

Low and high voltage three phase induction motors

W60 Line - Squirrel cage rotor - Vertical

Installation, Operation and Maintenance Manual





Installation, Operation and Maintenance Manual

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Dear Customer,

Thank you for purchasing a WEG motor. Our products are developed with the highest standards of quality and efficiency which ensures outstanding performance.

Since electric motors play a major role in the comfort and well-being of humankind, it must be identified and treated as a driving machine with characteristics that involve specific care, such as proper storage, installation and maintenance

All efforts have been made to ensure that the information contained in this manual is faithful to the configurations and applications of the motor.

Therefore, we recommend that you read this manual carefully before proceeding with the installation, operation or maintenance of the motor in order to ensure safe and reliable operation of your equipment and facility. If you need any further information, please contact WEG.

Always keep this manual close to the motor, so that it can be consulted whenever necessary.



ATTENTION

1. It is imperative to follow the procedures contained in this manual for the warranty to be valid;
2. The motor installation, operation and maintenance procedures must be performed only by qualified personnel.



NOTES

1. The total or partial reproduction of information supplied in this manual is authorized, provided that reference is made to its source. If this manual is lost, an electronic PDF file is available at www.weg.net or another printed copy may be requested.

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1 INTRODUCTION

This manual contains information regarding low and high-voltage, three-phase induction motors.

Motors with special features can be supplied with specific documents (drawings, connection diagram, characteristic curves etc.). Those documents, together with this manual, must be thoroughly evaluated before proceeding with the installation, operation or maintenance of the motor.

In order to use a frequency inverter, it is mandatory to follow the instructions contained in the specific technical documentation of the motor and in the manual of the frequency inverter.

If any additional explanation about motors with major special features is necessary, consult WEG. All procedures and standards contained in this manual must be observed in order to ensure proper operation of the motor and the safety of the personnel involved in its operation. Following these procedures is also important to ensure the validity of the motor warranty. Thus, we recommend the careful reading of this manual before the installation and operation of the motor. If any further information is still necessary, consult WEG.

1.1 SAFETY WARNINGS IN THE MANUAL

In this manual, the following safety warnings are used:



DANGER

Failure to observe the procedures recommend in this warning may result in death, serious injuries and extensive equipment damage.



ATTENTION

Failure to observe the procedures recommend in this warning may result in equipment damage.



NOTE

This provides important information for correct understanding and proper operation of the product.

2 GENERAL INSTRUCTIONS

All the personnel involved with the assembly, operation or maintenance of electrical installations must be permanently informed and updated on the standards and safety instructions that guide the job and are advised to strictly comply with them. Before beginning any job, the person in charge must make sure that all points have been duly observed and warn the respective personnel about the danger inherent to the task to be performed.

Improper application, inadequate handling or maintenance of the motor may cause serious injuries and/or material damages.

Therefore, it is highly recommended that these services be always performed by qualified personnel.


2.1 QUALIFIED PERSONNEL

The term qualified personnel means those who, because of their training, experience, education level, and knowledge of the applicable standards, specifications, accident prevention, safety standards and operating conditions, have been authorized by the persons in charge to execute the necessary tasks, and who are able to recognize and avoid any possible danger. Such qualified personnel must also know and be able to provide first aid procedures if necessary. The entire start-up, maintenance and repair tasks must only be performed by qualified personnel.

Qualified personnel must also observe:


- All the technical data regarding the allowed applications (operating conditions, connections and installation environment), included in the catalog, in the purchase order documents, in the operating instructions, in manuals and all other documentation;
- The specific regulations and conditions for the local installation;
- The use of suitable tools and equipment for handling and transportation;
- That the protective devices of the individual components are removed shortly before installation. Individual parts must be stored in vibration-free environments, avoiding falls and ensuring their protection against aggressive agents and/or that they do not jeopardize people.

2.2 SAFETY INSTRUCTIONS



DANGER

During normal operation of this equipment, a hazard associated with energized or rotating components with high voltage or elevated temperatures exists. Thus, the operation with open terminal boxes, unprotected couplings, improper handling, or failure to comply with the operating standards, may cause severe personal injuries and material damages.




ATTENTION

When devices and equipment are used outside the industrial environment, the user must ensure the safety of the equipment by adopting proper protection and safety measures during installation (for example, keep people away, avoid contact of children, etc.).

Those responsible for the safety of the installation must ensure that:

- Only qualified personnel install and operate the equipment;
- They have this manual and all other documents supplied with the motor at hand, as well as that they perform the tasks in strict compliance with the service instructions, relevant standards and specific product documentation;



ATTENTION

Failure to comply with installation and safety standards may void the product warranty. Firefighting equipment and first aid notices must be available in visible and easily accessible locations at the work site.

2.3 STANDARDS


The motors are specified, designed, manufactured and tested according to the standards described in Table 2.1. The applicable standards are specified in the commercial contract, which may indicate other national or international standards, depending on the application or installation location.

Table 2.1: Applicable standards

	IEC / NBR	NEMA
Specification	IEC60034-1 / NBR 17094	MG1-1,10,20
Dimensions	IEC60072 / NBR 15623	MG1-4,11
Tests	IEC60034-2 / NBR 5383	MG1-12
Levels of protection	IEC60034-5 NBR IEC 60034-5	MG1-5
Cooling	IEC60034-6 NBR IEC 60034-6	MG1-6
Mounting	IEC60034-7 NBR IEC 60034-7	MG1-4
Noise	IEC60034-9 NBR IEC 60034-9	MG1-9
Mechanical Vibration	IEC60034-14 NBR IEC 60034-14	MG1-7
Terminal marking	IEC60034-8 NBR 15367	MG1-2
Mechanical Tolerances	ISO286 / NBR6158	MG1-4
Balancing	ISO1940	MG1-7

2.4 ENVIRONMENTAL CONDITIONS

The motor was designed according to the specific environmental conditions (temperature and altitude) of your application and are described on the nameplate and in the datasheet of the motor.



ATTENTION

For the use of water-cooled motors in ambient temperatures below +5°C, antifreeze additives must be added to the water.

2.5 OPERATING CONDITIONS

In order for the product warranty to be valid, the motor must be operated according to nominal data indicated on its nameplate, observing all applicable standards and information contained in this manual.

2.6 VOLTAGE AND FREQUENCY

It is very important to ensure a proper power supply for the motor. The conductors and the entire protection system must ensure the quality of the power supply at the motor terminals within the limits, in accordance with the IEC60034-1 standard:

- Voltage: may vary within a range of $\pm 10\%$ of the rated value;
- Frequency: may vary within a range of -5% to $+3\%$ of the rated value.

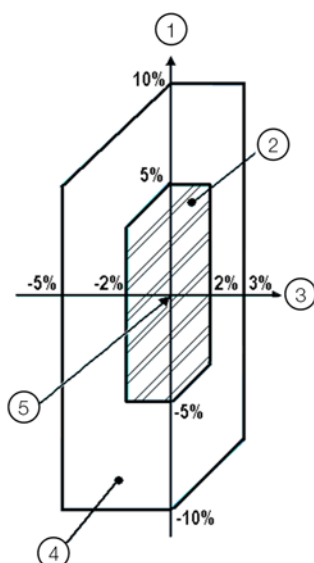


Figure 2.1: Voltage and frequency variation limits

Figure 2.1 caption:

1. Voltage
2. Zone A
3. Frequency
4. Zone B (outside zone A)
5. Voltage with rated characteristics

The motor must be able to perform its main function continuously in Zone A, but it may not fully meet its performance characteristics at rated voltage and frequency (refer to the point with rated characteristics in Figure 2.1), when it may present some deviations. The temperature rises may be above those at rated voltage and frequency.


The motor must be able to perform its main function in Zone B, but regarding the performance characteristics at rated voltage and frequency, it may present deviations greater than those of Zone A. The temperature rises may be higher than those observed at rated voltage and frequency, and they will most likely be higher than those in Zone A.


Prolonged operation in the periphery of Zone B is not recommended.

3 RECEIVING, HANDLING AND STORAGE

3.1 RECEIVING

All motors were tested and are in perfect operating conditions. The machined surfaces are protected against corrosion. The package must be inspected upon receipt for occasional damages during transportation.

 **ATTENTION**
Any damage must be photographed, documented and reported immediately to the carrier, the insurer and WEG. The non-communication of this damage will void the warranty.

 **ATTENTION**
Parts supplied in additional packages must be checked upon receipt.

- When lifting the package (or container), the proper hoisting points, the weight indicated on the package or on the nameplate and the operating capacity and conditions of the hoisting equipment must be observed;
- Motors packed in wooden crates must always be lifted by their own lifting lugs or by a proper forklift; they must never be lifted by the package;
- The package can never be overturned. Place it on the floor carefully (without impact) in order to avoid damage to the bearing;
- Do not remove the grease for protection against corrosion from the shaft end, or the closing plugs present in the terminal box holes. These protections must remain in place until the moment of the final assembly.
- A complete visual inspection of the motor must be carried out after removing the package;
- The shaft locking system must be removed just before the installation and stored to be used in future transportation of the motor.

3.2 HANDLING

- Vertical motors should be handled as shown in Figure 3.1;
- Use the upper eyebolts of the motor for movement in a vertical position, so that the suspension chains or cables are also in a vertical position, avoiding excessive stresses on the eyebolts.

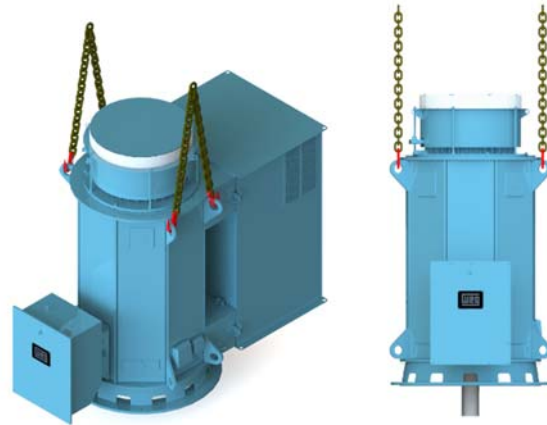




Figure 3.1: Handling of motors

 **NOTES**

- Observe the indicated weight. Do not lift the motor by blows or place it abruptly on the floor, as this may damage the bearings;
- To lift the motor, use only the eyebolts provided for this purpose. If necessary, use a cross member to protect the engine parts;
- The eyebolts on the heat exchanger, covers, bearings, radiator, junction box, etc., serve only for handling these components;
- Never use the shaft to lift the engine;
- The housing suspension eyebolts are for lifting the engine only. Never use them to lift the motor-driven machine assembly.

 **ATTENTION**

- To move or transport the motor, the shaft must be locked with the locking device supplied with the motor;
- Lifting devices and equipment must be capable of supporting the weight of the motor.

3.2.1 Positioning of the motors

Vertical motors are supplied with suspension eyebolts at the front and rear.

Some motors are transported in horizontal position and need to be moved to the original position.

Figure 3.2 shows the movement of the motors from the horizontal to the vertical position and vice versa.

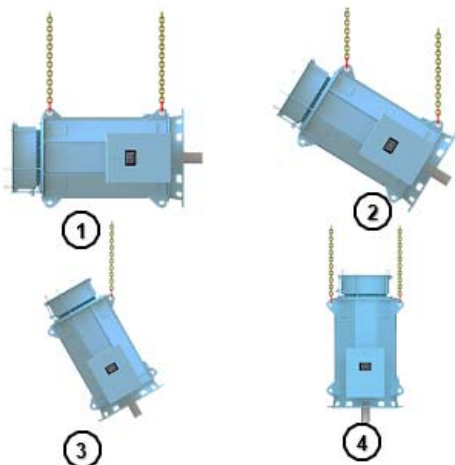


Figure 3.2: Positioning of motors

To position vertical motors, proceed according to the following recommendations:

1. Lift the motor through the side eyebolts using two cranes;
2. Lower the front part of the motor and at the same time lift the rear part of the motor until the motor is balanced;
3. Release the cables at the front of the motor and rotate the motor 180° to allow the fixing of these cables to the eyebolts at the rear of the motor;
4. Attach the loose cables to the eyebolts at the rear of the motor and lift the motor until the motor is in an upright position.



ATTENTION

Failure to comply with these recommendations may result in damage to equipment, injury to persons, or both.

3.3 STORAGE

If the motor is not installed immediately after reception, it must remain inside the package and stored in a location protected against moisture, vapors, sudden changes in temperature, rodents and insects.

The motor must be stored in vibration-free locations in order to avoid bearing damage.



ATTENTION

Space heaters must remain powered during storage in order to avoid moisture condensation inside the motor. Any damage to the paint or corrosion protection of the machined parts must be repaired.

3.3.1 Outdoor storage

The motor must be stored in a dry location, free of flooding and vibrations.

Repair any damages on the package before storing the motor, which is needed to ensure proper storage conditions.

Place the motor on platforms or foundations that ensure protection against humidity from the ground and prevent it from sinking into the soil. Free air circulation underneath the motor must be assured.

The cover used to protect the motor against the bad weather must not be in contact with its surfaces. In order to ensure free air circulation between the motor and such covers, place wooden blocks as spacers.

3.3.2 Extended storage

When the motor is stored for a long period of time (two months or more) before start-up, it is exposed to external agents, such as temperature variations, moisture, aggressive agents, etc.

The empty spaces inside the motor – such as rolling bearings, terminal boxes, and windings – are exposed to humidity, which can cause condensation, and, depending on the degree of air contamination, aggressive substances may also penetrate these empty spaces. Consequently, after long periods of storage, the winding insulation resistance may drop below the acceptable values, internal components, such as rolling bearings, may oxidize, and the lubricant power of the lubricant agent in the bearings may be adversely affected. All of these influences increase the risk of damages before starting the motor.



ATTENTION

To assure that the motor warranty be valid, it is necessary to make sure that all preventive measures described in this manual, such as constructive aspects, maintenance, packaging, storage, and periodical inspections, are followed and recorded.

The extended storage instructions are valid for motors that remain stored for long periods (two months or more) before start-up or motors already installed that are in a prolonged stoppage, considering the same period.

3.3.2.1 Storage location

In order to ensure the best storage conditions for the motor during long periods, the chosen location must strictly meet the criteria described in sections 3.3.2.1.1 and 3.3.2.1.2.

3.3.2.1.1 Indoor storage

In order to ensure better storage conditions for the motor, the storage site must comply strictly with the criteria described below:


- The storage site must be closed, covered, dry, free of air contaminants (moisture, vapor, dust, particles and aggressive fumes) and free of flooding;
- The site should be protected against sudden temperature variations, humidity, rodents and insects;
- Vibration-free location, to avoid damaging to the motor bearings;
- The floor must be of leveled concrete with resistant structure to support the motor weight;
- Must have system to fire detection and extinguishing;
- Be provided with electricity for supplying the space heaters with power failure detection system;

- Exclusive site to store electrical machines (do not mix with other equipment and/or products that could prejudice the correct motor storage);
- Site with facilities of cargo handling services, suitable to allow the motor handling and removal;
- There must be no gas present, such as chlorine, sulfur dioxide or acids;
- The site must have ventilation system with air filter;
- Ambient temperature between 5°C and 50°C, and should not present sudden temperature variation;
- Relative air humidity <50%;
- Must have prevention against dirt and dust deposition;
- The motor should be stored on a suitable metal base that prevents the absorption of moisture from the floor.

If any of these requirements is not met in the storage site, WEG suggests that additional protections be added to the motor package during the storage period, as follows:

- A closed wooden crate or the like with an electrical installation that allows the energization of the space heaters;
- If there is a risk of infestation and fungus formation, the package must be protected in the storage place by spraying it or painting it with appropriate chemicals;
- The package preparation must be prepared carefully by an experienced person.


3.3.2.1.2 Outdoor storage



ATTENTION
Outdoor storage of the motor is not recommended.

In case outdoor storage is unavoidable, the motor must be packed in specific packaging for such conditions, as follows:

- For outdoor storage (exposed to the weather), besides the packaging recommended for indoor storage, the package must be covered with protection against dust, moisture and other odd materials, using resistant canvas or plastic.
- The package must be placed on platforms or foundations that ensure protection against dirt and moisture and prevent it from sinking into the soil;
- After the package is covered, a shelter must be erected to protect it against direct rain, snow and excessive sun heat.



ATTENTION
In case the motor remains stored for long periods (two months or more), it is recommended to inspect it regularly as specified in the section Maintenance plan during storage of this manual.

3.3.2.2 Spare parts

- If parts are supplied separately (terminal boxes, heat exchanger, end shields, etc.), these parts must be mounted on motor to store it;
- Spare parts must be stored in an adequate place, as specified in sections 3.3.2.1.1 and 3.3.2.1.2 of this manual.
- The relative humidity inside the package must not exceed 50%.
- Rolling bearings must not be subject to shocks, falls or storage with vibration or humidity, which can cause marks on the internal tracks or on the balls, reducing their useful life.

3.3.3 Preservation during the storage

3.3.3.1 Space heater

Space heaters must remain powered during storage to avoid moisture condensation inside the motor and ensure that the winding insulation resistance remains within acceptable levels. The space heaters drive circuit must be unique and the voltage and current of this circuit must be measured and recorded monthly. It is recommended that a signal be installed near the motor to indicate that the space heaters are energized.

