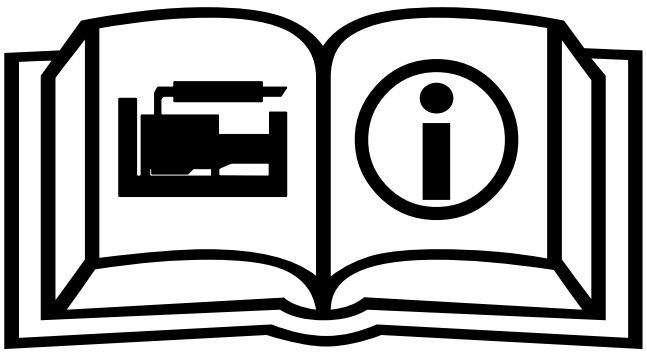
# GASOLINE GENSETS AND WELDING MACHINES GENERAL MANUAL



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# 1. INTRODUCTION

Thank you very much for purchasing this CAROD generator set.

This manual is only valid for the Generating Sets of Models of gasoline internal combustion engines.

Please keep these instructions in good conditions. Make sure this information is accessible at all times by those who have to operate or maintain the equipment.

It is recommended that all personnel who will operate the generating set read these instructions beforehand. It is also recommended that the equipment be installed, maintained and repaired by qualified personnel.

All generator sets require routine inspection and maintenance to ensure proper and safe operation.

It is intended that the content of this manual adjusts with the maximum precision to the information needs about the equipment, as well as that the data is as current as possible. However, the manufacturer reserves the right to change, alter or improve this product without prior notice and without incurring obligation.

Make sure you have fully understood the instructions detailed in this manual. Otherwise, you can request clarifications at:

**www.carod.es**
+ 34 976 140 800 – Carod – Technical Office.

To obtain spare parts or service, contact your nearest Carod dealer. Make sure you can provide the model and serial number of the equipment, motor or alternator that contains the part that is required.

# 2. SAFETY PRECAUTIONS

## 2.1. GENERAL RULES

The equipment must be operated only by qualified personnel.

It is necessary to know that improper use of the equipment could trigger an accident. To avoid this, before manipulating, maintaining or repairing the equipment it is important to follow the following guidelines:

Perform all inspections and safety checks detailed in the manual before operating the generator set.

I If it is observed that the equipment is not in safe operating conditions, do not start it up and disconnect the negative (-) of the battery until optimal safety conditions are restored.


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The installation of the equipment and the sizing of its loads is the responsibility of the installer and the final Customer. Make sure everything is done in compliance with established standards.

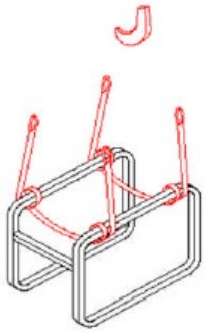
## 2.2. INSTALATION, HANDLING AND TRANSPORTATION PRECAUTIONS

The loading, unloading and movement of the generating set must be carried out by qualified personnel and under minimum safety conditions.

Make sure the floor can support the weight of the equipment.

When raising the genset, be sure to do so with an empty fuel tank and disconnect the battery to prevent unexpected starts.

In case of using a crane, make use of lifting slings to lift the group. In the following image you can see the correct way to place the slings for lifting.



In case of using a forklift, place the generating set centered on a pallet.

## 2.3. MAINTENANCE PRECAUTIONS

### *2.3.1. MECHANICAL RISK*

A running generator set has moving parts that can cause injury if you come into contact with them.

Avoid contact with the moving parts of the equipment at all times. Make sure that guards such as belt guards and other guards have not been removed and not replaced. Do not remove the belt covers, guards and other protections with the equipment running if you are not a qualified and authorized technician.

Do not work on the equipment with loose clothing, long loose hair, dangling, etc. They could get caught in moving parts.

Before manipulating the moving parts of the equipment, make sure that it cannot start up unexpectedly.

When carrying out mechanical or electrical repairs, first disconnect the battery negative to prevent the starter motor turning unexpectedly.

Wear gloves, safety shoes, safety glasses and head protection when working on the group.





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Combustion engines work at very high temperatures. Avoid contact with the surfaces of the running engine, especially with the exhaust manifold and exhaust pipes in general.

Remember that after a certain period of operation, fluids such as oil and coolant reach high temperatures. Avoid contact with these hot fluids.

### *2.3.2. ELECTRICAL RISK*

It is very important to connect the group to a reliable earth connection when carrying out its installation. This is crucial for electrical protections to work effectively. Otherwise, there is a risk of electrocution when coming into contact with the metallic parts of the equipment.

I Do not run an open or bench genset in the rain.

I Never handle the equipment with wet hands.

In the event of a generator set fire, use Class BC or ABC fire extinguishers. Never use water on a fire with nearby electrical equipment.

Avoid contact with terminals and other non-insulated electrically active elements.

When caring for an electrical shock victim:

I First open the circuit breaker for the circuit that has provided the jolt. Do not touch the victim with your bare hands until the source of the current has been removed.

If this is not possible, isolate ourselves with sticks, ropes, etc. without touching the victim directly and away from the cable.

Check vital signs and initiate CPR if necessary.

Cover the affected area with preferably sterilized material. (the entry and exit sites of electricity in the victim's body).

Transfer to a medical care center, even if the injuries are minimal: late alterations may appear.

### *2.3.3. FIRE AND EXPLOSION*

The fuel from the generating set is a potentially dangerous substance, which can lead to an explosion. Make sure not to fill the fuel tank completely, especially if you are going to be exposed to the sun or sources of intense heat. Do not expose or spill fuel on sources of intense heat.

Engine oil also emits vapors that ignite above a certain temperature. Do not expose the oil to flames or high energy sparks.

The vapor resulting from the chemical reaction of the batteries can be flammable if it accumulates in a very small space.



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Batteries in poor condition can lead to an explosion while being charged. Be sure to maintain your electrolyte level correctly, keep them clean, and replace them every 2 years.

It is highly recommended to install fully charged and revised class BC or ABC fire extinguishers near the generating set. Generator set operators must be familiar with its handling.

The place where the generating set is going to be installed must be well ventilated to avoid the accumulation of gases.

The floor of the group room must remain free of dirt that could spread a fire. Dirt can also be sucked into the fan and trapped in the radiator, blinding it and causing an over-temperature failure.

### *2.3.4. CHEMICAL RISK*

C Avoid skin contact with fuel, oil and engine coolant whenever possible. If swallowed, do not cause vomiting, call 91 562 04 20, or 112. If your clothing gets impregnated with fuel or lubricating oil, replace it with another and wash with soap and water.

Avoid totally skin contact with liquid battery electrolyte. It is very corrosive and its contact causes burns. In case of contact remove contaminated clothing as quickly as possible. Apply soap and wash the parts affected by the acid with plenty of water. If it comes into contact with the eyes, irrigate them with water quickly while they are open for at least 15 minutes, until they stop bothering. See a doctor if they continue to bother you. In case of accidental ingestion, drink large amounts of water, preferably with bicarbonate, and see a doctor as soon as possible.

S Do not inhale battery vapors if you think they may have concentrated in a closed cubicle.

### *2.3.5. NOISE*

I It is important to wear hearing protection when working in the vicinity of a running generator set.

Bench-mounted generator sets, which are not equipped inside soundproofing booths, produce high noise levels, which can exceed 105dB.

Prolonged exposure to noise of more than 85dB is dangerous for the integrity of the ears.





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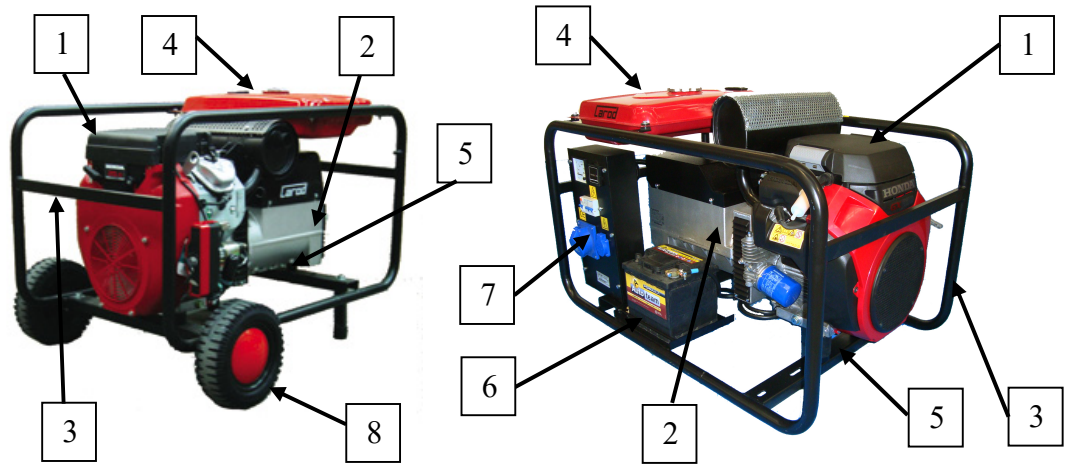
# 3. GENERATING SET SYSTEMS: DESCRIPTION, IDENTIFICATION AND WARNINGS

## 3.1. GENERATING SET DESCRIPTION

This equipment has the purpose of supplying electrical energy autonomously, at the voltage, frequency and number of phases that detail its characteristics.




The main components that define the generator set are motor (1), alternator (2).

The motor-alternator assembly is seated by means of vibration insulators (5) on a metallic tubular chassis (3) in which a fuel tank (4) is normally housed.

Depending on the models (engine with electric or manual start), the generator will be provided with a battery (6) and other options (control panel (7), wheels (8), etc.)

The purpose of the motor is to rotate the alternator, and to overcome the resistance to rotation that it offers, the greater the greater the electrical current it supplies, so that the rotation speed is constant despite the load.

