



Three-Phase Synchronous Motor for Elevators  
**COMPACT Type**  
**Gearless Motor for Elevators**  
**Instructions**  
**Totally-Enclosed Type**

400 V Class

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.

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## Preface

Thank you for purchasing the Three-phase Permanent Magnet Synchronous Motor for Elevator Inverters.

This manual describes the proper handling of this motor. Always read this manual and all enclosed documents before you attempt to install, operate, maintain, inspect, or otherwise use the motor. Also, make sure that you are familiar with all safety information and precautions that are relevant to the motor before you attempt to use it.

Also, make sure you are familiar with all safety information and precautions in the instruction manuals for the Electromagnetic Brake and Encoder before you attempt to use the motor.

General Precautions
<ul style="list-style-type: none"><li>• The diagrams in this manual may show the product without covers or safety shields to show details. Restore all covers and shields before operating the product and operate the product according to the instructions that are provided in this manual.</li><li>• Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.</li><li>• The products and specifications that are described in this manual or the contents and presentation of the manual may be changed without notice to improve the products or the manual.</li><li>• When ordering a new copy of the manual due to damage or loss, contact your Yaskawa representative or the nearest Yaskawa sales office and provide the manual number shown on the front cover of the manual.</li><li>• If the nameplate that is attached to the product become worn or is damaged, order a replacement from your Yaskawa representative or the nearest Yaskawa sales office.</li></ul>

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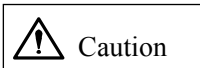
# Safety Information

The following conventions are used to indicate safety information in this manual.

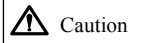
Information marked as shown below is important for safety. Always read this information and heed the precautions that are provided.





Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.



Indicates precautions that, if not heeded, could result in relatively serious or minor injury, or property damage.

In some situations, the precautions indicated with  could have serious consequences if not heeded.

The ISO and JIS standards specify different symbol marks to indicate hazards.

ISO Standard	JIS Standard
	


This manual uses the symbol marks that are defined by the ISO standard.

The warning labels on the products use either the ISO or JIS standard. Handle the product in the same way for either symbol mark.



Although not classified as DANGER or Caution precautions, important information is provided where relevant. Heed this important information as well.

# Safety Precautions

 <b>DANGER</b>	
	(Reference page)
<b>General</b>	
<ul style="list-style-type: none"> <li>• Do not use this motor in any area where there is a risk of explosion. Failure to observe this precaution may cause injury or fire.</li> <li>• Do not work on the motor while power is being supplied. Always turn OFF all power supply before you start any work. Failure to observe this precaution may cause electric shock.</li> <li>• Transportation, installation, wiring, operation, maintenance, and inspection must be performed only by qualified personnel. Failure to observe this precaution may cause electric shock, injury, or fire.</li> </ul>	
<b>Wiring</b>	
<ul style="list-style-type: none"> <li>• When connecting the motor to the power cable, follow all of the procedures that are given in the instruction manual. <span style="float: right;">21</span> Failure to observe this precaution may cause electric shock or fire.</li> <li>• Do not forcibly bend, pull, or pinch the power cable or leads. <span style="float: right;">21</span> Failure to observe this precaution may cause electric shock.</li> </ul>	
<b>Installation and Adjustment</b>	
<ul style="list-style-type: none"> <li>• Ground the motor according to all local electrical codes as they apply. <span style="float: right;">25</span> Failure to observe this precaution may cause electric shock.</li> <li>• Do not install the motor on a ceiling or wall. <span style="float: right;">16</span> Failure to observe this precaution may cause injury.</li> </ul>	
<b>Operation</b>	
<ul style="list-style-type: none"> <li>• Do not operate the motor with the cover removed from the terminal box. Replace the terminal box cover after wiring or after performing any other work. <span style="float: right;">26</span> Failure to observe this precaution may cause electric shock.</li> <li>• Never approach or touch the shaft or any rotating object during operation. <span style="float: right;">26</span> Failure to observe this precaution may cause injury as a result of becoming caught in a rotating object.</li> <li>• If power is interrupted, always turn OFF the power supply switch. <span style="float: right;">26</span> Failure to observe this precaution may cause injury.</li> </ul>	
<b>Maintenance and Inspection</b>	
<ul style="list-style-type: none"> <li>• When connecting the motor to the power cable, follow all the procedures that are given in the instruction manual. <span style="float: right;">28</span> Failure to observe this precaution may cause electric shock or fire.</li> <li>• The Electromagnetic Brake must be handled only by qualified personnel. <span style="float: right;">33</span> Failure to observe this precaution may cause injury.</li> </ul>	

## **DANGER**

(Reference page)

- Implement measures so that the elevator car or counterweight will not fall when you release the Electromagnetic Brake. 33  
Failure to observe this precaution may cause injury.
- Do not attempt to modify the motor in any way. 33  
Failure to observe this precaution may cause injury.
- Do not use the motor in any location where the Brake disc would be subject to contact with water drops or oil drops. 33  
Failure to observe this precaution may cause injury as a result of abnormal operation.
- Confirm that the emergency stop functions normally. 33  
Failure to observe this precaution may cause injury.
- Do not use the motor in any way that would cause the Brake specifications to be exceeded. 33  
Failure to observe this precaution may cause injury or damage.

## **Caution**

(Reference page)

### General

- Do not use the motor in any way that would cause the motor specifications to be exceeded. 26  
Failure to observe this precaution may cause electric shock, injury, or damage.
- Do not place your fingers or any other objects into the openings in the motor.  
Failure to observe this precaution may cause electric shock, injury, or fire.
- Do not use a motor that is damaged in any way.  
Failure to observe this precaution may cause injury or fire.
- Yaskawa is not responsible for any modification of the motor that was made by the user.
- Do not place any objects near the motor in any way that would obscure the nameplate.
- Never remove the nameplate.

### Unpacking

- Confirm that you have received the motor that you ordered. 8  
Installing the wrong motor may result in injury or damage.

### Transportation

- During transportation, be sufficiently careful not to drop or overturn the Motor. 9  
Always use the eyebolt when lifting the Motor. However, after installing the Motor to the machine, do not use the eyebolt to lift the whole machine from the Motor. Confirm the maximum allowable lifting weight of the lifting equipment and confirm the weight of the Motor on the nameplate, on the package, on the dimensions drawing, or in the catalog. Do not attempt to lift a Motor that exceeds the maximum allowable lifting weight of the lifting equipment.  
Failure to observe this precaution may cause the Motor to be dropped or overturned, resulting in injury or damage.

## Caution

(Reference page)

### Installation and Adjustment

- If the Motor may be subjected to dust, dirt, water drops, or other foreign material during temporary or permanent installation, protect the Motor from the dust, dirt, and water drops. 16
- Never leave flammable materials near the Motor. 16  
Failure to observe this precaution may cause fire.
- Do not place any objects that may restrict ventilation near the Motor. 16  
Failure to observe this precaution may interfere with cooling and cause explosion, ignition, or injury due to abnormal heating.
- If you turn the Motor by rotating the end of the shaft, insulate the lead terminals. 16  
Failure to observe this precaution may cause electric shock.
- When you couple the Motor to the load, make sure that the sheave is aligned properly. 18  
Failure to observe this precaution may cause injury due to flying machine parts or equipment damage.
- Install a cover or other guard to prevent contact with rotating objects. 18  
Failure to observe this precaution may cause injury.
- Before installing the rope on the sheave, make sure that the Motor is rotating in the correct direction. 18  
Failure to observe this precaution may cause injury or equipment damage.
- Do not stand on the Motor or hang from the Motor. 18  
Failure to observe this precaution may cause injury.

### Wiring

- When measuring insulation resistance, do not touch the terminals. 21  
Failure to observe this precaution may cause electric shock.
- Perform wiring according to all local electrical codes as they apply. 21  
Failure to observe this precaution may cause burning or fire.
- The Motor is equipped with a thermostat. Connect it to a protection circuit. 21, 35  
Overload protection is required by many electrical codes.  
Failure to observe this precaution may cause burning or fire.
- Do not wire the Motor directly from a commercial power supply. 21  
Overcurrents may damage the circuits or the Motor.
- Do not wire the Motor to anything other than the elevator inverter. 21  
Failure to observe this precaution may cause equipment damage or injury as a result of abnormal operation.