3.3.3.1.1 Drain

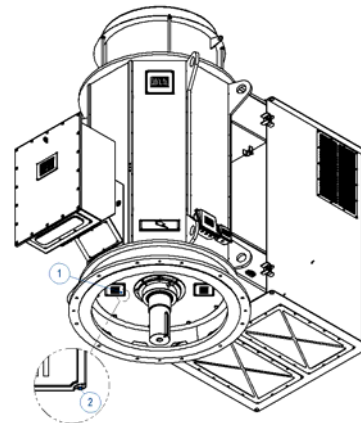


Figure 3.3: Motor drain

Figure 3.3 caption:

1. Drain position
2. Drain (Remove the inspection cover - 4xM5).

3.3.3.2 Insulation resistance

During the storage period, the insulation resistance of the motor windings must be measured and recorded every two months, and before the motor installation or eventually if there is any change in the preservation process (E.g., prolonged lack of electricity). The measurement procedures and the criteria for acceptance of the results shall be according to IEEE-43 Standard. Any insulation resistance reduction must be investigated.

3.3.3.3 Exposed machined surfaces

All exposed machined surfaces (e.g., shaft end and flanges) are protected at the factory with a temporary protective agent (rust inhibitor). This protection coating must be reapplied at least every six months or when removed and/or damaged.

Recommended Product: Protective agent Anticorit BW
Supplier: Fuchs

3.3.3.4 Sealing

The rubber seals, gaskets, plugs and cable glands of the motor shall be inspected annually and replaced, if necessary.

3.3.3.5 Bearings

3.3.3.5.1 Grease-lubricated rolling bearing

- The rolling bearings are lubricated at the factory for the motor tests.



ATTENTION

In order to keep the bearings in good condition during the storage period, **the shaft locking device must be removed every two months, and the motor rotor must be rotated at least 10 complete turns at 30 rpm** to circulate the grease and preserve the internal parts of the bearings.

- Before putting the motor into operation, the rolling bearings must be lubricated;
- If the motor remains stored for a period exceeding two years, the rolling bearings must be disassembled, washed, inspected and relubricated.

3.3.3.5.2 Sleeve bearing

Depending on the machine mounting position and the lubrication type, the machine can be transported with or without oil in the bearings. The machine storage must be done in its original operating position and with oil in the bearings, when so specified. The oil level must be respected, remaining in the middle of the sight glass. In order to keep the bearings in good conditions during the storage period, the following preservation procedures must be performed:

- Close all the threaded holes with plugs;
- Check if all the flanges (e.g., oil inlet and outlet) are closed. If not, they must be closed with blind covers;
- The oil level must be respected, remaining in the middle of the oil sight glass;
- Every two months the shaft locking device should be removed the shaft, add between 100 and 200ml of lubricating oil through the sight glass at the top of the bearing and rotate the shaft which can be done manually with the help of a lever, two or three complete turns are sufficient.



NOTES

For bearings that have a high-pressure oil injection system (jacking), this system must be activated before rotating the machine rotor. For bearings without an internal oil reservoir (dry sump) and for thrust and counter-bearings, the oil circulation system must be activated to turn the machine shaft. The shaft rotation must always be done in the machine rotation direction.

After six months of storage, the following procedure must be used for protecting both the bearing internally and the contact surfaces against corrosion:

- Close all the threaded holes with plugs;
- Seal the gaps between the shaft and the bearing seal on the shaft by applying water-proof adhesive tape;
- Check if all the flanges (e.g., oil inlet and outlet) are closed. If not, they must be closed with blind covers;
- Remove the upper sight glass from the bearing and apply the corrosion inhibitor spray (TECTYL 511 or equivalent) inside the bearing;
- Close the bearing with the upper sight glass.



NOTE

If the bearing has no upper sight glass, the top cover of the bearing must be disassembled to apply the corrosion inhibitor spray.

Each six months of storage, repeat the procedure described above. If the storage period exceeds two years, the bearing oil must be replaced.

3.3.3.6 Terminal boxes

When the insulation resistance of the motor windings is measured, the main terminal box and the other terminal boxes must also be inspected, observing the following aspects:

- The inside must be dry, clean and free of any dust accumulation;
- The contact elements cannot present corrosion;
- The seals must be in proper condition;
- The cable inlets must be correctly sealed.



ATTENTION

If any of these items are not in proper condition, proceeds the adequate maintenance and, if necessary, replace damaged parts.

3.3.3.7 Air-water heat exchanger

To ensure better conditions or the radiator storage for long-term storage, the following criteria must be strictly met:

- Remove the flanged connections from the radiator to gain access to it;
- Drain the water inside the radiator tubes and heads completely;
- Blow hot air in one of the nozzles from 15 to 20 minutes in order to eliminate humidity inside of radiator. For this procedure, the radiator tubes shall be horizontally placed, and the inlet and outlet water flanges placed in such a way that the water are eliminated;
- After dried, the nozzles shall be covered with blind flanges with new sealing gaskets in order to assure a perfect sealing;
- Install a pressure gauge on one of the blind flanges and a globe valve on the other;
- Pressurize the cooler with inert gas (Nitrogen or other) at a pressure of 1.2 bar abs;
- This pressure shall be checked monthly during the radiator term storage, which shall not be exposed to temperatures exceeding 50°C;
- Considering that the storage procedure is followed, the radiator seals must be replaced every 3 years, as recommended by the radiator supplier.



ATTENTION

The pressurized radiator must be handled with care. Use a warning plate informing that the equipment is pressurized and should not be exposed to temperatures exceeding 50°C.



NOTE

During short operation stoppages, instead of draining the water, it is preferable to keep its circulation at low speeds through the heat exchanger, thus ensuring that harmful products, such as ammonia compounds and hydrogen sulfide, are taken out of the radiator and not deposited inside.

3.3.3.8 Cleanliness and conservation of the motor during storage

- The motor should be free of oil, water, dust and dirt.
- The motor outside must be cleaned with compressed air under reduced pressure;
- Remove the removable rust signs with a clean cloth soaked in petroleum solvent.
- Check that the bearings and lubrication hollows are free of dust and dirt and if the bearing plugs are properly tightened.

Risks, marks or rust on the shaft-end should be carefully removed.

3.3.3.9 Inspections and records during storage

The stored motor must be inspected periodically and inspection records must be filed.

The following items must be inspected:

1. Check the motor for physical damages and repair it, if necessary;
2. Inspection of the cleanliness conditions;
3. Check for signs of water condensation inside the motor;
4. Check of the protective coating conditions of the exposed machined parts;
5. Check the paint conditions, and repair if necessary;
6. Check for aggressive agents signs;
7. Check the operation of the space heaters;
8. Measure and record the ambient temperature and relative humidity around the motor;
9. Measure and record the temperature, insulation resistance and polarization index of the stator winding;
10. Make sure that the storage location complies with the criteria described in section 3.3.2.1.

3.3.3.10 Predictive / preventive maintenance

WEG recommends that, every 3 years of storage, the stored motor be sent to a WEG Authorized Repair Shop or to WEG own factory, in order to perform a complete predictive maintenance.

The complete predictive maintenance procedure comprises disassembling the complete motor for inspection and, after assembly, performing a routine test in the laboratory.

3.3.3.11 Maintenance plan during storage

During the storage period, the motor maintenance must be performed and recorded according to the plan described in Table 3.1.

Table 3.1: Storage plan

	Monthly	2 months	6 months	2 years	Before start-up	Notes
STORAGE LOCATION						
Inspect the cleanliness conditions		X			X	
Inspect the humidity and temperature conditions		X				
Inspect for insect infestation signs		X				
PACKAGE						
Inspect for damage			X			
Check the internal relative humidity		X				
Replace the desiccant in the package (if any)			X			Whenever necessary.
SPACE HEATER						
Check the operating conditions	X					
Measure the circuit voltage and frequency	X					
Check the function of the signal system (if any)			X			
WHOLE MOTOR						
Perform external cleaning			X		X	
Check the painting conditions			X			
Check the rust inhibitor on the exposed machined parts			X			
Reapply the rust inhibitor			X			
Inspect the rubber seals and gaskets			X			
Complete predictive maintenance						According to section 3.3.3.10
WINDINGS						
Measure the winding temperature		X			X	
Measure the insulation resistance		X			X	
Measure the polarization index		X			X	
TERMINAL BOX AND GROUNDING TERMINALS						
Clean the interior of the terminal boxes				X	X	
Inspect the seals and gaskets				X	X	
ROLLING BEARINGS						
Rotate the shaft		X				
Relubricate the bearing					X	
Disassemble and clean the bearing						If the storage period exceeds 2 years.
SLEEVE BEARINGS						
Rotate the shaft		X				
Apply corrosion inhibitor spray			X			
Clean the bearings					X	
Change the oil						If the storage period exceeds 2 years.

3.3.4 Preparation for commissioning

3.3.4.1 Cleaning

- The internal and external parts of the motor must be free of oil, water, dust and dirt.
- Remove the rust inhibitor from the exposed surfaces with a cloth damped in a petroleum-based solvent;
- Make sure that the bearings and cavities used for lubrication are free of dirt and that the cavity plugs are correctly sealed and tightened. Oxidation and marks on the bearing seats and on the shaft must be carefully removed.

3.3.4.2 Bearing inspection



ATTENTION

If the motor storage period exceeds six months, the sleeve bearings must be disassembled, inspected and cleaned, before starting the motor operation.

The sleeve bearings without oil tank (dry crankcase), regardless of the motor storage period, should necessarily be disassembled, inspected and cleaned before starting the motor operation.

Reassemble the sleeve bearings and carry out lubrication.

Contact WEG to perform this procedure.

3.3.4.3 Bearing lubrication

Use the lubricant specified for bearing lubrication. Information on the bearings and lubricants are indicated on the bearing nameplates, and the lubrication must be done as described in section 7.9 of this manual, always considering the type of bearing.

3.3.4.4 Insulation resistance verification

Before putting the motor into operation, the insulation resistance must be measured according to section 3.3.3.2 of this manual.

3.3.4.5 Air-water heat exchanger

- When starting the motor, ensure that the water circulates freely through the radiator;
- The radiator bolts should be tightened with torques of 40 to 50Nm;
- Make sure that there is no water leakage. Check the radiator gaskets, and replace if necessary;
- Check the heat exchanger sealing rubbers and replace them if necessary.

3.3.4.6 Others

Follow the other procedures described in section 6 of this manual before putting the motor into operation.

4 INSTALLATION

4.1 INSTALLATION SITE

Electric motors must be installed in easily accessible places, allowing periodic inspections, on-site maintenance and, if necessary, removal for external services.

The following environmental conditions must be ensured:

- Clean and well-ventilated location;
- The installation of other equipment or walls must not block or hinder the motor ventilation;
- The area around and above the motor must be sufficient for maintenance or handling;
- The environment must be in accordance with the motor protection degree.

4.2 SHAFT LOCK

The motor leaves the factory with a lock on the shaft to prevent damages to the bearings during transportation. This lock must be removed prior to motor installation.



ATTENTION

The shaft-locking device must be installed whenever the motor is removed from its base (uncoupled) in order to prevent damages to the bearings during transportation.

The shaft end is protected at the factory with a temporary protective agent (rust inhibitor). During the motor installation, it is necessary to remove this product from the grounding brush (if any) contact track on the shaft.

4.2.1 Radial Lock

Depending on the bearing type, a locking device can be installed on the upper bearing for radial locking of the shaft during transport. This device is identified on the motor with a sticker, as shown in Figure 4.1.

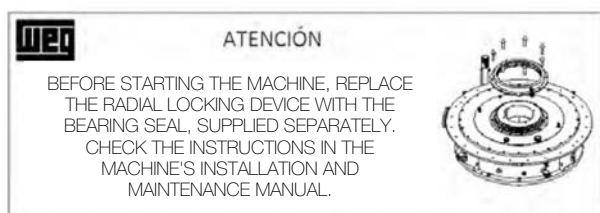


Figure 4.1: Adhesive label

It is essential that before starting the engine this device is removed and replaced with the original bearing seal which is supplied separately.

4.2.2 Procedure for replacement of the radial locking device

1. Remove the fastening screws of the locking device on the bearing cover;
2. Remove the screws that join the two parts of the bipartite device;
3. Remove the locking device as shown in Figure 4.2;

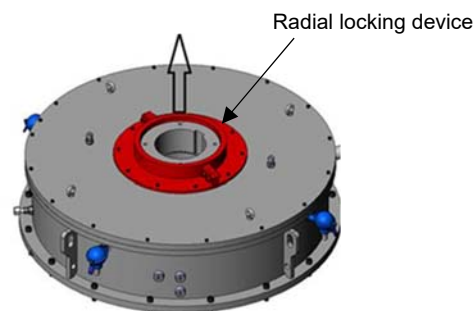


Figure 4.2: Radial locking device

4. Identify the outer seal of the bearing shipped separately;
5. Assemble the seal on the bearing, following the reverse procedure of disassembling the locking device.

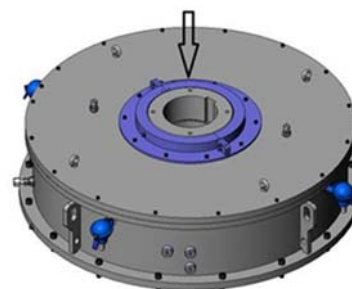


Figure 4.3: Bearing seal



NOTE

Store the radial locking device for use in future motor transports.

4.3 ROTATION DIRECTION

The motor rotation direction is indicated by a plate affixed to the frame on the drive end and in the motor specific documentation.



ATTENTION

Motors supplied with a single rotation direction must not operate in the opposite direction.

In order to operate the motor in the direction opposite to the specified, consult WEG.

4.4 INSULATION RESISTANCE

4.4.1 Safety Instructions



DANGER

In order to measure the insulation resistance, the motor must be turned off and stopped. The winding being tested must be connected to the frame and grounded until all residual electrostatic charges are removed. Capacitors (if any) must also be grounded before disconnecting and separating the terminals to measure the insulation resistance. Failure to comply with these procedures may result in personal injury.

4.4.2 General considerations

When the motor is not immediately put into operation, it must be protected against moisture, high temperatures, and dirt, thus avoiding impacts on the insulation resistance.

The winding insulation resistance must be measured before putting the motor into operation. If the environment is too humid, the insulation resistance must be measured periodically during storage. It is difficult to establish fixed rules for the actual value of winding insulation resistance, as it varies according to the environmental conditions (temperature, humidity), machine cleanliness conditions (dust, oil, grease, dirt) and quality and condition of the insulating material used. The evaluation of the periodical follow-up records is useful to conclude whether the motor is able to operate.

4.4.3 Measurement on the stator windings

The insulation resistance must be measured with a Megohmmeter. The testing voltage for the motor windings must be in accordance with Table 4.1 and IEEE43 standard.

Table 4.1: Voltage for the winding Insulation resistance test

Winding rated voltage (V)	Insulation resistance test - continuous voltage (V)
< 1000	500
1000 - 2500	500 - 1000
2501 - 5000	1000 - 2500
5001 - 12000	2500 - 5000
> 12000	5000 - 10000

Before measuring the stator winding insulation resistance:

- Disconnect all connections to the stator terminals;
- Disconnect and insulate all CTs and PTs (if any);
- Ground the motor frame;
- Measure the winding temperature;
- Ground all temperature sensors;
- Check the humidity.

The insulation resistance measurement of the stator windings must be done in the main terminal box.

The Megohmmeter must be connected between the motor frame and the winding.

The frame must be grounded and the three phases of the stator winding must remain connected to the neutral point, according to Figure 4.4.

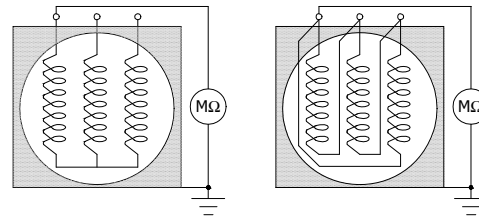


Figure 4.4: Megohmmeter connection

Whenever possible, each phase must be isolated and tested separately. The separate test allows the comparison between the phases. When a phase is tested, the other two phases must be grounded to the same ground of the frame, according to Figure 4.5.

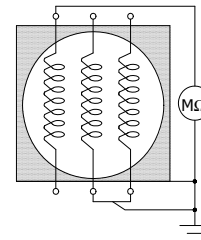


Figure 4.5: Connection of the Megohmmeter to separate phases

If the total winding measurement presents a value below the recommended, the neutral connections must be opened and the insulation resistance of each phase must be measured separately.



ATTENTION

Much higher values may be frequently obtained from motors in operation for long periods of time. Comparison with values obtained in previous tests on the same motor - under similar load, temperature and humidity conditions - may be an excellent parameter to evaluate the winding insulation conditions, instead of using the value obtained in a single test as the basis. Significant or sudden reductions are considered suspicious.

4.4.4 Additional Information



ATTENTION

After measuring the insulation resistance, ground the tested winding in order to discharge it. The testing voltage to measure the insulation resistance of the space heater must be 500 Vdc and for the other accessories, 100 Vdc. It is not recommended to measure the insulation resistance of thermal protectors.

4.4.5 Conversion of the measured values

The insulation resistance measured on the windings shall be converted to 40°C using the correction factor provided in Figure 4.6 (IEEE43 standard) and applying the following formula:

$$R_C = K_t \cdot R_t$$

Where:

R40 = referred insulation resistance at 40°C.