The function of the alternator is to generate the electrical current to supply the loads. It must be capable of maintaining constant voltage at nominal value despite load variation.

The alternator is protected against faults in the line it feeds by means of a circuit breaker with magnetothermal protection. Depending on options, it may also carry differential protection.

The control panel's mission is to act as a management interface for the operator, provide information on the status and operating parameters of the equipment and protect it against possible breakdowns.

Consult the technical sheet to see the minimum air flow specifications necessary for adequate cooling, autonomy calculations according to the fuel tank and consumption, etc.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### 3.2. PAINT

All the metal parts of the generating sets have a paint protection to prevent their deterioration.

The benches and control panels will be painted in satin black, powder-coated. The lateral and upper protection plates of the elements that make up the group will be painted in red. The standard red color of CAROD equipment is the RAL 3000 code.

Some odor and smoke may arise from the exhaust manifold as the factory paint burns off during the first few hours of engine operation. Use only special anti-caloric paint to paint exhaust pipes.

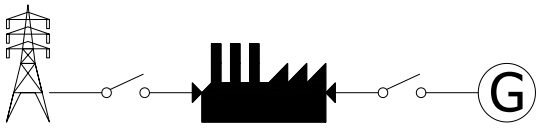
### 3.3. MANUAL GENERATING SETS

These equipments require manual operation to start and stop. They can also have a voltage-free contact to perform this function remotely or do it on a timed basis.


### 3.4. AUTOMATIC GENERATING SETS (EMERGENCY OR MAINS FAILURE)

These groups are designed to supply electrical power only in the event that the main electrical power supply fails. They are equipped with a network surveillance system that analyzes the status of the main supply network. In the event that said supply is defective or null, the generating set will give an order to switch the power supply of the loads from the normal supply to the group supply.

Installation of such switching will be required. It will go in a separate cabinet and will be made by interlocking contactors. It will be necessary to install the power cables and the signal cables between the switching and the group.





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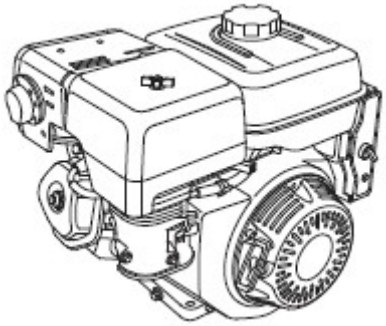
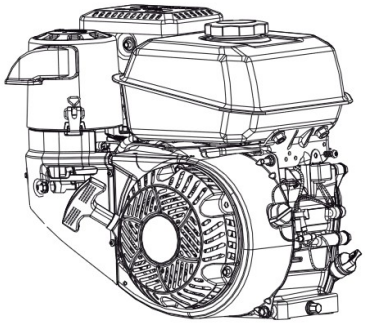
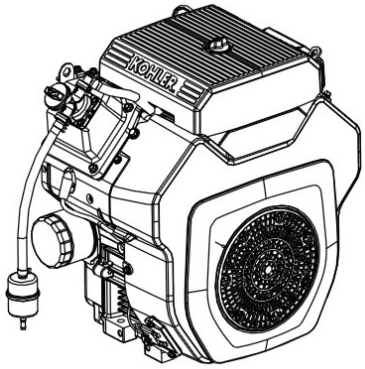
## 3.5. ENGINE GENERALITIES

CAROD generator sets mount several classes of engines, depending on the model. The engine of each group is specially designed to work in generator sets.

The generator set is powered by a single or twin-cylinder gasoline engine. The combustion system is carried out by means of a mechanical carburettor. The regulation and control system is mechanical and can be manual or electrically actuated. They will be cooled by air.








Read carefully the engine User Manual attached to each generator set



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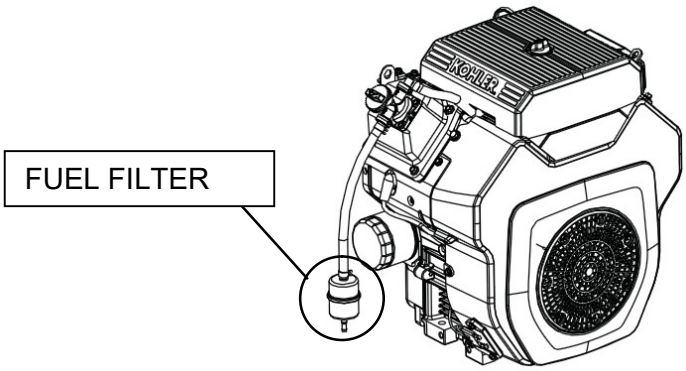
### *3.5.1. FUEL SYSTEM*

The gasoline engine needs a continuous and clean fuel supply. Depending on models, the engine may be equipped with a fuel filter. These filters must be replaced periodically with the same frequency with which the engine oil is changed (see the engine User's Manual where the filter change frequency is indicated)




The generator set is equipped with a fuel tank (called “daily use”). The engine itself can carry it; or, go in an external tank anchored to the chassis of the group. External tanks will have a suction pipe and a return pipe. All tanks are provided with a filler neck.

I The tank should have 5% headspace to prevent spillage and to allow the fuel to expand when heated.

I Refuel the tank with the engine stopped. Do not do so while smoking or in the presence of sources of intense heat. Make sure there is ventilation during the maneuver.

I It is convenient to drain and clean the inside of the fuel tank every 4-5 years.

I Remember that the shelf life of stored fuel is not unlimited and is highly dependent on storage conditions.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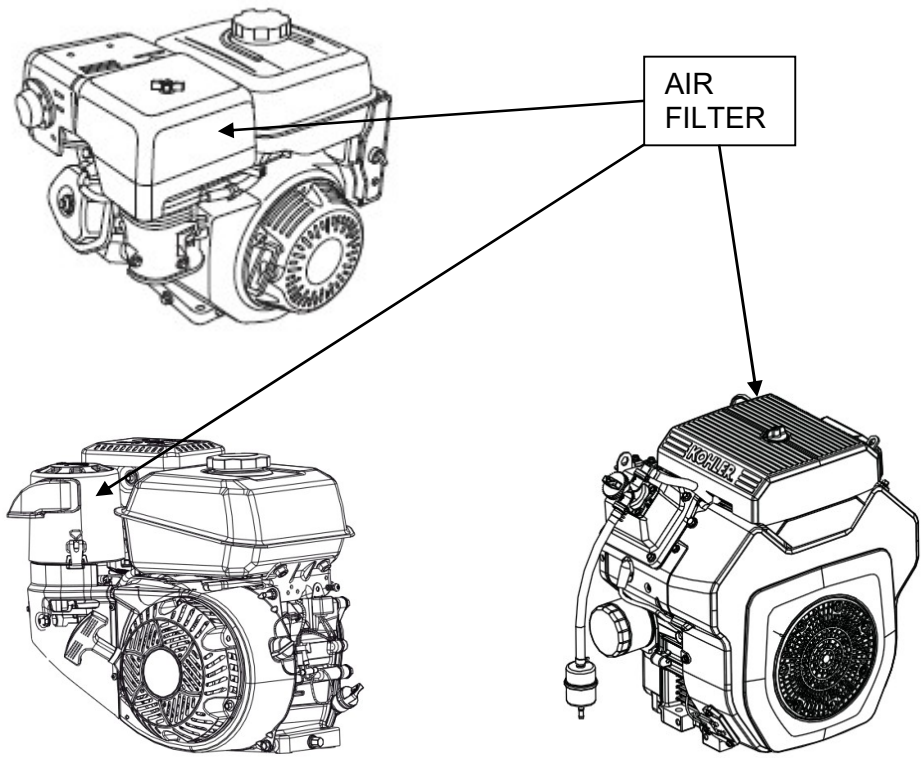
### *3.5.2. AIR INTAKE SYSTEM*

The engine needs to draw in clean air for its operation. To do this, the engine draws in through an air filter.

The air filter is an element that must be replaced according to the manufacturer's recommendations, according to a number of hours of operation or according to an elapsed time, whichever occurs first.




I Never run the engine without the air filter installed. Otherwise, dust and dirt could enter the engine, which would act as abrasives and destroy it in a short time.

Read carefully the engine User Manual that comes with each generator set. It indicates in detail how to change the filter, as well as its periodicity.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### *3.5.3. LUBRICATION SYSTEM*

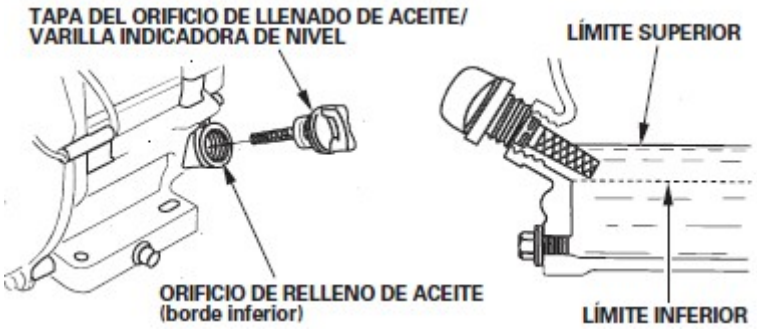
The engine needs oil to prevent friction between its metal components. Without it, friction would arise that would raise the temperature until the metal melted, destroying the engine.

The oil, with use, absorbs dirt from combustion and metal residues derived from wear. That is why it must be kept clean by continually passing it through one or more filters. Filters, in general, accumulate dirt and degrade over time. Oil also degrades with temperature and with combination with oxygen. All this results in the loss of its properties over time and engine operation.

Oil and filters need to be replaced according to the manufacturer's recommendations, based on a number of hours of operation or based on an elapsed time, whichever occurs first. Otherwise the engine will quickly deteriorate until it is useless. Use filters and oil with the characteristics recommended by the manufacturer.

The first oil change should be done after 100 hours of engine work. This is due to the fact that during the settling of the pieces in the first hours, many metallic particles accumulate in the oil and must be removed.

