

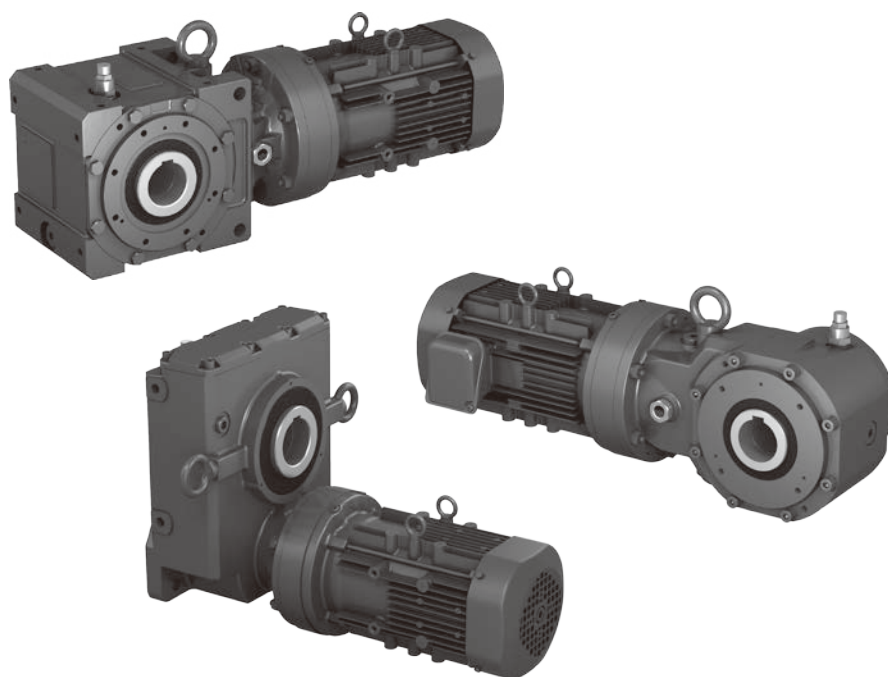
BUDDYBOX®

Bevel BUDDYBOX® 4 Series

Bevel BUDDYBOX® 5 Series

Helical BUDDYBOX®

Application Product : BUDDYBOX® with Torque Limiter



<Note>

- This product should be handled by only those who have been trained for the work.
Please read this manual carefully before use.
- Deliver this manual to the customer who will actually use the product.
- 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 understanding about the principle and mechanism of explosion proof motor (such as explosion-proof structures, construction of electrical facility, and relating laws) should conduct the transport, installation, plumbing, wiring, operation, maintenance and inspection of the equipment; otherwise, explosion, ignition, electric shock, personal injury, fire or damage to the equipment may result.
- 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”, and “the application products: BUDDYBOX Reducer with Torque Limiter”.

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	Application Product
		Without Brake	With Brake		
Mark	Common				

Contents

Common

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Application Product: BUDDYBOX Reducer with Torque Limiter

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! CAUTION

- Unpack the unit after verifying that it is positioned correct 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.

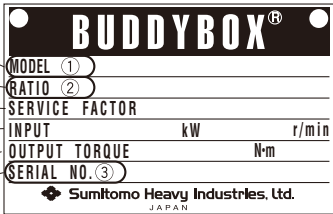
- [1] Does the information on the nameplate conform to what you ordered?
- [2] Was any part broken during transport?
- [3] Are all bolts and nuts tightened firmly?

1-1 Reading the Nameplates

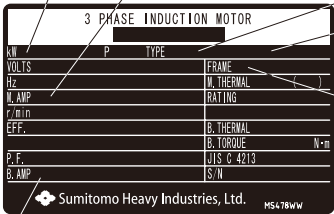
There are two main types of nameplates: type 1 and type 2. Representative examples are shown below. Please observe them by type.

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

(1) For Gearmotor



(Gear Unit Nameplate)



(Motor Unit Nameplate)

[1] Gearmotor nomenclature (See P5)

[2] Reduction ratio

- Service factor

- Input capacity, speed

- Allowable output torque

[3] Serial number

- Motor capacity

- Motor characteristics

- Motor nomenclature (See P7)

- Brake type for motor with brake (See P7)

- Motor frame size

- Brake torque for motor with brake

[3] Serial number

- Brake current value for motor with brake

Figure 1-1 Gearmotor Nameplate

(2) For Reducer

[1] Reducer nomenclature (See P5)

[2] Reduction ratio

- Service factor

- Input capacity, speed

- Allowable output torque

[3] Serial number

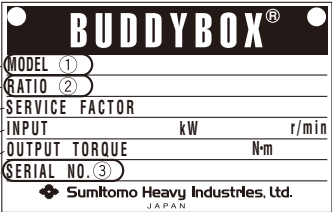


Figure 1-2 Reducer Nameplate

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

■ 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 P90) are the same as the required specification.

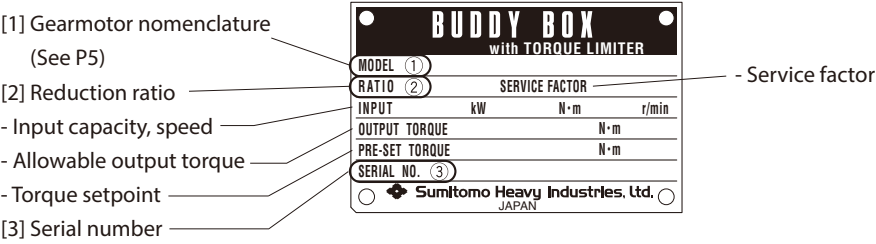


Figure 1-3 Torque Limiter Nameplate (Gear Unit Nameplate)

■ Alarm Torque Nameplate

For 2-point alarm configuration (double safety specification), an alarm torque nameplate is attached near the nameplate in figure 1-3.



Figure 1-4 Torque Limiter Nameplate (Alarm Torque Nameplate)

1-2 Checking Lubrication Method

Refer to “8-2 Confirmation of Lubrication Method” (P42) to confirm the lubrication method.

Oil lubricated machines are shipped without oil. Before operating, make certain to feed the recommended lubricating oil.
(See P43–49)

1-3 Gearmotor, Reducer Nomenclature

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

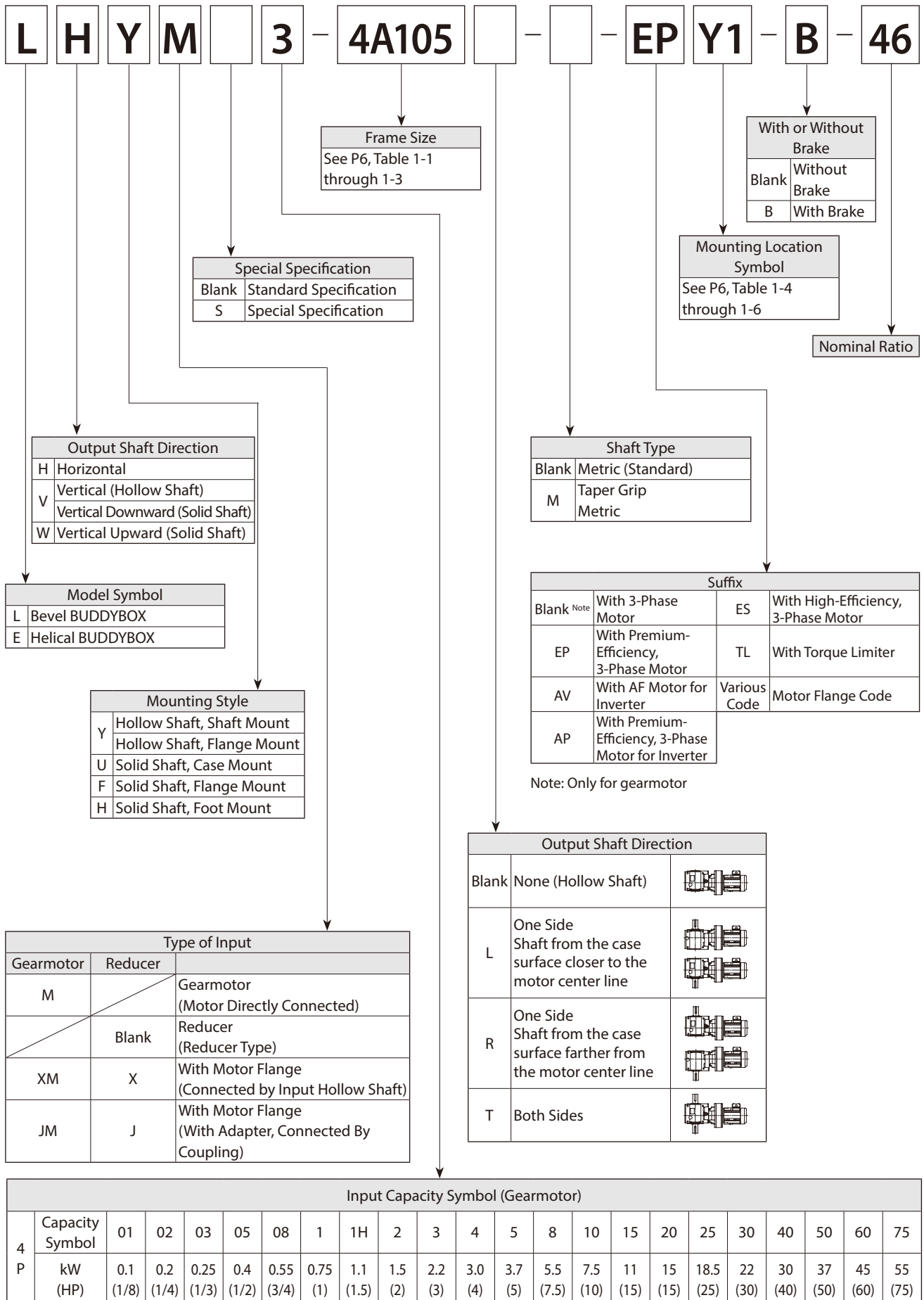


Table 1-1 Bevel BUDDYBOX 4 Series Frame Sizes

Bevel 1 Stage + CYCLO 1 Stage or Planetary Gear 1 Stage Reduction						Bevel 1 Stage + CYCLO 2 Stage Reduction					
4A100	4B120	4C140	4D160	4E170	4F180	4A10DA	4B12DA	4C14DA	4D16DA	4E17DA	4F18DA
4A105	4B125	4C145	4D165	4E175	4F185	4A12DA	4B12DB	4C14DB	4D16DB	4E17DB	4F18DB
4A110	4B140	4C160	4D170	4E180	4F190	4A12DB	4B14DA	4C14DC	4D17DA	4E17DC	4F19DA
4A115	4B145	4C165	4D175	4E185	4F195		4B14DB	4C16DA	4D17DB	4E18DA	4F19DB
4A120	4B160	4C170	4D180	4E190				4C16DB	4D17DC	4E18DB	
4A125	4B165	4C175	4D185	4E195					4D18DA	4E19DA	
4A140									4D18DB	4E19DB	
4A145											

Table 1-2 Bevel BUDDYBOX 5 Series Frame Sizes

Bevel 1 Stage + CYCLO 1 Stage or Planetary Gear 1 Stage Reduction				Bevel 1 Stage + CYCLO 2 Stage Reduction			
5Z100	5A110	5B120	5C140	5Z10DA	5A12DA	5B12DA	5C14DA
5Z105	5A115	5B125	5C145	5Z12DA	5A12DB	5B12DB	5C14DB
5Z110	5A120	5B140	5C160	5Z12DB		5B14DA	5C14DC
5Z115	5A125	5B145	5C165			5B14DB	5C16DA
5Z120	5A140	5B160	5C170				5C16DB
5Z125	5A145	5B165	5C175				

Table 1-3 Helical BUDDYBOX Frame Sizes

Helical 1 Stage + CYCLO 1 Stage or Planetary Gear 1 Stage Reduction						Helical 1 Stage + CYCLO 2 Stage Reduction					
Z6090	A6100	B6120	C6140	D6160	E6170	Z609DA	A610DA	B612DA	C614DA	D616DA	E617DA
Z6095	A6105	B6125	C6145	D6165	E6175			B612DB	C614DB	D616DB	E617DB
										D616DC	E617DC

Table 1-4 Bevel BUDDYBOX 4 Series Mounting Location Symbols

First Digit	Mounting Style	Second Digit	Mounting Posture
Y	Shaft Mount, Case Mount	1	Each Direction
F	Flange Mount	2	
G		3	
K	Foot Mount	4	
W		5	
V		6	

Table 1-5 Bevel BUDDYBOX 5 Series Mounting Location Symbols

First Digit	Mounting Style	Second Digit	Mounting Posture
Y	Shaft Mount	1	Each Direction
G	Flange Mount	2	
		3	
		4	
		5	
		6	

Table 1-6 Helical BUDDYBOX Mounting Location Symbols

First Digit	Mounting Style	Second Digit	Mounting Posture
Y	Shaft Mount	1	Each Direction
F	Flange Mount	2	
		3	
		4	
		5	
		6	

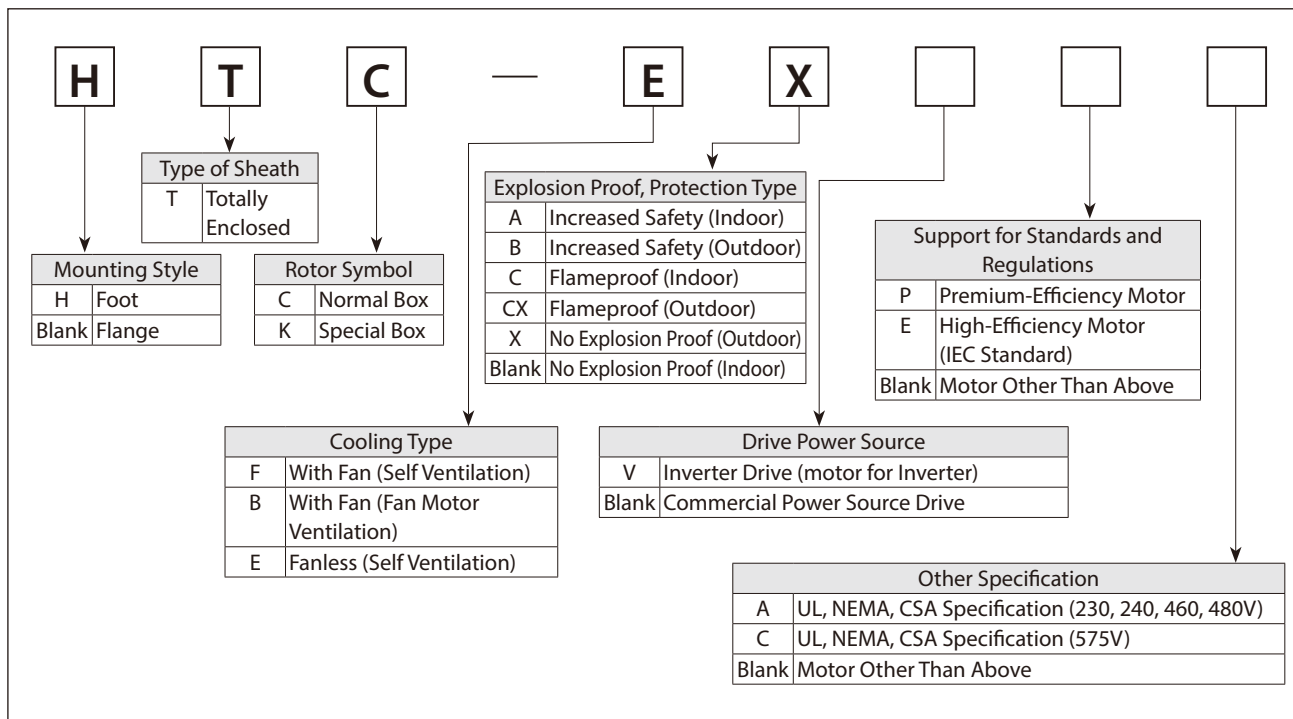
Note: For details of mounting location symbols, refer to the catalog.



1-4 Motor Nomenclature

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

When using another manufacturer's motor (motors made by other manufacturers are attached depending on motor specifications), follow the operation manual for that motor.



1-5 Brake Type

Table 1-7 shows the relationship between standard brake type, motor type, and capacity range.

Table 1-7 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	4P	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	-	18.5 22 30	-
ESB-250 (Horizontal Type) ESB-250-2 (Vertical Type)	-	37 45	30 37	37 45	-

Note: Depending on the specification, brake type may differ from the types shown in Table 1-7. 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
	One year	Six months
Rust prevention time		
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 P22) 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 period is 2 years or longer, replace the oil seals 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, make 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 due to falling of the machine or failure of hanging metal fitting.
- 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.
- Before mounting, moving, or transporting the machine, make sure to remove the lubricating oil for the machine lubricated by oil.
Moving machine with lubricating oil in may cause oil to discharge from the air vent, etc.

DANGER

- Do not use a standard unit in an explosive atmosphere. Under such conditions, an explosion proof motor should be used; otherwise, explosion, ignition, electric shock, personal injury, 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.
- For **flameproof motor driven by an inverter**, install an inverter in a place free from explosive gas since the inverter itself is not explosion proof; otherwise, explosion, ignition, electric shock, personal injury, 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 that may hinder ventilation around the gearmotor or reducer. 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, machine for clean room, and so on) in case oil or grease leaks; otherwise, the product may fail because of oil leakage.
- Before mounting, moving, or transporting the machine, make sure to remove the lubricating oil. Moving machine with lubricating oil in may cause oil to discharge from the air vent, etc.

4-1 Installation Location

Ambient temperature:	−10 to +40°C
Ambient humidity:	85%RH or less with no condensation
Altitude:	Maximum 1,000m
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 no direct heavy wind and rain)
	Vibration: Maximum 1G

- Mounting in conditions other than the above requires adherence to optional specifications. Please consult with us.
- Products 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 smooth operation, such as inspection and maintenance.
- Mount on a sufficiently rigid base.

4-2 Mounting Angle

Install the product so that the output shaft becomes 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. When 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.

4-3 Mounting Bolts

- Use mounting bolts with the strength class 8.8 (JIS B 1051) or more.
- For Bevel BUDDYBOX 4 Series, if radial load or axial load is applied to the output shaft, use mounting bolts with JIS strength class 10.9 or more.
(The flange lock bolts and foot plate lock bolts are in JIS strength class 10.9 or more.)
- For Bevel BUDDYBOX 4 Series with solid shaft, foot mount type with frame sizes 4A and 4B, it is recommended to use hexagon socket head bolts.

4-4 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 input shaft. (The inner surface of the input shaft is treated with rust prevention oil before shipping.)
- [2] Position the reducer on a base so that the input shaft is on top.
- [3] Align the input shaft with the notch of the clamp ring.
- [4] Remove the adapter plate cap and insert a hexagonal wrench through the setting hole into the hexagon socket head bolt of the clamp ring. Next, insert the motor shaft into the input shaft.
- [5] When assembling the motor and reducer, 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 securely inserted into the adapter plate spigot. If the bolt is tightened when the spigot is not inserted, one side is fasten and it 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 4-1.
- [8] After operating at low speed, increase the tightening torque as shown in Table 4-1.
- [9] Attach the adapter plate cap that had been removed.

Table 4-1 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

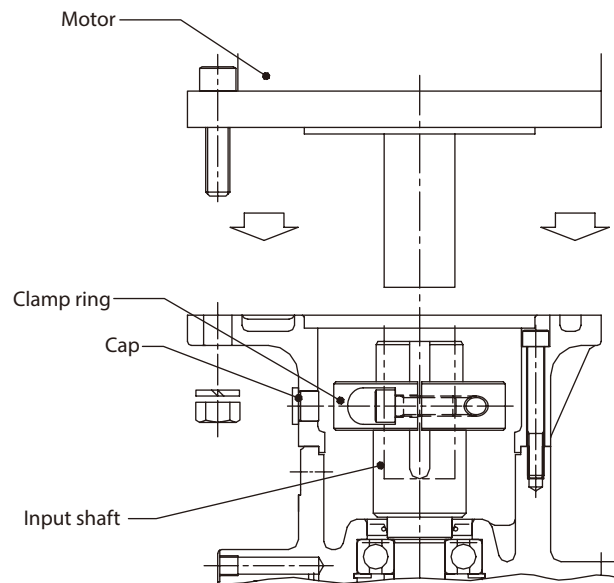


Figure 4-1 Assembly Diagram

4-5 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 input shaft. (The inner surface of the input shaft is treated with rust prevention oil before shipping.)
- [2] Align the motor shaft key with the keyway of the hole in the input shaft. (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 input shaft. Operation with uninserted spacer could result in the key falling out and damaging the shaft.
- [5] When assembling the motor and reducer, 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, one side is fasten. It 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 output shaft; otherwise the key could fly off, and injury may result.
- Attach the cover to the rotating parts to avoid someone touching them; 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.

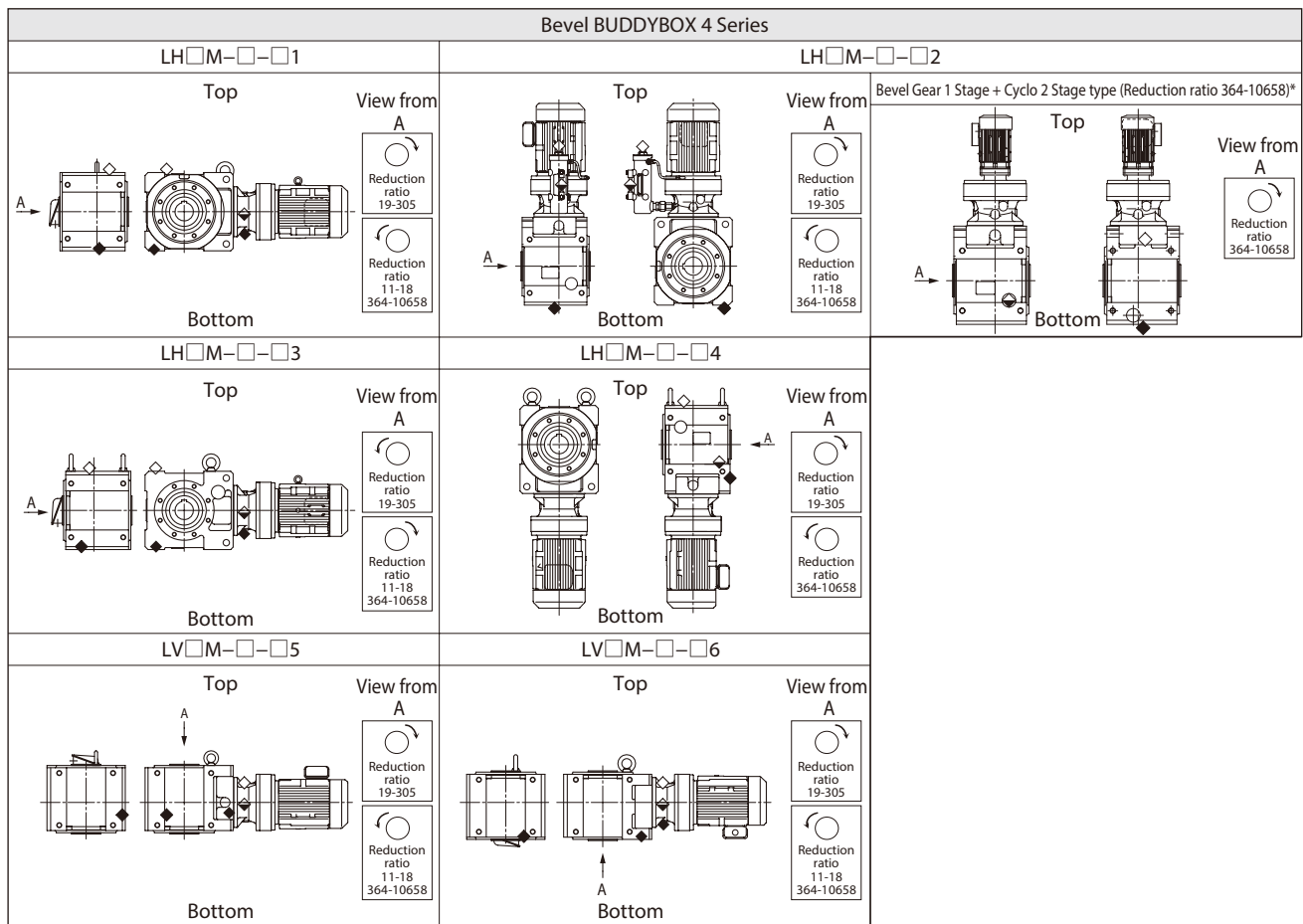
5-1 Checking Rotational Directions and Locations of Oil Fill and Oil Drain Ports

(1) For Gearmotor

- P12-13 shows the rotational directions of output shaft and locations of oil fill and oil drain ports when wiring is performed as on P24-37.
- When wiring is performed as shown on P24-37, the motor shaft rotates to the right as seen from the anti-load side.
- To make reverse rotation, reverse R and T on P24 and P26-33.

(2) For Reducer

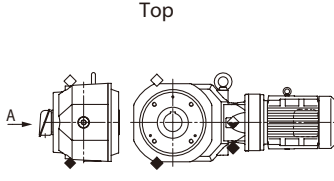
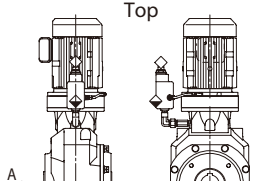
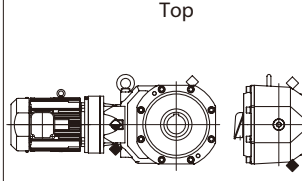









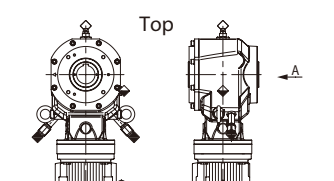
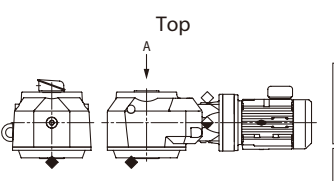
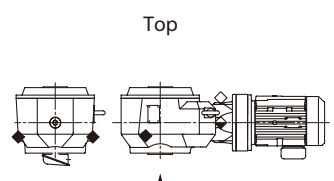









- When the input shaft rotates to the right, arrows on P12-13 show the rotational directions of output shaft. Confirm those directions when checking the oil fill and oil drain ports locations.



⌚ Output shaft rotation direction seen from "A" ◇ Oil filler port ◆ Oil gauge ◆ Oil drain port

Figure 5-1 Rotational Directions of Output Shaft and Locations of Oil Fill and Oil Drain Ports (Example: Hollow Shaft, Shaft Mount)

* Bevel Gear 1 Stage + Cyclo 2 Stage type of LH□M-□-□2 (reduction ratio 364-10658) applies different lubrication depending on the manufacture date and specification. See "8. Daily Inspection and Maintenance" for detail.

Bevel BUDDYBOX 5 Series					
LH□M-□-□1		LH□M-□-□2		LH□M-□-□3	
					
					
<p>View from A</p>  <p>Reduction ratio 19~305</p>  <p>Reduction ratio 11~18 364~4365</p>		<p>View from A</p>  <p>Reduction ratio 19~305</p>  <p>Reduction ratio 11~18 364~4365</p>		<p>View from A</p>  <p>Reduction ratio 19~305</p>  <p>Reduction ratio 11~18 364~4365</p>	
LH□M-□-□4		LV□M-□-□5		LV□M-□-□6	
					
					
<p>View from A</p>  <p>Reduction ratio 19~305</p>  <p>Reduction ratio 364~4365</p>		<p>View from A</p>  <p>Reduction ratio 19~305</p>  <p>Reduction ratio 11~18 364~4365</p>		<p>View from A</p>  <p>Reduction ratio 19~305</p>  <p>Reduction ratio 11~18 364~4365</p>	





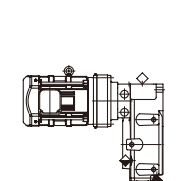
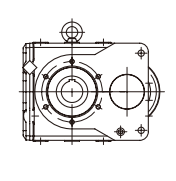








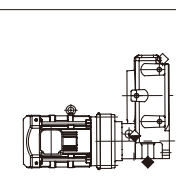
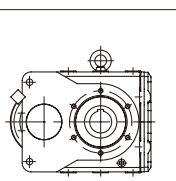








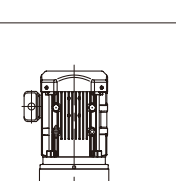
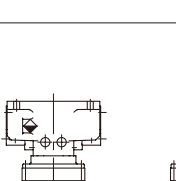






 Output shaft rotation direction seen from "A"
  Oil filler port
  Oil gauge
  Oil drain port

Figure 5-2 Rotational Directions of Output Shaft and Locations of Oil Fill and Oil Drain Ports (Example: Hollow Shaft, Shaft Mount)

Helical BUDDYBOX					
EH□M-□-□1			EH□M-□-□2		
					
					
<p>View from A</p>  <p>Reduction ratio 21~305</p>  <p>Reduction ratio 11~18 364~4365</p>			<p>View from A</p>  <p>Reduction ratio 21~305</p>  <p>Reduction ratio 11~18 364~4365</p>		
<p>View from B</p>  <p>Reduction ratio 11~18 364~4365</p>			<p>View from B</p>  <p>Reduction ratio 11~18 364~4365</p>		
EH□M-□-□3			EH□M-□-□4		
					
					
<p>View from A</p>  <p>Reduction ratio 21~305</p>  <p>Reduction ratio 11~18 364~4365</p>			<p>View from A</p>  <p>Reduction ratio 21~305</p>  <p>Reduction ratio 11~18 364~4365</p>		
<p>View from B</p>  <p>Reduction ratio 11~18 364~4365</p>			<p>View from B</p>  <p>Reduction ratio 11~18 364~4365</p>		
EV□M-□-□5			EV□M-□-□6		
					
					
<p>View from A</p>  <p>Reduction ratio 21~305</p>  <p>Reduction ratio 364~4365</p>			<p>View from A</p>  <p>Reduction ratio 21~305</p>  <p>Reduction ratio 364~4365</p>		





 Output shaft rotation direction seen from "A"
  Oil filler port
  Oil gauge
  Oil drain port

Figure 5-3 Rotational Directions of Output Shaft and Locations of Oil Fill and Oil Drain Ports (Example: Hollow Shaft, Shaft Mount)

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 5-4 should be no more than that shown in Table 5-1.

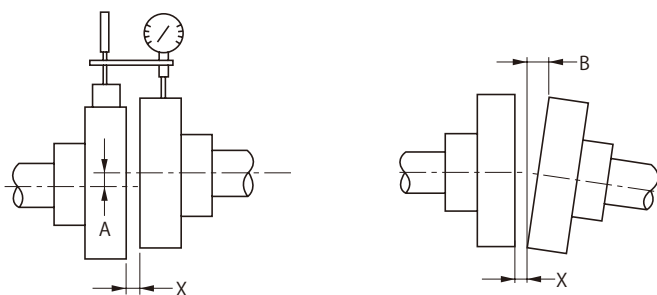


Figure 5-4

Table 5-1 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 diameter 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 5-5)

(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 5-6)
- When using multiple V belts, use the same V belts having the same circumferential length.

