# **Synchronous Alternators**

# Model GTK

# Installation, Operation and Maintenance Manual





# Installation, Operation and Maintenance Manual

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Dear Customer,

Thank you for purchasing the WEG alternator. It is a product developed with quality and efficiency levels that ensure optimal performance.

Electricity plays a role of major importance for the comfort and well-being of humanity. Since the alternator is responsible for generating this energy, this must be identified and treated as a machine whose characteristics include certain care, among them storage, installation, operation and maintenance.

All efforts were made to the information contained herein are truthful to the settings and use of the alternator.

Thus, we recommend reading this manual carefully before proceeding to installation, operation or maintenance of the alternator to ensure continuous and safe operation of the alternator and ensure your safety and of your facilities. If doubts persist, please refer to WEG.

Always keep this manual near the alternator, so it can be consulted whenever necessary.



# ATTENTION

- 1. It is imperative to follow the procedures in this manual for the warranty to be valid;
- 2. The procedures for installation, operation and maintenance of the alternator should be done by qualified people.



# NOTES

- 1. Reproduction of information in this manual, in whole or in part, is permitted provided that the source is quoted;
- 2. If this manual is lost, a copy in electronic format may be obtained by contacting www.weg.net or another printed copy may be requested from WEG.

# WEG EQUIPAMENTOS ELÉTRICOS S.A.

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# **1 INTRODUCTION**

This manual aims the assistance of the alternators G line. Alternators with specialties can be provided with specific documents (drawings, wiring diagrams, curve features, etc.). These documents must be carefully evaluated with this manual before proceeding with the installation, operation or maintenance of the alternator.

All procedures and standards contained in this manual should be followed to ensure the smooth operation of the alternator and safety of professionals involved in its operation. Observing these procedures is also important to ensure the warranty on the alternator. Therefore, we recommend reading this manual thoroughly before installation and operation of the alternator. If doubts persist, please refer to WEG.



# ATTENTION

In case of exchange of the components mentioned in this manual, the manufacturing date of the alternator must be observed in relation to the date of review of the manual.

# 1.1 SAFETY WARNINGS IN THE MANUAL

In this manual, the following safety warnings are used:



# DANGER

Failure to observe the procedures recommended in this warning may result in substantial property damage, serious injury or death.

# ATTENTION

Failure to observe the procedures recommended in this warning may result in property damage.



# NOTE

The text with this warning is intended to provide important information for the correct understanding and proper functioning of the product.



# **2 GENERAL INSTRUCTIONS**

Professionals who work with electrical installations, either in assembly, operation or maintenance, should be continuously updated and be informed about rules and safety regulations governing the service and are advised to observe them strictly. Before the initiation of any work, the responsible person must ensure that everything was properly noticed and alert operators to the dangers inherent in the task to be performed. Alternators of this type, if used improperly or receive poor maintenance, or when people do not receive the intervention of not qualified personnel may cause serious personal injury and/or material damage. It is therefore recommended that these services be always performed by qualified people.

# 2.1 QUALIFIED PEOPLE

It is understood by people qualified those professionals who, because of their training, experience, education level, knowledge of relevant standards, specifications, safety standards, accident prevention and knowledge of operating conditions, have been authorized by their leaders to carry out the work required and that can recognize and avoid potential danger. These qualified people must also know the first aid procedures and be able to provide such service if necessary. It is assumed that all work of commissioning, maintenance and repairs are done only by qualified people.

# 2.2 SAFETY INSTRUCTIONS

# DANGER

During operation, these devices have exposed energized or rotating parts, which may have high voltage or high temperature. Thus the operation with open terminal boxes, unprotected couplings, or incorrect handling without considering the standards of operation may cause serious injury and property damage.

Those responsible for safety of the facility must ensure that:

- Only qualified people perform installation and operation of equipment;
- These people have this manual and other documents provided with the alternator, as well as perform the work strictly observing the instructions of service, relevant standards and documentation of specific products.

Failure to comply with installation standards and safety may void the warranty.

Equipment for firefighting and first aid notices should be at work in clearly visible and easily accessible places.

## Please also notice:

- All technical data about the applications permitted (operating conditions, connections and installation environment) contained in the catalog, documentation of the application, operating instructions, manuals and other documents;
- The specific determinations and conditions to the installation site;
- The use of tools and equipment suitable for handling and transport;
- That protective devices of the individual components be removed before installation.

The individual parts must be stored in an environment free of vibrations, preventing falls and ensuring that they are protected against aggressive and / or endanger the safety of people.

# 2.3 STANDARDS

Alternators are specified, designed, manufactured and tested according to the following standards:

Table 2.	1: Ap	olicable	standa	ards

	IEC	NBR	ISO
Specification	60034-1	5117	
Dimensions	60072	5432	
Tests	60034-4	5052	
Protection degrees	60034-5	9884	
Cooling	60034-6	5110	
Mounting	60034-7	5031	
Noise	60034-14	5117	8528

# 2.4 ENVIRONMENT FEATURES

In accordance with IEC 60034.1, and ABNT 5117, the ambient operating conditions for which the alternators were designed are the following:

- 1. Ambient temperature: 15 °C to + 40 °C;
- 2. Altitude (sea level): up to 1000 m;
- 3. Environment without the presence of aggressive agents such as: salt spray, chemicals, etc.;
- 4. Environment according to the protection degree of the alternator.

Special conditions of environment are described on the rating plate and specific technical data sheet of the alternator.

# ATTENTION

For use of alternators with water cooling at temperatures below 0 °C, antifreeze additives must be added in water.

# 2.4.1 Harsh or marine environment

The industry standard alternator should not be used in harsh environments, because this action is subject to weather that can cause corrosion of mechanical parts and decrease the insulation resistance of the windings and consequently the burning of the alternator. In these situations, WEG is not responsible for damage that may occur on the alternator, depriving the product warranty according to the warranty terms.

# NOTE

Alternators applied in harsh environments should be equipped with additional protection against corrosion and poor insulation, ensuring, when requested, to guarantee performance of the product. Is considered harsh environment: marine environment or with high concentration of salinity and / or high humidity, materials in suspension that can be abrasive, and naval application with high ambient temperature variation. In these cases, please refer to WEG for correct specification of the alternator to the required application.

# 2.5 OPERATING CONDITIONS

For the warranty term of the product to be valid, the alternator must operate according to the nominal data, follow the standards and codes and the information contained herein.



# **3 RECEIPT, STORAGE AND HANDLING**

# 3.1 RECEIPT

All supplied alternators are tested and are in proper operating condition. The machined surfaces are protected against corrosion. The packaging must be checked immediately upon receipt to verify that it has not suffered damage during transport.



# ATTENTION

Any damage must be photographed, documented and reported immediately to the carrier, the insurer and to WEG. The lack of notice will void the warranty.



# ATTENTION

Additional parts supplied in packages should be checked on receipt.

- When lifting the package, the correct locations for lifting, the weight stated in the documentation and / or on the nameplate must be observed, as well as the capacity and operation of lifting devices;
- Alternators packed in wooden crates should always be raised by their own eyebolts or by appropriate forklift, but should never be raised by their timbers;
- The package can never be overturned. Place on the ground carefully (without causing impacts) to avoid damage to the bearings;
- Do not remove the grease for corrosion protection of the end of the shaft, flange and coupling discs nor the plugs closing holes of the terminal boxes;
- These protections should remain in place until the final assembly. After unpacking, you should make a complete visual inspection of the alternator;
- The shaft locking system should be removed just before the installation and stored in a safe place to be used in any future transportation of the alternator.

# 3.2 HANDLING

- Positions 1, 2 and 3 of Figure 3.1, represent the proper way of handling alternators and positions 4 and 5 show the wrong ways;
- The alternator was designed with eyebolts for its lifting. These eyebolts are designed to lift only the alternator, additional loads are not permitted;
- Cables and lifting devices must be appropriate.



Figure 3.1: Handling of alternator

# NOTES



- Observe weight indicated.
- Do not lift and do not put the alternator on the ground suddenly thus avoiding damage to the bearings.
- To lift the alternator, use only the existing eyebolts. If necessary, use a crossbeam to protect parts of the alternator.
- The eyebolts on the covers, bearings, terminal box, etc., only serve to handle these components.
- Never use the shaft to lift the alternator.
- To move the alternator, it must be with the shaft locked with the locking device supplied with the alternator.
- After removal of the safety device from the front side, while lifting the alternator it should not be inclined with the front downwards at risk of falling of the rotor.

# ATTENTION



Steel cables, clevises and lifting equipment must be appropriate and be capable of supporting the weight of the alternator, to avoid accidents, damage to the alternator or personal injury.

# Шер

# 3.3 STORAGE

Any damage to the paint or rust protections of machined parts should be retouched.