It is normal for the engine to consume a certain amount of oil during operation (usually between 0.25 and 1% of fuel consumption). This amount will increase the greater the load and wear on the engine.




It is necessary to control that the oil level inside the engine is maintained in the proper range. To do this, there is a metal rod marked with the maximum and minimum acceptable levels, with the tip submerged in the casing. It is necessary to verify that it is correct IN COLD before each start of the engine. If the level is abnormally high, notify the technical service. If the oil level is abnormally low, the situation should be studied to see if it could indicate a fault or is simply due to normal consumption.



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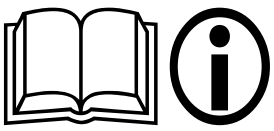
I If you are going to change the oil by yourself, make sure the level is within the range on the dipstick. Leave the level at mid-range, start the engine for a few seconds, stop it and wait 10 minutes. Watch the dipstick and correct the level back to mid-range on the dipstick. Remember that the correct level is observed with the engine cold and stopped.

I Never mix synthetic oil with mineral oil. The mixture can be corrosive to engine gaskets. If you do not know the nature of the engine oil, consult the manufacturer or replace everything, including the filters.

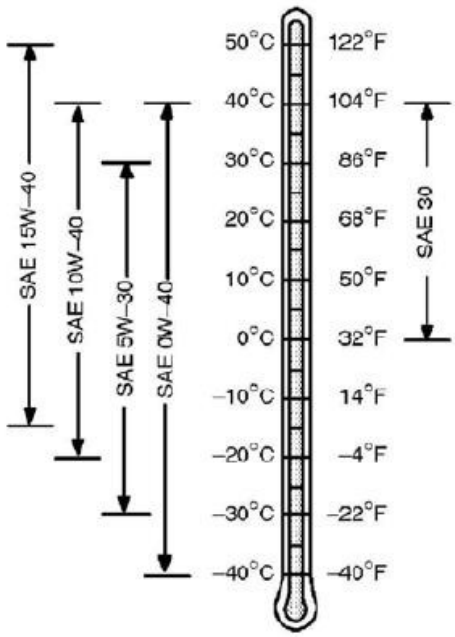
I Change the oil when it is hot. Be sure to wear heavy impervious gloves to avoid burns during handling.

Dispose of used oil and filters at an authorized waste manager.



Read carefully read the engine User Manual that comes with each generator set. It indicates in detail how to change the filter, as well as its periodicity.

**Oil Specifications**




The engine comes out mostly with 10W40 viscosity multigrade mineral oil from the factory. Consult the specifications recommended by the manufacturer in each particular case of motor.

Adapt the viscosity of the oil according to the usual temperature of the operating area of the generating set.

Consult the technical data sheet corresponding to the model of your generating set or the engine manual for the specifications that the lubricating oil must meet.





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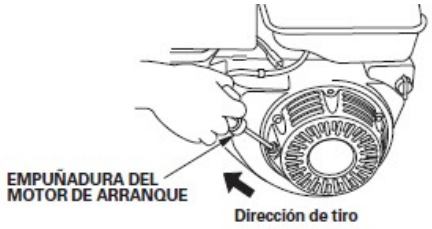
### *3.5.4. MAGNÉTIC PLATE AND BATTERY CHARGE REGULATOR*

In this type of engines, the battery can be charged through a magnetic plate, internally fixed to the engine that feeds a regulator that in turn charges the battery. It only works while the engine is running.

### *3.5.5. ENGINE STARTER*

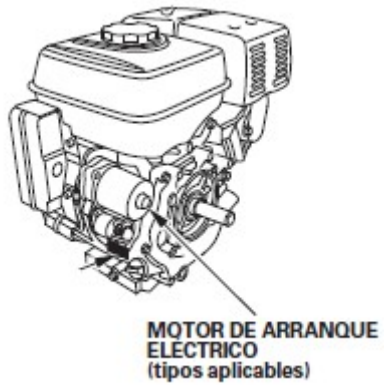
Depending on engine models, it can be started manually or by electric starter.

***Manual start***




Starting is done by means of a wire rope with a handle at the end. Pull the starter grip slightly until you feel resistance, and then pull it hard in the direction of the arrow as shown in the picture. Let the starter grip return smoothly.

***Electric start***




Starting is performed by a direct current motor whose mission is to rotate the engine crankshaft and compress the mixture in the cylinder chambers to start combustion. It is powered by the battery, at the nominal voltage of the electrical system (12V). When it rotates, it engages a pinion gear in a crown concentric to the crankshaft to flip the assembly.

The activation of the starter motor will be carried out by means of a contact key. In some cases (e.g. with control card), the starting will be done by a free potential contact commanded by the control card.

It is important to know that the starter can only work for a limited time. If its use time is prolonged, its temperature increases until it is destroyed.

I Do not tamper with the electrical installation to force the starter motor or it will be destroyed.

I If the starter has made many attempts and its temperature is detected to be high, please let it cool down for 15 minutes until it can be started again.

I The control card generator set is programmed to make a limited number of start attempts. If after that number of attempts it has not been able to start, a start failure alarm will appear and it will be indicated on the control panel. This is to prevent overheating of the starter motor.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### *3.5.6. ENGINE PROTECTIONS*

***Low oil pressure protection***

Low oil pressure in the engine lubrication channels can be indicative of a serious and imminent failure. The value of the oil pressure must be controlled in such a way that the engine stops when it is low.

This is achieved by means of a calibrated mechanical pressure switch that changes state when the pressure falls below a certain value.

### *3.5.7. EXHAUST SYSTEMS*

The engine produces hot and toxic exhaust gases. It is necessary to evacuate them outside the premises safely and through pipes designed in such a way that they do not hinder their exit..

I Avoid contact with the surfaces of the exhaust manifold and exhaust pipes.

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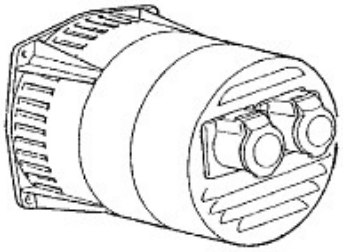
## 3.6. ALTERNATOR GENERALITIES

Its function is to produce the electrical energy supplied by the group. It needs to spin at a constant speed, stay clean, dry, and not overheat. The voltage value can be regulated by an electronic card, which also guarantees the stability of its value.



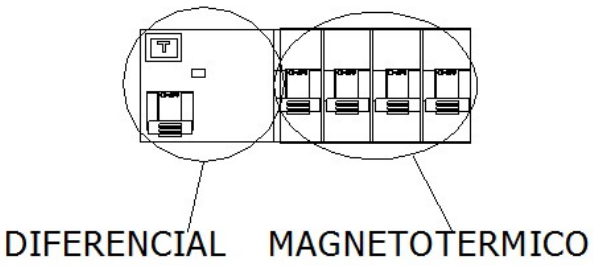
The alternator is air cooled by an internal fan. After activating the normal stop command, the genset must run idle for a while after being freed from the loads. The purpose of this is the cooling of the alternator of the generator.

I Do not stop the engine with the emergency button or any other method of immediate stopping after the alternator has worked with a high load. Otherwise, the latent heat from the windings could end up damaging the insulation.

I Prevent water from entering the alternator. If you are going to install a unit in a humid place, you must heat the alternator so that it does not remain humid.

### *3.6.1. MAGNETOTERMIC AND DIFERENTIAL PROTECTION*

The power output of the generating set is protected by a magnetothermal circuit breaker, calculated for the application.




In certain equipment, depending on the options, the differential protection will be provided by a differential switch for the detection of a separate leakage current.

I To prevent the consequences of a possible coincidence of faults, it is necessary to protect the loads with their respective circuit breakers.

I If you leave the lever of the circuit breaker or differential protection switch down, the electrical current will not reach the loads.

I If when raising a protection switch lever, with the equipment running, it goes back down, this may be indicative of a fault in the line. It is necessary to differentiate if it is a short circuit or a ground fault and solve the problem (see electrical diagram).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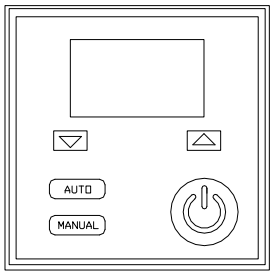
I Never override a protection switch. Repair the defect that causes it to trip. Otherwise, a serious breakdown or major accident could be triggered.

### 3.7. GENERAL INFORMATION ABOUT HANDLING CONTROL CARDS

The generator set control interface is a panel that will normally be installed on the external surface of the electrical panel. Its mission is to control the operation of the equipment (start, stop, operating mode, timings), protect it, indicate its status and, depending on its sophistication, a certain number of operating parameters of the group.

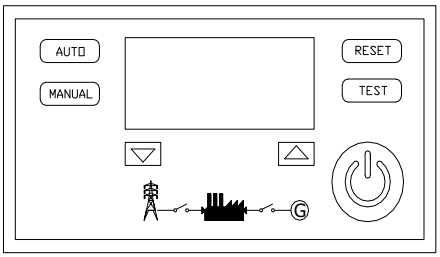
I If a fault light comes on, do not ignore it, correct the problem as soon as possible.

In general, we can find controllers that have MANUAL and AUTOMATIC operating modes.




In both manual application equipment and emergency application equipment, the manual mode will be used to start or stop the group directly from the buttons on the card, using the START and STOP buttons.

In the manual application groups, the automatic mode will be used to start or stop by means of the voltage-free contact, remotely or programmed.




In emergency application equipment, the automatic mode will be used so that the equipment remains monitoring the state of the mains lines and start and switch in case of failure of the same.

I In the groups with hourly programming or emergency application, do not forget to leave the controller in AUTO before leaving the installation. Otherwise, the controller will not start the genset when needed.

Controller cards have a number of programmable parameters, which will vary depending on the application and the type of engine.