Kt = Insulation resistance correction factor as a function of temperature, as shown in Figure 4.6.

Rt = measured insulation resistance.

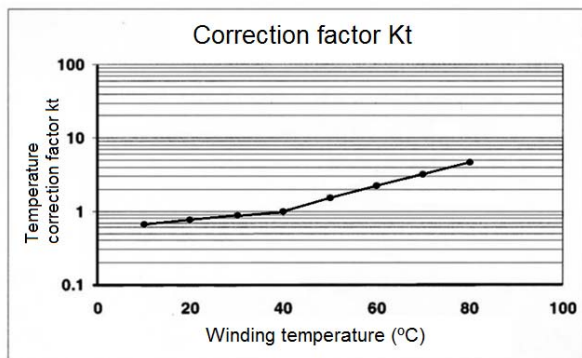


Figure 4.6: Insulation resistance correction factor due to temperature

The values used to generate the curve of Figure 4.6 are shown in Table 4.2.

Table 4.2: Correction factors (Kt) due to temperature

t (°C)	Correction factor Kt
10	0,7
20	0,8
30	0,9
40	1,0
50	1,5
60	2,3
70	3,3
80	4,6

4.4.6 Polarization Index (P.I.)

The polarization index is defined by the ratio between the insulation resistance measured in 10 minutes and the insulation resistance measured in 1 minute. This measurement procedure is always carried out at relatively constant temperatures.

The polarization index allows the assessment of the motor insulation conditions.

DANGER

In order to avoid accidents, the winding must be grounded immediately after measuring the insulation resistance.

4.4.7 Recommended Minimum Values

According to IEEE-43 Standard, the recommended minimum values for winding insulation resistance (R.I.) and Polarization Index (I.P.) are shown in Table 4.3:

Table 4.3: Minimum R.I. e I.P values

Winding voltage	Minimum R.I. (converted to 40°C)	Minimum I.P.
Up to 1000 V	5 MΩ	Not applicable
Greater than 1000 V	100 MΩ	2

4.5 PROTECTIONS

Motors used in continuous duty must be protected against overloads by means of a motor integral device, or an independent protection device, which is generally a thermal relay with rated or adjustable current equal to or below the value obtained by multiplying the full load motor supply current by:

- 1.25 for motors with service factor equal to or above 1.15;
- 1.15 for motors with service factor equal to 1.0.

Motors also have protection devices against overheating (in cases of overloads, locked rotor, low voltage, lack of motor ventilation).

4.5.1 Thermal protections

The over-temperature protections devices are installed on the main stator, bearings and other parts that require temperature monitoring and thermal protection. These sensors must be connected to an external temperature monitoring and protection system. The type of temperature sensor, the connection terminals and the setting temperatures for alarm and shutdown are given in the motor CONNECTION DIAGRAM.

4.5.1.1 Temperature limits for the windings

The temperature of the hottest spot of the winding must be kept below the limit of the insulation thermal class. The total temperature is obtained by the sum of the ambient temperature and the temperature rise (T), plus the difference between the average temperature of the winding and the hottest spot of the winding.

The ambient temperature must not exceed 40 °C, in accordance with NBR IEC60034-1 standard. Above this temperature, the working conditions are considered special and the motor specific documentation must be consulted. Table 4.5 shows the numerical values and the composition of the acceptable temperature at the hottest spot on the winding.

Table 4.4: Insulation class

Insulation class		B	F	H
Ambient temperature	°C	40	40	40
T = temperature rise (temperature measurement method by resistance variation)	°C	80	105	125
Difference between the hottest spot and the average temperature	°C	10	10	15
Total: temperature of the hottest point	°C	130	155	180

ATTENTION

If the motor operates with winding temperatures above the limits of the insulation thermal class, the lifespan of the insulation, and hence that of the motor, will be significantly reduced, or it may even result in the motor burnout.

4.5.1.2 Alarm and trip temperatures

The motor alarm and trip temperatures must be set at the lowest possible value. These temperatures can be determined based on the factory tests or through the motor operating temperature.

The alarm temperature can be set 10 °C above the machine operating temperature at full load, always considering the highest ambient temperature on site.



ATTENTION

The alarm and trip values may be determined as a result of experience, but they must not exceed the values indicated in the motor wiring diagram.



ATTENTION

The motor protection devices are listed in the WEG drawing – Wiring diagram. Not using these devices is the sole responsibility of the user and, in case of damage to the motor, it will void the warranty.

Table 4.5: Insulation Class

Insulation Class		B	F	H
Room temperature	°C	40	40	40
T = temperature rise (temperature measurement method by resistance variation)	°C	80	105	125
Difference between the hottest point and the average temperature	°C	10	10	15
Total: temperature of the hottest point	°C	130	155	180



ATTENTION

If the motor operates with winding temperatures above the insulation thermal class limits, the life of the insulation and, consequently, of the motor, will be significantly reduced or may even lead to motor burnout.

4.5.1.3 Alarm and shutdown temperatures

The alarm and shutdown temperatures of the motor should be set to the lowest possible value. These temperatures can be determined based on factory tests, or through the motor operating temperature. The alarm temperature can be set at 10°C above the machine operating temperature at full load, always considering the highest ambient temperature of the room.



ATTENTION

The alarm and shutdown values can be defined according to experience; however, they must not exceed the maximum values indicated in the motor connection diagram ambient temperature of the room.



ATTENTION

The motor protection devices are listed in the WEG drawing - connection diagram. Failure to use these devices is the full responsibility of the user and, in case of damage to the motor, will result in loss of warranty.

4.5.1.4 Temperature and ohmic resistance of the PT100 thermoresistance

Table 4.6 shows the temperature as a function of the ohmic resistance measured across PT100 RTDs.

$$\text{Formula: } \frac{\Omega - 100}{0.386} = \text{°C}$$

Table 4.6: Temperature X Resistance (Pt100)

°C	0	1	2	3	4	5	6	7	8	9
0	100.00	100.39	100.78	101.17	101.56	101.95	102.34	102.73	103.12	103.51
10	103.90	104.29	104.68	105.07	105.46	105.95	106.24	106.63	107.02	107.40
20	107.79	108.18	108.57	108.96	109.35	109.73	110.12	110.51	110.90	111.28
30	111.67	112.06	112.45	112.83	113.22	113.61	113.99	114.38	114.77	115.15
40	115.54	115.93	116.31	116.70	117.08	117.47	117.85	118.24	118.62	119.01
50	119.40	119.78	120.16	120.55	120.93	121.32	121.70	122.09	122.47	122.86
60	123.24	123.62	124.01	124.39	124.77	125.16	125.54	125.92	126.31	126.69
70	127.07	127.45	127.84	128.22	128.60	128.98	129.37	129.75	130.13	130.51
80	130.89	131.27	131.66	132.04	132.42	132.80	133.18	133.56	133.94	134.32
90	134.70	135.08	135.46	135.84	136.22	136.60	136.98	137.36	137.74	138.12
100	138.50	138.88	139.26	139.64	140.02	140.39	140.77	141.15	141.53	141.91
110	142.29	142.66	143.04	143.42	143.80	144.17	144.55	144.93	145.31	145.68
120	146.06	146.44	146.81	147.19	147.57	147.94	148.32	148.70	149.07	149.45
130	149.82	150.20	150.57	150.95	151.33	151.70	152.08	152.45	152.83	153.20
140	153.58	153.95	154.32	154.70	155.07	155.45	155.82	156.19	156.57	156.94
150	157.31	157.69	158.06	158.43	158.81	159.18	159.55	159.93	160.30	160.67

4.5.1.5 Space heater

When the motor is equipped with a space heater to prevent internal water condensation during long periods out of operation, it must be assured that the space heater is energized shortly after turning the motor off, and that it is de-energized before the motor is put into operation.

The values of the space heater supply voltage and power are informed in the connection diagram and in the specific plate affixed to the motor.

4.5.2 Water leak sensor

Motors with air-water heat exchangers are supplied with a water leak sensor intended to detect accidental water leaks from the radiator into the motor. This sensor must be connected to the control panel, according to the motor connection diagram. The signal of this sensor must be used to activate the alarm.

When this protection actuates, the heat exchanger must be inspected and, if any water leak is detected, the motor must be shut down and the problem corrected.

4.6 COOLING

The motor cooling system type may vary according to its application.

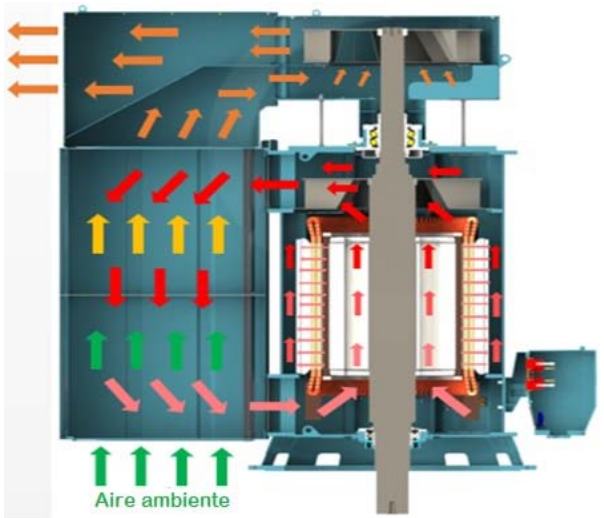
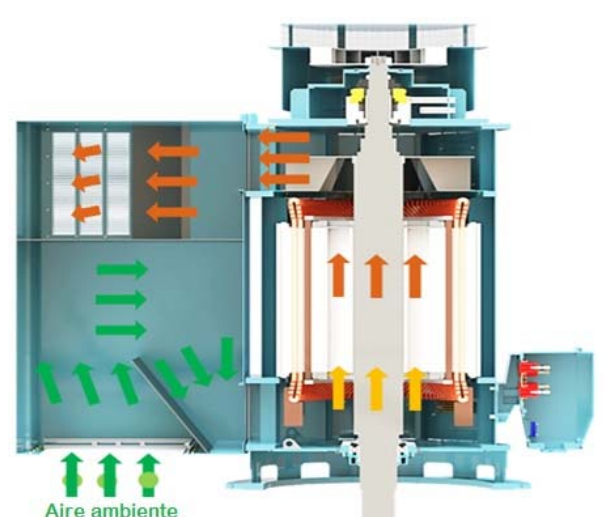
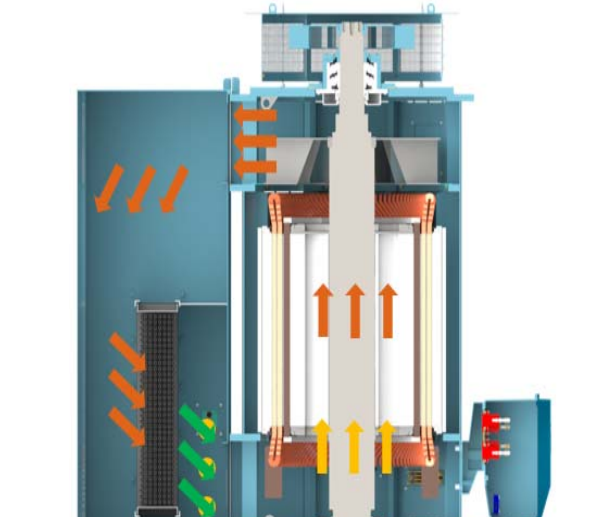
Only the correct installation of the motor and of the cooling system can ensure its continuous operation without overheating.



ATTENTION

The protection devices of the cooling system (if any) must be monitored periodically.

The air and/or water inlets and outlets (if any) must not be obstructed, because this could cause overheating and even lead to the motor burnout. For further details, refer to the motor dimensional drawing.

 <p>Aire ambiente</p>	<p>IC611 – Machine with self-ventilated air to air heat exchanger</p>
 <p>Aire ambiente</p>	<p>IC01 - Open self-ventilated machine</p>
 <p>Aire ambiente</p>	<p>IC81W - Enclosed machine with self-ventilated air-to-water heat exchanger</p>

4.6.1 Air-water heat exchange cooling

In motors with air-water heat exchanger, the internal air, in a closed circuit, is cooled by the radiator, which is a surface heat transmitter designed to dissipate heat. Clean water with the following characteristics must be used as coolant:

- pH: 6 to 9;
- Chlorides: maximum 25.0 mg/l;
- Sulphates: maximum 3.0 mg/l;
- Manganese: maximum 0.5 mg/l;
- Suspended solids: maximum 30.0 mg/l;
- Ammonia: without ammonia dashes.



ATTENTION

Data of the radiators that compose the air-water heat exchanger are informed on their nameplate and on the motor dimensional drawing.

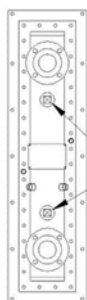
This data must be observed for the proper operation of the motor cooling system, thus preventing overheating.

4.6.1.1 Radiators for application with seawater



ATTENTION

In the case of radiators for applications with seawater, the materials in contact with the water (pipes and plates) must be corrosion resistant. Furthermore, the radiators may be fitted with sacrificial anodes (e.g., zinc or magnesium), as shown in Figure 4.7, which are corroded during the heat exchanger operation, protecting the radiator heads. In order to maintain the integrity of the radiator heads, these anodes must be replaced periodically according to their corrosion level.



Sacrificial anodes

Figure 4.7: Radiator with sacrificial anodes



NOTE

The type, quantity and position of the sacrificial anodes may vary according to the application.

4.7 ELECTRICAL ASPECTS

4.7.1 Electrical connections



ATTENTION

Analyze the electrical connection diagram supplied with the motor carefully before beginning the connection of the main cables and those of the accessories. For the electrical connection of auxiliary equipment, refer to their specific manuals.

4.7.1.1 Main electrical connections

The location of stator terminal box is identified in the specific motor DIMENSIONAL DRAWING.

The location of stator terminal box is identified in the specific motor DIMENSIONAL DRAWING.

Make sure the cross section and insulation of the main connection cables are suitable for the motor current and voltage. The motor must rotate in the rotation direction specified on the nameplate and on the sign arrow affixed to the motor drive end.



NOTE

The rotation direction is, by convention, determined looking to the shaft end at the motor drive end. Motors with a single rotation direction must only rotate in the indicated direction. In order to operate the motor in the rotation direction opposite to the specified, consult WEG.



ATTENTION

Before making the connections between the motor and the power supply, it is necessary to perform a careful measurement of the winding insulation resistance.

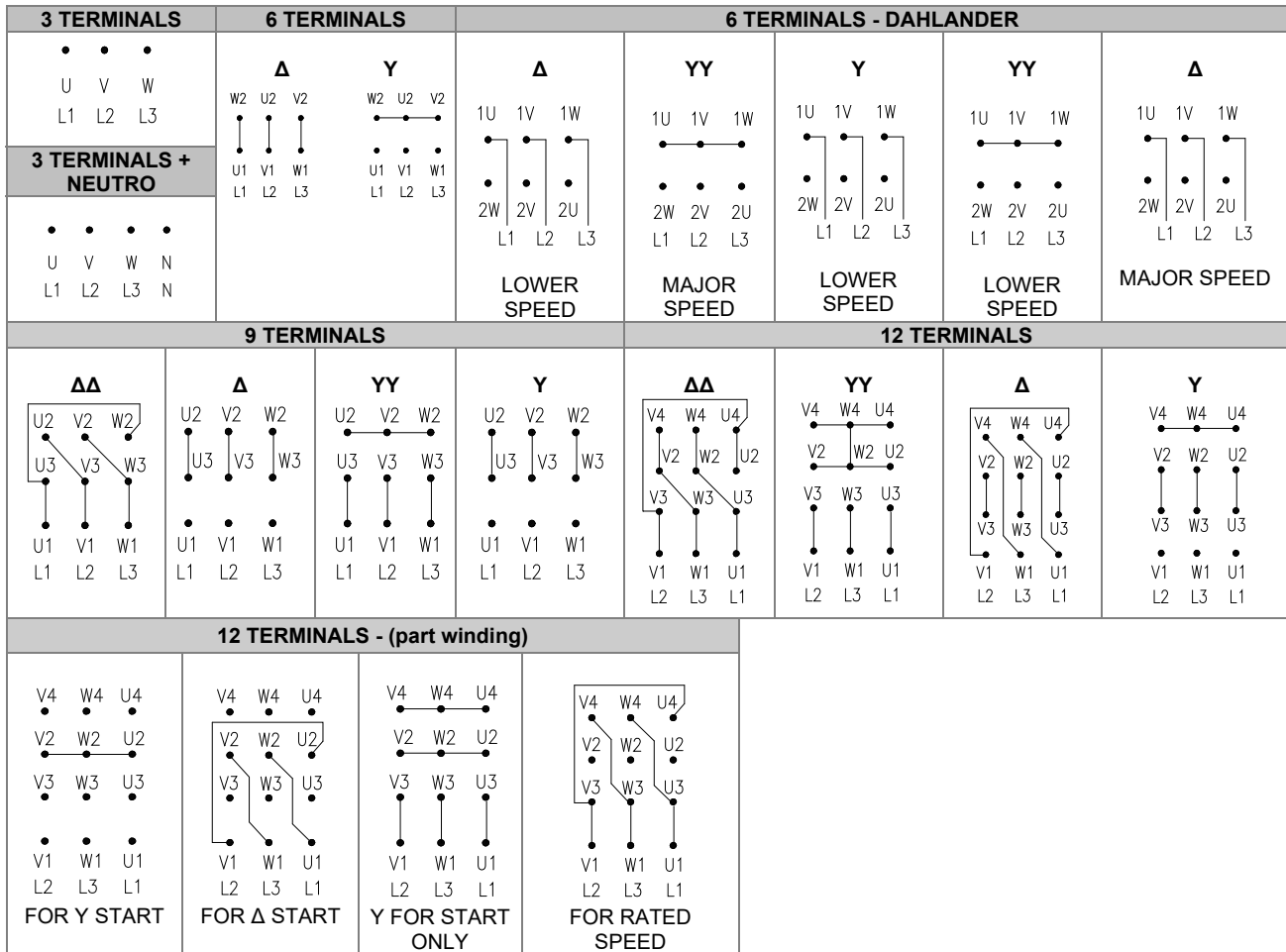
In order to connect the motor main power supply cables, unscrew the cover of the stator terminal box, cut the sealing rings (standard motors without cable gland) according to the diameter of the cables to be used and insert the cables in the sealing rings. Cut the power supply cables to the necessary length, strip the ends and mount the cable lugs that will be used.