# 3.3.1 Storage in sheltered environment

If the alternator is not installed immediately upon receipt, it shall remain in the packaging and stored in a place protected from moisture, steam, rapid changes in heat, rodents, insects and other agents that may damage the machine.

For the bearings not to be damaged, the alternator must be stored at locations free of vibration.

# 3.3.2 Storage in not sheltered environment

The alternator should be stored in dry place, free from floods and vibration.

Repair any damage in the package before storing the alternator, which is needed to ensure proper storage conditions.

Place the alternator on platforms or foundations that ensure protection against soil moisture and prevent it from sinking into the ground. Free movement of air underneath the alternator should be ensured.

The cover or tarpaulin used to protect the alternator against the weather should not be in contact with its surfaces. To ensure the free circulation of air between the alternator and the coverage, put wooden blocks as spacers.

# 3.3.3 Longer storage

When the alternator is stored, the empty spaces inside, bearings, connection box and windings are exposed to air humidity, which can condense. Depending on the type and degree of air pollution, also aggressive substances can penetrate these voids.

As a result, after prolonged storage, the resistance of the winding insulation can be reduced to below permissible values. Internal components such as bearings can oxidize and lubricity of the lubricant may be affected. All these influences increase the risk for damage before

the operation of the alternator.



# ATTENTION

To avoid losing the guarantee of the alternator, you should ensure that all preventive measures described in this manual are followed and recorded.

The instructions outlined below are valid for alternators, which are stored for long periods and / or are out of operation for a period of two months or more.

# 3.3.3.1 Storage location

To ensure the best storage conditions for long periods of the alternator, the location should comply strictly with the criteria described below.

# 3.3.3.1.1 Storage in sheltered environment

- The environment must be closed and covered;
- The location must be protected against moisture, vapors, aggressive agents, rodents and insects;
- There must be no the presence of corrosive gases such as chlorine, sulfur dioxide or acids;
- The environment must be free of continuous or intermittent vibration;
- The environment must have ventilation system with air filter;
- Ambient temperature between 5 °C and 60 °C, there should not be sudden fluctuation in temperature;
- Relative air humidity < 50%;</li>
- It must have prevention against dirt and dust;
- It must have fire detection system;
- It must be provided with electricity to supply the heating elements (if any).

If any of these requirements is not met in place of storage, WEG suggests that additional protections are incorporated in the packaging of the alternator during the storage period, as follows:

- Closed wooden box or similar with wiring that allows the heating elements (if any) to be energized;
- If there is a risk of infestation of fungus, the packaging should be protected on-site storage, spraying it or painting it with appropriate chemicals;
- The preparation of the package must be done carefully by a trained person.

# 3.3.3.1.2 Storage in not sheltered environment

# ATTENTION

It is not recommended to store the alternator in a not sheltered location.

If the storage at not sheltered environment cannot be avoided, the alternator must be packed in specific package for this condition, as follows:

- For storage at not sheltered environment, apart from the package recommended for internal storage, the packaging should be covered with a protection against dust, moisture and other foreign materials, using for this purpose a tarpaulin or sturdy plastic;
- Position the package on platforms or foundations that ensure protection against soil moisture, prevent it from sinking into the ground;
- Once the alternator is covered, a shelter should be erected to protect it from direct rain, snow or excessive heat from the sun.

# ATTENTION

If the alternator is kept in storage for extended periods, it is recommended to regularly inspect it as specified in item 3.3.3.9 of this manual.



## 3.3.3.2 Separate parts

- If there have been supplied spare parts (terminal boxes, covers, etc.), these parts must be packed as specified in items 3.3.3.1.1 and 3.3.3.1.2.
- The relative humidity inside the package must not exceed 50%.

## 3.3.3.3 Space heater

The space heaters of the alternator (if any) should remain energized during the storage period to avoid condensation of moisture inside of the alternator and thus ensure that the insulation resistance of the windings remains at acceptable levels.



# ATTENTION

The alternator space heaters must be connected when it is stored at room temperature < 5 °C and / or relative humidity > 50%.

# 3.3.3.4 Insulation resistance

During the storage period, the insulation resistance of the windings of the stator and exciter rotor of the alternator must be measured and recorded every three months prior to installation of the alternator.

Any decrease in value of insulation resistance should be investigated.

## 3.3.3.5 Exposed machined surfaces

All exposed machined surfaces (e.g., the shaft end, flange, coupling disc) are protected at the factory with a temporary protective agent (rust inhibitor).

This protective coating must be reapplied at least every 6 months or when it is removed and/ or damaged.

#### **Recommended Products:**

Name: Protective Oil Anticorit BW; Manufacturer: Fuchs.

# 3.3.3.6 Bearings

## 3.3.3.6.1 Shielded bearings

During the storage period, every two months, the locking device of the shaft should be removed and rotated manually to distribute the grease inside the bearing and keep it in good conditions. If the alternator is kept in storage for a period greater than two years, the bearings should be replaced.

# 3.3.3.6.2 Regreasable bearings

The bearings are lubricated at the factory for testing. During the storage period, every two months, the locking device of the shaft should be removed and rotated manually to distribute the grease inside the bearing and keep it in good conditions. If the alternator is kept in storage for a period greater than two years, the bearings should be cleaned, inspected to ensure its integrity and relubricated.

# ATTENTION

If it is not possible to rotate the shaft of the alternator, as recommended, check the condition of the bearing before putting the alternator into operation.

# 3.3.3.7 Terminal box

When the insulation resistance of the windings of the alternator is measured, the main terminal box and the other terminal boxes should also be inspected, especially considering the following:

- The inside must be dry, clean and free of dust deposition;
- The contacts must not be corroded;
- The seals should be in proper condition;
- The inlet of the cables must be properly sealed in accordance with the degree of protection of the machine.

# If any of these items is not correct, cleaning or replacement of parts should be performed.

## 3.3.3.8 Inspection and records during storage

The alternator stored should be inspected periodically and inspection records must be filed.

The following aspects must be inspected:

- 1. Physical damage;
- 2. Cleaning;
- 3. Signs of water condensation;
- Conditions of the protective coating of machined surfaces;
- 5. Conditions of painting;
- 6. Signs of harsh agents;
- Satisfactory operation of the space heaters (if any). It is recommended that an alarm or signaling system be installed on site for detecting power interruption of the space heaters;
- It is recommended to register the temperature and humidity surrounding the machine, the temperature of the winding insulation resistance and the rate of polarization;
- 9. Inspect the storage site that complies with the criteria described in the item 3.3.3.1.



# 3.3.3.9 Maintenance plan during storage

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

lable 3.1: Storage plan						
	Monthly	Every two months	Every six months	Every two years 2 years	Before going into operation	NOTE
Storage Location						
Inspect cleaning conditions		X			x	
Inspect humidity and temperature conditions		x				
Verify signs of harsh agents		x				
Measure vibration level	X					
Packaging						
Inspect physical damage			x			
Inspect inner relative humidity		x				
Replace the desiccant in the package (if any)			X			When necessary
Space heater (if any)						
Verify operation conditions	x					
Complete alternator					·	
Perform external cleaning			X		x	
Perform internal cleaning					x	
Verify painting conditions			x			
Verify the rust inhibitor on exposed parts			×			Replace inhibitor, if necessary
Windings						
Measure insulation resistance		x			x	
Measure polarization index		x			x	
Terminal boxes and grounding terminals						
Clean inside the terminal boxes				х	x	
Inspect seals				х	x	
Re-tighten the connection terminals					x	According to tightening torques informed herein
Regreasable roller bearings						
Rotate alternator shaft		x				
Relubricate the bearing			x		x	
Disassemble, clean, inspect and lubricate the bearing				x	x	If storage period is over 2 years
Shielded roller bearings						
Rotate alternator shaft		x				
Replace bearing				x		



# 3.3.3.10 Preparation for operation start

# 3.3.3.10.1 Cleaning

- The inside and outside of the alternator must be free of oil, water, dust and dirt;
- Remove the rust inhibitor of the exposed surfaces with a cloth soaked in a petroleum-based solvent.

Make sure the bearings used for lubrication and cavities are free from dirt and properly sealed.

## 3.3.3.10.2 Lubrication of bearings

In alternators with regreasable bearings, relubricate the bearings using the specified lubricant. Information on bearings and lubricants, as well as the procedure for lubrication are indicated in the item 6.5 in this manual.

## 3.3.3.10.3 Verification of insulation resistance



# ATTENTION

Before putting the alternator into operation, the insulation resistance of the windings should be measured as in item **"Insulation Resistance"** of this manual.

# 3.3.3.10.4 Others

Follow all other procedures in the item 5 in this manual before putting the alternator into operation.