I If you have to install a replacement card in a generating set, make sure beforehand that it has been properly programmed for that equipment.

If during the operation of the group a situation is detected in which its immediate stoppage is convenient, there is a red emergency button, in the shape of a mushroom. Its activation will immediately stop the group.

I Do not use this button to stop the group on a regular basis. This form of shutdown inhibits the cool down period and could trigger an alternator failure.





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Turn off the group by pressing the normal STOP button. It will continue to run empty to cool down before stopping for a programmed time.

In the event of a fault, the controller should indicate it and prevent booting until it is corrected. To reset the fault indicators once the problem has been corrected, it will be necessary to put the controller (depending on the model) in "OFF", "RESET", "OFF" or "POSITION 0" and then put it back in MANUAL or AUTO mode, as needed.

### *3.7.1. COMMON ALARMS*

We can find, depending on the sophistication of the controller, a certain number of alarm token types. The most common are:

- Low OIL PRESSURE.
- High coolant temperature.
- Overspeed.
- Start fail (engine fails to complete cranking).
- Generator alternator failure: voltage or frequency.
- Generator overload (protection trig).
- Emergency Stop button activated.
- Battery Low voltage/Battery charger failure.
- Low fuel level.

### *3.7.2. TIMERS*

We find different programmable timers in the controllers. The most common are:

- Preignition time of the engine (if required).
- Cool down time or idle time before stopping.
- First maintenance timer.
- Other maintenance timers.
- Delay of Over/under Frecuency failure.
- Delay of Over/under voltage failure.
- Duration of horn.
- Autotest period programmed in the group.
- Mains failure delay (EMERGENCY Groups).
- Group Circuit breaker conetion delay (EMERGENCY Groups).
- Retransfer time delay (EMERGENCY Groups).

Consult the controller card manual for your generator set for specific handling details.





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### 3.8. BATTERIES

Some batteries require maintenance. This means that its electrolyte evaporates during the normal charging process and its level must be checked and replenished.

Fill all beakers with distilled water up to the mark indicated by the manufacturer. If there is no such mark, fill in 15mm above the plates.

A  I Electrolyte vapor concentrates hydrogen, which is flammable. Do not check the electrolyte level of batteries with the light of a naked flame. Avoid sparking near or in the battery receptacle.

BC I Batteries accumulate hydrogen, the pressure of which must be released by a safety valve. If batteries have their pressure release port clogged, the electrolyte level is low and a glass leaks internally, they burst and spew acid.

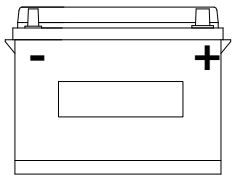
 I The electrolyte is corrosive. Wear anti-acid gloves and protective glasses to check the level and top it up.

If you detect that a battery has exploded, neutralize the sulfuric acid with baking soda or slaked lime.

Replace batteries, for your own safety, every 2 years. Keep them clean and maintained.

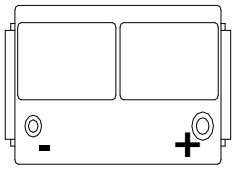
S Ventilate the receptacle (if any) where the batteries are stored before working on them.

Remember that the positive is the thick terminal and it is marked with red color. The negative terminal is thinner and is marked with black. Never reverse the polarity of the battery connections. Electrical equipment can be seriously damaged.




When tightening copper terminals around the studs, tighten them firmly, but remember that overtightening can break the arc of the terminal.

If you are going to relocate the batteries for any reason, remember that they should be as close to the starter motor as possible.




Temperature affects battery performance.

A low temperature favors the battery to accumulate more charge, but makes it difficult for it to release energy. The consequence is that with the cold they have less starting capacity. High temperature can damage batteries. It can be dangerous to carry out charging operations if the battery is over 45ºC.

C I Never tip over batteries. There may be an acid spill.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I Try to keep the batteries out of direct sunlight. This favors its self-discharge.

Keep terminals clean. Cover them with a thin layer of dielectric Vaseline to prevent corrosion.

If a lead-acid battery is deeply discharged, it will not return to its normal charge capacity.

Choose batteries based on the COLD CRANKING AMPS (CCA) value recommended by the generator set manufacturer. This is the important parameter for these equipments.

I Never disconnect or connect batteries while the engine is running.

### 3.9. STARTING WITH BATTERY CLAMPS

If the battery has been discharged enough to not be able to start the genset, jump starting can help.

I Do not attempt to jump start a set with a battery with frozen or frosted electrolyte. Heat the assembly to at least 5ºC before carrying out this operation.

The ideal way would be to do it as follows:

Remove the caps from the discharged battery (if maintenance is required) to ensure that there is no electrolyte vapor pressure built up in the battery. Do not allow foreign bodies to enter the vessels.

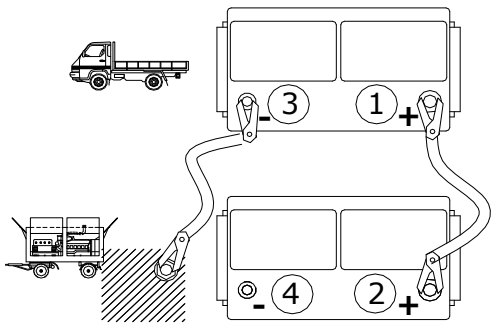
Check battery electrolyte level. It should be at a proper level.

Use for the rescue a system of the same voltage and with a battery equal to or greater than the one to be rescued.

Do not try to salvage a 12V system with a 24V one.

If you are going to do it from a vehicle, do it with the vehicle's engine running.
Do not allow the metal of the vehicle to touch the cluster.

The sequence of the connection of the cables of the clamps is the following:




1 Red wire to the + of the rescue battery
2 Red wire to the + of the rescued battery
3 Black wire to the - of the rescue battery
4 Black wire to GROUND screw, away from genset battery and fuel lines.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Let the generator set charge the battery for a long time. Then, disconnect the cables from the clamps in the reverse order of their connection.

### 3.10. BATTERY CHARGERS

In emergency application groups (mains failure) it is necessary to compensate the natural self-discharge of the batteries by connecting an automatic battery charger. This can be mounted on the electrical panel of the group or external to it. It needs a 230Vac voltage supply from the network for its operation.

Once connected to the network, the amount of charging current will depend on the capacity of the battery in Ampere-Hours, its conditions and the level of charge it presents. The charging current will decrease as the charge level increases and its voltage level increases.

If you are going to choose a battery charger yourself, adapt its features to the need of the batteries.

Do not install the battery charger outdoors or in humid places.

If the battery charging voltage is too high, the electrolyte will evaporate faster.

Turn off the battery charger if you detect that the battery is very hot.

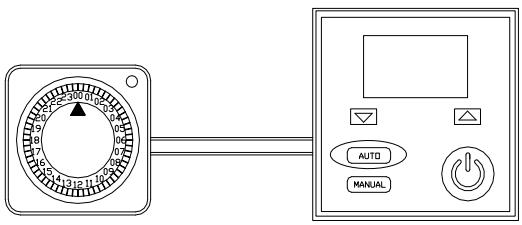
I Always turn off the battery charger before disconnecting the battery. Otherwise you could damage it.

In case of connecting a very discharged battery to a battery charger, we can find that it protects itself from an overcurrent by inhibiting the charge. You can connect to the charger a battery of the same characteristics charged in parallel with the discharged one to make the charger work.

### 3.11. TIME PROGRAMMER (TIMER SWITCH ON/OFF)

Preferably in manual application groups, the controller card usually includes an automatic operating mode, where by changing the state of a free voltage contact we order the start or stop of the group. This is used to program when the group should work or to control it remotely.

I Be very careful when installing the timer, carefully follow the diagram provided and connect the timer contact only to the indicated terminals. In case of doubt, consult qualified personnel.





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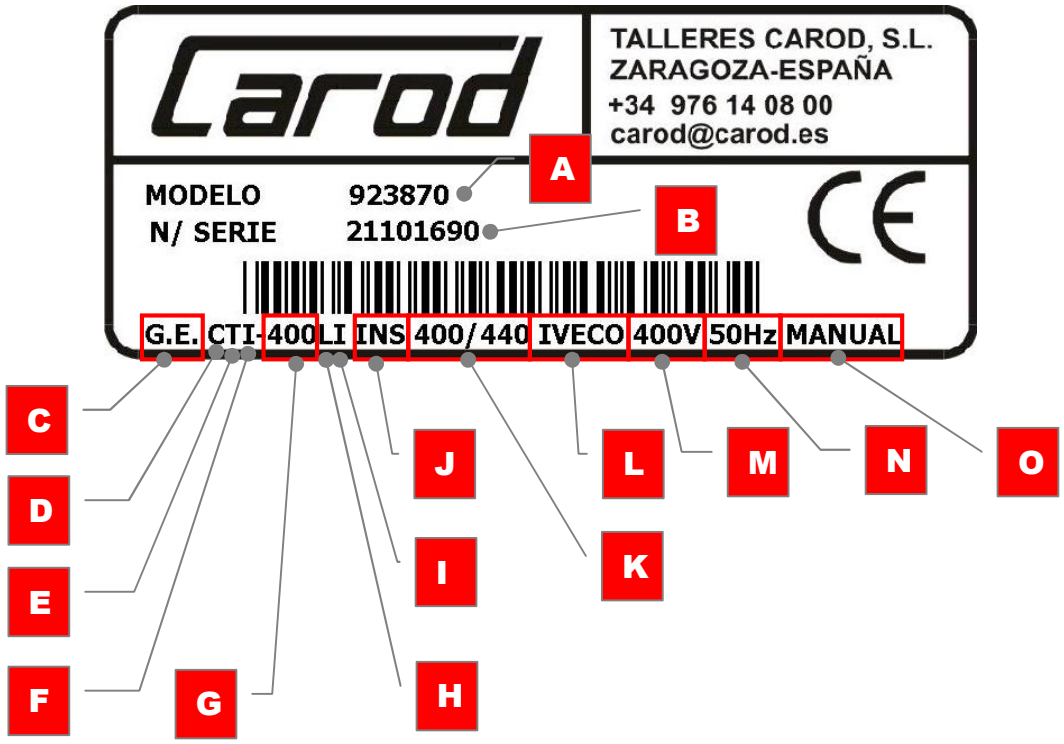
# 4. IDENTIFICATION LABEL OF THE GENERATOR SET

Every generating set has attached a label printed in black on silver like the one detailed in the drawing. Please make sure you have the serial number of the equipment to hand when requesting spare parts or technical assistance.




