TOSHIBA

TOSHIBA INTERNATIONAL CORPORATION

LOW VOLTAGE MOTORS

3-Phase Squirrel Cage Induction Motor

DN: 201623-001 — June 2022

Low-Voltage 3-Phase Squirrel Cage Induction Motor

Installation & Maintenance Manual

DN: 201623-001

June, 2022

Introduction

Thank you for choosing Toshiba and congratulations on the purchase of the Low-Voltage 3-Phase Squirrel Cage Induction Motor!

This manual provides information on how to safely install, couple to the driven equipment, and maintain the Toshiba Industrial Products ASIA Co. Ltd. (TIPA) Low-Voltage 3-Phase Squirrel Cage Induction Motor.

The squirrel cage induction motor was designed for an extended service life under very demanding conditions. However, should the motor require service, this manual includes a section that assists the repair technician with maintenance, disassembly/assembly, part replacement, testing, troubleshooting, and warranty information.

Maintenance recommendations include inspection requirements, cleaning methods, bearing lubrication, disassembly support, and testing methods.

To maximize the abilities of the Low-Voltage 3-Phase Squirrel Cage Induction Motor, a working familiarity with this manual will be required. This manual has been prepared for the Electrical Design Engineer, Installer, and Maintenance Personnel.

All TIPA motors are manufactured to international standard IEC 60034-30-1. The standard is further delineated by the following codes: IE1 (Standard Efficiency), IE2 (High Efficiency), IE3 (Premium Efficiency), and IE4 (Super Premium Efficiency).

NOTICE

Toshiba Industrial Products ASIA Co. Ltd. reserves the right to update the information in this manual, change product specifications, change product features, change product performance, and/or discontinue the product and any corresponding services addressed in this publication.

About This Manual

This manual was written by Toshiba International Corporation to provide concise and accurate information to you, our customer.

This manual includes a section about safety.

This manual contains safety information identified with safety symbols and the signal words DANGER, WARNING, CAUTION, and NOTICE as defined on pg. 1.

At Toshiba we are continuously striving for better ways to meet the constantly changing needs of our customers. E-mail your comments, questions, or concerns about this publication to TIPA Customer Support Center.

Purpose and Scope

This manual provides information on the various features and handling procedures including the following:

- Installation of new equipment,
- Alignment and coupling,
- Motor operation,
- Disposal of the removed equipment, and
- Maintenance/Troubleshooting.

WARNING

This manual includes a section about safety.

Qualified Personnel is defined on pg. 2.

All Qualified Personnel who install, maintain, remove, or dispose of this equipment must read the entire manual completely before attempting to install, maintain, service, remove, or dispose of this equipment.

All installation, maintenance, service, removal, or disposal must be done by Qualified Personnel who have been trained and are experienced in the installation and operation of electrical equipment. Qualified Personnel must be trained about the hazards present in the installation, operation, maintenance, and service of electrical equipment.

WARNING

This manual and the accompanying drawings are a permanent part of the equipment. This manual and the accompanying drawings must be readily available for reference and review.

Read and check all the specifications for this equipment. Dimensions shown in the manual are in the metric and/or the imperial equivalent.

Perform a thorough system analysis prior to using this equipment.

Never use this equipment in a manner that is not within the design specifications.

WARNING

The warnings and instructions in this manual cannot address all details or variations in the installation and operation of this equipment.

The installer/maintenance personnel are responsible for the safe installation and operation of this equipment.

Misuse of this equipment can result in severe personal injuries and damage to the equipment itself.

Modification of this equipment can result in severe personal injuries and damage to the equipment itself.

Modification of this equipment may void applicable safety certifications.

If you have any questions about any design specifications, contact the TIPA Customer Support Center immediately.

TIPA Customer Support Center

The TIPA Customer Support Center can be contacted for help in resolving any motor problem that you may experience or to provide application information.

The Support Center may be contacted by calling or writing to the appropriate center from the list below:

Toshiba Asia Pacific Pte., Ltd.

Singapore - Head Quarters

20 Pasir Panjang Road, #13-27/28 Mapletree Business City, Singapore 117439
Tel: (65) 6297-0990, DID: (65) 6305 5515 — Fax: 6305-5560.

Bangkok

No. 946, Dusit Thani Bldg., Room 1002, 10th Floor, Rama 4 Rd, Silom, Bangkok 10500, Thailand
Tel: (662) 236-6401/02/03 — Fax: (662) 237-4682.

Manila

42nd Fl., GT Tower International, 6815 Ayala Ave., Makati City, Metro Manila Philippines 1226
Tel: (632) 819-1048 — Fax: (632) 819-5479.

Kuala Lumpur

No.1-2, The Boulevard Mid Valley City, Lingkaran Syed Putra, 59200 Kuala Lumpur, Malaysia
Tel: (603) 2284-6222 — Fax: (603) 2288-1952.

Jakarta

16th Floor Summitmas Tower, Jl. Jenderal Sudirman, KAV.61-62, Jakarta, 12190 Indonesia
Tel: (6221) 520-0754 — Fax: (6221) 520-0774.

Ho Chi Minh City

Unit 1702,17th Floor, Centec Building 72-74 Nguyen Thi Minh Khai, District 3, Ho chi Minh City.

Vietnam

Tel: (848) 3827-4560 — Fax: (848) 3827-4564.

For further information on the products and services of Toshiba Asia-Pacific Corporation, please visit our website at https://www.asia.toshiba.com/business-products/.

At Toshiba International Corporation, we are always ready to discuss your equipment.
Feel free to call or click. We are here to help.

Complete the following information and retain for your records.

TOSHIBA INTERNATIONAL CORPORATION

TIPA Low-Voltage 3-Phase Squirrel Cage Induction Motor

Name of Application:____

Model Number:____

Serial Number:____

Project Name/Number (if applicable):____

Date of Installation:____

Inspected By:____

Comments:____

Warranty Information

The warranty for this motor applies to the motor itself.

The warranty for this motor is contained in Toshiba International Corporation's Standard Terms and Conditions of Sale (TIC Standard Warranty) available at https://www.toshiba.com/tic/cms_files/TCofSale.pdf and shall be the sole warranty unless a different warranty is provided in the applicable contract between the parties (Contract Warranty). If there is a Contract Warranty, that Contract Warranty shall be the sole warranty.

No statements in this manual create any new warranties.

No statements in this manual modify the terms of the TIC Standard Warranty or any Contract Warranty.

Misuse and/or modification of your equipment without the express, prior, written consent of Toshiba International Corporation will void all warranties.

TOSHIBA INTERNATIONAL CORPORATION SHALL NOT BE LIABLE UNDER ANY CIRCUMSTANCES FOR ANY CONSEQUENTIAL, INDIRECT, OR SPECIAL DAMAGES RESULTING DIRECTLY OR INDIRECTLY FROM THE USE OF THIS EQUIPMENT OR THE USE OF ANY INFORMATION CONTAINED IN THIS MANUAL.

Activating the Warranty

To activate the TIC warranty for your equipment go to the Toshiba International Corporation warranty and product registration website at https://www.toshiba.com/tic/service-warranty/general-warranty-product-registration. Complete the required fields and click submit. A warranty confirmation will be mailed to your registered contact.

Table of Contents

General Safety Information

DO NOT attempt to install, operate, perform maintenance, or dispose of this equipment until you have read and understood all of the product safety information and directions that are contained in this manual.

Safety Alert Symbol

The **Safety Alert Symbol** is comprised of an equilateral triangle enclosing an exclamation mark. This indicates that a potential personal injury hazard exists.

Signal Words

Listed below are the signal words that are used throughout this manual followed by a description and the associated symbols. When the words **DANGER**, **WARNING**, and **CAUTION** are used in this manual, they will be followed by important safety information that must be carefully followed.

The word **DANGER** preceded by the safety alert symbol indicates that an imminently hazardous situation exists that, if not avoided or if instructions are not followed precisely, will result in serious injury to personnel or loss of life.

The word **WARNING** preceded by the safety alert symbol indicates that a potentially hazardous situation exists that, if not avoided or if instructions are not followed precisely, could result in serious injury to personnel or loss of life.

The word **CAUTION** preceded by the safety alert symbol indicates that a potentially hazardous situation exists that, if not avoided or if instructions are not followed precisely, may result in minor or moderate injury.

The word **CAUTION** without the safety alert symbol indicates that a potentially hazardous situation exists that, if not avoided or if instructions are not followed precisely, may result in equipment and property damage.

Special Symbols

To identify special hazards, other symbols may appear in conjunction with the **DANGER**, **WARNING**, and **CAUTION** signal words. These symbols indicate areas that require special and/or strict adherence to the procedures to prevent serious injury to personnel or loss of life.

Electrical Hazard Symbol

A symbol that is comprised of an equilateral triangle enclosing a lightning bolt indicates a hazard of injury from electrical shock or burn.

Explosion Hazard Symbol

A symbol that is comprised of an equilateral triangle enclosing an explosion indicates a hazard of injury from exploding parts.

Equipment Warning Labels

DO NOT attempt to install, operate, perform maintenance, or dispose of this equipment until you have read and understood all of the product labels and user directions that are contained in this manual.

Warning labels that are attached to the equipment will include the exclamation mark within a triangle. **DO NOT** remove or cover any of these labels. If the labels are damaged or if additional labels are required, contact the Toshiba Customer Support Center.

Labels attached to the equipment exist to provide useful information or to indicate an imminently hazardous situation that may result in serious injury, severe property and equipment damage, or loss of life if safe procedures or methods are not followed as outlined in this manual.

Qualified Personnel

Installation, operation, and maintenance shall be performed by **Qualified Personnel** **<u>Only</u>**. A Qualified Person is one that has the skills and knowledge relating to the construction, installation, operation, and maintenance of the motor and the motor driven equipment. In conjunction with the aforementioned, will be familiar with the electrical equipment and will have received safety training on the hazards involved with motor operation (Refer to the latest edition of NFPA 70E for additional safety requirements).

Qualified Personnel shall:

- Have read and understood the entire manual.
- Be familiar with the construction and function of the motor, the equipment being driven, and the hazards involved.
- Be able to recognize and properly address hazards associated with the application of motor-driven equipment.
- Be trained and authorized to safely energize, de-energize, ground, lock out/tag out circuits and equipment, and clear faults in accordance with established safety practices.
- Be trained in the proper care and use of protective equipment such as safety shoes, rubber gloves, hard hats, safety glasses, face shields, flash clothing, etc., in accordance with established safety practices.