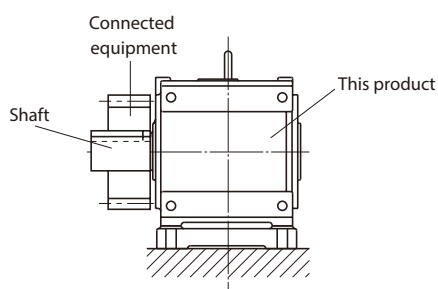


Figure 5-5

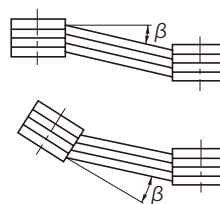


Figure 5-6

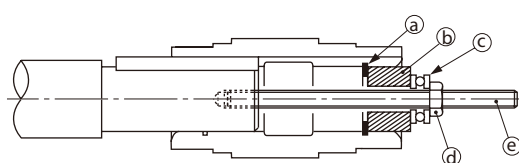
5-3 Hollow Shaft, Torque Arm Mount/Flange Mount

(1) Length of the Driven Shaft

When mounting the driven shaft to the hollow shaft, ensure that the insertion length is "recommended length of the driven shaft" or longer.
For details, refer to the catalog or consult with us.

(2) Mounting on the Driven Shaft

- [1] Apply molybdenum disulfide grease to the surface of the driven shaft and the inner diameter of the hollow shaft, and then insert this product to the driven shaft.
- [2] When the fitting part is hard, lightly hit the end face of the hollow shaft with a wooden hammer before insertion. At this time, do not hit the casing or oil seal. Also, if the fitting part is particularly hard, using the jigs shown in Figure 5-7 will help smoother insertion.



- (a) Retaining ring
- (b) Spacer
- (c) Thrust bearing
- (d) Nut
- (e) Head-cut bolt

Figure 5-7 Mounting Jigs

The hollow shaft is made with JIS H8 tolerance. The recommended tolerances for the driven shaft are as follows.

- When a uniform load is applied with no impact JIS h6 or js6
- When an impact load is applied or a radial load is large JIS js6 or k6
- Retaining ring (snap ring) size JIS B 2804 retaining C-ring

(3) Fixing to the Driven Shaft

When using the torque arm for rotation prevention, be sure to fix the product to the driven shaft.

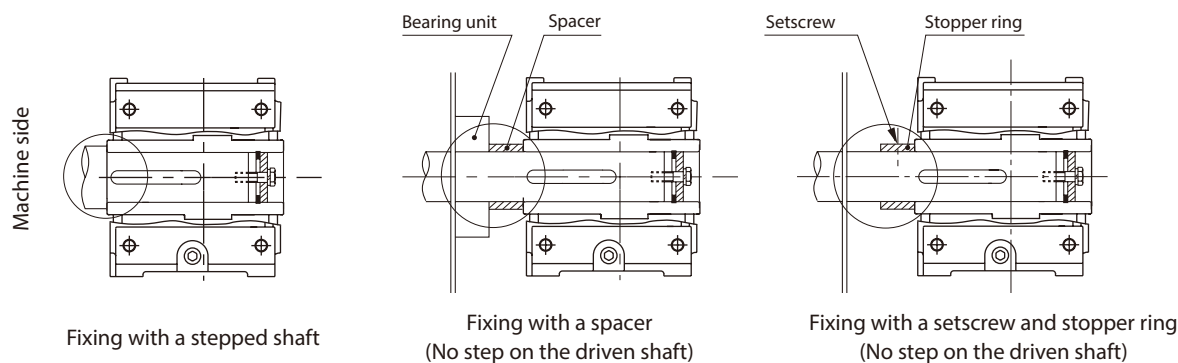


Figure 5-8 Example of Fixing Method that Prevents the Product from Moving to the Machine Side

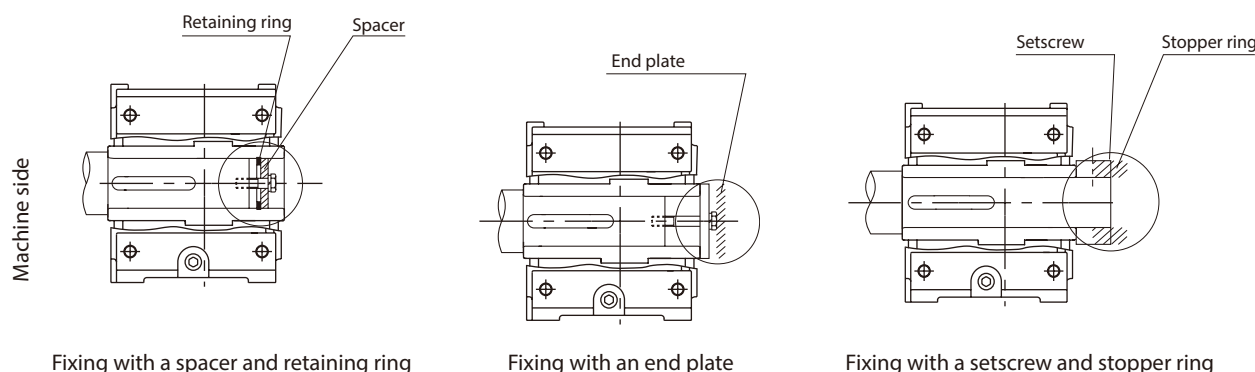


Figure 5-9 Example of Fixing Method that Prevents the Product from Moving to the Anti-machine Side

Note: 1. Jigs and parts for mounting and fixing need to be prepared by the customer.
2. For recommended dimensions, refer to the catalog.

(4) Mounting the Torque Arm (Optional)

- [1] Attach the torque arm to the driven machine side of the casing.
- [2] Provide a degree of freedom to the rotation stopper part of the torque arm (see Figure 5-11) to prevent excessive force from being applied between the casing and the driven shaft. (The customer needs to prepare the rotation stopper part.)
- [3] Do not fix the torque arm using a rotation stopper bolt, etc.
- [4] Attach disc springs (see Figure 5-12) as shock absorbers between the torque arm and the mounting bolt (or spacer) to relieve the impact.
- [5] Use a bolt with the strength class 10.9 (JIS B 1051) or more.
- [6] When mounting the torque arm, be sure to take a looseness prevention measure for the bolt.
(Use of a spring washer or U-nut, applying adhesive that prevents loosening of screws, etc.)

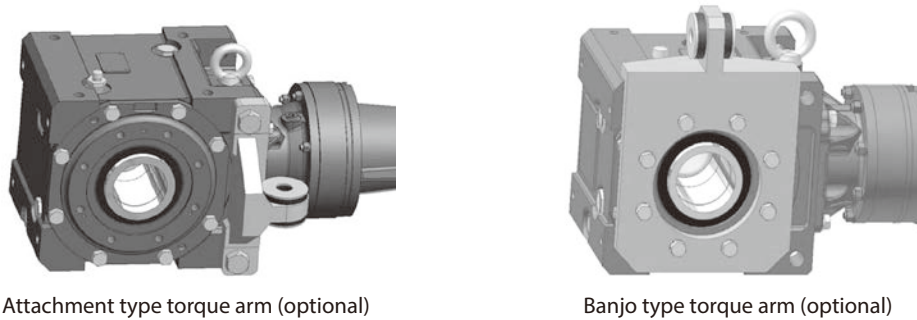


Figure 5-10 Usage Example of Torque Arm

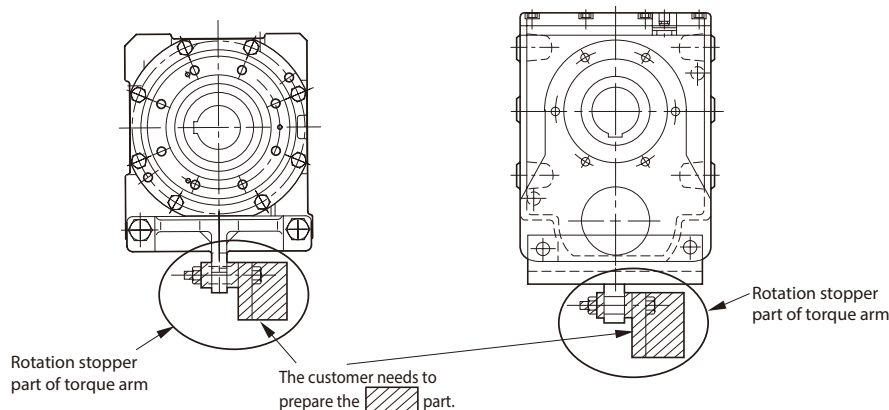


Figure 5-11 Example of Rotation Stopper (Attachment Type Torque Arm)

(5) Mounting the Disc Springs (Optional)

- [1] The optional disc spring is equivalent to DIN 2093.
- [2] Use a bolt with the strength class 10.9 (JIS B 1051).
- [3] Ensure that there is no gap in the assembly parts (indicated as "A" in Figure 5-12).
A gap in the assembly parts may damage the torque arm mounting part due to impact.
- [4] Make sure that the disc springs are not crushed.
If the nut is tightened until the disc springs are crushed during assembly, the disc springs will lose buffer actions, which may cause an excessive force to the mounting part of the reducer and the driven machine.
Be careful not to crush the disc springs when tightening with a double nut.
- [5] Apply lubricant such as grease to the contact surfaces and overlapping surfaces of the disc springs in order to reduce abrasion of the disc springs.
- [6] Take looseness prevention measures for the bolt, such as applying adhesive for looseness prevention and use of a U-nut.
- [7] If a gap is formed in the assembly part due to initial deflection of disc springs, retighten the nut to eliminate the gap. At this time, be careful not to crush the disc springs.

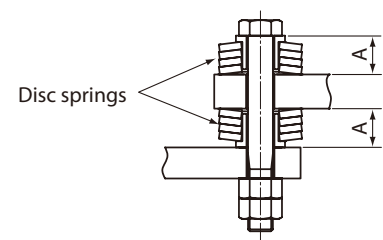


Figure 5-12 Disc Springs

(6) Mounting the Flange

- [1] Mount this product to the driven machine.
- [2] Assemble the driven shaft to the hollow shaft.
- [3] Assemble the driven shaft to the bearing unit and fix the bearing unit after checking there is no shaft runout.

Note: Be careful when mounting so that unnecessary force is not applied to the driven shaft and hollow shaft by the casing's being wrenched; otherwise, an excessive force may be applied to this product and the bearing unit, resulting in damage to the internal parts.

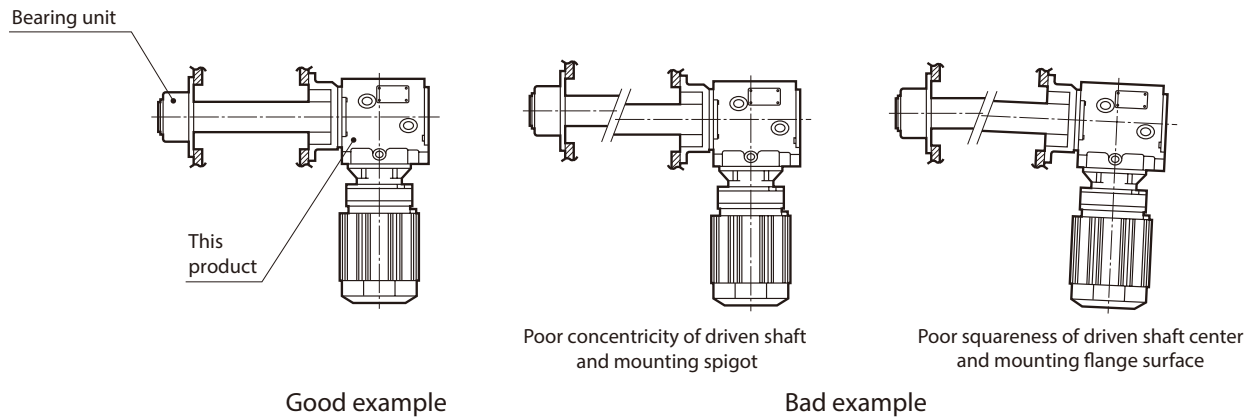


Figure 5-13 Example of Flange Mounting

(7) Removing from the Driven Shaft

Ensure that unnecessary force is not applied between the casing and the hollow shaft. Using the jigs shown in Figure 5-14 will help smoother removal.

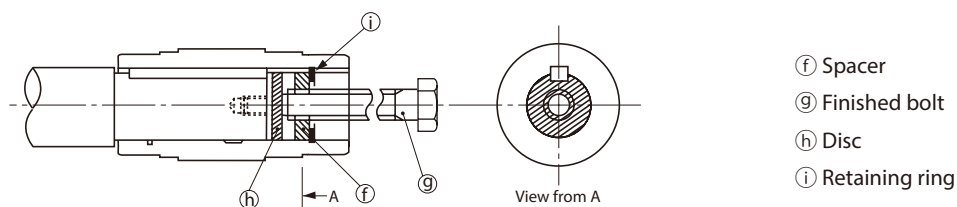


Figure 5-14 Removal Jigs

- Note: 1. Jigs and parts for removal need to be prepared by the customer.
2. For recommended dimensions, refer to the catalog.

5-4 Hollow Shaft, Shrink Disc Mount

(1) Mounting the Shrink Disc (Optional)

The shrink disc that comes with the product is shipped with grease applied to the surface where a boss is tightened, so it can be assembled without any additional work.

- [1] The insertion objects stuffed between both plates as buffer materials during transport can be removed by loosening all bolts.
- [2] When the shrink disc that has been used is removed and reused, at first disassemble and clean it, and apply seizure-preventive agent (such as molybdenum disulfide grease) to the sliding cone, tightening bolts, and the surface that makes contact with the bolt heads.
- [3] Completely degrease the holes of the boss and the shaft that makes contact with it.
- [4] Slide the shrink disc onto the hollow shaft. Do not tighten the tightening bolts until the driven shaft enters the hollow shaft.
- [5] Slide the driven shaft or the product, and insert the driven shaft to the hollow shaft.
- [6] When tightening the bolts, ensure that the surfaces of both plates are parallel to each other.
- [7] After confirming the shrink disc is correctly set, start tightening the bolts using a wrench with a short haft.
Tighten the bolts evenly in the clockwise direction (not diagonally) while keeping the both plates parallel. At this time, it is recommended to tighten each bolt by 90 degrees at one time.
- [8] Next, using the torque wrench set for the tightening torque indicated in Table 5-2, tighten each bolt in the clockwise direction by 90 degrees at first. As the tightening torque is being approached (about 80% of the tightening torque), tighten each bolt by 30 degree until the tightening torque is reached.

Even if it is confirmed that all bolts have been tightened with the tightening torque at first assembly, the tightening torque of the bolt tightened first may be dropped because the load applied per bolt is dispersed as bolts are tightened, and the total load applied to the bolt first tightened may reduce. Because of this, additionally tighten the bolts in the clockwise direction with the tightening torque.

However, this operation shall be up to 3 laps. Confirm that there is no looseness during this operation. Check the operation of the torque wrench with one-time click.

- [9] Confirm that all bolts have been tightened with the tightening torque shown in Table 5-2, and that the level between the sliding cone and the plate is uniform in the whole circumference.
- [10] Finally, ensure that the both plates are parallel.

Note: After the shrink disc is mounted in the above order, operate the product. Since the contact part of the hollow shaft and the driven shaft is not lubricated, scratches easily occur if it is rotated with the shrink disc not correctly mounted.

Table 5-2 Tightening Bolts

Frame Size	Quantity	Size	Strength Class (JIS B 1051)	Tightening Torque (N·m)
5Z10□, 5Z11□, 5Z12□	8	M6×25	10.9	12
4A10□, 4A11□, 4A12□, 4A14□ 5A11□, 5A12□, 5A14□	10	M6×25	10.9	12
4B12□, 4B14□, 4B16□ 5B12□, 5B14□, 5B16□	7	M8×30	12.9	35
4C14□, 4C16□, 4C17□ 5C14□, 5C16□, 5C17□	12	M8×35	12.9	35
4D16□, 4D17□, 4D18□	12	M10×45	12.9	69
4E17□, 4E18□, 4E19□	10	M12×45	12.9	120
4F18□, 4F19□	8	M16×55	10.9	250

Note: The symbol □ in frame size can be "0", "5", "DA", "DB" or "DC".

(2) Removing the Shrink Disc

- [1] Using a normal wrench, loosen each bolt in the clockwise direction by 90 degrees evenly, preventing concentration of load to a few bolts.
- [2] Continue to loosen bolts until the shrink disc moves on the hollow shaft. At this time, do not place a part of your body in the bolt shaft direction.
- [3] If the both plates are not parallel, do not remove the bolts; otherwise, the both plates may jump out of the sliding cone, resulting in injury. Therefore, loosen all bolts slightly, and insert a wedge between the both plates to make them parallel.

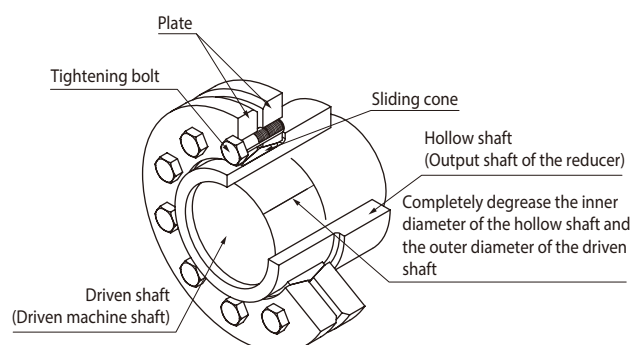


Figure 5-15 Shrink Disc Structure

5-5 Hollow Shaft, Taper Grip Mount

(1) Mounting the Taper Grip (Optional)

■ Preparation of the machine shaft to be mounted

- [1] Ensure that the shaft has no rust, bumps or dips (especially convexity).
- [2] The recommended tolerance for the shaft is h8.
- [3] Wipe off dust and oil attached on the shaft with cloth, alcohol solvent, etc.
Especially, wipe off oil and grease completely.

■ Setting the taper grip

- [1] Apply oil lightly to the screw part of the taper grip.
- [2] Place the thrust collar on the screw part of the taper grip.
Insert the taper grip into the hollow shaft while rotating the taper grip in the clockwise direction.
Insert the taper grip in rotation until the flange makes contact with the thrust collar. (Figure 5-16)
- [3] Next, rotate the taper grip in the anticlockwise direction, and align the counterbore hole of the thrust collar and the screw hole of the taper grip.
At this time, the distance between the thrust collar and the taper grip flange should be about 1mm. (Figure 5-17)
Next, tighten all set bolts to the taper grip.
The tightening force should be in the degree in which the bolt lightly makes contact with the counterbore hole of the thrust collar (force with which a screw is tightened directly with hand).

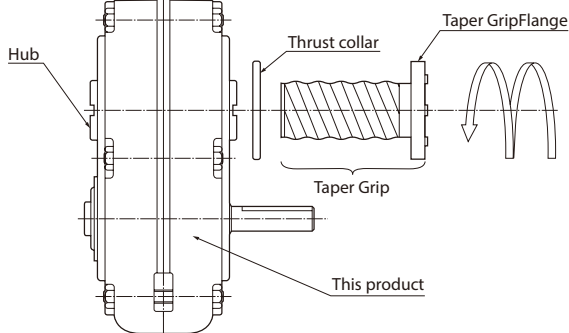


Figure 5-16 Mounting the Taper Grip

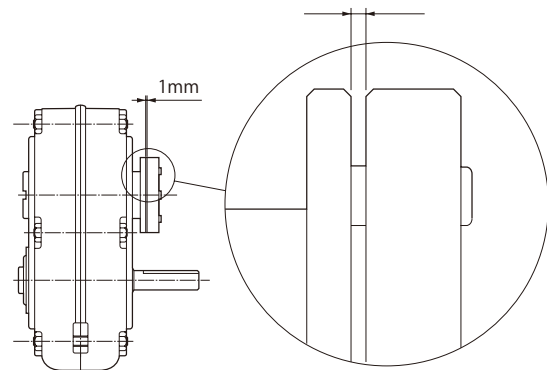


Figure 5-17 Gap between Taper Grip Flange and Thrust collar

■ Setting to the machine shaft

- [1] Place the hollow hole of the taper grip on the machine shaft, and insert it to the predetermined position (minimum length of thread engagement).
If it is difficult to insert, slightly loosen the tightening bolt. Do not hit it with a hammer, etc.
- [2] Tighten the screws of the taper grip.
When tightening the bolts, be sure to use a torque wrench.
The predetermined tightening torque for bolts is shown in Table 5-3, and Table 5-4 on P20.
First, tighten all bolts in the order shown in Figure 5-18 (1 → 2 → 3 → 4 → 5 → 6) with about one-third of the predetermined tightening torque.
Next, tighten all bolts in the same way with about two-third of the predetermined tightening torque.
Then, tighten all bolts in the same way with the predetermined tightening torque.
Finally, repeat tightening all bolts several times in the same way with the same predetermined tightening torque.
This is all for the mounting procedure.
(Use bolts with the strength class 12.9 (JIS B 1051) or more.)

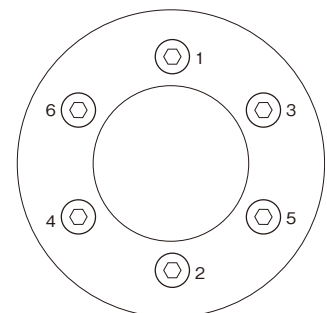


Figure 5-18 Bolt Tightening Order
1 → 2 → 3 → 4 → 5 → 6

■ Retightening after operation

[1] In 20 to 30 hours after operation, check the tightening torque. If the bolts are loose, retighten them with the predetermined tightening torque.

[2] Check the tightening torque periodically every six month.

Table 5-3 Tightening Bolts (Bevel BUDDYBOX)

Frame Size	Quantity	Size	Tightening Torque (N·m)
4A10□, 4A11□, 4A12□, 4A14□	6	M12×15	75
4B12□, 4B14□, 4B16□	6	M12×15	140
4C14□, 4C16□, 4C17□	6	M16×20	250
4D16□, 4D17□, 4D18□	6	M16×20	300
4E17□, 4E18□, 4E19□	8	M16×20	300

Table 5-4 Tightening Bolts (Helical BUDDYBOX)

Frame Size	Quantity	Size	Tightening Torque (N·m)
Z609□	6	M10×15	31
A610□	6	M12×15	51
B612□	6	M12×15	51
C614□	6	M16×20	128
D616□	6	M16×20	200
E617□	8	M16×20	200

Note: The symbol □ in frame size can be "0", "5", "DA", "DB" or "DC".

(2) Removing the Taper Grip

[1] Loosen the tightening bolts slowly in order until they are separated from the counterbore hole of the thrust collar.

[2] Next, hit the flange of the taper grip lightly with a wooden hammer.

In this way, the reducer is free from the machine shaft.

[3] Next, tighten the two tightening bolts lightly with hand.

This is necessary to prevent the taper grip from being locked when the reducer is removed from the shaft.

In this state, remove the reducer from the machine shaft.

When it is difficult to remove, use the taper grip flange with a puller for removal.

Note : 1. Never use oil or grease containing antifricition agent; otherwise, the predetermined transmission torque cannot be obtained.

2. Be sure to use a torque wrench to tighten the bolts with the predetermined torque in the order as described in this manual; otherwise, the predetermined transmission torque may not be obtained, or the bolts may be loosened.

3. Do not tighten the bolts with more than the predetermined tightening torque; otherwise, the bolts or the taper grip may be damaged.

4. For safety, retighten the bolts periodically.



When using another manufacturer's motor (There are some models made by other manufacturers.), 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 when working on the unit; otherwise, electric shock may result.
- Connect a power cable to the unit according to the diagram shown inside the terminal box or in the maintenance manual; otherwise, electric shock or fire may result.
- Do not forcibly bend, pull, clamp or push the power cable and lead wires; otherwise, electric shock or fire may result.
- Correctly ground the grounding bolt; otherwise, electric shock may result.
- For **explosion proof motor**, the lead-in condition 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 domestic laws and standards; 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 over current protecting device according to the laws and standards. It is recommended to install other protective devices (earth leakage breaker, etc.), in addition to an over current protecting device 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**, use an electromagnetic switch on the primary side (3-contact point type); otherwise, fire may result.
- PWM inverters that use IGBT generate high-voltage surges at the motor terminals, which may degrade the insulation on the motor windings. Especially when the motor is in the 400V class with the long cable, a surge voltage over 1300V occurs. Therefore, in this case, install an LCR filter, output AC reactor, etc. between the inverter and motor to inhibit the surge voltage.
- When using a **motor with brake**, do not energize the brake coil when the motor is stopped; otherwise, coil burnout 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; otherwise, explosion or ignition may result.
- 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 mounting bolts for terminal box 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.

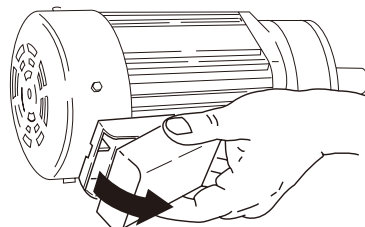


Figure 6-1

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, hours 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	Ohmmeter Voltage	Insulation Resistance (R)
Low-voltage motors of no more than 600V	500V	Minimum 1MΩ

Reference: JEC -2100 provides the following equation.

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

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

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

6-3 Coordination of System Protection

- Use a wiring breaker for short circuit proofing.
- Use an over current protecting device which operates when the currents exceed the rated current on the nameplate.
- For **Increased safety motor**, use an over current protecting device which operates in 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 joining pressure connection terminals as shown in figure 6-2.

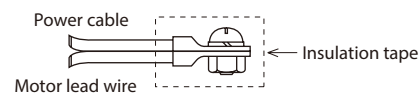


Figure 6-2



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	P24	P25
		4/8P	All	6	P24	-
	Increased safety, explosion proof	4P	0.1–7.5 11–55	3 6	P24	-
		Flameproof	4P	0.1–22 30–37	3 6	P24
Premium-Efficiency 3-Phase Motor	Standard	4P	0.75–3.7 5.5–55	3 6	P24	P25
	Increased safety, explosion proof	4P	0.75–3.7 5.5–22	3 6	P24	-
AF Motor for Inverter	Standard	4P	0.1–0.4 30–45	3 11	-	P25
	Flameproof	4P	0.2–15 22 30–37	3 6 11	-	P25
Premium-Efficiency, 3-Phase Motor for Inverter		4P	0.75–3.7 5.5–55	3 6	-	P25
High-Efficiency, 3-Phase Motor		4P	0.2–0.4	3	P24	P25

Table 6-3 With Brake

Motor Type	Number of Poles	Capacity (kW)	Brake Type	Number of Lead Wires	Page			
					One-Direction Rotation	Plugging Rotation	Inverter Drive	
3-Phase Motor	4P	0.1	FB-01A1	5	P26	P30	P34	
		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	P26	P30	P34	
		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	P27	P31	P35	
		7.5	FB-10E					
		11	FB-15E					
		15	FB-20		P28	P32		
		18.5 22 30	FB-30					
		37 45	ESB-250 ESB-250-2		P29	P33	P36	
AF Motor for Inverter	4P	0.1	FB-02A1	5	-	-	P34	
		0.2	FB-05A1					
		0.4	FB-1D					
		30 37	ESB-250 ESB-250-2	13			P37	
Premium-Efficiency, 3-Phase Motor for Inverter	4P	0.75	FB-1E	5	-	-	P34	
		1.5	FB-2E					
		2.2	FB-3E					
		3.7	FB-5E					
		5.5	FB-8E	8				P35
		7.5	FB-10E					
		11	FB-15E					
		15	FB-20					
		18.5 22 30	FB-30					
37 45	ESB-250 ESB-250-2		P36					
High-Efficiency, 3-Phase Motor	4P	0.2	FB-05A1	5	P26	P30	P34	
		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.

