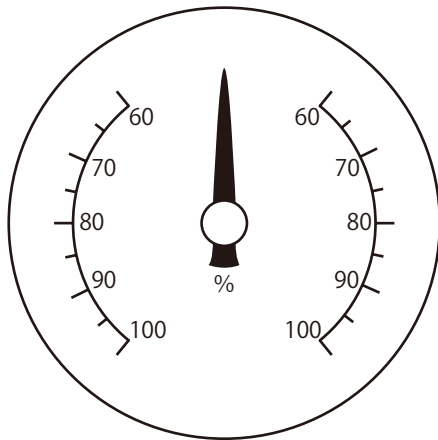


Figure 14-1 A-Type Torque Indicator
(60 – 100% load factor display)

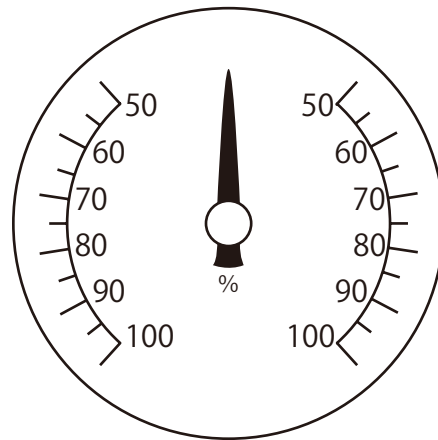


Figure 14-2 A-Type Torque Indicator
(50 – 100% load factor display)

- The pointer may deflect slightly when stopped or under no load. This is not a problem.
- For the reversible rotation specification, when left and right preset torques differ, the pointer position will be slightly move over.

(3) B-Type Torque Indicator

The B-type torque indicator displays load factors of 0 – 100%.

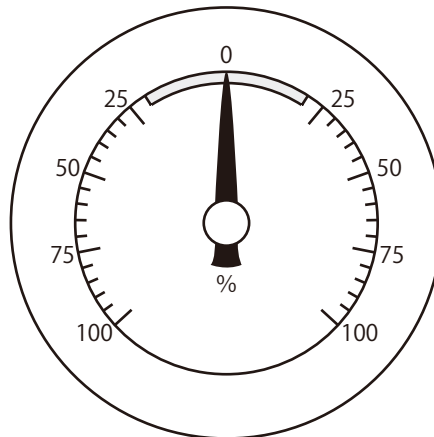


Figure 14-3 B-Type Torque Indicator (0 – 100% load factor display)

- In the case of a B-type torque indicator, the pointer will stop in the range of  when load is removed.
- Preset torque cannot be changed. Do not turn the adjustment bolt.