# **4 INSTALLATION**

# 4.1 INSTALLATION LOCATION

The alternator must be installed in easily accessible locations, allowing the performance of periodic inspections, local maintenance and, if necessary, their removal for external services.

The following environmental features must be observed:

- The alternators should get fresh and clean air and the installation location must allow easy air exhaustion of the operating environment of the equipment, preventing air recirculation;
- It must be avoided that the alternator aspires the exhaust fumes of diesel engine, because soot is a conductor for electricity and shortens the life of the insulation and this may cause burning of the alternator;
- The installation of other equipment or walls should not hinder or obstruct the ventilation of the alternator;
- The space around and above the alternator should be sufficient for its maintenance or handling;
- The environment must be in accordance with the protection degree of the alternator.



# NOTE

For alternators with single bearing, the shaft-locking device (used to protect the rotor /stator against damage during transport) shall be removed only just before coupling it to the driving machine.

# 4.2 DIRECTION OF ROTATION

The alternators of standard line G can operate in both directions of rotation.

The phase sequence is set to the *clockwise direction* of rotation (viewed facing the shaft end of the alternator - Powered Side).

The terminals of the alternators are marked in such a way that the sequence of terminals 1, 2 and 3 coincides with the sequence of phases R, S and T or L1, L2 and L3, when the direction of rotation is clockwise.

In the case of alternators that need to operate in a **counterclockwise** direction, the phase sequence must be changed (if required). It is recommended to check the rotation direction and sequence of phases required before the entry into operation of the alternator.



# ATTENTION

The wrong sequence of phases may cause damage to equipment supplied by the alternator. In the case of parallel operation with other alternators and / or grid, these must have the same phase sequence.

# 4.3 **PROTECTION DEGREE**

It is essential for the proper performance of the alternator and its durability, that the degree of protection for this equipment be observed in relation to the installation environment. The standard line G alternator has protection degree IP21 (protected against penetration of solid bodies of dimensions above 12 mm and splash of water in the vertical).

# 4.4 COOLING



Figure 4.1: Cooling system

The fan is fitted to the drive end near the rotor. Air enters through the non-drive end and goes out by radial openings in the cover / flange on the drive end.

# 4.4.1 Flange protection removing



Figure 4.2: Flange protection

Figure 4.2 legend:

- 1. Flange
- 2. Flange protection
- 3. Grille 4. Screv
- Screw
   Clamp



# ATTENTION

The protection (2) between the ventilation grille (3) and the flange (1) is an integral part of the package and must be removed when installing the alternator, so as not to impair the cooling during the operation. See the procedure as follow:

- Cut the clamps (5) that secure the protection grille;
- Remove the grille and flange protection;
   Reinstall the ventilation grille, securing it with the screws (4).



# 4.5 INSULATION RESISTANCE

# 4.5.1 Safety instructions



# DANGER

Before making the measurement of insulation resistance, the alternator must be stopped and unplugged from the load and the voltage regulator unplugged.

The winding being tested must be connected to the frame and ground for a period until removing the residual electrostatic charge. Failure to follow these procedures may result in personal injury.

# 4.5.2 General considerations

When the alternator is not immediately placed into operation, it must be protected against moisture, dirt and high temperature, thus avoiding that the insulation resistance

The insulation resistance of the windings must be measured before entry into operation.

If the environment is too humid, it is necessary to check it periodically during storage. It is difficult to determine rules for the real value of insulation resistance of a machine, since it varies with environmental conditions (temperature, humidity), conditions of machine cleaning (dust, oil, grease, dirt) and quality and conditions the insulating material used.

The evaluation of the periodic monitoring records is useful to conclude whether the alternator is able to operate.



NOTE

The insulation resistance must be measured using a **MEGOHMMETER**.

# 4.5.3 Measurement of the stator winding

The test voltage to the stator windings of the alternators must be as Table 4.1 in accordance with standard IEEE43.

Table 4.1: Voltage for measurement of the insulation resistance

Winding nominal 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, check the following:

- If all load cables are disconnected;
- If the voltage regulator is disconnected;
- If the frame of the alternator and the windings not measured are grounded;
- If the temperature of the winding has been measured;
- If all temperature sensors are grounded;

The measurement of the insulation resistance of the stator windings must be made in the main terminal box. The meter (Megohmmeter) must be connected between the frame of the alternator and the winding. The frame must be grounded and the three phases of the stator winding remain connected to the neutral point, as shown in Figure 4.3:



Figure 4.3: Measurement in the three phases

Whenever possible each phase must be insulated and tested separately. The separate test allows the comparison between the phases. When a phase is tested, the other two phases must be grounded on the same grounding of the frame, as shown below.



Figure 4.4: Measurement in separate phases

# 4.5.4 Measurement in the rotor winding, exciter and accessories

## Measurement of the rotor winding

- Disconnect rotor cables of the set of diodes;
- Connect the Insulation resistance meter (Megohmmeter) between the rotor winding and the shaft of the alternator. The measurement current cannot pass through the bearings.

Measurement of the stator winding of main exciter.

- Disconnect the power cables from the exciter;
- Connect the Insulation resistance meter (Megohmmeter) between the stator winding of the exciter (terminals I and K) and the frame of the alternator.

Measurement of the rotor winding of main exciter.

- Disconnect exciter rotor cables of the set of diodes;
- Connect the Insulation resistance meter (Megohmmeter) between the rotor winding and the shaft of the alternator. The measurement current cannot pass through the bearings.

Measurement of the stator winding of the auxiliary exciter (PMG) - alternators model GP-- :

- Disconnect cables that connect the auxiliary exciter to the voltage regulator;
- Connect the Insulation resistance meter (Megohmmeter) between the stator winding of the auxiliary exciter and the frame of the alternator.



# ATTENTION

The test voltage for the rotor, main exciter, auxiliary exciter and space heater must be 500 Vdc and other accessories 100 Vdc. It is not recommended the measuring of insulation resistance of thermal protectors.

On machines that are already in operation, higher values of insulation resistance, can be obtained compared to the initial values for commissioning.

The comparison with values obtained in previous tests on the same machine, in similar conditions of load, temperature and humidity serves as a better indication of the conditions of isolation than the value obtained in a single test, and any sudden reduction is considered suspicious.

# Шер

# 4.5.5 Minimum insulation resistance

Table 4.2: N	<i>1inimum</i>	insulation	resistance

	Minimum R.I. (referred to 40°C)
Stator voltage ≤ 1000 V	5 MΩ
Stator voltage > 1000 V	100 MΩ
Rotor and exciter	5 MΩ

# 4.5.6 Windings evaluation and preservation

Table 1.2: Evaluation of the incula	tion registence "I D "
Table 4.5. Evaluation of the insulat	

Un	R.I.	Insulation Status	Procedure
	< 5 MΩ	Critical*	Cleaning and drying
≤1000V	5 to 100 MΩ	Acceptable	Periodic monitoring
	> 100 MΩ	Normal	Normal operation
	< 100 MΩ	Critical*	Cleaning and drying
>1000V	100 to 500 MΩ	Acceptable	Periodic monitoring
	> 500 MΩ	Normal	Normal operation

\* The alternator must not operate in this condition.

# NOTE The dat is recor

The data in Table 4.3 serve as a reference. It is recommended to record all insulation resistance measurements performed on the alternator and maintain a history of these

alternator and maintain a history of these measurements.

Any sharp reduction in recorded amounts should be investigated.

The insulation resistance is influenced by the presence of moisture and dirt in the insulation material.

If the measured insulation resistance is lower than the values reported in Table 4.2, before the alternator come into operation, the windings must be carefully inspected, cleaned and, if necessary, dried according to the following procedure:

- Disassemble the alternator by removing the rotor and bearings;
- Place the winding components, which have low insulation resistance in an oven and heat them at a temperature of 130°C, keeping this temperature for at least 08 hours.
- Check the insulation resistance is achieved within acceptable values, as Table 4.3, otherwise refer to WEG.



# DANGER

Immediately after measuring the insulation resistance, ground the winding to prevent accidents.

# 4.5.7 Conversion of the measured values

The insulation resistance should be referred to 40°C. If the measurement is made at a different temperature, the reading must be corrected to 40°C, using the approximate correction provided by the curve of Figure 4.5, according to the IEEE43 standard.

The correction of the insulation resistance reading to  $40^{\circ}$ C is done by the relation:

$$R_{40} = Kt \cdot Rt$$

### Where:

Rt = insulation resistance at temperature "t". Kt = Correction factor of the insulation resistance as a function of the winding temperature, as shown in Figure 4.5.



Figure 4.5: Coefficient of variation of insulation resistance with temperature

The values used to generate the curve of Figure 4.5 are shown in Table 4.4.