4.7.2 Connection diagrams

4.7.2.1 Wiring diagrams according to IEC60034-8 standard

The following connection diagrams show the identification of the terminals in the junction box and the possible connections for the motors.

4.7.2.1.1 Stator connection diagrams



NOTE

When two or more motor connecting cables are used in parallel in order to divide the electric current, the identification of these cables is made with an additional suffix separated by a hyphen, according to Figure 4.8.

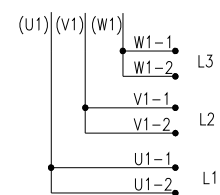
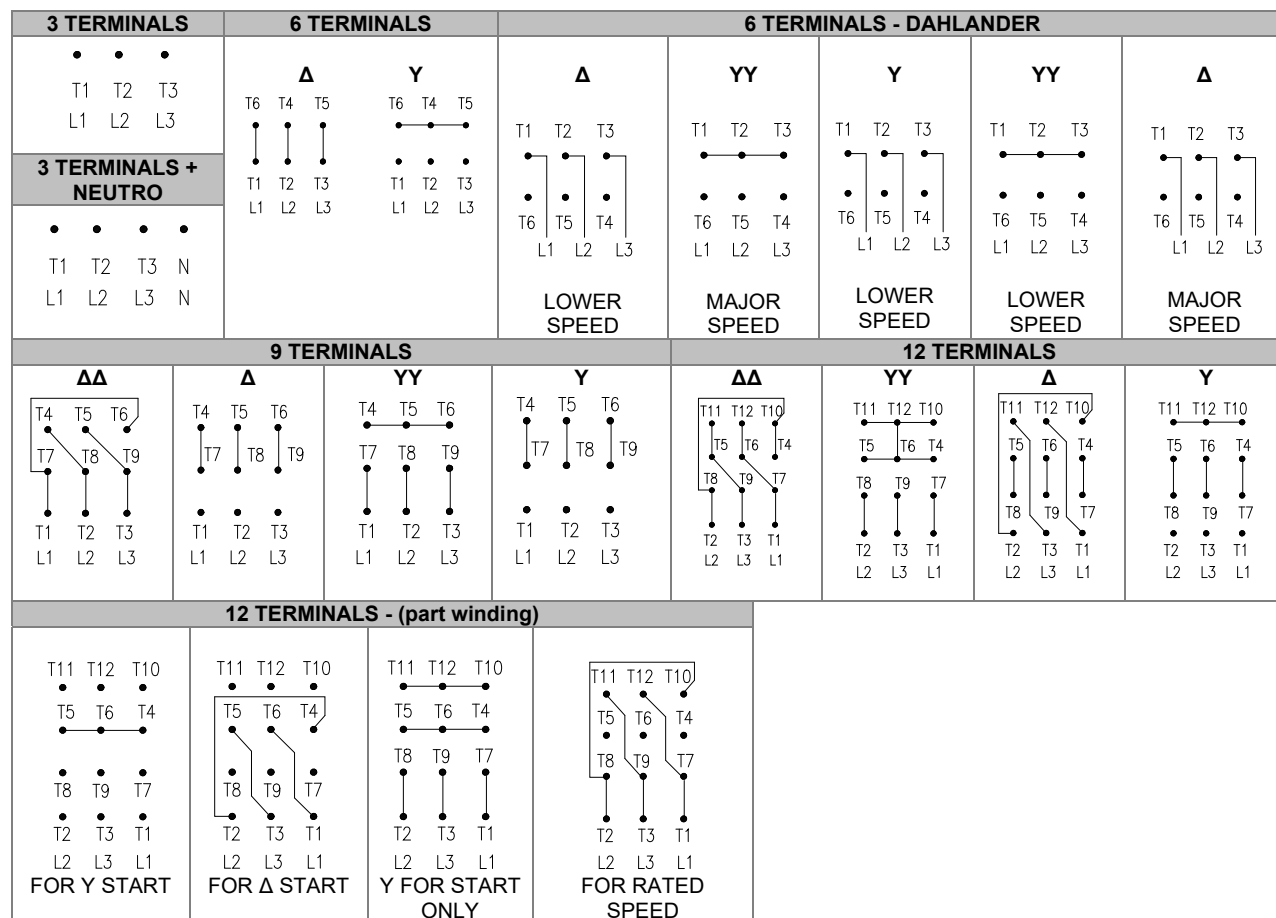


Figure 4.8: parallel connections

4.7.2.2 Wiring diagrams according to NEMA MG1 standard

4.7.2.2.1 Stator connection diagrams



NOTE

When two or more motor connection cables are used in parallel for the purpose of splitting the electrical current, the identification of these cables is done with an additional suffix followed by a hyphen, according to Figure 4.9.

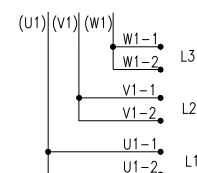


Figure 4.9: Parallel Connections

4.7.2.3 Rotation direction

- The rotation direction is indicated on the nameplate and must be observed looking to the shaft end at the motor drive end. The rotation direction must be checked before coupling the motor to the driven machine;
- Motors with terminal identification and connections as described in this manual have clockwise rotation direction, according to IEC60034-8 standard;
- In order to invert the rotation direction, it is necessary to swap any two phases;
- Motors with a single rotation direction, as indicated on the nameplate and on sign plate affixed to the frame, have unidirectional fan and must be operated only in the specified rotation direction. In order to invert the rotation direction of unidirectional motors, consult WEG.

4.7.2.4 Accessory connection diagrams

For the correct installation of the accessories, refer to the drawing in the specific CONNECTION DIAGRAM of the motor.

4.8 MECHANICAL ASPECTS

4.8.1 Base

- The base or structure where the motor will be installed must be sufficiently rigid, flat, free of external vibration and capable to withstand the mechanical loads to which it will be submitted;
- If the dimensioning of the base is not carefully executed, this may cause vibration in the base, on the motor and the driven machine;
- The base structural design must be done based on the dimensional drawing, on the information about foundation mechanical loads, and on the motor anchoring method.
- The customer is responsible for the design and construction of the foundation. It shall be sufficiently rigid to withstand circuit forces. To avoid resonance vibrations the foundation shall be designed so that the natural frequency (reed frequency) of foundation together with machine is not within +/- 20% of running speed frequency. The customer is also responsible for lateral and torsional critical speed analysis of the complete installation.



ATTENTION

Place shims of different thicknesses between the motor supporting surfaces and the base in order to allow a precise alignment.



NOTE

The user is responsible for dimensioning and building the foundation where the motor will be installed.

4.8.2 Base stresses

The base stresses are reported in the motor documentation.

4.8.3 Mounting the motor

Mount the motor securely and align it correctly with the driven equipment according to the following mounting types:

1. **Mounting the motor directly with the driven machine:** the two units must be firmly coupled and the driven machine must be installed on a suitable base;
2. **Mounting the motor on a metal base:** The base must be sufficiently rigid and vibration-free.



ATTENTION

Improper mounting of the equipment may cause excessive vibration, resulting in premature bearing wear and may even cause shaft breakage.

4.8.3.1 Flanged motor with solid shaft

To mount the motor on the driven machine, proceed as follows:

1. Lift the motor by the upper eyebolts and rotate it to better position the grease nipples, pipes and connection boxes;
2. Clean the flanges to be coupled;
3. Remove the locking device from the motor shaft;

4. Move the motor to the driven machine, fitting the motor flange to the flange of the driven machine;
5. Insert the flange fixing bolts and tighten them with adequate torque;
6. Couple the motor shaft to the driven machine;
7. Rotate the assembly shaft to ensure it rotates freely;
8. Align the equipment according to the procedure described in this manual;
9. Tighten all flange fixing bolts avoiding twisting or loosening;
10. Turn the shaft of the assembly again.

4.8.4 Anchor plate set

The anchor plate set, when used, is composed of the anchor plate, leveling bolts, leveling shims, alignment bolts and anchor bolts.



NOTES

When WEG supplies the anchor plate for fastening and aligning the motor, the dimensional and installation details of the anchor plate are supplied in the specific dimensional drawing of the motor. The user is responsible for mounting, leveling and grouting the anchor plates (except when otherwise specified by commercial agreement).

The anchor bolts must be fastened according to Table 4.7.

Table 4.7: Tightening torque of the anchor bolts

Type Ø	Dry tightening torque [Nm]	Tightening torque with Molycote [Nm]
M30	710	470
M36	1230	820
M42	1970	1300
M48	2960	1950
M56	3500	2300

After positioning the motor, perform the final leveling using the vertical leveling bolts and the leveling shims.



ATTENTION

Protect all the threaded holes to prevent grout from penetrating the threads during the grouting of the anchor plate and anchor bolts.

4.8.5 Natural frequency of the base

In order to ensure a safe operation, the motor must be precisely aligned with the coupled equipment and both must be properly balanced.

As a requirement, the motor installation base must be flat and meet the requirements of DIN 4024-1 standard. In order to verify if the criteria of the standard are being met, the following potential vibration excitation frequencies generated by the motor and coupled machine must be checked:

- The motor rotation frequency;
 - The double of the rotation frequency;
 - The double of the motor electric frequency.
- According to DIN 4024-1 standard, the natural frequencies of the base or foundation must be away from these potential excitation frequencies, as specified next:

- The first natural frequency of the base or foundation (first order natural frequency of the base) must be out of the range from 0.8 to 1.25 times any of the potential excitation frequencies above;
- The other natural frequencies of the base or foundation must be out of the range from 0.9 to 1.1 times any of the potential excitation frequencies above.

4.8.6 Leveling

The motor must rest on a surface with flatness of up to 0.08 mm/m.

Verify whether the motor is perfectly leveled, both in the vertical and horizontal planes. Make the proper adjustments by placing shims under the motor. The motor leveling must be checked with proper equipment.



NOTE

At least 75% of the motor foot support surfaces must rest on the motor base.

4.8.7 Alignment

The motor must be correctly aligned with the driven machine.



ATTENTION

Incorrect alignment can damage the bearings, generate excessive vibration and even break the shaft.

The alignment must be done according to the coupling manufacturer recommendations.

The motor and driven machine shafts must be aligned in the axial and radial directions, as shown in Figure 4.10 and Figure 4.11.

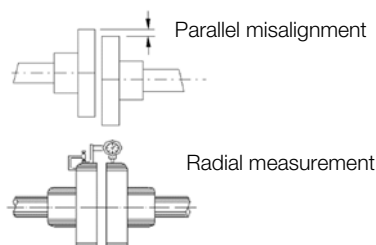


Figure 4.10: parallel alignment

Figure 4.10 shows the parallel misalignment of the two shaft ends and the practical way to measure it by using suitable dial gauges. The measurement is performed in four points 90° away from each other with the two half-couplings rotating together in order to eliminate effects of support surface irregularities on the dial gauge tip. Choosing the upper vertical point as 0°, half of the difference between the dial gauge measurements at the 0° and 180° points represents the vertical coaxial error. In case of deviation, it must be corrected by adding or removing leveling shims. Half of the difference between the dial gauge measurements at the 90° and 270° points represents the horizontal coaxial error. These measurements indicate when it is necessary to lift or lower the motor or move it to the right or to the left on the drive end in order to eliminate the coaxial error. Half of the maximum difference among the dial gauge measurements in a complete rotation represents the maximum eccentricity found. The misalignment in a complete shaft rotation, with rigid or semiflexible coupling, cannot exceed 0.03 mm. When flexible couplings are used, greater values than those indicated

above are acceptable, provided that they do not exceed the value allowed by the coupling manufacturer. It is recommended to keep a safety margin for these values.

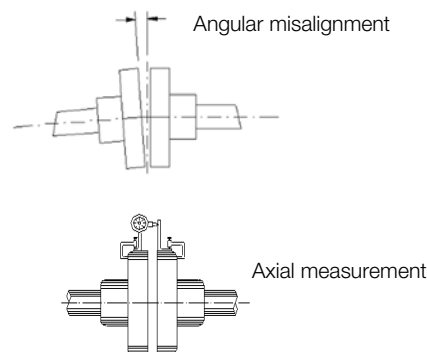


Figure 4.11: Angular alignment

Figure 4.11 shows the angular misalignment and a practical form to measure it.

The measurement is done in four points 90° away from each other, with the two half-couplings rotating together in order to eliminate effects of support surface irregularities on the dial gauge tip. Choosing the upper vertical point as 0°, half of the difference between the dial gauge measurements at the 0° and 180° points represents the vertical misalignment. In case of deviation, it must be corrected by adding or removing alignment shims. Half the difference between the dial gauge measurements at the 90° and 270° points represents the horizontal misalignment, which must be properly corrected by displacing the motor in the lateral/angular direction. Half of the maximum difference among the dial gauge measurements in a complete rotation represents the maximum angular misalignment found.

The misalignment in a complete shaft rotation, with rigid or semi flexible coupling, cannot exceed 0.03 mm. When flexible couplings are used, greater values than those indicated above are acceptable, provided that they do not exceed the value allowed by the coupling manufacturer. It is recommended to keep a safety margin for these values.

In the alignment/leveling, the influence of the temperature on the motor and the driven machine must be considered. Different expansions of the parts may change the alignment/leveling conditions during operation.

4.8.8 Couplings

Only proper couplings, which convey only torque without generating transversal forces, must be used.

For both flexible and rigid couplings, the shaft centers of the coupled machines must be in a single line. Flexible couplings mitigate the effects of residual misalignments and prevent transmission of vibration between the coupled machines, which does not occur when rigid couplings are used. The coupling must be mounted or removed with the aid of proper devices and never by means of rudimentary tools, such as hammers, sledgehammers, etc.

Follow the manufacturer's instructions when mounting or removing couplings or other drive elements and cover them with a touch guard. For trial run in uncoupled state, lock or remove the shaft end key. Avoid excessive radial and axial bearing loads (note manufacture's documentation). The balance of the machine is indicated as H= half and F= full key. In half key cases coupling must be half key balanced without a key. In case of protruding, visible part of the shaft end key, establish mechanical balance.



ATTENTION

Dowel pins, nuts, washers and leveling shims may be supplied with the motor, when requested in the purchase order.



NOTES

The user is responsible for the motor installation (unless otherwise specified by commercial agreement).

WEG is not liable for damages to the motor, associated equipment and installation occurred because of:

- Transmission of excessive vibration;
- Poor installations;
- Faulty alignment;
- Improper storage conditions;
- Noncompliance with the instructions before start-up;
- Incorrect electrical connections.

4.8.8.1 Direct coupling

Because of issues about cost, space economy, problems with belt sliding and more safety against accidents, direct coupling must be used whenever possible. Also, direct coupling is preferable in case of transmission with reduction gearing.



ATTENTION

Align the shaft ends carefully, and, whenever possible, use flexible coupling, leaving a minimum clearance (E) of 3 mm between the couplings, as shown in Figure 4.12.

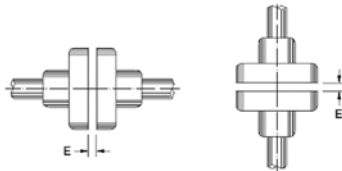


Figure 4.12: Axial clearance of the coupling (E)

4.9 HYDRAULIC UNIT

For further information on installation, operation and maintenance of the hydraulic unit (if any), refer to the motor dimensional drawing and the specific manual of this equipment.

5 STARTING

5.1 DIRECT ON-LINE STARTING

It is the simplest and most economically feasible method; however, it must only be used when the starting current does not affect the power grid.

Bear in mind that the starting current of motors may reach 6 to 7 times the rated current value. Therefore, it must be ensured that this current (I_p) will not affect the supply of other consumers because of the high voltage drop in the power grid.

The machine must be started/can be started when the temperature recorded at PT-100's of the three phases is equal to or greater than -20°C

When turning off the machine the heating resistors of the temperature rise circuit must be turned off.

There is an interlocking system so that the main machine's drive circuit breaker is only activated when the temperature recorded on the winding is greater than or equal to -20°C

This requirement is met in one of the three situations:

- a) When the power grid is "strong" enough and the motor current is negligible in relation to the grid capacity.
- b) The motor is always started without load, which reduces the starting time and, in turn, the duration of the starting current and the momentary voltage drop, which is acceptable for the other consumers of the grid;
- c) When DOL starting is duly authorized by the local electric utility company.