15-1 Construction Drawings

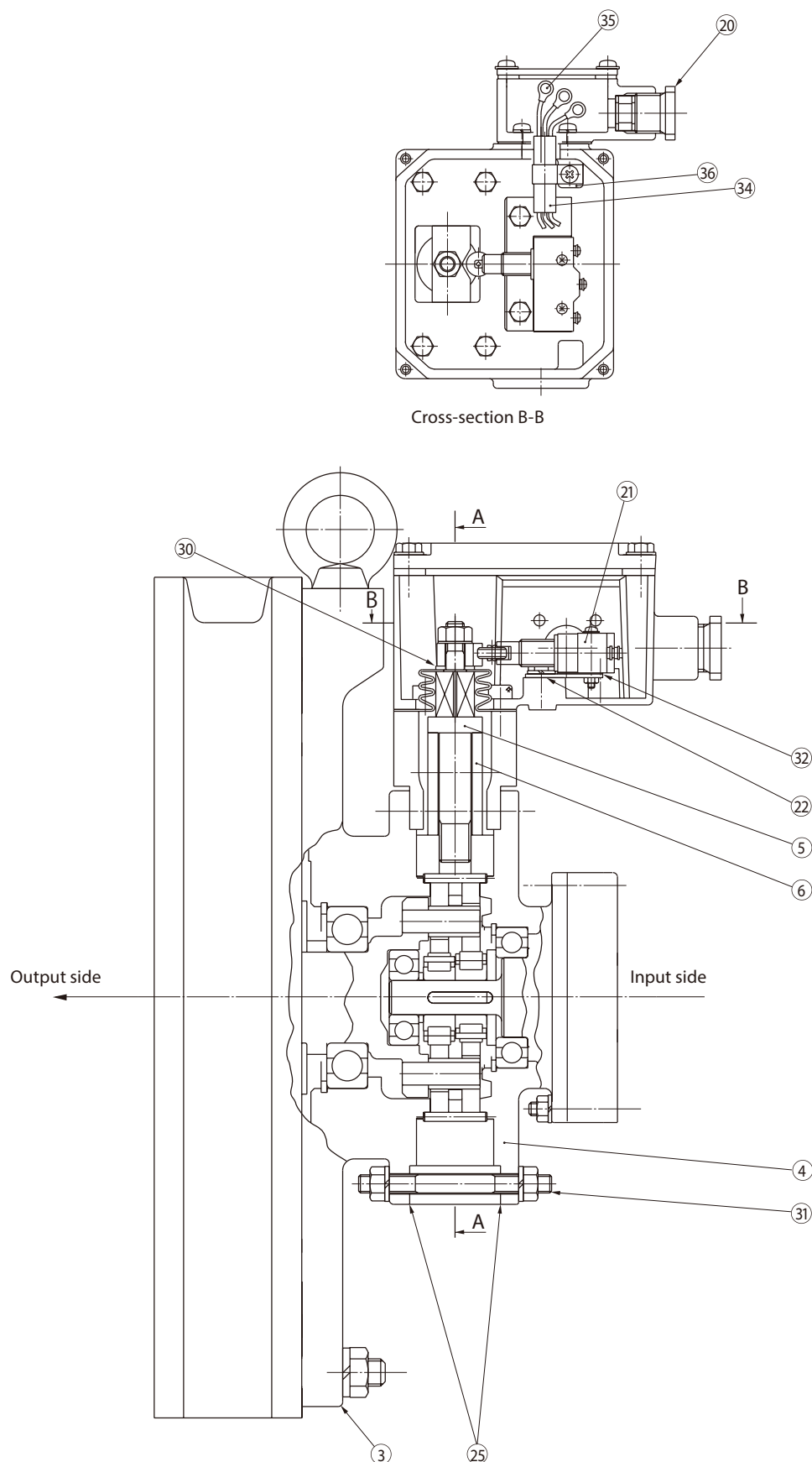


Figure 15-1 Type CHHM (Horizontal, Gearmotor), 3 Stage Reduction

Table 15-1 Torque Limiter Principal Parts

No.	Part Name
1	Fixed ring gear housing
2	Ring gear housing
3	Intermediate cover
4	Intermediate cover (Internal cover Motor flange bracket)
5	Dog bar
6	Bushing
7	Spring
8	Spring holder plate A
9	Spring holder plate B
10	Spring case
11	Case cover
12	Adjustment bolt
13	Adjustment scale plate
14	Switch box
15	Bellows
16	Dog
18	Toothed washer
19	Dog clamping nut
20	Cable gland for marine use
21	Limit switch
22	Switch mounting bracket
23	Switch box cover
24	Terminal cover
25	Gasket
26	Gasket
27	Gasket
28	O-ring
29	Stopper
30	Flat washer
31	Bolts for fixed ring gear housing
32	Insulation board
33	Stopping nut
34	Cabtyre cable
35	Limit switch lead terminal
36	Terminal plate (with clamp)
37	Terminal box
38	Gasket
39	Spacer
40	Gasket