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

Table 4.4: Insulation resistance correction factor in with the temperature

# 4.6 **PROTECTION**

# 4.6.1 Thermal protection

Alternators have, when requested by the client, protective devices against excessive rise in temperature, installed in the stator coils, and / or bearings, as follows:

Thermostat (bimetal): bimetallic thermal detectors, with normally closed silver contacts that open when they reach the temperature of operation. Thermostats can be connected in series or independently according to wiring diagram.

Thermistors (PTC or NTC type): Heat detectors, semiconductor compounds that vary their resistance sharply to reach the temperature of operation. Thermistors can be connected in series or independently according to wiring diagram.



NOTE

Thermostats and thermistors must be connected to a control unit that stops operation of the alternator or triggers a signaling device.

**Thermistor (RTD)** - A calibrated resistance element. Its operation is based on the principle that the electrical resistance of a metallic conductor varies linearly with temperature. The terminals of the detector must be connected to a control panel which includes a temperature gauge.



# NOTE

The thermistors type RTD allow monitoring of the absolute temperature. With this information, the relay can do the temperature reading, as well as the parameterization for alarm and shutdown according to the preset temperatures.

The following formula is used to convert the value of the ohmic resistance of the temperature measurement for thermistors Type Pt 100.

Formula: 
$$\frac{\Omega - 100}{0,386} = ^{\circ}C$$

Where:  $\Omega$  = ohmic resistance measured on the PT-100

The protective devices, when requested, are listed in the wiring diagram specific to each alternator. The non-use of these devices is the sole responsibility of the user, but may result in loss of guarantee in case of damage.

# 4.6.1.1 Temperature limits for the windings

The temperature of the hottest point of the winding must be kept below the limit of thermal class of insulation. The total temperature is composed of the sum of temperature with the rise of temperature ( $\Delta$ T), plus the difference between the average temperature of the winding and the hottest point of the winding. The ambient temperature is typically up to 40 °C. Above this value, the working conditions are considered special.

Table 4.5 shows the numerical values and composition of the permitted temperature of the hottest point of the winding. Table 4.5: Insulation class

Insulation class			Н
Ambient temperature	°C	40	40
T = temperature rise (resistance method)	°C	105	125
Difference between the hottest point and the average temperature	°C	10	15
Total: Temperature of the hottest point	°C	155	180

# ATTENTION

If the alternator works with winding temperatures above the limits of thermal class, the life of the insulation and hence of the alternator is reduced substantially, or even may cause burning of the alternator.

# 4.6.1.2 Thermal protection for the bearings

The temperature sensors installed on the bearings (if any) are used to protect them from damage due to operation with overheating.

# 4.6.1.3 Temperatures for alarm and shutdown

Temperature of alarm and shutdown must be parameterized as low as possible. These temperatures can be determined based on the results of tests or by operating temperature of the alternator. The temperature alarm can be set to 10°C above the operating temperature of the alternator at full load considering the highest ambient temperature at the location. The temperature set to shutdown shall not exceed the maximum permitted temperatures as listed in Table 4.6 and Table 4.7.

Table 4.6: Maximum	temperature	of stator -	continuous	dutv
10010 4.0. 110/01/10/11	tomporataro	or oraror	00111110000	aaty

STATOR WINDING				
Class of Insulation	Maximum temperature of protection setting (°C)			
	Alarm	Shutdown		
F	140	155		
Н	155	180		



ATTENTION

Alternators used in emergency systems (standby) can be elevated up to 25 ° C above the temperature in continuous operation as standard NEMA MG 1 and MG-22:40-1-22.84. Using the alternator in these conditions reduces the life of the alternator.

BEARINGS			
Maximum temperature of protection setting (°C)			
Alarm Shutdown			
110	120		



# ATTENTION

The temperature alarm and shutdown can be set based on experience, but must not exceed the maximum rate indicated in the Table 4.6 and Table 4.7.

# 4.6.2 Space heater

When the alternator is equipped with a heater to prevent condensation of water for long periods without operation, they must be programmed to be always energized after the shutdown of the alternator and be deenergized before the switch goes into operation.

The dimensional drawing and an existing specific identification plate on the alternator indicate the value of supply voltage and power of the installed space heaters.

# ATTENTION

If the space heaters remain energized while the machine is in operation, the winding may be damaged.

# 4.6.3 Auxiliary winding protection

The alternator has a protection fuse, connected in series with the auxiliary winding or the voltage regulator, with the function of protecting it against overload.



In case of operation of the fuse it is necessary to replace it with another of equal value, so that the alternator operates properly protected.

The fuse protects the alternator and voltage regulator in the following situations:

- 1. Loss of reference (feedback) of the voltage regulator;
- 2. 4. Connection of the cables of the auxiliary coll in short circuit, done on output cables of the coll or by erroneous connection on the voltage regulator;
- Connection of the output terminals of the voltage regulator in short circuit;
- Operation at low speed (used to heat the diesel engine), especially with the function U / F voltage regulator disabled, depending on the operating condition (rotate, adjust the regulator and others);
- In case of damage to the voltage regulator (burning of the power element or internal reference failure in the circuitry for comparison);

The fuse does not operate in case of short circuit of the alternator phases. In these cases, the protection should be done with a relay, allowing the motor starting and protection sensitization.

# 4.6.4 Diodes protection

The diodes are protected against overvoltage and / or power surge, according to Table 4.8. In case of failure of these components, they must be

replaced.

	Varistor	Capacitor
GTA161 - GTA252	✓	
GTA311 - GTA561	✓	✓
Type of assembly	THT	THT
Item (WEG)	10049848	10391625
Features	1W, 745Vcc, 550Vca 210J/2ms	0,1µf, 2000 Vcc, 630Vca

Table 4.8: Protection of the diodes

# 4.6.5 Protection against underfrequency

The protection against underfrequency avoids overcurrent in the auxiliary coil windings and excitation circuit of the alternator. The setting should in the U/F trimpot of the voltage regulator.

# 4.6.6 Maintenance of the short-circuit current

The G line WEG alternators are manufactured with the auxiliary coil inserted into the main stator slots, isolated from the main winding. This coil is designed to power the voltage regulator power circuit and maintain the alternator short-circuit current.

# NOTE

- 1. Due to the fact of the alternator to keep high lcc, an overcurrent relay must be provided and to open the main breaker in no more than 20s, under risk of burning the alternator.
  - To maintain the short circuit current above 3.0 x In, refer to WEG.

# 4.7 VOLTAGE REGULATOR

The electronic voltage regulator is designed to keep the voltage of the alternator constant independently of load. It may be mounted in the connection from the alternator or on the control panel.

Check in the <i>Manual of the voltage</i>	
regulator the terminals, wiring diagram and trimpots for adjustment. A wrong connection can mean the burning of the regulator and / or the alternator windings Defects caused by this reason are not covered under warranty.	

# 4.8 ELECTRICAL FEATURES

# 4.8.1 Electrical connections

The electrical connections of the alternator are responsibility of the end user and should be done by trained people. The connection diagrams can be found in item 4.8.2.

# 4.8.1.1 Main connection

The main cable connections must be made in accordance with the diagrams in this manual, using tightening torque according to Table 4.9 for fixing cables.

Table 4.9: Tightening torque of terminal screws for fixing the main cables

Screw diameter	Tightening torque (Nm)	
M5	4 - 5	
M6	8 - 9	
M8	19 -21	
M10	38 - 42	
M12	67 - 73	
M16	143 - 157	

# NOTE

The tightening torques of electrical terminal connections are informed in the alternators terminal board.





- Make sure the section and insulation of the connecting cables are suitable for the current and voltage of the alternator;
- Before making electrical connections between the alternator and the load or power grid, it is required to do a careful check of the insulation resistance of the winding, as shown in item 4.5.

# 4.8.1.1.1 Cables connection

Para obtenção de um contato elétrico eficaz, a conexão dos cabos de ligação nos pinos da placa de bornes deve atender a seguinte configuração:

To obtain an effective electrical contact, the connection of the cables to the terminal block pin must comply with the following configuration:



Figure 4.6: Cables connection

## Figure 4.6 legend:

- 1. Steel nut
- 2. Steel pressure washer
- 3. Flat steel washer
- 4. Flat brass washer
- 5. Brass nut
- 6. Flat brass washer
- 7. Flat steel washer
- 8. Grid cable connection terminal
- 9. Alternator cable connection terminal



# ATTENTION

This setting is valid to connecting the cables directly to the terminal block pins The brass washers and nuts should not be replaced with other with different material as they may impair the connection of the cables.

# 4.8.1.2 Grounding

The alternator must always be grounded with a cable with suitable section, using the threaded hole located in one of the feet thereof.



Figure 4.7: Grounding

# 4.8.1.3 Electronic voltage regulator connections

The electronic regulator is factory set and electrically connected to the alternator rated voltage.