For further information on workplace safety, visit www.osha.gov.

Limitations of Usage

Special considerations are required when using this product as a critical component in the support of human life, safety, or in the maintenance of a public function (critical applications). Use of this product in the critical applications without special consideration may result in injury to personnel or loss of life.

A thorough system assessment will be required regarding the product installation and operation within a critical application by an equipment designer tasked with ensuring that a fail-safe option is engaged in the event of a system failure.

The following is a listing of critical applications in which special considerations will be a requirement to use this product:

- Surgical operations,
- Life-support equipment (i.e., dialysis equipment, incubator, etc.),
- Exhaust toxic gas handling/smoke extraction,
- Fire defense,
- Traffic control of aviation, rail, maritime, etc.,
- Nuclear power plant operation,
- Communication, and
- Various other equipment similar to the aforementioned items.

This motor is not explosion-proof and is not to be used in an explosive, flammable, or corrosive environment.

Equipment Inspection

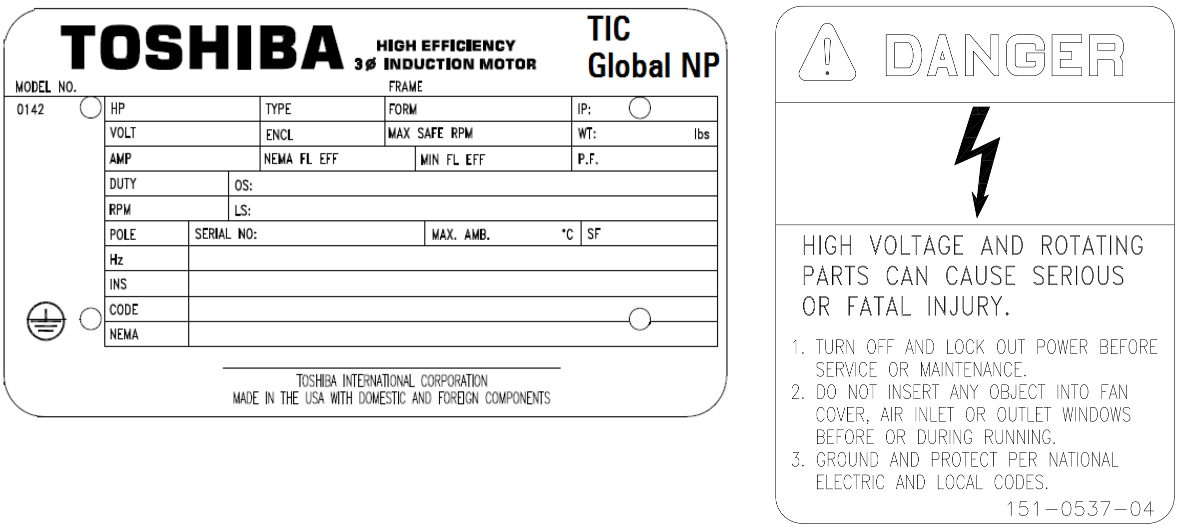
- Upon receipt of the equipment, inspect the packaging and equipment for shipping damage.
- If the motor has been exposed to a low temperature, do not remove the coverings until the motor has had sufficient time to attain a temperature that is close to that of the room in which it is to be unpacked. Otherwise, when opened, moisture will condense on the cold parts. This may reduce the electrical resistance of insulations or cause rust or corrosion of metallic parts.
- Carefully unpack the equipment and check for parts that may have been damaged during shipping, missing parts, or concealed damage. If any discrepancies are discovered, it should be noted with the carrier prior to accepting the shipment, if possible. File a claim with the carrier if necessary and immediately notify the TIPA Customer Support Center.

Handling Precautions

- Do not open the packaging upside down.
- Ensure that the motor has not experienced a fall during transport.

- Properly size up the load when lifting a motor. Use lifting equipment that is capable of lifting at least two times the load weight.
- Use the lifting bolt if so equipped.
- **DO NOT** include ancillary system components while lifting using the lifting bolt. Use the lifting bolt to lift the motor ONLY.
- **DO NOT** handle the motor by the shaft, terminal box, wires, or the fan cover. If no lifting bolt is provided, carry the motor by the frame using both hands.
- Wear gloves when handling the motor. The key way of the motor shaft can be extremely sharp and will cause hand lacerations if not handled properly.
- Ensure that the received motor nameplate specifications match the order specifications.

Figure 1. Typical Motor Labels.



Installation Precautions

CAUTION

Installation, operation, and maintenance shall be performed by Qualified Personnel ONLY.

Avoid installations in direct sunlight.

Select a mounting location that is easily accessible, has adequate personnel working space, and adequate illumination for equipment adjustment, inspection, and maintenance.

Avoid installation in areas where vibration, heat, humidity, dust, fibers, metal particles, corrosives, or sources of electrical noise are present.

Allow proper clearance spaces for installation. Do not obstruct the ventilation openings.

When installing the motor onto a wall or ceiling, ensure that the motor does not become dislodged from its mounting location.

Leakage current can result in fire or electrical shock. Connect the grounding terminal to earth ground.

—The Metal Conduit Is Not An Acceptable Ground—

Storage

If the motor is not put into immediate use, it should be stored indoors in an area that is clean and dry. Care should be taken to keep the equipment covered when moving from a cold location to a warm location, otherwise condensation may occur. If condensation does occur, allow the motor to dry thoroughly before applying power.

Using a megohmmeter, test the insulation resistance of the windings before applying power. A minimum of 10 megohms is recommended.

For long-term storage or when indoor storage is not available, the motor must be covered with plastic or weather-proof tarp. Cover the motor completely. Place a dehumidifying agent inside. To ward off the formation of condensation, do not wrap the motor tightly. This will allow for adequate ventilation. Precautions must also be taken to protect the motor from flooding or being exposed to harmful chemical vapors.

Ensure that any unpainted sections are covered. Retouch any scratched or flaked areas.

If condensate plugs or drain plugs are used, ensure that they are functional.

Remove the belt and store it separately, if applicable.

Whether indoors or outdoors, the area should be free from vibration. Excessive vibration can cause bearing damage. Any motor which must be stored in an area that is exposed to vibration must have the shaft locked to prevent any movement.

A systematic inspection and maintenance schedule should be established. If the motor is to be stored for 6 months or longer (3 months in a high temperature and/or high humidity areas), it should, in addition to the minor precautions above, have the insulation resistance of the windings tested every 3 months. A minimum of 1.0 megohms is recommended. A record of insulation values, temperature, time, humidity, and length of voltage application should be recorded to show winding conditions prior to start up.

If windings are designed for outdoor operation, they will not be affected by extreme or sudden temperature changes, or inclement weather in general. However, a weather proof cover with provisions for adequate ventilation should be used to guard against intrusion of salt, dust, or other abrasive or corrosive material.

It is recommended that the rotor be turned every month to redistribute the lubricant in the bearings. Oil or grease should be added every 6 months.

Every three months run the motor for five minutes without a load to redistribute the bearing lubricant and to ensure that the bearings are not defective.

— READ THE FOLLOWING CAREFULLY BEFORE INSTALLING OR STARTING MOTOR —

1. Ensure that the nameplate data is consistent with the order specifications.
2. Check whether any damage has occurred during storage/transportation. Freight Claims must be submitted by the consignee to the carrier in a timely manner.
3. Remove the bearing lock plate before start up (if used). Save the plate for reuse if subsequent shipping is required.
4. Turn the shaft by hand to ensure that it turns freely.
5. Perform a megohmmeter test.

Disposal

The motor contains resins, steel products, copper, aluminum, and other materials. Disposal of the motor is to be carried out by a specialist in industry waste disposal.

Never dispose of electrical components via incineration. Contact your local environmental agency for details on the disposal of electrical components and packaging in your area.

Operational Precautions

Turn off and lock-out/tag-out all power sources before connecting the power wiring to the equipment.

A motor produces more noise and vibration when it is operated at frequencies above 60 Hz. When operating a motor above 60 Hz, the rated limit of the motor may be exceeded; this may void the motor warranty.

If the system should emit smoke, or an unusual odor or sound, turn off the power immediately.

In the event of a power failure, remove power from the motor to avoid an unscheduled start-up upon power restoration.

Rotating equipment can cause injury to personnel. Do not go near the rotating shaft. Place warning signs at or near the rotating equipment.

Operating the motor beyond the rated specifications can result in system failure, fire, or injury to personnel.

Operation while exposed to water or snow can result in fire or electrical shock.

Typical Motor Components

Figure 2. Totally-Enclosed Fan-Cooled Motor.

Typical external components of the TIPA TEFC motor.

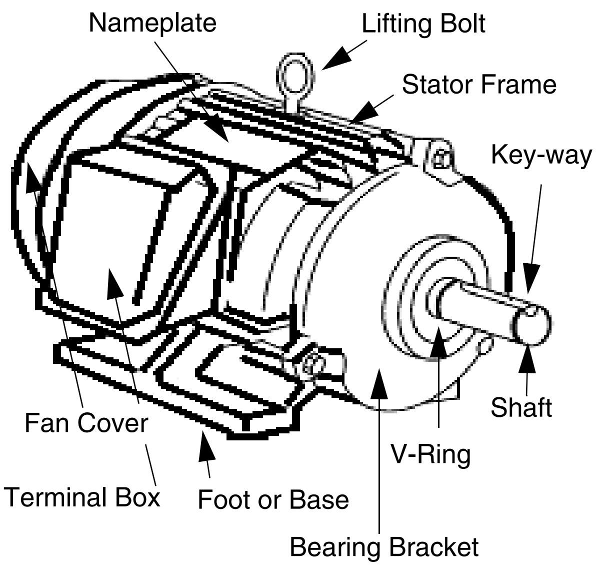
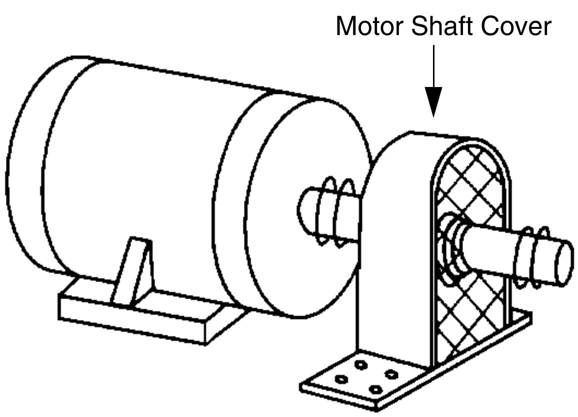


Figure 3. Motor Cover.