When the motor starting current is high, the following detrimental consequences may occur:

- a) The high voltage drop in the power supply system may cause interference in equipment installed in this system;
- b) The protection system (cables, contactors) must be oversized, increasing the installation costs.



NOTE

In some cases, there is an imposition of the electric utility companies that limits the voltage drop of the grid.

5.2 DIRECT ONLINE STARTING FREQUENCY

Since induction motors have a high starting current, the time spent to accelerate loads with high inertia results in a quick rise of the motor temperature. If the intervals between successive starts are too short, the temperature of the windings will rise quickly, reducing their useful life or even burning them. The NBR 17094 and IEC60034-1 standards establishes a minimum starting duty to which the motors must be able to comply:

- a) Two successive starts: the first one with the motor cold, i.e., with its windings at ambient temperature, and the second one right afterwards, but only after the motor has decelerated to a full stop;
- b) One start with the motor hot, i.e., with the windings at continuous duty temperature.

The first condition simulates the case in which the first motor start is aborted, for instance, by the trip of the motor protection, when a second motor start is permitted right afterwards.

The second condition simulates the case of an accidental motor shutdown under normal operation, for instance, by power outage, when the motor restart is allowed right after the power is reestablished.



NOTE

Special starting conditions must be checked in the specific motor documentation before starting the procedure.

5.3 LOCKED ROTOR CURRENT

The motor nameplate indicates the value of I_P/I_n , which is the relation between the starting current and the rated current of the motor.

5.4 STARTING WITH REDUCED CURRENT

If direct online starting is not possible, the following starting systems can be used in order to reduce the motor starting current.

- Star-delta starter;
- Series-parallel starter;
- Autotransformer starter;
- Static starter or soft starter;
- Frequency inverter.

6 COMMISSIONING

When the motor is started for the first time or after a prolonged standstill, several aspects must be considered besides the regular operation procedures.



ATTENTION

- Avoid any contact with electric circuits;
- Even low-voltage circuits may be life threatening;
- In any electromagnetic circuit, over voltages may occur under certain operating conditions;
- Do not open an electromagnetic circuit suddenly, because the presence of an inductive discharge voltage may break the insulation or injure the operator;
- In order to open those circuits, disconnect switches or circuit breakers must be used.

6.1 PRELIMINARY INSPECTION

Before the first motor start or after long periods out of operation, the following items must be inspected:

1. Check if all the motor fastening bolts are tightened;
2. Measure the winding insulation resistances, making sure they are within the specified values;
3. Check if the motor is clean and if the packages, measuring instruments and alignment devices were removed from the motor operating area;
4. Check if coupling connecting components are in perfect operating conditions, duly tightened and greased, where necessary;
5. Check if the motor is correctly aligned;
6. Check if the bearings are properly lubricated. The lubricant must be of the type specified on the nameplate;
7. Check the oil level of oil-lubricated bearings. Bearings with forced lubrication must have the oil pressure and flow as specified on their nameplate;
8. Inspect the cable connections of accessories (thermal protectors, grounding, space heaters, etc.);
9. Check if all electrical connections comply with the motor connection diagram;
10. Check if the motor is properly grounded;
11. The cables connected to the stator and rotor main terminals must be properly tightened in order to prevent their short-circuit or loosening;
12. Inspect the cooling system. In water-cooled motors, inspect the operation of the radiator water supply system. In motors with independent ventilation, check the rotation direction of the fans;
13. Motor air inlets and outlets (if any) must be unobstructed;
14. The moving parts of the motor must be protected to prevent accidents;
15. The terminal box covers must be correctly fastened;
16. Check if the power supply voltage and frequency comply with the data on the motor nameplate;
17. Inspect the operation of the anti-reversion devices (if any).

6.2 FIRST STARTING

After all preliminary inspections have been carried out, proceed according to the directions presented next in order to perform the first start of the uncoupled motor:

1. Turn off the space heater;
2. Set the protections in the control panel;
3. In oil-lubricated bearings, check the oil level;
4. In bearings with forced lubrication, start the oil circulation system and check the level, flow and pressure of the oil, making sure that they comply with the data on the nameplate.
5. If the system has oil flow detection equipment, it must be waited until the flow return signal from the oil

6. Start the industrial water-cooling system checking the required flow and pressure (motors with air-water heat exchanger);
7. Turn on the fans (motors with forced ventilation);
8. Switch on the high-pressure oil injection system (if any), keeping it on as informed in the motor technical documentation until the bearings get the lubrication by self-pumping;
9. Rotate the motor shaft slowly in order to check that no part is being dragged or any abnormal noises are occurring;
10. After the previous steps have been adequately completed, it is possible to proceed with the motor starting sequence;
11. Start the motor with no load, making sure it rotates smoothly without strange noises;
12. Check the rotation direction with the motor uncoupled;
13. In order to invert the rotation direction, just invert the connections of any two phases;



ATTENTION

In order to invert the rotation direction of motors with single direction, it is necessary to consult WEG.

14. Keep the motor rotating at rated speed and write down the bearing temperatures at 1-minute intervals until they become constant. Any sudden increase in bearing temperature indicates lubrication or friction surface abnormality;
15. Monitor the temperature, the oil level of the bearings, and the vibration levels. If there is a significant variation of any value, interrupt the motor starting, identify possible causes and make the necessary corrections;
16. When the bearing temperatures stabilize, it is possible to proceed to the other motor operation steps.



ATTENTION

The noncompliance with the procedures described in section 6.2 may impair the motor performance, cause damages and even lead to its burnout, voiding the warranty.

6.3 OPERATION

The operating procedures vary considerably depending on the motor application and the type of control equipment used.

The general procedures are described in this manual. For the control system operating procedures, refer to the specific manual of this equipment.

6.3.1 General

After a first successful starting test, couple the motor to the driven load, and then the starting procedure can be reinitiated, as follows:

- Start the motor coupled to the load until its temperature stabilizes and check for unusual noises, abnormal vibrations or excessive heating. If significant vibration variations occur regarding the initial operation condition until the condition after reaching thermal stability, then it is necessary to check the alignment and the leveling.
- Measure the current consumption and compare it to the value given on the nameplate.
- In continuous duty, without load variation, the measured current must not exceed the value indicated on the nameplate multiplied by the service factor;
- All the instruments and devices for measurement and control must be permanently monitored to detect occasional alterations, determine their causes and make the proper corrections.

6.3.2 Temperatures

- The temperatures of the bearings, stator winding and cooling system must be monitored while the motor is operating.
- These temperatures must stabilize within 4 to 8 hours of operation.
- The stator winding temperature depends on the machine load; therefore, the driven load must also be monitored during the motor.

6.3.3 Bearings

The system start, as well as the first hours of operation, must be monitored carefully.

Before putting the motor into operation, verify:

- If the high-pressure oil injection system (if any) is ON;
- If the external lubrication system (if any) is ON;
- If the used lubricant complies with the specifications;
- The lubricant characteristics;
- The oil level (oil-lubricated bearings);
- If the bearing alarm and trip temperatures are set;
- During the first start, it is important to pay attention to unusual vibrations or noises;
- If the bearing is not working silently and smoothly, the motor must be shut down immediately;
- In case of overheating, the motor must be shut down immediately for the inspection of bearings and temperature sensors, and the correction of possible causes;
- The motor must operate for several hours until bearing temperatures stabilize within the specified limits;
- After the bearing temperatures stabilize, check if there are no leaks through the plugs, gaskets or shaft end.

6.3.3.1 High pressure oil injection system

In the bearings that have the shaft lifting option at START or stop, through oil pressure, the activation of this system is done through an oil pump external to the motor, and the following procedure must be followed:



ATTENTION

The high-pressure oil injection system must be switched on before starting the engine and during the shutdown procedure, as described in the engine's technical documentation.

6.3.4 Radiators

During the operation of motors with air-water heat exchanger, it is necessary:

- Controlling the temperature at the radiator inlet and outlet and, if necessary, correcting the water flow;
- Adjusting the water pressure just to overcome the resistance in the pipes and in the radiator;
- In order to control the motor operation, it is recommended to install thermometers at the radiator air and water inlets and outlets and record these temperatures at certain time intervals;
- When installing the thermometers, recording or signaling instruments (siren, lights) can also be installed in certain places.

Verification of the radiator performance

- For operation control purposes, it is recommended that water and air temperatures at the radiator inlets and outlets be measured and recorded periodically;
- The radiator performance is expressed by the temperature difference between cold water and cold air during normal operation. This difference must be checked periodically. If an increase in this difference is observed after a long period of normal operation, verify the need for radiator cleaning.
- The accumulation of air inside the radiator can lead to a performance reduction or to its damage. In this case, a deaeration of the radiator and the pipes may solve the problem;
- The water pressure differential can be considered an indicator of the need for cleaning the radiator.
- It is also recommended to measure and record the difference between the water pressure before and after the radiator. Periodically, the values measured must be compared to the original value, and an increase of the pressure differential indicates the need for cleaning the radiator.


6.3.5 Vibration

The motors are balanced at the factory in compliance with the vibration limits established by IEC60034-14, NEMA MG1 – Part 7 and NBR 11390 standards (except when the purchase contract specifies different values). The vibration measurements are carried out on the NDE and DE bearings, in the vertical, horizontal and axial directions. When the customer sends the half coupling to WEG, the motor is balanced with the half coupling mounted on the shaft. Otherwise, according to the standards above, the motor is balanced with half-key (i.e., the key slot is filled with a bar of the same width, thickness and height of the key slot during the balancing operation).

The maximum vibration levels met by WEG for running motors are given in the wiring diagram.

The main vibration causes are:

- Misalignment between the motor and the driven equipment;
- Improper fastening of the motor to the base, with "loose shims" under one or more motor feet, and loose fastening bolts;
- Improper or insufficiently rigid base;
- External vibrations proceeding from other equipment.



ATTENTION

Operating the motor with vibration above the values contained in its wiring diagram may impair its useful life and/or performance.

6.3.6 Shaft vibration limits

In motors equipped with or prepared for the installation of proximity sensors (normally used on sleeve bearings), the surfaces of the shaft are prepared with special finishing in the areas adjacent to the bearings, in order to assure the correct measurement of the shaft vibration.

Shaft vibration must meet the maximum alarm and shutdown values given in the motor specific wiring diagram.

The main causes for increase in shaft vibration are:

- Coupling unbalance issues or other problems that may also generate machine vibration;
- Shaft shape problems in the measurement region, minimized during manufacturing;
- Residual magnetism or voltage on the shaft surface where the measurement is done;
- Scratches, dents or variations on the shaft finishing in the measurement region.


6.3.7 Shutdown

In order to shut down the motor, proceed as follows:

- Reduce the load of the driven equipment, if possible;
- Open the main circuit breaker;
- Switch on the high-pressure oil injection system (if any);


After the motor stops completely:

- Switch off the high-pressure oil injection system (if any);
- Switch off the oil circulation system of the bearings (if any);
- Switch off the hydraulic unit (if any);
- Shut down the industrial water system (if any);
- Switch off the forced ventilation system (if any);
- Switch on the space heaters. They must be kept ON until the next motor operation.



DANGER

Even after switching the motor off, while the rotor is rotating, there is danger to life by touching any of the motor active parts.



ATTENTION

The terminal boxes of motors equipped with capacitors must not be opened before their full discharge.
Discharge time of the capacitors: five minutes after shutting down the motor.


6.4 OPERATION AS ASYNCHRONOUS GENERATOR

To operation as an asynchronous generator, in addition to the procedures mentioned in item 6.3, the following particularities of this application must be considered:

6.4.1 Operation

To operate as an asynchronous generator, the induction machine must be electrically connected in parallel with the electrical grid and mechanically coupled to a driving machine that provides a speed slightly above the synchronous speed.

The more the speed of the rotor is increased, the more power is transferred as electromagnetic force to the stator, and in turn converted into electrical energy to feed the electrical grid.




ATTENTION

If the rotor rotates exactly at the synchronous rotation, the rotation of the stator magnetic field will be equal to the rotation of the rotor and, thus, there will be no current induction in the rotor and, consequently, no power generation.

6.4.2 Slippage

The rotation and electrical power generated by the asynchronous generator vary with the torque applied to it. In practice, the difference between the rotation at the rated power of the generator and the synchronous rotation is very small, about 1 to 3 percent. This difference in percentage is called slip.



ATTENTION

Verify on the technical data sheet the nominal rotation to operation as asynchronous generator. In this rotation, the generator will have the rated power of the nameplate. Imposing a torque above the maximum torque of the generator will cause over speed, which may damage the generator.

6.4.3 Precautions

- Asynchronous generators have the following restrictions: The machine driving the asynchronous generator must have precise SPEED control , as well as over SPEED protection;
- The induction generator must not operate with rotation above its rated rotation.

7 MAINTENANCE

7.1 GENERAL

A proper maintenance program for electric motors includes the following recommendations:

- Keep the motor and the associated equipment clean;
- Measure the winding insulation resistance periodically;
- Measure the temperature of windings, bearings and cooling system periodically;
- Check the wear, operation of the lubrication system and useful life of the bearings;
- Measure the motor vibration levels;
- Inspect the cooling system;
- Inspect associated equipment;
- Inspect all the motor accessories, protections and connections, ensuring that they are operating properly;



ATTENTION

Noncompliance with the recommendations of section 7.1 may cause undesired stoppages of the equipment. The frequency of such inspections depends on the local application conditions. Every time that it becomes necessary to transport the motor, the shaft must be properly locked to prevent damages to the bearings. Use the device supplied with the motor to lock the shaft. If the motor requires reconditioning or replacement of any damaged part, consult WEG.

7.2 GENERAL CLEANING

- Keep the frame clean, without external accumulation of oil or dust, in order to facilitate the heat exchange with the environment;
- The inside of the motor must also be kept clean, free of dust, debris and oils;
- For cleaning, use brushes or clean cotton cloths. If the dust is not abrasive, the cleaning must be done with an industrial vacuum cleaner, "aspiring" the dirt from the fan cover and the dust accumulated on the fan blades and on the frame;
- Debris impregnated with oil or moisture can be removed with a cloth soaked in appropriate solvents;
- Clean the terminal boxes when necessary. Terminals and connectors must be kept clean, free of rust and in perfect operating conditions. Avoid the presence of grease or verdigris in the connection parts.

7.2.1 Internal inspection

The inside inspection and cleaning on W60 motors can be performed from the top, removing the heat exchanger or ventilation box.

7.3 WINDING MAINTENANCE

To obtain more satisfactory operation and a longer life of the motor, the windings should be inspected and cleaned annually.

7.3.1 Winding inspection

Yearly, the windings must be submitted to a complete visual inspection, recording and repairing all and every damage or defect observed.

The winding insulation resistance measurements must be done at regular intervals, especially during humid weather and after prolonged motor stoppages. Low values or sudden variations in the insulation resistance must be investigated.

The windings must be submitted to complete visual inspections at frequent intervals, recording and repairing all and every damage or defect observed.

The winding insulation resistance can be increased up to an adequate value in the points where it is low (as a result of excessive dust and moisture) by means of the dust removal and by drying the winding moisture.

7.3.2 Winding cleaning

In order to obtain a more satisfactory operation and a longer useful life of the insulated windings, it is recommended to keep them free of dirt, oil, metal dust, contaminants, etc.

Therefore, it is necessary to inspect and clean the windings periodically, according to the recommendations of the "Maintenance Plan" of this manual. If reimpregnation is necessary, consult WEG.

The windings may be cleaned with an industrial vacuum cleaner with a non-metallic crevice tool or just a dry cloth.

For extreme dirt conditions, it may be necessary to use a proper liquid solvent for cleaning. This cleaning must be quick to prevent prolonged exposure of the windings to the solvent effects.

After being cleaned with solvents, the windings must be completely dried.

Measure the insulation resistance and the polarization index in order to assess the winding insulation conditions.

Winding drying time after cleaning varies depending on the weather conditions such as temperature, humidity, etc.



DANGER

Most solvents currently used are highly toxic and/or flammable. Solvents must not be used in the straight parts of the coils of high-voltage motors, because they may affect the protection against corona effect.

7.3.3 Inspections after cleaning

The following inspections must be carried out after the windings are carefully cleaned:

- Check the insulations of the winding and connections;
- Check if spacers, bindings, slot wedges, bandages and supports are properly fixed;
- Check for breaks, faulty welds, short-circuit between turns and against the frame in the coils and connections. In case any fault is detected, consult WEG.
- Ensure that all cables are properly connected and that terminal fixation components are duly tightened. Retighten, if necessary.

7.3.4 Reimpregnation

If any layer of resin on the windings is damaged during cleaning or inspection, such parts must be corrected with adequate material (in this case, consult WEG).

7.3.5 Insulation Resistance

The insulation resistance must be measured after the completion of all of the maintenance procedures.



ATTENTION

Before putting the motor back into operation, it is essential to measure the winding insulation resistance and ensure that the measured values meet the specifications.

7.4 COOLING SYSTEM MAINTENANCE

- In motors with air-air heat exchanger (IC611), the cooling pipes and noise attenuator (if any) must keep clean and unobstructed to ensure a perfect heat exchange. In order to remove the dirt accumulated in the pipes, a rod with a round brush at the end may be used. Noise attenuators (if any) can be cleaned with dry compressed air.



ATTENTION

It is recommended to close the openings of the external air circuit, if the motor is out of operation for long terms.