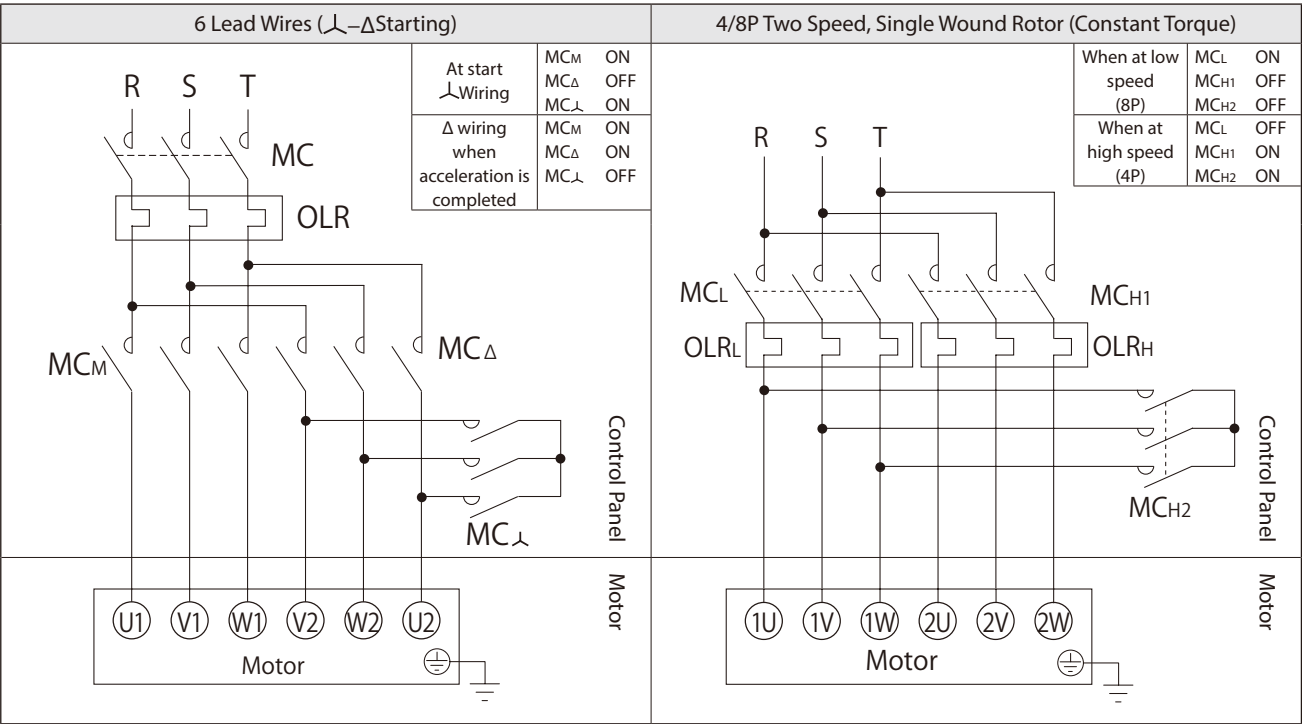
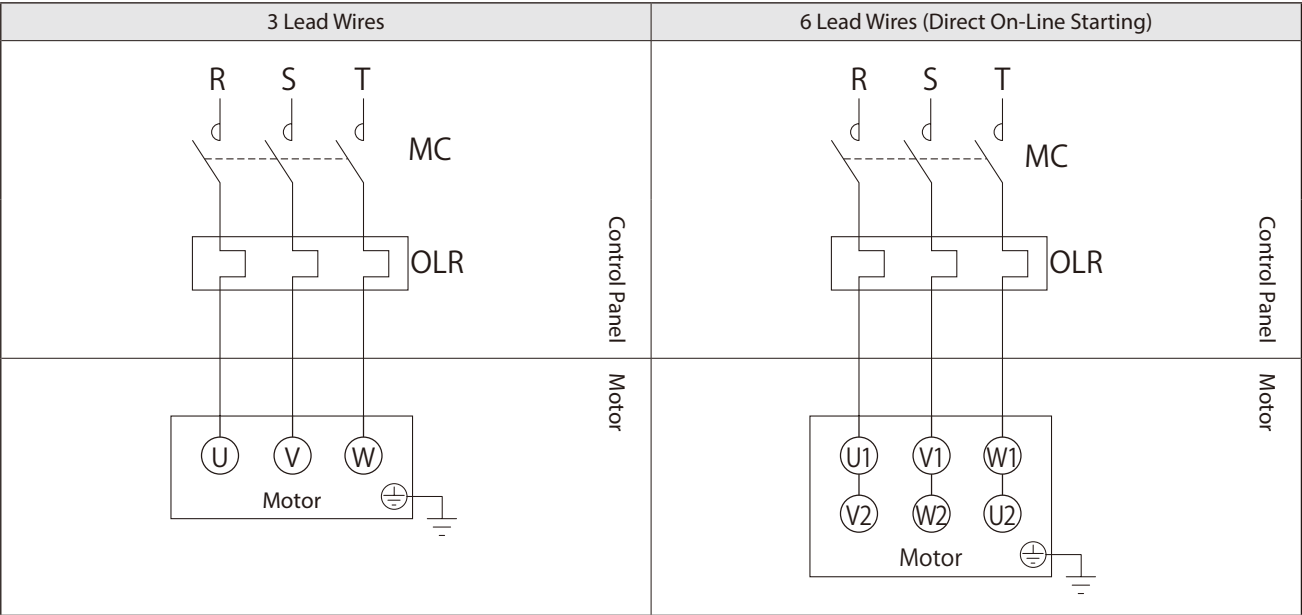


6. Wiring

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: Over current protection device or 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

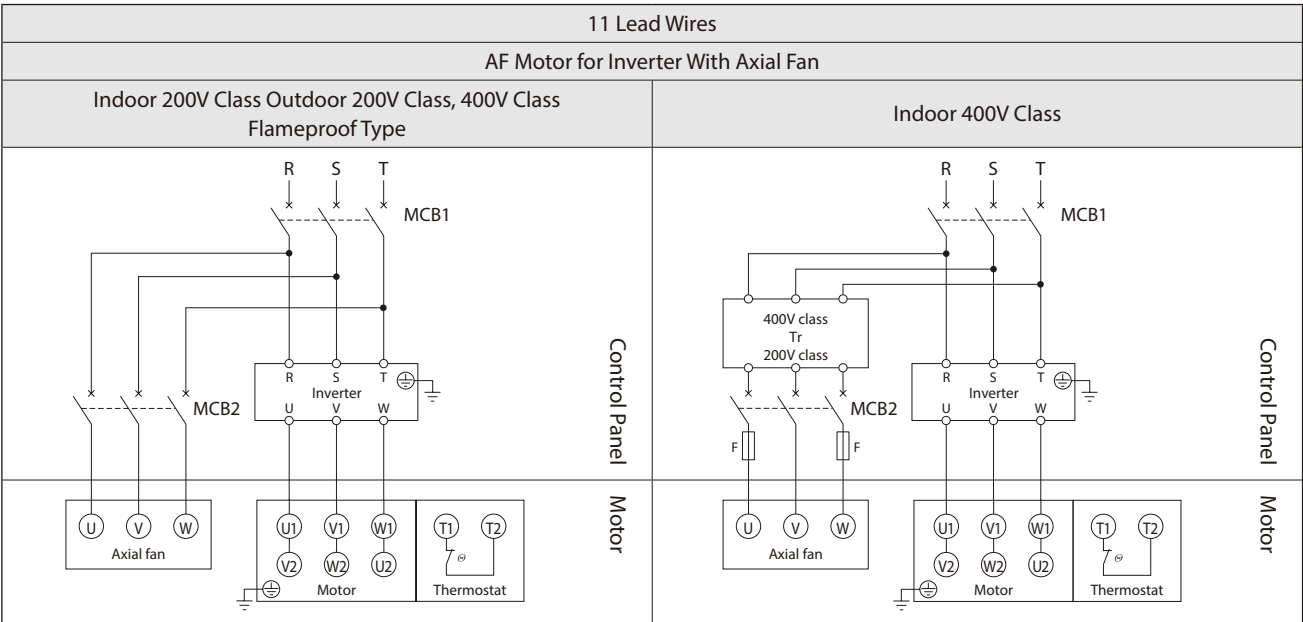
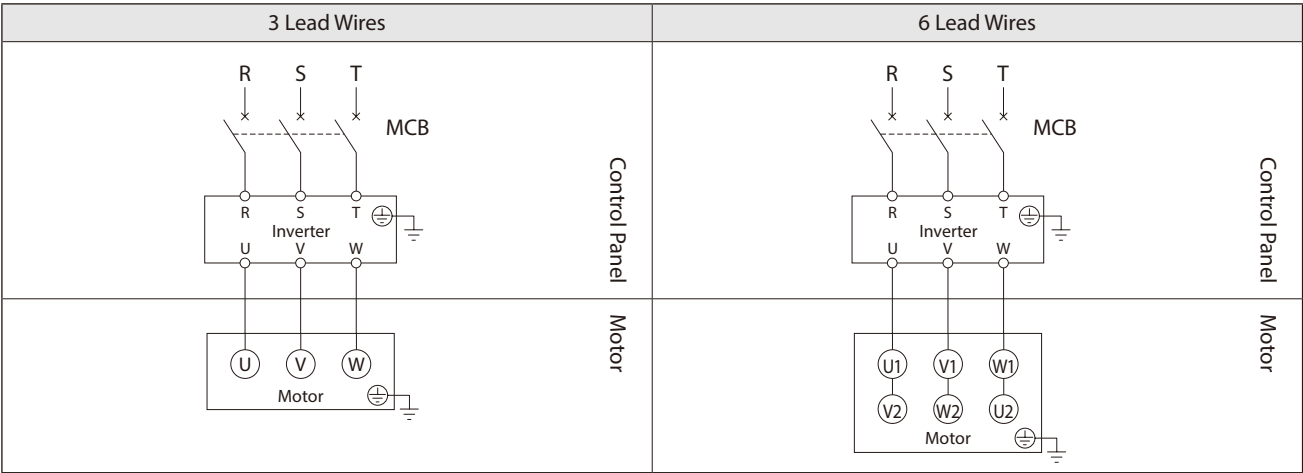
3-Phase Motor

Premium-Efficiency, 3-Phase Motor

AF Motor for Inverter

Premium-Efficiency, 3-Phase Motor for Inverter

High-Efficiency, 3-Phase Motor



MCB : Miniature circuit breaker

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.
 - 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 or P1, P2
Operating temperature: 135°C (for thermal class 155 (F))
- Operating function: Normally closed (break contact)
Maximum current: DC 24V, 18A; AC 230V, 13A



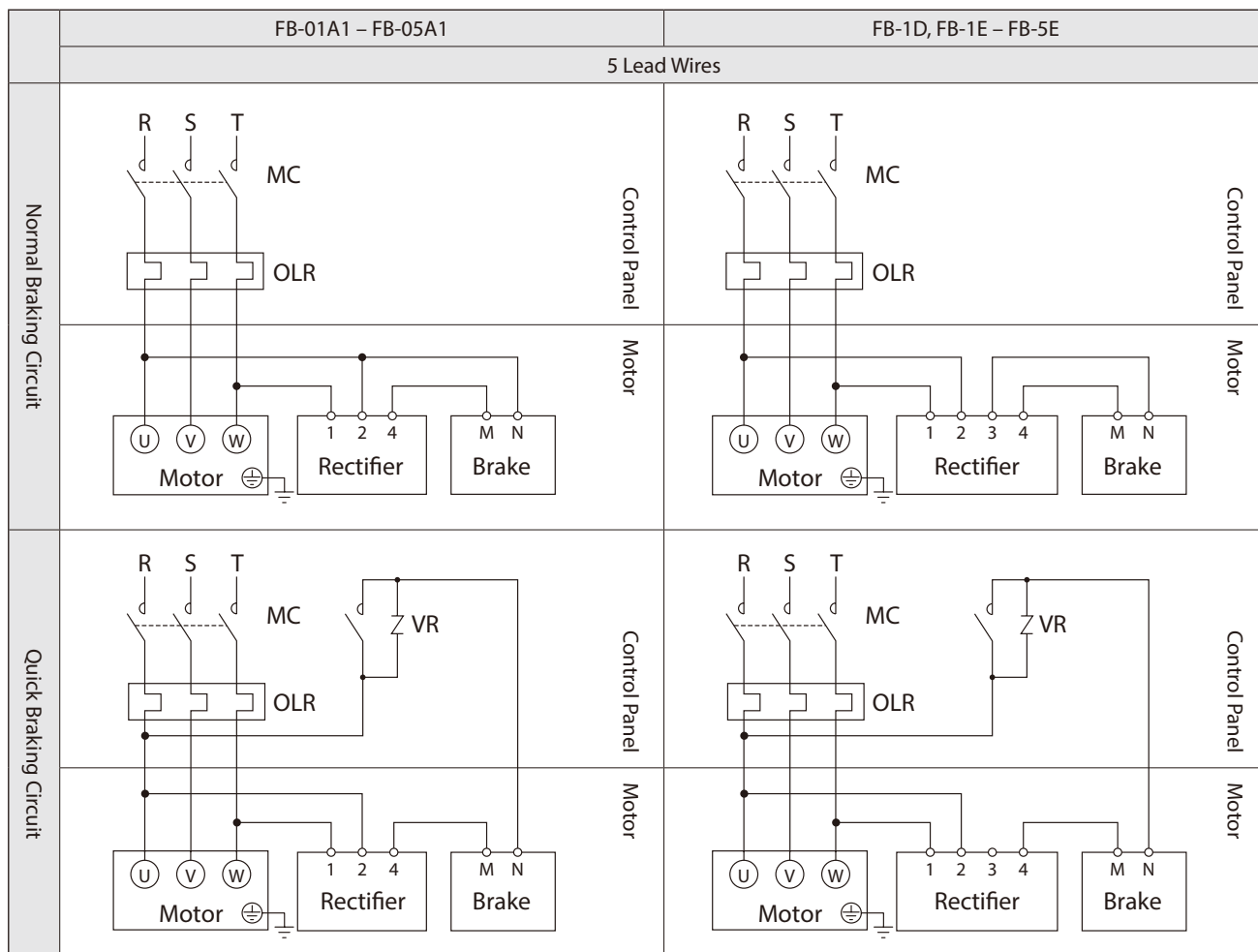
6. Wiring

■ 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 : Over current protection device or thermal relay

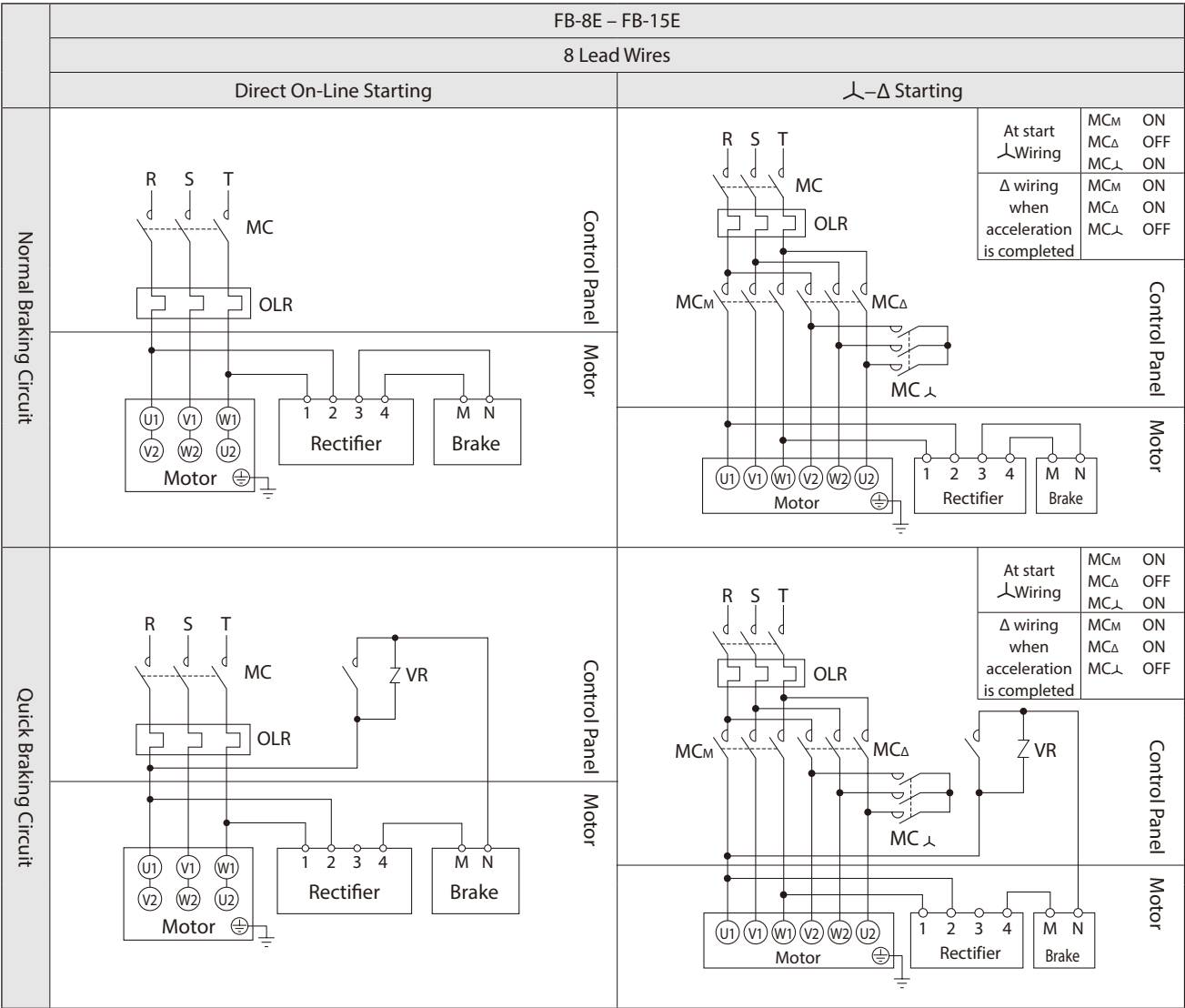
VR : Varistor (for protecting contact points, rectifier, etc.)

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 1-7 on P7.
- The interval time between the current stop and brake action is different between normal and quick braking circuits. Table 7-2 on P40 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 P38.
- 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



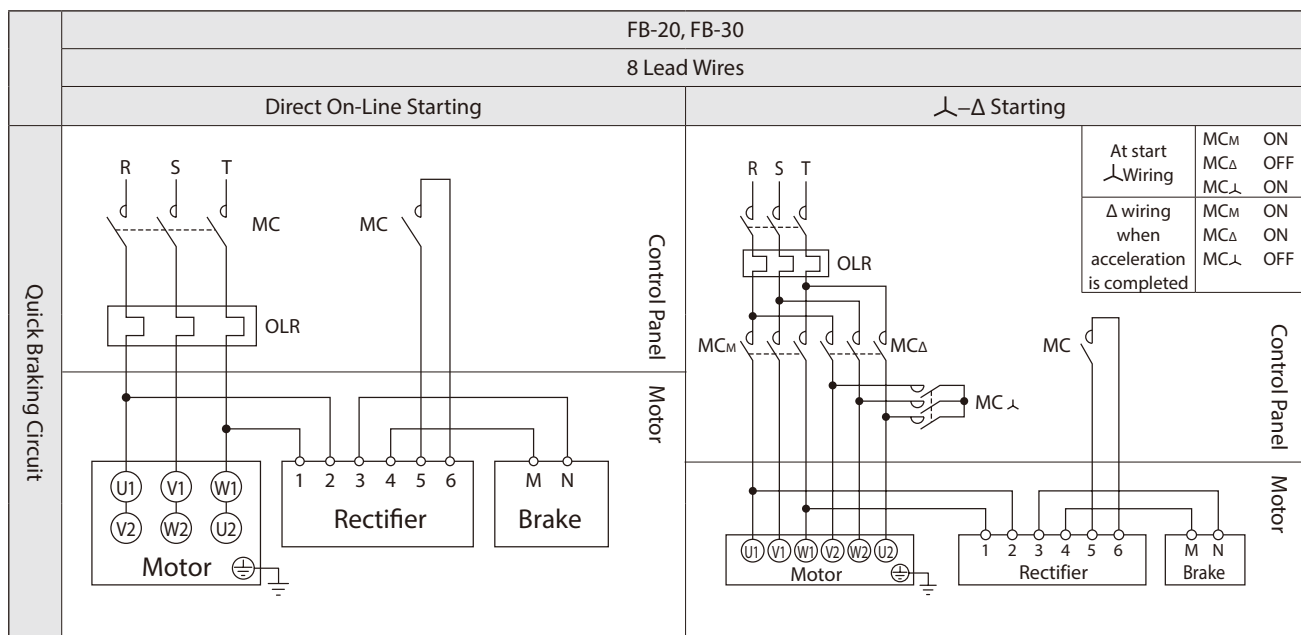
MC : Electromagnetic contactor
 OLR : Over current protection device or thermal relay
 VR : Varistor (for protecting contact points, rectifier, etc.)

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 1-7 on P7.
- The interval time between the current stop and brake action is different between normal and quick braking circuits. Table 7-2 on P40 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 P38.
- For quick braking circuits, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.



6. Wiring



MC : Electromagnetic contactor

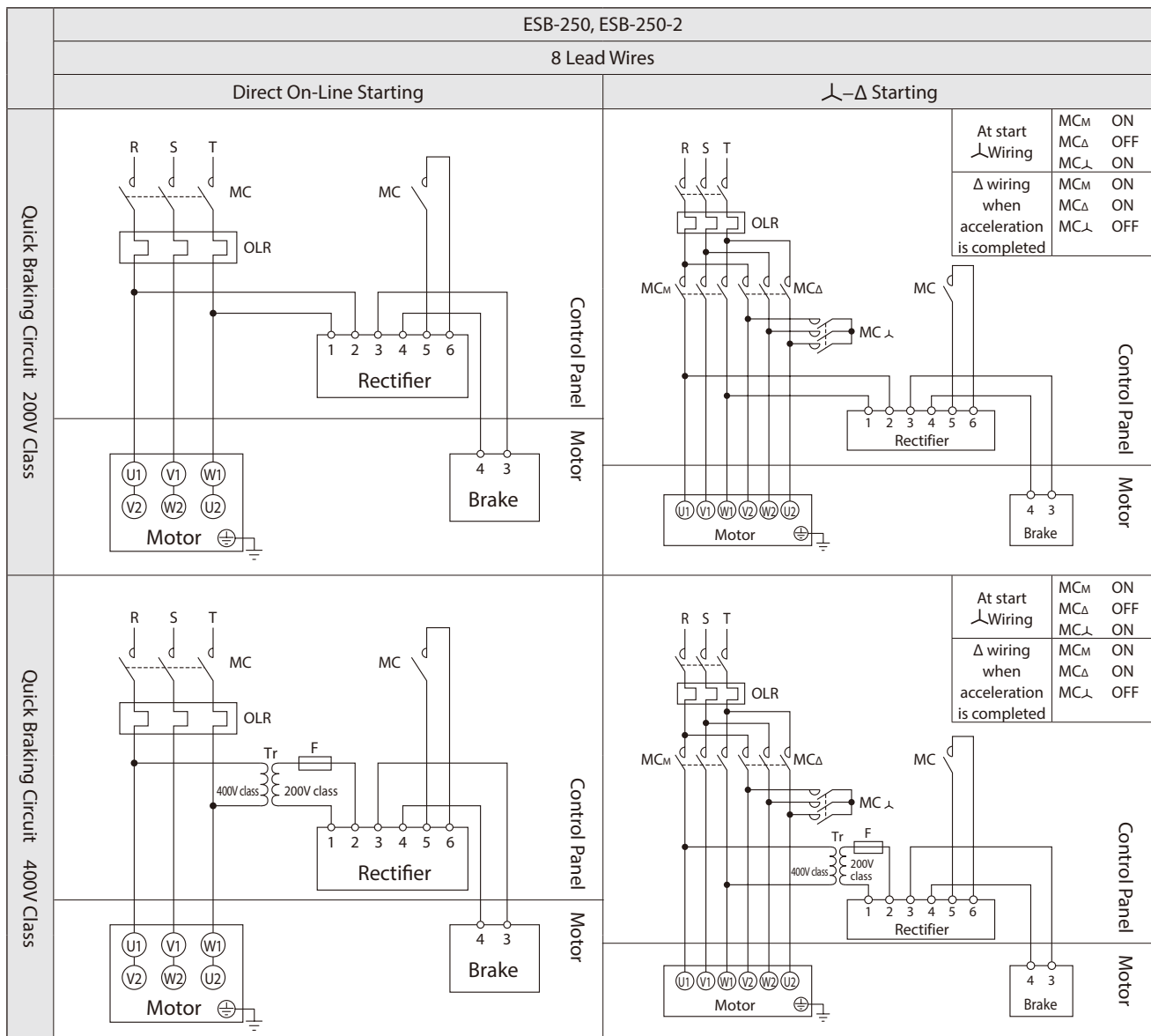
OLR : Over current protection device or thermal relay

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 1-7 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P38.
- 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 : Over current protection device or 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 1-7 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P38.
- For quick braking circuits, interlock brake circuit's electromagnetic contactor with the motor's electromagnetic contactor.
- Rectifiers are external to the main unit. Rectifiers are made for indoor use. Install in an area where they will not contact with water, etc.
- The brake unit is for 200V class. For 400V class power sources, prepare a 400V/200V transformer.



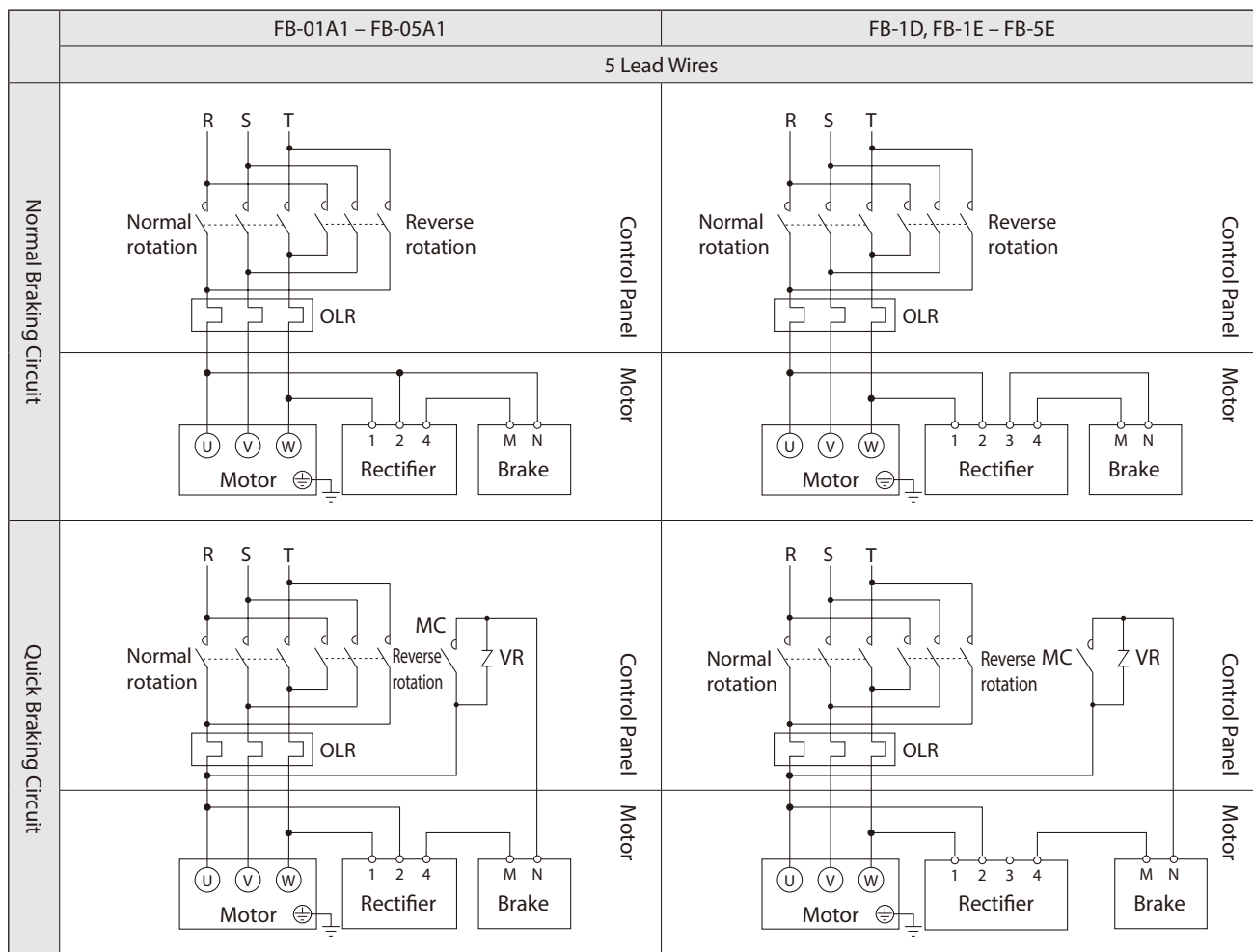
6. Wiring

■ 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 : Over current protection device or thermal relay

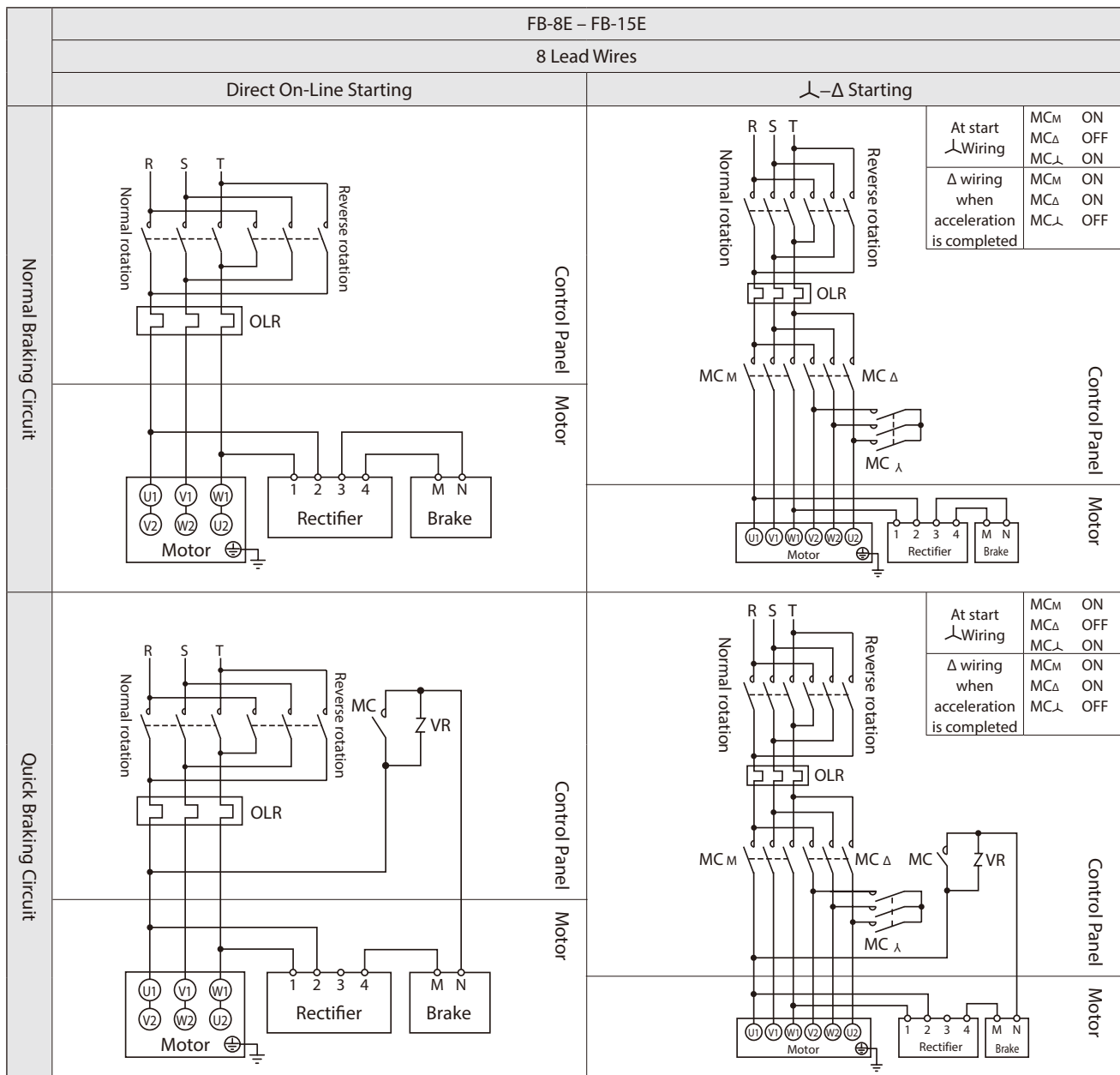
VR : Varistor (for protecting contact points, rectifier, etc.)

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 1-7 on P7.
- The interval time between the current stop and brake action is different between normal and quick braking circuits. Table 7-2 on P40 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 P38.
- For plugging operations using a quick braking circuit, interlock brake circuit's electromagnetic contactor with the motor's electromagnetic contactor.

■ With Brake 3-Phase Motor Plugging Operation

Premium-Efficiency, 3-Phase Motor



Electromagnetic contactor for normal and reverse rotation

MC : Electromagnetic contactor

OLR : Over current protection device or thermal relay

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

— Customer needs to prepare.

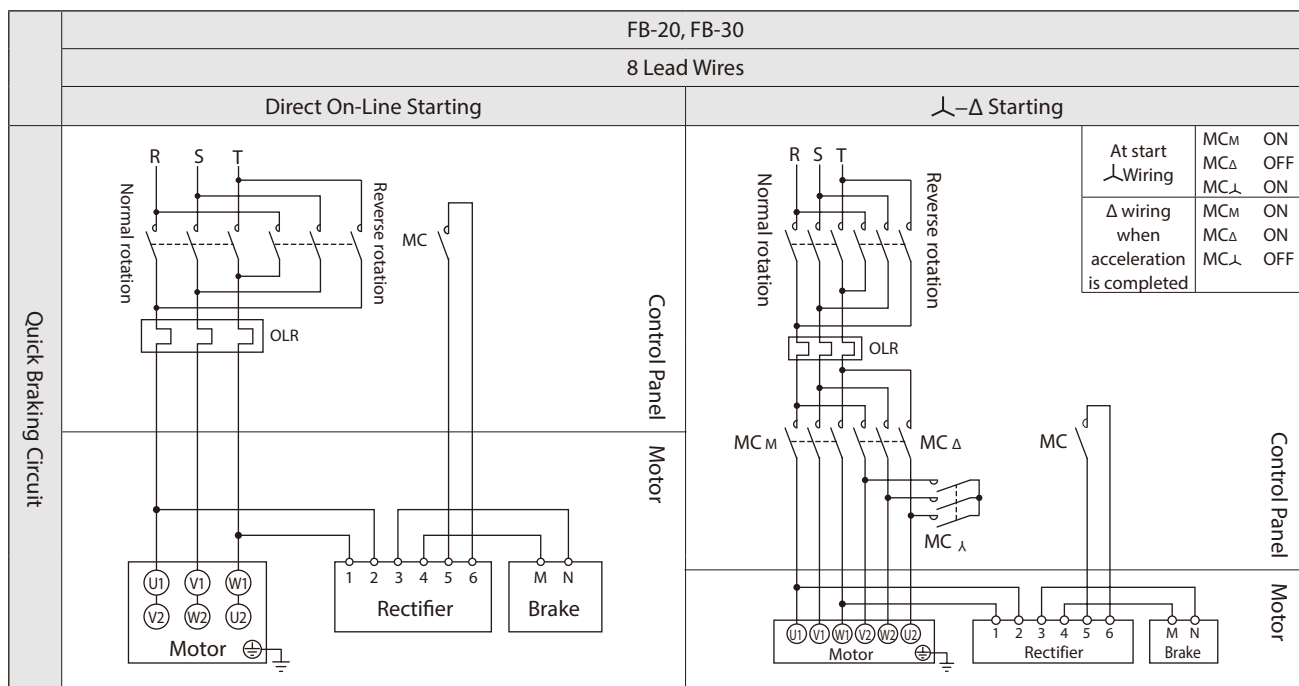
- This diagram shows cases for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see Table 1-7 on P7.
- The interval time between the current stop and brake action is different between normal and quick braking circuits. Table 7-2 on P40 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 P38.
- For plugging operations using a quick braking circuit, interlock brake circuit's electromagnetic contactor with the motor's electromagnetic contactor.



