

3-PHASE SQUIRREL-CAGE INDUCTION MOTOR

MODEL

SF-PR SERIES

INSTRUCTION MANUAL

Notice

Make sure that this Instruction Manual is delivered to the end user of this motor.

BAN-S-15917-B

3-PHASE SQUIRREL-CAGE INDUCTION MOTOR
SAFETY PRECAUTIONS FOR 3-PHASE SQUIRREL CAGE MOTOR

Thank you for purchasing the Mitsubishi Electric motor. Before starting use of this 3-phase squirrel cage motor (before starting installation, operation, maintenance or inspection, etc.), always read this manual and other enclosed documents thoroughly to ensure correct use. Become familiar with all the knowledge, safety information and safety precautions regarding the equipment before starting handling and operation.

After reading, always store this manual where it can be accessed easily. The safety precautions are ranked as "DANGER" and "CAUTION" in this Instruction Manual.

⚠ DANGER : When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.

⚠ CAUTION : When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as **⚠ CAUTION** may lead to major results depending on the situation. In any case, important information that must be observed is described.

⚠ DANGER
[General]

- ⊘ Do not use this motor in an explosive atmosphere. Use an explosion-proof motor for that type of atmosphere. Failing to observe this could lead to injuries or fires, etc. (Refer to page 2.)
- ⊘ Do not work with a live wire state. Always turn the power OFF before starting work. Failing to observe this could lead to electric shocks. (Refer to page 7.)
- Only trained persons must perform transportation, installation, piping and wiring, operation, maintenance and inspection. Failure to observe this could lead to electric shocks, injuries or fires, etc. as well as motor damage or failure. (Refer to page 7.)

[Piping and wiring]

- Always follow the connection drawing in the terminal box or the Instruction Manual when connecting the power cable. Failure to do so could lead to electric shocks or fires. (Refer to page 8.)
- ⊘ Do not bend, pull or catch the power cable or motor lead wires with force. Doing so could lead to electric shocks. (Refer to page 8.)

[Installation and adjustment]

- Always ground the grounding terminal. Failure to do so could lead to electric shocks. (Refer to page 7.)
- When installing the motor on a ceiling or wall, it could fall depending on the circumstances. Refer to the catalog or technical documents for details on the applicable range. Failure to observe this could lead to injuries. (Refer to page 2.)

[Operation]

- ⊘ Do not operate the motor with the terminal box cover removed. After work, return the terminal box cover to its original position. Failure to do so could lead to electric shocks. (Refer to page 9.)
- ⊘ Never go near or touch the rotating parts (shaft, etc.) during operation. Failure to observe this could lead to entanglement or injuries. (Refer to page 9.)
- Always turn the power switch OFF if a power failure occurs. Failure to do so could lead to injuries. (Refer to page 9.)

[Maintenance and inspection]

- Always follow the connection diagram in the terminal box or the Instruction Manual when connecting the power cable. Failure to do so could lead to electric shocks or fires. (Refer to page 8.)

- ⊘ : Indicates prohibited (must-not-do) operation
- : Indicates forced (must-do) operation
- ⚠ : Indicates cautionary notes to operation

CAUTION

[General]

- ⊗ Do not use the motor outside its specifications. Failure to observe this could lead to electric shocks, injuries or damage, etc. (Refer to page 1.)
- ⊗ Do not insert fingers or objects into the motor openings. Failure to observe this could lead to electric shocks, injuries or fires, etc. (Refer to page 9.)
- ⊗ Do not use a damaged motor. Failure to observe this could lead to injuries or fires, etc. (Refer to page 1.)
- Do not place items to impair visibility of the nameplate, and do not remove the nameplate. (Refer to page 2.)
- Modifications of the product by the user are not covered by the Mitsubishi Warranty. Thus, Mitsubishi will not bear any responsibility. (Refer to page 19.)

[Shipment and transportation]

- △ Dropping or failing of the motor during transportation will create a hazardous situation, so take special care.
- If the motor is provided with eye bolts, use the eye bolts. Avoid lifting the entire machine with the eye bolts after the motor is installed on a machine. (Refer to page 1.)
- ⊗ Check the nameplate, packaging, catalog or outline dimension drawings for the motor weight before lifting it, and do not lift a motor that exceeds the rated capacity of lifting devices.

[Unpacking]

- Confirm the orientation of the package. If the package is crated, take care to the nails when unpacking. Failure to do so could lead to injuries. (Refer to page 1.)
- Confirm that the delivered product is as ordered. Installation of an incorrect product could lead to injuries or damage etc. (Refer to page 1.)

[Installation and adjustment]

- When operating motor by star-delta starting, select an electromagnetic switch (three-conductor type) on the primary side. Failure to do so could lead to fires. (Refer to page 8.)
- When operating the motor with a 400V class inverter, install a suppressing filter or reactor on the inverter side, or use a motor with reinforced insulation. Failure to do so could lead to damage or fires due to insulation breakage. (Refer to page 10.)
- ⊗ Do not place objects around the motor that will block the ventilation. Do not place flammable objects around the motor. Failure to observe this could lead to blocking of the cooling leading to abnormal overheating, or to firers or burns, etc. (Refer to page 2.)
- The outdoor type motor has a drain hole, etc. on its bottom. Install the motor in the position shown in the outline drawing or final diagram. (Refer to page 2.)
- When coupling the motor with the load, take care to the centering, belt tension and pulley parallelism, etc. When directly coupling, take care to the coupling precision. When using a belt catching method, correctly adjust the belt tension. Confirm that the pulley and coupling tightening bolts are securely tightened before starting operation. Failure to do so could lead to injuries from broken pieces flying or to device damage.
- Install a safety cover, etc., so that the rotary sections cannot be touched. Failure to do so could lead to injuries. (Refer to page 2.)
- When running the motor as a single unit, remove the key installed on the shaft-end. Failure to do so could lead to injuries. (Refer to page 9.)
- Confirm the rotation direction before coupling the motor with machine. Failure to do so could lead to machine damage. (Refer to page 9.)
- ⊗ Never get on or hang from the motor. Failure to observe this could lead to motor damage or injuries. (Refer to page 2.)
- ⊗ Do not touch the motor shaft end keyway with bare hands. Failure to observe this could lead to injuries. (Refer to pages 1 and 9.)

[Piping and wiring]

- Wire the motor according to the Electrical Equipment Technical Standards or Interior Wiring Code. (Refer to page 7.)
- This motor does not have a circuit protection device. Installation of an overload protection device is mandatory under the Electrical Equipment Technical Standards. Installation of a protection device (leakage breaker, etc.) in addition to an overload protection device is recommended. Failure to do so could lead to burning or fires. General fuses may not be able to protect the motor from overcurrent. Monitor the operating condition of the fuse used, and, if the fuse cannot operate upon occurrence of trouble, install a motor breaker or a thermal relay. (Refer to pages 7 and 9.)

[Operation]

- ⊗ The motor will become hot during operation. Take care not to touch the motor with your hands or body. Failure to observe this could lead to burns, etc. (Refer to page 9.)
- Stop operation immediately if an abnormality occurs. Failure to observe this could lead to electric shocks, injuries or fires, etc. (Refer to page 10.)
- △ A small amount of grease may come out of the bearings, so care is needed when using the motor for a purpose or in a location that has to avoid oil (such as operation in a clean room or operation on a food machine).

[Electrolytic corrosion of bearings]

- △ When an inverter drives the motor, shaft voltage occurs theoretically on the motor shaft. The shaft voltage could rarely cause the bearings to experience electrolytic corrosion depending on the method of electrical installation, motor load and operating conditions and inverter settings (high carrier frequencies or installation of a capacitive filter).
- △ The following countermeasures may apply to the inverter to avoid electrolytic corrosion.
 - Reduce the carrier frequencies.
 - Add a common mode filter on the output side of the inverter.
 - Do not install a capacitive filter.

[Maintenance and inspection]

- ⊗ Never touch the terminal with bare hands when measuring the insulation resistance. Failure to observe this could lead to electric shocks. (Refer to page 9 and 11.)
- △ Follow the instructions on the lubrication procedure instruction plate to charge grease into or remove grease from the bearings. Be aware of the rotating bodies. Otherwise, a personal injury could result. (Refer to page 13.)
- ⊗ The motor frame will become hot during operation. Take care not to touch the motor with your hands or body for a while after stopping. Failure to observe this could lead to burns, etc. (Refer to page 18.)

[Disassembly, reassembly, repairs, modification]

- All disassembly, reassembly, repairs and modification must be done by a specialist. Failure to do so could lead to electric shocks, injuries or fires, etc. (Refer to page 19.)

[Disposal]

- Treat the motor as general industrial waste when disposing of it. (Refer to page 24.)

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(*) The characteristics value and the value without tolerance are representative values in this document.

1. ACCEPTANCE INSPECTION

Check the following points after the motor has been delivered and before installing it. **Before opening the package, confirm the orientation. If the package is crated, take care for the nails when unpacking.**

- a. Check the type (TYPE), output (kW), poles (POLE), voltage (V) and frequency (Hz) indicated on the nameplate.
- b. Check that the motor shaft can be rotated lightly by hand without any catching. **(Take care not to cut your hand on the keyway.)**
- c. Check that the motor has not been damaged during shipment.

If there are any unclear points regarding the above items or if any damage is found, notify the type (TYPE), output (kW), poles (POLE), voltage (V), frequency (Hz), manufacturing No. (SERIAL), manufacturing date (DATE) and the state to Mitsubishi or your dealer.

Do not use a damaged motor or a motor that does not satisfy the specifications. Doing so could lead to electric shocks, injuries or damage.

2. TRANSPORTATION AND STORAGE

(1) Transportation

Eye bolts are provided for motors that weigh 30kg or more. Use these eye bolts during transportation.

Note that these eye bolts are provided only for lifting the motor. **Lifting the machine with these eye bolts after the motor has been set on the partner machine will be very hazardous.**

(2) Storage

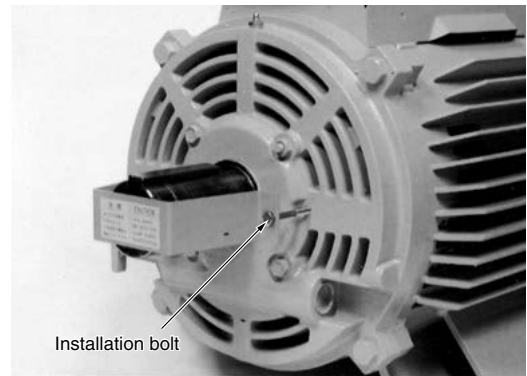
- a. Observe the following points when the motor is not to be used immediately after delivery.
 - (a) Store the motor in a clean and dry place.
 - (b) When storing the motor outdoors or where it will be subject to humidity, cover the entire product with a waterproof cover to protect it from rain water and dust.
- b. Observe the following points when storing the motor, and periodically (approx. once a month) check the following points.
 - (a) Measure the insulation resistance of the coils. If the insulation resistance has dropped excessively, thoroughly dry the coils and insulation according to the maintenance procedure on page 12 and take further care to keep them dry. Use the motor when the insulation resistance is 100MΩ and above. Do not use it if 1MΩ or below.
 - (b) Rust preventing agent is applied on the motor to prevent rust from forming during use. However, check that rust has not formed due to the storage conditions.
 - (c) When storing the motor for a long time, reapply rust preventing agent on the machining surface such as the shaft.
 - (d) When storing the motor for a long time in a warehouse or in the installed state, hand tune the motor or idly run the motor for five minutes approx. once a month.
 - (e) Refer to the separate "Long-term storage procedures (BAN-13984)" for further details on long-term storage of the motor.

3. SHAFT PROTECTION CLAMP

A motor that uses roller bearings is equipped with the shaft protection clamp so that the shaft displacement or vibration during the transport would not damage the roller bearings. (Refer to Fig. 1.)

Before hooking up the motor to a machine, loosen the installation bolt to remove the installation hardware.

If you have to transport the machine with the motor connected to it for delivery, be absolutely sure to remove the pulley and other devices and install this shaft protection clamp. Or provide the motor with some other means so as not to let the shaft be displaced.



(Nagoya Works B904138-1)

Fig. 1 Shaft protection clamp

4. INSTALLATION

Observe the following points as incorrect installation will shorten the motor's service life and can directly lead to accidents.

- a. **Always use an explosion-proof motor when using the motor in an explosive environment.**
- b. **When installing the motor outdoors, always use the outdoor type motor (IP44). If the installation environment is severe, use a water-proof and dust-proof motor (IP55). For the details, contact us.**
- c. The standard motor is not adequate for use in an acidic or alkaline environment. For use in this type of environment, contact Mitsubishi for a corrosion proof motor.
- d. **When installing the motor on a ceiling or wall, it could fall depending on the circumstances. Refer to the catalog or technical documents for details on the applicable range.**
- e. **Install a cover, etc., as a means to prevent foreign matter entering or persons touching the coupling, belt or pulley** that couple the motor and partner machine.
- f. Avoid installing the motor in a high-humidity, high-dust, high-temperature place where water or oil may come in contact. Select a well-ventilated, clean, dry environment.
- g. Note that if the motor is used in a dusty area, the heat radiation effect (cooling effect) of the motor may be degraded, resulting in rise of motor temperature, or dust may enter the bearings, thereby causing abnormal noise and damage.
- h. If the motor is installed near a wall or near other devices, the motor's cooling path will be blocked causing the motor to overheat. **Always provide a space (generally 20cm or more) when installing the motor.**
- i. Select a place where the motor can be easily serviced and inspected.
- j. To install, embed the motor in a concrete foundation or secure the motor to a rigid steel structure or wooden frame so that the shaft will always be horizontal. (When installing the vertical motor, make sure that the shaft is vertical and the shaft end is facing down.) Always install special motors according to the specifications. Most cases of abnormal motor vibration are caused by a weak foundation or incorrect coupling with the partner machine. Make sure to correctly install and couple the motor.
- k. **Do not place flammable matters around the motor.**
- l. **Never get on or hang from the motor.**
- m. **Make sure that the nameplate is always visible.** Do not place obstacles near the nameplate or remove the nameplate.
- n. The outdoor type motor has a drain hole, etc. on its bottom. Install the motor in the position shown in the outline drawing or final diagram. The standard structure of the shaft through hole on the load side of the outdoor flange type motor is not sealed. Ensure the water-tightness of the flange joints.
- o. After connecting with the machine, treat the machined motor shaft surfaces with a rust-preventive agent to prevent the motor shaft from rusting.

5. COUPLING WITH MACHINE

(1) Direct coupling (Refer to Fig. 2.)

Install the motor so that the center of the motor-shaft and the center of the partner machine's shaft are aligned. Place a linear under the motor or machine leg if necessary, and completely adjust.