A: Codification of the model of CAROD genset.
B: Serial N$^{er}$ of the genset.
C: G.E.: Generating set.
D: C means “Carod”.
E: T = Three-phase or M = Mono-phase
F: Engine’s manufacturer codification (M: MWM, L: Lombardini, I: Iveco…).
G: Number related to the power of the generator in kVAs
H: L = Group works at 1.500 r.p.m. w/o letter: 3.000 r.p.m.
I: Whith an “I” the generator set is soundproof.
J: “INS” means “soundproof”.
K: Nominal/Emergency nominal Power of the group.
L: Engine’s manufacturer.
M: Nominal voltage.
N: Nominal Frequency.
O: Continous working (MANUAL) or Emergency/Mains Failure (FTR).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# 5. TEMPORARY INSTALLATION OF THE GROUP

Some tips are described for equipment that is temporarily installed.

Locate the unit where it cannot be damaged by vehicles, does not obstruct the passage and away from sources of dust, other gases or vapors or exhaust fumes from other fixed equipment.

Seat the group on a firm, level surface. Make sure that this surface supports the weight of the equipment plus that of the machine that has to handle it. Consider that the equipment during its operation transmits certain vibrations to the ground.

Position the group so that it can be easily refueled.

I Make sure to connect the set to an effective earth connection at all times. Failure to do so implies risk of electrocution.

I Protect the drop cables from the group to the load. If they run on the floor, cover them with a sturdy surface to prevent damage and accidents.

If you temporarily install the equipment indoors, make sure it is well ventilated. Always channel the exhaust gas through pipes to the outside. Do not do it through tubes that are too narrow, or with narrowing and avoid sharp curves. A restricted exhaust pipe will greatly reduce the performance of the equipment.

I Keep in mind that exhaust smoke is dangerous and can be blown into inhabited areas.

L Read the section on PERMANENT INSTALLATION OF THE GROUP to find out about the needs of the equipment.



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# 6. PERMANET INSTALLATION OF THE GROUP

## 6.1. SPACE REQUIRED

The premises set up for the generating set must be dedicated solely to the generating set and related systems.

To correctly install a generator set in a permanent location, a space equal to or greater than the width of the set must be left around it to facilitate its operation, repair and maintenance. It will also help your ventilation.

If you are going to design the place for the generating set, expect that there may be more elements that take up space, such as the switchboard, exhaust ducting and silencer, auxiliary fuel tank with its transfer pump, bellows and hopper for channeling air from external refrigeration, power cables, control cables (with their trays, etc.).

It must be remembered that for a good cooling of the group or groups, one of the walls of the premises should have an air inlet or inlets located in the lower part, of sufficient section, and another wall opposite to this with the air outlet or outlets. , also from the appropriate section. It must be so that the air current circulates from the generator to the radiator.

## 6.2. PREPARATION THE LOCATION FOR MAINTENANCE TASKS

Consider that during the useful life of the group, it can break down, it can become small, out of regulation or obsolete.

Keep in mind that it may be necessary at some point to carry out replacement work on bulky and heavy parts, which require mounting on a trolley for movement. Design the premises in the vicinity of a forklift or attached to the street or to a garage where a large van can enter.

Avoid installing generator sets in places accessible only through stairs, narrow corridors and obstacles.

## 6.3. WAREHOUSE OF ACCESORIES AND CONSUMABLES

During the life of the generator set, there will be fluid consumption. It is necessary to control its level weekly and restore it periodically.

Replacement fluids are oil, coolant and, depending on the nature of the batteries, distilled water in sufficient quantity.

It will be necessary to set up a place, by regulation, outside the group premises, to store these fluids and other materials. It is advisable to have a roll of paper for industrial use, rags or other absorbent materials to prevent oil leaks, container trays, baking soda or lime to neutralize possible acid spills, documentation on the equipment, hearing protection equipment, work clothes ( not loose), anti-acid gloves, protective glasses, funnels of various sizes, cleaning material, spare parts that are considered, a flashlight with charged batteries, consumables such as Teflon, gaskets, etc., a first-aid kit and basic tools.


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There must be a visible and accessible place to keep a record of maintenance tasks, where it is noted the interventions with their date and hours of work of the team.

### 6.4. WARNING INDICATIONS

I Indicate in a conspicuous way and close to the equipment that the emergency generator set can start without prior warning.

Indicate that access to the group room is restricted to authorized personnel.

Indicate on the door of the room the escape route in case of fire and which is the emergency exit.
Indicate the prohibition of smoking in the group room.

Indicate on the door of the room that it is mandatory to use hearing protection in case the equipment works.

Make sure generator set warning stickers stay in place.

### 6.5. FIRE EXTINGUISHERS

Next to each access to the room, a checked and charged fire extinguisher, class BC or ABC, must be placed. It is necessary to indicate its presence with a luminescent panel.

### 6.6. PREPARATION OF THE GROUP ROOM AGAINST FIRE

According to each regulation, a fire resistance capacity of the premises of at least 1 or 2 hours may be required, and it must constitute a fire sector with respect to the rest of the building's premises. For example, access doors must be firewalls. Check local regulations.

### 6.7. EXIT DOORS IN THE GROUP ROOM

If the group's premises have more than the minimum surface area indicated by the regulations, it must have more than one access, one of them being the emergency exit, which must be kept indicated and operational. (Check local regulations).

The doors must be fireproof and open inwards, in order to overcome the negative pressure exerted by the fan when removing the air from the room. If they open outwards, there is a risk that they will close violently when starting the group and it will be difficult to open them.





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## 6.8. SETTLEMENT OF THE GROUP AND VIBRATION ISOLATION

The first and fundamental thing is to know the weight of the equipment and the capacity of the building structure to support it. Make sure the structure can support the weight of the generator set plus its accessories.

In the installations of emergency groups in basements, it is good to design a reinforced concrete plinth that acts as a support base and tends to isolate the vibrations of this equipment during its operation.

To work successfully, this base should weigh at least 2 times the weight of the entire pool assembly it will support. The plinth must be a rectangle that contains the dimensions of width and length of the group, protruding 150mm all around. It should also rise 150mm from the ground and be separated from the pavement in its entire height by an elastic material that isolates vibrations (rubber, polystyrene, fiberglass).

The concrete weighs about 2300 kg/m$^3$. These data should be used to calculate the height of the plinth foundation.

For its installation on a roof, it is advisable to isolate the vibrations of the group from the ground by means of dampers or silent blocks suitable for the application.

## 6.9. EMERGENCY LIGHTING

The generator room must have emergency lighting.

## 6.10. AIR INTAKE

A minimum intake air flow must be guaranteed to enable engine operation (see technical data sheet).

This air must be clean and fresh to guarantee the performance and duration of the equipment. It is usually taken from the same place as the group. If this place is usually very hot, it will be necessary to make an air intake from the outside.

Make sure that the air intake is away from dusty, polluted or very hot environments.

The engine must be installed in such a way that it does not suck in part of the exhaust gases. Exhaust gas recirculation can result in a serious breakdown.

## 6.11. EXHAUST GAS CHANNELING

The exhaust system must be designed in such a way that it facilitates the escape of the gases so that the maximum value of “exhaust back pressure” established by the engine manufacturer is not exceeded. Excessive restriction in this circuit results in increased fuel consumption, normally high exhaust temperatures, with related faults, and excessive black smoke.


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The circuit of exhaust pipes can be built in black steel or stainless steel. Flexible joints are required between the engine and the exhaust pipe to prevent vibration from breaking the pipes. These flexible joints should never be forced. Build the tube bends as large as practical to improve output.

The diameter of the exhaust must be larger than that of the exhaust outlet of the engine, but also not too large, otherwise water condensation will occur. It is necessary to calculate it according to the length and angles of the installation.

Preferably hang the exhaust sections from the ceiling to prevent it from being touched, do it with metal "swings". Not with rigid supports.

Do not allow the weight of the exhaust duct to rest on the engine outlet or on the hose. The turbo or the exhaust manifold would be damaged in the medium term.

Note that the exhaust is dilated. Install expansion joints in long sections and in pipe direction changes.

If you have to go through walls or ceilings, do not frame the tube on site. Drill a through hole with a radius about 60mm larger than that of the tube and fill the gap around the tube with fire retardant rock wool.

If you must insulate a section of exhaust to prevent contact burns, do so, but do not wrap the exhaust manifold. Its temperature could rise until it is destroyed.

Do not direct exhaust where it can be reabsorbed into the ventilation or intake system. Do not direct it upwind in its most usual direction.

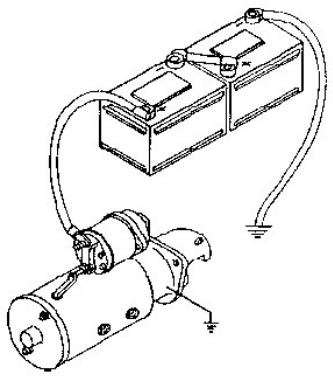
I Remember that the accumulation of exhaust gas is dangerous and generates loud noise. The ideal is to take the exit to the highest part and away from people as possible.

Prevent rain from entering through vertical exhausts, using rain covers.

In horizontal outlets, bevel cut the pipe so that it prevents the entry of rain and cover it with a fine metal mesh to prevent animals from nesting inside.