Rotating parts can cause injury. Exposed rotating parts must be covered and there should be signs posted at and/or near the equipment as a notification of the hazard.



System wiring is to be performed by Qualified Personnel **ONLY**.

Lock-Out/Tag-Out procedures are to be in effect during access to system terminals.

See the connection diagram within the terminal box for electrical wiring connectivity.

The terminal box houses live terminals and components and is a shock hazard. Remove system power before exposing terminal box components.

Ensure that the motor wiring is connected properly. Improper wiring can result in fire, injury to personnel, or loss of life.

Connect the grounding terminal to earth ground.

TIPA recommends installing an overload device to protect the equipment and personnel.

TIPA recommends an earth leakage circuit breaker.

Secure electrical wiring terminals to the specified torque.

Motor Installation

Foundation

A rigid foundation is necessary for smooth, stable, and reliable operation.

A satisfactory bond between the foundation and the grouting is required. The foundation surface must be roughened (if not cured rough) and cleaned before the bedplate or soleplate (hence forth will be referred to as bedplate) is secured to it.

Anchor Foundation Bolt

The purpose of foundation bolts is to anchor the motor and bedplate to the foundation such that, structurally, the foundation, motor, and bedplate become a single mass (see on pg. 6).

The bolt is enclosed in a casing three or four diameters larger than the bolt. This allows the bolt to be sprung horizontally when placing the motor bedplate in position for mounting — this permits slight adjustments for errors in the bolt position. Concrete is not placed inside of the casing at the time that the foundation is poured. Instead, the casing is filled with grout at the time that the motor is finally grouted into position.

Note: *If ever a hammer is used to make frame position adjustments, a light tap is all that is ever required. NEVER hammer the shaft of the motor to adjust its position.*

A foundation template, pattern, or frame, usually fabricated from wood, should be used to support the bolts and casings while the foundation is being built up around them. The dimensions required in constructing the supporting frame for the bolts and casings may be obtained from construction diagrams or by measuring the base of the motor.

Figure 4. Anchor Bolt.

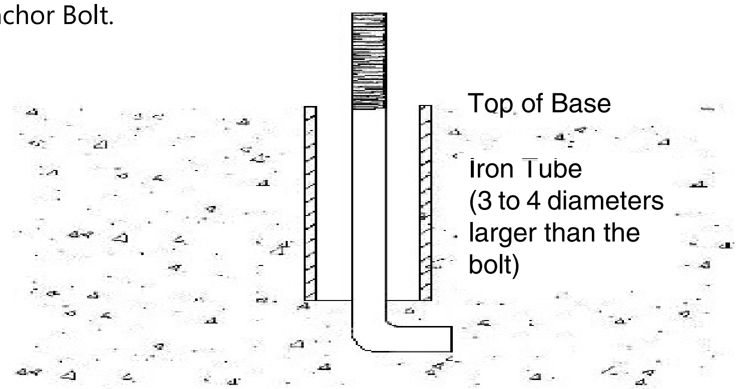
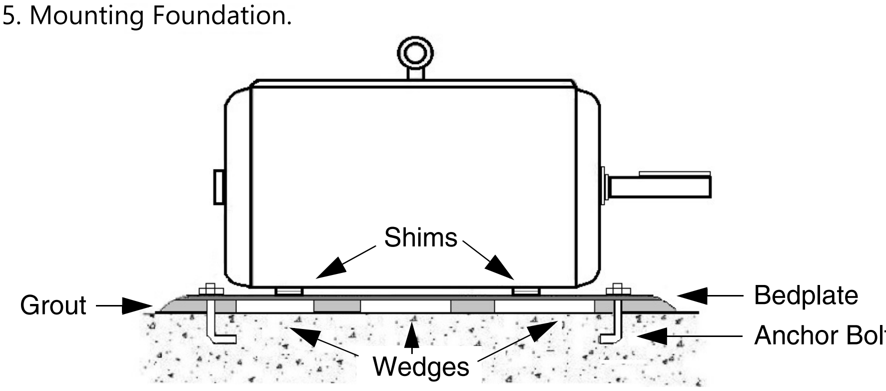
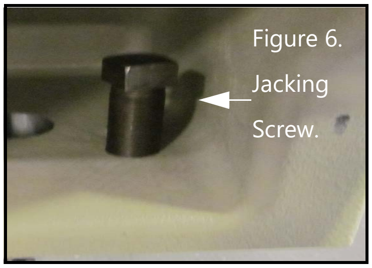


Figure 5. Mounting Foundation.



The motor is to be mounted securely onto a bedplate that is rigid enough to prevent any base-to-motor or motor-to-base vibration. The base must not impose bending or twisting strains on the motor housing.



Slotted shims are recommended when mounting the motor as it may be necessary to remove or add shims when aligning the shafts. The use of proper shims inserted under each mounting foot will prevent distortion of the motor housing when the mounting bolts are secured.

The following procedure is recommended for mounting the motor.

Note: *Where available, use the Jacking Screw (Figure 6.) to raise or lower the motor when shimming. Shims used shall be the same size as the foot print of the motor.*

1. Identify the mounting foot of the motor that will require the most shims and install shim(s) to that mounting foot.
2. Tighten the mounting foot bolt.
3. Insert feeler gauges under the remaining mounting feet to determine the thickness of shims required.
4. Insert the required number of shims under each mounting foot and tighten the mounting bolts.

Note: *Use a small number of thick shims rather than a large number of thin shims (0.51 cm/0.200" max.).*

5. Measure the alignment and, using shims, continue to adjust as required.

Bedplate Installation and Leveling

Install the bedplate onto the foundation by performing the following procedure.

1. Place 1.9 – 2.54 cm (0.75 – 1.0") thick iron wedges onto the foundation at the motor mounting location.

Note: *The iron wedges shall cover at least 75% of the motor mounting footprint.*

2. Position the iron wedges equally spaced and close to the foundation bolts.
3. Place the bedplate onto the foundation.
4. Use the iron wedges to position and level the bedplate onto the foundation.
5. Secure the bedplate onto the foundation using the foundation bolts.
6. Torque the foundation bolts securely.

The 1.9 – 2.54 cm (0.75 – 1.0") of space between the foundation and the bedplate is to be filled with grout.

DO NOT remove the wedges when grouting the bedplate — wedges are to properly sized for the application so as not to interfere with the grout form.

Grouting

The foundation mounting surface must be rough and clean to provide good grout anchorage. The grout shall be of the non-shrinking type.

Apply the grouting between the foundation and the bedplate by performing the following procedure.

1. Wash the top of the foundation.
2. Where possible, build a form (border) that extends 5.1 cm (2.0") around the periphery of the bedplate area. The form is used to contain the grout during the grout application.
3. Pour and pack in the grout.
4. Grout in by building a low dam around the inside and outside of the bedplate. Where possible, allow grout to extend beyond the bedplate periphery 5.1 cm (2.0") on all sides.
5. Pack the grout to a height of 1.3 cm (½") above the underside of the bedplate.

Note: *Too deep of a grouting will cause difficulty if the motor must be removed at a later date.*

Motor Coupling

Motor Coupling Alignment

When the base has been adjusted, leveled, and grouted, the correct motor leveling and coupling alignment are obtained with the aid of shims between the motor and the base. To give the motor proper support, it is important that the base and shims combine to create a level and stable platform.

Motor coupling can be measured using a dial indicator or using a feeler gauge. The preferred method is with the dial indicator; both methods will be discussed.

Rigid Coupling

Shaft Alignment

Extreme care must be taken to obtain correct shaft alignment when using rigid couplings. Circular concentric peripheral surfaces of the two coupling halves for a rigid coupling must indicate correct alignment of 0.03 mm (0.001”) maximum when the two coupling halves are rotated together.

The alignment may be checked by using a dial indicator, or with the aid of a straight-edge and thickness gauge or feelers as shown in Figure 7. and Figure 8. on pg. 9, respectively.

The preferred method of checking alignment is with the dial indicator. Bolt the indicator to one of the coupling halves and indicate the position of the dial button on the opposite coupling half with a chalk mark. Set the indicator dial to zero at the first position and then rotate both halves of the coupling to a new position where a reading is to be made. All readings must be made with the dial button located at the chalk mark. At least six readings are to be taken.

A variation in the dial reading at different positions of coupling rotation will indicate whether the machine has to be raised, lowered, or moved to one side or another to obtain alignment of the circular concentric peripheral surfaces of the two coupling halves within the specified tolerance.

Coupling Faces

In addition to the circular concentric peripheral surfaces check, a check of the separation of the coupling faces must be made to establish correct alignment. The separation between the faces of the coupling may be checked with a dial indicator fastened to one coupling half and a reference surface fastened to the other coupling half. Mark the location of the dial button on the reference surface and make all readings with the indicator in this position.

Set the dial of the indicator to zero for the first reading and use this as the reference. Be sure to rotate both halves of the coupling the same amount, aligning the bottom of the indicator and the mark on the reference surface for each of six readings. A variation of the readings at different positions must not exceed 0.03 mm (0.001”) and will indicate how the machine has to be adjusted to obtain correct alignment. After each adjustment of the motor, repeat the above procedure to ensure that the correct alignment and leveling have been obtained.

Flexible Coupling

Units coupled through flexible couplings should be aligned as accurately as possible. The two halves should indicate correct alignment to within 0.05 mm (0.002”) maximum on the circular concentric peripheral surfaces and 0.04 mm (0.0016”) maximum separation between faces. Although most flexible couplings will withstand greater misalignment than rigid couplings, extreme misalignment can cause vibration possibly resulting in failure of the motor bearings and/or shaft.

If the method shown in Figure 8. is used to check alignment of the machines, correct alignment exists when:

- The peripheries of the coupling halves are true circles of the same diameter and the faces are flat.
- The separation between the faces is held to within the specified tolerance at all points and a straight-edge lies squarely across the rims at any point.

Non-parallel faces will be indicated by a variation in separation of the coupling halves as they are rotated, and a difference in height of the coupling halves will be indicated by the straight-edge and feeler gauge test.