## Caution

(Reference page)

### Operation

- Do not use the Motor in any way that would cause the Motor specifications to be exceeded. 26
- Before starting operation, perform the Encoder offset tuning in *4.3 Preparations for Trial Operation*.  
Failure to observe this precaution may result in the Motor not starting, abnormal increases in the Motor current, or other problems.  
Set the carrier frequency to 8 KHz or higher and set the voltage modulation method to three-phase modulation.  
Failure to observe this precaution may cause strong unpleasant magnetic noise. Also, the rotor may heat abnormally. 26
- Use an inverter with vector control. Also, adjust the vector control phase to a 20° advanced phase (d-q axis control). Failure to observe this precaution may cause voltage saturation during acceleration, preventing acceleration in the specified time. 26
- This Motor is for an elevator. It is therefore designed with a 4-hour time rating of 40% ED.  
If you exceed this time rating, the thermal resistance life of the coil will decrease and the magnets may experience irreversible demagnetization. Design the elevator operation pattern accordingly. 26
- The surface temperature of the Motor and Brake will increase during operation. Do not touch them with your hands or body. 26  
Failure to observe this precaution may cause burn injury.
- When a malfunction occurs, stop operation immediately. 26  
Failure to observe this precaution may cause electric shock, injury, or fire.

### (Maintenance and Inspection)

- When measuring insulation resistance, do not touch the terminals. 28  
Failure to observe this precaution may cause electric shock.
- The surfaces of the Motor and Brake will become very hot. Do not touch them with your bare hands. 28  
Failure to observe this precaution may cause burn injury.
- Inspection must be performed only by qualified personnel. 28  
Failure to observe this precaution may cause electric shock, injury, or fire.
- Do not subject the Encoder to shock. 34  
Failure to observe this precaution may cause damage.

### Disposal

- When disposing of the Motor, treat it as a general industrial waste, abiding by all local regulations as they apply. 39
- Magnets are used in the Motor. Heat the Motor to 500°C or higher to demagnetize the magnets before you dispose of the Motor. 39  
Failure to observe this precaution may cause injury due to magnetic attraction.

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# 1 Inspection at Delivery

 <b>Caution</b>
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- |  |
|--|
| <ul style="list-style-type: none"><li>• Confirm that you have received the Motor that you ordered.<br/>Installing the wrong product may result in personal injury or equipment damage.</li></ul> |
|--|

Immediately after the Motor is delivered, check the following items:

- Was the correct Motor delivered according to the order?
- Are all accessories and spare parts present?

Check the invoice, product description, specifications, and order form against the Motor that was delivered.

- Was there any damage during transportation?

Examine the entire external appearance for any damage that might have occurred during transportation.

- Are there any disconnected wires, loose screws, or other loose parts?

Use a screwdriver or other tools as required.

If you discover any problems, contact the place of purchase or your Yaskawa representative immediately. If there is any damage, request a verification statement from the carrier.

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## 2 Transportation Precautions

### **Caution**

- During transportation, be sufficiently careful not to drop or overturn the Motor. Always use the eyebolt when lifting the Motor. However, after installing the Motor to the machine, do not use the eyebolt to lift the whole machine from the Motor. Confirm the maximum allowable lifting weight of the lifting equipment and confirm the weight of the Motor on the nameplate, on the package, on the dimensions drawing, or in the catalog. Do not attempt to lift a Motor that exceeds the maximum allowable lifting weight of the lifting equipment. Failure to observe this precaution may cause the Motor to be dropped or overturned, resulting in injury or damage.
- The eyebolt may be damaged if it is not securely tightened when lifting the Motor. Always securely tighten the eyebolt.



For Motors with a thrust block, always attach the thrust block again before transporting the Motor to prevent damage to the bearings due to vibration and shock during transportation.

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### 3 Product Specifications

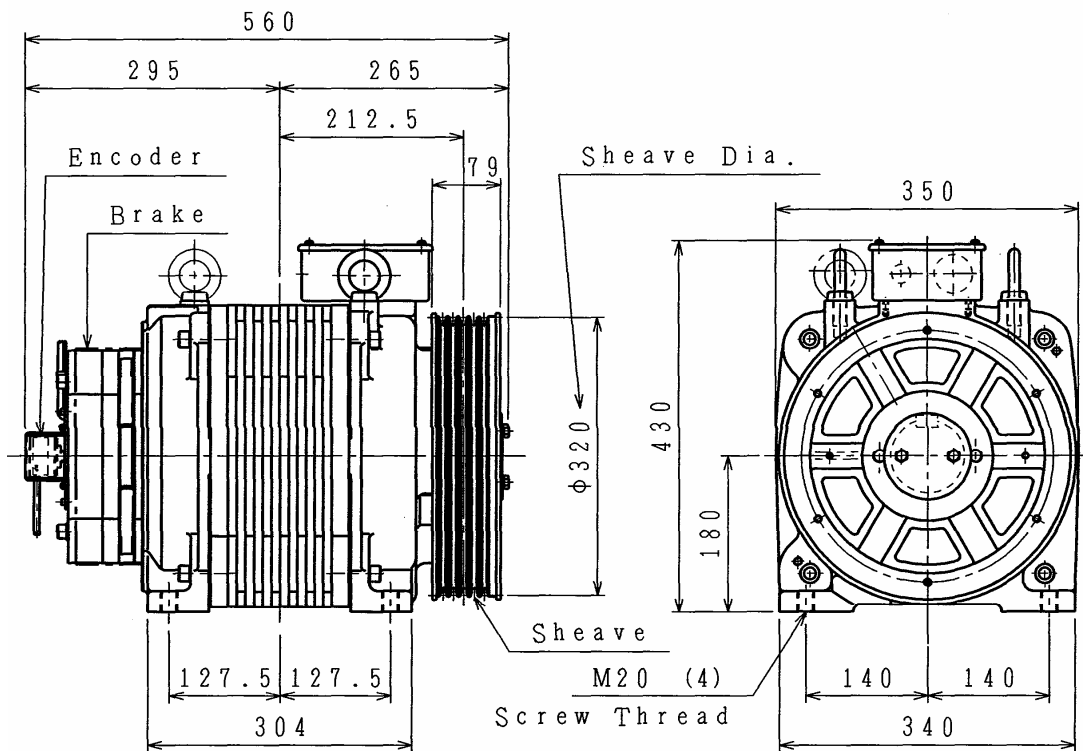
#### 3.1 Standard Specifications

Rated Output <sup>1)</sup>	Rated Load		Motor Rated Speed
	Elevator Speed	630kg	
	1m/s	3.9kW	
1.75m/s	6.8kW	209min <sup>-1</sup>	
Motor Frame No.		180ES	
Number of sheave groove		5	
Sheave shaft load		15700N	
Brake torque		2x320Nm	
Mounting method		Foot – mounted	
Standard		IEC60034-1	
Protection method		Totally-enclosed self-cooled (IEC IP42(not including Brake and Encoder))	
Cooling method		IC4A0	
Power supply ( input power supply)		3-phase 400V class	
Inverter		PWM (Pulse width modulation)	
Maximum torque		200% (corresponded to Inverter)	
Maximum output		170% (200%torque + 85%speed)	
Motor terminal voltage at max. output		360V or less <sup>2)</sup>	
Time rating		40%ED	
Insulation class		F class	
Noise		Motor: 60dB(A) or less (measured at 4 position at 1m in distance) Brake: 60dB(A) or less (at 1m, cut off , rated voltage and original gap)	
Environment	Location	Indoor (without corrosive gases or dust and dirt)	
	Temperature	-10~+40°C	
	Humidity	93%RH or less (non-condensing)	
	Altitude	1000m or less	
Encoder		Sin/Cos(Absolute type) [Power Supply: 5V 2048C/T, Cable length=0.5m] Extension cable for encoder is attached.(D-sub connector,cable length=5m) Encoder cable length : 5.5m (total)	
Sheave		attached	
Sheave cover		attached	
Sheave manual emergency operating device		not attached	
Brake & Limit switch		Electromagnetic brake (1D2A) over exciting voltage 110VDC, rated voltage 48VDC with EN-81 approval Limit switch (Normal Close)	
Painting		Munsell No. 6.0PB 3.9/11.0	

Note 1. Select a Motor output using an 80% efficiency for the elevator.

- Set the Motor's terminal voltage to 360 V based on a 5% reduction from the power supply voltage of 380 V.

### 3.2 Motor Dimensions



Approximate weight:250kg

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## 4 Storage

Store the Motor as specified in this chapter whenever you store it temporarily or long term.

### 4.1 Temporary Storage

#### 4.1.1 Storage Location

Store the Motor in a location that meets the following conditions.

- A clean and dry location
- Indoors

#### 4.1.2 Inspection during Storage

Inspect the Motor as follows once a month during storage:

- Apply a rust-proof coating to the machined surfaces of the shaft and other parts.
- Turn the Motor shaft 30 times or more manually or operate the Motor without connecting it to a load for five minutes.

Be sure to release the Brake before you start.

When you release the Brake, follow the specified Brake release power supply specifications or release the Brake manually. If more than the specified voltage is applied, the coil may be burnt.

For specific Brake release voltage specifications or the manual release procedure, refer to instruction manual for the Brake.