6. Wiring

■ With Brake 3-Phase Motor Plugging Operation

Premium-Efficiency, 3-Phase Motor



Electromagnetic contactor for normal and reverse rotation

MC : Electromagnetic contactor

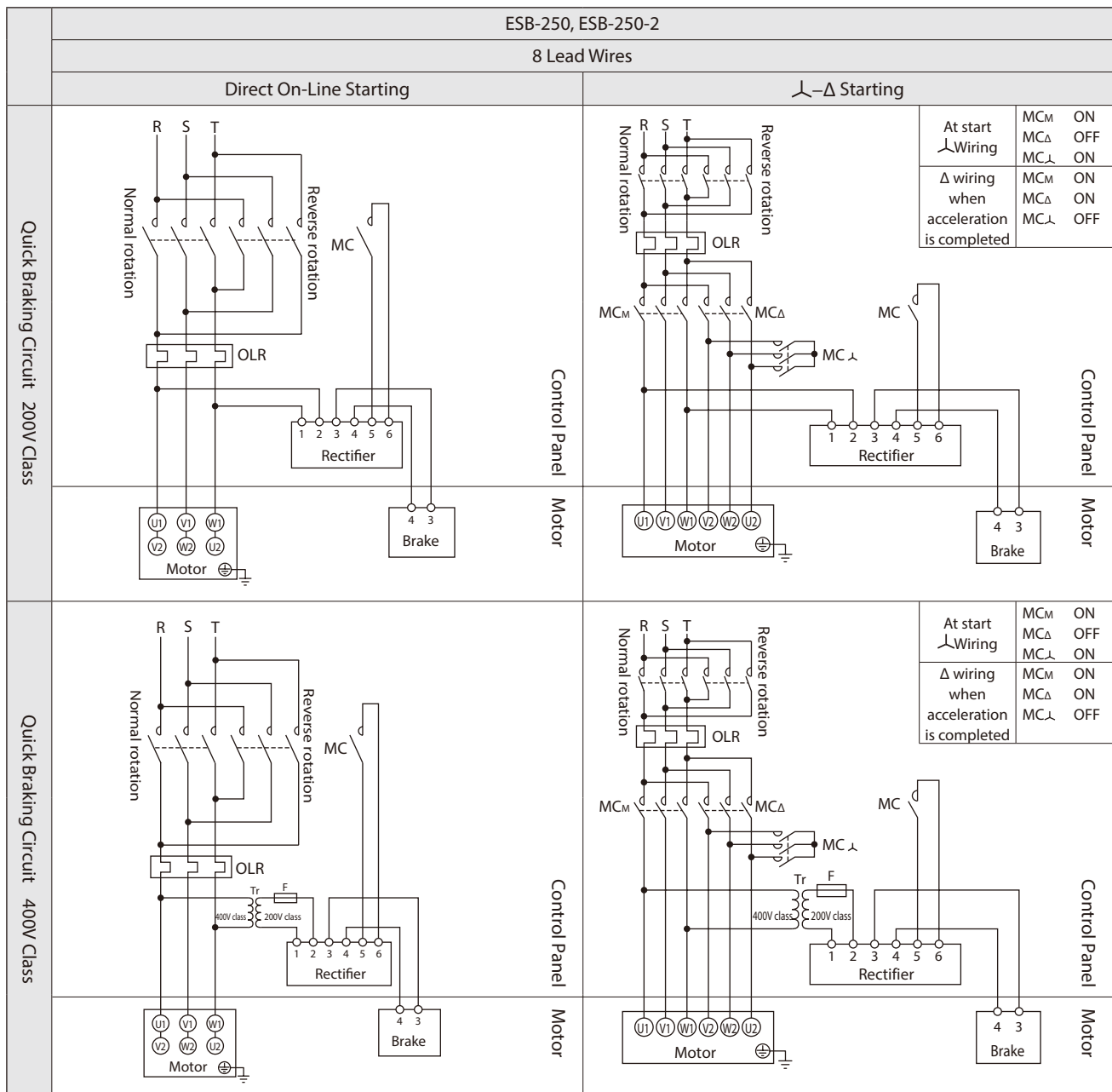
OLR : Over current protection device or thermal relay

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 1-7 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P38.
- 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 : Over current protection device or 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 1-7 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P38.
- 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.
- For plugging operations, interlock brake circuit's electromagnetic contractor with the motor's electromagnetic contractor.



6. Wiring

■ With Brake Inverter Drive

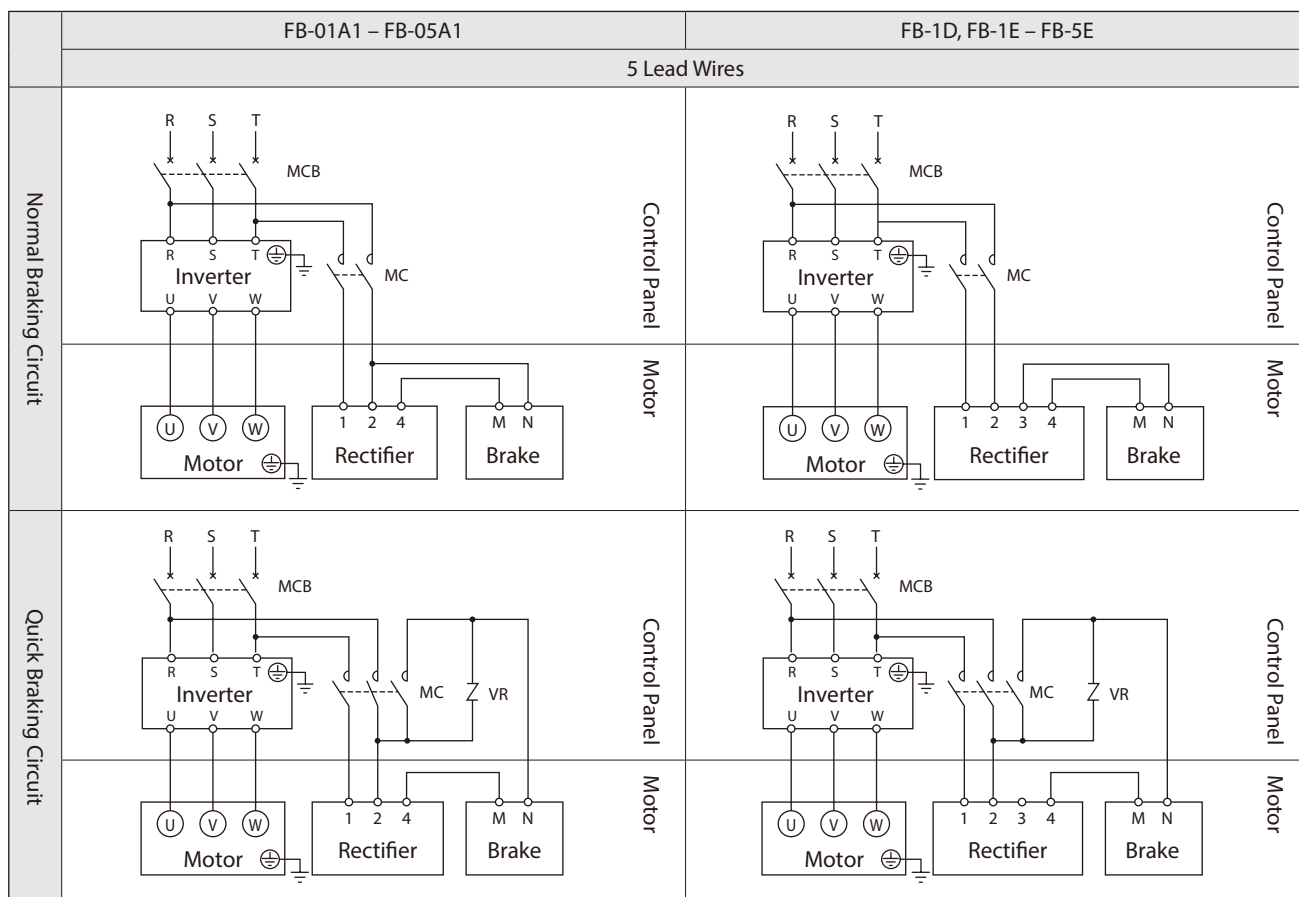
3-Phase Motor

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 : Miniature circuit breaker

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

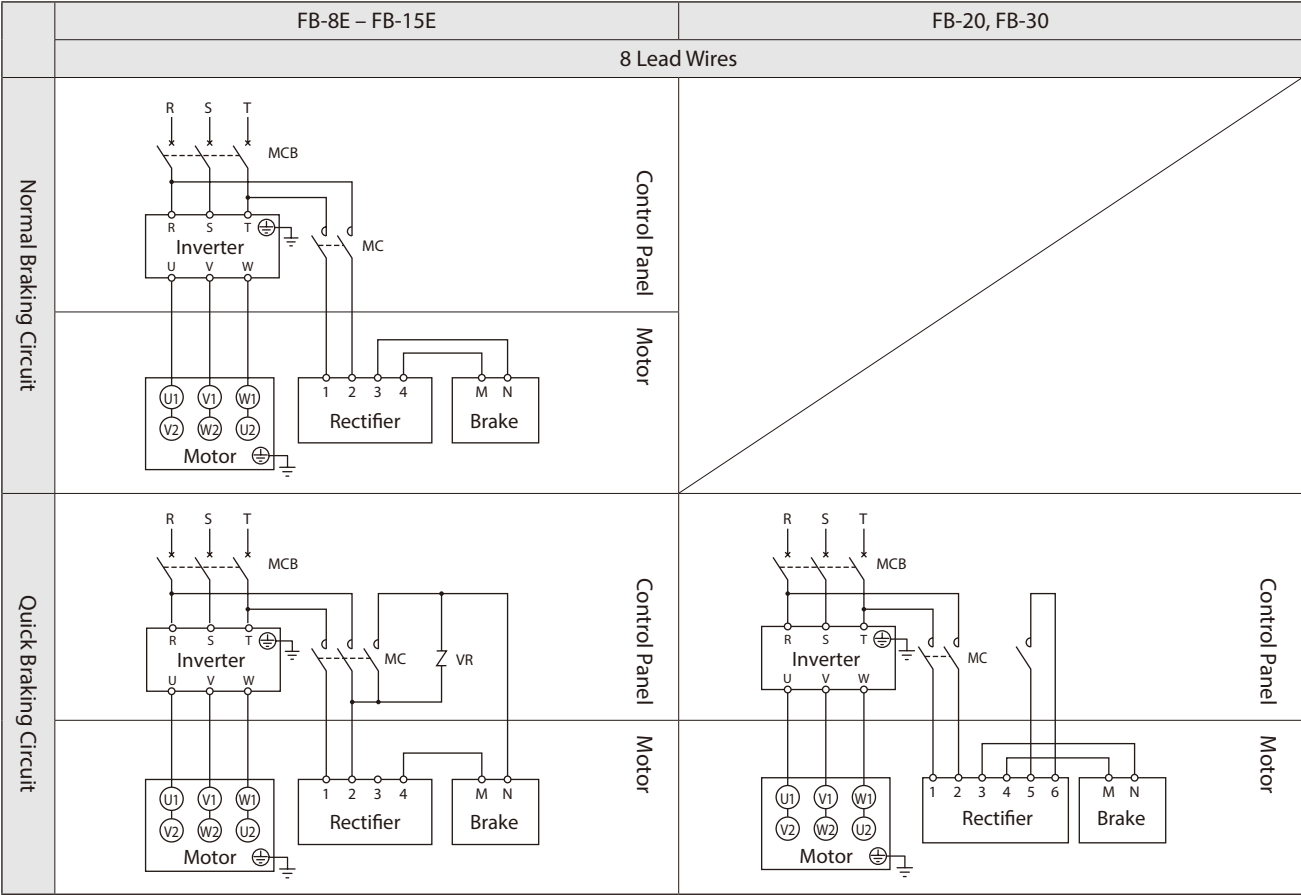
Customer needs to prepare.

- 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 1-7 on P7.
- The motor must be insulated to inverter-drive a 400V class 3-phase motor/high-efficiency, 3-phase motor.
- The interval time between the current stop and brake action is different between normal and quick braking circuits. Table 7-2 on P40 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 P38.

- 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 : Miniature circuit breaker
 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 1-7 on P7.
- The interval time between the current stop and brake action is different between normal and quick braking circuits. Table 7-2 on P40 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 P38.

- 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.

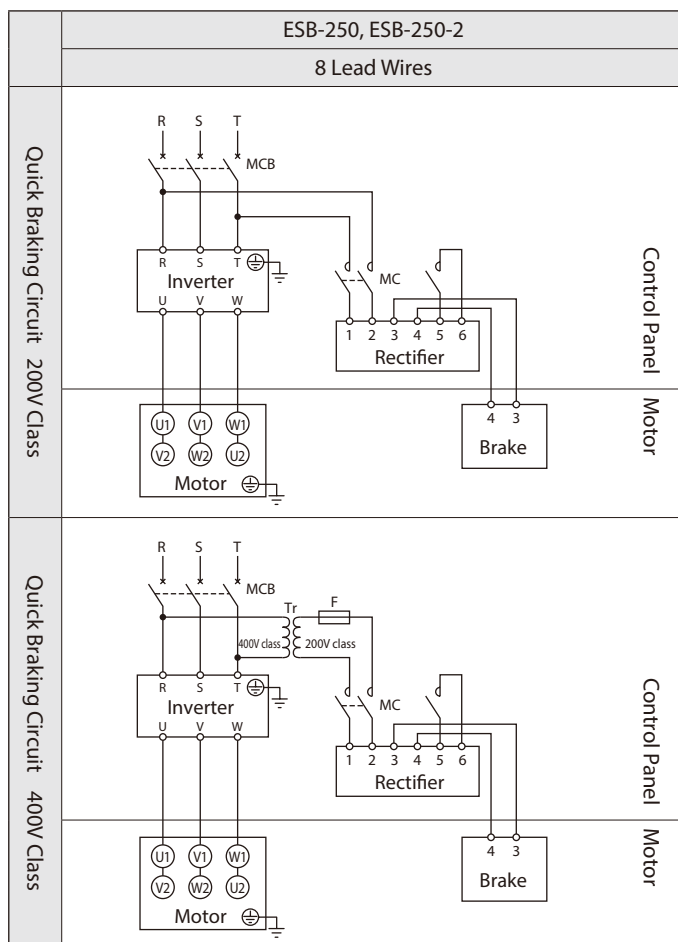


6. Wiring

■ With Brake Inverter Drive

Premium-Efficiency, 3-Phase Motor

Premium-Efficiency, 3-Phase Motor for Inverter



MC : Electromagnetic contactor

MCB : Miniature circuit breaker

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

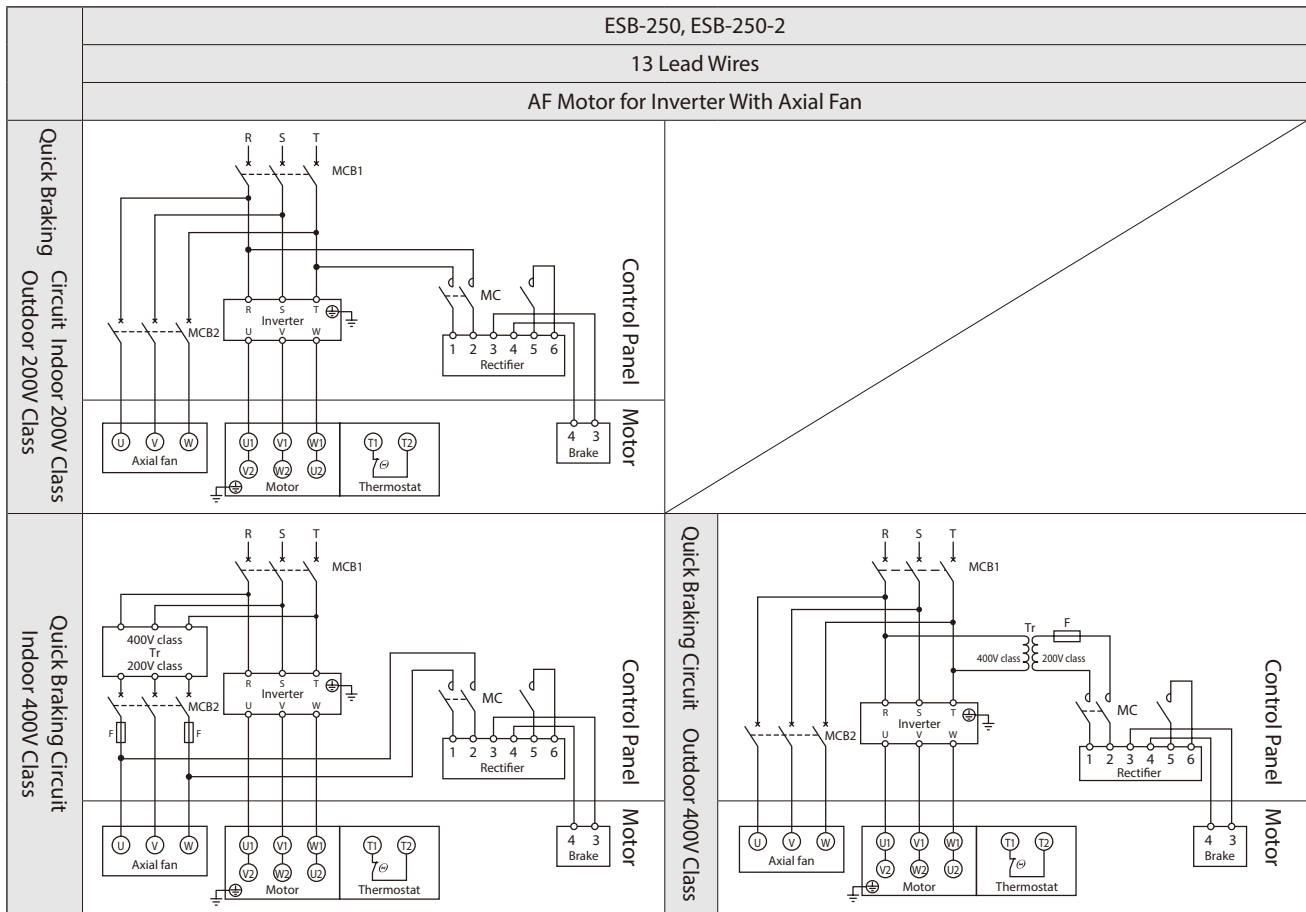
F : Fuse 3–5A

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 1-7 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P38.
- 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.

AF Motor for Inverter



MC : Electromagnetic contactor

MCB : Miniature circuit breaker

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 1-7 on P7.
- Use with a quick braking circuit. For information on electromagnetic contactors for quick braking circuits, see Table 6-4 on P38.
- 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: Normally closed (break contact)

Maximum current: DC 24V, 18A; AC 230V, 13A



6. Wiring

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)

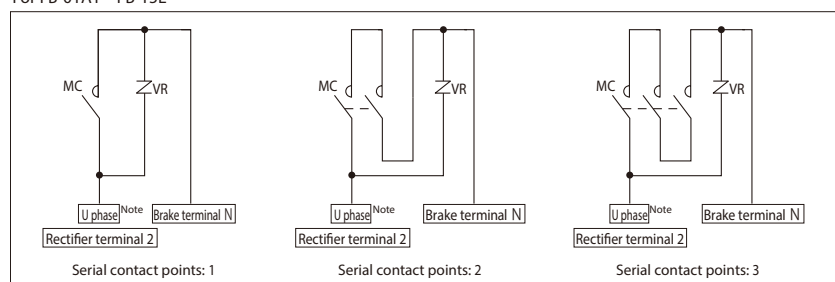
Table 6-4 Nomenclature for Parts Recommended When Using a Quick Braking Circuit (When Using an Alternating Current Electromagnetic Contactor).

AC Voltage	Brake Type	Recommended Contactor Nomenclature				Recommended Contactor Contact Point Capacity (DC-13 class)	Recommended Varistor (For Protecting Contactor Contact Points)										
		Made by Fuji Electric FA Components & Systems Co., Ltd.		Made by Mitsubishi Electric Corporation			Varistor Nomenclature		Maximum Allowable Circuit Voltage	Varistor Voltage	Power Rating						
200V 220V	FB-01A1	SC-05	Serial contact points: 1 (0.7A)	S-T12	Serial contact points: 1 (1.2A)	DC 110V	Minimum 0.4A	TND07V-471KB00AAA0	AC300V	470V (423-517V)	0.25W						
	FB-02A1						Minimum 0.5A				0.4W						
	FB-05A1						Minimum 0.7A				TND10V-471KB00AAA0	0.6W					
	FB-1D						Minimum 1.5A				1.0W						
	FB-1E	SC-05	Serial contact points: 2 (3.0A)	S-T12	Serial contact points: 2 (3.0A)		Minimum 3.0A	TND14V-471KB00AAA0			1.0W						
	FB-1HE						Minimum 3.0A										
	FB-2E						Minimum 3.0A										
	FB-3E						Minimum 3.0A										
	FB-4E	SC-05	Serial contact points: 3 (4.0A)	S-T20	Serial contact points: 3 (5.0A)		Minimum 5.5A	TND20V-471KB00AAA0			1.0W						
	FB-5E						Minimum 5.5A										
	FB-8E						Minimum 5.5A										
	FB-10E						Minimum 5.5A										
	FB-15E	SC-5-1	Serial contact points: 3 (10A)	S-T21	Serial contact points: 3 (10A)		Minimum 4.5A	TND20V-471KB00AAA0			1.0W						
	FB-20						Minimum 4.5A										
FB-30	Minimum 4.5A																
ESB-250	Minimum 4.5A																
ESB-250-2	Minimum 4.5A																
400V 440V	FB-01A1	SC-05	Serial contact points: 1 (0.25A)	S-T12	Serial contact points: 2 (0.5A)	DC 220V	Minimum 0.2A	TND10V-821KB00AAA0	AC510V	820V (738-902V)	0.4W						
	FB-02A1	SC-05	Serial contact points: 2 (0.4A)				Minimum 0.3A				0.6W						
	FB-05A1	SC-05	Serial contact points: 3 (2.0A)				Minimum 0.5A				TND14V-821KB00AAA0			1.0W			
	FB-1D						Minimum 1.0A							1.0W			
	FB-1E		S-T12	Serial contact points: 3 (2.0A)			Minimum 1.0A	TND20V-821KB00AAA0			1.0W						
	FB-1HE						Minimum 1.5A				1.0W						
	FB-2E						Minimum 3.0A				1.0W						
	FB-3E						Minimum 3.0A				1.0W						
	FB-4E	-	-	S-T20	Serial contact points: 3 (2.0A)		Minimum 1.5A				1.0W						
	FB-5E						Minimum 3.0A				1.0W						
	FB-8E						Minimum 3.0A				1.0W						
	FB-10E						Minimum 3.0A				1.0W						
	FB-15E			S-T21	Serial contact points: 3 (4.0A)		Minimum 2.5A				1.0W						
	FB-20						Minimum 2.5A				1.0W						
FB-30	Minimum 2.5A	1.0W															

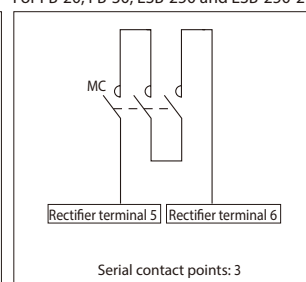
- This recommended contactor nomenclature is for Fuji Electric FA Components & Systems Co., Ltd. and Mitsubishi Electric Corporation contactors. Products from other manufacturers are also allowable if they have equivalent capabilities.
- Recommended contactor contact point capacity indicates the D-13 class rated used current in 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) the rating of main contact point and auxiliary contact point can differ, so check by catalog and other materials.
- Of the recommended contactors, the Mitsubishi Electric Corporation S-T12 and S-T20 have one auxiliary contact point. Please be careful in the case where the brake requires 2 and more contract points and is driven by inverter. (Other connectors in Table 6-4 have two or more auxiliary contact points.)
- This recommended varistor nomenclature is for Nippon Chemi-Con Corporation varistors. Products from other manufacturers are also allowable if they have equivalent capabilities.
- In the FB-20, 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).

⚠ DANGER

- Do not approach or touch rotating parts (output shaft, etc.) during operation; otherwise loose clothing may become caught in these rotating parts and cause serious injury or death.
- When the power supply is interrupted, be sure to turn off the power switch; 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 become 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

- **Oil-lubricated models and parts** are shipped without oil. Before operating, make certain to feed the recommended lubricating oil. (See P43–49)
- Some models require replenishment of oil at two locations (output side: bevel gear unit or helical gear part, input side: cyclo unit or planetary gear part).
- Grease is encapsulated in the grease lubrication part at the time of shipment.

After installation and wiring are completed, check the following 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?
 - For oil-lubricated models and parts lubricated with oil, is the oil level at the center of the oil gauge (Figure 7-1) when operation is stopped?
- Is the oil level in the center of red upper line and red or yellow underline (figure 7-1) when it stops? (There is no problem when the oil level between red upper line and red or yellow underline.)

Oil gauge center

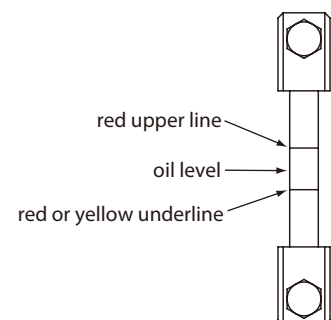
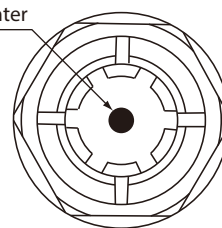


Figure 7-1 Oil Gauge

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

- Note: 1. Even if the oil level is adjusted to the center of the oil gauge at the time of lubrication, the oil level may drop when operation is stopped because the air inside of the reducer is released during operation. Therefore, be sure to check the oil level after test operation. When the oil level is low, replenish the lubricating oil.
2. Check the oil level some time after operation is stopped. The oil level cannot be checked during operation and immediately after operation is stopped.

7-2 Items to Check During Operation

Table 7-1 Items to Check During Operation

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

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

7-3 Brake Torque and Activation Delay Time

The table below shows 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 Torque (Dynamic Friction Torque) (N·m)	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		Normal Braking Circuit (Simultaneous Turn-Off Circuit)	Normal Braking Circuit for Inverter (Separate Turn-Off Circuit)	Quick Braking Circuit
	4P	4P	4P	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			
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	-	18.5	-	18.5	-	190	-	-	0.03–0.11
	-	22	-	22	-	220			
	-	30	-	30	-	200			
ESB-250 (Horizontal)	-	-	30	-	-	Horizontal 212 Vertical 195	-	-	0.065
	-	37	37	37	-	Horizontal 266 Vertical 244			
ESB-250-2 (Vertical)	-	45	-	45	-	Horizontal 320 Vertical 292			
	-								

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

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

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

⚠ DANGER

- Do not handle the unit when cables are energized. Be sure to turn off the power when working on the unit; otherwise, electric shock may result.
- Do not approach or touch any rotating parts (output shaft, etc.) during maintenance or inspection while 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 became 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 lubricant that we recommend.
- 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.
- 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 **explosion proof motors**, confirm that there is no gas or explosive vapor in the vicinity in order to prevent possible 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? Is there a sudden rise? Temperature rises during operation will differ according to model and type. However, there is no particular problem if fluctuation is slight even if the difference between the gear unit surface temperature and the ambient temperature is approximately 60°C. When the surface temperature turns over 90°C, oil deteriorates earlier. So, change oil earlier.
Oil level (Oil-lubricated models and parts)	Is the oil level at the center of the oil gauge when operation is stopped?
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?
Air breather cap	Is the air breather cap 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" (P80, 81). 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.

(1) Standard lubrication method (When driven at standard input speed)

- Check Table 8-2 to Table 8-4 for the lubrication method for the gear unit of the model used by the customer.
- Table 8-5 lists the maintenance method by lubrication method.
- For the Bevel BUDDYBOX with Torque Limiter, specifications may differ from those shown in Table 8-2 and Table 8-3. Check the manufacturing specifications.

Table 8-2 Bevel BUDDYBOX 4 Series

Frame Size	Bevel Gear 1 Stage + Cyclo or Planetary Gear 1 Stage Reduction		4A10□	4A11□	4A12□ 4B12□	4A14□ 4B14□ 4C14□	4B16□ 4C16□ 4D16□	4C17□ 4D17□ 4E17□	4D18□ 4E18□ 4F18□	4E19□ 4F19□
	Bevel Gear 1 Stage + Cyclo 2 Stage Reduction		4A10DA	—	4A12DA 4A12DB 4B12DA 4B12DB	4B14DA 4B14DB 4C14DA 4C14DB 4C14DC	4C16DA 4C16DB 4D16DA 4D16DB	4D17DA 4D17DB 4D17DC 4E17DA 4E17DB 4E17DC	4D18DA 4D18DB 4E18DA 4E18DB 4F18DA 4F18DB	4E19DA 4E19DB 4F19DA 4F19DB
Output Side	Bevel Gear Unit		Oil bath lubrication							
Input Side	Cyclo Unit or Planetary Gear Unit	Mounting Location ■1, ■3, ■5, ■6	Oil bath lubrication							
		Mounting Location ■2 Cyclo or Planetary Gear 1 Stage Reduction	Oil bath lubrication							
	Cyclo Unit	Mounting Location ■2* Cyclo 2 Stage Reduction	Long-life grease lubrication				Grease lubrication			
		Mounting Location ■4	Long-life grease lubrication				Grease lubrication			

*The lubrication method differs depending on the manufacture date and specification. You can identify them from the appearance. See P48.

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

2. The symbol ■ in mounting location can be "Y", "F", "G", "K", "W" or "V".

3. If input speed is not standard, consult with us.

4. For mounting positions ■5 and ■6, only the bearing on the upper side of the output shaft uses the grease lubrication method.

Table 8-3 Bevel BUDDYBOX 5 Series

Frame Size	Bevel Gear 1 Stage + Cyclo or Planetary Gear 1 Stage Reduction		5Z10□	5Z11□ 5A11□	5Z12□ 5A12□ 5B12□	5A14□ 5B14□ 5C14□	5B16□ 5C16□	5C17□
	Bevel Gear 1 Stage + Cyclo 2 Stage Reduction		5Z10DA	—	5Z12DA 5Z12DB 5A12DA 5A12DB 5B12DA 5B12DB	5B14DA 5B14DB 5C14DA 5C14DB 5C14DC	5C16DA 5C16DB	—
Output Side	Bevel Gear Unit		Oil bath lubrication					
Input Side	Cyclo Unit or Planetary Gear Unit	Mounting Location ■1, ■2, ■3, ■5, ■6	Oil bath lubrication					
	Cyclo Unit	Mounting Location ■4	Long-life grease lubrication			Grease lubrication		

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

2. The symbol ■ in mounting location can be "Y" or "G".

3. If input speed is not standard, consult with us.

4. For mounting positions ■5 and ■6, only the bearing on the upper side of the output shaft uses the grease lubrication method.