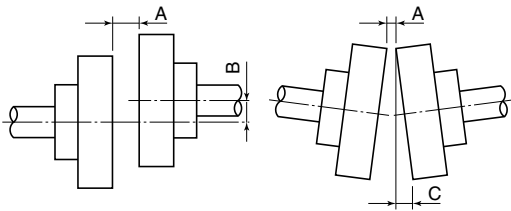


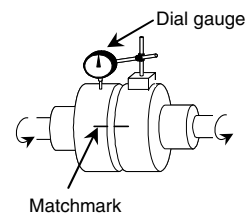
Fig. 2 Direct coupling with partner machine

Table 1 Allowable mounting dimensions of coupling

| Kind of coupling | Dimension A | Dimension B | Dimension C |
|-------------------|--|-----------------|-----------------|
| Rigid coupling | 0 mm | 0.03 mm or less | 0.03 mm or less |
| Flexible coupling | Coupling manufacturer's recommendation or less | 0.05 mm or less | 0.04 mm or less |

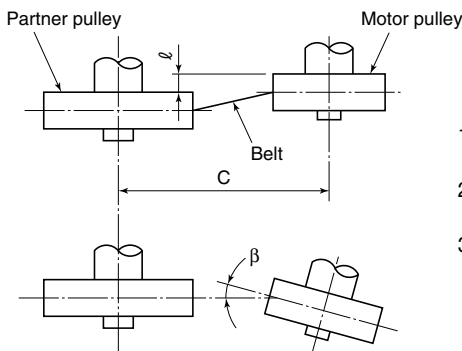
[Supplement] Coupling centering procedures

- (1) Put a matchmark on the outer periphery of the coupling.
- (2) Secure the dial gauge on one side of the coupling.
- (3) Turn the shaft by 90°, read the value on the dial gauge, and measure the gap in the matchmark with a thickness gauge.
- (4) Adjust the coupling until the value on the dial gauge and the measurement of gap conform to Table 1.



(2) Belt drive

- a. Set the motor and partner machine so that the shafts are parallel, and so that the centers of both pulleys are at a right angle on the same line. (Refer to Fig. 3.)



1. $\ell < 1$ mm when C is 1000 mm or less
2. $\ell < C/1000$ when C exceeds 1000 mm
3. $\beta < 1/3^\circ$

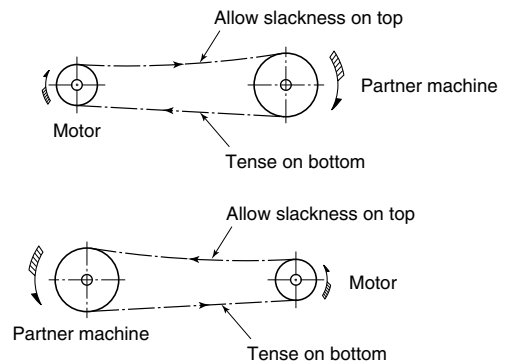


Fig. 3 Belt guiding method

- b. Make sure that the lower side of the belt is the tensed side. For this, first determine the rotation direction of the partner machine, and then determine the motor position. (Refer to Fig. 3.)
- c. Refer to Table 2 for the motor and partner machine shaft-to-shaft distance.
- d. Belt tensioning method

If the belt is too tense, the bearings may be damaged or the shaft may break. If the belt is too loose, slipping may occur causing the belt to be damaged or to come off. For the flat belt, the adequate degree is where the pulley rotates lightly when the belt is pulled with one hand. Calculate the tension of the V-belt with the following expression.

- (a) Obtain the span length t of the belt and V-pulley with the following expression or by actual measurement.

$$t = \sqrt{C^2 - \left(\frac{D-d}{2}\right)^2} \text{ (mm)}$$

Table 2 Motor and partner machine shaft-to-shaft distances

| | V belt | Flat belt |
|-------------------|-------------------|-----------------------|
| Adequate distance | Two times $D + d$ | Five to six times D |
| Min. distance | $D + d$ | Three times D |

- (b) Obtain the center of t , apply a perpendicular load to the V-belt at this center point, and obtain the deflection force T_d (N) where the deflection amount δ at that point is the following value.
- $$\delta = 0.016 \times t \text{ (mm) (Refer to Fig. 4.)}$$
- For example, the deflection amount for a distance of 1m between the belt contact would be $0.016 \times 1000 = 16$ (mm).
- (c) Obtain the deflection force T_d (N) for each belt, and **adjust the belt tension** so that the average value enters the range of the values given in Table 4.
1. When using multiple V-belts, use a matched set that has the same belt lengths.
 2. When running the motor after mounting a new belt, the belt will elongate after two to eight hours and become loose. Thus, adjust with the retensioning deflection force (T_d) according to Table 4.
 3. Always adjust the belt after it has been replaced. If an old belt is used for the replacement, adjust with the retensioning deflection force (T_d).

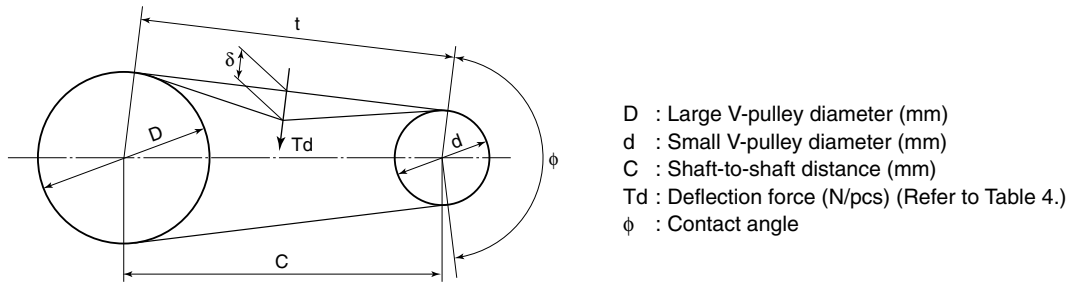


Fig. 4

- e. If the belt slackens during use, adjust the tension with the adjusting bolt on the motor's slide base. If the flat belt slips, apply a small amount of belt wax. Do not use wax for the V-belt.
- f. The pulley selection is often a problem for using the belt drive, so refer to the section "6. APPLICATION OF BELTS AND PULLEYS."
- g. The deflection force T_d given in Table 4 is the value for when the contact angle between the belt and V-pulley is 140° . If the contact angle changes, multiply the deflection force in Table 4 by the compensation coefficient K in Table 3, and obtain the deflection force for each.

(Example : 55kW, 4-pole, standard V-belt, contact angle 180° : Deflection force $T_d (180^\circ) = K \times T_d (140^\circ) = 0.9 \times (46 \text{ to } 53) \approx 41.4 \text{ to } 47.7$ (for new belt tensioning))

Table 3 Contact angle compensation coefficient

| Contact angle ϕ | 140° | 150° | 160° | 170° | 180° |
|----------------------|-------------|-------------|-------------|-------------|-------------|
| K | 1.0 | 0.98 | 0.94 | 0.91 | 0.9 |

- h. When using a V-belt or V-pulley other than that shown in Table 4, the deflection force T_d (N) must be calculated separately. Refer to the Japan Electrical Manufacturers' Association Technical Document No. 108 "V-belt tension and application" for the calculation method. Be aware that the deflection force (N) specified in the catalogs of the belt manufacturers may larger than the motor has expected. Depending on the situations, using such catalog values may lead to damage to the motor bearings or cause the shaft to break.

(3) Gear coupling

Engage the gears when the motor and partner machine shafts are parallel. Check the following points to confirm that the gears are correctly engaged. Note that if the gear diameter is small, bending load may be applied to the shaft. There is a possibility of generation of high frequency vibration as large as the number of teeth of gear \times rotation speed (nZ component). Check the vibration (speed/acceleration) to confirm that it is within the standard range. (Also in the case of use of timing belt, high frequency vibration may occur.)

- a. Check the centers of both gears aligned.
- b. If possible, apply a light coat of red iron oxide, and rotate the gears to confirm that the teeth are contacted.
- c. Check any abnormal noise during the rotation.
- d. Measure the backlash with a thickness gauge to check that it is adequate.

(4) Chain drive

Adjust the chain length so that a slight slackness is formed when the gears are aligned. The shaft-to-shaft distance should be larger than the diameter of the larger gears plus the diameter of the smaller gears. Consult with the chain manufacturer for the max. speed ratio and chain lubrication, etc.

(5) Coupling with internal shaft by key

If the shaft is fitted loosely in the hole, rotary eccentric load will be generated, and creep may occur on the fitting surfaces of the motor bearing. It is recommended that the gap between the fitting surfaces be 0.03 mm or less as a difference in diameter.

(6) Other precautions

a. The balance of the items fixed to the motor shaft such as the pulley, coupling, gears, fan and impeller must be **within G2.5** specified in JIS B 0905 (balance of rotation devices) when measured with a balancing machine (rotor balancing machine). **The motor will abnormally vibrate if the balance is incorrect.**

(Note) 1. Rusting of the outer bearing ring and wearing of the housing is caused by repeated fine friction of the bearing engagement section. This is caused by an unbalance.

2. Take note to the tolerable center runout of commercial flexible couplings.

b. **If the pulley or coupling is hammered hard to fit it to the motor shaft, the bearing may be damaged.**

When the shrinkage margin with the shaft is large, shrink-fit it. To fit the shaft end key, use a vinyl hammer. (An iron hammer will give a high impact and may damage the bearing.)

c. If a rust preventive agent with high rust prevention ability has been applied to the motor output shaft and attached key, remove the agent prior to use.

6. APPLICATION OF BELTS AND PULLEYS

If the selection of the belt and belt tensioning method are mistaken when coupling the motor and partner machine with a belt, an excessive force could be applied on the shaft end and bearings, and the life may be shortened and damage could occur. Observe the following points when making the selection and installing.

(1) The application of the motor side V-pulley and V-belt is as shown in Table 4. If the pulley diameter is smaller or the number of belts larger than the values given in Table 4 or if the stepped section of the motor shaft and the rim edge of the pulley are not on the same plate, confirm that the belt load is lower than the motor's tolerable radial load. If the belt load is larger than the motor's tolerable radial load, reselect motor or the pulley and belt combination. The relation of the force applied on pulley and motor shaft is as follows.

Relation of force applied on pulley diameter and shaft

.....The larger the diameter is, the smaller the force applied on the shaft will be.

Relation of force applied on pulley width and shaft stepped section

.....The larger the width is, the greater the force applied on the shaft stepped section will be.

Relation of force applied on pulley axial center and shaft stepped section

.....The greater the clearance between the center and shaft stepped section is, the greater the force applied on the shaft stepped section will be. (Install so that the motor shaft stepped section and pulley rim edge is on the same plate. (Refer to Fig. 5.)

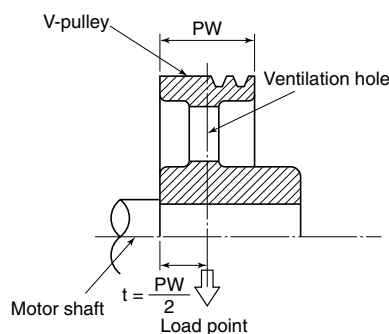


Fig. 5 Installation of pulleys

[Supplement] Formula for estimating axial load F_s by belts

$$F_s = 2 \times N \times (16 \times T_d - Y) \times \sin(\phi/2)$$

N : Number of belts

T_d : Deflection load (N) (Refer to Table 4.)

Y : Coefficient according to the kind of V-belt

A(14.7), B(19.6), C(29.4), D(58.8), 3V(19.6), 5V(49)

ϕ : Contact angle (Refer to Table 3.)

Remarks 1. For more information, refer to Technical Data No.108 issued by The Japan Electrical Manufacturers' Association.

2. For the allowable radial load at the shaft end, refer to Section "Technical Information" in the general catalog.

- (2) Use an arm-type pulley that has a ventilation hole so that the pulley does not obstruct the ventilation cooling.
Provide as large a ventilation hole as possible if a flat plate type is to be used. (Refer to Fig. 5.)
- (3) The V-Belt speed is as follows.
Standard V-belt max. 30m/s (Max. pulley diameter for 4-pole motor is 320.)
Narrow V-belt max. 40m/s (Max. pulley diameter for 4-pole motor is 425.)
- (4) Select the gear-ratio so that the contact angle ϕ of the belt and pulley is 140° or higher. (Refer to Fig. 4.)

Table 4 Application of V-belt and V-pulley and the deflection force for standard motors (Contact angle 140°)