- Check to make sure that there is no rust on the Motor. An anticorrosive coating is applied to the Motor to prevent it from rusting, but rust may still develop during storage depending on the storage conditions.
- Measure the insulation resistance of the coil to confirm that it is 3 MΩ or higher (guideline).

### 4.2 Long-term Storage

#### 4.2.1 Storage Location

Store the Motor in a location that meets the following conditions.

- A clean and dry location  
Ambient temperature: -15 to 50°C  
Humidity: 90% max. (preferably 70% to 75%)
- A location with no condensation
- Indoors
- A location not exposed to direct sunlight
- A location that is separated at least 2000 mm from walls and windows
- A location where the bottom of the Motor is separated at least 100 mm from the floor

- 
- A location that is free from corrosive gases or liquids
  - A location that is free from vibration (to protect the bearings)

## 4.2.2 Storage Method

Store the Motor under the following conditions.

- Unpack the Motor and touch up any scratches or peeling of the surface coating that occurred during transportation.
- Store the Motor in a flat horizontal location with the shaft oriented horizontally.
- Release the Brake (apply Brake torque) to hold the Motor shaft. (Store the Motor so that the Brake prevents the Motor shaft from turning.)
- Cover the top of the Motor to protect it from dust and dew.

Let the cover hang down to the floor to prevent the Motor from being fully enclosed.

If the Motor must be covered completely in a sealed condition, place desiccant inside the cover.

## 4.2.3 Maintenance and Inspection during Storage

Record the storage conditions during storage.

Inspect the Motor as follows once a month during storage:

- Visually inspect the shaft and other machined surfaces and touch up the anticorrosive coating anywhere that is has come off.

Turn the Motor shaft 30 times or more manually or operate the Motor without connecting it to a load for five minutes.

Be sure to release the Brake before you start.

When you release the Brake, follow the specified Brake release power supply specifications or release the Brake manually.

If more than the specified voltage is applied, the coil may be burnt.

For specific Brake release voltage specifications or the manual release procedure, refer to instruction manual for the Brake.

- Check to make sure that there is no rust on the Motor.

An anticorrosive coating is applied to the Motor to prevent it from rusting, but rust may still develop during storage depending on the storage conditions. Particularly rust on the sliding surfaces of the Brake (i.e., the armature and bracket surfaces) or disc will adversely affect Brake characteristics. Pay attention to rust from condensation or humidity.

- Measure the insulation resistance of the coil to confirm that it is 3 MΩ or higher (guideline). Pay attention to any changes in the resistance.

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## 4.3 Preparations for Trial Operation

After storing the Motor, perform the following preparations before performing trial operation.  
Overhaul any Motor that has been stored for 5 years or longer.

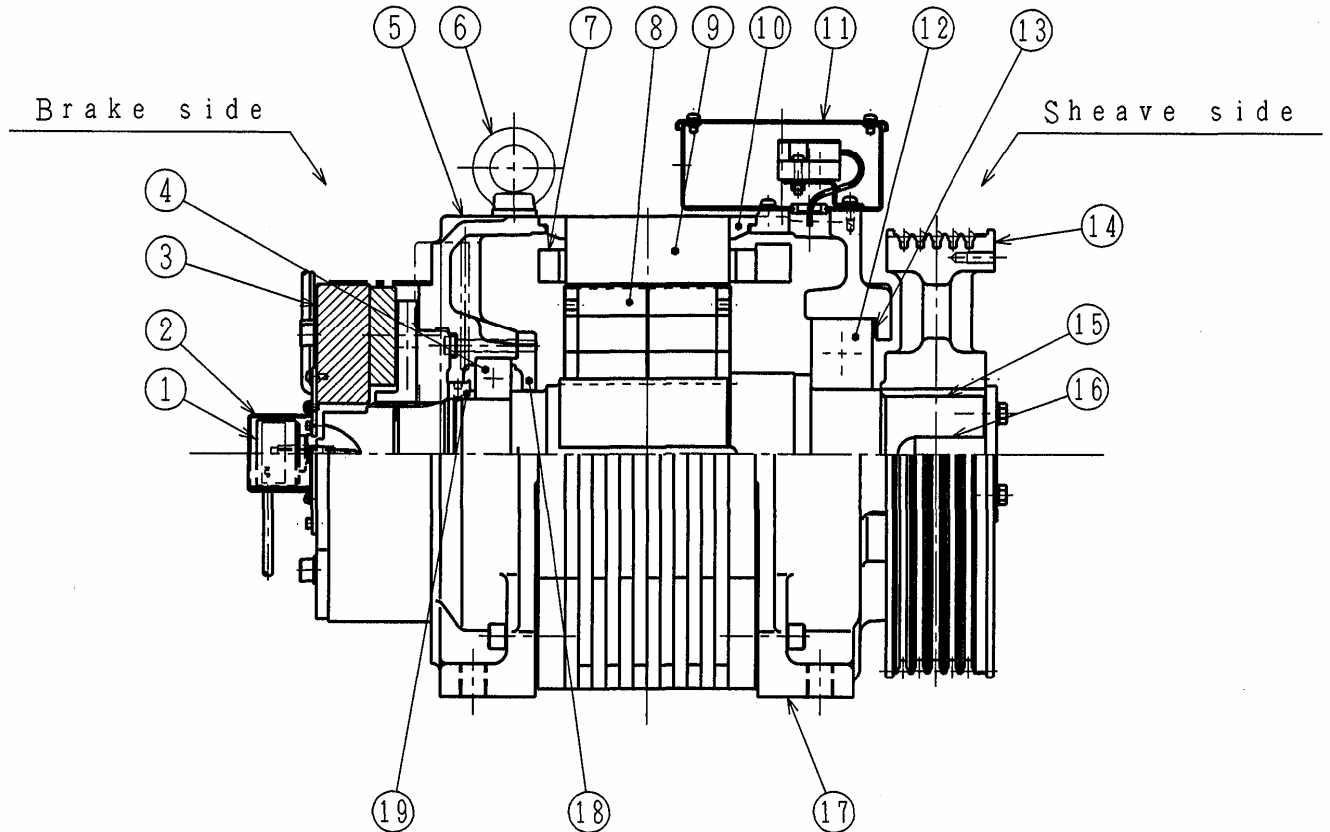
Always perform the following inverter adjustments before performing trial operation on the Motor.

- Perform Encoder offset tuning.  
Make sure that the carrier frequency of the inverter is set to 8 KHz or higher and that the voltage modulation method is set to three-phase modulation.
- If any Motor parameters are required to set up the inverter, enter them from the technical sheets that are provided by Yaskawa before starting trial operation. Be careful of adverse changes (such as vibration caused by excessive loop gain) in the drive performance due to inconsistencies between the actual Motor parameters and the set values.
- To prevent voltage saturation during an overload of the Motor, d-q axis control must be performed by the inverter. One way to control this is to set the vector control axis to a 20° advanced phase against the magnetic axis.  
However, if the inverter provides another control method to prevent voltage saturation, setting the vector control axis to a 20° advanced axis is not required.

## 5 Structure

### 5.1 Internal Motor Structure

The internal structure of the Motor is shown in the following figure.



①	Encoder	⑦	Stator coil	⑬	Wave washer
②	Encoder cover	⑧	Rotor core	⑭	Sheave
③	Brake	⑨	Stator core	⑮	Shaft
④	Bearing	⑩	Stator core retainer	⑯	Key
⑤	Bracket	⑪	Terminal Box	⑰	Bracket
⑥	Eyebolt	⑫	Bearing	⑱	Bearing cover
				⑱	Grease valve



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## 6 Installation

### **DANGER**

- Do not install the Motor on a ceiling or wall.  
Failure to observe this precaution may cause injury.

### **Caution**

- If the Motor may be subjected to dust, dirt, water drops, or other foreign material during permanent or temporary installation, protect the Motor from the dust, dirt, water drops.
- Never leave flammable materials near the Motor.  
Failure to observe this precaution may cause fire.
- Do not place any objects that may restrict ventilation near the Motor.  
Failure to observe this precaution may interfere with cooling and cause explosion, ignition, or injury due to abnormal heating.
- If you turn the Motor by rotating the end of the shaft, insulate the leads.  
Failure to observe this precaution may cause electric shock.

Install the Motor as described in the remainder of this chapter.

### 6.1 Removing Anticorrosive Coating

Before you install the Motor, remove any anticorrosive coating (including grease) with paint thinner. When you do so, do not apply paint thinner to any other parts of the Motor.

### 6.2 Installation Location

Install the Motor in a location that meets the following conditions.

- A well ventilated, dry location
- A location with limited dust and dirt
- A location where inspections can easily be performed
- A location with a high foundation that prevents the Motor from being submerged in water
- A location where any surrounding water is completely drained
- A location where water or oil will not leak from pipes

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## 6.3 Installation Orientation

Mount the Motor so that the shaft is horizontal.