Table 8-4 Helical BUDDYBOX

Frame Size	Helical Gear 1 Stage + Cyclo or Planetary Gear 1 Stage Reduction		Z609□	A610□	B612□	—	—	—	C614□	D616□	E617□
	Helical Gear 1 Stage + Cyclo 2 Stage Reduction		Z609DA	A610DA	B612DA B612DB	C614DA C614DB	D616DA D616DB D616DC	E617DA E617DB E617DC	—	—	—
Output Side	Helical Gear Unit		Oil bath lubrication								
Input Side	Cyclo Unit or Planetary Gear Unit	Mounting Location ■1, ■2, ■3, ■4	Long-life grease lubrication			Grease lubrication			Oil bath lubrication		
	Cyclo Unit	Mounting Location ■5, ■6	Long-life grease lubrication			Grease lubrication			Grease lubrication		

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

2. The symbol ■ in mounting location can be "Y" or "F".

3. If input speed is not standard, consult with us.

Table 8-5 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 Lubrication and Discharge Procedures
Oil lubrication	Oil Bath	Self-lubricating	Required	8-3 (1) P43	8-3 (2) P43	8-3 (3) P44-46	8-3 (4) P47-49
Grease lubrication	Long-life grease Grease	Self-lubricating	Not required	8-4 (1) P50	8-4 (2) P50	8-4 (3) P51	8-4 (4) P52

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

(1) Oil Change Interval

Table 8-6 Lubricating Oil Inspection and Change Intervals

Lubrication	Change Interval		Operating Condition
	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 location where temperature are not maintained between 0 and 35°C or in the case the surface temperature of gear part is more than 90°C, etc.,

- 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 8-7.

Table 8-7 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	Shell Omala S2 GX 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	Shell Omala S2 GX 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	Shell Omala S2 GX 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 8-8. Use within this required viscosity range.

Table 8-8 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 BUDDYBOX 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, or lubricating oil might need to be preheated, or cooled. Please consult with us.

(3) Oil Fill Quantity

- Table 8-9 to Table 8-11 provide 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 is at the center of the oil gauge, because the oil quantity may be more or less than requirement even if the oil is replenished according to Table 8-9 to Table 8-11.
- For the Bevel BUDDYBOX with Torque Limiter, refer to P92.

■ Bevel BUDDYBOX 4 Series

Table 8-9 Approximate Oil Fill Quantity (L)

Bevel Gear 1 Stage + Cyclo or Planetary Gear 1 Stage Reduction

Frame Size	Mounting Location						
	Y1, F1, G1 K1, V1	Y2, F2, G2 K2, V2, W2	Y3, F3, G3 K3, V3, W3	Y4, F4, G4, K4, W4		Y5, F5, G5 K5, V5	Y6, F6, G6 K6, V6
				Output Side	Input Side		
4A10 <input type="checkbox"/>	1.6	3.3	1.6	1.1	Long-life grease lubrication	1.4	1.8
4A11 <input type="checkbox"/>	1.7	3.4	1.7			1.4	1.9
4A12 <input type="checkbox"/>	1.7	3.5	1.7			1.5	1.9
4A14 <input type="checkbox"/>	1.9	4.1	1.9		Grease lubrication	1.7	2.1
4B12 <input type="checkbox"/>	3.3	6.6	3.3	1.7	Long-life grease lubrication	3.3	3.2
4B14 <input type="checkbox"/>	3.5	7.3	3.5		Grease lubrication	3.5	3.4
4B16 <input type="checkbox"/>	3.9	7.8	3.9			4.0	3.9
4C14 <input type="checkbox"/>	5.5	11.4	5.5	2.7		5.3	5.9
4C16 <input type="checkbox"/>	6.0	12.0	6.0			5.7	6.3
4C17 <input type="checkbox"/>	6.3	12.8	6.3			6.1	6.7
4D16 <input type="checkbox"/>	10.1	20.1	10.1	4.6		9.7	10.4
4D17 <input type="checkbox"/>	10.4	20.8	10.4			10.0	10.8
4D18 <input type="checkbox"/>	10.7	21.3	10.7			10.3	11.1
4E17 <input type="checkbox"/>	14.6	29.1	14.6	6.3		13.1	16.1
4E18 <input type="checkbox"/>	14.7	29.4	14.7			13.2	16.2
4E19 <input type="checkbox"/>	15.7	30.7	15.7			14.2	17.2
4F18 <input type="checkbox"/>	20.0	39.7	20.0	7.3		18.5	21.4
4F19 <input type="checkbox"/>	20.8	40.9	20.8			19.3	22.2

Bevel Gear 1 Stage + Cyclo 2 Stage Reduction

Frame Size	Mounting Location									
	Y1, F1, G1 K1, V1	Y2, F2, G2, K2, V2, W2*				Y3, F3, G3 K3, V3, W3	Y4, F4, G4, K4, W4		Y5, F5, G5 K5, V5	Y6, F6, G6 K6, V6
		Input side (Cyclo part) Grease lubricated type		Oil bath lubricated models	Output side		Input side			
		Output side	Input side							
4A10DA	1.7	1.0	Long-life grease lubrication	3.2	1.7	1.1	Long-life grease lubrication	1.4	1.9	
4A12DA	1.7			3.4	1.7			1.5	2.0	
4A12DB	1.8			3.4	1.8			1.5	2.0	
4B12DA	3.3	2.0	Long-life grease lubrication	6.5	3.3	1.7	Long-life grease lubrication	3.4	3.3	
4B12DB	3.4			6.6	3.4			3.4	3.3	
4B14DA	3.5			7.0	3.5			3.6	3.5	
4B14DB	3.6	3.5	Long-life grease lubrication	7.0	3.6	2.7	Long-life grease lubrication	3.6	3.5	
4C14DA	5.6			11.2	5.6			5.3	5.9	
4C14DB	5.6			11.2	5.6			5.4	5.9	
4C14DC	5.6	5.0	Grease lubrication	11.3	5.6	4.6	Grease lubrication	5.4	6.0	
4C16DA	6.0			11.8	6.0			5.8	6.4	
4C16DB	6.1			11.9	6.1			5.9	6.4	
4D16DA	10.1	7.3	Grease lubrication	20.0	10.1	6.3	Grease lubrication	9.8	10.5	
4D16DB	10.1			20.0	10.1			9.8	10.5	
4D17DA	10.2			20.0	10.2			9.8	10.6	
4D17DB	10.5	12.0	Grease lubrication	20.6	10.5	7.3	Grease lubrication	10.2	10.9	
4D17DC	10.7			20.7	10.7			10.3	11.0	
4D18DA	10.8			21.1	10.8			10.5	11.2	
4D18DB	11.7	7.3	Grease lubrication	21.4	11.7	6.3	Grease lubrication	11.4	12.1	
4E17DA	14.6			28.8	14.6			13.1	16.1	
4E17DB	14.7			28.9	14.7			13.2	16.2	
4E17DC	14.8	12.0	Grease lubrication	29.0	14.8	7.3	Grease lubrication	13.3	16.3	
4E18DA	14.8			29.3	14.8			13.3	16.3	
4E18DB	15.7			29.6	15.7			14.2	17.2	
4E19DA	17.5	7.3	Grease lubrication	31.0	17.5	6.3	Grease lubrication	16.0	19.0	
4E19DB	17.7			31.0	17.7			16.2	19.2	
4F18DA	20.1			39.6	20.1			18.6	21.5	
4F18DB	21.0	12.0	Grease lubrication	39.9	21.0	7.3	Grease lubrication	19.5	22.4	
4F19DA	22.6			41.2	22.6			21.1	24.0	
4F19DB	22.8			41.2	22.8			21.3	24.2	

*The lubrication method differs depending on the manufacture date and specification. You can identify them from the appearance. See P48.
 Note: 1. The symbol □ in frame size can be "0" or "5".

2. Output side: Bevel gear unit, Input side: Cyclo unit or Planetary gear unit













3. Depending on the viscosity or temperature of the lubricating oil, it takes time to replenish oil.

4. For grease replenishment amount for the grease lubrication part, refer to P51.

■ Bevel BUDDYBOX 5 Series

Table 8-10 Approximate Oil Fill Quantity (L)

Bevel Gear 1 Stage + Cyclo or Planetary Gear 1 Stage Reduction

Frame Size	Mounting Location						
	Y1, G1	Y2, G2	Y3, G3	Y4, G4		Y5, G5	Y6, G6
				Output side	Input side		
5Z10 	0.8	1.6	0.8	0.7	Long-life grease lubrication	0.7	0.9
5Z11 	0.9	1.7	0.9			0.7	1.0
5Z12 	0.9	1.8	0.9			0.8	1.0
5A11 	1.6	3.1	1.6	0.8	Grease lubrication	1.4	1.9
5A12 	1.7	3.2	1.7			1.4	1.9
5A14 	1.9	3.6	1.9			1.7	2.2
5B12 	2.7	5.2	2.7	1.6	Long-life grease lubrication	2.3	3.1
5B14 	2.9	5.5	2.9		Grease lubrication	2.5	3.3
5B16 	3.3	6.2	3.3			3.0	3.7
5C14 	5.4	10.7	5.4	3.5		5.1	5.7
5C16 	6.1	11.6	6.1		5.8	6.4	
5C17 	6.5	12.1	6.5		6.2	6.8	

Bevel Gear 1 Stage + Cyclo 2 Stage Reduction

Frame Size	Mounting Location						
	Y1, G1	Y2, G2	Y3, G3	Y4, G4		Y5, G5	Y6, G6
				Output side	Input side		
5Z10DA	0.9	1.6	0.9	0.7	Long-life grease lubrication	0.9	1.0
5Z12DA	0.9	1.8	0.9			1.1	1.1
5Z12DB	1.0	1.8	1.0			1.1	1.1
5A12DA	1.7	3.2	1.7	0.8		1.4	2.0
5A12DB	1.8	3.2	1.8			1.4	2.0
5B12DA	2.7	5.2	2.7	1.6	2.4	3.2	
5B12DB	2.8	5.3	2.8		2.4	3.2	
5B14DA	2.9	5.5	2.9		Grease lubrication	2.6	3.4
5B14DB	3.0	5.5	3.0	2.6		3.4	
5C14DA	5.5	10.8	5.5	3.5		5.1	5.7
5C14DB	5.5	10.8	5.5			5.2	5.7
5C14DC	5.5	10.9	5.5			5.2	5.8
5C16DA	6.1	11.6	6.1		5.9	6.5	
5C16DB	6.2	11.7	6.2		6.0	6.5	

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

2. Output side: Bevel gear unit, Input side: Cyclo unit or Planetary gear unit
3. Depending on the viscosity or temperature of the lubricating oil, it takes time to replenish oil.
4. For grease replenishment amount for the grease lubrication part, refer to P51.

■ Helical BUDDYBOX

Table 8-11 Approximate Oil Fill Quantity (L)

Helical Gear 1 Stage + Cyclo or Planetary Gear 1 Stage Reduction

Frame Size	Mounting Location											
	Y1, F1		Y2, F2		Y3, F3		Y4, F4		Y5, F5		Y6, F6	
	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side
Z609 □	0.6	Long-life grease lubrication	0.6	Long-life grease lubrication	0.5	Long-life grease lubrication	0.6	Long-life grease lubrication	1.1	Long-life grease lubrication	1.0	Long-life grease lubrication
A610 □	0.8		0.9		0.7		0.9		1.5		1.4	
B612 □	1.0		1.5		1.0		1.5		2.0		1.8	
C614 □	1.7	0.4	2.1	0.4	1.3	0.4	2.1	0.4	4.7	Grease lubrication	3.5	Grease lubrication
D616 □	2.7	0.7	3.5	0.7	2.0	0.7	3.5	0.7	7.0		5.5	
E617 □	3.5	0.9	4.2	0.9	2.5	0.9	4.2	0.9	9.0		7.0	

Helical Gear 1 Stage + Cyclo 2 Stage Reduction

Frame Size	Mounting Location											
	Y1, F1		Y2, F2		Y3, F3		Y4, F4		Y5, F5		Y6, F6	
	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side	Output Side	Input Side
Z609DA	0.6	Long-life grease lubrication	0.6	Long-life grease lubrication	0.5	Long-life grease lubrication	0.6	Long-life grease lubrication	1.1	Long-life grease lubrication	1.0	Long-life grease lubrication
A610DA	0.8		0.9		0.7		0.9		1.5		1.4	
B612DA	1.0		1.5		1.0		1.5		2.0		1.8	
B612DB												
C614DA	1.7	Grease lubrication	2.1	Grease lubrication	1.3	Grease lubrication	2.1	Grease lubrication	4.7	Grease lubrication	3.5	Grease lubrication
C614DB												
D616DA	2.7		3.5		2.0		3.5		7.0		5.5	
D616DB												
D616DC												
E617DA	3.5		4.2		2.5		4.2		9.0		7.0	
E617DB												
E617DC												

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

2. Output side: Helical gear unit, Input side: Cyclo unit or Planetary gear unit

3. Depending on the viscosity or temperature of the lubricating oil, it takes time to replenish oil.

4. For grease replenishment amount for the grease lubrication part, refer to P51.

(4) Oil Fill and Drain Procedures

■ Bevel BUDDYBOX 4 and 5 Series (except for Mounting Location Symbols Y2, F2, G2, K2, V2, and W2)

- Oil Fill Procedure

- [1] Remove the air breather from the oil filler port.
- [2] Pour oil into the oil filler port, keeping an eye on the oil gauge to check the oil level.
- [3] Some time after the oil is lubricated, confirm that the oil level is at the center position of the oil gauge.
- [4] Attach the air breather to the oil filler port.
- [5] When attaching the air breather, make sure that the seal washer is assembled and the air breather cap is securely closed. (The air breather cap may become loose due to vibration. Periodically check it is tightened securely.)

- Oil Drain Procedure

- [1] Before draining oil, remove drain plugs from all oil drain ports.
- [2] When attaching the drain plug, make sure that the seal washer is assembled.

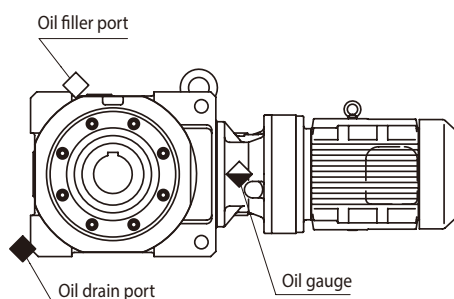


Figure 8-1 Locations of Oil Filler Port and Oil Drain Port
(Example: Bevel BUDDYBOX 4 Series LHYM-Y1)

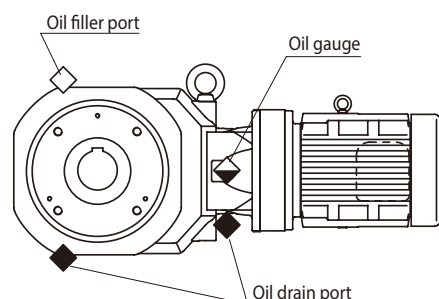


Figure 8-2 Locations of Oil Filler Port and Oil Drain Port
(Example: Bevel BUDDYBOX 5 Series LHYM-Y1)

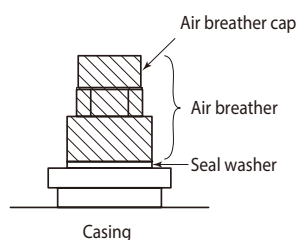


Figure 8-3 Oil Filler Port

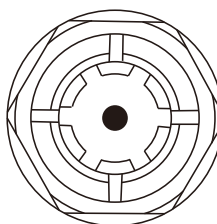


Figure 8-4 Oil Gauge

For locations of oil filler ports and oil drain ports other than the above, refer to P12 to 13.

■ Bevel BUDDYBOX 4 and 5 Series (Mounting Location Symbols Y2, F2, G2, K2, V2, and W2)

- Oil Fill Procedure

[1] Remove the oil filler port A and the oil fill cup lid. (It is not necessary to remove the air breather from the oil fill cup lid.)

[2] Pour oil into the oil filler port A, keeping an eye on the oil gauge to check the oil level.

- For Bevel BUDDYBOX 4 Series, lubrication time can be shortened by using oil filler port B together.

- First, remove the plug of oil filler port B, and pour oil into the gear case on the output side. Confirm that the output side is filled with the lubricating oil, and then attach the plug of the oil filler port B. Make sure that the seal washer is assembled to the plug.

- Next, pour oil from the oil filler port A to fill the inside the gear case on the input side with the lubricating oil.

[3] Some time after the oil is lubricated, confirm that the oil level is at the center position of the oil gauge.

[4] Attach the oil fill cup lid and the air breather to the oil filler port.

[5] When attaching the oil fill cup lid and the air breather, make sure that the seal washer is assembled and the air breather cap is securely closed. (The air breather cap may become loose due to vibration. Periodically check it is tightened securely.)

- Oil Drain Procedure

[1] Before draining oil, remove the drain plug from the oil drain port.

[2] When attaching the drain plug, make sure that the seal washer is assembled.

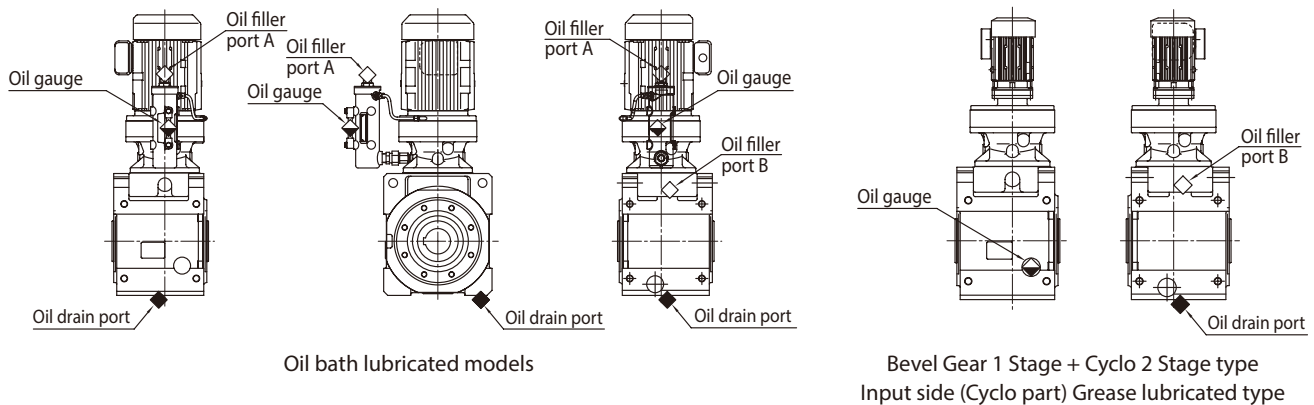


Figure 8-5 Locations of Oil Filler Port
(Example: Bevel BUDDYBOX 4 Series LHYM-Y2)

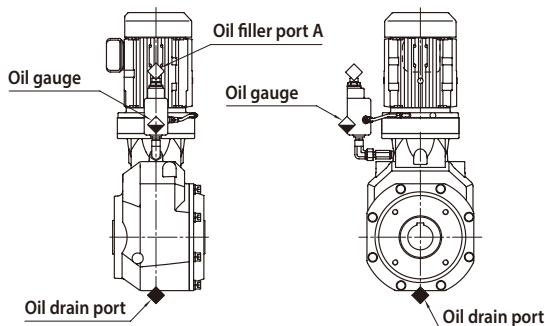


Figure 8-6 Locations of Oil Filler Port and
Oil Drain Port
(Example: Bevel BUDDYBOX
5 Series LHYM-Y2)

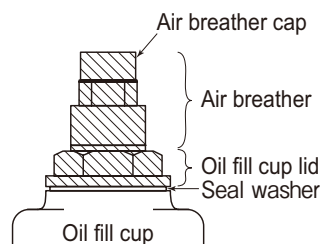


Figure 8-7 Oil Filler Port

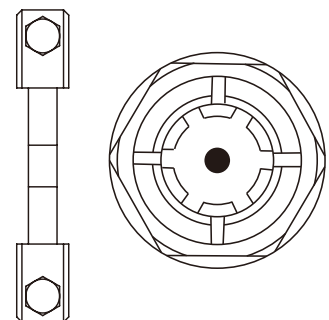


Figure 8-8 Oil Gauge

Note) In the case of Input side (Cyclo part) of Bevel Gear 1 Stage type + Cyclo 2 Stage type is lubricated by grease, there is no oil filling port A and oil fill cup, and plug of oil filling port B is changed to air breather (check from its appearance). Fill oil by following the instruction of P47.

■ Helical BUDDYBOX

- Oil Fill Procedure

- [1] Remove the air vent plug from the oil filler port. (Depending on the type, lubrication is required at two locations.)
- [2] Pour oil into the oil filler port, keeping an eye on the oil gauge to check the oil level.
- [3] Some time after the oil is lubricated, confirm that the oil level is at the center position of the oil gauge.
- [4] Attach the air vent plug to the oil filler port.

- Oil Drain Procedure

- [1] Before draining oil, remove drain plugs from all oil drain ports.
- [2] For Helical BUDDYBOX frame size Z6090 to C6145 F5 and Y5, remove the two drain plugs from the oil drain ports of the gear case on the output side.

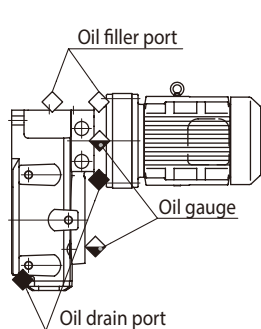


Figure 8-9 Locations of Oil Filler Port and Oil Drain Port
(Example: Helical BUDDYBOX EHYM-Y1)

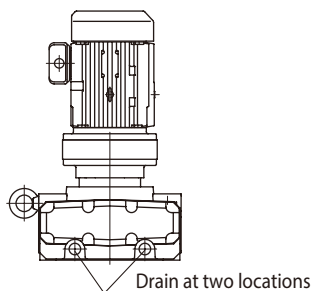


Figure 8-10 Locations of Oil Filler Port and Oil Drain Port
(Example: Helical BUDDYBOX EVYM-Z6090 to C6145-Y5)

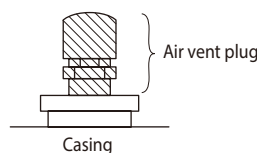


Figure 8-11 Oil Filler Port

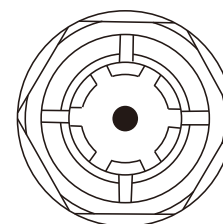


Figure 8-12 Oil Gauge

For locations of oil filler ports and oil drain ports other than the above, refer to P12 to 13.

- Only fill oil when the machine is stopped.
- Depending on the viscosity or temperature of the lubricating oil, it takes time to replenish oil. Be careful not to allow the oil to overflow or to be replenished too much.
- Supply the oil to the center of the oil gauge.
- Even if the oil level is adjusted to the center of the oil gauge at the time of oil supply, the oil level may drop when operation is stopped because the air inside of the reducer is released during operation. Therefore, be sure to check the oil level after test operation. If the oil level is low, replenish the lubricating oil.
- Check the oil level some time after operation is stopped. The oil level cannot be checked during operation and immediately after operation is stopped.
- For daily oil level management, see Table 8-1 on P41.

(5) Long Term Inactivity

Table 8-12 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.
	More than 1 month	Before resting the machine, flush once, 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 Lubrication Part (Input Side: Cyclo Part or Planetary Gear Part)

(1) Grease Replenishment Intervals

Table 8-13 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.
Grease Lubricated Machines	Replenish as shown in Table 8-14. Maintenance with disassembly after approximately 20,000 hours or 3 to 5 years will increase lifetime.

Table 8-14 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 8-15 Recommended Grease (Grease Used When Shipped)

Type	Mounting Location		Frame Size	Grease Type	Manufacturer	Description	Ambient Temperature	
Bevel BUDDYBOX 4 Series	Cyclo 2 Stage Reduction Y2, F2, G2 K2, V2, W2		4A10 □, 4A11 □, 4A12 □ 4B12 □	Long-life grease	NIPPECO	BEN10-No.2	-10~50℃	
					Mobil	UNIREX N2		
	Y4, F4, G4 K4, W4		4A14 □ 4B14 □, 4B16 □ 4C14 □, 4C16 □, 4C17 □ 4D16 □, 4D17 □, 4D18 □ 4E17 □, 4E18 □, 4E19 □ 4F18 □, 4F19 □	Grease	COSMO	COSMO GREASE DYNAMAX SH No.2		
Bevel BUDDYBOX 5 Series	Y4, G4		5Z10 □, 5Z11 □, 5Z12 □ 5A11 □, 5A12 □ 5B12 □	Long-life grease	NIPPECO	BEN10-No.2	-10~50℃	
					Mobil	UNIREX N2		
				5A14 □ 5B14 □, 5B16 □ 5C14 □, 5C16 □, 5C17 □	Grease	COSMO		COSMO GREASE DYNAMAX SH No.2
Helical BUDDYBOX	Y1, Y2 Y3, Y4 F1, F2 F3, F4	Reduction ratio 11~18	Z6090, Z6095 A6100, A6105 B6120, B6125	Long-life grease	Shell	Shell Alvania EP Grease R0	-10~40℃	
	All	Reduction ratio 21~4365	Z609 □ A610 □ B612 □	Long-life grease	NIPPECO	BEN10-No.2	-10~50℃	
					Mobil	UNIREX N2		
			C614DA, C614DB D616DA, D616DB, D616DC E617DA, E617DB, E617DC	Grease	COSMO	COSMO GREASE DYNAMAX SH No.2		
	Y5, Y6 F5, F6			C6140, C6145 D6160, D6165 E6170, E6175	Grease	COSMO		COSMO GREASE DYNAMAX SH No.2

- The symbol □ in frame size can be "0", "5", "DA", "DB" or "DC".
- Only use grease listed in Table 8-15.
- For order placement of grease, contact Sumitomo Heavy Industries Power Transmission & Controls Sales Co., Ltd. Service Center (see back cover).
- When regularly used in ambient temperatures outside the 0 to 40°C range, some specifications will differ. Please consult with us.
- Cyclo 2 Stage type of Bevel Buddy Box 4 Series with Installing position ■2 applies different lubrication method depending on the manufacture date and specification. You can identify them from the appearance. See P48.
- When using Helical BUDDYBOX with frame size E617 □ in severe conditions, please consult with us.

(3) Grease Replenishment Quantity

- The table shows the replenishment quantity when the input side (Cyclo unit or Planetary gear unit) is lubricated with grease.
Replenish by using the value in the tables as a guideline.
- The output sides (Bevel gear unit and Helical gear unit) of all models are lubricated with oil.
- For the Bevel BUDDYBOX with Torque Limiter, refer to P92.

Grease Replenishment Quantity (g) (Guidelines)

■ Bevel BUDDYBOX 4 Series

Frame Size	Mounting Location
	Y4, F4, G4, K4, W4
4A10 □	Long-life grease lubrication
4A11 □	
4A12 □	
4A14 □	
4B12 □	Long-life grease lubrication
4B14 □	150–225
4B16 □	150–225
4C14 □	250–375
4C16 □	150–225
4C17 □	250–375
4C18 □	335–500
4D16 □	150–225
4D17 □	250–375
4D18 □	335–500
4E17 □	370–550
4E18 □	335–500
4E19 □	370–550
4F18 □	500–750
4F19 □	370–550
4F19 □	500–750
Frame Size	Mounting Location
	Y2, F2, G2, K2, V2, W2 Y4, F4, G4, K4, W4
4A10DA	Long-life grease lubrication
4A12DA	
4A12DB	
4B12DA	
4B12DB	8.5–12.5
4B14DA	
4B14DB	
4C14DA	
4C14DB	20–30
4C14DC	
4C16DA	
4C16DB	
4D16DA	40–60
4D16DB	
4D17DA	
4D17DB	
4D17DC	85–125
4D18DA	
4D18DB	
4D18DC	
4E17DA	20–30
4E17DB	
4E17DC	
4E18DA	
4E18DB	150–225
4E19DA	
4E19DB	
4E19DC	
4F18DA	110–165
4F18DB	
4F19DA	
4F19DB	

■ Bevel BUDDYBOX 5 Series

Frame Size	Mounting Location
	Y4, G4
5Z10 □	Long-life grease lubrication
5Z11 □	
5Z12 □	
5A11 □	
5A12 □	150–225
5A14 □	
5B12 □	
5B14 □	
5B16 □	250–375
5C14 □	
5C16 □	
5C17 □	
5Z10DA	Long-life grease lubrication
5Z12DA	
5Z12DB	
5A12DA	
5A12DB	8.5–12.5
5B12DA	
5B12DB	
5B14DA	
5B14DB	20–30
5C14DA	
5C14DB	
5C14DC	
5C16DA	40–60
5C16DB	
5C16DC	
5C16DB	

■ Helical BUDDYBOX

Frame Size	Mounting Location	
	Y1, Y2, Y3, Y4 F1, F2, F3, F4	Y5, Y6, F5, F6
Z609 <input type="checkbox"/>	Long-life grease lubrication	Long-life grease lubrication
A610 <input type="checkbox"/>		
B612 <input type="checkbox"/>		
C614 <input type="checkbox"/>	Oil lubrication	150–225
D616 <input type="checkbox"/>		250–375
E617 <input type="checkbox"/>		335–500
Z609DA	Long-life grease lubrication	
A610DA		
B612DA		
B612DB		
C614DA	8.5–12.5	
C614DB	20–30	
D616DA	20–30	
D616DB	40–60	
D616DC	85–125	
E617DA	20–30	
E617DB	40–60	
E617DC	85–125	

- Long-life grease lubricated models do not require grease replenishment.
- The symbol □ in frame size can be “0” or “5”.
- Input side (Cyclo part) of Cyclo 2 Stage type with Installing position ■2 applies different lubrication method depending on the manufacture date and specification. You can identify them from the appearance. See P48.
- For replenishment amount for the oil lubrication part, refer to P44 to P46.

(4) Procedures for Filling and Discharging

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

- [1] Remove the grease discharge plug.
- [2] Use a grease gun to replenish the grease from the grease fitting, referring to the quantity of grease shown in Table 8-16 on P51 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.

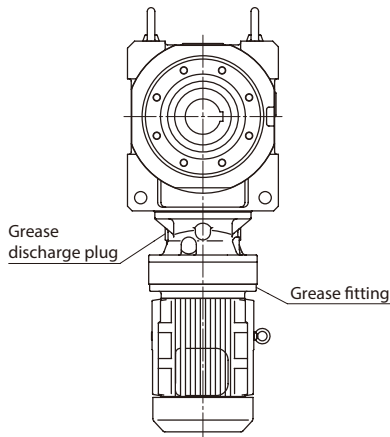


Figure 8-13 Location of Grease Fill and Discharge Port
(Example: Bevel BUDDYBOX 4 Series LHYM-Y4)

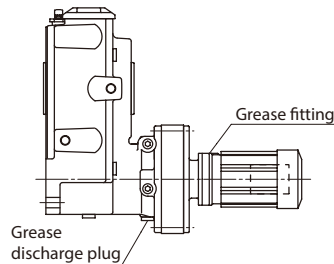


Figure 8-14 Location of Grease Fill and Discharge Port
(Example: Helical BUDDYBOX EHYM-Y3)

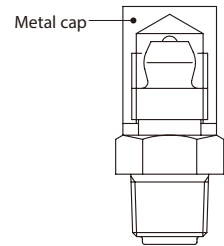


Figure 8-15 Grease Fitting with Metal Cap

- Replenish 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 it when replenishing.
- Replenish grease slowly.
- Replenishing more than the quantity shown in Table 8-16 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, if there are exposed surfaces of steel. Please consult with the nearest maintenance shop for the replacement of oil seal or V-ring.
- If the unit stops and starts frequently, 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.