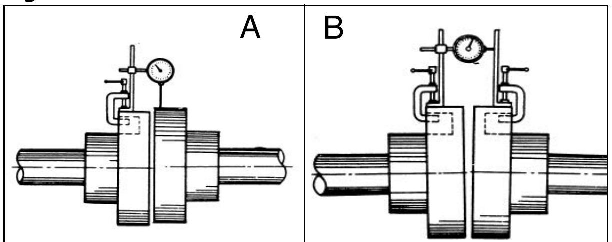
When the coupling halves have been correctly aligned with the motor feet bolted in position, place temporary bolts in two coupling holes for clamping the halves together. Then, ream for a light drive fit through both halves for regular coupling bolts.

The preferred method of measuring coupling alignment is with a dial indicator as shown in Figure 7.

Clamp the dial indicator to the coupling as indicated below to measure the circular concentric peripheral surfaces of the coupling halves for parallel alignment.

Also, as shown below, clamping a reference surface to the opposite coupling half allows the dial indicator to be used for measuring the separation of the coupling halves for axial alignment.

Figure 7. Dial Indicator.



A: Circular concentric peripheral surfaces check using a dial indicator.

B: Separation of the coupling faces check using a dial indicator.

Balance (Direct-Coupled Motors)

TIPA motors are balanced at the factory to standard commercial tolerances. Field disassembly/ assembly may result in unbalanced operation.

To correct this condition, disconnect the coupling halves and rotate one shaft 90° with respect to the other shaft. Re-connect the coupling and run the motor. If not corrected, repeat the procedure until normal operation resumes.

If the unbalanced condition persists, disconnect and rotate the same shaft another 90° with respect to the other shaft until balanced operation resumes.

If a chain, gear, V-belt, or flat belt drive is used on the output shaft, perform a minimum sprocket diameter check.

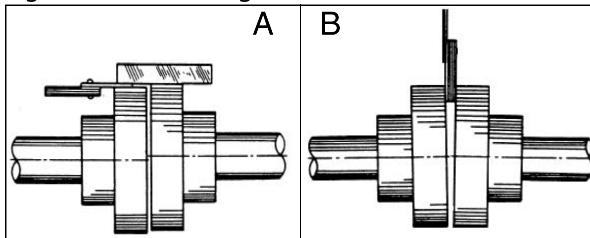
Direct coupling via a flexible means does not require a check for minimum sprocket diameter.

The straight-edge, or thickness gauge or feeler gauge is an alternative method of measuring coupling adjustment as shown in Figure 8.

Use a straight-edge, or thickness gauge or feeler gauge to check the alignment of the circular concentric peripheral surfaces of the coupling halves as shown below (A). The separation between the faces of the coupling halves can be measured as shown below (B).

Rigid coupling tolerances and flexible coupling tolerances for the circular concentric peripheral surfaces and coupling faces are as indicated in the section titled Motor Coupling on pg. 8.

Figure 8. Feeler Gauge.



A: Circular concentric peripheral surfaces check using a feeler gauge.

B: Separation of the coupling faces check using a feeler gauge.

Vibration

On new installations excessive vibration may be encountered while running. Listed below are some of the more common causes.

- Improper shimming and/or a soft foot.
- Misalignment.
- Shafts of the motor and load are not properly aligned.
- Unbalanced load.
- Worn bearings on the motor and/or the driven machine.
- A resonant mounting condition — the effect is increased when the motor is coupled to the load.
- Vibration of the driven equipment.
- Sprung shafting.
- Improper or cracked foundation.
- Electrical imbalance.
- Rotor imbalance.

Seek the simple solution first.

Table 1 lists acceptable vibration test limit levels. A vibration detector will be required to measure the system vibration levels.

After satisfactory alignment and vibration testing, install dowel pins in the base of the motor and in the bases of the driven equipment. This will prevent creeping and subsequent misalignment during operation.

Table 1. Vibration Limits (for resiliently mounted machines).

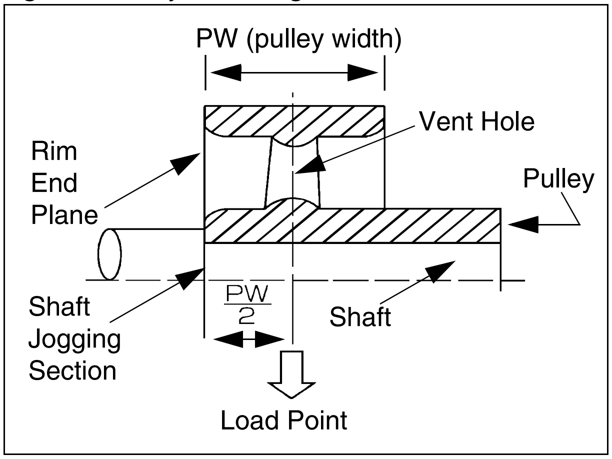
RPM at 60 Hz	Velocity (in/s peak)	Velocity (mm/s peak)	
3600	0.15	3.8	*Note:* *NEMA values at no load.*
1800	0.15	3.8	*Note:* *For machines with rigid mounting, multiply the limiting values by 0.8.*
1200	0.15	3.8	
900	0.12	3.0	*Note:* *All large TIPA motors are constructed to make field balancing possible. Sleeve bearing motors are designed with split bearings so that the rotor can be run in its own bearings while balancing.*
720	0.09	2.3	
600	0.08	2.0	

Belt Installation

1. Prepare the pulley and belt.

   If two or more belts are required, use a matched set of belts of the same peripheral length.
   Provide vent holes on the pulley as large as possible to allow ventilation cooling of the motor as shown in Figure 9.
2. Install the pulley.
   Put the rim end plane of the pulley and the shaft jogging section on the same plane so that the load applied to the shaft jogging section as well as to the bearing is minimized.
   Make the load point nearer to the motor side.
3. Secure the pulley.
4. Ensure correct motor direction.
5. Ensure that the shafts of the motor and the driven machine are parallel.
6. Ensure that the line drawn between the centers of the two pulleys is perpendicular to the shafts.
7. Install the belt(s) and adjust for the proper distance.

Figure 9. Pulley Mounting.



Motor Operation

Motor Start-Up Precheck

Perform the following checks before the initial start up.

- Inspect the motor for foreign materials and general cleanliness.
- Ensure that the motor is dry — particularly on the first start and after the machine has stood idle for some time.
- Ensure that all drain and fill plugs/caps are secured.
- Ensure that all gaskets are in place and all bolts/ screws are secured.
- Ensure that the oil level and/or grease quantity is correct.
- Use a megohmmeter to determine the condition of the windings (e.g., moisture present, winding shorts, etc.).
- Check all connections to the motor and ensure that the proper phase connections are applied and are secured.
- Ensure that all auxillary connections are secured.
- Turn off space heaters during motor operation.
- Ensure that the applied input voltage and frequency are within ±10% and ±5%, respectively, of the nameplated voltage and frequency.
- Check the alignment of the motor and coupled load such that the shaft and bearings of the motor will not be subjected to unnecessary strain or wear.
- If possible, ensure that the rotor turns freely.

⚠ DANGER

Ensure that all personnel are clear of the motor and the driven equipment during the following test.

Motor Testing

- Ensure that there are no obstructions or interferences to motor operation. **DO NOT** turn the rotor by inching (short thrusts at reduced power).
- When operating the motor under a no-load condition, ensure that the shaft key has been removed. An unsecured key can become dislodged and can cause equipment damage or severe injury to personnel.
- Run the motor without a load to confirm direction of rotation and basic functionality. Motors with unidirectional blowers can be operated only in the direction shown on the rotation plate attached to the motor.

  If the opposite direction is required for a 3-phase motor, switch any two of the 3-phase input lines or contact the TIPA Customer Support Center for support.

Note: The certified motor outline will define the motor direction.

- Run the motor for approximately one hour to check for any unusual heating of bearings or windings. This also permits lubrication warm-up before torque is applied to rotating parts.
- Run the motor under a load. Check the bearing housing occasionally while running. Using the proper protective gear and/or measuring device, ensure that bearing overheating does not occur.

Maintenance

Routine cleaning, lubrication, and inspections are required components of preventive maintenance. Proper maintenance results in extended mean-time between failures and greatly reduced repairs.

It is also important to create and store maintenance records. These records serve as a guide to preventive maintenance and provides an indication of what spare parts should be stocked to prevent lengthy motor outages.

The frequency of routine checks will depend on several variables. A few of the primary operational considerations are:

- Cleanliness
- Insulation resistance
- Lubrication and bearings
- Environmental factors such as excessive moisture, dust, etc.

Cleanliness

Dirt, dust, and oil are the greatest enemies of electrical equipment. When dirt or dust settles on a machine it may prevent heat dissipation and restrict ventilating passages. This may lead to overheating and insulation breakdown. Some types of dust are electrically conductive and may also cause insulation breakdown.

Dust and dirt may be removed from electrical equipment with dry compressed air, dry cloths, or by brushing. The compressed air must be dry and at a low pressure (less than 172 kPa/25 psi) as not to damage the insulation. Grit, iron and copper dust, graphite, and lamp black should be removed by suction. Hose tips for either pressure or suction should not be metal.

Dust and dirt also have a harmful effect in that they tend to absorb oil or grease. This may result in the formation of gum that is not easily removed.

Oil or grease covered machines should be cleaned thoroughly and have a fresh coating of insulating varnish applied. Most of the oil or grease can be removed with a cloth moistened with an appropriate solvent/cleaner. A brush should be used for surfaces difficult to reach by hand. Use a spray gun to clean inaccessible slots and passages. After using the solvent, be sure to dry the windings with dry compressed air.

DO NOT use a solvent that has toxic effects or which has a deteriorating affect on varnish.

Insulation Resistance

Moisture may develop in a motor during long-term storage. To determine if there is moisture in the motor, an insulation test may be used. A megohmmeter can be used to measure the insulation resistance which is an indicator of the presence of moisture in the motor.

The insulation resistance is to be measured per IEEE Standard 43.

When comparisons are made between present and previous readings, it is possible to observe the winding insulation trend. When correlating periodic readings, it is desirable to test at a definite voltage and time, and to record other pertinent conditions (e.g., ambient temperature, humidity, etc.).

The recommended minimum insulation resistance in megohms at 40° C (104° F) is equal to the rated motor potential in kilovolts plus one megohm (e.g., a motor with a rating of 4000 volts would have a minimum insulation resistance limit of 4.0 + 1 resulting in a 5 megohms minimum).