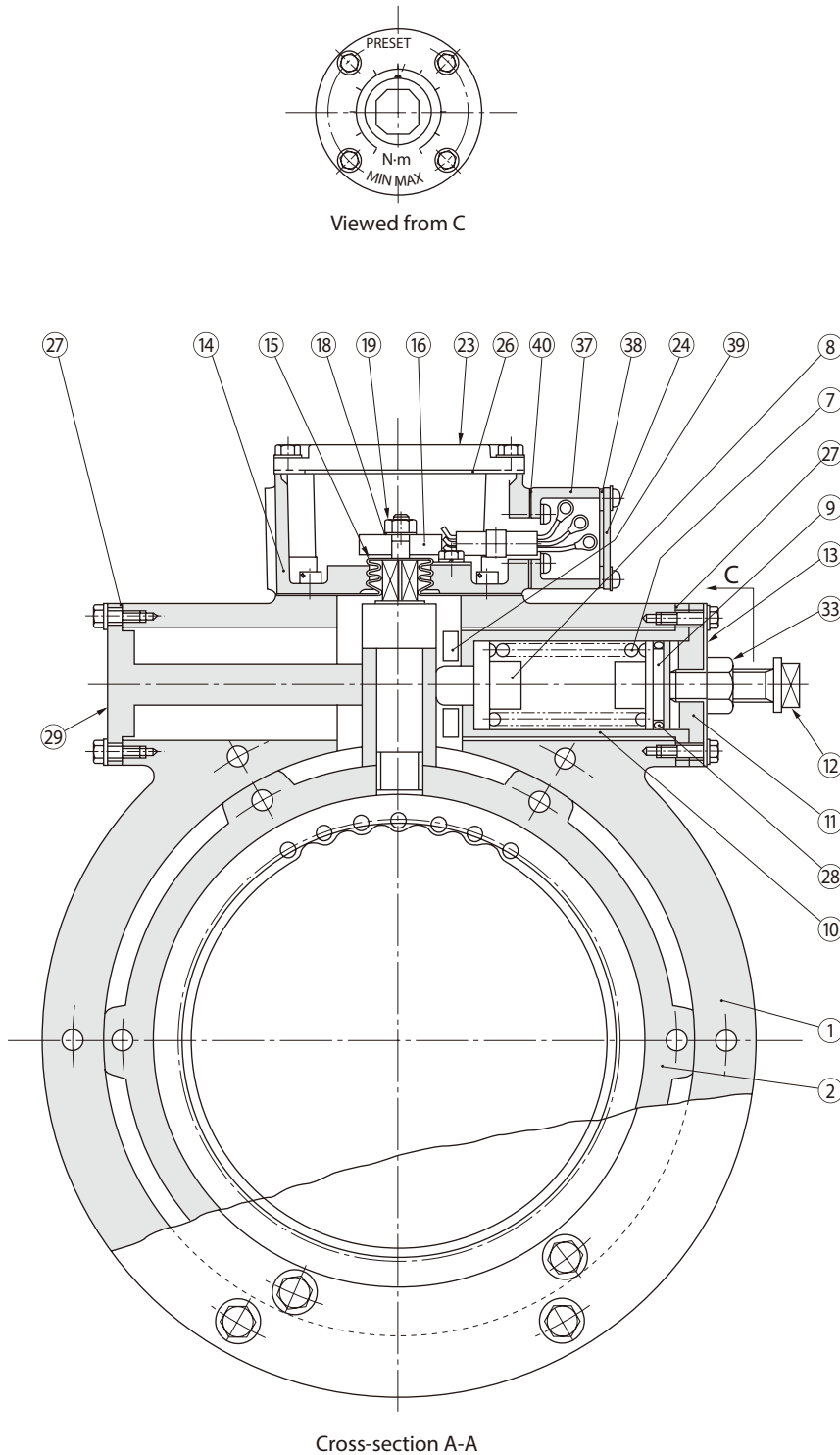


Figure 15-2 Type CHHM (Horizontal, Gearmotor), 3 Stage Reduction

15-2 Torque Indicator Construction Drawings

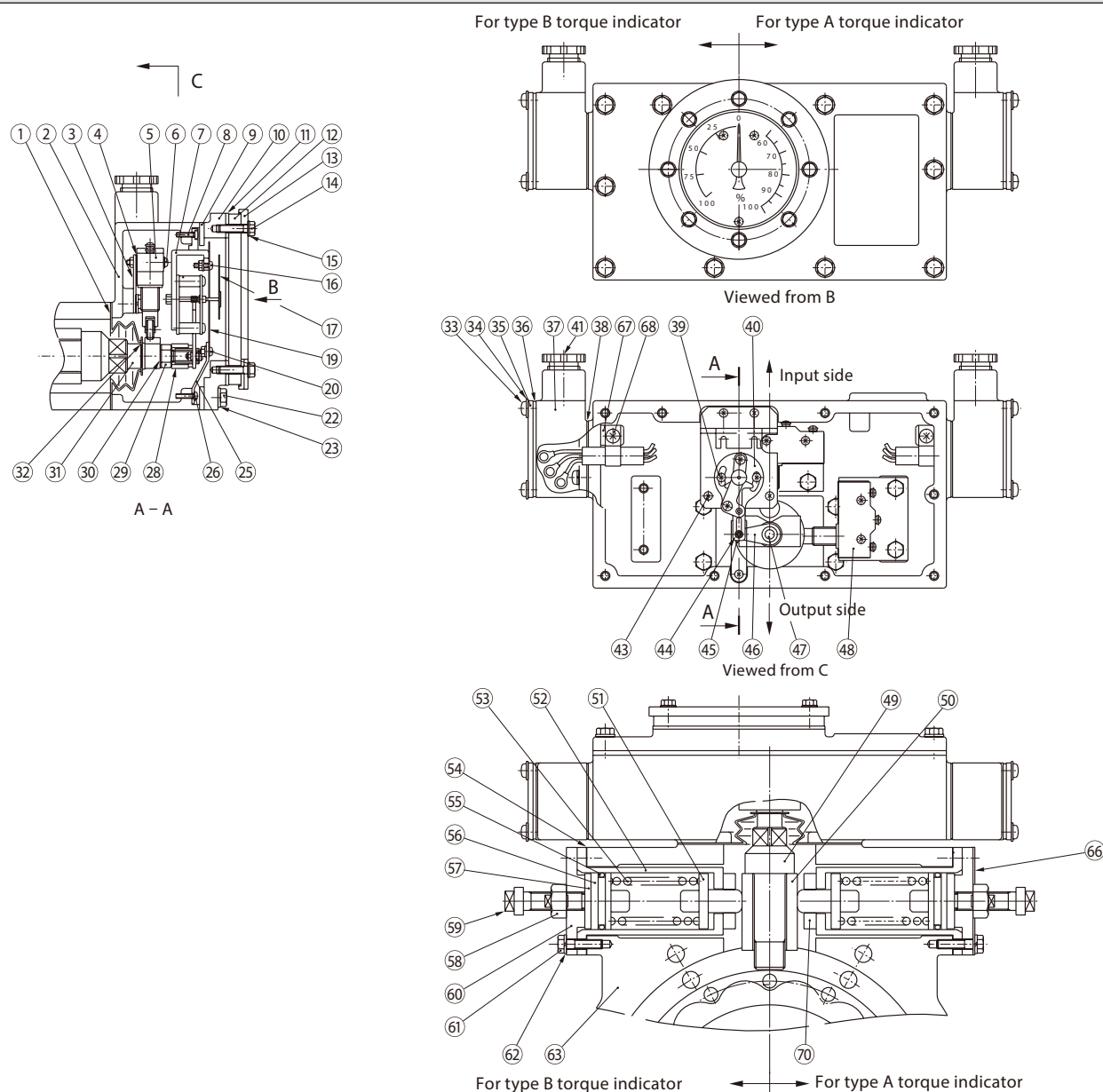


Table 15-2 Torque Indicator Principal Parts

No.	Part Name
1	Bellows
2	Switch box
3	Switch mounting bracket
4	Insulation board
5	Microswitch (for stopping motor)
6	Philips pan head machine screw
7	Motor assembly mounting base
8	Philips pan head machine screw
9	Gasket
10	Switch cover
11	Gasket
12	Transparent cover
13	Holding plate for transparent cover
14	Upper bolt
15	Washer with rubber
16	Philips pan head machine screw
17	Pointer
19	Scale plate
20	Philips pan head machine screw
22	Upper bolt
23	Washer with rubber