| Rate output kW | No. of poles | Standard V-belt | | | | | | Narrow V-belt | | | | | |
|----------------|--------------|-----------------|--------------|-------------------------------|--------------------|-----------------------------|------------------|---------------|--------------|-------------------------------|--------------------|-----------------------------|------------------|
| | | Model | No. of belts | Pulley | | Deflection force Td (N/pcs) | | Model | No. of belts | Pulley | | Deflection force Td (N/pcs) | |
| | | | | Nominal diameter (min. value) | Width (max. value) | For new belt | For retensioning | | | Nominal diameter (min. value) | Width (max. value) | For new belt | For retensioning |
| 0.75 | 2 | A | 1 | 80 | 20 | 6.9 to 7.8 | 5.4 to 6.9 | 3V | 1 | 71 | 17.4 | 6.9 to 7.8 | 5.9 to 6.9 |
| 1.5 | 2 | A | 2 | 80 | 35 | 7.8 to 8.8 | 5.9 to 7.8 | 3V | 1 | 75 | 17.4 | 13 to 15 | 9.8 to 13 |
| 2.2 | 2 | A | 2 | 90 | 35 | 9.8 to 11 | 7.8 to 9.8 | 3V | 1 | 75 | 17.4 | 18 to 21 | 14 to 18 |
| 3.7 | 2 | A | 3 | 90 | 50 | 9.8 to 12 | 7.8 to 9.8 | 3V | 2 | 75 | 27.7 | 16 to 18 | 13 to 16 |
| 5.5 | 2 | A | 3 | 112 | 50 | 13 to 15 | 9.8 to 13 | 3V | 3 | 75 | 38.0 | 16 to 18 | 13 to 16 |
| 7.5 | 2 | A | 3 | 132 | 50 | 15 to 18 | 12 to 15 | 3V | 4 | 80 | 48.3 | 15 to 18 | 12 to 15 |
| 0.75 | 4 | A | 1 | 80 | 20 | 11 to 13 | 8.8 to 11 | 3V | 1 | 71 | 17.4 | 13 to 15 | 9.8 to 13 |
| 1.5 | 4 | A | 2 | 90 | 35 | 11 to 12 | 7.8 to 11 | 3V | 2 | 75 | 27.7 | 13 to 15 | 9.8 to 13 |
| 2.2 | 4 | A | 2 | 100 | 35 | 14 to 16 | 11 to 14 | 3V | 2 | 75 | 27.7 | 18 to 21 | 14 to 18 |
| 3.7 | 4 | A | 3 | 112 | 50 | 14 to 16 | 11 to 14 | 3V | 2 | 100 | 27.7 | 23 to 25 | 18 to 23 |
| 5.5 | 4 | B | 3 | 125 | 63 | 19 to 22 | 15 to 19 | 3V | 3 | 100 | 38.0 | 22 to 25 | 17 to 22 |
| 7.5 | 4 | B | 3 | 150 | 63 | 22 to 25 | 17 to 22 | 3V | 3 | 125 | 38.0 | 24 to 27 | 19 to 24 |
| 11 | 4 | B | 4 | 160 | 82 | 23 to 25 | 18 to 23 | 3V | 4 | 125 | 48.3 | 26 to 30 | 21 to 26 |
| 15 | 4 | B | 5 | 170 | 101 | 24 to 26 | 18 to 24 | 3V | 6 | 125 | 68.9 | 24 to 27 | 19 to 24 |
| 18.5 | 4 | B | 5 | 200 | 101 | 25 to 28 | 20 to 25 | 3V | 6 | 140 | 68.9 | 26 to 30 | 21 to 26 |
| 22 | 4 | B | 5 | 224 | 101 | 27 to 31 | 22 to 27 | 3V | 6 | 160 | 68.9 | 27 to 31 | 22 to 27 |
| 30 | 4 | C | 5 | 224 | 136 | 39 to 45 | 30 to 39 | 5V | 4 | 180 | 77.9 | 52 to 60 | 41 to 52 |
| 37 | 4 | C | 6 | 224 | 161.5 | 40 to 46 | 31 to 40 | 5V | 4 | 200 | 77.9 | 58 to 67 | 45 to 58 |
| 45 | 4 | C | 6 | 265 | 161.5 | 44 to 51 | 34 to 44 | 5V | 4 | 224 | 77.9 | 63 to 73 | 49 to 63 |
| 55 | 4 | C | 7 | 265 | 187 | 46 to 53 | 36 to 46 | 5V | 5 | 224 | 95.4 | 62 to 71 | 48 to 62 |
| 0.75 | 6 | A | 2 | 80 | 35 | 8.8 to 9.8 | 6.9 to 8.8 | 3V | 1 | 75 | 17.4 | 18 to 20 | 14 to 18 |
| 1.5 | 6 | A | 2 | 100 | 35 | 14 to 16 | 11 to 14 | 3V | 2 | 75 | 27.7 | 18 to 21 | 14 to 18 |
| 2.2 | 6 | A | 3 | 100 | 50 | 13 to 15 | 11 to 13 | 3V | 2 | 90 | 27.7 | 22 to 25 | 17 to 22 |
| 3.7 | 6 | B | 3 | 125 | 63 | 18 to 21 | 14 to 18 | 3V | 3 | 100 | 38.0 | 22 to 25 | 17 to 22 |
| 5.5 | 6 | B | 3 | 150 | 63 | 23 to 25 | 18 to 23 | 3V | 3 | 140 | 38.0 | 24 to 26 | 19 to 24 |
| 7.5 | 6 | B | 4 | 150 | 82 | 23 to 25 | 18 to 23 | 3V | 4 | 140 | 48.3 | 24 to 27 | 19 to 24 |
| 11 | 6 | B | 5 | 170 | 101 | 24 to 27 | 19 to 24 | 3V | 5 | 140 | 58.6 | 27 to 31 | 22 to 27 |
| 15 | 6 | B | 5 | 224 | 101 | 25 to 29 | 20 to 25 | 3V | 6 | 160 | 68.9 | 27 to 31 | 22 to 27 |
| 18.5 | 6 | C | 4 | 224 | 110.5 | 39 to 45 | 30 to 39 | 5V | 3 | 180 | 60.4 | 62 to 71 | 48 to 62 |
| 22 | 6 | C | 5 | 224 | 136 | 38 to 43 | 29 to 38 | 5V | 4 | 180 | 77.9 | 55 to 64 | 43 to 55 |
| 30 | 6 | C | 5 | 265 | 136 | 44 to 51 | 34 to 44 | 5V | 4 | 224 | 77.9 | 61 to 70 | 47 to 61 |
| 37 | 6 | C | 6 | 265 | 161.5 | 45 to 52 | 35 to 45 | 5V | 4 | 224 | 77.9 | 74 to 84 | 57 to 74 |
| 45 | 6 | C | 7 | 280 | 187 | 45 to 52 | 35 to 45 | 5V | 5 | 224 | 95.4 | 72 to 82 | 56 to 72 |

7. WIRING

(1) Wiring procedures

Wiring work must be done according to the Electrical Equipment Technical Standards and Interior Wiring Code by a trained worker using suitable wiring tools. **Working with live wires is dangerous. Always turn the power OFF before starting the work.** The outline of the wiring requirements is shown in Table 5. If the wiring distance is long, the voltage drop will increase. **In this case, wire so that the voltage drop is 2% or less during motor operation.**

Table 5 Motor wiring

| Output (kW) | Min. wire thickness ¹ | | Max. distance of electrical wiring ² | | Overcurrent circuit breaker (A) ³ | | | | Rated current of excess graduation current meter for motor (A) | | Min. grounding wire thickness | |
|-------------|----------------------------------|---------------------|---|------------|--|------------|------------------------------------|------------|--|------------|-------------------------------|---------------------|
| | | | | | Full-voltage starting | | Using starter (Star-delta starter) | | | | | |
| | 200V class | 400V class | 200V class | 400V class | 200V class | 400V class | 200V class | 400V class | 200V class | 400V class | 200V class | 400V class |
| 0.75 | 1.6 mm | 1.6 mm | 54 m | 217 m | 15 | 15 | - | - | 5 | 5 | 1.6 mm | 1.6 mm |
| 1.5 | 1.6 mm | 1.6 mm | 32 mm | 130 m | 30 | 15 | - | - | 10 | 5 | 1.6 mm | 1.6 mm |
| 2.2 | 1.6 mm | 1.6 mm | 23 mm | 94 m | 30 | 15 | - | - | 10 | 5 | 1.6 mm | 1.6 mm |
| 3.7 | 2.0 mm | 1.6 mm | 23 mm | 60 m | 50 | 30 | - | - | 15 | 10 | 2.0 mm | 1.6 mm |
| 5.5 | 5.5 mm ² | 1.6 mm | 27 mm | 40 m | 75 | 40 | 40 | 20 | 30 | 15 | 5.5 mm ² | 2.0 mm |
| 7.5 | 8 mm ² | 2.0 mm | 31 mm | 48 m | 100 | 50 | 50 | 30 | 30 | 15 | 5.5 mm ² | 2.0 mm |
| 11 | 14 mm ² | 5.5 mm ² | 37 mm | 57 m | 125 | 75 | 75 | 40 | 60 | 30 | 8 mm ² | 5.5 mm ² |
| 15 | 22 mm ² | 8 mm ² | 43 mm | 65 m | 125 | 100 | 100 | 50 | 60 | 30 | 8 mm ² | 5.5 mm ² |
| 18.5 | 38 mm ² | 14 mm ² | 61 mm | 93 m | 125 | 100 | 125 | 60 | 100 | 40 | 8 mm ² | 5.5 mm ² |
| 22 | 38 mm ² | 22 mm ² | 51 mm | 124 m | 150 | 125 | 125 | 75 | 100 | 60 | 8 mm ² | 8 mm ² |
| 30 | 60 mm ² | 22 mm ² | 62 mm | 92 m | 200 | 125 | 175 | 100 | 150 | 60 | 14 mm ² | 8 mm ² |
| 37 | 100 mm ² | 38 mm ² | 86 mm | 126 m | 250 | 125 | 225 | 125 | 200 | 100 | 22 mm ² | 8 mm ² |

(*1) The minimum wiring thickness is for when three wires are placed in a conduit (full-voltage starting).

(*2) The guideline for the maximum distance of an electrical wiring is that the voltage drop at the distant end is to be 2% or less for the minimum wire thickness.

(*3) The overcurrent circuit breaker is for power distribution. To protect a motor with a circuit breaker, choose a circuit breaker commensurate with the rated output of that particular motor.

There are three classes of general motor insulation, Class E, Class B and Class F. If high-temperature insulation material such as Class F insulation is used, the temperature in the terminal box will be relatively high. Thus, use wiring cables and insulation tape that have a high temperature resistance. (Refer to Table 6.)

Table 6 Examples of motor wiring materials

| Thermal class of motor | Wiring material (Example) | | | | | |
|------------------------|--|-------------------------|----------------------------|-------------------------|-------------------------------|-------------------------|
| | Insulation wiring | Tolerable max. temp. °C | Cable | Tolerable max. temp. °C | Insulation tape | Tolerable max. temp. °C |
| 120(E) | Vinyl insulated wire | 60 | Vinyl cable | 60 | Vinyl adhesive tape | 60 |
| | Rubber insulated wire | 60 | Natural rubber cable | 60 | | |
| 130(B) | Class 2 vinyl insulated wire | 75 | Polyethylene cable | 75 | Self-fusing butyl rubber tape | 80 |
| | Polyethylene insulated wire | 75 | Butyl rubber cable | 80 | | |
| | Ethylene propylene rubber insulated wire | 80 | EP rubber cable | 80 | | |
| | Bridged polyethylene insulated wire | 90 | Bridged polyethylene cable | 90 | | |
| 155(F) | Bridged polyethylene insulated wire | 90 | Bridged polyethylene cable | 90 | Polyester adhesive tape | 120 |
| | Silicon rubber insulated glass mesh wire | 180 | Silicon rubber cable | 180 | Silicon glass adhesive tape | 180 |

Remarks : The tolerable max. temperature indicates the main examples for each material. Some products may tolerate a higher temperature. Consult the manufacturer for details.

(2) Grounding (earthing)

The insulation material of the motor is an insulator and also is a conductor. Thus, the motor has a capacitance between the ground. If the motor is not grounded, an induction voltage that is approx. 50 to 60% of the power voltage may be generated in proportion to this capacitance between the frame and ground. To prevent accidents caused by electric shocks, **always ground the motor according to the Electrical Equipment Technical Standards Clause 18 to 28.** A grounding screw is provided in the motor's terminal box or on the lower part of the frame. If the grounding screw loosens due to vibration during operation, sparks may be ignited at the grounding section. Wire the grounding wire so that the grounding screw will not loosen because of the grounding wire vibrating, and lock the grounding screw.

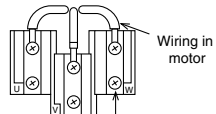
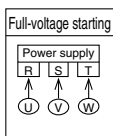
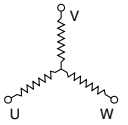
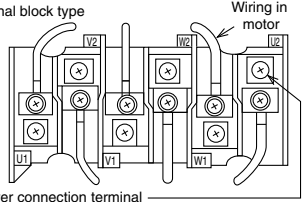
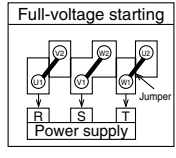
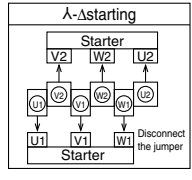
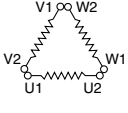
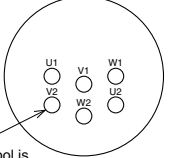
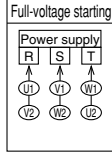
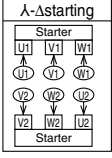
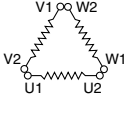
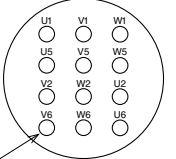
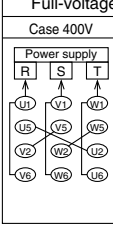
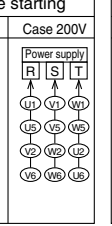
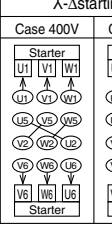
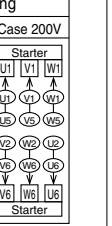
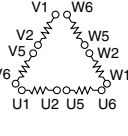
(3) Switch and fuse

Select the switch fuse according to the local power company's standards. Refer to Table 5 for the capacity and wire size of the switch, fuse and instruments. Use of the Mitsubishi MS magnetic switch for starting the motor and as overload protection is recommended.

(4) Structure of motor terminal lead sections and connection to power supply

- Follow Table 7 when connecting the power supply to the lead wires or terminal block terminals. Also refer to the connection nameplate in the terminal box and to the catalogs, etc.
- Do not bend, pull or catch the power cable or motor lead wires with force. Otherwise, the lead wires may be cut.**
- Tighten the terminals firmly so that they will not be loosened by vibration during operation.**
- Do not disconnect or replace the wires in the motor.**

Table 7 Structure of standard motor terminal lead sections and connection to power supply

| Frame No. | Output (kW) | | Terminal lead structure | Connection method | No. of outlet wire terminals |
|------------|-------------|-------------|--|---|---|
| | 2P, 4P | 6P | | | |
| 80 to 112 | 0.75 to 3.7 | 0.75 to 2.2 | Terminal block type  Wiring in motor Power connection terminal M4 screw tightening torque 140 to 165N•cm | Full-voltage starting  | 3 terminals  |
| 132 | | 3.7 | Terminal block type  Wiring in motor Power connection terminal M4 screw tightening torque 140 to 165N•cm | Full-voltage starting  λ - Δ starting  | 6 terminals  |
| 160 to 180 | 11 to 30 | 7.5 to 22 | Lug type Lead-out wire arrangement  Terminal symbol is indicated on end of lead for M6 | Full-voltage starting  λ - Δ starting  |  |
| 180 to 225 | 37 to 55 | 30 to 45 | Lug type Lead-out wire arrangement  Terminal symbol is indicated on end of lead for M6 | Full-voltage starting Case 400V  Case 200V  λ - Δ starting Case 400V  Case 200V  | 12 terminals  |

(5) Precautions for λ - Δ starting method

If the motor is installed in a dusty and humid environment and the voltage will always be applied when the neutral point is cut off during motor stopping, the insulation may deteriorate and burn. In this case, always observe the following precautions

- When selecting the λ - Δ starter, **select one with a magnetic switch (3-conductor type) on the primary side**, and prevent the application of the voltage onto the motor wiring during stopping.
- If not using the primary side magnetic switch, **always open the power side switch when stopping the motor.**

(6) Protection device

This motor does not have a protection device. Installation of an overload protection device is mandatory under the Electrical Equipment Technical Standards. Installation of a protection device (leakage breaker, etc.) besides an overload protection device is recommended. If switching surge may be caused by operating a circuit breaker, switch or magnetic valve, install a protection device for limiting surge.

(7) Terminal box

- a. The direction of the terminal box can be changed in 90° steps by loosening the screws in the box. When changing the direction of the terminal box, make sure that the inner lead wires are not caught. Apply a waterproof sealing agent to the mounting screws of the terminal box seat of the outdoor type motor.
- b. **Running the motor with the terminal box cover removed could lead to electric shocks. Always return the terminal box cover to the original position after work is completed.**

8. INITIAL STARTING

Check the following points before turning the switch ON to run the motor for the first time.