Note: The insulation resistance voltage can cause electrical shock. Do not touch the test terminals during the insulation resistance testing.

Recommended Practice for Drying

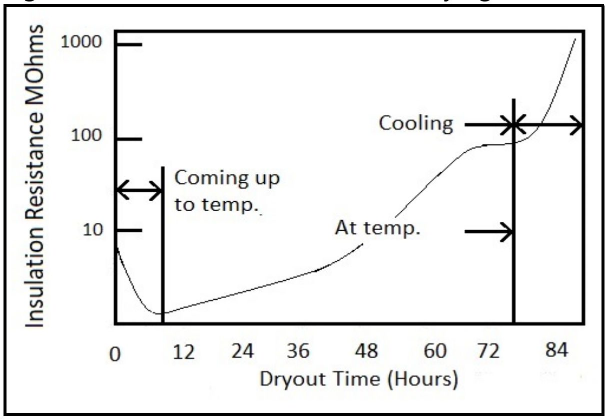
Drying the motor will be required if the insulation resistance value is too low. This may be accomplished by using an external heat source or by circulating direct current through the coils.

Apply External Heat

Place the motor into an enclosure and apply heat from steam pipes or electric strip heaters. The enclosure should have a vent at the top for the evaporated moisture to escape.

This process should be carried out slowly or winding damage could result (see Figure 10. on pg. 13). Sufficient time should be allowed for the process. At no time should the temperature be allowed to exceed 85° C (185° F).

Figure 10. Insulation Resistance vs. Drying Time.



Apply Direct Current

An alternative method of drying the windings requires direct current. Frequently, welding sets are available and can be operated in parallel to obtain the desired current. For suitable drying temperature, the direct current (DC) should be about one-half of the rated alternating current (AC) value specified on the nameplate of the motor.

DO NOT exceed an insulation temperature of 75° C (167° F).

Securely connect the leads from the current transformer and temperature detectors. Current flow and the temperature are to be monitored to protect the motor from damage.

The current **MUST BE LIMITED** so that the maximum temperature of the windings do not exceed 85° C (185° F).

The insulation resistance drops rapidly initially as the winding heats up, then rises slowly as the moisture is driven off, and finally levels off at a steady value. Drying may be concluded when a fairly steady value of insulation resistance is reached.

It is advisable to keep annual records of insulation resistance readings and the conditions (e.g., ambient temperature, humidity, etc.) under which the readings are taken.

Heating of Bearings

Bearings should be periodically checked for excessive heating. This is very important during the run-in period when overheating occurs most frequently. If overheating does occur, immediately determine the cause and take corrective action.

Overheating of Antifriction Bearings

It is always advisable to make frequent checks on the temperature of the bearings. Total bearing temperature should not exceed 140° C (284° F).

TIPA standard settings for antifriction bearings alarm activation is 100° C (212° F) and trips at 110° C (230° F).

Listed below are the most probable causes of bearings overheating.

- Grease contamination.
- Insufficient amount of grease.
- Too much grease — Causing churning.
- Grease too stiff — Prevents free action in the bearings.
- Excessive thrust due to misalignment or excessive imposed loads.
- Pounding caused by bearings being loose on shaft or balls being worn.
- Actual bearing failure caused by a broken ball, broken cage, or flat balls.
- Heat from an external source causing a high bearing temperature.

Problems due to grease failures are many times due to inferior grease that is not neutral or free of moisture, acid, or non-lubricating fillers. These characteristics cause the grease to turn rancid in a short period of time and may actually etch and roughen the highly polished surface of the bearings. Some grease types also tend to become tacky or gummy and prevent freedom of the ball or roller action.

For performance issues caused by degradation of grease performance, the bearings should be disassembled and thoroughly cleaned with petroleum solvent or flushing oil. The bearing chamber should then be refilled with a new good grade of grease. Be sure that all solvent is removed before filling with grease. Fill the bearing chamber to three-quarters capacity to obtain the best efficiency. See the nameplate of the motor for the correct grease type to be used.

Bearing malfunctions may be caused by a coupling misalignment. **DO NOT** exert pressure on one side of the frame to make it fit into an uneven base or floor. If the frame distortion is excessive, bearing operation will be affected.

Mechanical failures caused by defective bearings should be remedied by replacing the bearings, determining the underlying cause, and taking the steps to avoid a recurrence of the problem.

Excessive temperature rise of the bearings may also be reduced by removing the source of external heat if applicable.

Daily and Periodic Inspections

Daily Inspections

WARNING

Daily inspections will include a visual of the motor for any obvious signs of wear. Some motor inspections will be performed while running (e.g., sound, temperature, or vibration).

Table 2 lists the more common system anomalies that may affect motor-driven systems and provides an accompanying corrective action for each.

Toshiba recommends that inspection records be logged and updated with each inspection that required corrective action.

The inspection records shall include, as a minimum, the system operating conditions including the ambient temperature, standard/severe duty operation, corrective action, etc.

Table 2. Daily Inspection.

Inspection Item	Inspection Focus	Probable Cause	Corrective Action
Leaks	Motor housing/bearing seepage	Defective bearing(s).	Replace bearing(s). Confirm proper motor/load alignment and coupling. Lubricant at proper level. Lubricant system secured.
Wires, Cable	Insulation damage/ routing	External damage, cracks, burns, etc.	Repair, replace, reroute wire/cables.
Motor Housing	Corrosion, Staining	Application-specific.	Check for fluid leaks, pump housing leak, lubricant system breach, etc.
Terminal Box	Discoloration, Rust, and/or Corrosion	Paint deterioration, overheat from poor electrical connection.	Repaint. Secure terminal box connections.
Motor Overheating	Motor 3-phase power, Coupling	Overloaded. Incorrect line voltage. Unbalanced electrical power. Motor/load coupling. Bearings.	Run unloaded/loaded (test). Confirm 3-phase power specifications. Secure and ensure mechanical coupling alignment. Perform a motor megohmmeter test. Check lubricant level.
Odor	Odor source	Overload. Electrical. Fluid Leak. Overheat.	Stop motor. Confirm connections. Check for lubricant leaks. Check bearings. Reduce/remove load.
Motor System	Condensation/ accumulation of moisture	Leaks. Recently moved to warmer environment.	Determine/remove moisture source

Periodic Inspections

⚠ WARNING ⚠

Contact with live parts can result in electric shock!

Periodic inspections will include stopping the motor, performing the standard lock-out/tag-out procedure and is to be performed regularly every 12 – 24 months.

Periodic inspections include bearing maintenance. Bearings are to be cleaned, serviced, and replaced if required.

Perform the periodic inspections in accordance with the listed items of Table 3 on page 16 and in conjunction with the daily inspection items.

Temperature Measurements

Ensure that the temperature rise of the motor remains within the specified range.

The temperature rise is measure by subtracting the ambient temperature from the motor temperature.

The motor temperature is measured via thermometer or thermocouple on the bearing, motor frame, and/or terminal box.

Extreme temperature measurements require that the motor be stopped and a more detailed investigation be performed.

Table 3. Periodic Inspection Items.

	Condition	Possible Cause	Corrective Action
Start Up/Running	Overheat	Ventilation. Load obstruction. Bearings. Improperly aligned. Coupling anomaly. Physical obstruction.	Increase ventilation. Repair/replace bearings. Ensure that motor/load coupling is as designed. Reduce load. Ensure 3-phase, nameplate voltage/frequency. Ensure that the load is free of any obstructions.
	Humidity	System moved to a warmer climate (condensation).	Add a dehumidifier. Allow the system time to reach the temperature of the new environment.
	Flood/Snow Ingress	Check IEC IP rating for application.	
	Oil Leak	System lubricant leaked.	Check lubrication level. Check lubrication system seals.
Load Coupling	Overload	Reduce load. Ensure 3-phase, nameplate voltage/ frequency.	
	Vibration	Ensure that the load is balanced. Check motor/load coupling and alignment.	Run motor unloaded. Isolate vibration source. Foundation/bedplate not secure.
	Pulley Misaligned		Check motor/load pulley alignment.
	Pulley Too Large (no cooling)		Increase ventilation. Remove all air flow obstructions.
Load Coupling	Angle of Contact Too Small	Difference in pulley sizes.	Ensure that the pulleys and drive belt sizes are correct for the application. Use a wedge belt system.
	Dust/Debris collection	Coefficient of friction may be reduced because of dust/ debris.	Vacuum and wipe away any build up of dirt, dust, or debris.
	Thrust Load Too Large		The weight of any ancillary machinery should not be supported by the motor bearings alone.

Table 3. Periodic Inspection Items.

	Condition	Possible Cause	Corrective Action
Electrical	No Power	Loose, unattached, or incorrectly fastened electrical connections.	Secure all 3-phase input voltage and ground terminals.
	Unstable Operation.	Unsecured/ improperly grounded. Loose/unsecured connections.	Secure all 3-phase input voltage and ground terminals.
	Load Point Too Far Away	The motor load increases with the distance away from the motor.	Reduce the motor/load distance.

Vibration Measurements

The vibration level is measured while the motor is running.

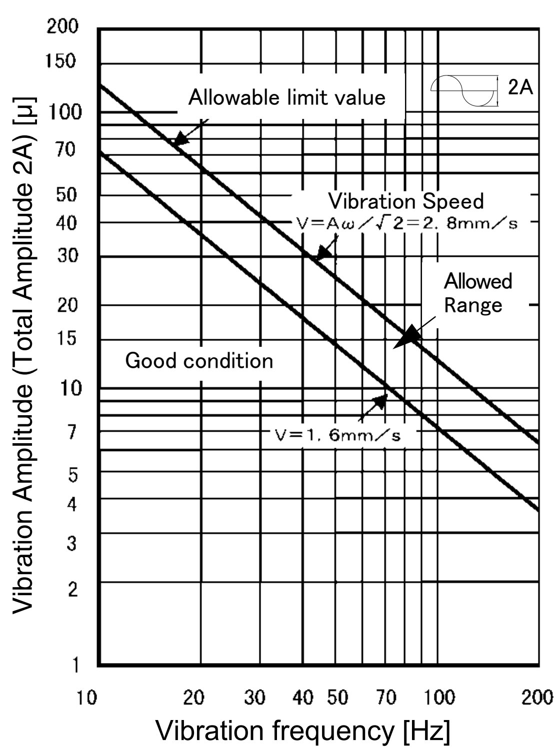
A vibration meter is used to measure motor vibration. A transducer is attached to the motor frame and is connected to the meter.