No.	Part Name
25	Scale plate mounting base
26	Philips pan head machine screw
28	Spacer for rod
29	Upper nut
30	Toothed washer
31	Dog
32	Flat washer
33	Upper bolt
34	Washer with rubber
35	Terminal cover
36	Gasket
37	Terminal box
38	Gasket
39	Philips pan head machine screw
40	Internal machine
41	Cable gland for marine use
43	Philips pan head machine screw
44	Sector
45	Nut
46	Rod
47	Bushing for rod

No.	Part Name
48	Microswitch (for alarm)
49	Dog bar
50	Bushing
51	Spring holder plate A
52	Spring case
53	Spring
54	Gasket
55	O-ring
56	Spring holder plate B
57	Preload plate
58	Lock nut
59	Adjustment bolt
60	Case cover
61	Upper bolt
62	Washer with rubber
63	Fixed ring gear housing
66	Adjustment scale plate
67	Terminal plate
68	Upper bolt
70	Spacer

Figure 15-3 Torque Indicator

Application Product

CYCLO[®] Drive with Special Vertical Base Mount

C14VM C15VM C17VM C18VM
C24VM C25VM C27VM C28VM
C3VM



This manual covers the base unit.

For information on handling the reducer unit and the motor unit see P1 – 80.

Contents

16. Coupling with Other Machines	92
17. Daily Inspection and Maintenance	94
18. Construction Drawings	95

⚠ CAUTION

- When coupling the gearmotor or reducer with a load, check that centering is within the specified limits. Correctly tighten bolts on the coupling before operation; otherwise, injury may result because of misalignment.
- Confirm the rotation direction before coupling the unit with the driven machine. For C15VM, C18VM, C25VM and C28VM, check the direction of the shaft end screw. (Standard specification is left-handed screw.) Incorrect rotation direction may cause personal injury or damage the equipment.

16-1 Agitator Shaft Assembly

The connected agitator's shaft end shape will differ based on product model. Connect in accordance with the product's coupling shape.

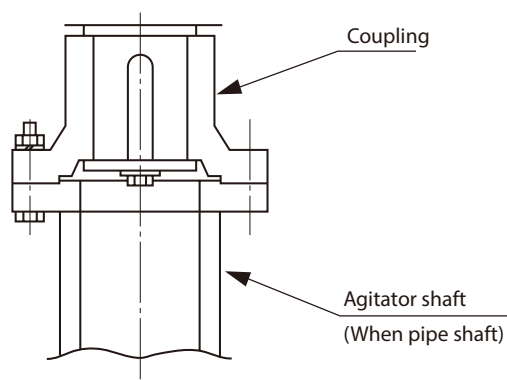


Figure 16-1 Example of Agitator Shaft Assembly
(C14VM, C17VM, C24VM, C27VM)

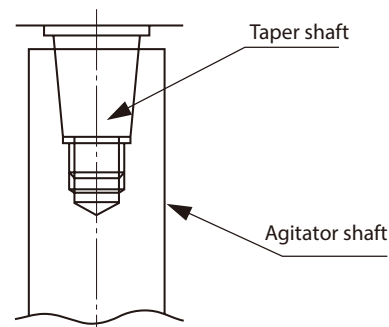


Figure 16-2 Example of Agitator Shaft Assembly
(C15VM, C18VM, C25VM, C28VM)

Note: For C14VM, C24VM, C17VM, C27VM, use coupling bolts with the strength class shown in Table 16-1.

Table 16-1 Coupling Bolts
C14VM

Frame Size	JIS Strength Class
609□, 610□	8.8 and above
612□	12.9 and above
613□	10.9 and above
614□	12.9 and above
616□	10.9 and above
617□	
618□	
619□	

C17VM

Frame Size	JIS Strength Class
609□, 610□	8.8 and above
612□	
613□, 614□	
616□	
617□	
618□	
619□	
6205	
6215	
6225	
6235	
6245	
6255	
6265	

C24VM, C27VM

Frame Size	JIS Strength Class
608□	8.8 and above
609□, 610□, 611□	
612□	
613□	
614□	
616□	
617□	
618□	

Note: The symbol □ in frame size can be "0" or "5". For 2 stage reduction and 3 stage reduction types, DA, TA, etc. will be appended to the frame size.