- a. Is the insulation resistance above the specified value when the motor has been subjected to moisture during shipment or storage? (Insulation resistance must be 1M Ω or more for the low voltage motor.) **Never touch the terminals with bare hands when measuring the insulation resistance. Failure to observe this could lead to electric shocks.**
- b. Are any screws loose?
- c. Rotate the shaft by hand and confirm that it rotates freely without catching. (Remove the shaft protection clamp first.) **Take care not to cut your hand on the keyway.**
- d. Is an adequate fuse installed?
- e. **Are the power supply and grounding connections secure?**
- f. Check the motor as a single unit first if there may be a problem when the machine rotation direction is reversed. **In this case, remove the key installed on the shaft.**

If the rotation direction must be changed, interchange two of the three power wires connected. Note that the rotation direction is fixed if a skew fan is used. Be sure to refer to the outline dimension drawings for more details.

- g. Is the connection with the machine correct? (Refer to Section 5. COUPLING WITH MACHINE.)
- h. When using a star delta (λ - Δ) starter or start compensator, confirm that the handle is at the start position.

9. REGULAR OPERATION

- a. Keep the load as light as possible when turning the switch ON, and apply the load after the full speed is reached.
- b. Use an ammeter to check that the load is adequate. Adjust the load so that it is lighter than the value noted on the nameplate. If a current exceeding the current value on the nameplate is flowed, overload operation will occur and may lead to burning of the coil.
- c. The motor may be damaged if the starting time is too long or if the number of continuous starts is too high.
- d. Check that there is no abnormal noise in the bearings.
- e. **If a power failure occurs during operation, always turn the switch OFF.** Be aware that leaving the power ON may cause unexpected motor behaviors and subsequent personal injuries such as follows: Depending on the load, the load may be too heavy for the motor to start up, causing the motor electrical devices to burn or the motor to start operating unexpectedly.
- f. Never go near or touch the rotating parts (shaft, etc.) during operation. Failure to observe this could lead to entanglement or injures. Also, **do not insert your fingers or objects such as a screwdriver into the fan cover or bracket openings.** If the rotary sections such as the fan is contacted, a hazardous state leading to injuries or damage could occur.
- g. The motor surface will become hot during operation. **Touching these with your fingers or body could lead to burns.**
- h. The temperature rise limits for the coils and bearings are as shown in Table 8.

Table 8 Temperature rise limit (For ambient temperature of 40°C)

(Unit: K (Kelvin))

| Parts | Thermal Class 120 (E) | | Thermal Class 130 (B) | | Thermal Class 155 (F) | |
|----------------------------------|-----------------------|--------------------|-----------------------|--------------------|-----------------------|--------------------|
| | Resistance method | Thermometer method | Resistance method | Thermometer method | Resistance method | Thermometer method |
| Coils (standard values) | 75 | – | 80 | – | 105 | – |
| Bearings (recommended values) | – | 55 (surface) | – | 55 (surface) | – | 65 (surface) |

(Note) If the ambient temperature exceeds 40°C, subtract the value in Table 8 by the difference.

- i. **Immediately stop the motor if an abnormality occurs.**
- j. Where driving the motor with a 400V class inverter, **install a suppressing filter or a reactor on the inverter side or use a motor with reinforced electrical insulation.** The allowable voltage to a surge insulation reinforced motor is 1250V0-p. If the voltage has to exceed the allowable voltage, install filters.

10. VIBRATION

(1) Tolerable vibration during operation

- a. When running a loaded machine with the motor, the motor may also vibrate due to the coupling precision with the loaded machine or the effects of the vibration generated from the loaded machine. The degree of vibration will fluctuate according to the state of the foundation and base.
Though this vibration should be small regardless to say, its magnitude depends somewhat on such factors as the motor speed and installation conditions. Figure 6 shows the ranges that do not adversely affect to the practical operation. If the vibration exceeds this tolerable value, find the cause, and take appropriate measures.
- b. **The range that the standard structure motor can withstand shocks is generally 4.9m/s² [0.5G].** If an abnormal vibration acceleration could be applied on the motor such as when using the motor for a press, etc., consult your dealer. The value in { } is for reference.
- c. If the machine side unbalance is large due to the installation of a fan or blower, etc., directly onto the motor shaft or direct coupling with the partner machine, the motor vibration will increase and may damage the bearings, etc. **The motor side balance must be within G2.5 specified in JIS B 0905 (balance of rotation devices).**
- d. If the motor vibration is significant, check the residual unbalance in rotating bodies (balance quality within G2.5 is recommended) and direct coupling accuracy (Refer to 5-(1).). If the balance and direct coupling accuracy are appropriate, check the natural frequency in the installed state to confirm that the motor vibration does not resonate with rotational components or 2f component of the power supply. If it resonates with the components, change the rigidity of installation.

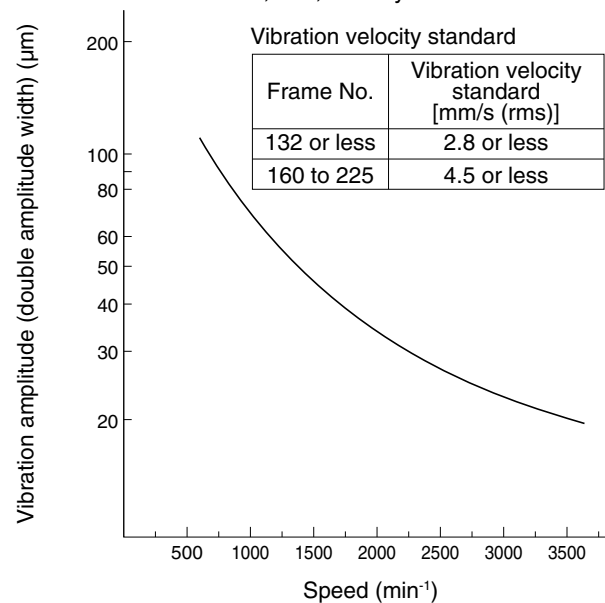


Fig. 6 Tolerable motor vibration value (Max. value on frame)

(2) Vibration during stopping

If vibration is applied on the motor during stopping, fluting (fine friction due to relative fine vibration on bearing rolling race surface) may occur on the bearings. This may lead to abnormal noise from the bearings or bearing damage, so caution is required. If this fluting occurs, the balls or rollers and the inner and outer rings must not be moved relatively.

- a. Constantly rotate the motor with some method.
- b. Fix the bearing's roller race surface so that it does not vibrate relatively.
- c. If the vibration is not large, alternately run two or more motors at intervals of several days.
- d. Decrease the vibration of the neighboring machines during operation.
- e. Modify the foundation or floor structure so that the vibration when the motor is stopping is decreased.

11. MAINTENANCE

The quality of maintenance will greatly affect the motor life.

(1) Inspection and maintenance schedule

- a. Motors used periodically, such as emergency motors absorb moisture as the stop time is long. This causes the insulation resistance to drop. Thus, daily caution is important.
- b. Motors used continuously, such as for pumps and fans, require frequent overhauling and inspection.
- c. Recording of daily inspection, monthly inspections and disassembly inspections is helpful for future maintenance.
- d. Refer to Table 9 for the overhaul and inspection intervals.

Table 9 Overhaul and inspection intervals

| Installation location \ Frequency of use | Used infrequently | Continuously used |
|--|-------------------------|-------------------------|
| Dusty environment | Once every 1 to 2 years | Once in two years |
| Clean environment | Once every 2 to 3 years | Once every 3 to 5 years |

(2) Daily inspections

- a. Noise Prepare a sounding rod and listen to the noise from each motor section. Abnormal noise such as magnetic noise, mechanical noise, mechanical friction noise and bearing noise can be detected.
- b. Odors..... Accidents can be sensed by a smell of varnish burning when the motor overheats due to overloads or blocked ventilation.
- c. Appearance Check for oil leak, and check that the ventilation paths are not blocked. If oil is leaking, the vibration may be significant. Check the vibration. (In operating environment with large vibration, oil separated from excessive grease in the bearings may leak to the outside.) Wipe away oil with waste cloth. If the bearing temperature is high, check the load (current value). However, a slight leak of grease may not be a problem for bearings that require lubrication as long as the temperature does not rise excessively. Even in the case of shielded bearings, an insignificant amount of separated oil may leak at the initial stage, but this will not affect the operation. **Touching any part of the bearings or frame to check the temperature is dangerous. Use a temperature measuring device, such as an alcohol thermometer.**

(3) Monthly inspections

- a. Deterioration or consumption of grease
..... Replenish or replace the grease according to the maintenance schedule. (Refer to 13-(4)(5).)
- b. Check that the insulation resistance is above the specified value. (1MΩ or higher for the low voltage motor.)
Do not touch the terminals with bare hands when measuring. Doing so could lead to electric shocks.
- c. Surface painting
..... Rust will form easily if the paint is peeled. Always repair the paint.
- d. Dust contamination on inlet and outlet ports
..... Remove the dust from the inlet and outlet ports. Otherwise, insufficient cooling could cause excessive heat buildup.

(4) Inspections and cleaning during disassembly

Check the operation state and make records before starting the overhaul. Use these records when restarting operation after the overhaul.

- a. Bearings Remove dust and foreign matter from the bearings and bearing housing. Remove the old grease and charge them with fresh grease. As for the amount of grease, follow the "Initial charge amount" indicated on the "Grease lubrication procedure" instruction plate or Table 12. When shielded bearings are used, replace the bearings. Check the fitting between the shaft and the bearings (normally k5) and the fitting between the bearings and the bearing housing of the bracket (normally H6). If worn out or out of tolerance, replace the concerned parts or repair those parts by such a method as metal spraying.
- b. Coils and insulation... Check the wiring for looseness in the straps, and for adherence of dirt. Clean as required.
- c. Other sections Inspect the other sections and repair or replace the damaged parts. Clean any contaminated parts.
- d. Painting Repaint the motor if possible even if the paint is not peeling.

12. SERVICING OF COILS AND INSULATION

(1) When coil has absorbed moisture

Measure the insulation resistance with a megger tester when the coil has absorbed moisture during shipment, storage or when the motor has been stopped for a long time, and at the times specified in the maintenance plan. If this measurement value drops suddenly, dry the coil. It is recommended to use the motor at 100MΩ or more. If the insulation resistance is lower than the following value, do not use the motor.

Low voltage motor: 500V megger for one min., 1 (MΩ) at 40°C

Space heater : 500V megger for one min., 1 (MΩ) at room temperature (before charging)

To dry the coil, disassemble the motor, and use the following method until the insulation resistance is restored.

- Place the coil in an oven that does not exceed 90°C.
- Cover the motor with a piece of canvas or equivalent material, open a hole at the top so the moisture can escape, and dry by blowing hot air, or using a heating device or lamp. Adjust the temperature so that it does not exceed 90°C and cause partial heating.

(2) When coil is dirty

If the coil is dirty or if the insulation resistance cannot be restored even when the coil is dry, clean the coil with the following method.

- Wipe dust on the coil off, or wash the coil with a cleaning solvent using hot water or low pressure steam. After cleaning, rinse the coil with clean water.
- If the dust cannot be removed with the solvent, wash the coil with a cloth or brush and volatile oil, gasoline or carbon tetrachloride.**

Take care to prevent poisoning in this case.

- Dry the coil with the method described in section (1).
- Apply high-grade varnish with a brush, by spraying or by dipping while the coil is dry and still warm if possible.
- Always check the insulation resistance before starting the motor.

13. MAINTENANCE OF BEARING AND LUBRICATION

The changes in the grease's lubricating performance differ mainly on the type of grease, size and type of bearing, operation speed, operation state and ambient atmosphere (dust and moisture).

The consumption of grease used to lubricate the bearings is very low, but special care must be taken to the lubrication to prevent remarkable wear or accidents.

(1) Bearing lubrication and maintenance procedures

Table 10 Bearing lubrication and maintenance procedures

| | Shielded ball bearings | Ball bearings, roller bearings |
|--|--|---|
| Motor application range | According to Table 11 | According to Table 11 |
| Grease replenishment | Not required ^{*3} | Use a grease gun to lubricate. Refer to Section (2) for the lubrication method. |
| Applicable grease | Multemp SRL (Kyodo Yushi) or urea grease (NTN: MP-1, NSK: EAM, JTEKT: KVC) ^{*1} | Multemp SRL (Kyodo Yush) ^{*1} |
| Frequency of grease replenishment | — | According to Section (4) |
| Frequency of changing whole grease | — | According to Section (4) ^{*2} |
| Grease replenishment amount, initial charge amount | — | According to Section (5) |

(*1) The allowable limit of temperature rise is 65K (at an ambient temperature of 40°C) for the Multemp SRL and urea grease.

(*2) If unable to follow this lubrication frequency for some reasons, be absolutely sure to carry out the overhaul as described in "11. MAINTENANCE".

(*3) The recommended replacement frequencies for shielded ball bearings are as follows: Every 10,000 hours for 2-pole motors and every 20,000 hours for 4-pole motors and above (when lubricating with Multemp SRL grease).

(*4) The thermal service life of the urea grease is about 2.5 times longer than that of the Multemp SRL. Note, however, that using the urea grease will not contribute to increasing the fatigue service life of the bearing.

Be sure to use the grease of specified trade names. If the type of grease is of the same soap base (same lithium base, for example) and of the same oil base (diester oil, for example) or only the consistency is different between the two, it could be practically all right. However, do not mix different kinds of grease of different soap bases (lithium base and urea base, for example) or different kinds of grease of different oil bases (synthetic oil and mineral oil). If you have to switch to grease of a different trade name, disassemble and thoroughly clean the concerned parts before stuffing the new grease.

(2) Method of grease lubrication (replenishment)

The motors with open bearings and a grease over-stuffing prevention structure are of either of the two configurations below. Lubricate the motor of each configuration according to the procedures below.

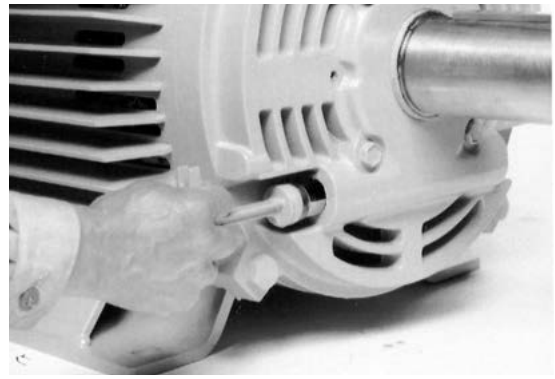
In each event, when removing the old grease and charging the new, use care so as not to come into contact with the rotating bodies such as the shaft.

a. Motor equipped with grease removal device

- (a) Before charging the new grease, dispose of all the old grease.
- (b) Remove the grease removal device. [Refer to Fig. 7 (a).] Remove the old grease contained in the grease removal device.
- (c) Install the grease removal device once again. Charge the specified amount of new grease through the grease fitting. After charging the new grease, you do not have to remove the grease removal device until the next grease lubrication. Lubricate the motor with the new grease while operating the motor. The motor bears the "Grease lubrication procedure" instruction plate. Be sure to charge the amount of grease replenishment specified on this instruction plate or in Table 12. When installing the grease removal device again, be sure to install the device to the correct orientation. The grease removal device has an arrow on it. Be sure to install it in a manner that this particular arrow is always directed towards the shaft. (For a horizontal structured motor, the grease removal device is located below the shaft. Thus, the arrow must be directed upwards towards the shaft.) [Refer to Fig. 7 (b).] If the grease removal device is installed with a screw, be sure to install it with the screw in the same manner and condition as it was installed before.
- (d) Do not charge the grease more than the specified amount. Otherwise, too much grease may cause the bearing temperature to rise excessively or may cause the grease to leak through the shaft through hole.
- (e) You can install the grease removal device on the left or on the right of the motor. In this case, remove the cap on the other side of the motor with a flathead screw driver or a similar tool as shown in Fig. 7 (c). Then, install the grease removal device there.

b. For tapered plug type

Remove the tapered plug from the oil discharge port as shown in Fig. 7 (d). Charge it with the fresh grease as gradually as possible to the specified amount while operating the motor. In order to eliminate the old, dirty grease, leave the discharge port open for about 20 minutes after charging the fresh grease so that the old grease naturally comes out. Then, tighten the tapered plug.