# ATTENTION

When there is a change in the alternator main connections for voltage change, it is also necessary to change the connections of the reference voltage cables in the voltage regulator according to the specific wiring diagram.

# 4.8.1.4 Terminal identification

Main terminals (connection cables of the stator phases) 1 up to 12, N

## Connection terminals on the voltage regulator

E1 or E2 (brown) – Feedback of single-phase voltage. E3/4 (green) – Common of the circuit of supply and of the feedback power of the single phase of the voltage regulator.

 ${\bf R}$  (blue),  ${\bf S}({\rm gray})$  and  ${\bf T}({\rm orange})$  – feedback of three-phase voltage.

**3** (yellow) – Supply of the power circuit of the voltage regulator.

F+ (red) and F- (black) – Main excitatory field

AX1 (blue), AX2 (gray) and AX3 (orange) – Auxiliary exciter - supply of power circuit of the voltage regulator – model GPA.

N (white) - Feedback of single-phase voltage (GPA)

## Terminals of accessories

- 16 to 19 Space heaters
- 20 to 35 Thermosensors on the stator (PT100)
- 36 to 51 Thermistors on the stator (PTC)
- 52 to 67 Thermostats on the stator
- 68 to 71 Thermistors on the bearings
- 72 to 75 Thermistors on the bearings
- 76 to 79 Thermostats on the bearings
- 80 to 82 Tachometric dynamos
- 88 to 91 Thermometers
- 94 to 99 Current Transformers



# 4.8.2.1 Three-phase alternators – 12 terminals

4.8.2 Connection diagrams

		Star Series (a	access to neutral)	Star Parallel (ad	ccess to neutral)	Triangle Series
MUSUR     Image: state stat		1				
				VOLTA	GE(V)	
	L-L	380 - 415	440 - 480	190-208	220 - 240	220 - 240
60Hz	L - N	220 - 240	254 - 277	110-120	127 – 139	
	E1 - E3/4 (Reference)	190 - 207	220 - 240	190-208	220 – 240	220 – 240
	L-L	380	380 - 400 190 - 200		200 – 220	
50Hz	L - N 220 - 230 110 - 115		_			
00112	E1 - E3/4 (Reference)	190	0 – 200	190 – 200		200 – 220
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		$\begin{array}{c} 8 \text{ pins} \\ \hline \\ 12 \\ 3 \\ \hline \\ 11 \\ 2 \\ \hline \\ 2 \\ \hline \\ 1 \\ 1$				
		12 pins - fr	ame 315 - 355	12 pins - fran	ne / 315 - 355	12 pins - frame / 315 – 355
CONT		N 10 6 10 12 10 10 10 10 10 10 10 10 10 10 10 10 10	$\begin{array}{c} 3 \\ 1 \\ 3 \\ 3 \\ 3 \\ 3 \\ 1 \\ 1 \\ 1 \\ 1 \\$	12005 11004	9 8 8 7 1 1 1 1 1 1 1 1 1 1 1 1 1	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$



# ATTENTION

- The alternator is supplied with the voltage regulator (AVR) connected to operate at the alternator rated characteristics;
- In case of maintenance or modification of the alternator wiring connections, connect correctly the cables E1, E3/4 and 3 on the AVR, as follows:
  - The cables E1 and E3/4 refers to AVR sensing voltage.
  - The cables 3 and E3/4 refers to AVR power supply.
- In alternators with 12 terminals, always connect the alternator cables E1 and E3/4 on the AVR terminals E1 and E3/4, regardless of connection type or alternator rated voltage. In these cases, the AVR terminal E2 should not be used.



# NOTE

To obtain the wiring diagrams of the alternator of frame 400 and higher, refer to WEG.



## 4.8.2.2 Three-phase alternators - 6 terminals





# ATTENTION

- The alternator is supplied with the voltage regulator (AVR) connected to operate at the alternator rated characteristics;
- In case of maintenance or modification of the alternator wiring connections, connect correctly the cables E1 or E2, E3/4 and 3 on AVR, as follows:
- The cables E1 or E2 and E3/4 refers to AVR sensing voltage.
- The cables 3 and E3/4, refers to AVR power supply.
- In WEG alternators with single voltage (6 or 3 terminals) from 160 to 300 V, always connect the alternator cables E1 and E3/4 on the AVR terminals E1 and E3/4, as the diagrams above;
- In WEG alternators with single voltage (6 or 3 terminals) from 320 to 600 V, always connect the alternator cables E2 and E3/4 on the AVR terminals E2 and E3/4, as the diagrams above.



# NOTE

To obtain the wiring diagrams of the alternator of frame 400 and higher, refer to WEG.



# 4.8.2.3 Three-phase alternators with single-phase connection - 12 terminals

# **^**

# ATTENTION

- The cables E1 and E3/4 refers to sensing voltage for AVR (see the AVR manual).
- For delta single-phase connection, the sensing terminals of the AVR (E1 and E3/4) originally connected at the main cables 7 and 9 and the auxiliary coil cable 4 originally connected on the terminal 9, must be removed from the original position. Reconnect these cables as follows:
  - Cables 4 and E3/4 on main cable 8.
  - Cable E1 on main cable 1, as diagrams above.

Observe the single-phase power informed on the brochure.

# 4.8.2.4 Electrical connections of the voltage regulator

- To perform correctly the electrical connections of the alternator with the voltage regulator, refer to the manual of the voltage regulator.
- The voltage regulator model used depends on the characteristics of the alternator and the desired application, thus, the electrical connections with the alternator and the identification of the terminals may differ from one model to another.
- The manual of the voltage regulator is provided with the alternator.
- The default alternator model of line G is the GTA (with auxiliary coil and without auxiliary exciter).
- It is not recommended that the alternator work without GTA auxiliary coil, because with this configuration the power supply of the voltage regulator is impaired in cases of short circuit or overload. This condition is allowed only in emergency cases when there is failure of the auxiliary coil. As soon as possible, the alternator must be repaired to maintain the original characteristics.
- The alternators with auxiliary exciter (model GPA) are special and should be manufactured in consultation with WEG.
- When using a transformer to adjust the reference voltage of the voltage regulator, the transformer cannot be installed inside the terminal box of the main alternator.



# 4.8.3 Accessories connection diagram

## Accessories terminals

- 16 a 19 Space heaters 20 a 35 – Stator thermoresistance (PT100) 36 a 51 – Stator thermistors (PTC)
- 52 a 67 Stator thermostats
- 68 a 71 Bearing thermoresistance (PT100)
- 72 a 75 Bearing thermistors
- 76 a 79 Bearing thermostats
- 88 a 91 Thermometers
- 94 a 99 Current transformers

# 4.8.3.1 Stator thermostats









2 per phase in series





# 4.8.3.2 Bearing thermostats



# 4.8.3.3 Stator thermoresistances







# 4.8.3.4 Bearing thermoresistances





# ATTENTION

The identification of the PTC sensor terminals is showed in the item 4.8.1.4. When using 2 sensors per phase are added the suffixes A to alarm and D for shutdown. For alternators supplied with specific connection diagram, this takes precedence over the connection diagrams of this manual.

# 4.8.3.5 Space heaters





# 4.9 MECHANICAL FEATURES

## 4.9.1 Bases and foundations

- The dimensioning of the base should be performed to confer rigidity to the structure, avoiding amplification of the vibration levels of the set. The base should have a flat surface against the feet of the alternator in order to prevent deformations in its frame.
- The base should always be leveled from the ground (floor). The leveling is achieved by placing backstops between the base and the floor.
- 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.

## 4.9.2 Alignment and leveling

The alternator must be perfectly aligned with the driving machine, especially in cases of direct coupling.



# ATTENTION

Incorrect alignment can cause defects in the bearings, vibration and even shaft rupture.

# 4.10 GENERAL NOTE OF INSTALLATION

NOTE

The user is responsible for installing the alternator.

WEG is not responsible for damage to the alternator, associated equipment and installation, which occurred due to:

- Excessive vibrations transmitted:
- Poor facilities;
- Failures in alignment;
- Inappropriate storage conditions;
- Failure in following instructions before start-up:
- Incorrect electrical installation.

# 4.11 COUPLING

# 4.11.1 Direct coupling

Only appropriate couplings should be used, suitable exclusively for the torque transmission without causing transversal forces. Shaft centers of alternators and drive machine, must be absolutely aligned either for flexible or any other type of coupling. The flexible coupling is used to absorb vibrations and to compensate small assembly misalignments. All types of coupling arrangements must be assembled or disassembled using proper devices and never using hammer.

# 4.11.2 Belt and pulley coupling

When a speed relation is necessary, the transmission with belt is more frequently used. The pulley diameter should not be lower than 2/3 of the alternator frame diameter. The width of the pulley should not exceed the shaft end length. The maximum diameter is limited by the weight and by the admissible peripheral speed. The peripheral speed for belt type V is 33m/s.