16-2 Allowable Bending Moment, Axial Load

Table 16-2 Allowable Bending Moment (N·m)

Frame Size	Model			
	C14VM, C15VM	C17VM, C18VM	C24VM, C25VM	C27VM, C28VM
608 □	—	—	343	687
609 □	343	687	638	1230
610 □	343	687	638	1230
611 □	—	—	638	1230
612 □	638	1230	1080	2160
613 □	1080	2160	1570	3140
614 □	1080	2160	1570	3140
616 □	1570	3140	2260	4410
617 □	2260	4410	2940	5890
618 □	2940	5890	3830	7550
619 □	3830	7550	—	—
6205	—	10800	—	—
6215	—	13700	—	—
6225	—	15700	—	—
6235	—	18600	—	—
6245	—	24500	—	—
6255	—	31400	—	—
6265	—	37300	—	—

Table 16-3 Allowable Axial Load (N)

Frame Size	Model				
	C14VM, C15VM	C17VM, C18VM	C24VM, C25VM	C27VM, C28VM	C3VM
608 □	—	—	981	981	—
609 □	981	981	1670	1670	—
610 □	981	981	1670	1670	—
611 □	—	—	1670	1670	—
612 □	1670	1670	2650	2650	—
613 □	2650	2650	3730	3730	—
614 □	2650	2650	3730	3730	—
616 □	3730	3730	4910	4910	—
617 □	4910	4910	6180	6180	—
618 □	6180	6180	7650	7650	21600
619 □	7650	7650	—	—	32400
6205	—	9810	—	—	—
6215	—	11800	—	—	46100
6225	—	13700	—	—	51000
6235	—	15700	—	—	51000
6245	—	20600	—	—	—
6255	—	24500	—	—	—
6265	—	29400	—	—	—

Note: 1. The symbol □ in frame size can be "0" or "5". For 2 stage reduction and 3 stage reduction types, DA, TA, etc. will be appended to the frame size.

2. Allowable bending moment is the value in the mounting flange.
3. Axial load is possible in the vertical direction. (C3VM only faces downward.)
4. Use is possible up to the allowable value, even if bending moment and axial load are both present. (Except C3VM.)
5. Depending on the bending moment, axial load exceeding the allowable value may be allowed. Please consult us. (Except C3VM.)
6. C3VM values are for reduction ratios of 1/2537 and above.
7. Allowable values are the same for 2 and 3 stage reduction types.

17-1 Base Unit Grease Replenishment

- All base unit bearings are grease lubricated. Units are shipped greased using the greases in Table 17-2, so they can be used as is.
- Make certain to perform maintenance. Neglecting maintenance is a source of problems.

(1) Grease Replenishment Intervals

Table 17-1 Grease Replenishment Intervals

Part	Replenishment Interval
Base unit	1 time/2 – 3 years

(2) Recommended Grease

Table 17-2 Recommended Grease (Grease Used when Shipped)

Ambient Temperature °C	Manufacturer	Description
-10 to 50	COSMO	COSMO GREASE DYNAMAX SH No.2
	Mobil	UNIREX N2

(3) Grease Replenishment Quantity

Table 17-3 Grease Replenishment Quantity Guidelines (g)