### 6.12. BATTERY INSTALATION

If you are going to relocate the batteries for any reason, remember that they should be as close to the starter motor as possible.



Temperature affects the performance of batteries. A low temperature favors the battery to accumulate more charge, but makes it difficult for it to release energy. The consequence is that with the cold they have less starting capacity. High temperature can damage batteries. It can be dangerous to carry out charging operations if the battery is over 45ºC.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I Try to keep the batteries out of direct sunlight. This favors its self-discharge.

SB I Electrolyte vapor concentrates hydrogen, which is flammable. Try not to install batteries in a closed receptacle where electrolyte vapor can accumulate.

### 6.13. BATTERY CHARGER INSTALATION

Do not install the battery charger outdoors or in humid places.

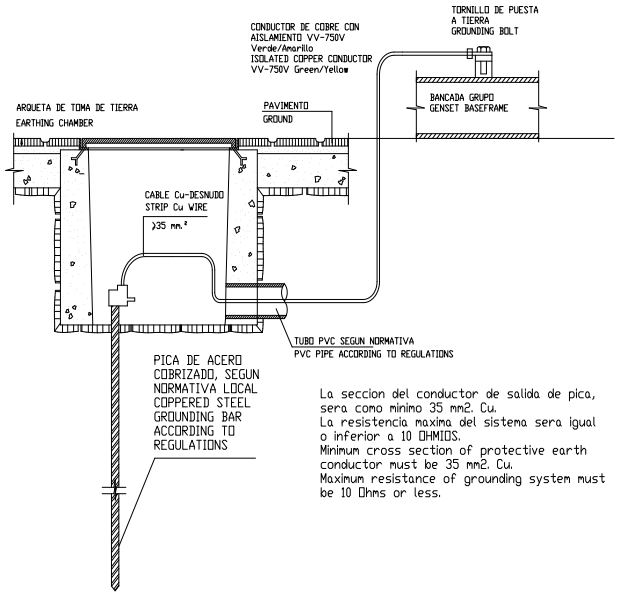
### 6.14. ELECTRICAL CONECTION: PHASES, NEUTRAL, CONTROL AND GROUND

Use conductors of the nature and section prescribed by the current Low Voltage Regulation, according to the nature of its conductive material, its insulating material and the maximum current that they will withstand plus a 10% overload, the ambient temperature, voltage drop, the installation method (embedded, aerial…).

The connection terminals must be of the correct dimensions and well crimped to the connection cables.

I A bad connection of the power cables can generate an electric arc and with it a fire.

Size the neutral cable preferably with the same section as the power cables, especially if you plan to connect loads with a high harmonic content (large battery chargers, welders, large groups of gas discharge lamps…).




If you anticipate that the loads are going to be balanced and mostly resistive and linear, the section of the neutral conductor must be equal to the section of the power conductors up to 16mm$^2$. If they have 25 or 35mm$^2$, they may be 16mm$^2$. If they have more than 35mm$^2$, they may be half the section of the power conductors, at least up to 400mm$^2$$^2$.

I Always connect the chassis of the group to an effective earth ground. Otherwise, there may be a risk of electrocution by coming into contact with the metallic masses of the equipment.

This last sizing rule is applicable to the grounding conductor. The maximum resistance of the ground conductor should be 25Ω (Ohms).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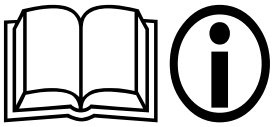
In special cases, the grounding of the group must be independent from that of the installation. Check that the ground connection point of the alternator(s) complies with the grounding regulations in one of the following three systems: TT (neutral to ground and ground masses with independent grounds); TN (neutral and masses to the same ground); IT (isolated neutral and earth masses). Normally the TT system is used.

The signal and control wiring must go in a separate tray from the rest of the wiring.

Alternating current wiring, even for control, must always be separated from direct current wiring.

The control wiring tray must be separated by a minimum of 30 centimeters from any other tray with power or alternating current wiring.

The signal and control wiring will have a minimum section of 1.5 $mm^2$, unless another higher section is required due to a very long distance.



Do not forget to consult and comply with current regulations.





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# 7. STORAGE

If storage is required, leaving the equipment out of use for a period of more than six months, it is advisable to follow some guidelines to facilitate its availability for operation when you want to use it again.

- Start the engine until the oil reaches more than 70ºC.
- Switch off the group, leave it in “OFF”.
- Drain the oil from the crankcase and remove the oil filter. Protect the filter hole.
- Disconnect the negative of the battery. If it can be used in another application.
- Empty the fuel tank.
- Remove and empty the fuel filter. Protect exposed holes.
- Do not store the equipment in humid, dusty or extremely cold places.
- Cover the equipment with a plastic during its inactivity time.

When returning to service, reinstall new oil and filters. Connect a working battery, fill the tank with new and clean fuel.

# 8. GENERATOR SET LOADS

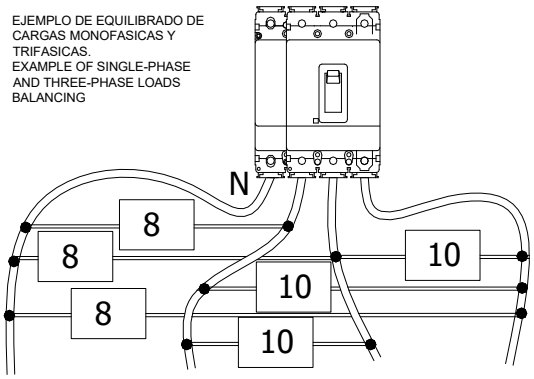
The power sizing of the loads to be fed is the buyer's responsibility. It is advisable to leave a minimum margin of 10% on the calculated necessary power so that the generator does not work at 100% of its capacity. If the work is going to be constant, it is recommended to load it to 75-80%.

Nor is it recommended that the engine always work with a load of less than 60%, since it would not reach its operating temperature, the oil in the crankcase would rise until it was removed through the exhaust manifold joints and it would also suffer premature wear. Make sure you buy the generator you need.

It is advisable to protect the loads powered by the generating set by means of magnetothermal switches, to protect them from a possible coincidence of faults.

When single-phase loads are connected in a three-phase group, it is of vital importance to distribute these loads equally among the three phases. Otherwise, we could overload one of the lines and develop a problem.

EJEMPLO DE EQUILIBRADO DE CARGAS MONOFASICAS Y TRIFASICAS.
EXAMPLE OF SINGLE-PHASE AND THREE-PHASE LOADS BALANCING




There are certain types of loads that include solid-state switches (welders, battery chargers, large sets of gas discharge lamps...) and they generate a large number of harmonics. In these cases, a more oversized generator set than usual will be necessary, to avoid excessive heating of the magnetic cores of electrical machines and overload of the neutral cable. Oversizing is also necessary in the case of motor loads with frequent starts.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# 9. CONMUTATION SYSTEM FOR EMERGENCY GROUPS

The voltage monitoring module (which can be incorporated into the controller card) analyzes the status of the supply network parameters.

If it detects a failure, it sends the group start command. When it reaches the appropriate voltage and frequency value, it will give the commutation order so that the loads are powered by the group. To do this, it must open some contacts and close others.

When mains power is restored, the group, after a programmed safety time, will switch again so that the loads are powered by the normal mains.

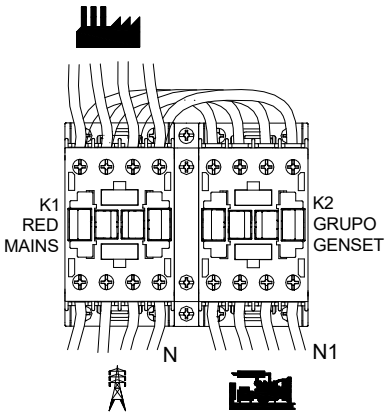
After shedding the loads, the genset will idle to cool the alternator for the programmed cool down time. Once this time has elapsed, the stop order will be activated.

It is necessary to know that when the network fails, there will be a time of absence of energy of several seconds while the group starts, stabilizes and the switching takes place.

In the case of feeding a critical load that cannot afford this absence of voltage, the group will have to be combined with a UPS (Uninterruptible Power Supply).

Consult the electrical diagram to know how the switching is connected to the group.

The switching will be carried out by means of contactors with mechanical interlocking to avoid the simultaneous input of the network and the group, thus avoiding a possible electrical failure.





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# 10. CONSIDERATIONS REGARDING THE START-UP OF THE GENERATING SET

## 10.1. GENERAL ISSUES

Both the first start-up of the generating set and the start-up after a complex repair should be carried out by a qualified technician with knowledge of this equipment.

Before starting up the group, make sure that you know how to use the controller and that you have read and understood the instructions in this manual.

It is advisable to do the first start-up with the lever of the magnetothermal circuit breaker lowered. If it is observed that the electrical parameters of the group are correct, raise the lever.

See the instruction section of the control card (if any) to learn how to operate the group.

## 10.2. INSPECTION BEFORE STARTING (ALWAYS APPLICABLE)

Before starting, check the oil levels and if you equip batteries with maintenance, the electrolyte level of the batteries.

I See the sections “Lubrication system”, “Cooling system” and “Batteries” for the methodology and risks of this practice.

## 10.3. AFTER STARTING

Whenever the equipment starts up, it is convenient that someone go to observe at least the initial moments of operation.

If there is, it is necessary to attend from time to time the panel of the controller card in case it indicates any abnormality during the operation of the equipment. The controller shall not indicate failure warnings during normal operation of the equipment.

The parameters must be within the range specified in the engine and alternator specifications section.


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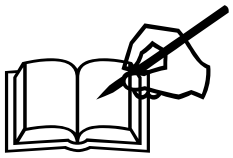
# 11. GENERATOR SET MAINTENANCE

## 11.1. GENERAL ISSUES

Maintenance and overhaul must be carried out only by qualified technicians. Properly following the maintenance program set out in your engine manual is the key to a long life of the generating set.