8-6 Motor Bearing Maintenance

- Standard motors manufactured by Sumitomo use sealed bearings without grease filling and discharging structure.
- When using another manufacturer's motor (There are some models made by other manufacturers.), follow the operation manual for that motor.
- Although it will depend on operation conditions, maintenance with disassembly after approximately 20,000 hours or 3 to 5 years will increase lifetime.
- Contact the nearest authorized maintenance shop regarding maintenance with disassembly.

8-7 Brake Maintenance and Inspection

DANGER

- Do not handle the unit when cables are 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 operating times exceed 2 million (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 value, 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	P54	P65
FB-1D	P55	P66
FB-1E	P56	P67
FB-1HE, FB-2E	P57	P68
FB-3E, FB-4E	P58	P69
FB-5E, FB-8E	P59	P70
FB-10E, FB-15E	P60	P71
FB-20	P61	P72
FB-30	P62	P73
ESB-250, ESB-250-2	P63	P74

Please refer to P76 for the way to remove and attach one-touch release lever.



8. Daily Inspection and Maintenance

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

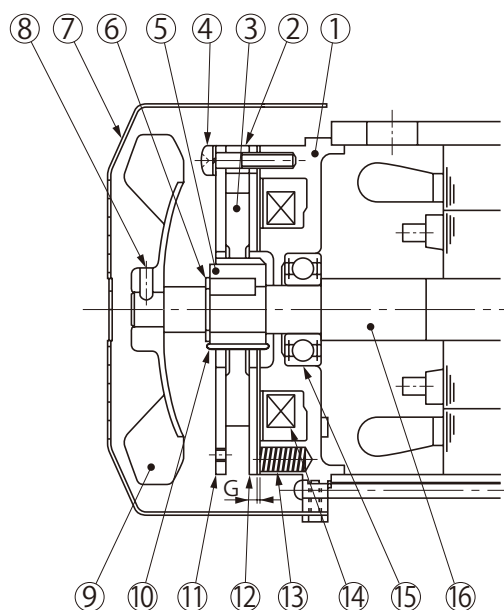


Figure 8-16

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] and [9].

- Gap Inspection

- (1) Remove the cover [7].
- (2) Insert a gap gauge between the stationary core [1] and the armature plate [12], measuring 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 0.3mm.)
- (4) Turn the power on and off to check brake action.
- (5) Attach the fan [9] and cover [7]. Use a fan set screw [8] coated with Three Bond TB2365 (Sumitomo part number: EW444WW-01), and tighten with a torque of 0.3–0.5N·m.

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

■ FB-1D (Indoor Type)

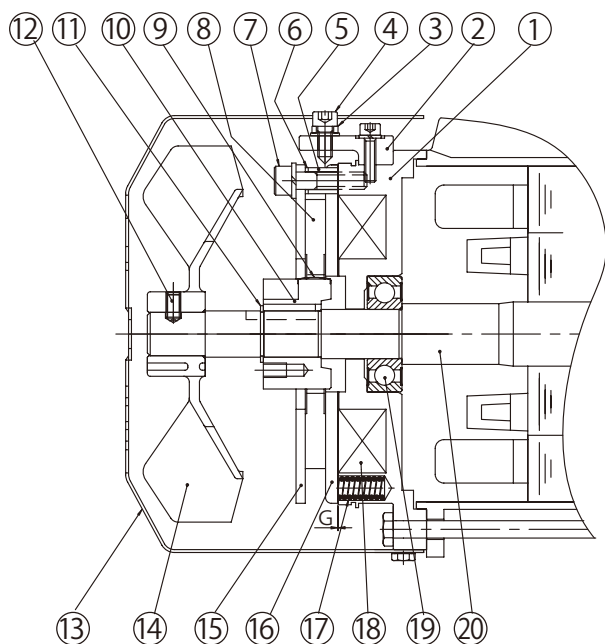


Figure 8-17

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], measuring 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 0.2–0.25mm. 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 0.2–0.25mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [5], gap adjustment shims [6], attachment bolts [7] and the fixed plate [15] as a set.
- (6) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (7) Turn the power on and off to check brake action.
- (8) Attach the fan [14], fan set screw [12] and cover [13]. Use a fan set screw [12] coated with Three Bond TB2365 (Sumitomo part number: EW445WW-01), and tighten with a torque of 0.85–1.05N·m. Finally, attach the brake release bolt [4] and the manual release prevention spacer [3].



8. Daily Inspection and Maintenance

■ FB-1E (Indoor Type)

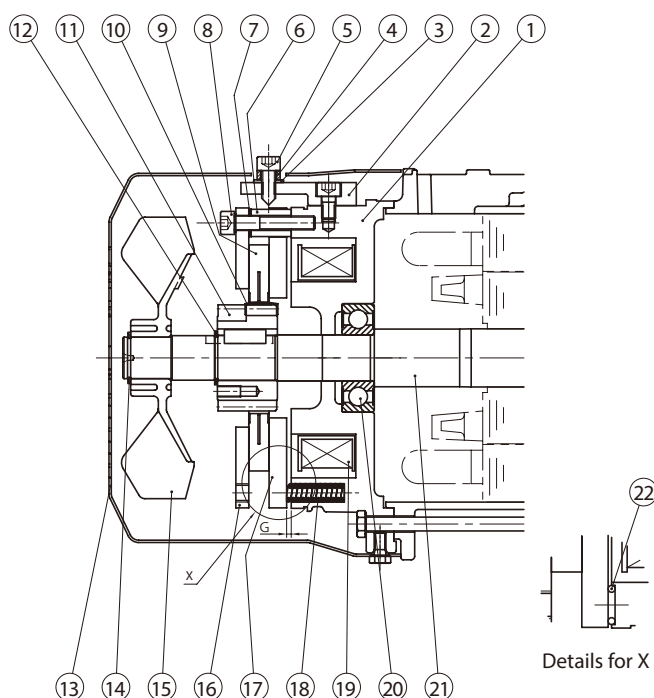


Figure 8-18

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], measuring 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 0.2–0.25mm. 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 0.2–0.25mm. 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)

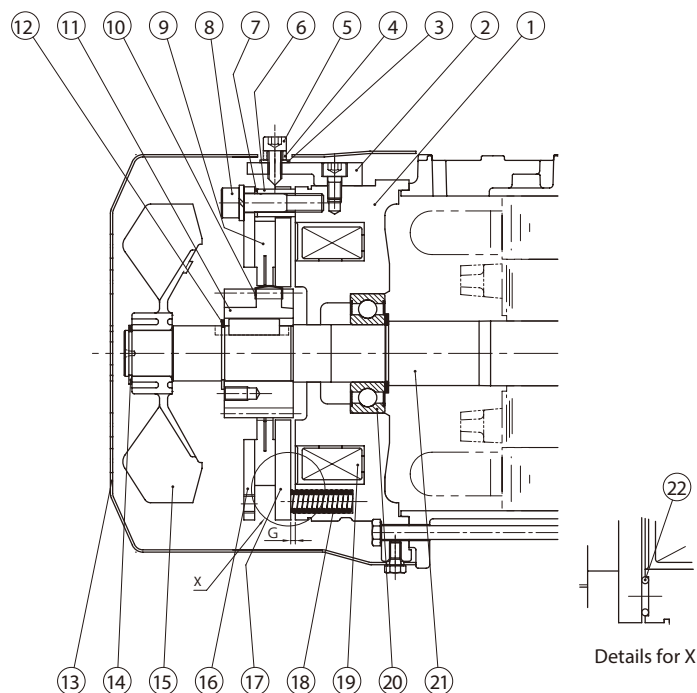


Figure 8-19

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], measuring 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 0.35–0.45mm. 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 0.35–0.45mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [6], gap adjustment shims [7], attachment bolts [8] and the fixed plate [16] as a set.
- (6) Check the gap G, and readjust the shims if there is a large difference between the gap and the required value.
- (7) Turn the power on and off to check brake action.
- (8) Attach the fan [15], shaft-retaining C-ring [14] and cover [13].
- (9) Finally, attach the brake release bolt [5] and the manual release prevention spacer [4].



8. Daily Inspection and Maintenance

■ FB-3E, FB-4E (Indoor Type)

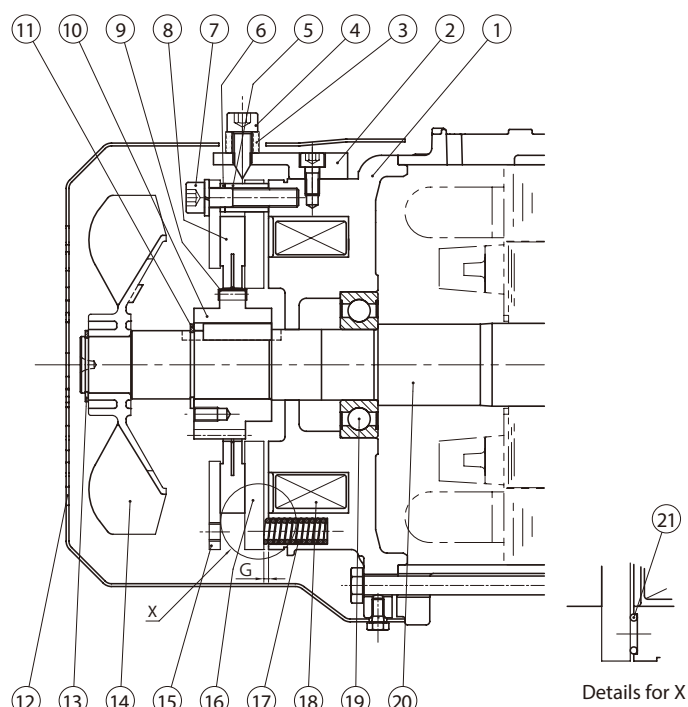


Figure 8-20

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

- 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], measuring 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 0.45–0.55mm. 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 0.45–0.55mm. 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].

■ FB-5E, FB-8E (Indoor Type)

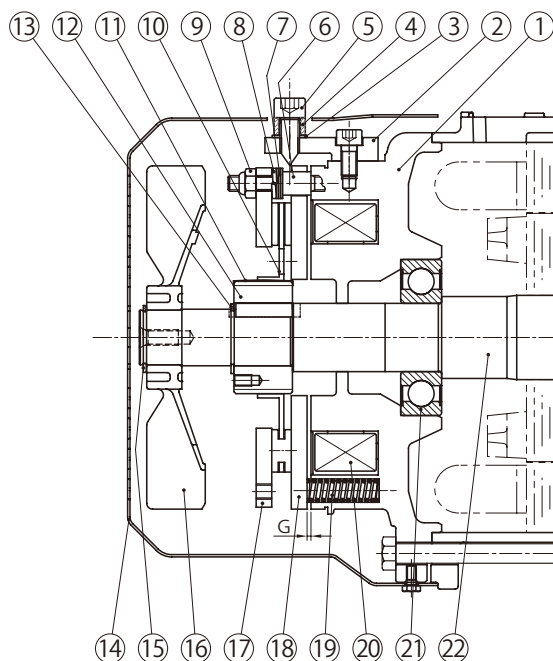


Figure 8-21

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], measuring 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], rotating 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].



8. Daily Inspection and Maintenance

■ FB-10E, FB-15E (Indoor Type)

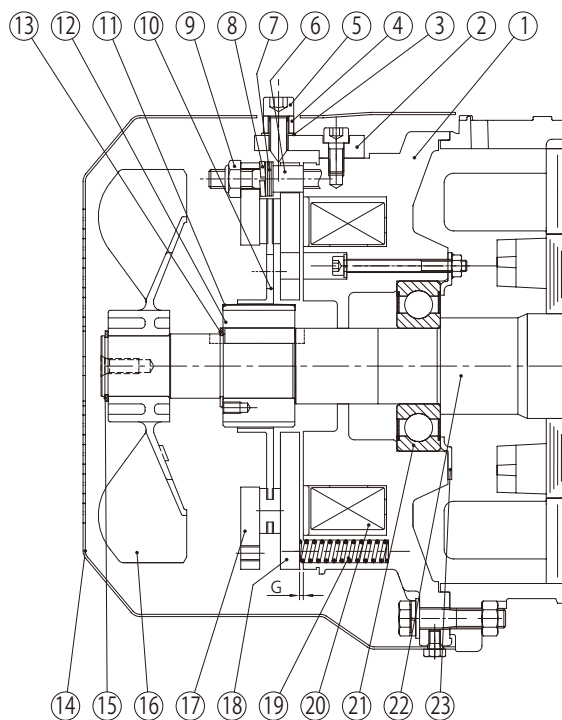


Figure 8-22

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], measuring 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], rotating 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)

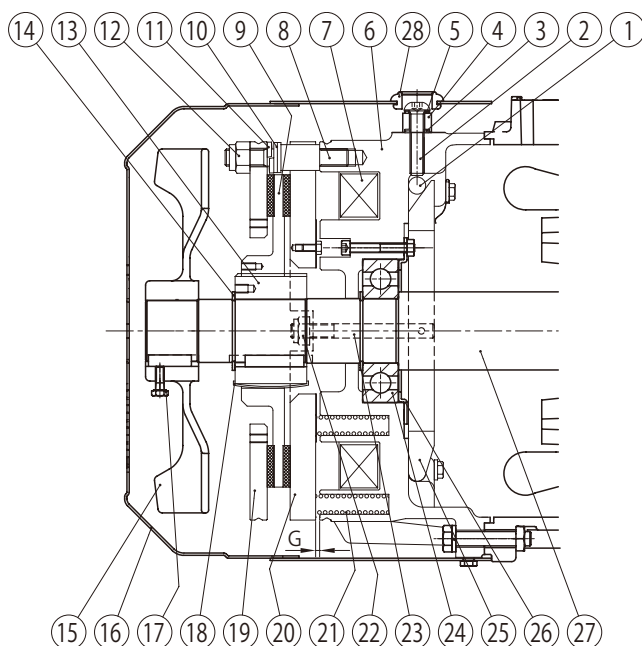


Figure 8-23

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], measuring 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], rotating 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

■ FB-30 (Indoor Type)

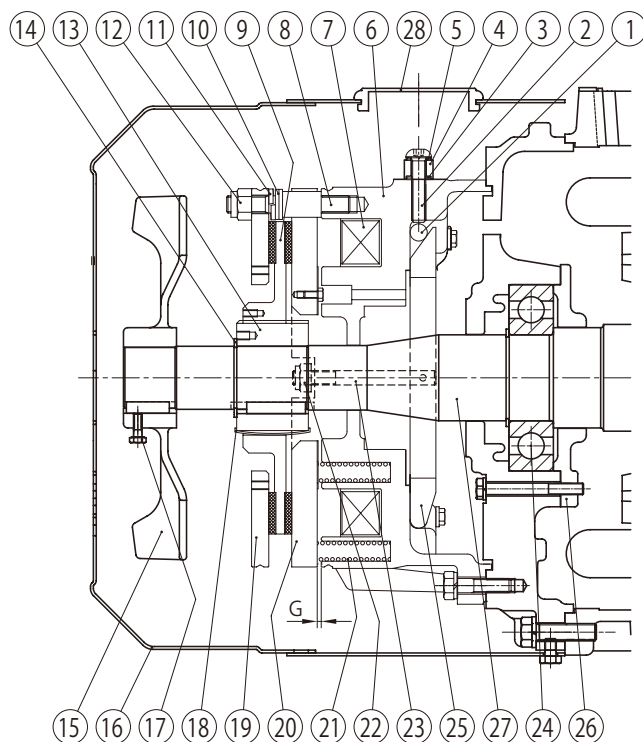


Figure 8-24

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], measuring 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], rotating to the right the gap adjusting nuts [12] that are attached to ends of the stud bolts [8]. If large adjustments to the gap are not possible, decrease the number of adjusting washers [10]. There are 3 gap adjusting nuts [12]. Adjust these in turn so that 3 positions on the circumference are uniformly at the required gap.
- (3) Turn the power on and off to check brake action.
- (4) Attach the cover [16] and grommet [28].

■ ESB-250, ESB-250-2 (Indoor Type)

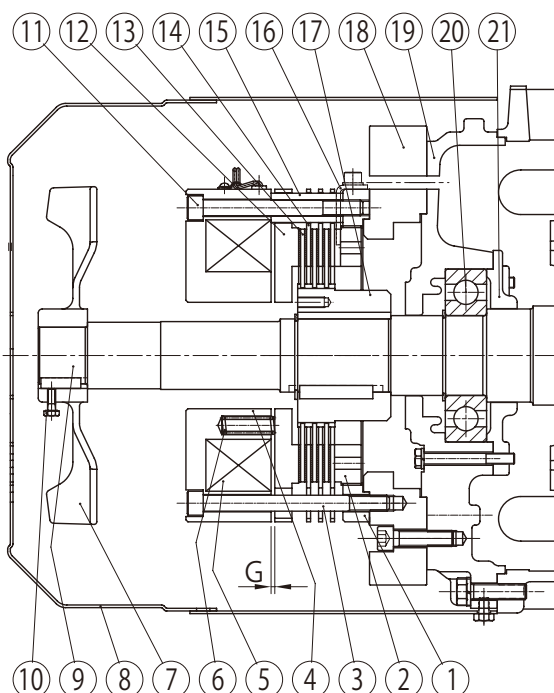


Figure 8-25

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
	Steady voltage
	DC180V (for AC200V input)
	DC90V (for AC200V input)
Maximum output current	DC1.8A (Steady output)
Over excitation time	0.4~1.2s
Insulation resistance	100MΩ or larger (When measured with 1000V megohmmeter)
Insulation withstand voltage	AC2000V for one time or more
Maximum frequency	Inching
	Constant
	When on-time 1.2s or less: 8 cycles/min
	When on-time exceeds 1.2s: 30 cycles/min
Allowable ambient temperature	-20°C ~ 60°C

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

Outline Drawing

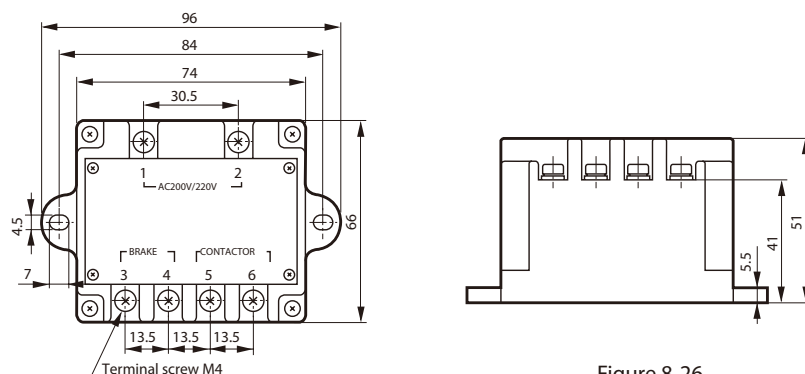
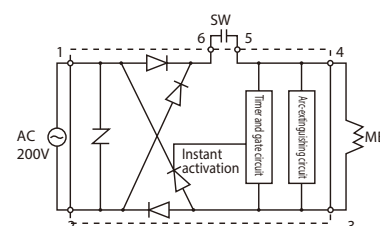


Figure 8-26

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 cover [8].
- (2) Insert a gap gauge between the field [4] and armature [12], measuring 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 P79.
- (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 8-27)
- (3) Insert the gap adjusting bar (customer to prepare an angle plate. See Figure 8-29) 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 8-28)
- (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.

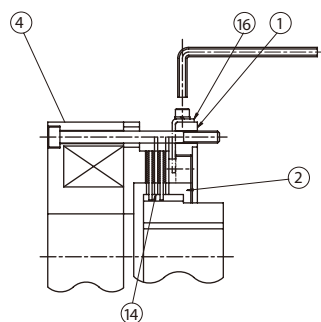


Figure 8-27

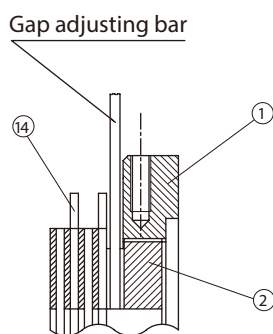


Figure 8-28

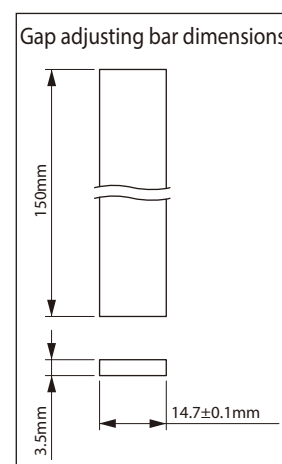


Figure 8-29

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

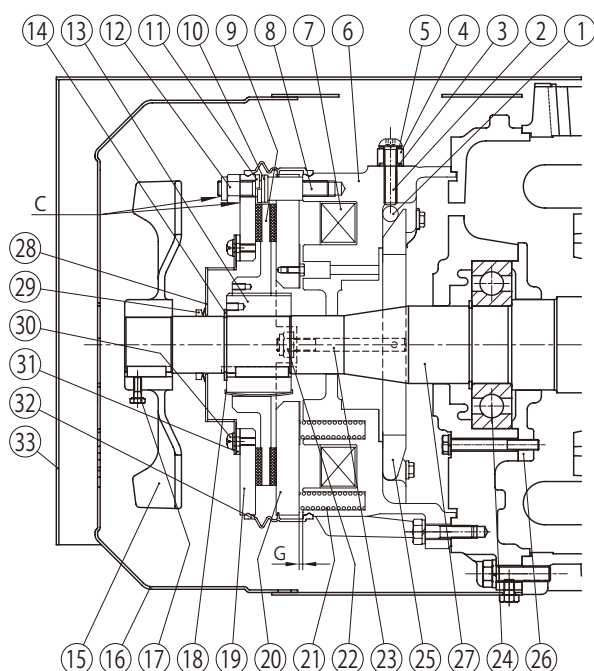


Figure 8-30

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

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], measuring 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 0.3mm.)
- (7) Attach the waterproof cover [12] by using the attachment bolts [13]. Attach the waterproof cover [12] so that the gap (A) between its hole and the motor shaft [19] is nearly uniform around the circumference.
- (8) Clean the surface of the waterproof seal [14] to remove impurities.
- (9) As shown in the construction diagram, install the waterproof seal [14] between the stationary core [17] and the waterproof cover [12]. Insert the waterproof seal [14] with its arrow mark pointing toward the load side. (Align the hole in the waterproof seal [14] for the release bolt with the position of 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 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 0.3-0.5N·m.



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



8. Daily Inspection and Maintenance

■ FB-1D (Outdoor Type)

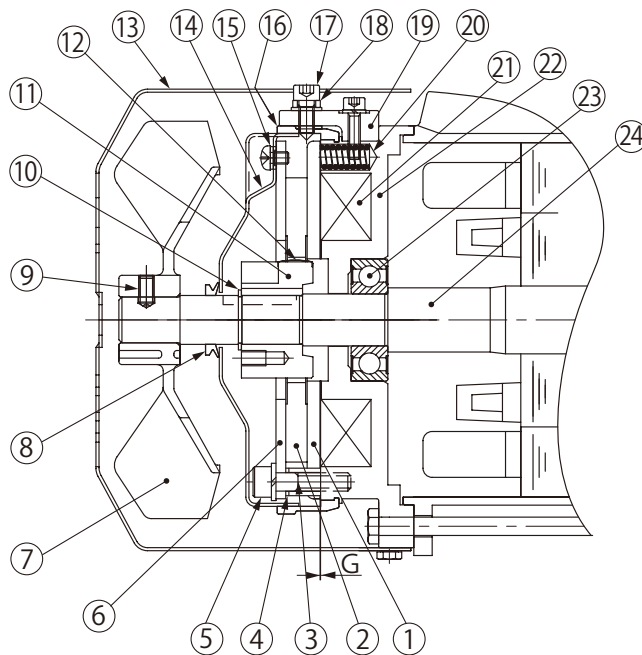


Figure 8-31

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

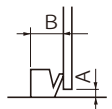
- Gap Inspection

- (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], measuring 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 0.2–0.25mm. 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 0.2–0.25mm. 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] by using the attachment bolts [15]. Attach the waterproof cover [14] so that the gap (A) between its hole and the motor shaft [24] is nearly 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 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 0.85–1.05N·m. Finally, attach the brake release bolt [17] and the manual release prevention spacer [18].



■ FB-1E (Outdoor Type)

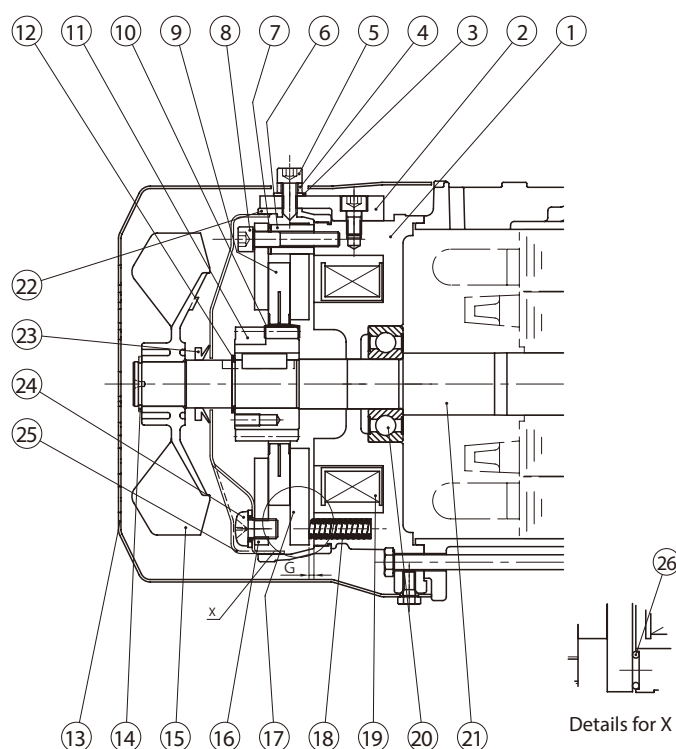


Figure 8-32

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], measuring 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 0.2–0.25mm. 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 take off the gap adjustment shims [7] or the shock absorber [26].
- (8) The gap adjustment shims [7] have a thickness of 0.2–0.25mm. 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] by 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 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].





8. Daily Inspection and Maintenance

■ FB-1HE, FB-2E (Outdoor Type)

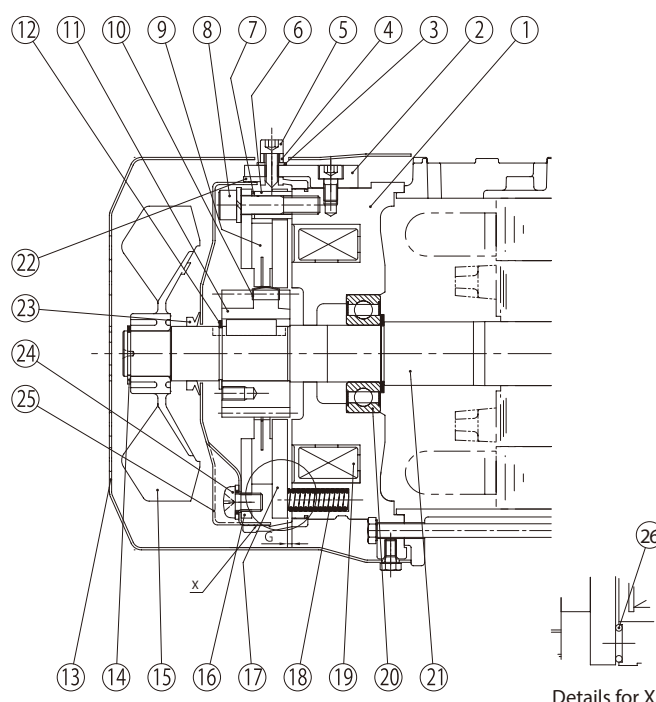


Figure 8-33

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

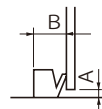
- Gap Inspection

- (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], measuring 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 0.35–0.45mm. 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) 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 0.35–0.45mm. Reduce the number of shims according to the wear conditions, then reassemble the spacers [6], gap adjustment shims [7], attachment bolts [8] and the fixed plate [16] as a set.
- (9) Check the gap G, and readjust the shims if there is a large difference between it and the required value.
- (10) Attach the waterproof cover [25] by 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 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-3E, FB-4E (Outdoor Type)

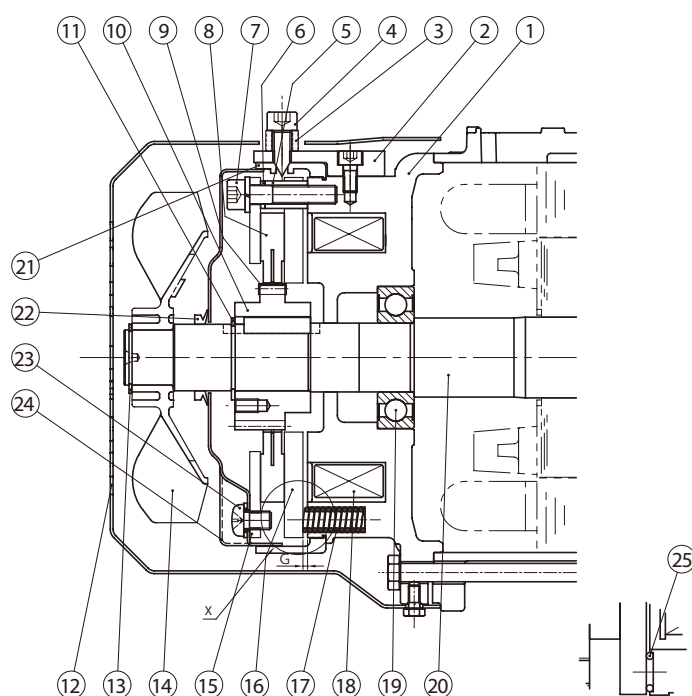


Figure 8-34

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

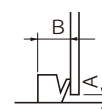
- Gap Inspection

- (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], measuring 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 0.45–0.55mm. 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 0.45–0.55mm. 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] by 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 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].