Frame Size	Model								
	C14VM, C15VM		C17VM, C18VM		C24VM, C25VM		C27VM, C28VM		C3VM
	Bearing A	Bearing B	Bearing A	Bearing B	Bearing A	Bearing B	Bearing A	Bearing B	Bearing
608 □	—	—	—	—	5	5	7	5	—
609 □	5	5	7	5	7	5	10	5	—
610 □	5	5	7	5	7	5	10	5	—
611 □	—	—	—	—	7	5	10	5	—
612 □	7	5	10	5	13	7	15	7	—
613 □	13	7	15	7	17	10	35	10	—
614 □	13	7	15	7	17	10	35	10	—
616 □	17	10	35	10	20	15	50	15	—
617 □	20	15	50	15	30	20	70	20	—
618 □	30	20	70	20	35	30	100	30	25
619 □	35	30	100	30	—	—	—	—	40
6205	—	—	40	35	—	—	—	—	—
6215	—	—	65	50	—	—	—	—	65
6225	—	—	65	50	—	—	—	—	65
6235	—	—	70	65	—	—	—	—	95
6245	—	—	125	85	—	—	—	—	—
6255	—	—	125	110	—	—	—	—	—
6265	—	—	210	150	—	—	—	—	—

Note: 1. The symbol □ in frame size can be "0" or "5". For 2 stage reduction and 3 stage reduction types, DA, TA, etc. will be appended to the frame size.

2. Replenishment quantities are the same for 2 and 3 stage reduction types.

(4) Replenishment Procedure

Using a grease gun, replenish through grease fittings [2] and [8] (see P95, for C3VM, use [6]). See Table 17-3 for guidelines on quantity.

- If the product has not been operated for one year or longer, make certain to replenish grease before resuming operation.
- Grease while the machine is running to improve grease distribution.
- Replenish grease slowly.
- Contact the nearest authorized maintenance shop concerning a complete grease change.

17-2 Main Unit Maintenance

Oil seals have lifetimes. 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. Because sliding surfaces for oil seals are made of carbon steel, take periodic rust prevention measures regularly not to spread rust on them by applying rustproof oil and so on, if there are exposed surfaces of steel.

Please consult with the nearest maintenance shop for the replacement of oil seal or V-ring.