## 6.4 Installation Foundation

The bed, foundation, or trestle must have a rigid construction to prevent vibration due to the weight of the Motor and the dynamic load during operation.



If the Motor is installed on a foundation along with other equipment, the natural frequency of the Motor support, including the base or trestle, must be different enough from the Motor's rotational frequency range (120% or more) to prevent abnormal vibration due to resonance. The natural frequency must also be sufficiently different from any integer multiple of the Motor's rotational frequency range.

If two Motors are installed near each other and the foundation is not strong enough, vibrations from one Motor may be transmitted to the other, possibly causing bearing damage.

Particularly if one of the Motors is stopped for extended periods of time, fretting corrosion may occur. Make sure that the double amplitude of vibration at the Motor when it is stopped does not exceed 3  $\mu\text{m}$  (guideline).

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## 7 Connecting the Load

### **Caution**

- When you couple the Motor to the load, make sure that the sheave is aligned properly.  
Failure to observe this precaution may cause injury due to flying machine parts or equipment damage.
- Install a cover or other guard to prevent contact with rotating objects.  
Failure to observe this precaution may cause injury.
- Before installing a rope on the sheave, make sure that the Motor is rotating in the correct direction.  
Failure to observe this precaution may cause injury or equipment damage.
- Do not stand on the Motor or hang from the Motor.  
Failure to observe this precaution may cause injury.

You must release the Brake to rotate the Motor shaft. Release the Brake by manipulating the Brake power supply. Refer to *11 Electromagnetic Brake* for information on the Brake power supply.

### 7.1 Rope Installation

#### Rope Installation Procedure

##### 1) Removing the Sheave Cover

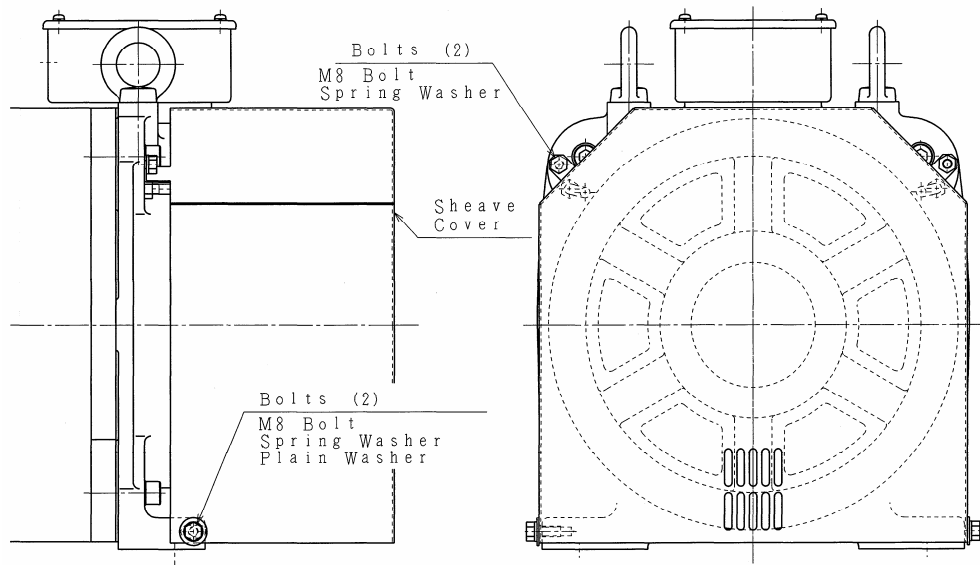
Remove the bolts (M8 bolts with spring and plain washers) from the bottom left and right sides of the Motor (two bolts total).

Remove the bolts (M8 bolts with spring washers) from the front of the Motor (two bolts total).

You can remove the sheave cover after you remove the above four bolts.

Use a box wrench to remove and tighten the bolts.

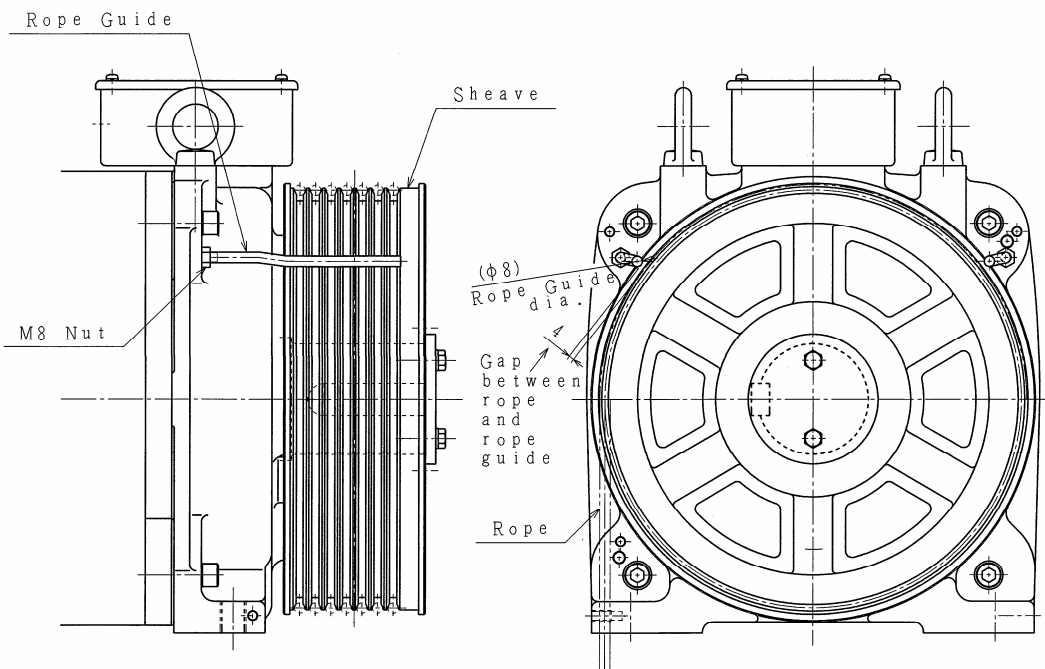
An open-end wrench may strike the Motor, preventing you from turning the bolts. Be careful not to let the sheave cover fall when you remove the bolts.



## 2) Removing the Rope Guides

Remove the two rope guides from the front of the Motor.

Loosen the M8 nuts, and then turn the rope guides to loosen and remove them.



## 3) Installing the Ropes

Loop the ropes around the grooves in the sheave.

## 4) Attaching the Rope Guides

Attach the rope guides to the front of the Motor by attaching the M8 nuts to the rope guide screws. Adjust the angles of the rope guides so that the gap between the rope guide and the rope is between 3.5 and 4 mm. Then tighten the M8 nuts to secure the rope guides. (The M8 tightening torque is 9.8 N•m.)

5) Attaching the Sheave Cover

Attach the sheave cover. Tighten the mounting bolts (M8 bolts with spring washers) from the front of the Motor (two bolts total).

Tighten the mounting bolts (M8 bolts with spring and plain washers) from the bottom left and right sides of the Motor (two bolts total). (The M8 tightening torque is 9.8 N•m.)

Assembly Precaution

When you secure the sheave cover, confirm that it does not interfere with the sheave or Motor shaft before you operate the Motor.

## 7.2 Sheave Installation

- When you remove or attach the sheave for maintenance or other work, select a clearance fit so that the bearings are not damaged. Do not use a shrink fit or force fit.
- If the sheave load increases, the shaft or the bearings may be damaged.
- To reduce the load on the bearings, keep the load point of the sheave as close to the bearing side as possible to reduce distance L between the sheave load point and the bearings, as shown in *Figure 7.1*.

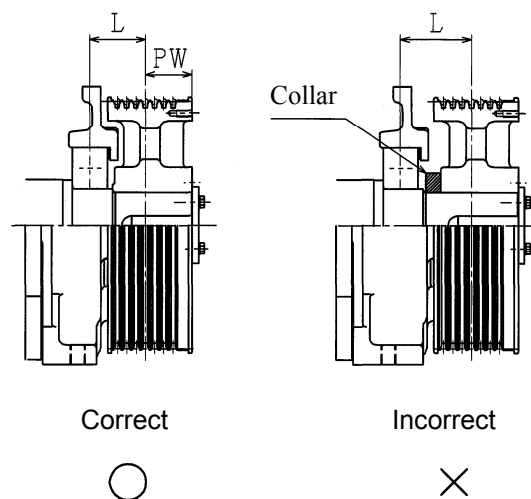


Figure 7.4 Sheave Installation

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## 8 Wiring

### **DANGER**

- When connecting the Motor to the power cable, follow all the procedures that are given in the instruction manual.  
Failure to observe this precaution may cause electric shock or fire.
- Do not forcibly bend, pull, or pinch the power cable or leads.  
Failure to observe this precaution may cause electric shock.