8. Daily Inspection and Maintenance

■ FB-5E, FB-8E (Outdoor Type)

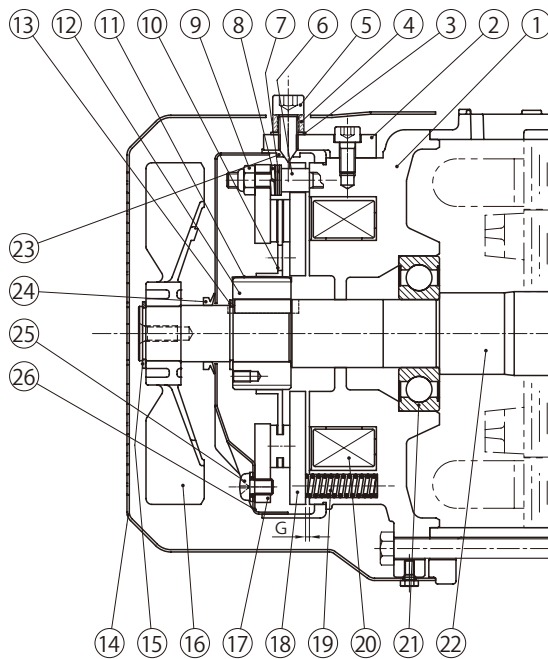


Figure 8-35

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

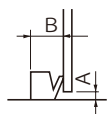
- Gap Inspection

- (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], measuring 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], rotating 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] by 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 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)

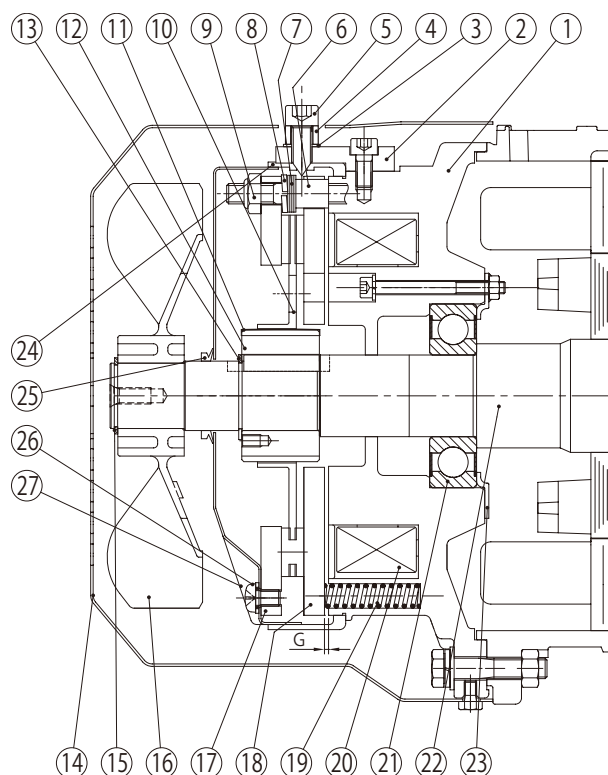


Figure 8-36

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

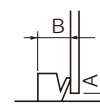
- Gap Inspection

- (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], measuring 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], rotating 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] by 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 [25]. Wipe off the lip and surface near the lip of the V-ring [25], lightly coat 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].





8. Daily Inspection and Maintenance

■ FB-20 (Outdoor Type)

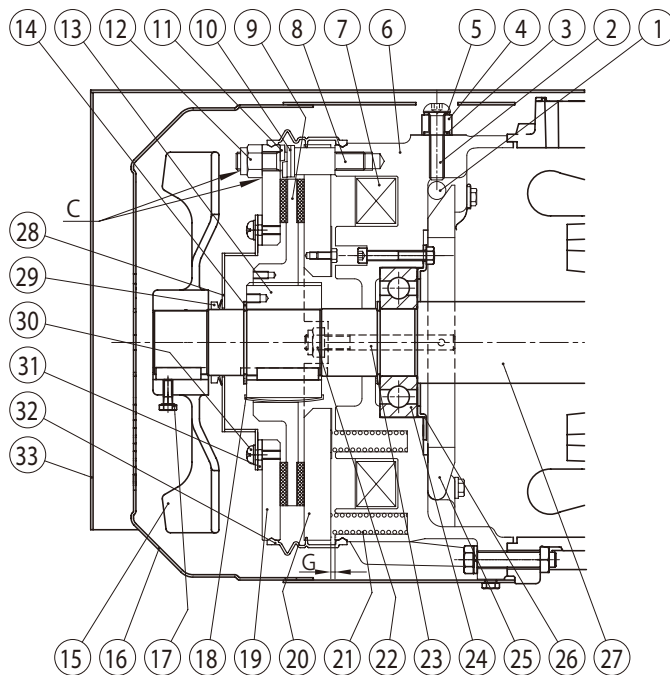


Figure 8-37

- Gap Inspection

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

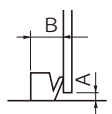
- Gap Adjustment

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

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



■ FB-30 (Outdoor Type)

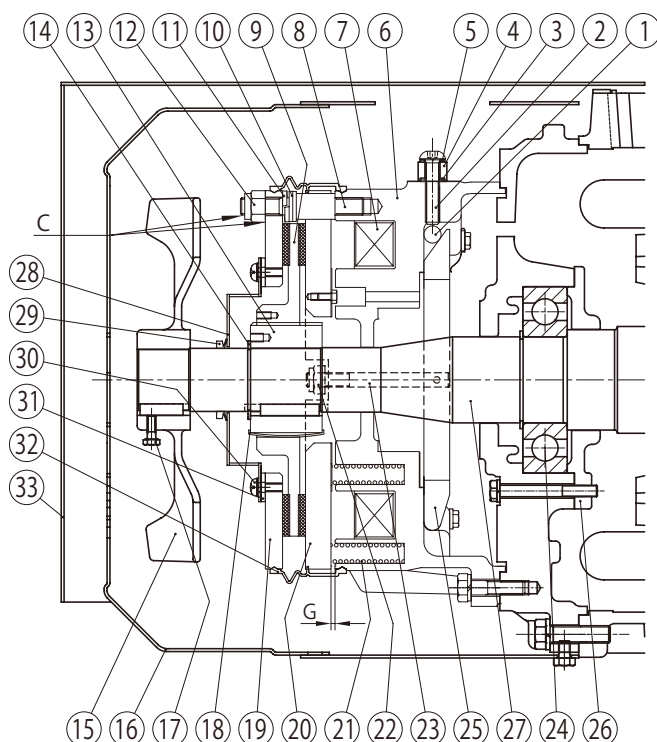


Figure 8-38

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.

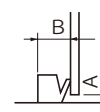
- Gap Inspection

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

- Gap Adjustment

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





8. Daily Inspection and Maintenance

■ ESB-250, ESB-250-2 (Outdoor Type)

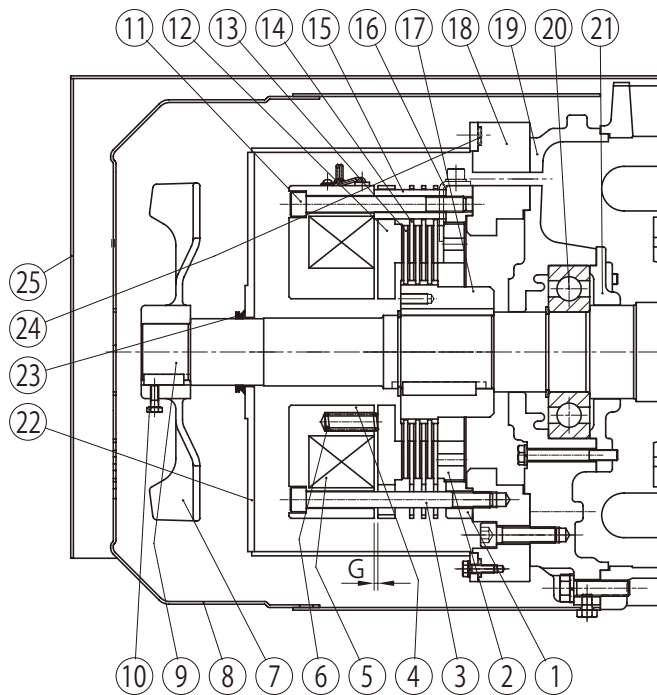


Figure 8-39

Items		Specifications
Rated input voltage		AC200/220V 50/60Hz
Maximum input voltage		AC240V 50/60Hz
Minimum input voltage		AC170V 50/60Hz
Standard output voltage	Instantaneous voltage	DC180V (for AC200V input)
	Steady voltage	DC90V (for AC200V input)
Maximum output current		DC1.8A (Steady output)
Over excitation time		0.4–1.2s
Insulation resistance		100MΩ or larger (When measured with 1000V megohmmeter)
Insulation withstand voltage		AC2000V for one time or more
Maximum fre-quency	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 – 60°C

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.

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

Outline Drawing

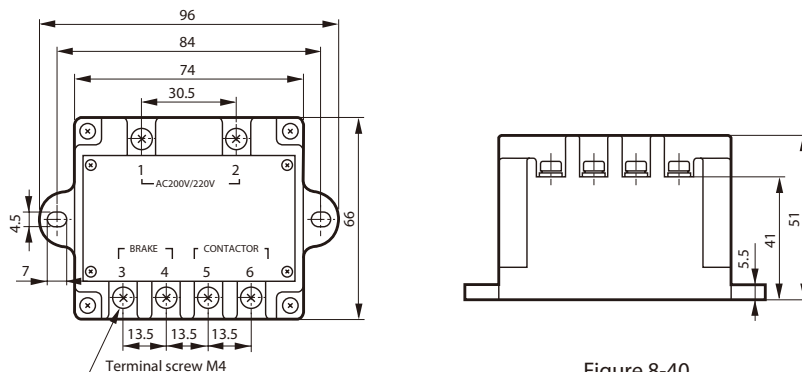
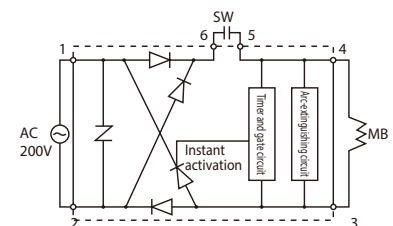


Figure 8-40

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 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], measuring 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 P79.
- (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 8-41)
- (3) Insert the gap adjusting bar from between the outer disc [14] and the center ring [1] into a hole for a gap adjusting screw [2]
(Customer needs to prepare an angle plate. See Figure 8-43).
Rotating to the left as seen from the field [4] side, will narrow the gap. (See Figure 8-42)
- (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.

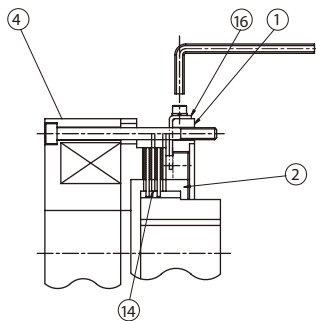


Figure 8-41

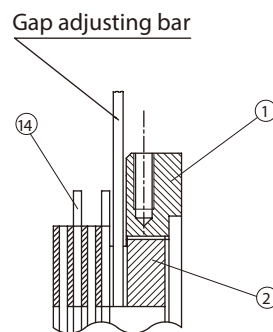


Figure 8-42

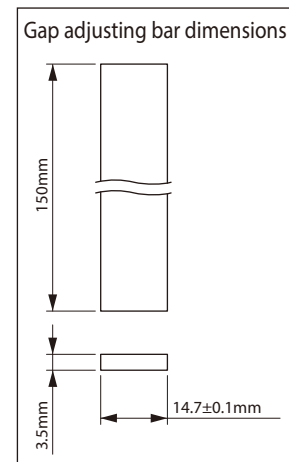


Figure 8-43



8. Daily Inspection and Maintenance

8-9 Removing and Installing One-Touch Release Lever

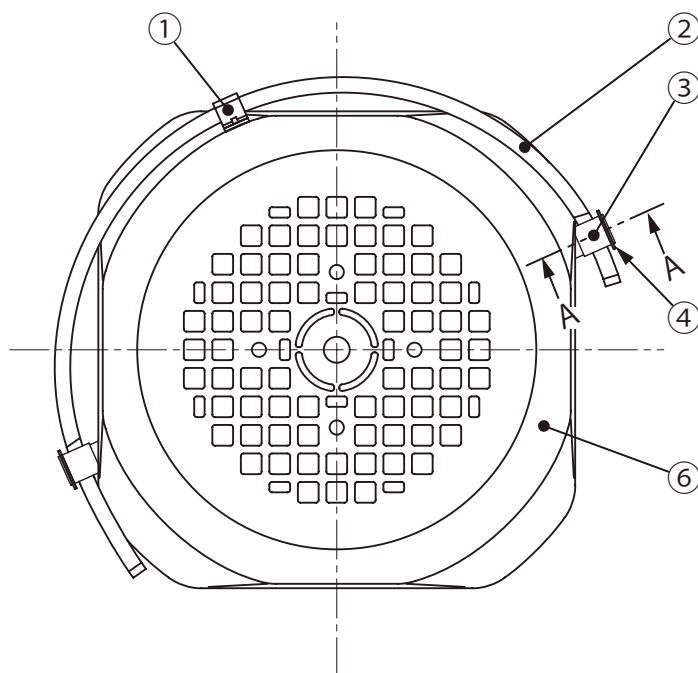
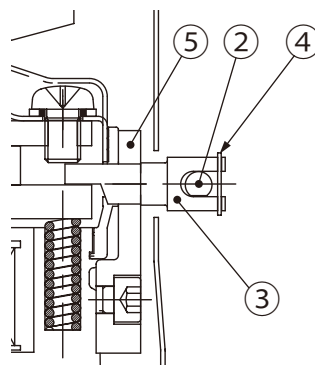


Figure 8-44

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).
After removing the release lever [2], be careful not to allow the release pin [3] to come off.
- (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.
(Do not expand the release lever overly).
- (4) Attach retaining ring [4].
- (5) Check that brake is released by pushing release lever [2].
- (6) Fix release lever [2] to holder [1].

8-10 Changing the Brake Lining and Inner Disc

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



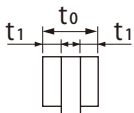
(1) FB Brakes (excluding FB-01A1 – FB-05A1), ESB-250, ESB-250-2

When the thickness of brake lining (FB brake) or inner disc (ESB-250, ESB-250-2) reaches the use limit thickness in Table 8-18

(2) FB-01A1 – FB-05A1

When after gap adjustment the brake gap still reaches the limit (see P54, P65)

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, including the gap adjusting nuts) as a set.
- After 2 million or more cycles of operation, (for FB-30, ESB-250, ESB-250-2 1 million cycles or more), or after 10 years or more have passed since shipment from the factory, inspect to check whether continued operation is possible, even if the lining 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 in the following cases. [1] 10 or more years have elapsed since the manufacturing date [2] the brake is used outdoors or in a high-humidity environment, [3] 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. Daily Inspection and Maintenance

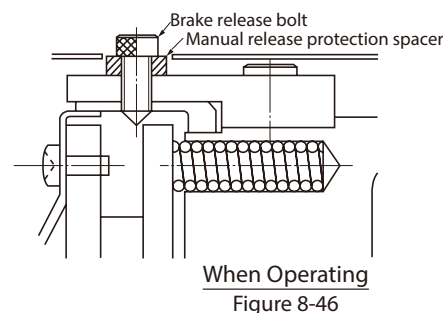
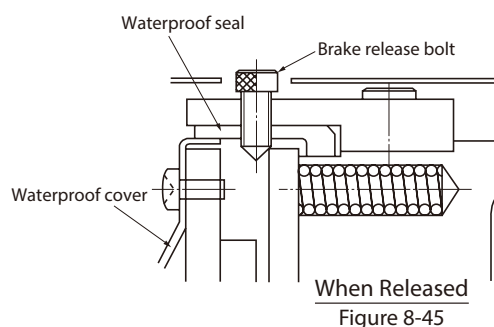
8-12 Manually Releasing the Brake

To manually release the brake without turning on the brake, 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 it 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 8-45, 8-46)
- (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 8-46)
- (3) This table shows brake release bolt sizes.

Brake Type	Bolt Size
FB-01A1 – FB-05A1 FB-1D	M5
FB-1E – FB-2E	M6
FB-3E – FB-4E	M8
FB-5E – FB-15E	M10

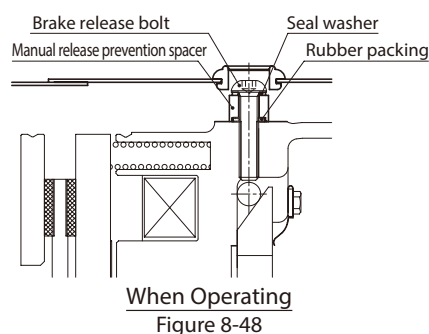
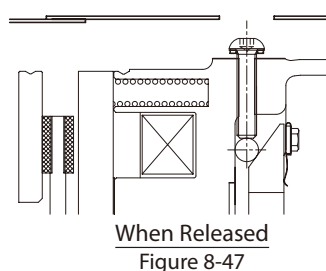


Note : Indoor types do not come with waterproof seals or waterproof covers.

■ FB-20, FB-30

- (1) In the case of outdoor types, remove the lid on the window part of the 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 8-47)
- (2) After releasing the brake, to return it to its original condition, for safety, return the manual release prevention spacer [4] and the rubber gasket [3] that were removed in (1) to their original positions, and firmly tighten the brake release bolt [2]. (See Figure 8-48) 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 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 [2] 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 [4] attached.



■ 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.

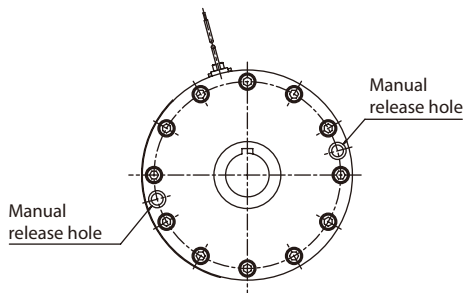


Figure 8-49

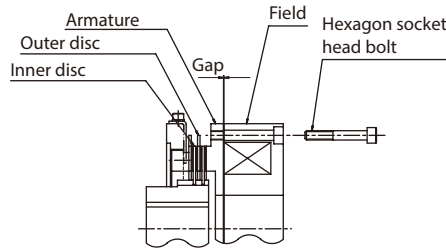


Figure 8-50

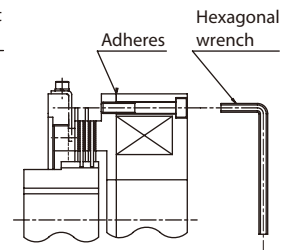


Figure 8-51

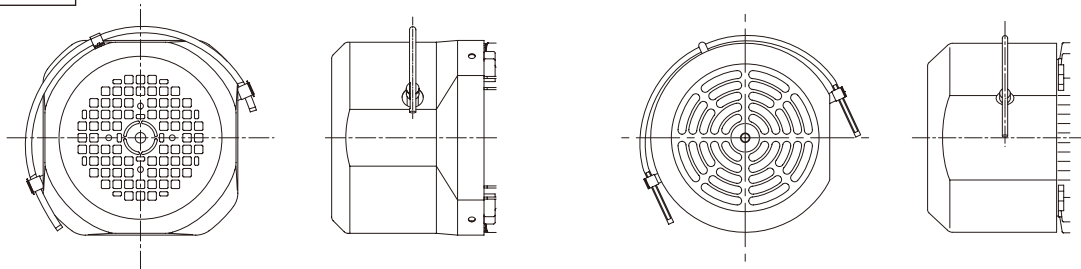
■ One-Touch Release Lever Method (Optional on all FB brakes except FB-20, FB-30)

Just pushing down the release lever enables brake releasing operation. (See Figure 8-52)

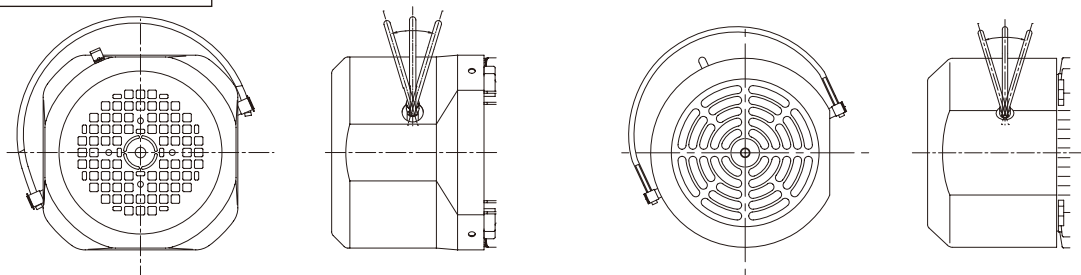
- (1) To release the brake, pull the release lever out of the holder, and push it toward the load or anti-load side.
(Some specifications do not allow pushing the release lever toward the load side.)
Be careful not to push the lever too far. Pushing the lever too far could damage the brake.
(Push the release lever while checking 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 as long as the lever is pushed down, but it works when the lever is released from the hand.

When Operating



When Brake is Manually Released



Premium Efficiency Motor

Other Than Premium Efficiency Motor

Figure 8-52


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 P54–75)
The motor rotates without a load but the output shaft does not rotate			Damage to gear unit due to overloading of gears, etc.	Confer with authorized maintenance shop.
The output 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	Change the connection.	
	Fuse tripping	The lead wire is short circuited.	Confer with authorized maintenance shop.	
Poor contact between motor and starter		Make good connection.		
Excessive temperature rise			Overload	Decrease the load to the specified value.
			Voltage drop or rise	Contact the electric power company.
			The ambient temperature is high	Improve the ventilation method.
			Damaged bearing	Confer with authorized maintenance shop.
			Abnormal wear of reducer parts due to overload, etc.	Confer with authorized maintenance shop.
Oil leakage	Blot or drip of a small amount of oil or grease from seal section of input or output 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 input or output 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 frame, 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		In rare cases this will occur in a low load range. The influence of load fluctuation and vibration from the device causes it.	Performance and lifetime are not affected. It is OK to continue operation.
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 P54–75)
		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 P26–35)
		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 	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 (Bevel BUDDYBOX 4 Series)

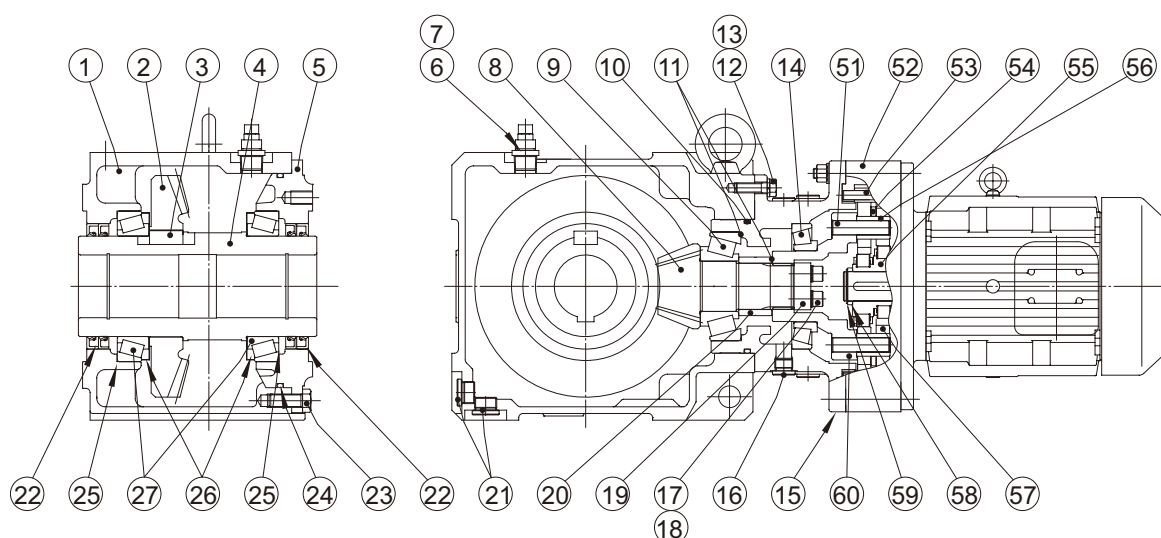


Figure 10-1 Type LHYM (Gearmotor), (Example: Frame size 4C145-Y1)

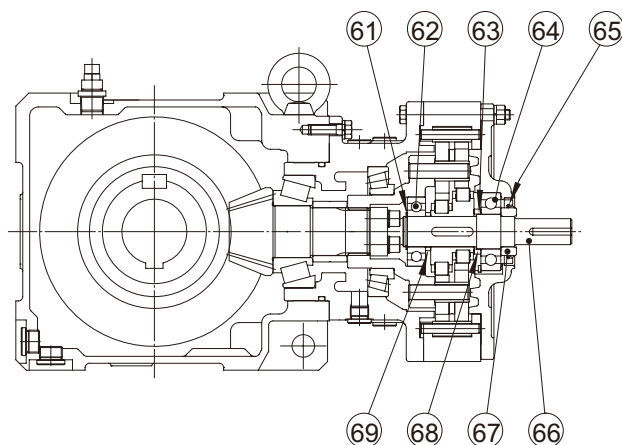


Figure 10-2 Type LHY (Reducer), (Example: Frame size 4C145-Y1)

Table 10-1 Gear Unit, Principal Parts (Bevel BUDDYBOX 4 Series)

Part Number	Parts Name	Part Number	Parts Name	Part Number	Parts Name	Part Number	Parts Name
1	Casing	15	Flanged casing	51	Slow speed shaft pin	65	Oil seal
2	Gear	16	Hexagon socket flange head plug	52	Ring gear housing	66	Input shaft
3	Both corner parallel key	17	Hexagon socket head bolt	53	Ring gear pin	67	Collar
4	Hollow shaft	18	Spring washer	54	Spacer ring	68	Distance
5	Output shaft cover	19	Holder plate	55	Eccentric cam	69	Distance
6	Bushing	20	Collar	56	Slow speed shaft roller		
7	Air vent plug	21	Hexagon socket flange head plug	57	Cycloid disc		
8	Pinion shaft	22	Oil seal	58	Distance		
9	Pinion shaft A bearing	23	Finished bolt	59	Retaining ring		
10	O-ring	24	O-ring	60	Pin carrier		
11	Shim	25	Shim	61	Retaining ring		
12	Finished bolt	26	Nilos ring	62	Input shaft A bearing		
13	Spring washer	27	Output shaft bearing	63	Retaining ring		
14	Pinion shaft B bearing			64	Input shaft B bearing		

10-2 Gear Unit Construction Drawings (Bevel BUDDYBOX 5 Series)

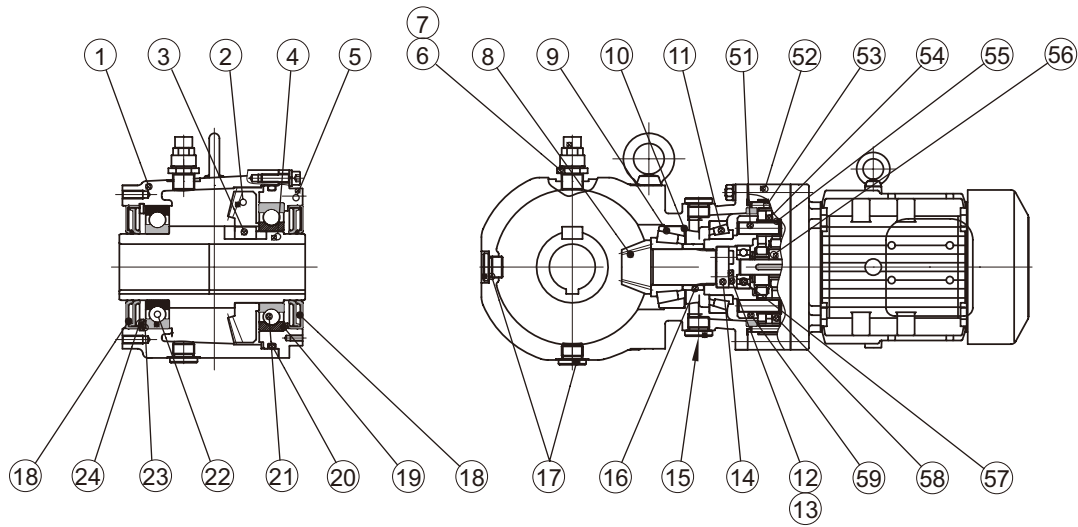


Figure 10-3 Type LHYM (Gearmotor), (Example: Frame size 5Z115-Y1)

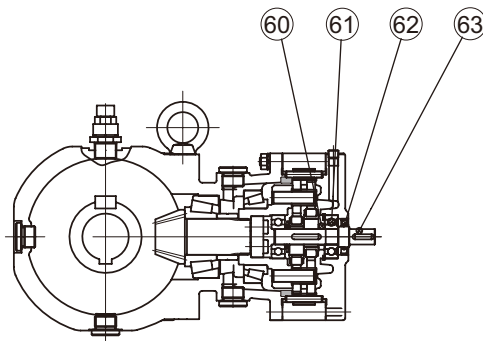


Figure 10-4 Type LHY (Reducer), (Example: Frame size 5Z115-Y1)

Table 10-2 Gear Unit, Principal Parts (Bevel BUDDYBOX 5 Series)

Part Number	Parts Name	Part Number	Parts Name	Part Number	Parts Name
1	Casing	14	Holder plate	51	Slow speed shaft pin
2	Gear	15	Hexagon socket flange head plug	52	Ring gear housing
3	Both corner parallel key	16	Collar	53	Ring gear pin
4	Hollow shaft	17	Hexagon socket flange head plug	54	Spacer ring
5	Output shaft cover	18	Oil seal	55	Slow speed shaft roller
6	Bushing	19	Shim	56	Eccentric cam
7	Air vent plug	20	O-ring	57	Cycloid disc
8	Pinion shaft	21	Output shaft A bearing	58	Pin carrier
9	Pinion shaft A bearing	22	Output shaft B bearing	59	Input shaft A bearing
10	Shim	23	Shim	60	Distance
11	Pinion shaft B bearing	24	Retaining ring	61	Input shaft B bearing
12	Hexagon socket head bolt			62	Oil seal
13	Spring washer			63	Input shaft

Code 21 and Code 22: Frame size Z uses ball bearings, and frame sizes A to C use roller bearings.