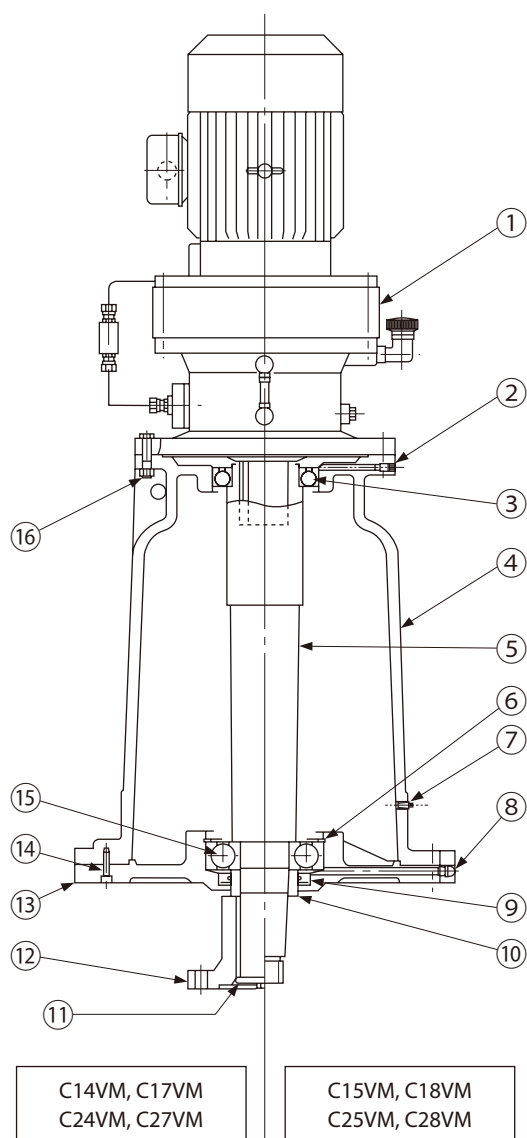


Figure 18-1 Models C14 – 28VM

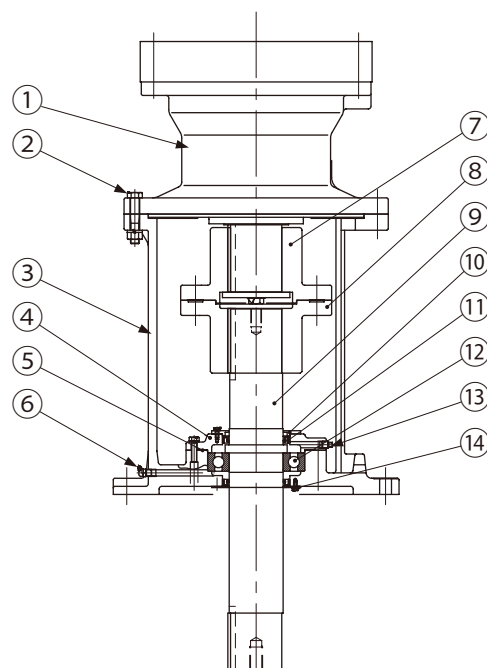


Figure 18-2 C3VM

Table18-1 Gear Unit, Principal Parts (Models C14 – 28VM)

No.	Parts Name	No.	Parts Name
1	CYCLO Drive	9	Oil seal
2	A-type grease fitting	10	Collar
3	Bearing B	*11	End plate
4	Base (1)	*12	Rigid flanged shaft coupling
5	Shaft	13	Base (2)
6	Snap ring for opening	14	Fitting up bolt
7	Plug	15	Bearing A
8	B-type grease fitting	16	Hexagon head bolt, nut

Note: Parts indicated by * are only for C14VM, C24VM, C17VM and C27VM.

Table18-2 Gear Unit, Principal Parts (C3VM)

No.	Parts Name	No.	Parts Name
1	CYCLO Drive	8	3V Coupling (2)
2	Hexagon head bolt	9	3V shaft
3	3V base	10	Dust-tight cover
4	Cover	11	Oil seal
5	Gasket	12	Bearing
6	Grease fitting	13	Drain plug
7	3V Coupling (1)	14	Oil seal

The scope of our product warranty is limited to our manufacturing range.

Warranty (period and contents)

Warranty Period	The product warranty period is 18 months after delivery, 18 months after shipment of the product from the seller, or 12 months from product commissioning, whichever is first.
Warranty Conditions	In the event that any problem or damage to the product arises during the “Warranty Period” from defects in the product whenever the product is properly installed and combined with the buyer's equipment or machines, maintained as specified in the maintenance manual, and properly operated under the conditions described in the catalog or as otherwise agree on in writing between the seller and the buyer or its customers, the seller will provide, at its sole discretion, appropriate repair or replacement of the product, without charge, at a designated facility, except as stipulated in the “Warranty Exclusions” described below. However, if the product is installed or integrated into the Buyer's equipment or machines, the seller does not reimburse the following costs: removal or reinstallation of the product or other incidental costs related thereto, any lost opportunity, any profit loss or other incidental or consequential losses or damage incurred by the buyer or its customers.
Warranty Exclusions	Notwithstanding the above warranty, the warranty as set forth herein does not apply to any problem or damage to the product caused by: 1. Installation, connection, combination or integration of the product with or into the other equipment or machine that is rendered by any person or entity other than the seller; 2. Insufficient maintenance or improper operation by the buyer or its customers, such that the product is not maintained in accordance with the maintenance manual provided or designated by the seller; 3. Improper use or operation of the product by the buyer or its customers without informing the Seller, including, without limitation, the buyer's or its customers' operation of the product not in conformity with the specifications and use of lubricating oil that is not recommended by the seller; 4. Any problem or damage to any equipment or machine into or with which the Product is installed, connected or combined, or on any specifications particular to the buyer or its customers; 5. Any changes, modifications, improvements or alterations to the product or those functions that are rendered on the product by any person or entity other than the seller; 6. Any parts in the product that are supplied or designated by the buyer or its customers; 7. Earthquake, fire, flood, sea breeze, gas, thunder, acts of God or any other reasons beyond the control of the seller; 8. Normal wear and tear or deterioration of the product's parts, such as bearings and oil seals; and 9. Any other problems with or damage to the product that are not attributable to the seller.

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Specifications, dimensions, and other items are subject to change without prior notice.



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