- In case of air-water heat exchangers (IC81W), periodic cleaning in the radiator pipes is necessary to remove all and any incrustation, according item 7.5.
- In open motors (IC01), the air filters should be cleaned with dry compressed air. If dust is difficult to remove, wash the filter with cold water and neutral detergent and dry it in horizontal position. Replace the filters, if necessary.

7.5 RADIATOR MAINTENANCE

The degree of dirt in the radiator can be detected by the increase of the temperature at the air outlet. When the temperature of the cold air, under the same operating conditions, exceeds the specified value, it can be assumed that the pipes are dirty.

If corrosion is found in the radiator, it is necessary to provide adequate protection against corrosion (i.e., zinc anodes, cover with plastic, epoxy or other similar products), in order to prevent further damage to the parts already affected.

The external surface of all the radiator parts must always be kept in good conditions.

Instructions for removal and maintenance of the radiator

In order to remove the radiator for maintenance, use the following procedure:

1. Close all the water inlet and outlet valves after stopping the ventilation;
2. Drain the water through the radiator drain plugs;
3. Remove the heads, keeping the bolts, nuts, washers and seals (gaskets) in a safe place;
4. Brush the inside of the pipes carefully with nylon brushes in order to remove residues. If damages to the radiator tubes are found during the cleaning, they must be repaired;

5. Reassemble the heads, replacing the gaskets, if necessary.

Sacrificial anodes

Sacrificial anodes are used in radiators that operate with seawater. The regular inspection must be carried out, according to the maintenance plan. If excessive corrosion is found in the sacrificial anode, the frequency of inspection must be increased in order to determine the corrosion period and establish a plan for proper replacement intervals.

7.6 VIBRATION

Any evidence of increase in the unbalance or vibration of the motor must be investigated immediately.



ATTENTION

After torquing or disassembling any machine screw, it is necessary to apply Loctite.

7.7 MAINTENANCE OF THE ANTI-REVERSION RATCHET

The anti-reversion condition of the ratchet (if any) should be inspected according to the maintenance schedule described in Table 9.1.

The ratchet will be used dry, so the seal will not comply with the machine's degree of protection. On the other hand, it is necessary to protect the internal parts of the ratchet (bearings and track) from solid particles that can block the mechanism.

7.8 ENCODER MAINTENANCE

The correct installation of the encoder (if any) is very important to its operation. Both disassembly and assembly must be carried out in accordance with the procedures in the specific manual of the manufacturer of this equipment and by qualified and trained personnel. In case of doubt, consult WEG.

7.9 BEARING MAINTENANCE

7.9.1 Grease-lubricated rolling bearings



NOTE

The rolling bearing data, amount and type of grease, and lubrication intervals are informed on a bearing nameplate affixed to the motor.

The bearings shall be relubricated annually or according to the lubrication interval stated on the bearings nameplate, whichever occurs first.

- The informed lubrication intervals, consider a 70 °C working temperature of the rolling bearing;
- Based on the operating temperature ranges listed in Table 7.1, apply the following correction factors for the rolling bearing lubrication intervals:

Table 7.1: Reduction factor for lubrication intervals

Bearing operating temperature	Reduction factor
Below 60 °C	1.59
Between 70 and 80 °C	0.63
Between 80 and 90 °C	0.40
Between 90 and 100 °C	0.25
Between 100 and 110 °C	0.16

7.9.1.1 Instructions for lubrication

The lubrication system was designed in such a way that during the lubrication of the rolling bearings, all the old grease is removed from the rolling bearing races and expelled through a drain which enables the exit of the grease but prevents the ingress of dust or other harmful contaminants.

This drain also prevents damage to the rolling bearings by excessive lubrication.

It is recommended to make the lubrication with the motor in operation in order to ensure the renewal of the grease in the rolling bearing housing.

If that is not possible due to the presence of rotating parts near the grease nipple (pulleys, etc.) which may put the operator at risk, follow the procedures below:

- With the motor stopped, inject approximately half of the total intended amount of grease and operate the motor for approximately one minute at full speed;
- Stop the motor and inject the rest of the grease.



Figure 7.1: Grease reservoir

7.9.1.3 Type and amount of grease

Relubrication of the bearings should always be carried out with the original grease specified on the bearing nameplate and in the motor documentation.



ATTENTION

The injection of all the grease with the motor stopped may lead to the penetration of part of the lubricant into the motor through the internal seal of the rolling bearing cap;

It is important to clean the grease nipples prior to lubrication in order to prevent foreign materials from being dragged into the rolling bearing. For lubrication, use only manual grease gun.



ATTENTION

WEG does not recommend the use of any grease other than the original motor grease.

Correct lubrication, i.e., applying the correct grease in the correct quantity, is important, since both deficient and excessive lubrication cause damage to the bearings. Excessive lubrication causes temperature increase due to the high resistance to the movement of the rotating parts and, mainly, due to the churning of the grease, which ends up completely losing its lubricating characteristics. As well as excessive grease accumulation in the grease reservoir, resulting in premature bearing maintenance.

7.9.1.2 Procedure for lubrication of bearings

1. Wipe with a cotton cloth around the grease hole;
2. With the rotor running, inject grease with a hand grease gun according to the quantity indicated on the nameplate affixed to the motor;
3. Keep the motor running long enough to drain all the excess grease into the internal grease reservoir of the bearing;
4. Inspect the bearing temperature to make sure there were no significant changes;

Excess grease drains out through the lower drain internal to the bearing and is deposited in the grease reservoir.



NOTE

It is not necessary to remove old grease from the reservoir after each relubrication. The grease reservoir is sized to meet relubrications for the life of the bearing. When replacing the bearing, the reservoir should be cleaned and the old grease disposed of in an appropriate location.

7.9.1.4 Alternative greases

If it is not possible to use the original grease, the alternative greases listed in Table 7.2 can be used, under the following conditions:

1. The motor speed must not exceed the limit speed of the grease, according to the type of rolling bearing, as informed in Table 7.2;
2. The bearing lubrication interval must be corrected by multiplying the interval informed on the bearing nameplate by the multiplication factor informed in Table 7.2;

Table 7.2: Options and characteristics of the alternative greases for regular applications

Manufacturer	Grease	Constant operating temperature (°C)	Multiplication factor
Exxon Mobil	UNIREX N3 (Lithium Complex Soap)	(-30 to +150)	0.90
Shell	GADUS S2 V100 3 (Lithium Soap)	(-30 to +130)	0.85
Petrobras	LUBRAX INDUSTRIAL GMA-2 (Lithium Soap)	(0 to +130)	0.85
Shell	GADUS S3 T100 2 (Diurea Soap)	(-20 to +150)	0.94
SKF	LGHP 2 (Polyurea Soap)	(-40 to +150)	0.94

7.9.1.5 Procedure for changing the grease

In order to replace the **POLYREX EM103** grease by one of the alternative greases, the bearings must be opened to remove the old grease and then filled with the new grease. If it is not possible to open the bearings, the old grease must be purged by applying new grease until it begins to appear in the exit drawer with the motor running.

In order to replace the **PETAMO GHY 133 N** grease by one of the alternative greases, you must first open the bearings, completely remove the old grease, and then fill it with new grease.



ATTENTION

When the bearing is opened, inject the new grease through the grease nipple to expel the old grease found in the grease inlet tube, and apply the new grease in the rolling bearing, to the inner and outer bearing caps, filling 3/4 of the empty spaces. In case of double bearings (ball bearing + roller bearing), also fill 3/4 of the empty spaces between the intermediate rings. Never clean the rolling bearing with cotton-based cloths, because they may release some lint, working as solid particles.



NOTE

WEG is not liable for the grease change or for any damages arising from this change.

7.9.1.6 Low temperature greases

Table 7.3: Grease for application at low temperatures

Manufacturer	Grease	Constant operating temperature (°C)	Application
Exxon Mobil	MOBILITH SHC 100 (Lithium Soap and Synthetic Oil)	(-50 to +150)	Low temperature

7.9.1.7 Grease compatibility

You can say that greases are compatible when the properties of the mixture are within the property ranges of the greases individually.

In general, greases with the same type of soap are compatible; however, depending on the proportion of the mixture, there might be incompatibility. Therefore, it is not recommended to mix different types of grease without consulting the grease supplier or WEG.

Some thickeners and basic oils cannot be mixed because they do not form a homogeneous mixture. In this case, one cannot rule the possibility of hardening or softening of the grease, or reduction of the dropping point of the resulting mixture.



ATTENTION

Greases with different types of bases must never be mixed.
For example: Lithium-based greases must never be mixed with sodium or calcium-based greases.

7.9.1.8 Disassembly - vertical bearings

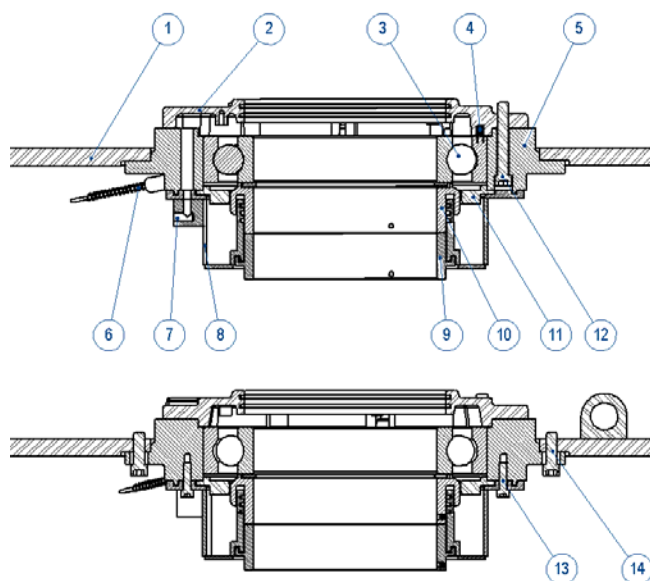


Figure 7.2: Lower bearing

Figure 7.2 caption:

1. Bottom cover
2. Internal fixing ring
3. Bearing
4. Spring
5. Lower bearing hub
6. Temperature sensor
7. Grease fitting
8. Grease reservoir
9. Protective disc
10. Grease centrifuge
11. External fixing ring
12. Screw
13. Screw
14. Screw

7.9.1.8.1 Before disassembly

- Remove the grease inlet extension tubes;
- Thoroughly clean the outside of the bearing;
- Remove grounding brush (if present);
- Remove temperature sensors.

7.9.1.8.2 Disassembly of the bottom bearing

To disassemble the bearing, proceed according to the following guidelines:

1. Place the motor in a horizontal position;
2. Remove the screws (13), the protection disk (9) and the grease reservoir (8);
3. Remove the grease centrifuge (10) and the external fastening ring (11);
4. Remove the screw (14) and remove the lower bearing hub (5);
5. Remove the lower cover (1);
6. Remove the bearing (3);
7. Remove the inner circlip (2), if necessary.

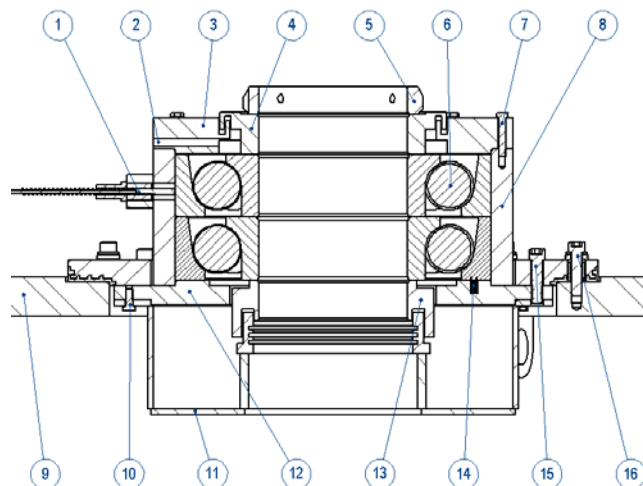


Figure 7.3: Upper bearing

Figure 7.3 caption:

1. Temperature sensor
2. Grease
3. External fixing ring
4. Labyrinth ring
5. KMT nut
6. Bearing
7. Screw
8. Upper bearing hub
9. Upper bearing cap
10. Screw
11. Grease reservoir
12. Internal fastening ring
13. Grease centrifuge
14. Spring
15. Screw
16. Screw

7.9.1.8.3 Disassembling the top bearing

To disassemble the bearing, proceed according to the following guidelines:

1. Shim the motor shaft with a hydraulic jack;
2. Remove the KMT nut (5) and remove the labyrinth ring (4);
3. Remove the screws (7) from the outer bearing locating ring (7);
4. Remove the external locating ring (3);
5. Remove the screws (15 and 16) and remove the bearing hub (8);
6. Remove the top cover (9);
7. Move the inner locking ring away from the bearing, to obtain space to place the device and remove the bearing;
8. Remove the bearing (6);
9. Remove the grease centrifuge (13) and the inner locking ring (12); 10.
10. Remove the screw (10) and grease reservoir (11) To clean it and discard the old grease.



ATTENTION

- When disassembling the bearings, care should be taken to avoid damaging the balls, rollers, as well as the shaft surface;
- Store the disassembled parts in a clean and safe place.

7.9.1.9 Bearing assembly

- Clean the bearings completely and inspect the disassembled parts and the inside of the bearing caps;
- Make sure the rolling bearing, shaft and bearing cap surfaces are perfectly smooth;
- Fill up to ¾ of the inner and outer bearing cap deposits with the recommended grease (Figure 7.4) and lubricate the rolling bearing with enough grease before assembling it;
- Before assembling the rolling bearing on the shaft, heat it up to a temperature between 50 °C and 100 °C;
- For the complete assembly of the bearing, follow the disassembly instructions in the reverse order.
- The efficiency of sealing against taconita will be given by the filling of grease between the protrusions of the labyrinth seal and outer ring (if any)



Figure 7.4: Outer bearing cap

7.9.2 Oil bearing bearings

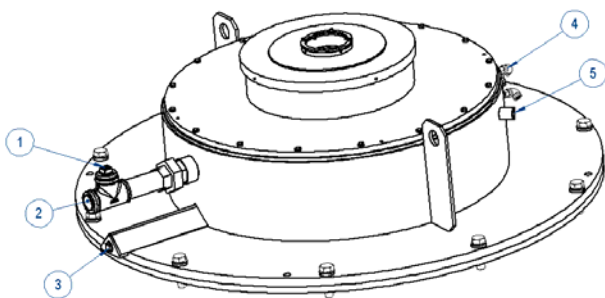


Figure 7.5: Oil bearing

Figure 7.5 caption:

1. Oil inlet
2. Oil level sight glass
3. Oil outlet
4. Temperature sensor
5. Cooling water inlet and outlet (optional use)



ATTENTION

The breather hose (6) should not be kinked to avoid oil accumulation inside it.

7.9.2.1 Lubrication to Instructions

Oil drainage: When it is necessary to change the oil in the bearings, remove the oil outlet cap (3) and drain the oil completely.

To oil placement in the bearing:

- Close the oil outlet with the plug (3);
- Remove the oil inlet cap or filter (1);
- Put the specified oil up to the level (in the middle of the oil level sight glass).



NOTES

1. All unused threaded holes must be closed with plugs and no connection may leak;
2. The oil level is reached when the lubricant can be seen approximately in the middle of the level sight glass;
3. The use of a LARGER amount of oil does not damage the bearing, but may cause leakage through the shaft seals;
4. Never use or mix hydraulic oil with lubricating oil in bearings.

7.9.2.2 Type of oil

The type and quantity of lubricating oil to be used are specified on the nameplate affixed to the motor.

7.9.2.3 Changing oil

Bearing oil change should be carried out according to the intervals depending on the working temperature of the bearing shown in Table 7.4:

Table 7.4: Oil change intervals

Bearing operating temperature	Bearing oil change intervals
Below 75 °C	20,000 hours
Between 75 and 80 °C	16,000 hours
Between 80 and 85 °C	12,000 hours
Between 85 and 90 °C	8,000 hours
Between 90 and 95 °C	6,000 hours
Between 95 and 100 °C	4,000 hours

The service life of the bearings depends on their operating conditions, engine operating conditions and maintenance procedures.

Proceed according to the following guidelines:

The oil selected to the application must have the appropriate viscosity to the operating temperature of the bearing. The type of oil recommended by WEG already takes these criteria into account;

Insufficient amount of oil can damage the bearing;

The minimum recommended oil level is reached when the lubricant can be seen at the bottom of the oil level sight glass with the motor.



ATTENTION

The oil level should be checked daily and should remain in the middle of the oil level sight glass.

7.9.2.4 Bearing operation

The start of the system, as well as the first hours of operation, should be carefully monitored. Before start, check:

- Whether the oil used is in accordance with that specified on the nameplate;
- The characteristics of the lubricant;
- The oil level;
- The alarm and shutdown temperatures set to the bearing.

During the first start, watch for any vibration or noise. If the bearing does not run quietly and smoothly, the motor should be shut down immediately.

The motor should be run for a few hours until the bearing temperature stabilizes. If the bearings overheat, the motor should be shut down and the bearings and temperature sensors checked.

Check for oil leaks from plugs, seals or shaft end.

7.9.2.5 Cooling with water circulation

Bearings lubricated with oil, when water circulation cooling is applied, have a coil inside the bearing oil reservoir through which the water circulates.