### **Caution**

- When measuring insulation resistance, do not touch the terminals.  
Failure to observe this precaution may cause electric shock.
- Perform wiring according to all local electrical codes as they apply.  
Failure to observe this precaution may cause burning or fire.
- The Motor is equipped with a thermostat. Connect it to a protection circuit.  
Overload protection is required by many electrical codes.  
Failure to observe this precaution may cause burning or fire.
- Do not wire the Motor directly from a commercial power supply.  
Overcurrent may damage the circuits or the Motor.
- Do not wire the Motor to anything other than the elevator inverter.  
Failure to observe this precaution may cause equipment damage or injury as a result of abnormal operation.

### Wiring Precautions

- Perform wiring according to all local electrical codes and power company regulations as they apply. A long wiring distance will increase the voltage drop.
- Wire the cable so that it will not be damaged at the cable lead-in during operation.
- Apply liquid packing to the threaded portion of the conduit to waterproof it and tighten the conduit securely.

## 8.1 Terminal Box Cable Lead-in

The terminal box is attached to the top of the Motor. The cables enter the terminal box from the Brake side.

The orientation of the terminal box cannot be changed.

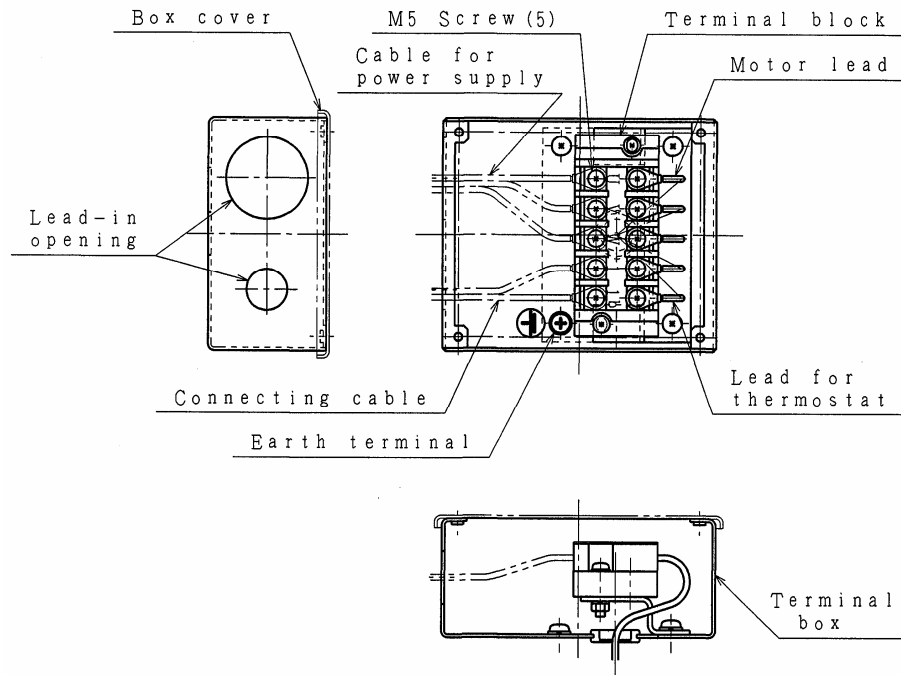


Figure 8.1 Terminal Box Structure

## 8.2 Connecting Lead Terminals

### 8.2.1 Motor Leads and Thermostat Leads

Refer to *Figure 8.2* and connect the cables to the Motor lead terminals and thermostat lead terminals.

The power cable, power transformer, and input reactor between the inverter and Motor lead terminals depend on wiring conditions and other application conditions. Prepare these parts according to the application.

Refer to *13. Thermostat* for the thermostat specifications.

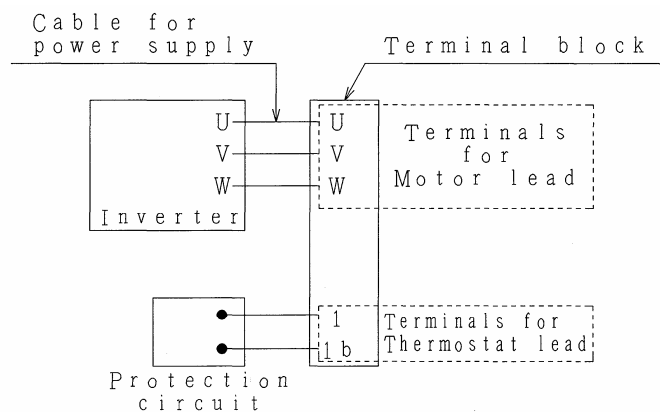


Figure 8.2 Lead Terminal Connection Diagram

## 8.2.2 Brake Leads

The Brake coil leads and limit switch leads are routed as shown in the following figure.

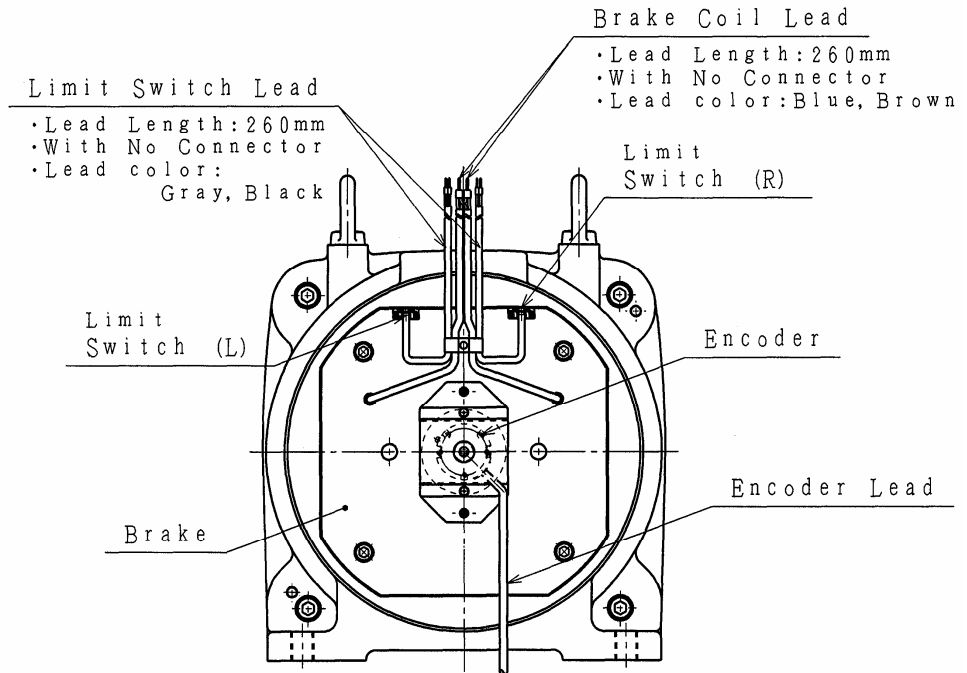


Figure 8.3 Brake Lead Routing Diagram (Viewed from Brake Side)

### 1) Brake Coil Leads

A DC power supply is used. There is no polarity. The blue and brown lead connections can be reversed without any problem.

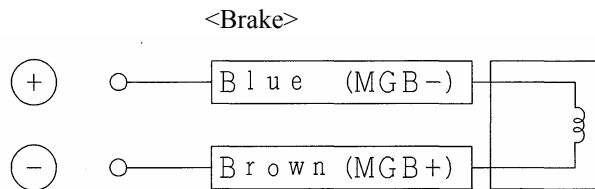


Figure 8.4 Connection Diagram (Example) for Brake coil Lead Terminals

### 2) Limit Switch Leads

Two limit switches are installed, one on the left and one on the right.

There are two limit switch leads for each limit switch. Connect the leads according to the lead colors as shown in *Figure 8.5*.