(Nagoya Works B904138-9)

Fig. 7 (a)

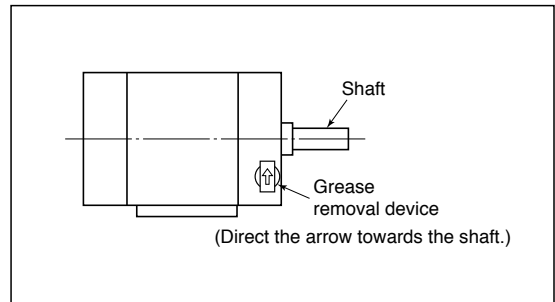
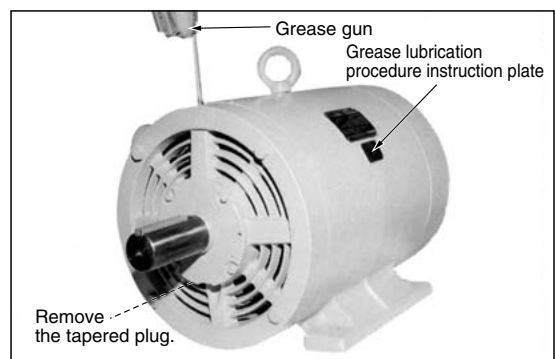


Fig. 7 (b)



(Nagoya Works B904138-5)

Fig. 7 (c)



(Nagoya Works B750058-5)

Fig. 7 (d)

(3) Bearing tables

Table 11 Bearing list

| Motor type | Frame symbol | No. of poles | Load side | Anti-load side |
|-----------------|------------------|-----------------|-----------|----------------|
| SF-PR SF-PRV | 80M | All poles | 6204ZZ | 6204ZZ |
| | 90L | | 6205ZZ | 6205ZZ |
| | 100L | | 6206ZZ | 6205ZZ |
| | 112M | | 6207ZZ | 6206ZZ |
| | 132S } 132M } | | 6308ZZ | 6207ZZ |
| | 160M } 160L } | | 6309ZZ | 6308ZZ |
| | 180M | | 6311ZZ | 6310ZZ |
| | 180L | | 4 poles | 6312ZZ |
| | 180LD | 2 poles | 6312ZZC3 | 6311ZZ |
| | | 6 poles | 6312ZZ | 6311ZZ |
| | 200LD | 2 poles | 6312ZZC3 | 6312ZZC3 |
| | | 4 poles or more | 6315ZZ | 6312ZZ |
| | 225S | 2 poles | 6312ZZC3 | 6312ZZC3 |
| | | 4 poles or more | 6315ZZ | 6312ZZ |

(Note) ZZ indicates a shielded ball bearing, and C3 indicates radial internal clearance (Refer to Table 14-2).

(4) Grease replenishment frequency and whole grease change frequency

Refer to Table 12 to determine the grease lubrication based on the bearing number (BEARING) indicated on the nameplate and the number of poles. (The grease replenishment frequency is indicated on the "Grease lubrication procedure" instruction plate.)

When exceeding the number of times of grease replenishment, disassemble the motor and clean the discharge ports of the bearings. Remove the old grease and stuff the bearing with the fresh grease.

(5) Grease replenishment amount and initial charge amount (The amount of grease is also indicated on the "Grease lubrication procedure" instruction plate.)

Table 12 Grease replenishment amount, grease replenishment frequency and whole grease change frequency

| Bearing number | Bearing dimensions | | | Replenishment amount while in usual operation g | Initial charge amount during disassembling g | Replenishment frequency (hours) | | | | |
|---|--------------------|----------------|-------|---|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| | Inner diameter | Outer diameter | Width | | | 12 poles | 8 poles | 6 poles | 4 poles | 2 poles |
| 6311 | 55 | 120 | 29 | 35 | 80 | 8500 | 8500 | 6000 | 3500 | 1200 |
| 6312 | 60 | 130 | 31 | 40 | 100 | 8500 | 8000 | 6000 | 3500 | 1200 |
| 6313 | 65 | 140 | 33 | 45 | 120 | 8500 | 7500 | 5500 | 3000 | 1200 |
| 6314 | 70 | 150 | 35 | 50 | 150 | 8500 | 7000 | 5000 | 3000 | — |
| 6315 | 75 | 160 | 37 | 55 | 180 | 8500 | 6500 | 4500 | 2500 | — |
| 6316 | 80 | 170 | 39 | 60 | 210 | 8500 | 6500 | 4500 | 2500 | — |
| Whole grease change frequency for ball bearings | | | | | | Every 2 times of grease replenishment | Every 2 times of grease replenishment | Every 3 times of grease replenishment | Every 5 times of grease replenishment | Every 8 times of grease replenishment |
| NU217 | 85 | 150 | 28 | 45 | 115 | 4500 | 3500 | 2500 | 1500 | — |
| Whole grease change frequency for roller bearings | | | | | | Every 3 times of grease replenishment | Every 3 times of grease replenishment | Every 5 times of grease replenishment | Every 8 times of grease replenishment | — |

(6) Bearing noise

The easiest way to check a bearing is to listen to the noise it generates. Listen to the bearing noise during operation so that abnormalities can be found at an early stage.

However, do not rely on the noise only to decide pass or fail. Check the vibration, temperature and discharged grease so that you do not judge the practically all right parts to be defective.

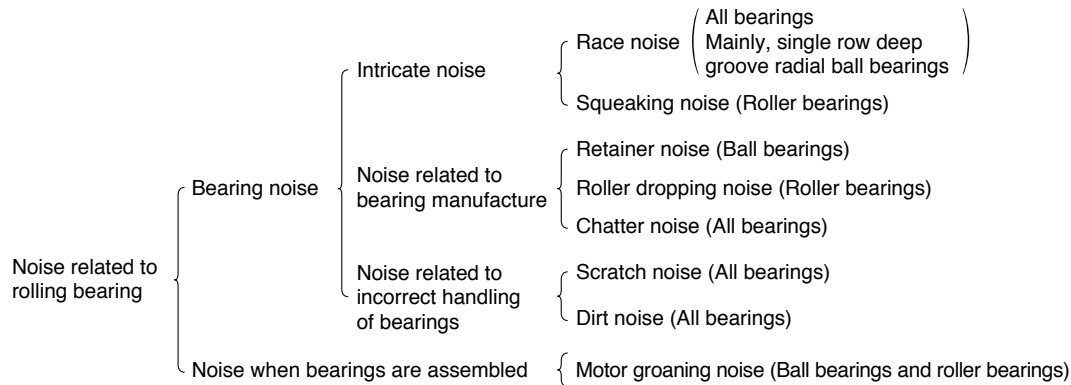


Table 13

| | Cause of noise | Measures |
|---------------------------|--|--|
| Race noise (normal noise) | This noise is characteristic of the rolling bearing and occurs in every bearing. The noise is generated when the roller rolls over the locus due to rotation of the bearings. This should be a smooth and continuous noise. | Normal noise |
| Squeaking noise | This is a "squeaking" noise generated by almost all roller bearings. It is a metallic sound, and is caused by the non-uniform movement of the rolling element in a no-load area. This noise has the following characteristics. 1) This noise is heard when grease lubrication is used, and is rarely heard when oil is used. 2) This noise occurs easily when the lubrication performance (especially oil) is poor. 3) This noise occurs easily during the winter. 4) This noise occurs easily when only a radial load is applied and the radial clearance of the bearings is large. 5) This noise occurs at a certain rotating speed range, and the range differs according to the size of the bearings. (If this noise is heard, try replenishing a small amount of the designated grease. This noise may occasionally be heard in ball bearings.) | <ul style="list-style-type: none"> As long as the noise is not caused by a heavy load, and is only due to vibration or temperature, use can be continued. Replenish the grease. Use bearings with a small radial clearance. Use soft grease with a good oil performance. Use a bearing for squeaking noise measures. |
| Retainer noise | This noise is heard when the retainer vibrates during bearing rotation and collides with the rolling element. The noise is cyclic and has the following characteristics. 1) This noise is heard in both grease lubrication and oil lubrication. 2) This noise occurs easily in ball bearings having a large radial clearance. 3) This noise occurs easily when a moment is applied to the outer bearing ring. | <ul style="list-style-type: none"> When using ball bearings, decrease the radial clearance or apply a pre-load. Use a lubricant with a good lubrication performance. Replenish the grease. |
| Roller dropping noise | This noise is generated due to the radial clearance and the relation of the clearance between the retainer and rolling element. If the bearing is being used in a horizontal rotor, this noise is generated when the balls drop faster than the retainer due to the gravity of the rolling element when in a no-load area near the top, and collide with the retainer. This noise is not heard during low speed operation or normal operation, and often occurs just before stopping. | <ul style="list-style-type: none"> This is not an abnormal noise. Decrease the radial clearance if necessary. |
| Chatter noise | The bearings vibrate when there is a circular spiral having a relatively large crest on the inner/outer race raceway surface or rolling surface. If the speed is constant, this sound will have a constant frequency. | <ul style="list-style-type: none"> Replace the bearings. |
| Scratch noise | A cyclic noise sounding like a riveter and vibration occur if the raceway surface or rolling surface has scratches (scratches, indentation and rust). The cycle may be constant if the speed is constant. The cycle becomes longer as the rotating speed drops. As for ball bearings, if the scratch is on the raceway surface, the noise may be continuous. However, if the scratch is on the ball, the noise may not be heard. The noise, however, is still cyclic. This noise may sound differently after replenishing grease. The major causes and characteristics are as follows. 1) While the motor stands still, vibration from other equipment causes the bearing raceway surface to be damaged by scratches. The scratches are at the same spacing as the ball-to-ball spacing. 2) An excessive radial load and/or excessive vibration causes the bearing raceway surface to be damaged by fretting or peeling. 3) The electrolytic corrosion while driven by an inverter causes the bearing raceway surface to be damaged by striped pattern scratches. | <ul style="list-style-type: none"> Replace the bearings. Investigate the cause of scratches. Do not give an excessive impact or shock to the bearings during assembling the bearing or transport the motor. Isolate the motor from the machine so as not to vibrate the other. Reduce the radial load or the magnitude of vibration. Lower the carrier frequency of the inverter. Install a filter. |
| Dirt noise | A non-cyclic noise is heard when there is dirt in the bearings. 1) When the bearings were not completely washed. 2) When foreign matter entered the lubricant. 3) When dirt entered the bearings during rotation. | <ul style="list-style-type: none"> Wash the bearings. Replace the bearings. |
| Groaning noise | This noise is caused by a resonance of the natural vibration of the vibration system composed of the ball bearings axial spring and rotor, and the vibration system formed between this assembly and the bracket. This is caused by the resulting unstable vibration. | <ul style="list-style-type: none"> Use grease with a good lubrication performance. Apply an appropriate pre-load. Decrease the radial clearance. Loosen the fitting of the outer ring. Increase the axial rigidity of the bracket. |

(7) Bearing clearance

When purchasing bearings from a bearing manufacturer, order the type with the bearing No. noted on the motor nameplate. Observe the following points when placing the order.

a. Clarification of clearance symbol

The bearing clearance is very important for the bearing life, noise and vibration. Thus, when purchasing the bearings, the clearance symbol must be clearly instructed in addition to the basic bearing No. (e.g. 6310, NU314, etc.) and shielded symbol (e.g. ZZ, etc.). General motors use bearings with a special clearance to suppress noise and vibration. This clearance is indicated with the symbol "CM". The relation of each clearance is shown in Table 14. If a special clearance is used, it is indicated on the motor nameplate. However, the "CM" clearance symbol is abbreviated. **When placing your order, indicate the "motor" or "CM" clearance symbol** (e.g. 6310ZZ or 6310ZZCM for motor).

Table 14-1 Radial internal clearance of deep groove ball bearings (Unit: 0.001mm)

| Nominal dimension of bearing bore diameter (mm) | | Clearance | | | | | | | | | |
|---|---------------|-----------|------|--------|------|------|------|------|------|------|------|
| | | C2 | | Normal | | CM | | C3 | | C4 | |
| More than (<) | Less than (≥) | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| 10 | 18 | — | 9 | 3 | 18 | 4 | 11 | 11 | 25 | 18 | 33 |
| 18 | 24 | — | 10 | 5 | 20 | 5 | 12 | 13 | 28 | 20 | 36 |
| 24 | 30 | — | 11 | 5 | 20 | 5 | 12 | 13 | 28 | 23 | 41 |
| 30 | 40 | — | 11 | 6 | 20 | 9 | 17 | 15 | 33 | 28 | 46 |
| 40 | 50 | — | 11 | 6 | 23 | 9 | 17 | 18 | 36 | 30 | 51 |
| 50 | 65 | — | 15 | 8 | 28 | 12 | 22 | 23 | 43 | 38 | 61 |
| 65 | 80 | — | 15 | 10 | 30 | 12 | 22 | 25 | 51 | 46 | 71 |

[Remarks] When using the clearance as the measurement clearance, the clearance compensation amount is as follows to compensate the increase in the radial clearance cause by the measurement load. The smaller of the C2 clearance compensation amounts is used for the min. clearance and the larger is used for the max. clearance.

| Nominal dimension of bearing bore diameter (mm) | | Measurement load (N) | Compensation amount of radial internal clearance | | | |
|---|---------------|----------------------|--|---------------|----|----|
| More than (<) | Less than (≥) | | C2 | Normal and CM | C3 | C4 |
| 10 (inclusive) | 18 | 24.5 | 3 to 4 | 4 | 4 | 4 |
| 18 | 50 | 49 | 4 to 5 | 5 | 6 | 6 |
| 50 | 280 | 147 | 6 to 8 | 8 | 9 | 9 |

Table 14-2 Internal radial clearances of roller bearings (with cylindrical holes not interchangeable)

(Unit: 0.001mm)

| Nominal dimension of bearing bore diameter (mm) | | Internal radial clearances | | | | | | | | | | | |
|---|---------------|----------------------------|------|------|------|--------|------|------|------|------|------|------|------|
| | | C2 | | CM | | Normal | | C3 | | C4 | | C5 | |
| More than (<) | Less than (≥) | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| 80 | 100 | 25 | 45 | 35 | 55 | 45 | 70 | 80 | 105 | 105 | 125 | 155 | 180 |

14. DISASSEMBLY OF MOTOR AND REMOVAL OF BEARINGS

(1) Disassembly of motor

When disassembling the motor, observe the following instructions.