It is convenient to record these maintenance tasks in a format where the interventions and revisions are noted, with the date and hours of work of the group corresponding to the moment in which they are carried out.


Before performing any maintenance or repair on the group, make sure that it cannot start unexpectedly.

## 11.2. CLEANING

I Prevent water from entering the generator. Also inside the electrical panel. If you suspect that water has entered any of these components, disconnect the battery negative and apply a heater in the direction of the areas that need to be dried until necessary.

I Avoid climbing on top of the engine. You could damage wiring, sensors, or other delicate items.

I Do not clean the generator set when it is running.

I Make sure it can't boot unexpectedly while you're cleaning it. Leave it at “STOP”. If in doubt, disconnect the negative of the battery.

I Do not use flammable solvents to clean the group.

Keep the refrigeration pathways of the group and the installation room clear and clean.

## 11.3. PERIODIC TEST OF THE GENERATOR SET

In generating sets, especially emergency ones (mains failure), periodic operation is needed to check their integrity and for the oil to permeate certain internal components of the engine, avoiding their corrosion or seizure.

It is good that the group works weekly, preferably with load until it reaches the maximum refrigerant temperature and stabilizes.

Do not run the group more than 10 minutes without load.

It is warned that if the motor remains without working for more than a month, internal corrosion may appear, shortening its useful life. If the fuel breaks down it will be necessary to repair the generator set.

In the network failure controller cards there is the possibility of programming this periodic test, with or without switching the load.

### 11.4. OIL AND FILTERS CHANGE

Every certain number of operating hours, it is required to replace the lubricating oil and engine oil and fuel filters. This task is performed every 250h or every 500h. Consult the engine manual to verify the number of hours of the interval.

### 11.5. DAIRY REVISION

- ☑ Visually check the entire generating set for signs of leaks from the fuel system, cooling system or lubricating oil containment gaskets.
- ☑ Check that the oil level has not risen or fallen outside the limits.
- ☑ Check fuel level in the tank.
- ☑ Check the voltage and appearance of the batteries (See section "Batteries").
- ☑ Observe if the group is in AUTOMATIC mode (Groups with Control Card).
- ☑ Check that there are no objects or dirt obstructing the ventilation paths of the alternator, radiator, or that could be trapped by the fan or group belts.
- ☑ Check that there is no dirt that could be absorbed by the fan in the immediate vicinity of the group if it were to start operating.
- ☑ Observe if the control panel shows the data normally (Groups with Control Card).
- ☑ Observe if there are any fault warning lights on the control panel.
- ☑ If the group works every day in a dusty environment, shake the dust from the air filter and apply the daily weekly inspection guidelines.

Correct if abnormalities detected. Record them in the maintenance log.

### 11.6. WEEKLY REVISION

- ☑ Observe the cleanliness of the radiator and the cooling pipes in the room. Observe the integrity of the exhaust circuit. Observe the integrity of the motor wiring.
- ☑ We must measure a battery voltage value equal to between 12V and 14V. If we exceed the charging voltage, the electrolyte in the batteries will quickly evaporate.
- ☑ Run the set 5-10 minutes every week preventively, preferably with load, but if not possible, without load.
- ☑ The parameters must be within the range specified in the engine and alternator manual.
- ☑ The generated voltage must not go beyond the value by more than 5% with respect to the nominal. It must be stable.
- ☑ The frequency can be about 50-52Hz with no-load.
- ☑ The controller panel should function normally and should not indicate failure warnings during equipment operation (Groups with Control Card)
- ☑ If the generating set alternator is equipped with brushes, check for possible wear (see alternator section).





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### 11.7. MONTHLY REVISION

- ☑ Observe the electrolyte level of the batteries. Replace it if necessary.
- ☑ Run the set on load for at least one hour.
- ☑ Check if the battery voltage value rises when starting the group. This way you will know if the charging alternator works.

Remember that to check the proper functioning of the engine speed control and the alternator voltage regulation board, the set should be running under load.

The oil pressure returns to normal 10 seconds after the engine starts running. It goes down as the engine approaches its normal operating temperature until it stabilizes. The low oil pressure light should not come on.

If you are going to record values of operating temperature, oil pressure, voltage, frequency, etc., wait for the engine to reach normal operating temperature and stabilize. Take the values then.

The frequency can be around 52Hz without load and 48Hz at full load, depending on the engine speed governor.

If tested on load, the electrical current generated must not exceed the maximum value corresponding to the power of the group. If so, the protection systems should act.

### 11.8. SEMI-ANNUAL REVISION OR EVERY 250 HOURS

- ☑ Clean the battery terminals and apply dielectric petroleum jelly.
- ☑ Check that the screws of the power cable connection terminals are firmly tightened.
- ☑ Check that the exhaust circuit bolts are firmly tightened.
- ☑ In emergency application groups, simulate a network failure to test switching and automatic start of the group.
- ☑ Carry out the maintenance operations indicated in the engine and alternator maintenance section, depending on the hours of operation or the time elapsed since the last service.

### 11.9. ANNUAL REVISION

- ☑ Inspect alternator.
- ☑ Inspect crankshaft vibration damper.
- ☑ Inspect Engine and alternator supports.
- ☑ Change engine oil and filter if it has not worked for the necessary number of hours to require changing before.
- ☑ Change engine fuel filters if it has not worked the number of hours necessary to require changing before.
- ☑ Check the operation of the engine protection systems.
- ☑ Inspect starter motor.
- ☑ Observe possible leaks from the crankshaft seal.
- ☑ Clean equipment.
- ☑ Clean the radiator.


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## 11.10. EVERY 2 YEARS

☑ Replace the batteries with others of identical features and size.

Remember that generator sets operating in very intensive applications require more frequent testing.

Applying a checklist does not exempt from applying the other corresponding ones if the set intervals have been met.





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| MAINTENANCE LOG (Complete it weekly). | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GENSET SERIAL NUMBER: | | | | | | | | | | | |
| TECHNICIAN | | | | | | | | | | | |
| DATE | | | | | | | | | | | |
| RUNNING HOURS | | | | | | | | | | | |
| **Stationary chek** | | | | | | | | | | | |
| Room Temperature | | | | | | | | | | | |
| Battery voltage | | | | | | | | | | | |
| Battery OK | | | | | | | | | | | |
| Heating Resistance OK | | | | | | | | | | | |
| Oil level OK | | | | | | | | | | | |
| Coolant level OK | | | | | | | | | | | |
| Fuel level OK | | | | | | | | | | | |
| Water separator drain | | | | | | | | | | | |
| Room cleaning OK | | | | | | | | | | | |
| Radiator cleaning OK | | | | | | | | | | | |
| **Running check** | | | | | | | | | | | |
| Air filter restriction | | | | | | | | | | | |
| Frecuency without load | | | | | | | | | | | |
| Voltage without load | | | | | | | | | | | |
| Frecuency with load | | | | | | | | | | | |
| Voltage with load | | | | | | | | | | | |
| Generator current with load | | | | | | | | | | | |
| Coolant temperature | | | | | | | | | | | |
| Oil pressure (if indicated) | | | | | | | | | | | |
| Exhaust manifold temperature | | | | | | | | | | | |
| Test duration (hours) | | | | | | | | | | | |



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# 12. IDENTIFICATION AND SOLUTION OF FAULTS

I Note: for any electrical repair, first disconnect the battery negative to prevent unexpected starting.

Next, a guide for the identification and solution of possible faults in the group will be exposed. If you do not meet the necessary qualifications to follow the instructions without risk, seek the assistance of an expert technician in generator sets.

**THE ENGINE DOESN'T START**

**Starter motor doesn't rotate**

- ❑ Observe if the battery voltage is correct. Charge or replace if bad.
- ❑ Check if there are blown fuses in the panel.
- ❑ See if there is any alarm light on the controller. Reset alarms if so.
- ❑ Battery terminals broken, loose or with poor contact.
- ❑ With the electrical diagram:
- ❑ Check the power supply and status of the starter motor drive relay.
- ❑ Review electrical installation in search of loose or loose connections.
- ❑ Check starter motor solenoid, state of its brushes, continuity and insulation of its windings, state of the attack pinion.
- ❑ Faulty controller board.
- ❑ Faulty starter relay.

**Starter motor rotates but the engine doesn't start**

- ❑ Check if the group has gasoline.
- ❑ Check that fuel reaches the gasoline filter and that it is not clogged
- ❑ Seized stop solenoid valve. Check if it makes a "click" when changing the state of the supply voltage. Attention to possible failure of the controller card.
- ❑ Failure in the starter motor. Check if the correct voltage reaches the terminals.
- ❑ Fuel in poor condition.
- ❑ Fuel filter clogged with dirt. Replace.
- ❑ If white smoke comes out of the exhaust pipe, it indicates that the engine is receiving fuel but is having difficulty starting. Consult the corresponding section of the engine manual.
- ❑ □ Dirty and/or clogged fuel tank breather.

**ENGINE TAKES TO START**

- ❑ Lack of fuel flow. Clogged filter.
- ❑ Clogged air filter.
- ❑ Starter motor with damaged pinion.

**GENERATOR STOPS DUE TO AN ALARM**

**Engine Overheating**

- ❑ Check carefully if the high temperature is real.
- ❑ Check that abundant air enters and leaves the group room.
- ❑ Ensure that the temperature in the group room does not exceed 40ºC. Otherwise, improve ventilation.
- ❑ Check the oil level.

**Low oil pressure**

- ❑ Check oil level and top up if necessary.
- ❑ Check bypass in the pressure switch circuit. If it is OK, try to replace the pressure switch.
- ❑ Check with a manometer if the actual engine oil pressure is within the expected range.
- ❑ Worn connecting rod - crankshaft bearings.
- ❑ Worn oil pump.
- ❑ Obstructed or dropped oil suction pipe.
- ❑ Oil pressure regulation valve poorly regulated or blocked.
- ❑ If the pressure is really low, notify the technical service.
- ❑ Remember that if the group appears stopped and the low oil pressure warning light is on, it could be because it has run out of fuel, stopping unexpectedly.