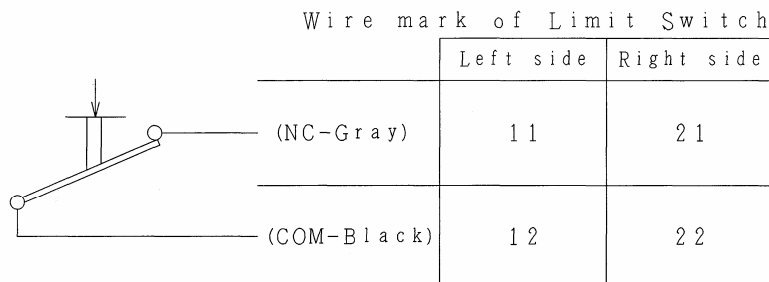
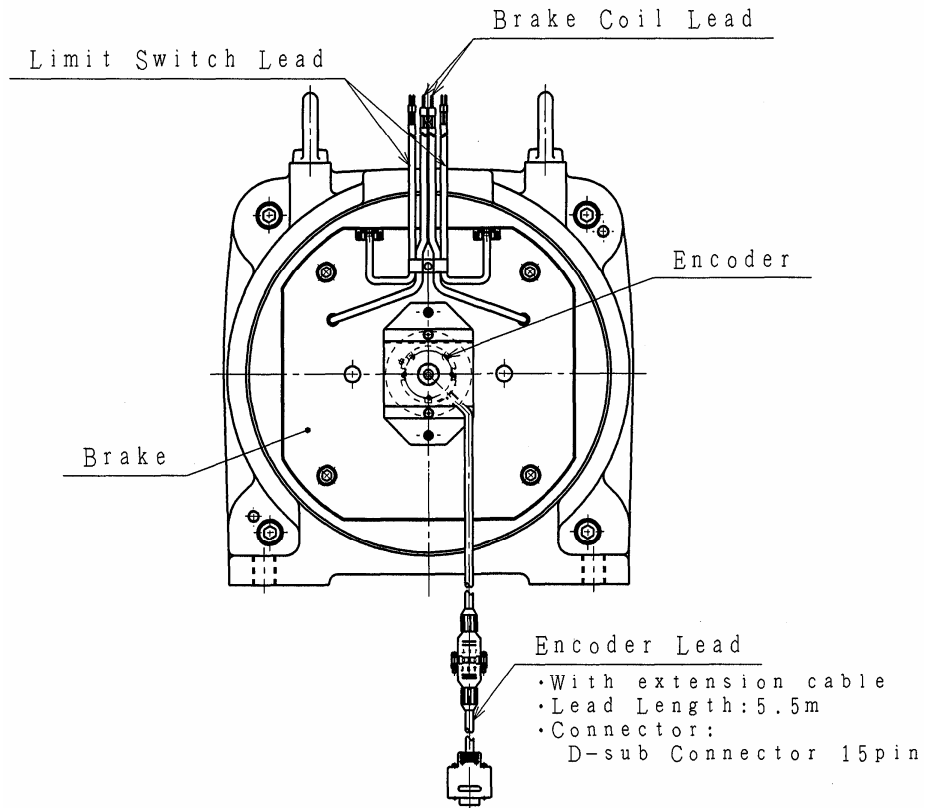


Figure 8.5 Limit Switch Lead Terminal Marks



### 8.2.3 Encoder Lead

The Encoder lead is routed as shown in the following figure.



### TS5213N587 (Sine Wave) Wiring Specifications

The wiring specifications are given in the following table.

Connection of Encoder

PIN No.	FUNCTION
1	B- Output
2	N.C.
3	R+ Output
4	R- Output
5	A+ Output
6	A- Output
7	GND (0V)
8	B+ Output
9	DC+5V
10	C- Output
11	C+ Output
12	D+ Output
13	D- Output

---

## 8.3 Grounding

 <b>DANGER</b>
---

- |  |
|--|
| <ul style="list-style-type: none"><li>• Ground the Motor according to all local electrical codes as they apply.<br/>Failure to observe this precaution may cause electric shock.</li></ul> |
|--|

An earth terminal (M6) is provided inside the terminal box. Always connect this terminal to ground.

## 8.4 Wiring

Wire the Motor as described below.

1. Remove the terminal box cover.
2. Tentatively connect the power cable to the lead terminals and perform trial operation to confirm the desired direction of rotation. As viewed from the coupling, the standard rotation direction is counterclockwise. If you need to reverse the direction, reverse the connections of the V and W phase leads of the three leads. If you reverse the rotation direction of the Motor, also reverse the rotation direction of the Encoder (i.e., two-phase wave advance/lag).
3. A terminal block is used for the lead terminals. Connect crimped terminals (M5) to the power cable and then connect them to the terminal block with the connecting screws.

## 9 Operation

### **DANGER**

- Do not operate the Motor with the cover removed from the terminal box. Replace the terminal box cover after wiring or after performing any other work.  
Failure to observe this precaution may cause electric shock.
- Never approach or touch the shaft or any rotating object during operation.  
Failure to observe this precaution may cause injury as a result of becoming caught in a rotating object.
- If power is interrupted, always turn OFF the power supply switch.  
Failure to observe this precaution may cause injury.

### **Caution**

- Do not use the Motor in any way that would cause the Motor's specifications to be exceeded.
- Before starting operation, perform the Encoder offset tuning in *4.3 Preparations for Trial Operation*.  
Failure to observe this precaution may result in the Motor not starting, abnormal increases in the Motor current, or other problems.  
  
Set the carrier frequency to 8 KHz or higher and set the voltage modulation method to three-phase modulation.  
Failure to observe this precaution may cause strong unpleasant magnetic noise. Also, the rotor may heat abnormally.
- Use an inverter with current vector control.  
Also, adjust the vector control phase to a 20° advanced phase (d-q axis control).  
Failure to observe this precaution may cause voltage saturation during acceleration, preventing acceleration in the specified time.
- This Motor is for an elevator. It is therefore designed with a 4 hour time rating of 40% ED.  
If you exceed this time rating, the thermal resistance life of the coil will decrease and the magnets may experience irreversible demagnetization. Design the elevator operation pattern accordingly.
- The surface temperature of the Motor and Brake will increase during operation.  
Do not touch them with you hands or body.  
Failure to observe this precaution may cause burn injury.
- When a malfunction occurs, stop operation immediately.  
Failure to observe this precaution may cause electric shock, injury, or fire.

Observe the following precautions when you operate the Motor.

- Confirm that the installation, machine coupling, wiring, fuse, and ground are all correct before you start operation.
- Measure the load current with an ammeter and compare it with the current that is given on the nameplate to confirm that the load is suitable.

The time rating concepts for the Motor are described below.

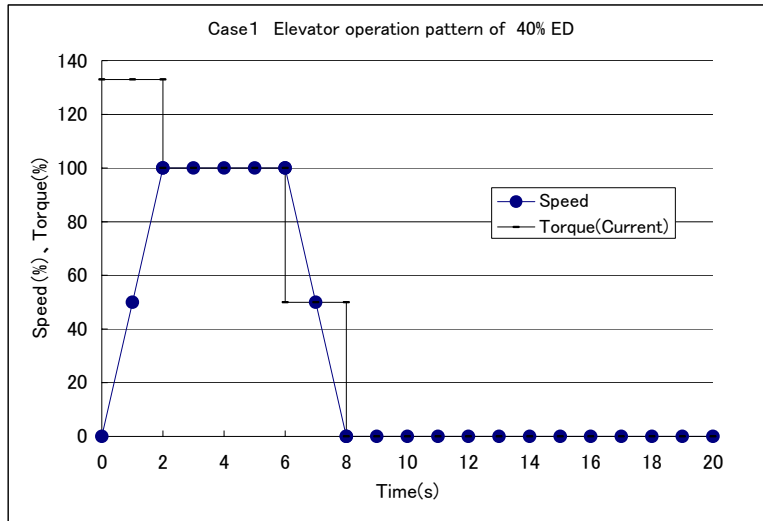
- Number of times elevator starts: 180 times/hour
- Time per operation: 20 s (Stopped time: 12 s, Operating time: 8 s)
- Actual elevator operating time per day: 4 hours (based on the following formula).

$$180 \times 20 \times \frac{8}{(12 + 8)} \times 8(H) \div 3600(S) \cong 4 (H)$$

Also, a load time rate of 40% ED indicates that the effective torque (effective current) for one elevator cycle is 63% of the Motor's rated torque (current).

Refer to the following two examples of elevator operation patterns.

When operation is performed for this time and torque, the Motor's effective torque is 63% of the Motor's rated torque (current). Always set up the Motor so that the Motor's effective torque is 63% or less of the rating.