To ensure efficient cooling of the bearing, the circulating water must have at the bearing inlet, a temperature lower or equal to that of the environment, to cooling occurs.

The water pressure should be 0.1 bar and the flow rate 0.7 l/s. The pH must be neutral. Clean water with the following characteristics should be used as cooling fluid:

- pH: between 6 and 9;
- Chlorides: maximum 25.0 mg/l;
- Sulfates: maximum 3.0 mg/l;
- Manganese: maximum 0.5 mg/l;
- Suspended solids: maximum 30.0 mg/l;
- Ammonia: no traces.



NOTE

Under no circumstances should water leak to the inside of the oil reservoir, which will contaminate the lubricant.

7.9.2.6 Disassembly of bearings

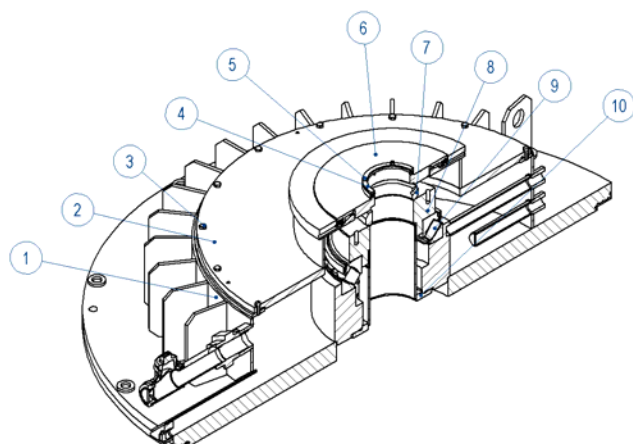


Figure 7.6: Upper bearing

Figure 7.6 caption:

1. Oil tank
2. Upper bearing cover
3. Screw
4. Fixing ring
5. Screw
6. Labyrinth disc
7. KMT nut
8. Bearing hub
9. Bearing
10. Oil retaining tube

Before disassembling the upper bearing:

- Chock the rotor on the shaft end with a hydraulic jack;
- Completely drain the oil from the bearing;
- Thoroughly clean the outside of the bearing;
- Remove the temperature sensors.

Disassembling the upper bearing

To disassemble the bearing, carefully follow the instructions below, keeping all parts in a safe place:

- Remove the screw (5), the locking ring (4) and the labyrinth disc (6);
- Remove the screw (3) and the upper bearing cover (2);
- Remove the KMT nut (7);
- Remove the bearing hub (8);
- Remove the bearing (9);



ATTENTION

When disassembling the bearings, care should be taken not to damage the balls, rollers or shaft surface; Store disassembled parts in a clean and safe place.

7.9.2.7 Mounting the bearings

- Thoroughly clean the bearing, oil reservoirs and inspect all bearing mounting to parts for damage.
- Make sure that the bearing contact surfaces are smooth, without scratches or traces of corrosion;
- Before mounting the bearing on the shaft, heat it to a temperature between 50 and 100°C;
- To complete assembly of the bearing, follow the disassembly instructions in reverse order.



ATTENTION

During bearing assembly, apply sealant (e.g., Curil T) to seal oil reservoir surfaces. Inspect seals and sealing to ensure proper sealing.

7.9.3 Rolling bearing replacement

The disassembly of rolling bearings must be done with an appropriate tool (rolling bearing puller).

The arms of the puller must be placed on the lateral surface of the bearing inner ring to be disassembled or on an adjacent part.

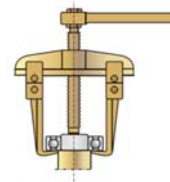


Figure 7.7: Tool for rolling bearing extraction

7.9.4 Sleeve bearings

7.9.4.1 Bearing data

Dry sump bearings or those that use two oil outlets per bearing do not have an oil level sight glass. It is therefore not necessary to check the oil level.

The characteristic data, such as oil flow, quantity and type, are indicated on the bearing nameplate and must be strictly observed; otherwise, overheating and damages to the bearings may occur.

The hydraulic installation (for bearings with forced lubrication) and the oil supply for the motor bearings are responsibilities of the user.

7.9.4.2 Bearing installation and operation

For information on the bill of materials, assembly and disassembly instructions, and maintenance details, refer to the specific installation and operation manual of the bearings.

7.9.4.3 Cooling with water circulation

Sliding bearings with circulating water cooling have a coil inside the bearing oil reservoir through which water circulates.

To ensure efficient cooling of the bearing, the circulating water must have at the bearing inlet, a temperature lower or equal to that of the environment, to cooling occurs.

The water pressure should be 0.1 bar and the flow rate 0.7 l/s. The pH should be neutral.

Clean water with the following characteristics should be used as cooling fluid:

- pH: between 6 and 9;
- Chlorides: maximum 25.0 mg/l;
- Sulfates: maximum 3.0 mg/l;
- Manganese: maximum 0.5 mg/l;
- Suspended solids: maximum 30.0 mg/l;
- Ammonia: no traces.



NOTE

Under no circumstances should water leak to the inside of the oil reservoir, which will contaminate the lubricant.

7.9.4.4 Oil change

Self-lubricated bearings

The bearing oil change must be done according to the intervals, which depend on the bearing operating temperatures, shown in Table 7.5:

Table 7.5: Oil change intervals

Bearing operating temperature	Bearing oil change intervals
Below 75 °C	20,000 hours
Between 75 and 80 °C	16,000 hours
Between 80 and 85 °C	12,000 hours
Between 85 and 90 °C	8,000 hours
Between 90 and 95 °C	6,000 hours
Between 95 and 100 °C	4,000 hours

Bearings with external oil circulation

The oil of the bearings must be changed every 20,000 hours of operation or whenever the lubricant presents modifications in its characteristics. The oil viscosity and pH must be checked periodically.



NOTE

The oil level must be inspected daily, and it must remain in the middle of the oil sight glass.

The bearings must be lubricated with the specified oil, respecting the flow rate informed on their nameplate; All threaded holes that are not used must be closed with plugs and no fitting may present leaks.

The oil level is reached when the lubricant can be seen approximately in the middle of the sight glass. The use of a larger amount of oil will not damage the bearing, but it can cause leaks through the shaft seals.



ATTENTION

The care with the lubrication will determine the useful life of the bearings and the safety in the motor operation. Therefore, the following recommendations must be observed:

- The selected lubricant oil must be the one with proper viscosity for the operating temperature of the bearings; That must be observed at every oil change or during periodical maintenances;
- Never use or mix hydraulic oil with the lubricant oil of the bearings;
- Lack of lubricant, due to incomplete filling or non-monitoring of the level, can damage the bearing shells;
- The minimum oil level is reached when the lubricant can be seen in the lower part of the sight glass with the motor stopped.

7.9.4.5 Sealing

Make visual inspections of the sealing, making sure that the dragging marks of the seal on the shaft do not compromise its integrity, checking for cracks and broken parts. Cracked or broken parts must be replaced.

In case of bearing maintenance, in order to assemble the seal, it is necessary to carefully clean the seal contact surfaces and its enclosure and cover the sealing with a non-hardening component (i.e., **Curil T**). The two halves of the labyrinth taconite seal must be joined by a garter spring. The drain holes located in the lower half of the seal must be cleaned and unobstructed.

Improper installation can damage the sealing and cause oil leakage.



ATTENTION

For further information about the dismounting and mounting of sleeve bearing seals, refer to the specific manual of this equipment.

7.9.4.6 Slide bearing operation

The START of the system, as well as the first hours of operation, should be carefully monitored.

Before START, check:

Whether the oil inlet and outlet pipes (if any) are clean. Clean the tubes by pickling, if necessary;

- The characteristics of the lubricant;
- The oil level;
- The alarm and shutdown temperatures set to the bearing.

During the first START, watch for any vibration or noise. If the bearing does not run quietly and smoothly, the motor should be shut down immediately.

The motor should be run for a few hours until the bearing temperature stabilizes. If the bearings overheat, the motor should be shut down and the bearings and temperature sensors checked.

Check for oil leaks from plugs, seals or shaft end.

7.9.4.7 Slide bearing maintenance

Slide bearing maintenance includes:
 Periodic check of oil level and lubricant conditions;
 Verification of bearing noise and vibration levels;
 Monitoring of operating temperature and retightening of set screws and mounting bolts;
 to facilitate heat exchange with the medium, the housing should be kept clean, with no oil or dust accumulation on the outside.

The rear bearing is electrically insulated. The spherical seating surfaces of the bushing in the housing are lined with an insulating material. Never remove this lining;
 The anti-rotation pin is also insulated, and the sealing seals are made of non-conductive material;
 Temperature monitoring instruments in contact with the bushing should also be properly insulated.

7.9.4.8 Disassembly and assembly of bearings

NOTE
 If bearings manufactured by WEG are supplied, please refer to the specific manual of the bearing supplied with the motor, which contains information on assembly, disassembly and maintenance.

7.9.4.8.1 Heeling (upper)

The function of the upper thrust bearing is to support the weight of the motor and the axial thrust to which it was designed. Its main elements are the stationary thrust shoes and the rotating pivots (see Figure 7.8).

The pivots receive the load through the axial shoes.

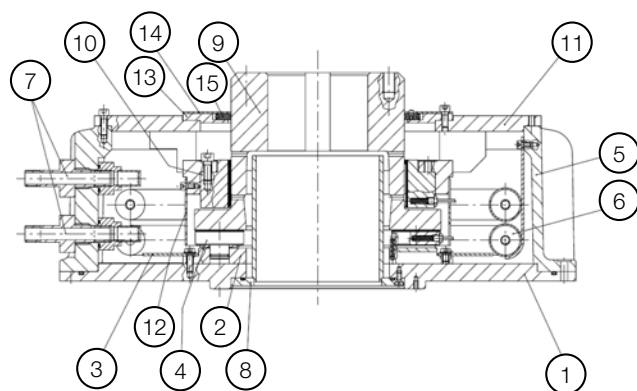


Figure 7.8: Upper thrust bearing

Figure 7.8 caption:

1. Lower flange
2. Shoe base ring
3. Axial segment
4. Axial shoe
5. Bearing housing
6. Serpentine (optional)
7. To cooling water connections
8. Standpipe (standpipe)
9. Runner
10. Bushing
11. Bearing cap
12. Vertical guide plate (skirt)
13. Seal housing
14. Seal fixing ring
15. Fluctuating seal

Before disassembly:

- Chock the rotor on the shaft end with a hydraulic jack;
- Completely drain the oil from the bearing;
- Thoroughly clean the outside of the bearing;
- Remove the temperature sensors.

Disassembly

- Shim the rotor on the shaft end with a hydraulic jack;
- Remove the screws securing the upper bearing cover and remove it;
- Disassemble the bearing, following the instructions in the manufacturer's manual.

Assembly

To assemble the bearing, follow the disassembly procedure in reverse order.

7.9.4.8.2 Guide bearing (lower)

The function of the lower guide bearing is to provide radial location of the motor shaft, without stress or axial displacement limitation.

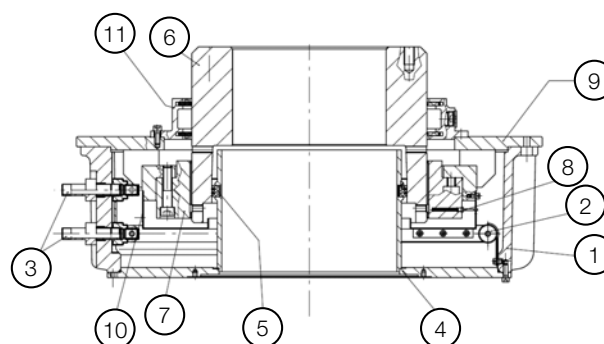


Figure 7.9: Lower guide bearing

Figure 7.9 caption:

1. Bearing housing
2. Serpentine
3. To cooling water connections
4. Standpipe (standpipe)
5. Standpipe seal
6. Runner
7. Bushing
8. Thermoresistance (optional)
9. Cover
10. Radial segment
11. Double seal

Before disassembly:

- Completely drain the oil from the bearing;
- Thoroughly clean the outside of the bearing;
- Remove the temperature sensors;
- Remove the grounding brush (if present);
- Uncouple the motor and place it in a horizontal position.

Disassembly

- Remove the screws securing the lower bearing cover and remove it;
- Disassemble the bearing, following the instructions in the manufacturer's manual.

Assembly

To assemble the bearing, follow the disassembly procedure in reverse order.

7.9.5 Bearing protection

7.9.5.1 Adjustment of the protections



ATTENTION

The following temperatures must be set in the bearing protection system:
 Alarm 110 °C - Off 120 °C.
 The alarm temperature should be set 10 °C above the working temperature, not exceeding the 110 °C limit.

7.9.5.2 Disassembly/assembly of the sleeve bearing temperature sensors

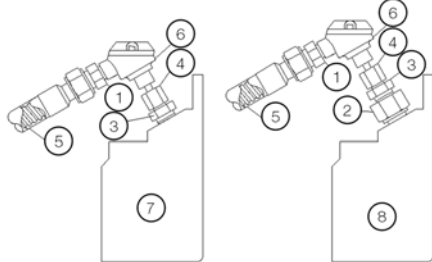


Figure 7.10: Pt100 on the bearings

Figure 7.10 caption:

1. Reduction nipple
2. Insulating adapter
3. Locknut
4. Bulb
5. Flexible metal tube
6. Pt-100 temperature sensor
7. Non-insulated bearing
8. Insulated bearing

Disassembly instructions:

If it is necessary to remove the Pt100 for bearing maintenance, proceed according to the following instructions:

- Remove the Pt100 carefully, locking the locknut (3), and unscrewing just the Pt100 from the bulb (4);
- Parts (2) and (3) must not be disassembled.

Assembly instructions:



ATTENTION

Before assembling the Pt100 on the bearing, check if it does not contain marks of knock or any other damage that may compromise its operation.

- Insert the Pt100 into the bearing;
- Restrain the locknut (3) with a wrench;
- Screw it in the bulb (4), adjusting it so that the tip of the Pt100 touches the outer surface of the bearing.



NOTES

- The assembly of the Pt100 on non-insulated bearings must be done directly on the bearing, without the insulating adapter (2);
- The tightening torque to assemble the Pt100 and the adapters must not exceed 10Nm.

8 MOTOR DISASSEMBLY AND ASSEMBLY



ATTENTION

All the repair, disassembly and assembly services must be performed only by properly qualified and trained professionals; otherwise, equipment damage and personal injury may occur. If any further explanations are necessary, consult WEG.

The disassembly and assembly sequences depend on the motor model.

Always use proper tools and devices. Any damaged part (cracks, dents on machined parts, faulty threads) must be replaced, avoiding restorations.

8.1 PARTS LIST

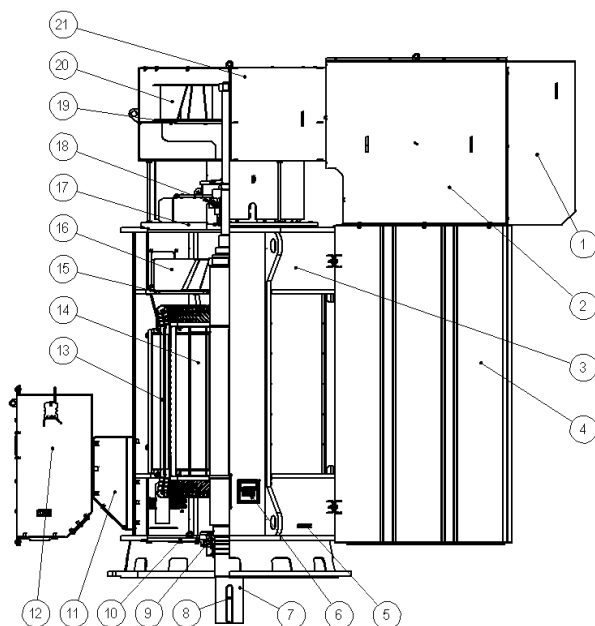


Figure 8.1: Overview of a typical solid shaft motor

Figure 8.1 caption:

1. External noise attenuator
2. Air directional
3. Housing
4. Heat exchanger
5. Grounding
6. Accessory connection box
7. Shaft
8. Shaft end key
9. Lower bearing
10. Bottom cap
11. Junction box support
12. Stator connection box
13. Stator
14. Rotor
15. Internal air deflector
16. Internal fan
17. Top cover
18. Upper bearing
19. External air deflector
20. External fan
21. Fan protection box

8.2 DISASSEMBLY

When disassembling the motor, the following precautions should be considered:

1. Before disassembling the engine, disconnect the cooling water and lubrication pipes (if any);
2. Disconnect the electrical and accessory connections;
3. Remove the heat exchanger and noise suppressor (if any);
4. Remove bearing temperature sensors and grounding brush;
5. To prevent damage to the rotor, provide a bracket to support the shaft on the front and rear sides;
6. To disassemble the bearings, follow the procedures described in this manual, according to the bearing type;
7. Removal of the rotor from inside the motor should be done with a suitable device and with the utmost care to that the rotor is not dragged against the stator plate pack or against the coil heads, avoiding damage.

8.3 ASSEMBLY

To assemble the motor, follow the disassembly procedures in reverse order.

8.4 TIGHTENING TORQUE

Table 8.1 and Table 8.2 present the tightening torques of the bolts recommended to mount the motor or its parts.



NOTE

The strength class is normally indicated on the head of the hexagonal bolts.