The measured vibration will vary as a function of the transducer mounting location. Multiple readings form multiple frame locations are required.

The vibratory acceptable limits are shown in Figure 11. If the measured vibration level exceeds the established limits a system analysis will be required to determine the cause.

The motor vibration acceleration limit is 0.5G from the load side (opponent machine) or from outside.

Figure 11. Vibration Allowable Range.



Note: Vibration frequency is not the rotational speed of the motor.

Motor Lubrication

Adequate lubrication is required for normal motor operation and to assure a long motor life. TIPA motors are properly greased at the time of manufacture. Electric motor relubrication is a critical part of the maintenance program for the motor-driven system.

In addition it is recommended that motors that have been stored for a period of six months or more be relubricated prior to commissioning.

Lubrication Specifications

A standard hand held grease gun typically delivers 1.25 grams/pump stroke.

Table 4 lists the recommended grease volume for the listed frame sizes.

Table 4. Stored Motor Relubrication Guidelines.

Frame Size	Grease Supply
143-256	2.5 – 3.75 grams
284-405	5 grams
444 and Larger	

Ensure that the grease nipples are clean and free of dirt before regreasing. Only use grease that is fresh and free of contamination.

TIPA motors may be equipped with an automatic grease relief fitting, a grease plug, or a grease outlet cover plate.

The new grease may not fully expel the remaining used grease.

Avoid over greasing — Use the recommended grease volumes.

Note: When relubricating roller bearings the monthly service time is one half.

Grease leakage around the shaft hole of the motor housing could indicate an over-greasing condition. Excess grease should be purged by running the motor temporarily with the relief fitting open.

It may be necessary to remove an automatic grease relief fitting due to hardening of grease. Motors using a grease plate may require that old grease be scraped out once every two years as a minimum.

Standard Service

Table 5. Service Conditions.

Service Conditions	
Standard Duty	Eight hours per day. Light to normal loading. Clean and dust-free conditions.
Severe Duty	24 hours per day. Light to normal shock loading and/or vibration. Exposure to dirt or dusty conditions.
Very Severe Duty	24 hours per day. High ambient temperature. Normal ti high shock loading and/or vibration. Exposure to dusty conditions. Confined mounting conditions. Reduce severe duty interval by 1/3.

See Tables 7 and 8 on pg. 19 for the relubrication schedules of horizontal and vertical motors, respectively.

See Tables 9, 10, and 11 on pg. 19 for the relubrication volume requirements of horizontal and vertical motors, and of vertical motor angular contact bearings, respectively.

Before greasing ensure that fittings are clean and free of dirt and contaminates.

Remove the relief plug or plate and pump the required amount of grease using a low-pressure hand-held grease gun.

Allow the motor to run with the grease outlets open for the specified time periods as indicated in Table 6 before replacing any hardware.

Table 6. Pre-Hardware-Change Run Times.

Frame Size	Recommended Run Time
143T-365T	20 – 30 minutes
405T and larger	60 minutes

Table 7. Horizontal Motor Lubrication Schedule.

Sync. RPM Range	Frame Size	Type of Service	
		Standard Duty	Severe Duty
3600 – 3000 1800 – 750	143 – 256	8 months 30 months	4 months 12 months
3600 – 3000 1800 – 750	284 – 365	8 months 24 months	4 months 12 months
3600 – 3000 1800 – 750	404 – 5811	8 months 18 months	4 months 8 months

Table 8. Vertical Motor Lubrication Schedule.

Sync. RPM Range	Frame Size	Type of Service	
		Standard Duty	Severe Duty
3600 – 3000 1800 – 750	180 – 250	8 months 30 months	4 months 10 months
3600 – 3000 1800 – 750	280 – 360	8 months 24 months	3 months 8 months
3600 – 3000 1800 – 750	400 – N449	4 months 18 months	2 months 6 months

Table 9. Horizontal Motor Bearing Lubrication Volumes.

Frame Size	Bearing Size	Periodic Grease Amount
143 – 256	6205/6206 6207/6208/6305 6306 6308/6309	3 grams 5 grams 10 grams 20 grams
284 – 365	6211 6309 6310/6312 6314	10 grams 20 grams 30 grams 50 grams
404 – 5811	6216 6313/NU313/ NU317 NU318/NU320 6317/6318 6320/6322/6324 NU322/NU324 NU328/NU228	10 grams 20 grams 30 grams 50 grams 80 grams 80 grams 80 grams 100 grams

Table 10. Vertical Motor Bearing Lubrication Volumes.

Frame Size HP	Bearing Size	Periodic Grease Amount
180	6306	7 grams
210 – 280	6308 6309 6310	10 grams 13 grams 15 grams
320 – 360	6311 6312	17 grams 20 grams
400 – N449	6313 6314 6315 6318	23 grams 26 grams 30 grams 41 grams

Table 11. Vertical Motor Angular Contact Bearing Lubrication Volumes.

Frame Range	Bearing Size	Periodic Grease Amount
180LP	7306B	14 grams
210LP – 280LP	7308B 7309B 7310B	21 grams 25 grams 30 grams
320LP – 360LP	7311B 7312B	10 grams 20 grams 30 grams 50 grams
400LP – N449LP	7313B 7314B 7315B 7318B	46 grams 53 grams 56 grams 82 grams

Recommended Greases

WARNING

DO NOT mix greases of different brands. This practice may destroy the composition and physical properties of the grease.

In the event that a different grease is required, open the grease outlet and purge the system as much as possible of the existing grease.

Repeat the system purge after one week of service. Consult the TIPA Customer Support Center for further information on grease type compatibility.

The nameplate of the motor will typically specify the grease to be used with the motor.

Standard 840 and 841 TIPA motors are greased at the factory using the following lubricant:

Table 12. Factory Grease Type.

Grease Name	Mobil Polyrex® EM or Equivalent
Manufacturer	Exxon Mobile Corp.
Operating Temp. Range	-30° C – 50° C (-22° – 122° F)

Recommended Greases for Standard Applications

Table 13. Standard Applications Grease Type.

Operating Ambient Temp. -30° – 50° C (-22° – 122° F)	
Grease Name	Manufacturer
Chevron® SRI	Chevron Corp.
Mobile Unirex® N 2	Exxon Mobile Corp.
Mobile Polyrex® EM	Exxon Mobile Corp.
Shell Dolium® R	Shell Oil Co.
Mobilith SHC® 100	Exxon Mobile Corp.

Unless otherwise specified on the motor nameplate, use the recommended greases for the listed temperature range.

Recommended Greases for Special Applications

The following greases recommended for special applications only and should be used only for motors specifically built for such conditions.

Table 14. Special Applications Grease Type.

Operating Minimum Ambient Temp. -60° C (-76° F).	
Grease Name	Manufacturer
Operating Maximum Ambient Temp. 90° C (194° F).	
Dow Corning® 44	Dow Corning Corp.
Mobile Unirex® S2	Exxon Mobile Corp.
Triton®460	Conoco Phillips Co.
Mobilith SHC® 460	Exxon Mobile Corp.

Heating of Bearings

Bearings should be periodically checked for excessive heating. This is very important during the run-in period when overheating occurs most frequently. If overheating does occur, immediately determine the cause and take corrective action.

Overheating of Antifriction Bearings

It is always advisable to make frequent checks on the temperature of the bearings. Total bearing temperature should not exceed 140° C (284° F).

TIPA standard settings for antifriction bearings alarm activation is 100° C (212° F) and trips at 110° C (230° F).

Listed below are the most probable causes of bearings overheating.

- Grease contamination.
- Insufficient amount of grease.
- Too much grease — Causing churning.
- Grease too stiff — Prevents free action in the bearings.
- Excessive thrust due to misalignment or excessive imposed loads.
- Pounding caused by bearings being loose on shaft or balls being worn.

- Actual bearing failure caused by a broken ball, broken cage, or flat balls.
- Heat from an external source causing a high bearing temperature.

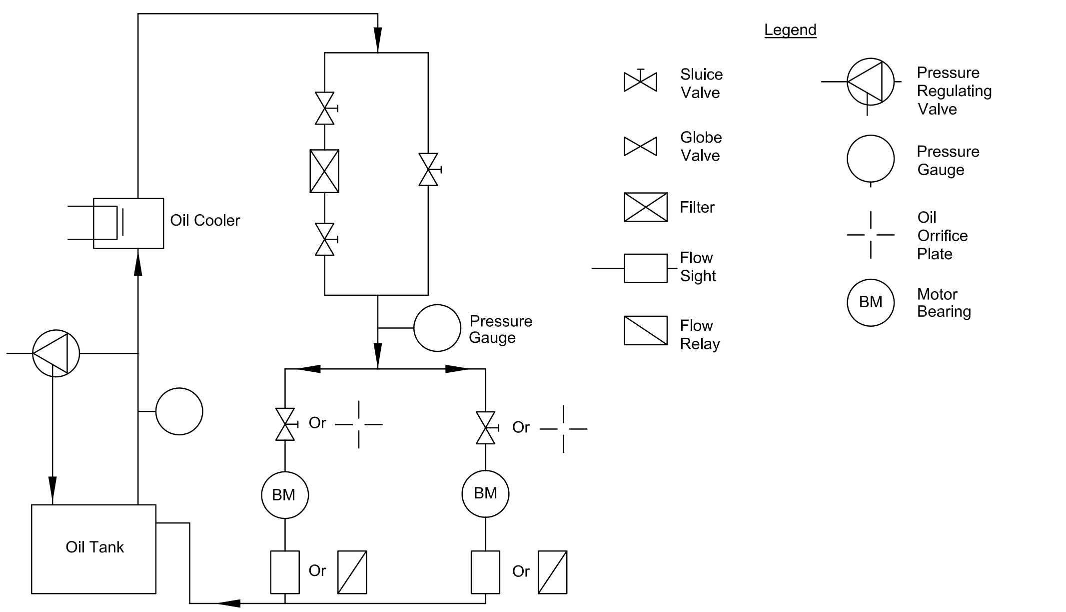
Problems due to grease failures are many times due to inferior grease that is not neutral or free of moisture, acid, or non-lubricating fillers. These characteristics cause the grease to turn rancid in a short period of time and may actually etch and roughen the highly polished surface of the bearings. Some grease types also tend to become tacky or gummy and prevent freedom of the ball or roller action.