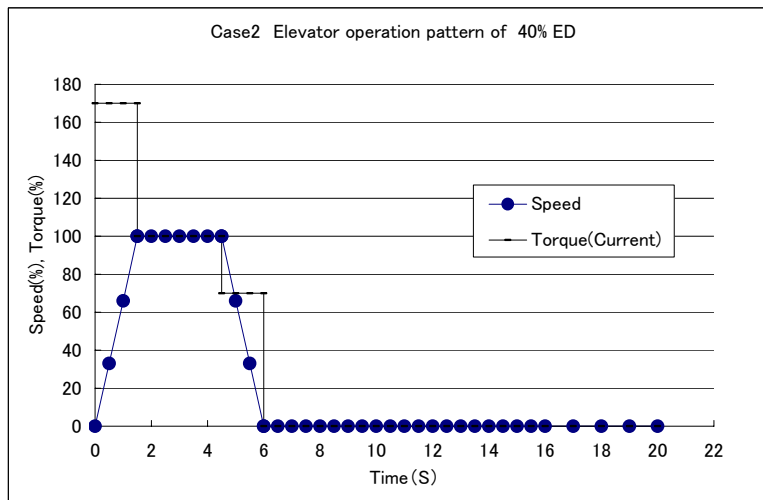
Acceleration time: 2(S),  
at Accelerating torque 133%

Time of constant speed operation: 4(S)  
at Torque 100%

Deceleration time: 2 (S),  
at deceleration torque 50%

Down time: 12(S)

RMS torque =  $\sqrt{(2 \cdot 133^2 + 4 \cdot 100^2 + 2 \cdot 50^2) / (8+12)} = 63.5(\%)$   
(current)



Acceleration time: 1.5(S),  
at Accelerating torque 170%

Time of constant speed operation: 3(S)  
at Torque 100%

Deceleration time: 1.5 (S),  
at deceleration torque 70%

Down time: 14(S)

RMS torque =  $\sqrt{(2 \cdot 133^2 + 4 \cdot 100^2 + 2 \cdot 50^2) / (8+12)} = 63.5(\%)$   
(current)

---

## 10 Maintenance and Inspection

### **DANGER**

- When connecting the Motor to the power cable, follow all the procedures that are given in the instruction manual.  
Failure to observe this precaution may cause electric shock or fire.

### **Caution**

- When measuring insulation resistance, do not touch the terminals.  
Failure to observe this precaution may cause electric shock.
- The surfaces of the Motor and Brake will become very hot. Do not touch them with your bare hands.  
Failure to observe this precaution may cause burn injury.
- Inspection must be performed only by qualified personnel.  
Failure to observe this precaution may cause electric shock, injury, or fire.

## 10.1 Maintenance and Inspection

Periodically perform the inspections that are given in Table 10.1, including during periodic elevator inspections.

Table 10.1 Maintenance and Inspection Items.

Inspection Period		Inspection Location or Item	Inspection Method	Criteria	
During Operation	Operation Stopped				
Monthly	○	Motor vibration	Feel the bearings by hand or use a vibration meter.	Vibration (double amplitude): 50 μm max.	
	○	Motor noise	Check by listening.	Must be free from mechanical vibration or abnormal mechanical noise.	
	○	Bearing noise	Check by listening, with or without a listening rod.	Must be free from intermittent or abnormal noise.	
	○	Motor and bearing temperatures	Feel with your hand or use a thermometer.	Must differ only slightly from the value in the test report. Must differ only slightly from the last measurement value.	
	○	Motor odor	Check by smelling.	Must be free from abnormal odors.	
	○	Coupling to load machine	Check visually and by listening.	Must be free from abnormally large vibration or noise.	
	○	Load current value	Use an ammeter.	Must not be greater than the rated load current.	
		○	Loose bolts on Motor	Tighten using a wrench.	Must not be loose.
		○	Motor cleaning	Remove dust by blowing it off with compressed air.	Must be free from dust.
	○		Bearing grease supply	Supply grease using a grease gun.	-
		○	Tightening of terminal box cover	Tighten using a wrench.	Must not be loose.
		○	Deterioration of leads in terminal box	Check visually.	Must not be deteriorated.
		○	Loose or damaged ground lead	Tighten using a wrench.	Must not be loose or damage.
Annually		Insulation resistance of stator coil	Measure at the terminals using an insulation tester.	Must be 3 MΩ or higher.	
		Cleaning Motor exterior	Remove dust by blowing it off with compressed air.	Must be free from dust.	

---

## 10.2 Bearings

The life of the bearings is approximately 10 years.

If, however, there is abnormal noise near the bearings, replace the bearings. It is possible that they are damaged or worn.

To replace the bearings, use bearings with one of the bearing numbers that are given in *Table 10.2*.

Table 10.2

Bearing No.	Manufacturer
TMB319LLU-RC3/L448QH	NTN Corporation
6216LLUCS38/L542QP	

The bearings use sealed grease. Grease cannot be added.

## 10.3 Bearing Replacement

Normally, bearing replacement is performed by Yaskawa when the Motor is overhauled.

Contact your Yaskawa representative or the nearest Yaskawa sales office.

If you must handle the bearings yourself, observe the following precautions.

Be advised that this will void the warranty.

- Do not handle the bearings with your bare hands.  
Doing so may cause the bearings to rust. Always wear clean gloves when handling the bearings.
- Prevent dust from adhering to the bearings.  
Store the bearings wrapped in clean paper to prevent dust from adhering to them until you are ready to assemble them into the Motor.
- Use only natural cooling for the bearings. Do not use compressed air or a fan to cool the bearings. Doing so may cause dust or foreign matter to adhere to the bearings.
- Do not allow the bearings to become scratched.
- Do not allow foreign objects to enter the Motor.

Use the following procedure to replace the bearings.

### Preparing the Bearings

To replace the bearings, use bearings with one of the bearing numbers that are given in the dimensions drawing.

---

## Removing the Bearings

Use a gear puller to remove the bearings as shown in *Figure 10.2*. Do not remove the rotor from the stator.

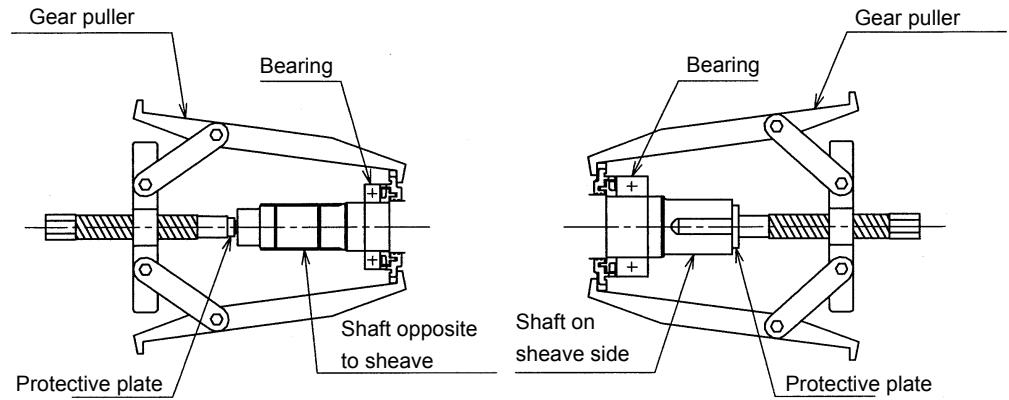


Figure 10.2

## Mounting the Bearings

- Apply a thin coat of grease to the shaft.
- Heat the bearings to between 90 and 100°C.
- Quickly press the bearings onto the shaft all the way until they reach the shaft shoulder. (Press the bearings onto the shaft until they cool.)
- Confirm that you can rotate the outer ring of the bearings with your hand.



---

## 11 Electromagnetic Brake

### **DANGER**

- The Electromagnetic Brake must be handled only by qualified personnel.  
Failure to observe this precaution may cause injury.
- Implement measures so that the elevator car or counterweight will not fall when you release the Electromagnetic Brake.  
Failure to observe this precaution may cause injury.
- Do not attempt to modify the Motor in any way.  
Failure to observe this precaution may cause injury.
- Do not use the Motor in any location where the Brake disc would be subject to contact with water drops or oil drops.  
Failure to observe this precaution may cause injury as a result of abnormal operation.
- Confirm that the emergency stop functions normally.  
Failure to observe this precaution may cause injury.
- Do not use the Motor in any way that would cause the Brake specifications to be exceeded.  
Failure to observe this precaution may cause injury or damage.

Refer to the instruction manual (P14000260) for the structure and handling procedures for the Electromagnetic Brake.

Read the instruction manual completely and make sure that you are familiar with all safety information and precautions on the Electromagnetic Brake before you attempt to inspect or maintain it.

"Electromagnetic Brake Specifications"

Manufacturer: T.E. Alzola S.L.

Product name: Dry-type Single-plate Non-excitation Brake (DC Power Supply)

Model number	FDY400R VER1
Static/dynamic friction torque	320 N•m min. per side × 2
Rated holding voltage	48 VDC ±10% (average for full/half-wave rectification)
Overexcitation voltage	110 VDC ±10% for 1 s (average for full/half-wave rectification)
Time rating	50% duty (when 1 cycle = 18 s)
Insulation class	Class F
Power supply mechanism	<p>Stabilized power supply, full-wave-rectified power supply, or half-wave-rectified power supply</p> <p>Discharge circuit</p> <p>Emergency: DC circuit cutoff (varistor cutoff) [varistor voltage: 470 V] Switch (1)</p> <p>Normal: AC circuit cutoff (diode cutoff) Switch (2)</p> <p>The diagram illustrates a power supply and discharge circuit. It features a power source with terminals labeled 'Power +' and 'Power -'. The circuit includes two switches, 'Switch (2)' and 'Switch (1)', connected in series. A diode is connected in parallel with the power source, with its cathode towards the positive terminal. A varistor is connected in parallel with the diode. A brake resistor is connected in parallel with the varistor and diode. The text indicates that in an emergency, Switch (1) is used for DC circuit cutoff (varistor cutoff), and in normal operation, Switch (2) is used for AC circuit cutoff (diode cutoff).</p>

## 12 Encoder

### **Caution**

- Do not subject the Encoder to shock.  
Failure to observe this precaution may cause damage.