Table 8.1: Tightening torque of screws to metal parts

Material / Resistance class		Carbon Steel / 8.8 or above		Stainless steel / A2 – 70 or above	
% Yield Strength		70%		70%	
Lubricant		Dry	Molycote 1000	Dry	Molycote 1000
Diam	Pitch (mm)	Screws tightening torque (Nm)			
M4	0,7	2,1	1,8	1,8	1,3
M5	0,8	4,2	3,6	3,6	2,7
M6	1	8	6	6,2	4,5
M8	1,25	19,5	15	15	11
M10	1,5	40	29	30	22
M12	1,75	68	51	52	38
M14	2	108	81	84	61
M16	2	168	126	130	94
M18	2,5	240	174	180	130
M20	2,5	340	245	255	184
M22	2,5	470	335	350	251
M24	3	590	424	440	318
M27	3	940	621	700	466
M30	3,5	1170	843	880	632
M33	3,5	1730	1147	1300	860
M36	4	2060	1473	1540	1105
M42	4,5	3300	2359	2470	1770
M48	5	5400	3543	4050	2657

Table 8.2: Tightening torque of screws to metal / insulating parts

Material / Resistance class		Carbon Steel / 8.8 or above		Stainless steel / A2 – 70 or above	
% Yield Strength		40%		40%	
Lubricant		Dry	Molycote 1000	Dry	Molycote 1000
Diam	Pitch (mm)	Screws tightening torque (Nm)			
M4	0,7	1	1	1	1,3
M5	0,8	2	2	1,7	2,7
M6	1	4,4	3	3,4	4,5
M8	1,25	10,7	7,5	8,3	11
M10	1,5	21	15	16,5	22
M12	1,75	37	26	28	38
M14	2	60	42	46	61
M16	2	92	65	72	94
M18	2,5	132	90	100	130
M20	2,5	187	126	140	184
M22	2,5	260	172	190	251
M24	3	330	218	240	318
M27	3	510	320	390	466
M30	3,5	640	433	480	632
M33	3,5	950	590	710	860
M36	4	1130	758	840	1105
M42	4,5	1800	1213	1360	1770
M48	5	2970	1822	2230	2657

8.4.1 SPARE PARTS

8.4.2 Spare parts required

WEG recommends that the following spare parts, which are required to the maintenance procedures recommended in the motor maintenance plan, be kept in stock:

Table 8.3: Spare parts required

Temperature sensor to front and rear bearing
Heating resistor
Felt filter (if any)
Grounding brush
Lubricant to bearings
Front and rear bearing
Teflon seal (roller bearings)
Bushing assembly (slide bearings)
Floating labyrinth seal (slide bearings)
Mechanical seal (slide bearings)

The availability of the necessary spare parts is important. To reduce the times of the engine due to the need to change components.

8.4.3 Optional spare parts

The following spare parts are optional and can be ordered to meet eventual replacement needs.

Table 8.4: Optional spare parts

Front and rear bearing to vibration sensor (if applicable)
Vibration signal converter to front and rear bearing (if applicable)
Air to temperature sensor (if applicable)
Water to temperature sensor (if applicable)
Water loss sensor assembly (if applicable)
Repeater relay to water loss sensor (if applicable)
Water regulating valve (if applicable)
Inner locking ring (bearing pads)
Outer locking ring (bearing pads)
Grease centrifuge (bearing races)
Labyrinth ring (rolling bearings)
Cylindrical pressure spring (rolling bearings)
Oil regulating valve, if applicable (slide bearing)



NOTES

When ordering spare parts, inform the type and serial number of the motor as specified on its nameplate. Spare parts should be stored in a clean, dry and well-ventilated environment and, if possible, at a constant temperature.

9 MAINTENANCE PLAN

The maintenance plan described in Table 9.1 is only referential, and the intervals between each maintenance intervention may vary according to the motor location and operating conditions.

For the associated equipment, such as the water supply unit or control and protection system, it is necessary to refer to their specific manuals.

Table 9.1: Maintenance plan

DIARY	
▪ Complete engine	▪ Noise, vibration and temperature inspection of windings and bearings.
WEEKLY	
▪ Bearings	▪ Inspect noise, vibration, oil flow, leakage and temperature.
▪ Protection and control equipment	▪ Recording of measurement values.
▪ Complete engine	▪ Noise and vibration inspection.
▪ Air filters	▪ Cleaning, when necessary.
ANNUALLY (COMPLETE INSPECTION)	
▪ Stator winding	▪ Visual inspection, cleaning, verification of terminals, insulation resistance measurement
▪ Rotor	▪ Visual inspection, cleaning
▪ Bearings	▪ Inspection of lubricant quality and relubrication when necessary.
▪ Air-to-water heat exchanger	▪ Inspection and cleaning of radiators,
▪ Air-to-air heat exchanger	▪ Inspection of sacrificial anodes (if any).
▪ Protection and control equipment	▪ Replacement of radiator head gaskets (gaskets)
▪ Complete motor	▪ Inspection of heat exchanger and cleaning of vent tubes.
▪ Junction boxes, grounding	▪ Test run
▪ Coupling	▪ Retighten screws
▪ Filter	▪ Cleaning of terminal box
▪ Complete motor	▪ Retighten screws
EVERY 2 YEARS (TOTAL OVERHAUL)	
Complete motor	<ul style="list-style-type: none"> ▪ Disassembly of the entire engine ▪ Verification of parts and pieces ▪ Inspection of seals and gaskets (replace if necessary) ▪ Check for signs of ingress of water or dust into the housing, according to IP protection rating
Stator winding and rotor	<ul style="list-style-type: none"> ▪ Cleaning ▪ Verification of winding fastening and shims ▪ Insulation resistance measurement
Rotor	▪ Inspection of shaft (wear, fouling)
Bearings	<ul style="list-style-type: none"> ▪ Cleaning of bearings and replacement, if necessary. ▪ Inspection of bushings and replacement, if necessary. ▪ Inspection and recovery of shaft seat, if necessary. ▪ Replacement of static seals (o'rings). ▪ Replacement of dynamic seals (labyrinth seal to sliding bearing)
Junction boxes, grounding	<ul style="list-style-type: none"> ▪ Internal cleaning ▪ Retightening of screws
Coupling	▪ Alignment check and retightening of bolts.
Monitoring devices	▪ If possible, disassemble and test for serviceability.
Filter	▪ Cleaning
Air-to-water heat exchanger	▪ Inspection and cleaning of radiators
Air-to-air heat exchanger	▪ Cleaning of heat exchanger tubes

10 ABNORMALITIES, CAUSES AND SOLUTIONS



NOTE

The instructions of Table 10.1 present only a basic list of abnormalities, causes and corrective actions. In case of questions, consult WEG.

Table 10.1: Basic list of abnormalities, causes and corrective actions

ABNORMALITY	POSSIBLE CAUSES	CORRECTION
Neither coupled nor uncoupled does the motor start	▪ At least two power cables are interrupted, without voltage	▪ Check the control panel, the power cables, and the terminals
	▪ Rotor is locked	▪ Unlock the rotor
	▪ Bearing damaged	▪ Replace the bearing
Motor starts with no load, but fails when load is applied It starts very slowly and does not reach the rated speed	▪ Load torque is too high during the start	▪ Do not apply load to the driven machine during the start
	▪ Power supply voltage is too low	▪ Measure the power supply voltage, and set it to the correct value
	▪ Very high voltage drop in the power cables	▪ Check the sizing of the installation (transformer, cable section, relays, circuit breakers, etc.)
	▪ Rotor with faulty or interrupted bar	▪ Check and repair the rotor winding
	▪ A power cable was interrupted after the start	▪ Check the power cables
The stator current oscillates under load with double the slip frequency. Motor presents a humming noise during starting	▪ Rotor winding is interrupted	▪ Check and repair the rotor winding
Very high no load current	▪ Power supply voltage is too high	▪ Measure the power supply voltage and set it to the correct value
Hot spots in the stator winding	▪ Short-circuit between turns	▪ Rewind
	▪ Interruption of the parallel wires or phases of the stator winding	
	▪ Faulty connection	▪ Redo the connection
hot spots in the rotor	▪ Interruptions in the rotor winding	▪ Repair the rotor winding or replace it
Abnormal noise during operation with load	▪ Mechanical causes	▪ The noise normally decreases when the speed reduces, see also: “noisy operation when uncoupled”
	▪ Electrical causes	▪ The noise disappears when the motor is switched off. Consult WEG
When coupled, there is noise; when uncoupled, the noise disappears	▪ Defect in the coupling parts or in the driven machine	▪ Check the power transmission, the coupling and the alignment
	▪ Defect in the gear coupling	▪ Align the drive set
	▪ Unaligned/unleveled base	▪ Align/level the motor and the driven machine
	▪ Faulty balancing of the components or of the driven machine	▪ Perform new balancing
	▪ Defective coupling	▪ Repair or replace the coupling
	▪ Wrong rotation direction of the motor	▪ Invert the connection of two phases

ABNORMALITY	POSSIBLE CAUSES	CORRECTION
Stator winding becomes very hot under load	▪ Fans with inverted rotation direction	▪ Correct the rotation direction of the fans
	▪ Insufficient cooling due to dirty air channels	▪ Open and clean the air passage channels
	▪ Overload	▪ Measure the stator current; reduce the load. Analyze the motor application
	▪ High number of starts or moment of inertia too high	▪ Reduce the number of starts
	▪ Voltage too high, therefore, the iron losses increase	▪ Do not exceed 110% of the rated voltage, except when otherwise specified on the nameplate
	▪ Voltage too low, therefore, the current is very high	▪ Check the supply voltage and the voltage drop in the motor
	▪ Interruption in a power cable or in a winding phase	▪ Measure the current in all the phases and, if necessary, correct it
	▪ Rotor drags against the stator	▪ Check the airgap, operating conditions (vibration etc.), bearing conditions
	▪ The operating condition does not correspond to the nameplate data	▪ Keep the operating condition according to the nameplate or reduce the load
	▪ Unbalance in the power supply (blown fuse, wrong command)	▪ Check if there is voltage unbalance or operation with two phases and correct it
	▪ Dirty windings	▪ Clean
	▪ Air ducts clogged	
	▪ Dirty air filter	▪ Clean the filter element
▪ Rotation direction is not compatible with the fan used	▪ Check the fan regarding to the motor rotation direction	
Noisy operation when uncoupled	▪ Unbalance	▪ Noise remains during deceleration after disconnecting the voltage ▪ Perform new balancing
	▪ Interruption in one phase of the stator winding	▪ Measure the current of all connecting cables
	▪ Fastening screws are loose	▪ Retighten and lock the screws
	▪ The rotor balancing conditions become worse after the assembly of the coupling	▪ Balance the coupling
	▪ Resonance in the foundation	▪ Adjust the foundation
	▪ Motor frame is deformed	▪ Check flatness of the base
	▪ Bent shaft	▪ The shaft may be warped
		▪ Check the rotor balancing and eccentricity
▪ Airgap is not even	▪ Check the shaft warping or rolling bearing wear	

11 DECLARATION OF CONFORMITY

EU Declaration of Conformity



Manufacturers:

WEG Equipamentos Elétricos S.A.
Av. Prefeito Waldemar Grubba, 3000
89256-900 - Jaraguá do Sul – SC – Brazil
www.weg.net

WEG Industrie (India) PVT. LTD.
Plot n° E-20 (North), SIPCOT Industrial Complex
Phase II – Expansion II,
Mornapalli Village, Hosur 635 109
Tamil Nadu - India
www.weg.net/in

WEG MEXICO, S.A. DE C.V
Carretera Jorobas - Tula Km 3.5, Manzana 5,
Lote 1, Fraccionamiento Parque Industrial Huehuetoca,
Municipio de Huehuetoca, C.P. 54680,
CD. de Mexico y Área Metropolitana – Mexico
www.weg.net/mx

WEG (Nantong) Electric Motor Manufacturing CO., LTD.
No. 128# - Xinkai South Road, Nantong
Economic & Technical Development
Zone, Nantong, Jiangsu Province – China
www.weg.net/cn

WEGeuro – Industria Eléctrica S.A.
Rua Eng Frederico Ulrich,
4470-605 – Maia – Porto – Portugal
www.weg.net/pt
Contact person: Luís Filipe Oliveira Silva Castro Araújo
Authorised Representative in the European Union
(Single Contact Point)

The manufacturer declares under sole responsibility that:

WEG synchronous and asynchronous motors, WEG generators and their components used for following lines:

M..., W60, WGM, G... and S...

.....

when installed, maintained and used in applications for which they were designed, and in compliance with the relevant installation standards and manufacturer's instructions, comply with the provisions of the following relevant European Union harmonisation legislation, wherever applicable:

Low Voltage Directive 2014/35/EU*
Machinery Directive 2006/42/EC**

EMC Directive 2014/30/EU (electric motors are considered inherently benign in terms of electromagnetic compatibility)

The fulfilment of the safety objectives of the relevant European Union harmonisation legislation has been demonstrated by compliance with the following standards, wherever applicable:

**EN 60034-1:2010 + AC:2010/ EN 60034-3:2008 / EN 60034-5:2001 + A1:2007/ EN 60034-6:1993/
EN 60034-7:1993 + A1:2001/ EN 60034-8:2007 + A1: 2014/ EN 60034-9:2005 + A1:2007/
EN 60034-11:2004/ EN 60034-12:2002 + A1:2007/ EN 60034-14:2004 + A1:2007/
EN 60204-1:2006 + A1:2009 + AC:2010 and EN 60204-11:2000 + AC:2010**

CE marking in: **1998**

* Electric motors designed for use with a voltage rating higher than 1000V are not considered under the scope.

** Low voltage electric motors are not considered under the scope and electric motors designed for use with a voltage rating higher than 1000V are considered partly completed machinery and are supplied with a

Declaration of Incorporation:

The products above cannot be put into service until the machinery into which they have been incorporated has been declared in conformity with the Machinery Directive.

A Technical Documentation for the products above is compiled in accordance with part B of annex VII of Machinery Directive 2006/42/EC.

We undertake to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery identified above through WEG authorised representative established in the European Union. The method of transmission shall be electronic or physical method and shall be without prejudice to the intellectual property rights of the manufacturer.

Signed for and on behalf of the manufacturer:
Eduardo de Nobrega
Managing Director

Jaraguá do Sul, March 19th, 2019

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12 ENVIRONMENTAL INFORMATION

12.1 PACKAGE

Electric motors are supplied in cardboard, polymer, wood or metallic material packages. These materials are recyclable or reusable and must be properly disposed according to the current regulations of each country. All the wood used in the packaging of WEG motors comes from reforestation and receives anti-fungal treatment.

12.2 PRODUCT

Electric motors, under the constructive aspect, are manufactured mainly with ferrous metals (steel, cast iron), nonferrous metals (copper, aluminum) and plastic. The electric motor, in general, is a product that has a long useful life; however, when it must be disposed, WEG recommends that the materials of the packaging and of the product be properly separated and sent for recycling.

The non-recyclable materials must be properly disposed according to the environmental regulations, i.e., in industrial landfills, co-processed in cement kilns or incinerated. The service providers for recycling, disposal in industrial landfills, co-processing or incineration of waste must be properly licensed by the environmental agency of each state to carry out these activities.

12.3 HAZARDOUS WASTE

Grease and oil waste used to lubricate the bearings should be disposed, according to the instructions of the relevant environmental agencies, because its improper disposal can cause impacts to the environment.

13 SERVICE NETWORK

To consult the Service Network, access the website www.weg.net.

14 WARRANTY TERM

These products, when operated under the conditions stipulated by WEG in the operating manual for such product, are warranted against defects in workmanship and materials for twelve (12) months from start-up date or eighteen (18) months from manufacturer shipment date, whichever occurs first.

However, this warranty does not apply to any product which has been subject to misuse, misapplication, neglect (including without limitation, inadequate maintenance, accident, improper installation, modification, adjustment, repair or any other cases originated from inadequate applications).

The company will neither be responsible for any expenses incurred in installation, removal from service, consequential expenses such as financial losses nor transportation costs as well as tickets and accommodation expenses of a technician when this is requested by the customer.

The repair and/or replacement of parts or components, when effected by WEG within the Warranty period do not give Warranty extension, unless otherwise expressed in writing by WEG.

This constitutes WEG's only warranty in connection with this sale and is in lieu of all other warranties, expressed or implied, written or oral.

There are no implied warranties of merchantability or fitness for a particular purpose that apply to this sale.

No employee, agent, dealer, repair shop or other person is authorized to give any warranties on behalf of WEG nor to assume for WEG any other liability in connection with any of its products.

In case this happens without WEG's authorization, Warranty is automatically cancelled.

LIABILITY

Except as specified in the foregoing paragraph entitled "Warranty Terms for Engineering Products", the company shall have no obligation or liability whatsoever to the purchaser, including, without limitation, any claims for consequential damages or labor costs, by reason of any breach of the express warranty described therein.

The purchaser further hereby agrees to indemnify and hold the company harmless from any causes of action (other than cost of replacing or repairing the defective product as specified in the foregoing paragraph entitled "Warranty Terms for Engineering Products"), arising directly or indirectly from the acts, omissions or negligence of the purchaser in connection with or arising out of the testing, use, operation, replacement or repair of any product described in this quotation and sold or furnished by the company to the purchaser.



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