For performance issues caused by degradation of grease performance, the bearings should be disassembled and thoroughly cleaned with petroleum solvent or flushing oil. The bearing chamber should then be refilled with a new good grade of grease. Be sure that all solvent is removed before filling with grease. Fill the bearing chamber to three-quarters capacity to obtain the best efficiency. See the nameplate of the motor for the correct grease type to be used.

Bearing malfunctions may be caused by a coupling misalignment. **DO NOT** exert pressure on one side of the frame to make it fit into an uneven base or floor. If the frame distortion is excessive, bearing operation will be affected.

Mechanical failures caused by defective bearings should be remedied by replacing the bearings, determining the underlying cause, and taking the steps to avoid a recurrence of the problem. Excessive temperature rise of the bearings may also be reduced by removing the source of external heat if applicable.

Figure 12. Typical Oil Flow Diagram.



Motor Disassembly and Reassembly

Remove/Replace Antifriction Bearings

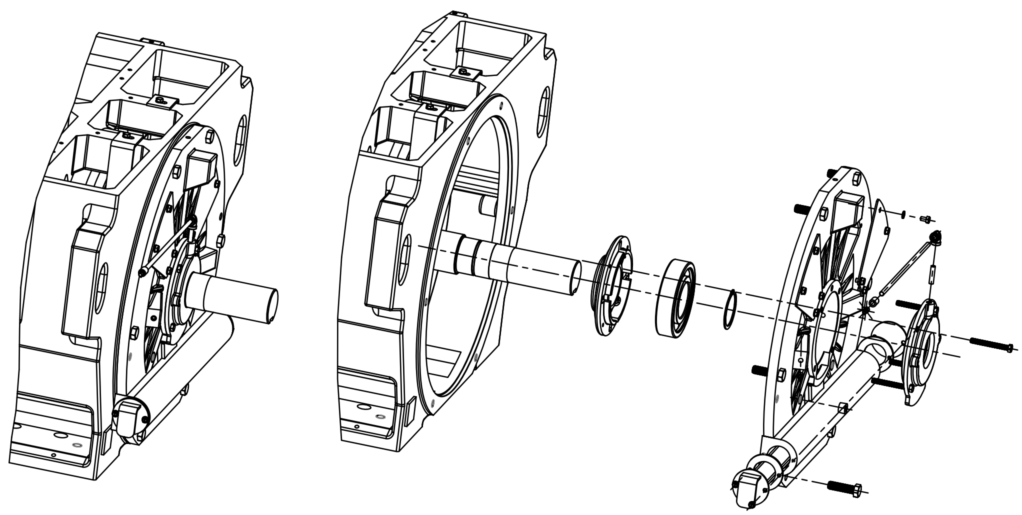
When removing or replacing a bearing set, there are several guidelines that should be adhered to in every case. Following these rules closely will prevent damage to the bearings or motor and will result in a longer bearing life.

Remove the Bearings

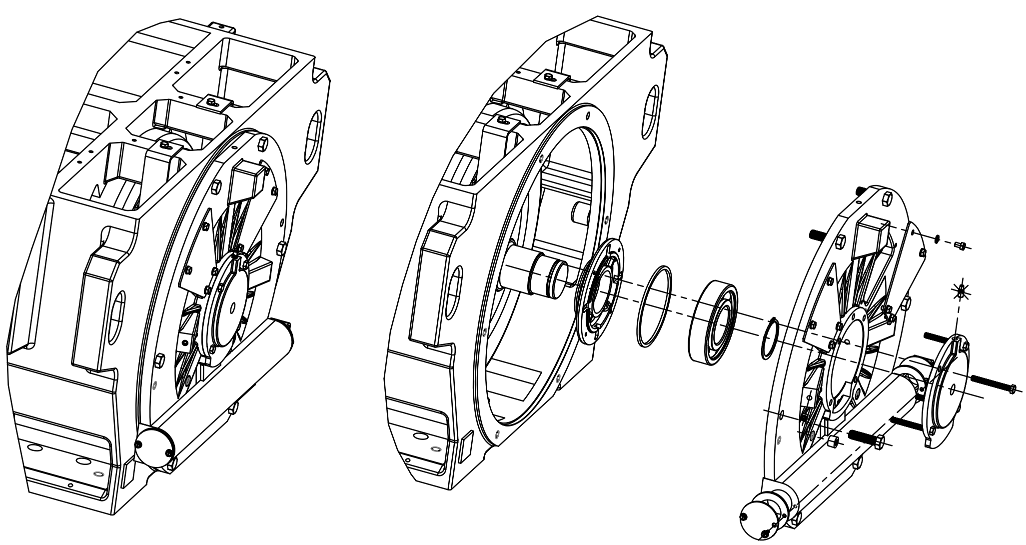
When removing the bearings, always use an approved bearing puller. Follow all standard bearing puller instructions and safety procedures (i.e., safety glasses, protective gloves, etc.).

Figure 13. Drive End and Opposite Drive End Bearing Assemblies.

Drive End Bearing Assembly



Opposite Drive End Bearing Assembly



Install the Bearings

Bearing Installation Precautions

- **NEVER** open the protective cover on new bearings — Prevents dust or dirt exposure.
- **DO NOT** remove the bearings from the received package until the moment of installation. **Always** open the package in a clean place.
- **NEVER** clean new antifriction bearings — The slushing oil on new bearings should not be removed.
- **DO NOT** pack the bearings to capacity as this will cause overheating. Fill the bearing chamber to three-quarters capacity with clean grease.
- **DO NOT** force the bearings onto a shaft by means of the outer race.
- **DO NOT** attempt to force the bearings onto a badly worn shaft or a shaft that is too large for the bearings.

Installation

Pressing in or induction heating are commonly accepted bearing installation methods.

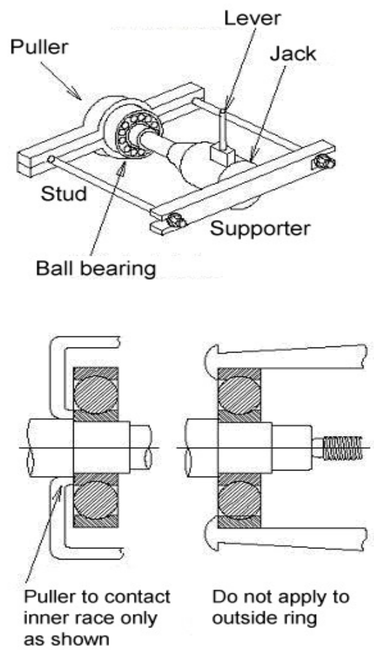
When pressing in, coat the shaft with a thin film of oil.

Note that the metal tube fits against the inner race of the bearings. **DO NOT** strike the tube very hard — light tapping will suffice.

Induction heating is the process wherein the bearings are heated in an oven or oil bath allowing for it to expand and slide onto the shaft. Before heating, ensure that the inner diameter of the bearings have been checked against the shaft journal dimension to prevent too tight of a fit after the bearings cool. The maximum difference of bore to journal should be 0.0004".

Use a temperature of approximately 121° C (250° F). If the temperature is too high damage to the bearings may result and if the temperature is too low it may cause the bearings to seize onto the shaft.

Figure 14. Bearing Puller.



Rotor Removal

CAUTION

The rotor may be pulled out for internal inspection, repair, and cleaning (figure Figure 15. on pg. 24).

After disassembling the bearing brackets, bearings, and other accessories, the rotor is lifted with chain blocks connected to the shaft ends, shifted along the axial plane, and pulled out of the stator.

Axial space requirements for the rotor removal and reinsertion will be two times the rotor length.

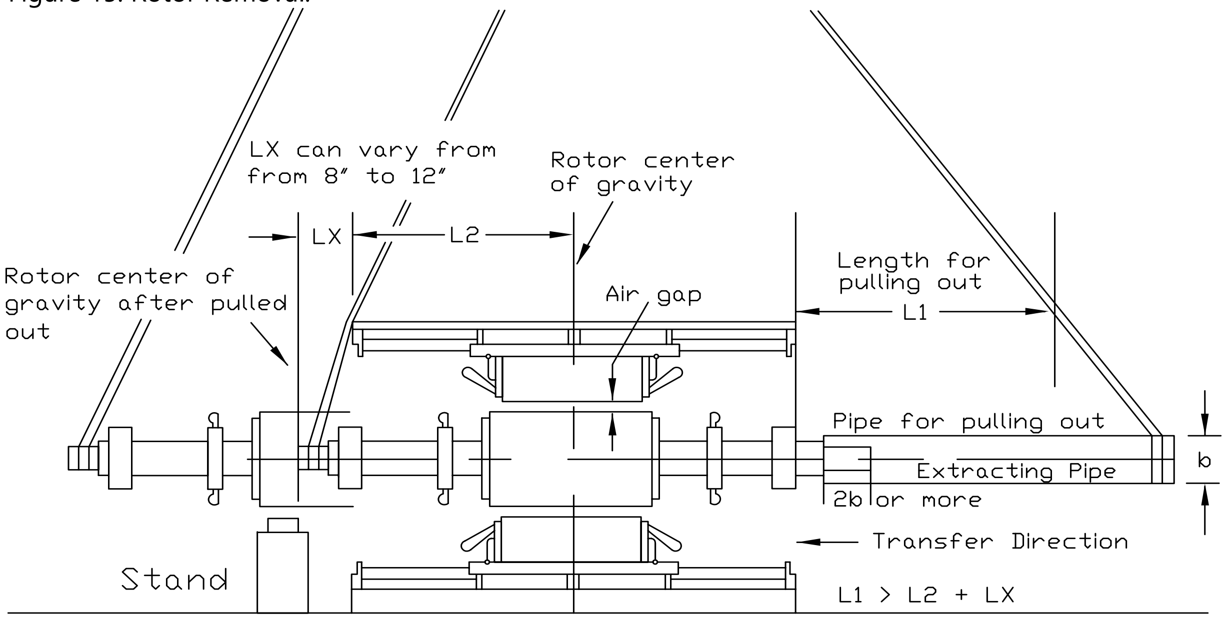
Two or more lifting hooks which can micro-adjust the horizontal shift and height of the rotor are required. Typically, the rotor is lifted by chain blocks hung to the hooks of a traveling crane.

A pipe or extension shaft that is capable of holding the rotor shaft is required to pass the rotor through the stator.