A photoelectric rotary encoder is used as the detector.

Never subject it to shock.

Refer to the instruction manual (P14000203) for the handling procedures for the Encoder.

"Encoder Specifications"

Manufacturer: Tamagawa Seiki Co., Ltd.

Model number: TS5213N587

Attachment details are shown in *Figure 12.1*.

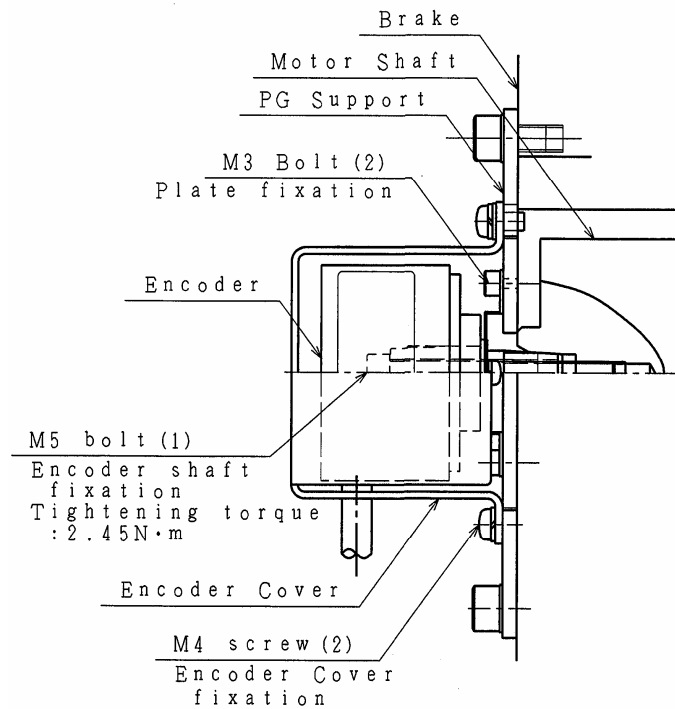


Figure 12.1 Encoder Attachment Details

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## 13 Thermostat

 <b>Caution</b>
--

- |  |
|--|
| <ul style="list-style-type: none"><li>• The Motor is equipped with a thermostat. Connect it to a protection circuit. Overload protection is required by many electrical codes. Failure to observe this precaution may cause burning or fire.</li></ul> |
|--|

A bimetal conductive thermostat is used. It breaks the circuit if the maximum coil temperature is reached. (N.C. contacts are used.)

"Thermostat Specifications"

Manufacturer: Ubukata Industries Co., Ltd.

Model number: UT-451

Contact ratings	Voltage: 250 VAC	Current: 2.5 A AC
Contact switching	Open temperature: 150 $\pm$ 5°C	Close temperature: 128 $\pm$ 11°C

---

## 14 Overhaul

Strong magnets are built into the rotor to firmly hold it to the stator. Therefore, the rotor is difficult to remove from the stator with normal disassembly tools. The procedure can also be hazardous if not performed correctly. Always request overhauls from your Yaskawa representative or the nearest Yaskawa sales office.

## 15 Troubleshooting

Table 16.1 lists possible causes of problems that may occur during operation of the Motor, the inspection methods for the problems, and the corrective actions to be taken.

Table 16.1 Troubleshooting

Problem	No.	Possible Cause	Inspection Method	Corrective Action
Motor does not start and there is no humming sound.	1	Power failure	Measure the voltages between inverter input terminals R, S, and T.	Consult the power company.
	2	Broken leads or two phases of coil open	Check whether normal voltages are being applied to Motor terminals U, V, and W.	Check for disconnection and repair them or rewind the coil.
	3	<ul style="list-style-type: none"> <li>• Failure to release an interlock</li> <li>• Loose connection</li> <li>• Inverter failure</li> <li>• Wire disconnection</li> </ul>	If the defective part cannot be located visually, turn OFF the power and check each part and the wiring.	<ul style="list-style-type: none"> <li>• Release all interlocks. Inspect and adjust the installation.</li> <li>• Turn OFF the power and then repair or replace the defective part.</li> </ul>
	4	Inverter trip due to Inverter error detection	Check inverter error indications.	Correct the problem according to the instruction manual for the inverter.
Motor does not start and there is a humming sound.	5	Wrong inverter	Check the nameplate on the inverter and make sure that the elevator inverter is being used.	Replace the inverter with an elevator inverter.
	6	Overload	<ul style="list-style-type: none"> <li>• Turn OFF the power and check for an overload.</li> <li>• Turn OFF the power and make sure that the Motor or load is not locked.</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce the load. Or, increase the capacity of the Motor.</li> <li>• Remove the cause of the overload.</li> </ul>
	7	Locked by Brake	<ul style="list-style-type: none"> <li>• Turn OFF the power to the Motor and turn the shaft to see if the Brake is released when the power is turned ON.</li> </ul>	<ul style="list-style-type: none"> <li>• Apply the normal overexcitation voltage and holding voltage to the Brake.</li> </ul>
Motor operation starts, but the overcurrent protection on the inverter functions immediately.	8	Wrong inverter selection	<ul style="list-style-type: none"> <li>• Check the startup current.</li> <li>• Check the overload tolerance of the inverter.</li> <li>• Check the startup torque of the load.</li> </ul>	<ul style="list-style-type: none"> <li>• Increase the set value of the inverter's acceleration time.</li> <li>• Increase the capacity of the inverter.</li> </ul>
	9	Short circuit between coil layers in the Motor	Measure the coil resistance in each layer and check the balance.	If voltages are not balanced, replace the Motor.
	10	Short circuit in an external circuit	Turn OFF the power to the Motor and check the external circuits.	Repair or replace the defective external circuit.

(Continued)

Note: If the supply voltages are not balanced, the output power will significantly decrease and the Motor will stop, or the Motor temperature will rise and burn the coils. To correct this, balance the supply voltages so that each current does not exceed the rated current.

Table 16.1 Troubleshooting (Continued)

Problem	No.	Possible Cause	Inspection Method	Corrective Action
Motor operation starts, but the overcurrent protection on the inverter functions after a while.	11	Small inverter capacity	Check the capacity of the inverter.	Increase the capacity of the inverter.
	12	Long startup time	<ul style="list-style-type: none"> <li>• Measure the startup time.</li> <li>• Check the set value of the inverter's acceleration time.</li> <li>• Check the load moment of inertia.</li> </ul>	<ul style="list-style-type: none"> <li>• Correct the set value.</li> <li>• Increase the capacity of the inverter.</li> </ul>
	13	Voltage drop in power supply	Measure the voltages between the Motor terminals U, V, and W.	If a measured voltage is below the rated voltage by 10% or more, check the power capacity and lead capacity and restore the normal voltage.
	14	Overload	Measure the load current and compare it with the rated current.	Reduce the load or replace the Motor with one with larger capacity.
	15	Short circuit between layers	Turn OFF the power and measure the resistances between Motor terminals U, V, and W.	If the resistances are extremely unbalanced, cause 9 in this table is possible. Repair or replace the Motor if necessary.
Motor does not accelerate. (The speed decreases during operation.)	16	Insufficient torque due to voltage drop in power supply	Measure the voltages between the Motor terminals U, V, and W.	Check the power capacity and lead capacity and restore the normal voltages.
	17	Overload	Measure the load current and compare it with the rated current.	Reduce the load or replace the Motor with one with larger capacity.
	18	Motor voltage saturation	Check to see if the phase advance for vector control is 20° to 30°.	Set suitable control phases.

Note: If the supply voltages are not balanced, the output power will significantly decrease and the Motor will stop, or the Motor temperature will rise and burn the coils. To correct this, balance the supply voltages so that each current does not exceed the rated current.

---

## 16 Disposal

### **Caution**

- When disposing of the Motor, treat it as a general industrial waste, abiding by all local regulations as they apply.
- Magnets are used in the Motor. Heat the Motor to 500°C or higher to demagnetize the magnets before you dispose of the Motor.  
Failure to observe this precaution may cause injury due to magnetic attraction.



# Three-Phase Synchronous Motor for Elevators

# COMPACT Type

# Gearless Motor for Elevators

## Instructions

## Totally-Enclosed Type

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### 製造・販売

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FAX：021-59903467

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