ASSEMBLY OF PULLEYS: The assembly of pulleys on shafts featured with keyway and threaded hole must be done by inserting it halfway up to the keyway merely by manual pressure. On shafts without threaded hole it is recommended to heat up the pulley to about 80°C (figure below).



DISASSEMBLY OF PULLEYS: for disassembly of pulleys it is recommended to use the devices shown in figure below in order not to damage the key neither shaft surface.



Hammers should be avoided when fitting pulleys and bearings. The fitting of bearings with the aid of hammers causes spots in the bearing races. These initially small spots increase with usage and can develop up to a stage that causes complete damage to the bearing. The correct positioning of a pulley is shown in figure below.





CORRECT



INCORRECT

INCORRECT



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**RUNNING:** Avoid unnecessary thrusts on the bearings by ensuring that the shafts are parallel and the pulleys perfectly aligned according to the figure below).

CORRECT



INCORRECT



INCORRECT



Laterally misaligned pulleys, when running, transmit alternating knocks to the rotor and can damage the bearing housing. Belt slippage can be avoided by applying a resin type material such as rosin. Belt tension is only required to avoid slippage during operation according to the picture below:



NOTE: A belt with excessive tension increases the force on the shaft end causing vibrations and fatigue leading to a possible shaft rupture.

Excessively small pulleys should be avoided; these cause shaft flexion as belt traction increases with the decrease of pulley size.

When specific pulleys are required, contact WEG in order to insure a correct designing.

# **5 COMMISSIONING**

- The alternator leaves the factory with a lock on the shaft or disc for better safety in transportation. Before putting it into operation, this lock must be removed.
- The connection of the terminals comply with the nominal characteristics of the alternator plate.
- To perform the adjustment of voltage and frequency, refer to the manual of the voltage regulator.

#### 5.1 **PRELIMINARY TEST**

Before being given the initial start or after a long time without operation, check:

- 1. If the alternator is clean and the packaging materials and protective elements were removed from;
- 2. If the connection parts of the coupling are in perfect condition and well-greased and tightened where necessary;
- 3. If the alternator is aligned;
- 4. If the bearings are properly lubricated and in working condition:
- 5. If the cables of the thermal protectors, grounding and of the heaters are connected. (if any);
- 6. If the insulation resistance of the windings has the prescribed value;
- 7. If all objects such as tools, measuring instruments and alignment devices were removed from the alternator work area;
- 8. If the alternator is well fixed;
- 9. If electrical connections are in accordance with the wiring diagram alternator;
- 10. If the voltage regulator is properly connected and adjusted according to its installation manual;
- 11. If the conductors of the grid are properly connected to the main terminals as to prevent a short circuit or their release;
- 12. If the alternator is properly grounded;
- 13. Manually rotate the set in order to ascertain if there is no interference in the air-gap. Driven the alternator at no load, it must rotate slightly and without strange noises.
- 14. If the air inlets and outlets are clear:
- 15. If the measure "G" is in accordance with the specification for the diesel engine to be coupled (for single bearing alternators).

#### 5.2 **INITIAL SPIN**

In addition to following the safety instructions, given in chapter 2.2 of this manual, to put the alternator into operation for the first time the following procedure must be adopted:

- a) Make sure that the alternator terminals are disconnected from the load by removing the fuse panel or circuit breaker or placement of the key in b) position "off";
- c) Turn off the space heaters of the alternator (if any), before putting it into operation;
- d) Disconnect the voltage regulator (removing the fuse in series with the auxiliary coil);
- e) Rotate the set and check for weird noises;
- Activate the alternator to rated speed and check noise, f) vibration and check all protective devices;

#### 5.3 **OPERATION**

After following the procedures described previously:

- a) Stop the alternator and connect the voltage regulator (put the fuse in series with the auxiliary coil).
- b) Activate the genset until it reaches the rated speed:
- c) Make the necessary adjustments. The voltage regulator manual describes the function of the adjustable trimpots of the alternator electrical quantities and the procedures for making these adjustments.
- d) Close the main circuit breaker and apply load and monitor the voltage, current and frequency of the alternator making sure that it is within the specified.
- e) Check the vibration and temperature of the genset. If there is significant variation in the vibration of the genset between the initial condition and after thermal stability, it is necessary to reassess the alignment / leveling of the genset.



# ATTENTION

All measuring instruments and control should be under constant observation so that any changes in operation can be detected and remedied.

#### 5.4 TRIMPOTS ADJUSTMENT

The trimpots of the voltage regulator are pre-set during alternator testing at the factory.

After the factory tests, the U/F and Stb trimpots are sealed, indicating that these quantities are preset. If it is necessary to make new adjustments using these trimpots, the voltage regulator manual must be consulted.



45 50 (Hz)

54 60 (Hz)



# 5.5 SHUTDOWN

- a) Before stopping the alternator, open the main circuit breaker to disconnect the load;
- b) If the alternator is equipped with space heaters, make sure that they remain energized while the switch remains stationary.



# DANGER

Even after de-excitation, there is still voltage at the terminals of the machine, so only after the full stop of the equipment it is allowed to do any work. Risk of death if not attending to that

described above.

# 5.6 ALTERNATORS IN PARALLEL

# 5.6.1 With each other and / or with the electrical grid

Minimum requirements for operation in parallel of the alternator, not including the drive machine control:

- 1. The alternator must have the same operating voltage of the other alternator or the grid;
- 2. The voltage regulator must allow the operation of the alternator in parallel;
- Add a parallel CT (In / 5) of 5 -10 VA phase which is not used as a reference for the voltage regulator and make the electrical connection according to the manual of the voltage regulator.
- 4. Having a panel suitable for protection and operation of the alternator in parallel.
- 5. The timing and setting of the active power must be imposed by the speed control of primary machines.

In case of high currents neutral appear, use a ground coil or open the neutral connection of one alternator. That happens especially when the alternators are not equal or when feeding loads with high harmonic content.



# ATTENTION

This type of installation must be performed by technical staff.

For transient operations in parallel (e.g. loading ramp) in which the switch will operate in a simple way after a period in parallel, the parallel CT should be shortcircuited, it is therefore unnecessary in this operation.

# **6 MAINTENANCE**

Maintenance procedures should be followed to ensure the proper performance of equipment. The frequency of inspections will depend essentially on local conditions of application and conditions of service.

Failure to comply with one of the items listed below can mean a reduction in the life of the alternator, unnecessary stops and / or damage to facilities.

# 6.1 EMERGENCY GENSETS

The alternators used in emergency gensets should, according to humidity degree of the site, receive load of 2 to 3 hours each month.

# 6.2 CLEANING

The frame, multi-leaf dampers and deflecting grids must be kept clean, without accumulation of oil or dust on the outside to facilitate heat exchange with the environment. Also inside the alternators must be kept clean and free of dust, debris and oil. To clean them, you should use brushes or clean cotton cloth. If dust is not abrasive, a jet of compressed air must be used blowing the dirt from the fan cover and eliminating any accumulation of dust contained in the fan blades and frame.

Debris impregnated with oil or moisture can be cleaned with cloth dipped in a suitable solvent.

The terminal box must have terminals clean, no rust, in perfect mechanical condition and without deposits of grease or verdigris.

# 6.3 NOISE

The noise must be observed at regular intervals 1-4 months. In case of anomaly the alternator must be stopped and the cause must be investigated and solved.

# 6.4 **VIBRATION**

Maximum vibration level for the on-load alternator: **20mm/s** (RMS).



# ATTENTION

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

# 6.5 BEARINGS

Temperature control in the bearing is also part of routine maintenance of the alternators. The elevated temperature must not exceed 60 °C, measured in the outer ring of the bearing.

The temperature can be controlled permanently with thermometers placed outside the frame or thermal elements embedded (optional).

Temperature of alarm and shutdown for the bearings can be adjusted respectively to 110 °C and 120 °C.

# 6.5.1 Lubrication

Shielded or sealed bearings do not allow relubrication. These bearings must be replaced when reach 20,000 operating hours or 30 months, whichever occurs first. Re-greasable bearings shall be relubricated **annually** or according to the lubrication intervals reported in Table 6.1, whichever occurs first.

Table 6.1: Bearing data				
Frame	Bearing	Bearing	Lubrication interval (hours of operation)	Grease amount (g)
160	DE	6211 ZZ–C3 (*)	-	-
100	NDE	6209 ZZ–C3 (*)	-	-
200	DE	6313 ZZ–C3 (*)	-	-
200 NDE 62		6210 ZZ–C3 (*)	-	-
250	DE	6318 ZZ–C3 (*)	-	-
250	NDE	6214 ZZ–C3 (*)	-	-
215	DE	6320 ZZ–C3 (*)	-	-
315	NDE	6316 ZZ–C3 (*)	-	-
055	DE	6322-C3 (**)	4.500	60
335	NDE	6220-C3 (**)	4.500	31
400	DE	6324-C3 (**)	4.500	72
400	NDE	6226-C3 (**)	4.500	46

(\*) – ZZ shielded bearings may be replaced by 2RS or DDU sealed bearings.