10-3 Gear Unit Construction Drawings (Helical BUDDYBOX)

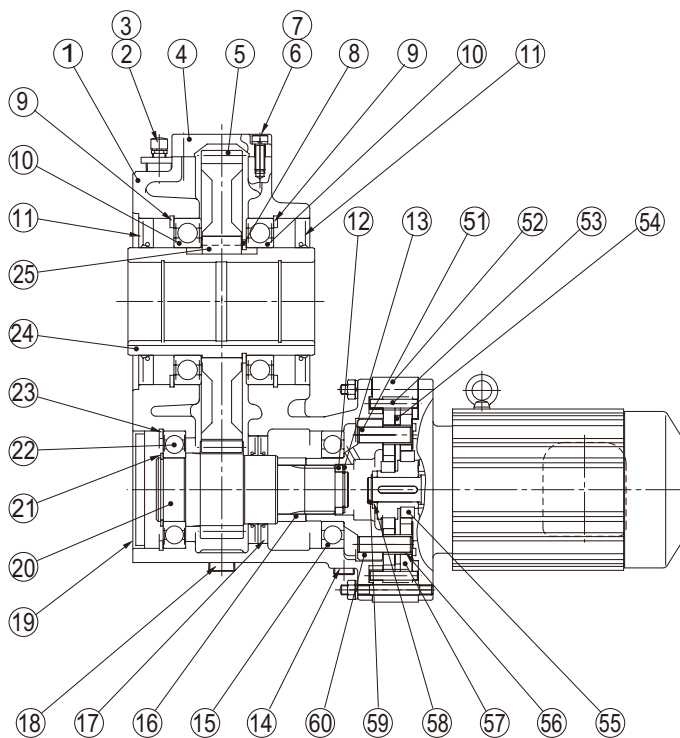


Figure 10-5 Type EHYM (Gearmotor) (Example: Frame size C6145-Y3)

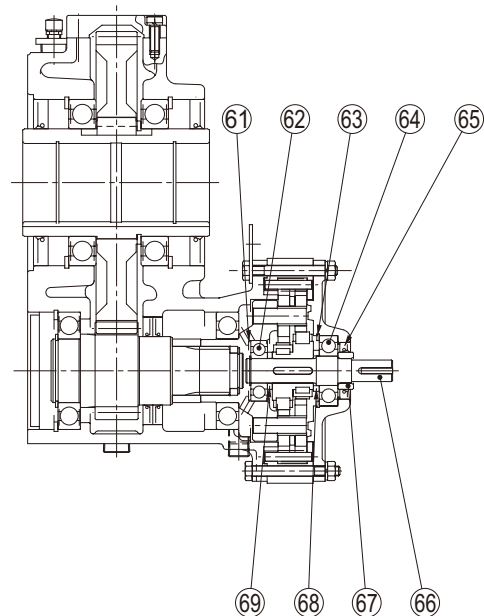


Figure 10-6 Type EHY (Reducer), (Example: Frame size C6145-Y3)

Table 10-3 Gear Unit, Principal Parts (Helical BUDDYBOX)

Part Number	Parts Name	Part Number	Parts Name	Part Number	Parts Name	Part Number	Parts Name
1	Casing	14	Hexagon socket plug	51	Slow speed shaft pin	64	Input shaft B bearing
2	Bushing	15	Pinion shaft B bearing	52	Ring gear housing	65	Oil seal
3	Air vent plug	16	Pinion shaft spacer	53	Ring gear pin	66	Input shaft
4	Cover	17	Oil seal	54	Spacer ring	67	Collar
5	Gear	18	Hexagon socket plug	55	Eccentric cam	68	Distance
6	Finished bolt	19	Seal cap	56	Slow speed shaft roller	69	Distance
7	Spring washer	20	Pinion shaft	57	Cycloid disc		
8	Retaining ring	21	Retaining ring	58	Distance		
9	Retaining ring	22	Pinion shaft A bearing	59	Retaining ring		
10	Output shaft bearing	23	Retaining ring	60	Pin carrier		
11	Oil seal	24	Hollow shaft	61	Retaining ring		
12	Distance	25	Both corner parallel key	62	Input shaft A bearing		
13	Retaining ring			63	Retaining ring		

10-4 Motor Unit Construction Drawing

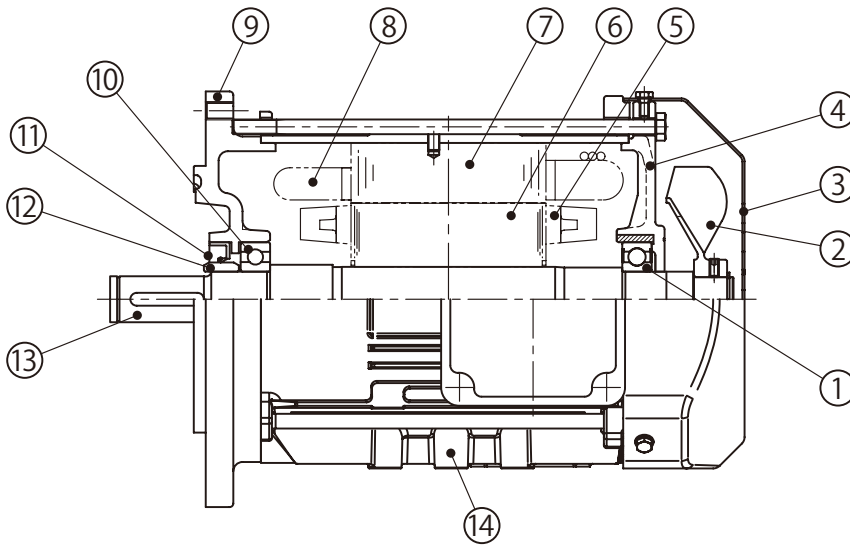


Figure 10-7 BUDDYBOX Reducer Direct Connection Motor (Example: N-100L 2.2kW 4P)

Table 10-4 Principal Parts of Motor

Code	Part 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

Application Product

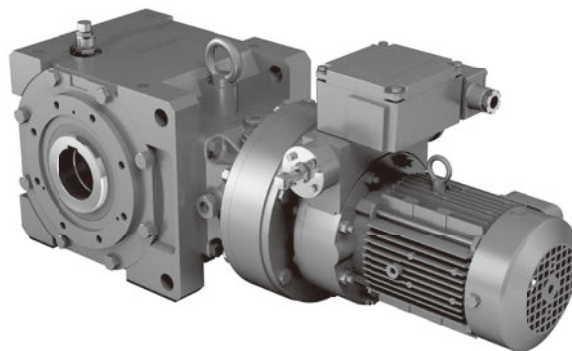
BUDDYBOX[®] Reducer with Torque Limiter

This manual covers the torque limiter unit.

For information on handling the reducer unit and the motor unit, see P1–85.

Contents

11. Wiring	88
12. Adjusting Preset Torque	90
13. Daily Inspection and Maintenance	91
14. Torque Indicator	93
15. Construction Drawings	94



⚠ DANGER

- Do not handle the unit when cables are energized. Be sure to turn off the power when working on the unit; otherwise, electric shock may result.
- Connect a power cable to the unit 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 the domestic laws and standards 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.)

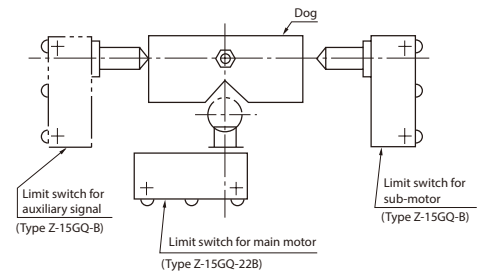


Figure 11-1 Limit Switch

(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 possible.
- [4] The limit switch may activate at startup if startup torque exceeds preset torque (when shock occurs at startup, or when 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.

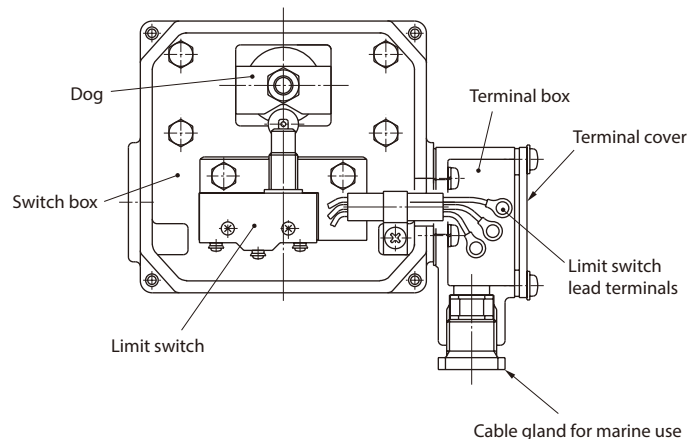


Figure 11-2 Terminal Box, Switch Box

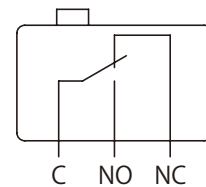


Figure 11-3 Type of Contact (1c)

- 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.

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

(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 piece)
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
	15		2.5	1.25	15		3	1.5
	10		1.5	0.75	6		1.5	0.75
DC 8	15		3	1.5	15		5	2.5
	15		3	1.5	10		5	2.5
	6		3	1.5	5		5	2.5
	0.5		0.5	0.5	0.05		0.05	0.05
	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 7ms (DC) or less.

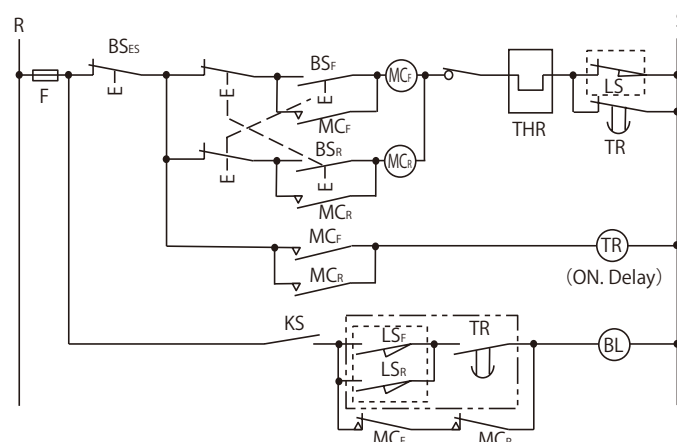
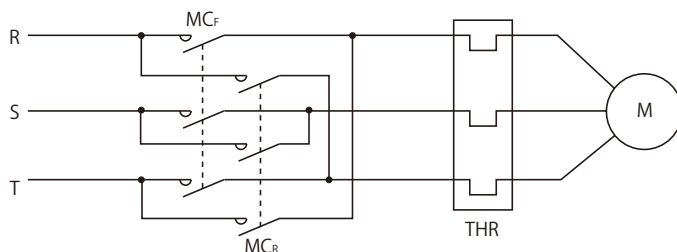
3. A lamp load is a load with an inrush current 10 times as high.

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 BUDDYBOX Reducer 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 value at which the torque limiter functions to exceeds the initial setpoint. Damage to the machine may occur.

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

- 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.

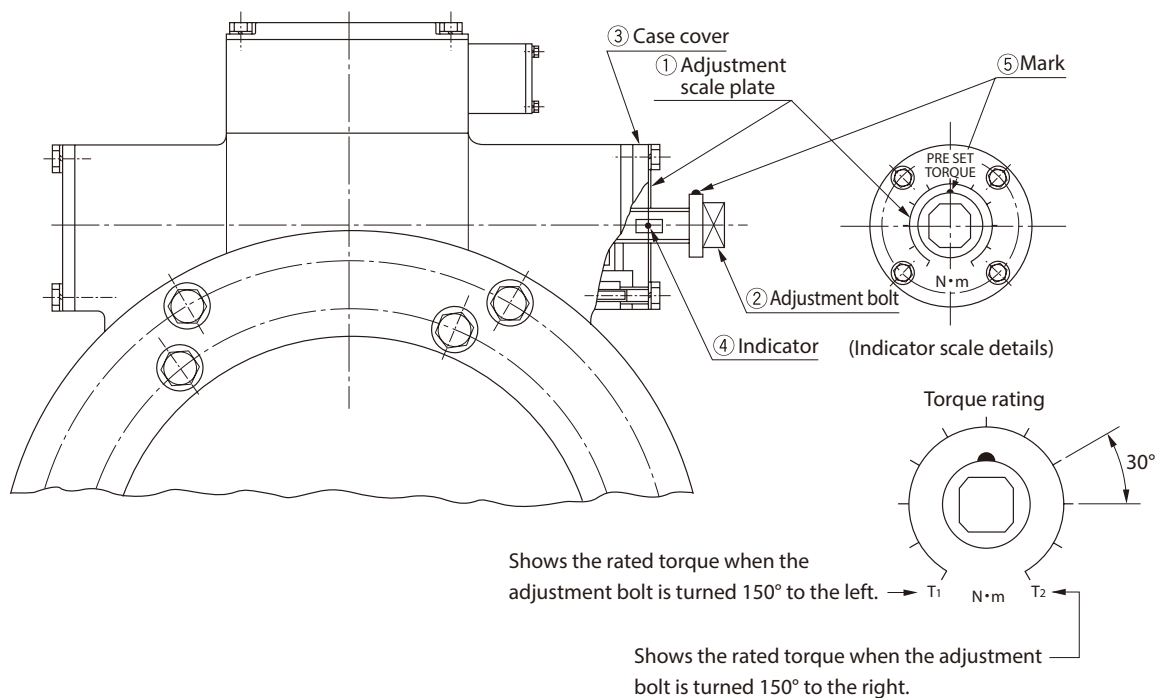


Figure 12-1 Adjusting Preset Torque

- 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; otherwise, preset torque value changes and the torque limiter does not work 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 Lubrication

- For the Bevel BUDDYBOX with Torque Limiter, the frame size and lubrication method may differ from those of models without torque limiter. Check the manufacturing specifications. Lubricating oil fill quantity and grease replenishment quantity, refer to Table 13-1 and Table 13-2.
- Lubricating oil fill quantity and grease replenishment quantity for Helical BUDDYBOX with Torque Limiter is the same as those without torque limiter.
- Lubricating oil change intervals, recommended lubricating oils, oil fill and drain procedures, grease replenishment intervals, recommended grease, oil fill and drain procedures, etc., refer to "8. Daily Inspection and Maintenance".
- If information you need is not in the tables, please consult with us.

■ Bevel BUDDYBOX 4 Series

Table 13-1 Approximate Oil Fill Quantity (L)

Frame Size	Mounting Location							
	Y1, F1, G1 K1, V1	Y2, F2, G2, K2, V2, W2		Y3, F3, G3 K3, V3, W3	Y4, F4, G4, K4, W4		Y5, F5, G5 K5, V5	Y6, F6, G6 K6, V6
4A10DA	1.7	1.0	Long-life grease	1.7	1.1	Long-life grease	1.4	1.9
4A12DA	1.7			1.7			1.5	2.0
4A12DB	1.8			1.8			1.5	2.0
4B12DA	3.3	2.0	Long-life grease	3.3	1.7	Long-life grease	3.4	3.3
4B12DB	3.4			3.4			3.4	3.3
4B14DA	3.5			3.5			3.6	3.5
4B14DB	3.6	3.5	Long-life grease	3.6	2.9	Long-life grease	3.6	3.5
4C14DA	5.6			5.6			5.3	5.9
4C14DB	5.6			5.6			5.4	5.9
4C14DC	5.6	5.0	Grease	5.6	4.6	Grease	5.4	6.0
4C16DA	6.0			6.0			5.8	6.4
4C16DB	6.1			6.1			5.9	6.4
4C17DB	6.7	7.3	Grease	6.7	6.3	Grease	6.2	7.3
4D16DA	10.1			10.1			9.8	10.5
4D16DB	10.1			10.1			9.8	10.5
4D17DA	10.2	12.0	Grease	10.2	7.3	Grease	9.8	10.6
4D17DB	10.5			10.5			10.2	10.9
4D17DC	10.7			10.7			10.3	11.0
4D18DA	10.8	7.3	Grease	10.8	6.3	Grease	10.5	11.2
4D18DB	11.7			11.7			11.4	12.1
4E17DA	14.6			14.6			13.1	16.1
4E17DB	14.7	12.0	Grease	14.7	7.3	Grease	13.2	16.2
4E17DC	14.8			14.8			13.3	16.3
4E18DA	14.8			14.8			13.3	16.3
4E18DB	15.7	12.0	Grease	15.7	7.3	Grease	14.2	17.2
4E19DA	17.5			17.5			16.0	19.0
4E19DB	17.7			17.7			16.2	19.2
4F18DA	20.1	12.0	Grease	20.1	7.3	Grease	18.6	21.5
4F18DB	21.0			21.0			19.5	22.4
4F19DA	22.6			22.6			21.1	24.0
4F19DB	22.8			22.8			21.3	24.2

Approximate Grease Replenishment
Quantity (g)

Frame Size	Mounting Location	
	Y2, F2, G2, K2, V2, W2	Y4, F4, G4, K4, W4
4A10DA		
4A12DA		
4A12DB		
4B12DA		
4B12DB		
4B14DA	8.5–12.5	
4B14DB	20–30	
4C14DA	8.5–12.5	
4C14DB	20–30	
4C14DC	40–60	
4C16DA	20–30	
4C16DB	40–60	
4C17DB	40–60	
4D16DA	20–30	
4D16DB	40–60	
4D17DA	20–30	
4D17DB	40–60	
4D17DC	85–125	
4D18DA	40–60	
4D18DB	150–225	
4E17DA	20–30	
4E17DB	40–60	
4E17DC	85–125	
4E18DA	40–60	
4E18DB	150–225	
4E19DA	110–165	
4E19DB	150–225	
4F18DA	40–60	
4F18DB	150–225	
4F19DA	110–165	
4F19DB	150–225	

■ Bevel BUDDYBOX 5 Series

Table 13-2 Approximate Oil Fill Quantity (L)

Frame Size	Mounting Location					
	Y1, G1	Y3, G3	Y4, G4		Y5, G5	Y6, G6
			Output side	Input side		
5Z10DA	0.9	0.9	0.7	Long-life grease	0.9	1.0
5Z12DA	0.9	0.9			1.1	1.1
5Z12DB	1.0	1.0			1.1	1.1
5A12DA	1.7	1.7	0.8	Long-life grease	1.4	2.0
5A12DB	1.8	1.8			1.4	2.0
5B12DA	2.7	2.7			2.4	3.2
5B12DB	2.8	2.8	1.6	Long-life grease	2.4	3.2
5B14DA	2.9	2.9			2.6	3.4
5B14DB	3.0	3.0			2.6	3.4
5C14DA	5.5	5.5	3.5	Grease	5.1	5.7
5C14DB	5.5	5.5			5.2	5.7
5C14DC	5.5	5.5			5.2	5.8
5C16DA	6.1	6.1			5.9	6.5
5C16DB	6.2	6.2			6.0	6.5

Approximate Grease Replenishment
Quantity (g)

Frame Size	Mounting Location	
	Y4, G4	
5Z10DA		
5Z12DA		
5Z12DB		
5A12DA		
5A12DB		
5B12DA	8.5–12.5	
5B14DA	20–30	
5C14DA	8.5–12.5	
5C14DB	20–30	
5C14DC	40–60	
5C16DA	20–30	
5C16DB	40–60	

Note: 1. Output side: Bevel gear unit, Input side: Cyclo unit

2. Replenishment is not required for frame sizes indicated with  since they are long-life grease series.

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%).

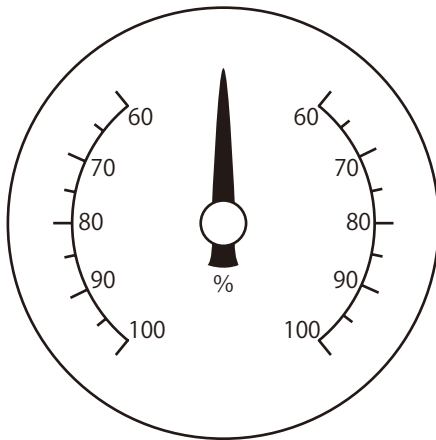


Figure 14-1 A-Type Torque Indicator
(60–100% Load Factor Display)

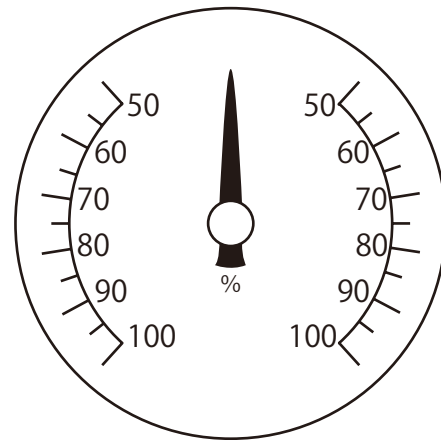


Figure 14-2 A-Type Torque Indicator
(50–100% Load Factor Display)

- 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 moved over.

(3) B-Type Torque Indicator

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

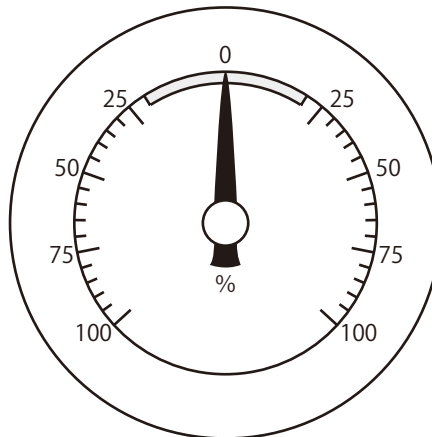
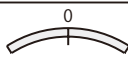


Figure 14-3 B-Type Torque Indicator (0–100% Load Factor Display)

- 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

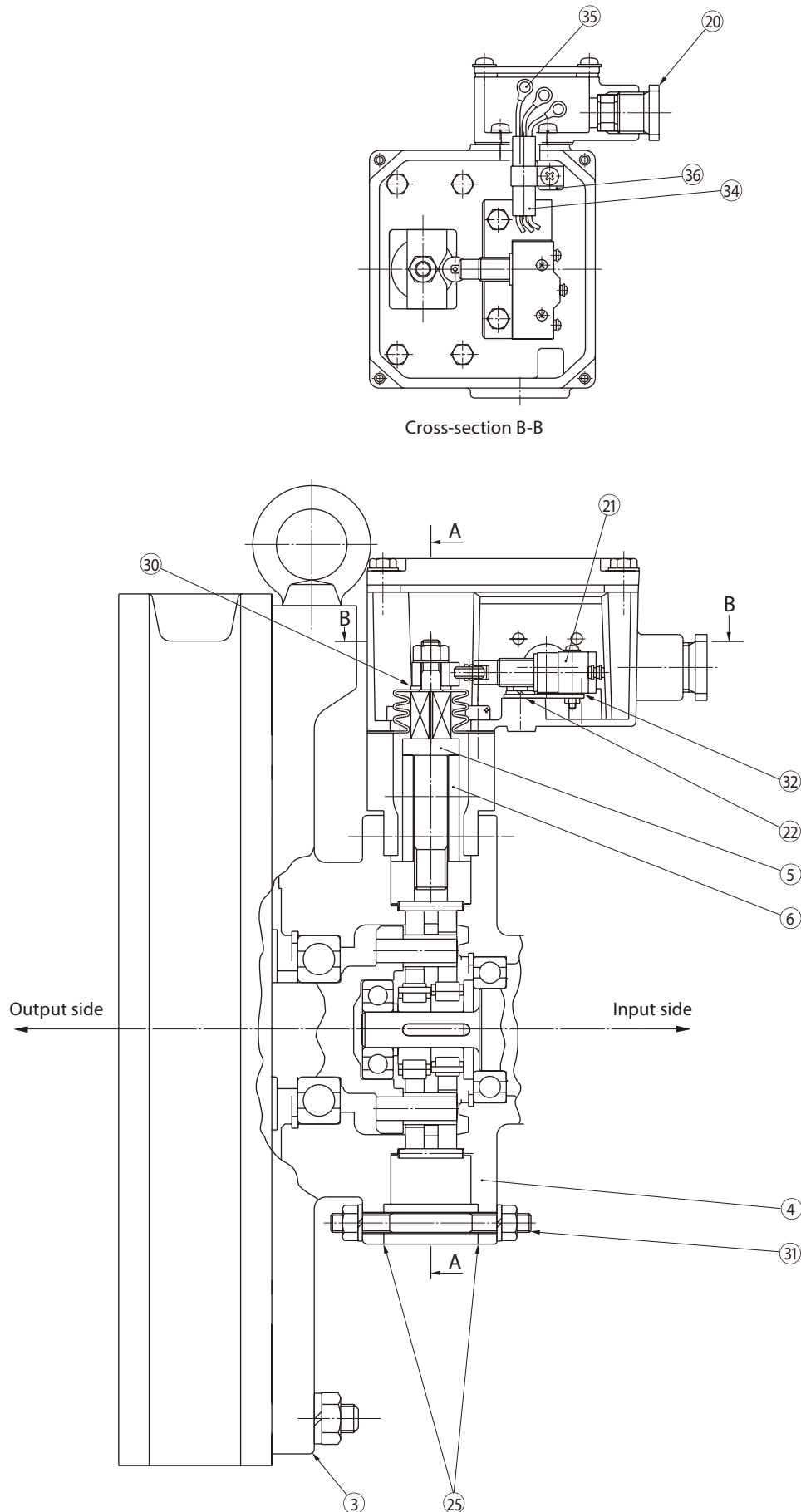


Figure 15-1 Bevel Gear or Helical Gear 1 Stage + Cyclo 2 Stage Reduction

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

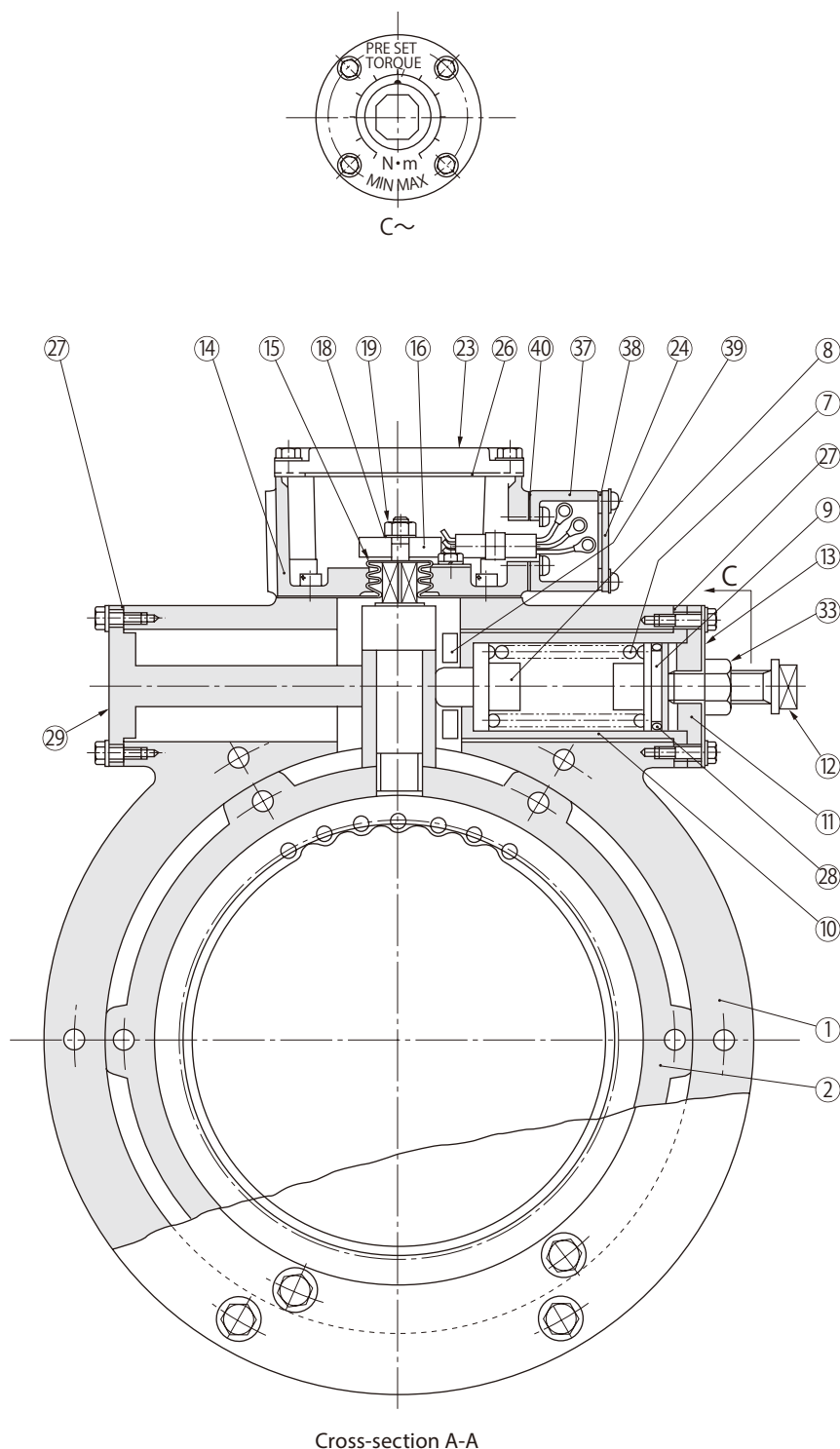


Figure 15-2 Bevel Gear or Helical Gear 1 Stage + Cyclo 2 Stage Reduction

15-2 Torque Indicator Construction Drawings

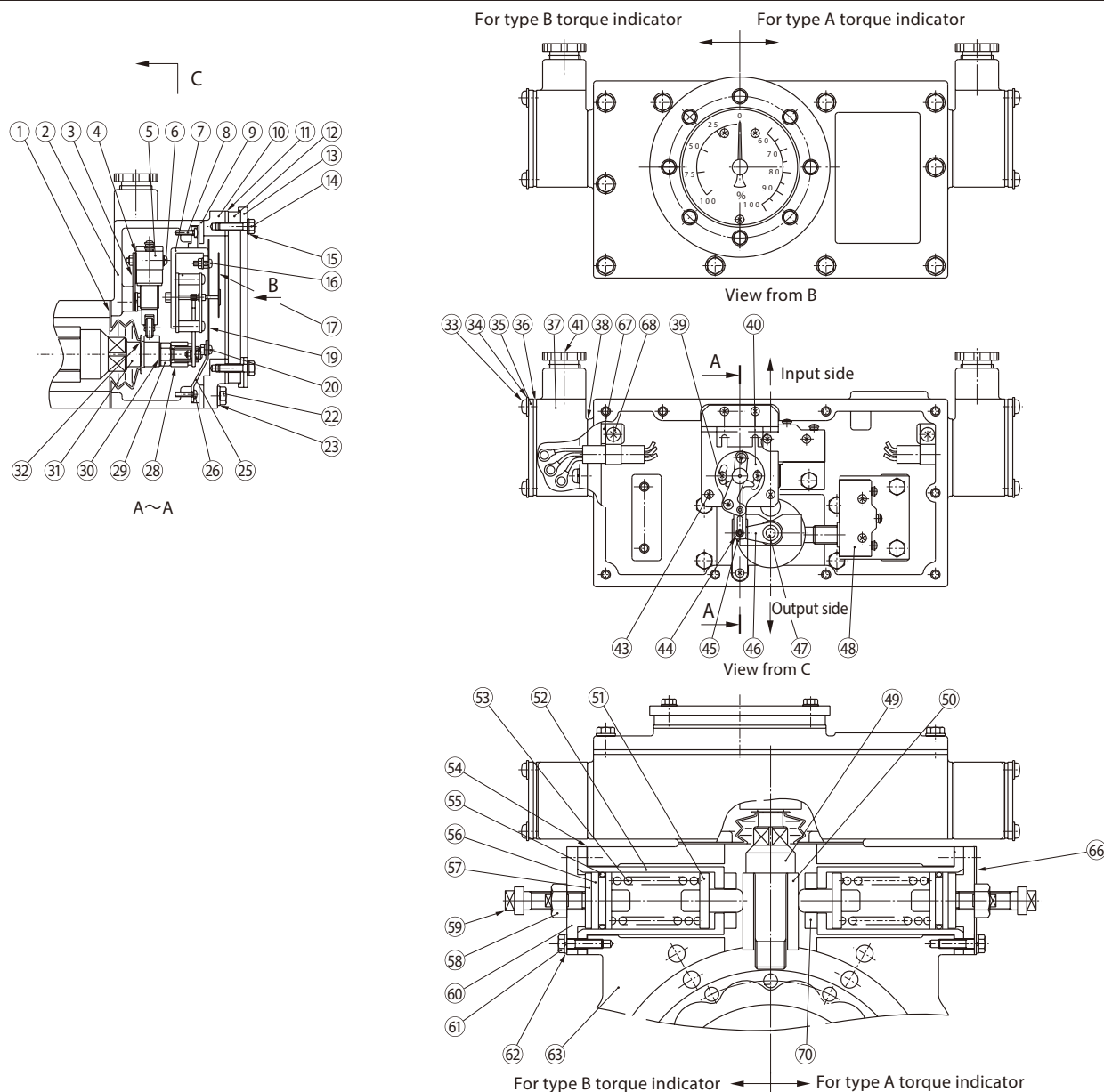


Table 15-2 Torque Indicator Principal Parts

Part Number	Parts 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	Finished bolt
15	Washer with rubber
16	Philips pan head machine screw
17	Pointer
19	Scale plate
20	Philips pan head machine screw
22	Finished bolt
23	Washer with rubber

Figure 15-3 Torque Indicator

Part Number	Parts 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	Finished 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

Part Number	Parts 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	Finished bolt
62	Washer with rubber
63	Fixed ring gear housing
66	Adjustment scale plate
67	Terminal plate
68	Finished bolt
70	Spacer

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

Warranty (period and description)

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

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