- a. Put matchmarks on the parts so that the positions of the installed parts can be checked on reassembly. Particularly, when using the outdoor type motor, check the gap between the flinger used for the shaft through hole and bracket and the gap between the water flinger and bracket. If the motor has a drain hole, clearly indicate the position of the hole. When the motor uses open bearings, check the positions of the grease port in the bearing cover and the oil supply and drain ports in the bracket.
- b. When drawing out the rotor, take care not to damage the coil end of stator.

(2) Removal of bearing

If the bearing is removed forcibly by hitting with a hammer or wrenching, the shaft may be bent. Remove it sufficiently carefully using the special tool or a gear puller.

a. Removal with press

Hold the rotor with the bearing inner ring as shown in Fig. 8, and slowly press the shaft end to remove the bearing.

b. Removal with bearing puller

When drawing out the bearing with a bearing puller as shown in Fig. 9, set the claws on the bearing inner ring and turn the handle to draw it out. For the motor that requires grease lubrication, set the claws of the tool on the housing cover as shown in Fig. 10, and draw out the bearing. Check for difference in length between the right and left parts of the tool. If the bearing is drawn out in an inclined state, the shaft fitting surface may be deformed.

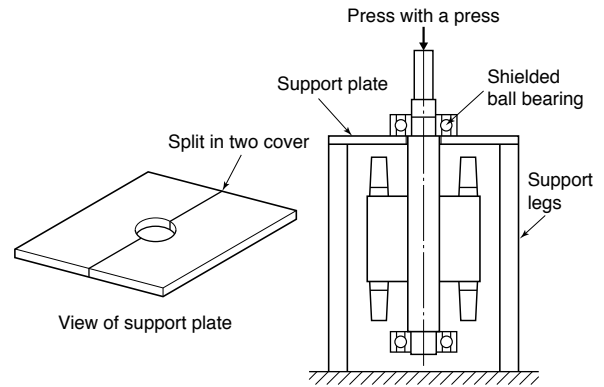
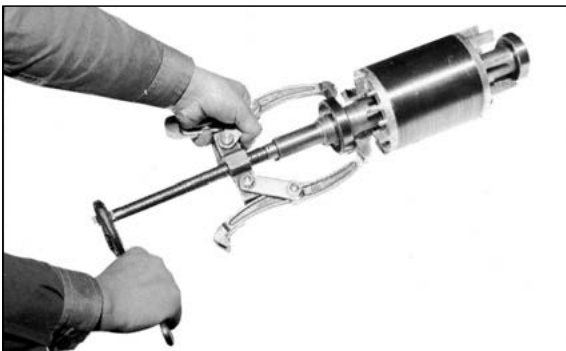


Fig. 8 Removal of bearings with a press



(Nagoya Works B750058-2)

Fig. 9 Removal with a bearing puller (1)

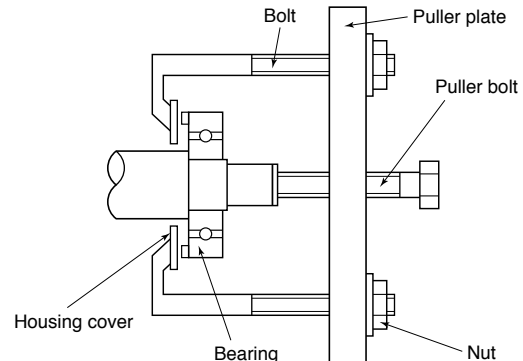


Fig. 10 Removal with a bearing puller (2)

15. REASSEMBLY OF MOTOR AND INSTALLATION OF BEARINGS

(1) Reassembly of motor

When disassembling the motor, observe the following instructions.

- a. When creep-resistant bearings (with O-rings) are used
Before reassembling, apply grease (Alvania S2 or the like) between the two O-rings on the bearing outer ring.
- b. When inserting the rotor into the stator
When inserting the rotor, take care not to damage the stator coil. Touching the keyway may cause personal injury. After inserting, check that the coil is free from scratches, and reassemble the motor.
- c. When installing the bracket
Apply a thin layer of grease (Alvania S2 or the like) to the bearing housing.

- d. Outdoor type motor
- Before reassembling, apply a sealing agent (ThreeBond 1102D or the like) to the frame fitting surface of the bracket.
 - When the flinger, water flinger and V-ring will be fitted to the shaft through hole, apply a thin layer of grease (Alvania S2 or the like) to the bracket surface. Take care not to stain the shaft with grease or oil. The mounting dimensions of the flinger and water flinger shall be identical with those before disassembly. (Normally, the gap between the flinger and bracket shall be 0.3 to 0.5mm, and that between the water flinger and bracket shall be 1 to 1.5mm.) Bring the V-ring into slight contact with the bracket. After fitting them, turn the shaft by hand, and check for abnormal noise and non-smooth rotation.
- e. When open bearings are used
- When installing the housing cover and bracket, check the grease port in the housing cover and the oil supply and drain ports in the bracket, and ensure that they are located in the same positions as before disassembly.
- f. Totally-enclosed fan-cooled motor
- When installing the fan, apply grease (Alvania S2 or the like) to the shaft mounting surface. (So, the fan can be removed easily next time.) Apply a screw locking agent (ThreeBond 1401B or the like) to the setscrews of the fan before tightening.
- g. Tightening of screws
- Tighten the screws to the tightening torques shown in Table 15. To install the frame bracket of motor of frame size 132 or below, fit the clamping bolts (through bolts) perpendicularly to the fitting surface.

Table 15 Screw tightening torque standard (iron)

| Screw size | M4 | M5 | M6 | M8 | M10 | M12 | M16 |
|--------------|------|-----|-----|------|------|-----|-----|
| Torque (N·m) | 1.65 | 3.2 | 5.5 | 13.2 | 26.5 | 46 | 110 |

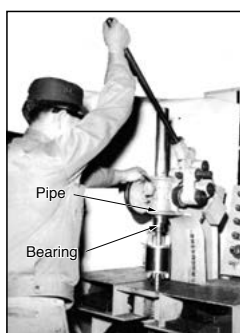
(Note) Except tapping screws

(2) Installation of bearings

When assembling the bearings onto the shaft, clean the fitting section of the bearings, remove any scratches and protrusions, and then fit with the following method.

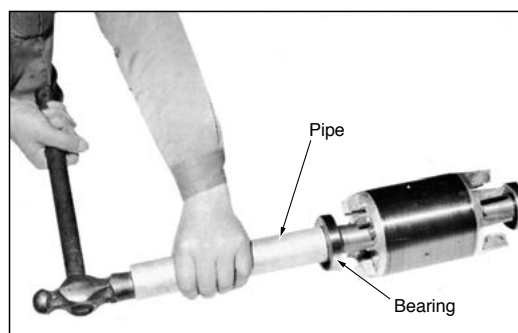
a. Installation of a shielded ball bearing

- Apply oil on the bore diameter of the bearing and the fitting face of the shaft, and press the bearing squarely onto the shaft by placing a suitable piece of pipe against the inner ring and carefully pressing with a press as shown in Fig. 11. If a press is not available, tap the bearing lightly and slowly lower it as shown in Fig. 12. In this case, **take not to pry the bearing or to contact the pipe against the bearing retainer seal or outer ring section.**
- When heating the bearing with a heater or oven before insertion, heat the bearing to approx. 90°C (**take care not to exceed 100°C**), and then fit it onto the shaft. When mounting onto the shaft, always wear protective equipment to prevent burns, etc.
- After fitting the bearing onto the shaft, check visually and with a thickness gauge that there is no gap between the shaft and bearing.
- If the lock nut is tightened or the bearing is mounted on the bracket before the bearing cools down, the bearing may be wrenched. Reassemble after the bearing sufficiently cools down.



(Nagoya Works B750058-3)

Fig. 11 Installation of the bearing with a press



(Nagoya Works B750058-1)

Fig. 12 Installation of the bearing with a hammer

b. Installation of open type ball bearings or roller bearings

- (a) Put the bearing into a clean oil bath and heat it up to about 90°C for 30 minutes. Make absolutely sure that the temperature does not by all means exceed 100°C. Put the heated bearing on the shaft. Do not move the bearing until it has completely cooled down. Be sure to put on appropriate protective wears and devices so as not to get burned when putting the bearing on the shaft. (Before putting the bearing on the shaft, assemble the shaft box cover and other devices.)
- (b) Do not attempt to tighten the lock nut or assemble the bearing on the bracket. Otherwise, the bearing may be displaced. Make sure that the bearing has completely cooled down before starting the reassembling.

16. TROUBLESHOOTING, SERVICING AND PRODUCT WARRANTY

(1) Commission all disassembly, reassembly and repairs of the motor to a specialist.

Modifications of the product by the user will not be covered by the Mitsubishi warranty.

(2) Common troubles and remedies are described in Table 16.

If the problem cannot be solved easily, or if there are any unclear points, consult Mitsubishi Sales Office, local agent or service center.

Notify the following items when making inquiries on troubles or when purchasing spare parts.

- a. The type (TYPE), output (kW), No. of poles (POLE), frame No. (FRAME), manufacturing No. (SERIAL) and manufacturing date (DATE) listed on the motor nameplate.
- b. Length of use.
- c. Usage site.
- d. Place and state of trouble.
- e. Name and quantity of spare parts. (Refer to the "17. MOTOR CONSTRUCTION DRAWINGS" for the part names.)

(3) Warranty period and coverage

- a. As a principle, Mitsubishi shall bear the cost of repairs resulting from equipment problems for a period one year after product delivery, or 18 months from the time of shipment, whichever is shortest.
- b. This warranty covers the shipped product only. Responsibility for customer losses or compensation attributed to breakdown of this product are not covered by the warranty.
- c. For important machines, prepare spare machines or motors, or ensure the redundancy.
- d. The product modified or repaired by the customer is not covered by the warranty.

Table 16 Troubleshooting and remedial actions

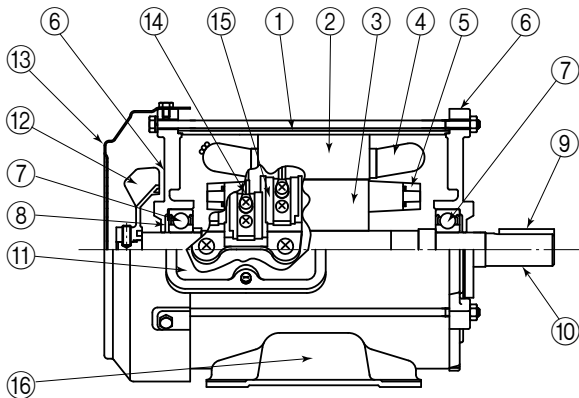
| Phenomenon | | Cause | Remedy |
|---|--|--|--|
| The motor does not rotate even in the no-load state | 1. The motor can be manually rotated in either direction. | <ul style="list-style-type: none"> 1. The switch or wire contact is faulty. 2. The fuse or a wire is broken. 3. The stator coil is faulty. | <ul style="list-style-type: none"> 1. Adjust or replace the contact section. 2. Inspect and repair or replace. 3. Have specialist repair. |
| | 2. An abnormal noise is heard. A groan is heard. A groan is heard when starting. | <ul style="list-style-type: none"> 1. One phase is open causing a single phase state. 2. The switch or wire contact is faulty. 3. The fuse or a wire is broken. 4. The stator winding is faulty. 5. There is a constraint in the motor (bearing damage, etc.) | <ul style="list-style-type: none"> 1. Check the switch and power circuit. 2. Adjust or replace the contact section. 3. Inspect and repair or replace. 4. Have specialist repair. 5. Have specialist repair. |
| | 3. No noise is heard. | <div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); margin-right: 5px;">Other than motor:</div> <ul style="list-style-type: none"> 1. The stator winding is faulty. 2. Each interlock release state is faulty. 3. Power failure. 4. The fuse or two wires are broken. 5. Two or more switches have a faulty contact. 6. Two or more starters have broken wires. </div> | <ul style="list-style-type: none"> 1. Have specialist repair. 2. Inspect the circuit. 3. Contact the power company. 4. Inspect and repair or replace. 5. Adjust or replace the contact section. 6. Inspect and repair the starter conductor section. |
| | 4. Motor does not rotate even manually. | <ul style="list-style-type: none"> 1. Stator and rotor completely contact. 2. Bearings are damaged. | <ul style="list-style-type: none"> 1. Have specialist repair. 2. Have specialist repair. |
| | 5. The protection device functions. | <ul style="list-style-type: none"> 1. The terminal contact is faulty. 2. The stator winding is faulty. | <ul style="list-style-type: none"> 1. Repair the contact section. 2. Have specialist repair. |