(\*\*) – Re-greasable bearings

Estimated useful life for re-greasable bearings = 40,000 h.

For other frame sizes, the bearing type and lubrication interval are reported on a plate fixed on the alternator frame.

# 6.5.1.1 Type and amount of grease

The relubrication of the bearings should always be made with **original grease**, specified on the nameplate and in the documentation of the bearings of the alternator. The WEG alternators are provided with grease POLIREX EM 103.



# ATTENTION

- 1. WEG does not recommend the use of any grease different from the original grease of the alternator.
- 2. When the bearing is opened inject the fresh grease through the grease nipple to eject the old grease found in grease inlet tube and applying new grease to the bearing, the inner ring and outer ring by completing three quarters of the voids.
- 3. Never clean the bearing with a cotton cloth as it may release lint serving as a solid particle.
- Proper lubrication is important, that is, the grease applied correctly and in a suitable quantity, for both a poor lubrication as lubrication excessive bring the bearing adverse effects.
- 5. Excessive lubrication entails temperature rise due to the large resistance offered to the movement of rotating parts and, mainly, due to beating of grease, which ultimately completely loses its characteristics of lubrication.

# NOTE

WEG is not responsible for the change of grease or for any damages arising from the change.



# 6.5.1.2 Instructions for lubrication

The lubrication system is designed such that during relubrication of bearings, all of the old grease is removed of bearings and expelled through a tube which enables the output of the same, but prevents the entry of dust or other hazardous contaminants into the bearing.

This drain also prevents damage to the bearings due to the well-known problem of excessive relubrication. It is advisable to perform relubrication with the alternator in

operation, so as to ensure the renewal of grease in the bearing housing.

If this is not possible due to the presence of parts near the grease nipple (pulleys etc.), which can jeopardize the physical integrity of the operator, proceed as follows:

- With the alternator stopped inject approximately half the total amount of grease planned and operate the alternator for approximately 1 minute at full speed;
- Stop the alternator and inject the remaining grease. Injection of all grease with the alternator stopped can cause penetration of the lubricant to the inside of the alternator.



# ATTENTION

It is important to clean the grease cups prior to lubrication, to prevent foreign material from being drawn into the bearing.



# NOTE

The data of bearings, quantity and type of grease and lubrication intervals are reported in an identification plate fixed on the alternator. Verify this information before making lubrication.

- The lubrication intervals informed in the plate consider a working temperature of the bearing of 70°C.
- Based on the operating temperature ranges listed below, apply the following correction factors for lubrication intervals of bearings:
  - Operation temperature lower than 60 °C: 1,59
  - Operation temperature from 70 °C to 80 °C: 0,63
  - Operation temperature from 80 °C to 90 °C: 0,40
  - Operation temperature from 90 °C to 100 °C: 0,25
  - Operation temperature from 100 °C to 110 °C: 0,16

# 6.5.1.3 Procedures for relubrication of bearings

- 1. Remove the cover of the drain;
- 2. Clean with a cotton cloth around the grease cup hole;
- 3. With the alternator running, inject grease until new grease begins to flow from the drain or until the amount of grease informed in Table 6.1 has been introduced;
- 4. Operate the alternator long enough so that excess grease flow through the drain;
- 5. Inspect the bearing temperature to make sure that there was no significant change;
- 6. Replace the cover of the drain.

# 6.5.2 Bearings replacement



ATTENTION

For security, the bearings replacement must be done with the alternator disconnected from the driving machine.

# 1. Put the alternator in a vertical position with the side of

Frame 160 and 200

the coupling discs to the top;

6.5.2.1 Alternator with single bearing - B15T

- Remove the whole rotor, preferably with an eyebolt having the same thread of the center hole of the shaft end, increasing it with the use of a hoist;
- 3. Replace the bearing and replace the complete rotor, making sure that the O-ring is in position at the hub of the back cover.

### Frame 250

- 1. Release the cables of the exciter (F+) e (F-).
- 2. Remove the cover and multi-leaf damper to access the rear bearing and perform the exchange.

## Frames 315 and 400

To disassemble the rear of the alternator and have access to the bearing, follow the instructions below:

- 1. Release cables (F+) and (F-) in the terminal box;
- 2. Remove back multi-leaf damper;
- 3. Remove the cables of the main rotor connected to the rectifier bridge of the exciter rotor;
- Remove the screws that hold the exciter rotor shaft and remove it manually;
- Remove the screws of the back cover attached to the frame and remove this cover along with the exciter stator:
- 6. Replace the bearing and assemble the alternator.

# 6.5.2.2 Alternator with double bearing - B35T

To perform the exchange of the bearings in the alternator with double bearing, it is necessary to disassemble the alternator entirely.

# 6.5.2.3 Bearing withdraw

Bearing withdraw should always be made with the use of appropriate tools (bearing puller).



Figure 6.1: Device to withdraw bearings

## ATTENTION

A bearing should only be removed from the shaft when absolutely necessary

#### Instructions:

- The extractor grabs must be applied on the side of the bearing inner ring to be disassembled or on an adjacent part.
- 2. Before installation of new bearings, the shaft seats should be cleaned and lightly lubricated.
- 3. The bearings must be heated to a temperature between 50 °C and 100 °C to facilitate assembly.
- 4. The bearings should not be subjected to shock, drops, storage with vibration or humidity, which can cause marks on the internal races or in the balls, reducing their life.



# 6.6 MAINTENANCE OF THE EXCITER

# 6.6.1 Exciter

For the proper performance of its components, the exciter alternator should be kept clean.

Check the insulation resistance of the windings of the exciter main and of the auxiliary exciter (if any) periodically to determine the insulation condition of the same by following the procedures described herein.

# 6.6.2 Test on the diodes

Diodes are components that have great durability and do not require frequent tests. If the alternator indicating a defect presents failure in the diode or an increase in field current for the same load condition, then the diodes should be tested in accordance with the following procedure:

- 1. Release the connections of all the diodes with the rotor winding of the exciter;
- 2. With an ohmmeter, measure the resistance of each diode in both directions.



only in the anode-cathode direction, i.e. in the condition of direct polarization.

The diode is considered good when presenting low ohmic resistance (up to approximately 100  $\Omega$ ) in its forward direction and high resistance (approx. 1 M $\Omega$ ) in opposite direction. Defective diodes have ohmic resistance 0  $\Omega$  or greater than 1 M $\Omega$  action in both measured directions. In most cases, the method with ohmmeter to test the diodes is sufficient to identify faults in the diodes. However, in some extreme cases it may be necessary to apply the rated voltage of blocking and / or current flow for detecting fault in the diodes. Due to the efforts required for these tests, in case of doubt, it is recommended to perform the exchange of the diodes.

# 6.6.3 Diodes replacement

To access the diodes and perform the exchange, it is necessary to:

- Disassemble the alternator (frame 160);
- Remove the back inspection cover (frame 200);
- Remove the back multi-leaf damper (frames 250 to 400);
- For other frames, refer to WEG.

To replace the diodes, proceed as follows:

- Undo the connection of the 6 diodes to the exciter rotor;
- Release support for diodes of the exciter rotor and remove it;
- Secure the support in a bench lathe with protection on the jaw, and remove all diodes;
- Install three new diodes of the same polarity (AND or CTD) in one of two connection bridges;

- Install the other connecting bridge, three new diodes of polarity opposite of the three diodes previously installed;
- Secure all diodes, tightening them with a torque wrench respecting the tightening torques in Table 6.2;
- Secure the set of diodes in the exciter rotor;
- Make the connections of the diodes with the exciter rotor winding.



# ATTENTION

It is essential that the indicated tightening torques are respected so that the diodes are not damaged in the assembly.

## Table 6.2: Tightening torque of the diodes

Diode base thread (mm)	Torque key of torque meter (mm)	Tightening torque (Nm)
M6	11	2
M8	17	4
M12	24	10
M16	32	30

Table 6.3: Table of used diodes				
Frame	WEG		Technical	
	designation		specification	
160	DS4	AND	Diode thread M6	
			20A/1.200V AND	
		CTD	Diode thread M6	
			20A/1.200V CTD	
200 - 315	DS6	AND	Diode thread M8	
			45A/1.200V AND	
		CTD	Diode thread M8	
			45A/1.200V CTD	
355 - 450	DS8	AND	Diode thread M8	
			70A/1.200V AND	
		CTD	Diode thread M8	
			70A/1.200V CTD	
For other frames, refer to WEG				

For other frames, refer to WEG.