When a pipe is used, it shall be of the material matching the rotor weight and have an inner diameter of 0.2 to 0.78" (5.08 to 19.8 mm) larger than the mating shaft diameter.

Wind a protective sheet around the rotor shaft at the contact point to a length of at least twice the pipe diameter. The shaft may then be inserted into the pipe.

Figure 15. Rotor Removal.



Lifting the Rotor

1. Insert the extracting pipe.
2. Wind the protective sheet around the contact portion of the shaft.
3. Insert the pipe to a depth of at least twice the diameter of the pipe.
4. Slowly lift the rotor through the chain block, paying close attention to the rotor-to-stator air gap.

Removing the Rotor

Ensure that the rotor does not contact the stator throughout the operation.

Slowly shift the rotor along its axial plane. When the center of gravity of the rotor exits the stator, rest the rotor on the stand. Pull-out is completed.

Inserting the Rotor

The insertion is made by the reverse order of pull-out.

Completion of the insertion phase occurs when the difference between the core ends of the stator and rotor are equal at both ends.

Electrical Testing

Field Insulation Test

Field insulation tests on large motors are performed to determine the following:

- The condition of the insulation.
- The need to recondition insulation system to prolong the life of the motor.
- A long-range program to detect progressive deterioration.

Because the motor may be commissioned within a wide range of environments and applications, this section will discuss installation variables and other systemic considerations that apply with each installation.

Each installation must be evaluated for the specific conditions of the application to determine the test method that is best-suited for the application.

The insulation resistance test is made with DC rather than AC to determine if a system can be tested with high voltage. For 0 – 7000 volt form-wound induction motors, the tests in Table 13 are recommended.

Table 13. Recommended Insulation Tests.

Type of Winding	Voltage Range	Type of Test					
		AC Hipot		DC Ohmmeter		DC Hipot	
		Pre Service	In Service	Pre Service	In Service	Pre Service	In Service
Form	0 – 600	Yes	Yes	Yes	Yes	No	No
	601 – 7000	Yes	No	No	No	Yes	Yes

Effect of Altitude on Temperature Rise

Because most motors are cooled by convection and because the density and corresponding cooling ability of the air decreases with altitude, allowances must be made for operation in altitudes above 1.0 km (3300’).

NEMA Standards specify that the temperature rise as tested at low altitudes shall be less than that tabulated in the Temperature Rise Standard by 1% of the specified temperature rise for each 100 m (330’) increase in altitude above 1.0 km (3300’).

As an illustration, an open motor tested at sea level must have a full load temperature rise of only 64° C (147° F) to be suitable for operation at 9900 feet altitude with the standard temperature rise of 80° C (176° F).

The calculations are as shown below:

Standard Temperature Rise Open Motor = 80° C (176° F).
Allowance for 3.01 km (9900’) Altitude.
Maximum Permissible Temperature Rise at Low Altitude is 64° C (80° C - 16° C).

$$\frac{9900 - 3300}{330 * 100} * 80° C = 16° C$$

Special Equipment (Accessories)

Some of the following special equipment or accessories may be required as a function of several variables including motor size, ambient operating conditions such as moisture, dust, temperature, etc.

Space Heaters

Space heaters are provided in electrical motors that operate under damp, cold, humid, or environmentally exposed conditions.

To counteract dampness, heaters are designed to maintain the internal temperature of the motor at approximately 5° C (41° F) above the ambient temperature.

Heaters may be specially designed to keep lubricants from becoming excessively cold. Operating temperatures may be controlled to meet various requirements.

The location of the space heaters in the machine is dependent on the use for which they are provided. Typically, the heaters are mounted on one or both of the bearing arms, the frame, or coil guards.

Where heaters are to be used, some consideration should be given to the installation position as it applies to the disassembly of the equipment (when required).

Do not operate the space heaters while the motor is running.

Stator Temperature Detectors

Many large motors are equipped with temperature detectors to detect the stator winding temperature. The type of detector used is based solely on the customer requirements. The leads are brought out to a separate auxiliary terminal box.

Several types of temperature detectors are available for sensing stator winding temperature.

Resistance Temperature Detectors

A Resistance Temperature Detector (RTD) is a variable resistor in which the resistance value of the component varies as a function of an ambient thermal condition. The resistance variation is used to indicate changes in temperature. The RTDs are installed in the motor slots.

Thermocouple

Thermocouples are comprised of the connection between two dissimilar metals that produce a voltage when heated. This voltage is calibrated and used to indicate the ambient motor temperature.

Thermocouples are installed in the motor slots. The thermocouples are designed to operate in conjunction with instruments that measure the varying voltage across the bimetal junction.

Bearing Temperature Detectors

Many sleeve bearing motors are supplied with some type of bearing temperature detector. These devices will provide a warning or shut down the equipment if the bearings overheat. The overheat may be caused by any one or more of several possible conditions (e.g., misalignment, loss of lubrication, bearing failure, etc.).

Bearing temperature detectors are available in several varieties. Typical detectors are resistance-temperature detectors, thermocouples, thermistors, bulbs filled with expandable liquids, bimetallic elements, etc. Each of these detector types require some form of switching equipment to process the signal from the device.

Air Filters

Air filters on motors are designed to trap air borne dirt before it gets into the working parts of a motor. The usefulness of filters is dependent upon the operating environment and how frequently they are cleaned and/or changed.

The air filter types are listed below.

- Metallic Air Filters

  These are permanent, cleanable, viscous-type filters made of galvanized metal construction. Stainless steel and Monel construction are also available. It is constructed of horizontal layers of galvanized wire screen mesh (so arranged as to provide a large filtering area) and has no direct passages through the filter media.

- Non-Metallic Filters

  These are washable, replaceable filters of foam with a metallic frame for support.

- Dry Type Filters

  These are non-reusable filters composed of a fiberglass material on a round wire frame.

All motors are designed to operate properly with or without air filters. However, air filters do tend to restrict and reduce the volume of air that cools the motor. To ensure that the motor does not reach a critical temperature, stator winding protection devices are recommended.

Ordering Information and Spare Parts

Ordering Information

TIPA motors and spare parts may be ordered from the Toshiba.com\tic\ website. Hover over the Products pull-down menu. Select Low Voltage Adjustable Speed Drives. From the subsequent menu click Spare Parts Catalog.

Spare Parts Listing

The recommended spare parts listed in Table 14 are wear items and are normally the most susceptible to damage. The table should be considered as a guide only, but it will offer reasonable security for normal operations.

Stock size will depend on the application primarily. Critical applications where continuous operation is of primary importance will require a larger supply of parts.

Each user will have to evaluate the proper requirements in this respect.

Table 14. Recommended Spare Parts for AC Motors.

Item	Part Name	1 to 4 Motors	5 to 9 Motors	10 to 25 Motors
1	DE Bearings (AF)	1	2	2
2	NDE Bearings (AF)	1	2	2
3	Oil Rings (where required)	1 Set	1 Set	2 Sets
4	Sleeve Bearing Liners	1 Set	1 Set	2 Sets

Service Guide

The following table lists operational symptoms that may occur, probable causes, and the suggested approaches to a solution. This table is intended as both a diagnostic aid and a quick reference sheet. If the source of the malfunction is unknown, or the solution is not achieved after using this information, report the matter to the TIPA Customer Support Center

DANGER

Service, repair, and maintenance operations may require live system interaction. Care should be taken when measuring running system conditions and is to be performed by Qualified Personnel only.

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Troubleshooting Assistance		
Symptom	Probable Cause	Remedy
Failure to start	• Loose, unattached, or incorrectly fastened electrical connections. • Low line voltage. • Excessive load. • Open circuit in stator windings or in squirrel cage bars. • Short circuit in rotor or stator.	• Confirm as correct and tighten all mechanical and electrical connections. • Check panel meters. • Reduce load. • Remove load/retest. • Run a continuity check. Check condition of coils and bars. Repair if possible. If impractical, order renewal parts from the TIPA Customer Support Center.
Motor overheating	• Overloaded. • Improper line voltage or incorrect frequency. • Ventilation obstructed. • Unbalanced electrical power. • Excessive heat, humidity, dirt, etc., has adversely affected insulation.	• Reduce load. • Clean motor. • Check voltage/frequency of each phase. • Failing bearings. • Motor/load misalignment. • Perform an insulation resistance check with a megohmmeter.
Noisy or overheat-ing bearings	• Misalignment between motor and driven machine. • Excessive, low, or improperly packed grease (if grease lubed). • Low oil level (if oil lubed). • Improper fit of bearings or in Babbitt liners (especially in oil grooves). • Excessive belt tension or excessive load side thrust. • Contaminated oil.	• Check alignment and correct as necessary. • Clean bearings and repack with proper viscosity grease. Check for damage. • Drain and fill to correct level with correct viscosity. Check for scoring of bearing surfaces. • Replace bearings if damaged. • Reduce belt tension or load side thrust. Check alignment and correct as necessary. • Drain oil, flush clean, and refill with recommended oil.

Troubleshooting Assistance		
Symptom	**Probable Cause**	**Remedy**
Abnormal noise or abnormal vibration	• Foreign matter between fan and another object. • Single-phase operation. • Unbalanced electrical power. • Air gap is unequal. • Loose coupling between motor and the driven equipment. • Loose motor and/or driven equipment.	• Check fan path for obstruction. • Remove foreign object — Keep surroundings free of foreign objects. • Check for unbalanced voltage. • Align the rotor to the center of the stator. • Check and/or replace bearings. • Tighten mounting bolts securely.
Vibration	• Improper alignment between motor and driven machine. • Loose or incorrect base attachment. • Worn bearings. • Unbalanced load. • Warped base.	• Measure vibration amount with vibration sensor at sides of frame and bearings at shaft height. Determine if the source is in the motor or in the driven machine. If excessive vibration is an issue, corrective measures must be taken. • Measure around concentric periphery of coupling with both clamps and dial gage, or with feeler gage and straight edge. Realign if required. Check vertical with a bubble scale or plumb bob. • Check coupling and make adjustments as required. • Remove the load and run the motor to determine if the load is unbalanced. • Worn drive gears of the driven machine.
Improper direction	Mis-wired.	• Reverse any two of the 3-phase power leads to the motor and observe the direction of rotation. Refer to connection plate, connection drawing, or the certified motor outline. • Remove load and test.
Poor or intermittent overall performance	• Improper grounding.	• Check all grounds. • Add ground strap/connection as required.

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