| | Phenomenon | Cause | Remedy |
|--|---|---|--|
| Motor rotates during no-load state | 1. The motor can be manually rotated in either direction. | 1. The connection is incorrect. | 1. Inspect and adjust the connection. |
| | 2. The protection device functions. | 1. The stator winding is faulty. | 1. Have specialist repair. |
| | 3. The speed does not increase. | 1. λ - Δ starter contact is faulty. 2. The stator winding is faulty. | 1. Inspect and repair the λ - Δ starter. 2. Have specialist repair. |
| | 4. A groan is heard. | Excessive current 1. The motor frictional torque is large. 2. The clearance of the stator and rotor is incorrect. 3. The stator winding is faulty. 4. One phase opened causing a single phase state during starting. 5. The stator winding is faulty. | 1. Have specialist repair. 2. Have specialist repair. 3. Have specialist repair. 4. Inspect switch and power circuit. 5. Have specialist repair. |
| | 5. Temperature rises abnormally during no-load operation. | 1. The power is abnormal. 2. The cooling ventilation is obstructed. 3. The fan rotation direction is reversed. 4. The filter is clogged. | 1. Improve the power facility. 2. Improve the cooling ventilation. 3. Change the fan rotation to the correct direction. 4. Clean or replace the filter. |
| | 6. A rolling sound or metallic sound is heard in the bearing section. | 1. The bearings are defective. 2. The grease has deteriorated. | 1. Have specialist repair. 2. Replace the grease. |
| | 7. The vibration is large. | 1. The motor side is unbalanced. 2. Vibration of the parts installed on the motor is large. 3. The rotor is faulty. 4. The foundation is resonating. 5. The strength of the installation frame is weak. 6. The foundation bolts are loose. | 1. Rebalance the rotor. 2. Adjust the balance of installed parts. 3. Replace the rotor. 4. Reinforce the foundation frame. 5. Reinforce the installation frame. 6. Retighten the foundation bolts. |
| During a load (rotates during no-load state) | 1. The belt disconnects. | 1. Overload. 2. The partner machine is faulty and belt does not rotate. 3. The belt tension is incorrect. | 1. Reselect the motor rating. 2. Inspect and repair the partner machine. 3. Set the belt again. |
| | 2. The protection device functions. The relay trips. The fuse is blown. | 1. The partner machine is faulty. 2. The relay or fuse selection is incorrect. 3. The usage conditions are incorrect. Usage time, frequency. 4. Overload. 5. The power is faulty. | 1. Adjust the partner machine. 2. Replace the relay or fuse. 3. Review the usage conditions. 4. Reselect the motor rating. 5. Improve the power facility. |
| | 3. The switch overheats. | 1. The switch selection is incorrect. 2. The switch contact is faulty. | 1. Reselect the switch. 2. Adjust the switch. |
| | 4. The motor overheats. | 1. The stator winding is faulty. 2. Overload. 3. The power is faulty. 4. The usage conditions are incorrect. | 1. Have specialist repair. 2. Reselect the motor rating. 3. Improve the power facility. 4. Review the usage conditions. |
| | 5. The speed drops. The speed does not increase. The acceleration is slow. The motor does not rotate. | 1. The power is faulty. 2. The rotor is faulty. 3. Overload. | 1. Improve the power facility. 2. Replace the rotor. 3. Reselect the motor rating. |
| | 6. The temperature rises abnormally during load operation. | 1. The power is faulty. 2. The cooling ventilation is blocked. 3. The ambient temperature is too high. 4. Overload. 5. The stator winding is faulty. | 1. Improve the power facility. 2. Improve the cooling ventilation. (Remove dirt, etc.) 3. Improve the ambient environment. 4. Reselect the motor rating. 5. Have specialist repair. |
| | 7. The bearings overheat. | 1. The shaft center is off. 2. The bearings are defective. 3. Overgreasing. 4. The belt is too tense. 5. The grease has deteriorated, is insufficient, or the quality is poor. | 1. Center the shaft. 2. Replace the bearings. 3. Adjust the grease amount. 4. Adjust the belt tension. 5. Replenish or replace the grease. |
| | 8. An abnormal noise is heard. Groaning noise. Moving noise. | 1. The power is faulty. 2. The ventilation path is blocked. 3. Overload. 4. The bearings are defective. 5. The grease is poor. 6. The rotor is faulty. 7. The rotor's iron core is contacting the stator's iron core. 8. The rotation section is contacting the stator or outer sheath. 9. The installation of parts such as the bracket or fan is faulty. 10. The fitting at the mating surfaces of the bracket has worn out. (Rotation of load is excessively unbalanced. Excessive vibration) | 1. Improve the power facility. 2. Remove the obstacle. 3. Reselect the motor rating. 4. Replace the bearings. 5. Replenish or replace the grease. 6. Replace the rotor. 7. Have specialist repair. 8. Have specialist repair. 9. Retighten or adjust. 10. Adjust the balance. Reduce the vibration. Replace the bracket and/or bearing. |
| | 9. The vibration is great. | 1. The coupling alignment is incorrect. 2. The coupling is faulty. 3. The machine side is unbalanced. 4. Impact is conveyed from machine side. | 1. Recouple. When recentering and coupling consider the thermal expansion margin. 2. Inspect and adjust the coupling. 3. Review the machine side balance. 4. Inspect the machine side. |
| | 10. The ammeter sways. | 1. The power is faulty. 2. The load varies. 3. The belt tension is incorrect. 4. Cyclic swaying with groan, the stator or rotor is faulty. | 1. Improve the power facility. 2. Adjust the load. 3. Adjust the belt tension. 4. Inspect and repair the stator and rotor. |

17. MOTOR CONSTRUCTION DRAWINGS

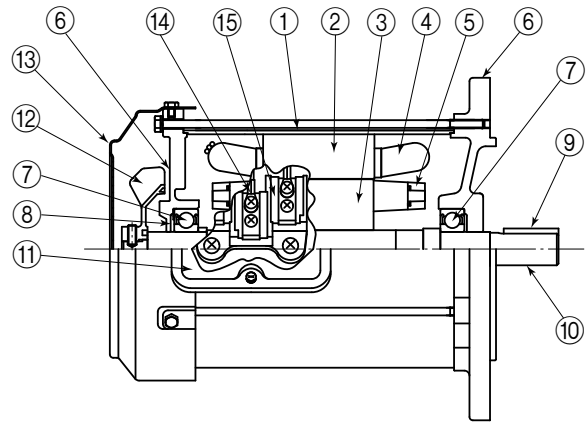
SF-PR (V) type motor construction drawings

●SF-PR (80M, 90L)



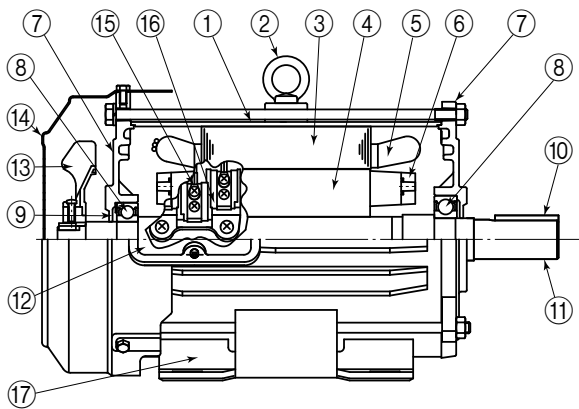
| | | | |
|---|------------------|----|---------------------|
| 1 | Frame | 9 | Shaft end key |
| 2 | Stator core | 10 | Shaft |
| 3 | Rotor core | 11 | Terminal box |
| 4 | Stator coil | 12 | External fan |
| 5 | End ring fan | 13 | External fan cover |
| 6 | Bracket | 14 | Ring crimp terminal |
| 7 | Bearing | 15 | Terminal block |
| 8 | Preloaded spring | 16 | Installation leg |

●SF-PRV (80M, 90L)



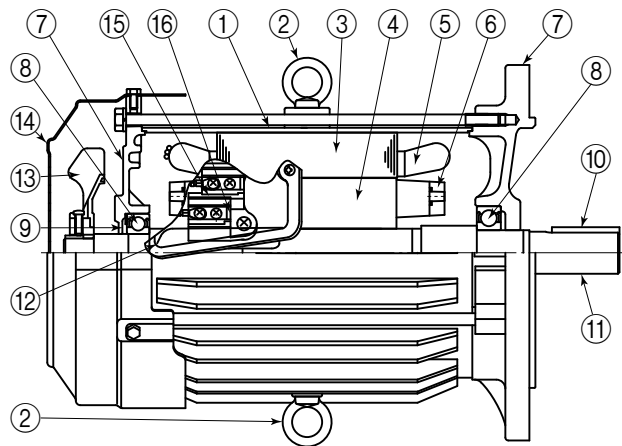
| | | | |
|---|------------------|----|---------------------|
| 1 | Frame | 9 | Shaft end key |
| 2 | Stator core | 10 | Shaft |
| 3 | Rotor core | 11 | Terminal box |
| 4 | Stator coil | 12 | External fan |
| 5 | End ring fan | 13 | External fan cover |
| 6 | Bracket | 14 | Ring crimp terminal |
| 7 | Bearing | 15 | Terminal block |
| 8 | Preloaded spring | | |

●SF-PR (100L to 132M)



| | | | |
|---|------------------|----|---------------------|
| 1 | Frame | 10 | Shaft end key |
| 2 | Eye bolt | 11 | Shaft |
| 3 | Stator core | 12 | Terminal box |
| 4 | Rotor core | 13 | External fan |
| 5 | Stator coil | 14 | External fan cover |
| 6 | End ring fan | 15 | Ring crimp terminal |
| 7 | Bracket | 16 | Terminal block |
| 8 | Bearing | 17 | Installation leg |
| 9 | Preloaded spring | | |

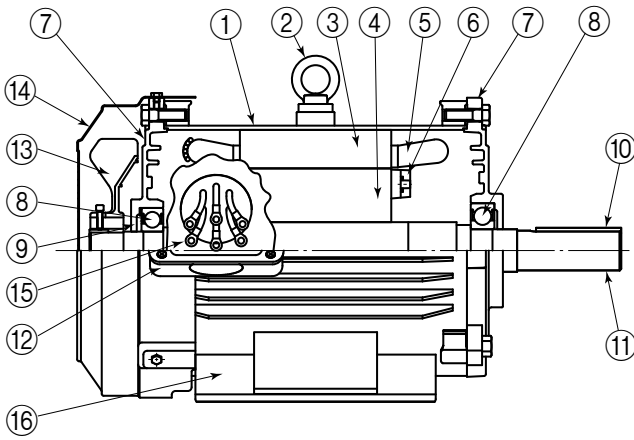
●SF-PRV (100L to 132M)



| | | | |
|---|------------------|----|---------------------|
| 1 | Frame | 10 | Shaft end key |
| 2 | Eye bolt | 11 | Shaft |
| 3 | Stator core | 12 | Terminal box |
| 4 | Rotor core | 13 | External fan |
| 5 | Stator coil | 14 | External fan cover |
| 6 | End ring fan | 15 | Ring crimp terminal |
| 7 | Bracket | 16 | Terminal block |
| 8 | Bearing | | |
| 9 | Preloaded spring | | |

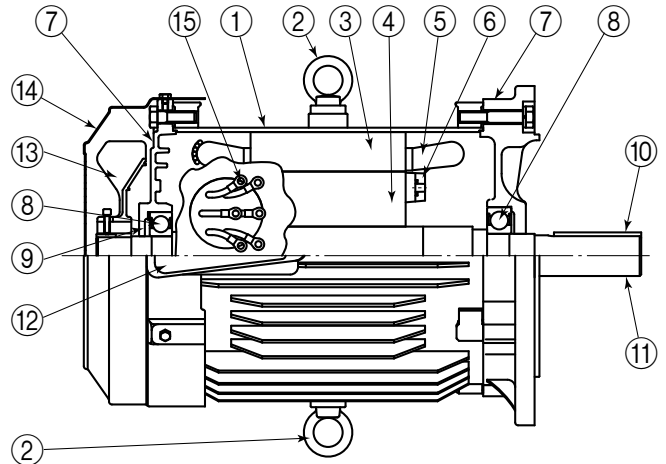
Remarks The construction drawings show typical models. There may be slight differences depending on indoor/outdoor use, installation, frame numbers and other specification.

●SF-PR (160M to 180M)



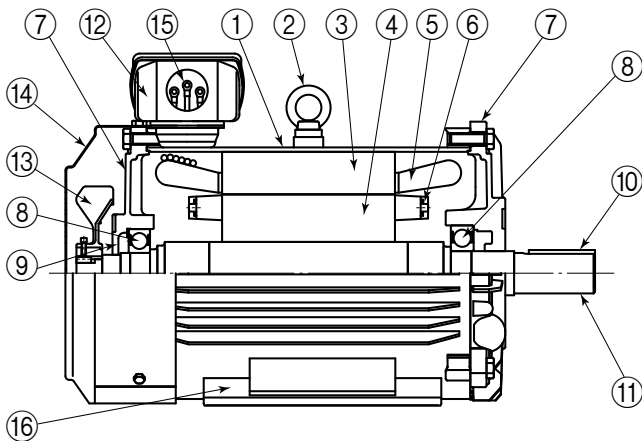
| | | | |
|---|--------------|----|---------------------|
| 1 | Frame | 9 | Preloaded spring |
| 2 | Eye bolt | 10 | Shaft end key |
| 3 | Stator core | 11 | Shaft |
| 4 | Rotor core | 12 | Terminal box |
| 5 | Stator coil | 13 | External fan |
| 6 | End ring fan | 14 | External fan cover |
| 7 | Bracket | 15 | Ring crimp terminal |
| 8 | Bearing | 16 | Installation leg |

●SF-PRV (160M to 180M)



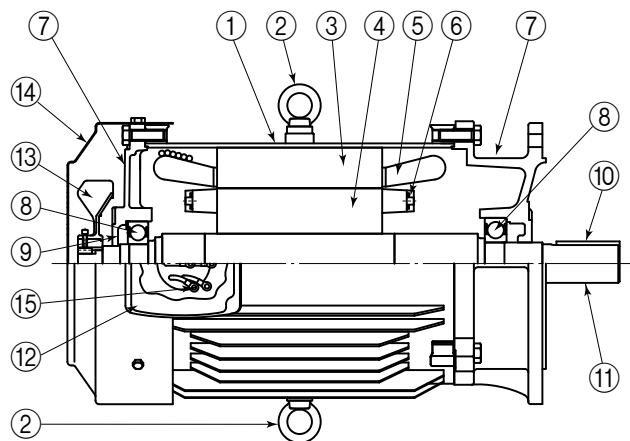
| | | | |
|---|--------------|----|---------------------|
| 1 | Frame | 9 | Preloaded spring |
| 2 | Eye bolt | 10 | Shaft end key |
| 3 | Stator core | 11 | Shaft |
| 4 | Rotor core | 12 | Terminal box |
| 5 | Stator coil | 13 | External fan |
| 6 | End ring fan | 14 | External fan cover |
| 7 | Bracket | 15 | Ring crimp terminal |
| 8 | Bearing | | |

●SF-PR (180LD to 225S)



| | | | |
|---|--------------|----|---------------------|
| 1 | Frame | 9 | Preloaded spring |
| 2 | Eye bolt | 10 | Shaft end key |
| 3 | Stator core | 11 | Shaft |
| 4 | Rotor core | 12 | Terminal box |
| 5 | Stator coil | 13 | External fan |
| 6 | End ring fan | 14 | External fan cover |
| 7 | Bracket | 15 | Ring crimp terminal |
| 8 | Bearing | 16 | Installation leg |

●SF-PRV (180LD to 225S)



| | | | |
|---|--------------|----|---------------------|
| 1 | Frame | 9 | Preloaded spring |
| 2 | Eye bolt | 10 | Shaft end key |
| 3 | Stator core | 11 | Shaft |
| 4 | Rotor core | 12 | Terminal box |
| 5 | Stator coil | 13 | External fan |
| 6 | End ring fan | 14 | External fan cover |
| 7 | Bracket | 15 | Ring crimp terminal |
| 8 | Bearing | | |

Remarks The construction drawings show typical models. There may be slight differences depending on indoor/ outdoor use, installation, frame numbers and other specification.

[Supplement] Structure of outdoor type motor

The major parts of the outdoor type motors (IP44) are the same as those of the indoor type motors. However, special consideration is given to the following items to enhance the waterproofing effect.