# 6.6.4 Test on varistor

The varistor is the device installed between the two bridges connecting the diodes and has the purpose of protecting diodes against overvoltage.

To test the conditions of operation of the varistor an ohmmeter can be used.

The resistance of a varistor must be very high ( $\pm$  20,000 ohms).

In case of damages verified in the varistor or if its resistance is very low, it must be replaced.



# 6.6.5 Replacement of the varistor

To replace the varistor, WEG recommends to proceed as orientation to follow:

- 1. Replace the damaged varistor by a new identical to the original, as reported in Table 4.8;
- 2. To replace the varistor, loosen the screws that secure the bridges connecting the diodes;
- When removing the varistor, observe carefully how the components were mounted so that new varistor is installed the same way;
- 4. Before mounting the new varistor, make sure that all contact surfaces of the components are clean, leveled and smooth so as to ensure a perfect contact between them;
- 5. Attach the new varistor tightening the screws that hold the connecting bridges just enough to make a good electrical connection, watch the filling with silicone in the compartment of the new varistor.

# 6.6.6 Test on the capacitor

The capacitor is the device installed between the two bridges connecting the diodes and has the purpose of protecting diodes against voltage surge.

To test the operating conditions of the capacitor a multimeter can be used with the function of measuring capacitance.

The capacitance measurement should be according to the specification for the component;

In case of damages verified in the capacitor or if capacitance is above the specified tolerance, it must be replaced.

# 6.6.7 Replacement of the capacitor

To replace the capacitor, WEG recommends to proceed as orientation to follow:

- 1. Replace the damaged capacitor by a new identical to the original, as reported in Table 4.8;
- 2. To replace the capacitor, loosen the screws that secure the bridges connecting the diodes;
- When removing the capacitor, observe carefully how the components were mounted so that new capacitor is installed the same way;
- 4. Before mounting the new capacitor, make sure that the connection terminals and screws are clean, ensuring a perfect contact between them.
- 5. Fix the capacitor again tightening the terminals that attach to connecting bridges, just enough to make a good electrical connection. Observe the filling with silicone in the compartment of the new capacitor.

# 6.7 AIR FLOW

The air inlets and outlets of the alternator should be kept clear, so that heat exchange is efficient. If there is deficiency in heat exchange, the alternator will overheat and damage the winding (burning of the alternator).



# NOTE

If filters are installed in the air inlet, daily inspect, clean or replace if necessary.

# 6.8 COMPLETE INSPECTION

The frequency of inspections should be defined according to the environment where the alternator is installed. The more aggressive the environment (dirt, oil, salt spray, dust, etc.) the smaller should be the time interval between inspections, as follows:

- Clean the dirty windings with a brush;
- Use a cloth dampened in a suitable solvent to remove grease, oil and other impurities from the winding;
- Dry with dry air;
- Blow compressed air through the ducts in the stator plate package, the rotor and bearings.

## NOTE

Compressed air should always be blown after cleaning, never before.

- Drain condensed water;
- Clean inside the terminal boxes;
- Measure insulation resistance;



# ATTENTION

The absence of complete inspections in the alternator will cause the accumulation of dirt inside. The operation under these conditions may reduce the life, cause unwanted downtime and additional costs for the recovery of the equipment.



Pos.	Description
1	Front cover
2	Shaft
3	Front bearing
4	Rotor winding
5	Stator winding
6	Frame
7	Eyebolt
8	Set of rectifiers
9	Exciter stator
10	Rear cover
11	Exciter rotor
12	Fan
13	Air baffle
14	Rear bearing

# 7.1 HOW TO ORDER

When ordering spare parts, alternator type and serial number must be always given as indicated on the nameplate or on the frame.

# 7.2 KEEPING STOCK

It is recommended to keep in stock the following spare parts:

Bearings; Set of rectifiers

The spare parts must be stored in clean, dry environments and aired well, if possible, with constant temperature.



# **8 TROUBLESHOOTING**

Below are listed some abnormal situations that can occur on the switch in service, as well as the correct procedure for verification and correction.

THE ALTERNATOR DOES NOT EXCITE				
ANOMALY	PROCEDURE			
Interruption in the auxiliany winding circuit	Check the union of the cables of the auxiliary winding in the connection			
	block extending to the connecting block the regulator and fuse.			
Burned fuse.	<ul> <li>Replace the fuse (as specified).</li> </ul>			
	<ul> <li>Disconnect the wires to the regulator and perform external excitation with</li> </ul>			
Residual voltage too low.	battery 12 to 20Vcc (negative pole in F- and positive pole in F +), until the			
5	beginning of the excitation process. The starting battery of the diesel			
Drive anod is not correct	Moscure the aread and regulate it			
Drive speed is not correct.	Check the continuity of the cobleg. E, and E L, make measurements in all			
Interruption in the main excitation circuit.	the diodes and replace defective diodes or replace the whole set			
Belay or other component of the voltage regulator	<ul> <li>Replace voltage regulator.</li> </ul>			
faulty				
External potentiometer for voltage adjustment				
ruptured or interrupted connection.	Check the connections to terminals 11-12 and potentiometer.			
Varistor of protection of the diodes (if any) is	If defective, the varistor should be replaced, or there is no a spare part,			
faulty.	remove it temporarily.			
ALTERNATOR DOES NOT EXCITE, UP TO RATED VOLTAGE				
ANOMALY	PROCEDURE			
Faulty rotating diodes.	<ul> <li>Replace the set of diodes.</li> </ul>			
Incorrect speed.	Measure the speed of the primary machine and regulate it.			
Voltage adjustment below the rated voltage.	<ul> <li>Adjust the voltage potentiometer in the voltage regulator or the external one.</li> </ul>			
Supply of voltage regulator is not according to the	Varify if connections are according to the manual of valtage regulator			
desired output voltage.				
IN NO LOAD, THE ALTERNATOR EXCITES UP TO RATED VOLTAGE, BUT COLLAPSES WITH THE LOAD				
ANOMALY	PROCEDURE			
Sharp speed decrease.	Control Diesel selector.			
Faulty rotating diodes.	Replace the set of diodes.			
THE ALTERNATOR, IN NO L	AD, IS EXCITED THROUGH OVERVOLTAGE.			
ANOMALY				
Paulty voltage initistor of regulator.	Replace regulator.			
incorrect.	<ul> <li>Check voltage / operation ratio.</li> </ul>			
Supply of voltage regulator is not according to the	Pode the connections. Check the manual of the voltage regulator			
desired output voltage.				
OSCILLATION ON ALTERNATOR VOLTAGE				
ANOMALY	PROCEDURE			
Stability improperly set	Adjust the stability of the regulator with the Stb trimpot.			
Oscillations in the speed of the drive machine.	<ul> <li>Frequent oscillations are originating from the drive machine and need to be eliminated.</li> </ul>			
MEC	HANICAL ANOMALIES			
ANOMALY	PROCEDURE			
Overheating of bearings.	<ul> <li>Faulty bearing, lack of lubrication or excessive axial clearance.</li> </ul>			
Overheating in the alternator frame	<ul> <li>Air input or output partially clogged or hot air is returning to the</li> </ul>			
	alternator, alternator overload or over excitement.			
Excessive vibration.	<ul> <li>Misalignment, faulty assembly or clearance in coupling.</li> </ul>			
Strong voltage drop with subsequent recovery:	Incorrect adjustment of stability, alternator operating with simple			
(flashes)	parallelism system turned on or momentary overload.			



# ATTENTION

The machines included in this manual are in continuous improvement, so the information in this manual is subject to changes without notice.

# 9 ENVIRONMENTAL INFORMATION

# 9.1 PACKAGE

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

# 9.2 PRODUCT

Alternators, under the constructive aspect, are manufactured primarily with ferrous metals (steel, cast iron), nonferrous metals (copper, aluminum) and plastic. The alternator, in general, is a product that has a long service 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 landfill, co-processed in cement kilns or incinerated. The service providers of 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.

# 9.3 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.

# **10 SERVICE NETWORK**

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

# **11 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 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 WEGeuro – Industria Electrica 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 alternators and their components used for following lines:

#### G..., AG10

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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 RoHS 2011/65/EU

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 60034-5:2001 + 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 60034-14:2004 + A1:2007/ EN 60204-1:2018/ EN IEC 60204-11:2019 and EN IEC 63000:2018

#### CE marking in: 1998

\* Synchronous alternator designed for use with a voltage rating higher than 1000V are not considered under the scope. \*\* Low voltage alternators are not considered under the scope and alternators 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: Rodrigo Fumo Fernandes Engineering Director

Jaraguá do Sul, April 11st, 2022





# **12 WARRANTY**

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 invoice 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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