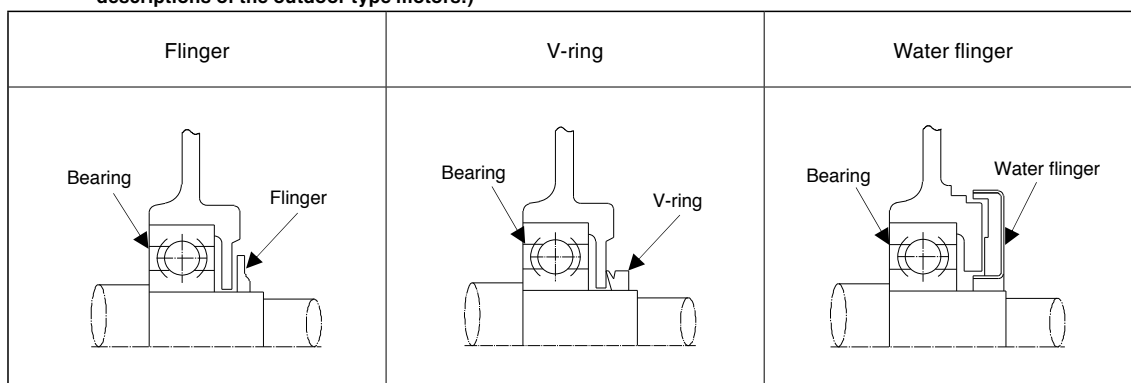
- (1) Shaft through hole Provided with flinger, V-ring and end cover. The parts used for horizontal type motors with legs are shown in Table 17. When replacing the bearing, replace the flingers and V-ring with new ones.
- (2) Terminal box For frame size of 80 to 180, steel plate boxes are used, and for frame size of 200 and above, cast iron terminal boxes are used. Packing is provided between terminal-box cover and its base. If the packing is deformed or cracked, replace it with new one.
- (3) Fitting surfaces A sealing agent has been applied to the fitting surfaces of frame and bracket. When reassembling, apply the agent in the same manner.
- (4) Installation method ... Use the motor in the posture shown in the outline drawing. Take care that the drain hole is not clogged.
- (5) Painting Paints excelling in weather resistance, salt water resistance and chemical resistance are used.

Table 17 Standard parts of shaft through holes of outdoor type motors (horizontal type with legs)

| Installation method/part | | Frame No. | 80 to 132 | 160 to 225 |
|--------------------------------------|----------------|-----------|----------------------|----------------------|
| Installation with shaft horizontal | Anti-load side | | Flinger | Flinger |
| | Load side | | Flinger End cover | Flinger End cover |
| Installation with shaft end downward | Anti-load side | | V-ring | Water flinger |
| | Load side | | Flinger End cover | Flinger End cover |
| Installation with shaft end upward | Anti-load side | | Flinger | Flinger |
| | Load side | | Water flinger | Water flinger |

(Note) 1. The structure of the shaft through hole on the load side of the flanged motor is basically same as that of the indoor type motor.
 2. The end cover is fitted after a sealing agent is applied.
 3. It is recommended to replace rubber parts every 2 years.

Fig. 13 Parts of shaft through holes of outdoor type motors (This table shows parts names. Refer to Table 17 above for the descriptions of the outdoor type motors.)



18. DISPOSAL

Treatment of waste: The following laws apply when disposing of this product. Consideration must be given to each regulation. The following laws are effective in Japan. When disposing of this product outside of Japan (overseas), local laws shall take precedence. Make an indication or notification on the product, etc., if necessary.

(1) Requirements stipulated in the Law for the Promotion of Effective Utilization of Resources

- a. When no longer necessary, this product should be recycled into resources if possible.
- b. Often when recycling products into resources, the resources are sorted into iron scraps and electric parts and sold to scrap dealers. Thus, this product should be sorted and sold to respective dealers.

(2) Requirements stipulated in the Waste Management and Public Cleansing Law

- a. When no longer necessary, this product should be recycled into resources and sold as indicated in Section (1) above to reduce the amount of wastes.
- b. When the unwanted product cannot be sold and is to be disposed of, it must be handled as industrial waste as stipulated in this law.
- c. Disposal of industrial waste must be commissioned to an industrial waste disposer approved under this law. The product must be properly treated, including the management of a manifest.
- d. The bearing grease used in this product is also designated as industrial waste. Bearings which have been replaced and spent grease must be properly processed, such as commissioned to an industrial waste disposer. Disposal of spent grease by the user can cause environmental pollution.

19. EXPORTING

- (1) 3-phase induction motors are not regarded as strategic equipment and therefore it is not necessary to apply to the Ministry of Economy, Trade and Industry for export permission. However, there is a possibility of being asked to explain this when clearing the product through customs, and therefore it will be necessary to request a document from Mitsubishi explaining its non-strategic status.
- (2) Depending on the country to which the product is being exported, limitations will apply based on local laws and certifications systems, and therefore it is necessary to ensure that the motor is appropriate for that country.

20. COMBINATION WITH THE INVERTER

Where you use the V/F control of an 800 series inverter and a 700 series inverter to drive the motor, follow the procedure below to define the parameters.

(1) Where generating the output of 150% torque (maximum torque for a short period of time) at output frequency of 6Hz is not required:

<Where using an 800 series inverter>

- Set Pr.14 "the selection of applied load" to "0 (factory setting)". (For constant torque load setting)
- Set Pr.71 "the applicable motor" to either "70, 73 or 74". (SF-PR motor setting)
- Set Pr.81 "the motor pole" to "9999 (factory setting)". (Setting of Pr.81 ≠ 2, 4, 6)
- The system automatically sets a value from Table 18 to Pr.0 "torque boost". Note that if Pr.0 "torque boost" is altered from the initial setting, no automatic setting occurs.

Table 18 Table of setting values [Common to 200VAC and 400VAC classes: Where generating output of 6Hz, 150% torque (maximum torque for a short period of time) is not required.]

| Type | Output (kW) | Parameter setting |
|-------|-------------|--|
| | | Pr.0 "torque boost (%)" Pr.81=9999 (Pr.81 ≠ 2,4,6) |
| SF-PR | 0.75 | 4.0 |
| | 1.5 | 3.0 |
| | 2.2 | 2.5 |
| | 3.7 | 2.5 |
| | 5.5 | 2.0 |
| | 7.5 | 2.0 |
| | 11 | 1.5 |
| | 15 | 1.5 |
| | 18.5 | 1.5 |
| | 22 | 1.5 |
| | 30 | 1.0 |
| | 37 | 1.0 |
| | 45 | 1.0 |
| 55 | 0.7 | |

<Where using a 700 series inverter>

- Set Pr.14 "the selection of applied load" to "0 (factory setting)". (For constant torque load setting)
- Set Pr.71 "the applicable motor" to "1". (constant torque motor setting)
- Set a value from Table 19 to Pr.0 "torque boost".

Table 19 Table of setting values [Common to 200VAC and 400VAC classes: Where generating the output of 6Hz, 150% torque (maximum torque for a short period of time) is not required.]

| Type | Output (kW) | Parameter setting |
|-------|-------------|---|
| | | Pr.0 "torque boost (%)" Number of poles: 2, 4, 6 |
| SF-PR | 0.75 | 4.0 |
| | 1.5 | 3.0 |
| | 2.2 | 2.5 |
| | 3.7 | 2.5 |
| | 5.5 | 2.0 |
| | 7.5 | 2.0 |
| | 11 | 1.5 |
| | 15 | 1.5 |
| | 18.5 | 1.5 |
| | 22 | 1.5 |
| | 30 | 1.0 |
| | 37 | 1.0 |
| | 45 | 1.0 |
| 55 | 0.7 | |

(Note) When operating an SF-PR type premium efficiency motor (IE3), its output current tends to increase compared to a standard efficiency motor (IE1) and a high efficiency motor (IE2). Even if operating to the torque boost value recommended by Mitsubishi Electric, the output current may still increase depending on the loading condition. If the protection devices such as an electronic thermal relay (E.THT, E.THM), a stall prevention device (OL, E.OLT) or other protective function activates, adjust the Pr.0 torque boost setting depending on the load.

(2) Where generating the output of 150% torque (maximum torque for a short period of time) at output frequency of 6Hz is required:

<Where using an 800 series inverter>

- a. Set Pr.14 "the selection of applied load" to "0 (factory setting)". (For constant torque load setting)
- b. Set Pr.71 "the applicable motor" to either "70, 73 or 74". (SF-PR motor setting)
- c. Set Pr.81 "the motor pole" to either "2, 4 or 6". (Number of motor poles, 2: 2 poles, 4: 4 poles or 6: 6 poles)
- d. The system automatically sets a value from Table 20 to Pr.0 "torque boost". Note that if Pr.0 "torque boost" is altered from the initial setting, no automatic setting occurs.

Table 20 Table of setting values [Common to 200VAC and 400VAC classes: where generating the output of 6Hz, 150% torque (maximum torque for a short period of time) is required.]

| Type | Output (kW) | Parameter setting | | |
|-------|-------------|-------------------------|--------------------|--------------------|
| | | Pr.0 "torque boost (%)" | | |
| | | Number of poles: 2 | Number of poles: 4 | Number of poles: 6 |
| | | Pr.81=2 | Pr.81=4 | Pr.81=6 |
| SF-PR | 0.75 | 7.4 | 6.0 | 6.4 |
| | 1.5 | 5.8 | 5.0 | 3.7 |
| | 2.2 | 6.0 | 4.5 | 3.3 |
| | 3.7 | 6.4 | 4.5 | 4.2 |
| | 5.5 | 4.5 | 3.7 | 3.3 |
| | 7.5 | 4.4 | 4.5 | 3.8 |
| | 11 | 3.5 | 3.3 | 3.5 |
| | 15 | 4.5 | 3.0 | 3.5 |
| | 18.5 | 4.0 | 3.2 | 3.0 |
| | 22 | 2.5 | 3.4 | 3.0 |
| | 30 | 3.0 | 2.0 | 2.5 |
| | 37 | 2.0 | 2.5 | 2.6 |
| | 45 | 2.0 | 2.0 | 2.4 |
| 55 | 2.0 | 2.0 | — | |

<Where using a 700 series inverter>

- a. Set Pr.14 "the selection of applied load" to "0 (factory setting)". (For constant torque load setting)
- b. Set Pr.71 "the applicable motor" to "1". (constant torque motor setting)
- c. Set a value from Table 19 to Pr.0 "torque boost".

Table 21 Table of setting values [Common to 200VAC and 400VAC classes: where generating the output of 6Hz, 150% torque (maximum torque for a short period of time) is required.]

| Type | Output (kW) | Parameter setting | | |
|-------|-------------|-------------------------|--------------------|--------------------|
| | | Pr.0 "torque boost (%)" | | |
| | | Number of poles: 2 | Number of poles: 4 | Number of poles: 6 |
| | | Pr.81=2 | Pr.81=4 | Pr.81=6 |
| SF-PR | 0.75 | 7.4 | 6.0 | 6.4 |
| | 1.5 | 5.8 | 5.0 | 3.7 |
| | 2.2 | 6.0 | 4.5 | 3.3 |
| | 3.7 | 6.4 | 4.5 | 4.2 |
| | 5.5 | 4.5 | 3.7 | 3.3 |
| | 7.5 | 4.4 | 4.5 | 3.8 |
| | 11 | 3.5 | 3.3 | 3.5 |
| | 15 | 4.5 | 3.0 | 3.5 |
| | 18.5 | 4.0 | 3.2 | 3.0 |
| | 22 | 2.5 | 3.4 | 3.0 |
| | 30 | 3.0 | 2.0 | 2.5 |
| | 37 | 2.0 | 2.5 | 2.6 |
| | 45 | 2.0 | 2.0 | 2.4 |
| 55 | 2.0 | 2.0 | — | |

(Note) When operating an SF-PR type premium efficiency motor (IE3), its output current tends to increase compared to a standard efficiency motor (IE1) and a high efficiency motor (IE2). Even if operating to the torque boost value recommended by Mitsubishi Electric, the output current may still increase depending on the loading condition. If the protection devices such as an electronic thermal relay (E.THT, E.THM), a stall prevention device (OL, E.OLT) or other protective function activates, adjust the Pr.0 torque boost setting depending on the load.

21. CHEMICAL SUBSTANCES

(1) Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products



This symbol mark indicates an environment protection usage limit applied to electrical and electronic products sold in China, and is based on the “Requirements of Concentration Limits for Certain Restricted Substances in Electrical and Electronic Products”. As long as the safety and usage productions related to the product are observed, there will be no environmental pollution or serious effect to human bodies or assets within this number of years from the date of manufacture.

(Note) When disposing of the product after appropriate use, always follow the local laws and ordinances regarding the collection and recycling of electrical and electronic products.

Note: This symbol mark is for China only.

(2) Names of six hazardous substances, contents, and parts containing hazardous substances

The names, contents, and parts containing the six hazardous substances in this product are listed below.

Names and contents of hazardous substances in the product

| Part Name | Hazardous Substances | | | | | |
|----------------|----------------------|--------------|--------------|-------------------------------|--------------------------------|---------------------------------------|
| | Lead (Pb) | Mercury (Hg) | Cadmium (Cd) | Hexavalent Chromium (Cr (VI)) | Polybrominated biphenyls (PBB) | Polybrominated diphenyl ethers (PBDE) |
| Structure part | × | ○ | ○ | ○ | ○ | ○ |
| Stator | ○ | ○ | ○ | ○ | ○ | ○ |
| Rotor | ○ | ○ | ○ | ○ | ○ | ○ |
| Brakes | × | ○ | ○ | ○ | ○ | ○ |
| Detector | ○ | ○ | ○ | ○ | ○ | ○ |

This table is prepared in accordance with the provisions of SJ/T11364.

○: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T26572.

×: Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.

(Note) “Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products” does not guarantee shipping to China. Before shipping to China, always confirm the Product’s High-Efficiency restrictions and Safety Standards, etc.

(1) 电器电子产品有害物质限制使用标识



根据《电器电子产品有害物质限制使用管理办法》，该标识适用于在中国销售的电器电子产品，其中的数字为产品的环保使用期限。只要遵守本产品在安全和使用方面的注意事项，从生产日期起的环保使用期限内不会造成环境污染或对人体、财产产生深刻的影响。

(注) 产品正常使用终结废弃时，有关电器电子产品的回收、再利用等要遵守各自治体的法律法规的要求。
 Note: This symbol mark is for China only.

(2) 含有有害6物质的名称，含有量，含有部品

本产品中所含有的有害6物质的名称，含有量，含有部品如下表所示。

产品中有害物质的名称及含量

| 部件名称 | 有害物质 | | | | | |
|------|--------|--------|--------|---------------|------------|--------------|
| | 铅 (Pb) | 汞 (Hg) | 镉 (Cd) | 六价铬 (Cr (VI)) | 多溴联苯 (PBB) | 多溴二苯醚 (PBDE) |
| 构造部件 | × | ○ | ○ | ○ | ○ | ○ |
| 转子 | ○ | ○ | ○ | ○ | ○ | ○ |
| 定子 | ○ | ○ | ○ | ○ | ○ | ○ |
| 制动器 | × | ○ | ○ | ○ | ○ | ○ |
| 检测器 | ○ | ○ | ○ | ○ | ○ | ○ |

本表格依据SJ/T11364的规定编制。

○：表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。
 ×：表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T26572规定的限量要求。

(注) 并不保证发往中国的产品带有“电器电子产品有害物质限制使用标识”。
 将产品发往中国之前，请确认是否符合产品的高效规定和安全标准等。

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New publication effective Feb.2022.
Specifications subject to change without notice.
Printed in Japan.