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**Low engine speed**

❑ If the speed is abnormally low, check that the power connected to the group is not higher than the nominal. See the value of the current consumed and try to remove the load.
❑ If it is not overloaded, it may be a speed control problem. Notify technical service.

**Fuel level**

❑ Check that the fuel level is sufficient.
❑ If it is OK, check the operation of the level sensor.

**Generator voltage fault**

❑ Check circuit breakers and fuses in the electrical panel.
❑ Check that the loads are balanced.
❑ Check the state of the alternator diodes.
❑ Fault in alternator voltage regulator.
❑ Check alternator voltage regulator fuse.
❑ If the loads have power transistors or similar, disconnect them and check if the voltage is normal.
❑ Controller card with faulty voltage detector.

**Over - intensity**

❑ Check that the power value of the loads is within the range supported by the alternator. If it supports excessive current, disconnect loads.

❑ The group can be protected against overloads by the magnetothermal switch and by reading the current from the controller. Depending on the programmed current threshold value, this can order the group to stop.

**Battery charge failure**

❑ In motors with a regulator, check that the alternating voltage from the magnetic plate arrives and the positive after contact that it needs.
❑ If everything is correct and the systems do not generate a charge signal, replace the component if necessary.

**ENGINE STOPS FOR NO APPARENT REASON**

❑ Emergency not indicated due to controller failure.

**GENERATOR DOESN'T STOP BUT SHOWS WARNINGS**

**Battery low voltage**

❑ Check the fuses and circuit breakers of the electrical panel that feeds the charger (in emergency groups).
❑ Check that the battery charger is powered at 220V.
❑ Check that the batteries are not older than 2 years.
❑ Check that the batteries have a correct electrolyte level.
❑ Verify that the charger works correctly with 220V power and with a battery in good condition. Otherwise, replace or repair the charger.

**THE GENERATOR DOESN'T STOP BUT THERE IS A STOP ORDER**

❑ Check if the group has dropped the charges and is simply cooling down.
❑ Check that the electromagnet or the fuel supply electrovalve (or stop, or "stop") reacts when it is excited.
❑ If it always remains open despite the change in the state of its actuation voltage, it must be disassembled and checked or replaced.
❑ If the group stops when de-energized and we have a voltage value that does not disappear from the fuel supply electrovalve or electromagnet, check the corresponding circuit.
❑ Faulty controller card.

**ENGINE RUNS IRREGULARLY**

❑ Irregular fuel supply. It may be low fuel level.
❑ Clogged fuel filter.
❑ Excessive oil level. Check level.
❑ Grabable speed control rack.

**ENGINE OVERHEATING**

❑ Ensure that the equipment has sufficient cooling air passage (see room cooling) and that hot air from the radiator or exhaust does not recirculate.


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❑ Check that the air filter is not clogged. Change filter if suspected.
❑ Ensure that there are no obstructions in the engine air intake circuit.

**ENGINE STOPS WITHOUT AN ORDER**

❑ Check that there is a fuel level in the tank.
❑ Check that there is a justified shutdown alarm.
❑ Blocked air filter.
❑ Check that the stop solenoid valve does not close unintentionally.
❑ Check that the fuel circuit is not dirty.
❑ Ensure that the motor load is not excessive.
❑ Fault in the control card.
❑ Clogged fuel tank breather.

**ENGINE RUNS SLOWLY AND DOESN'T ACCELERATE**

❑ Excess of load.
❑ Clogged fuel filter.
❑ Broken regulator spring.
❑ Speed control rack engaged.

**LIGHT GRAY OR WHITE EXHAUST SMOKE**

❑ The engine has not started for a long time.
❑ Excessively prolonged operation without load.
❑ Engine running in.
❑ Segments and sleeves worn.
❑ Excessive oil level.
❑ Excessive oil consumption. Observe the state of engine wear.

**BLUISH EXHAUST SMOKE**

❑ Excessive oil consumption. Assess the state of engine wear and check the oil level in the crankcase.

**BLACK OR DARK GREY EXHAUST SMOKE**

❑ Clogged air filter. shake or change
❑ Operation with excess of load.
❑ Carbon in the engine and in the exhaust accumulated due to work with a light load.
❑ Fuel in poor condition. Drain, clean and replace fuel.

**OIL LEAKS THROUGH THE EXHAUST MANIFOLD JOINTS**

❑ Very prolonged operation without load. Undercharged alternator.
❑ Excessive oil level. Check the level.

**LOSS OF ENGINE POWER**

❑ Clogged fuel filters.
❑ Very dirty air filter.

**THE SWITCH BETWEEN MAINS AND GROUP IS NOT PERFOMED**

❑ Check that the group contactor works (DANGER: do not force to close the group contactor and the mains contactor at the same time).
❑ Fault in the controller card or in the voltage monitor (if it has one).
❑ If mains does not feed the load, check the contactor in the same way.

**CONTROLLER CARD WITH ALL LIGHTS ON**

❑ Low battery voltage. Check it.
❑ Failure in the controller

**ALTERNATOR DOESN'T GENERATE**

❑ Check if the group's main thermal lever has risen.
❑ The alternator has lost its remaining magnetism. Follow the instructions to magnetize the core again.
❑ Faulty alternator rectifier diode.
❑ Destroyed rectifier varistor.
❑ Failure in the voltage regulator card.
❑ Winding cut or derived.
❑ Very low engine speed.
❑ Destroyed capacitor (if single phase).
❑ Worn brushes or broken brush holder (if equipped with brushes).

**UNSTABLE VOLTAGE**

❑ Unstable engine speed. Engine speed control fault.
❑ Voltage regulator with poorly adjusted stability potentiometer.
❑ Defective alternator voltage regulator.
❑ Load incorrectly connected. You may be losing touch with the vibration


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## HIGH VOLTAGE WITHOUT LOAD

- ❑ Engine speed too high.
- ❑ Poorly regulated voltage potentiometer of the voltage regulator.
- ❑ Failure in the alternator voltage regulator card.
- ❑ Capacitor with too much capacity in single-phase generator.

## LOW VOLTAGE WITHOUT LOAD

- ❑ Engine speed too low.
- ❑ Voltage potentiometer of the alternator voltage regulator card incorrectly adjusted.
- ❑ Failure in the alternator voltage regulator card.
- ❑ Alternator winding communicated.
- ❑ Faulty bridge rectifier diode.
- ❑ Varistor destroyed.
- ❑ Capacitor with too low capacity in single-phase group.
- ❑ No-load voltage of 20% of the nominal. Adjusting the alternator voltage regulator potentiometer has no effect.
- ❑ Blown fuse in the voltage regulator.
- ❑ Rupture of the excitation winding.
- ❑ Poor voltage regulator supply.

## CORRECT VOLTAGE WITHOUT LOAD BUT LOW VOLTAGE WITH LOAD

- ❑ Very high load. Reduce the load of the group if it is appreciated that the frequency indicated by the controller is less than 48Hz.
- ❑ Failure in the alternator voltage regulator card.
- ❑ Shorted rectifier diode.

## LOW VOLTAGE

- ❑ Voltage between 50% and 70% of the nominal.
- ❑ Check alternator frequency. If it is low, it indicates an overload of the equipment or a problem in the motor speed regulator. Try releasing loads.
- ❑ Voltage potentiometer not calibrated in the voltage regulator.
- ❑ Blown fuse in the voltage regulator.
- ❑ Fault in the voltage regulator.

## ABNORMAL NOISE IN THE GENERATOR

- ❑ Bearing (or bearings) worn.
- ❑ Loose coupling.
- ❑ Problem of harmonics in the load.

## OVERHEATING IN THE ALTERNATOR

- ❑ Dirt clogging the cooling opening.
- ❑ Overloaded alternator.
- ❑ Poor ventilation in the room.

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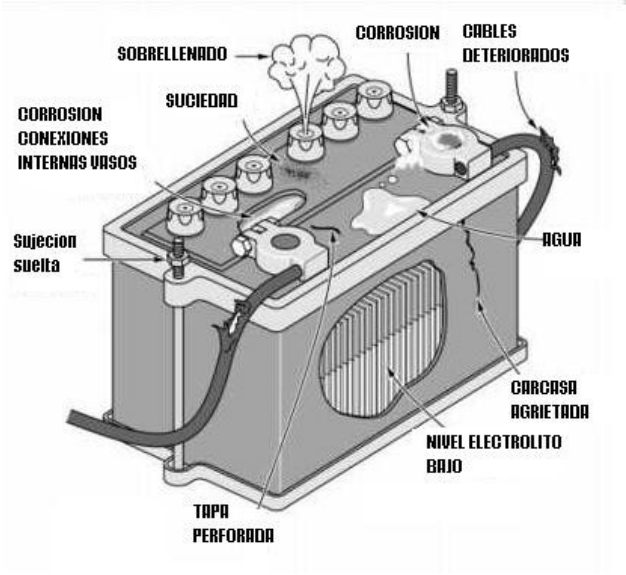
## TROUBLESHOOTING IN BATTERIES




I Danger. Batteries contain a highly corrosive sulfuric acid solution. This liquid must not be spilled under any circumstances. It must be handled with special anti-acid gloves and goggles or protective mask for the eyes. See “Batteries” section for hazard information.

The section is applicable to batteries that require maintenance.

**Acid leaks out of filler holes.**

❑ Battery too full of electrolyte. Remove and neutralize the remaining electrolyte with bicarbonate.

❑ Replenish distilled water only up to the indicated mark.

**Electrolyte level drops too quickly.**

❑ The charging voltage is too high.
❑ Regulate battery charger or install power diodes in series to circuit to reduce voltage.

**The battery has poor starting performance.**

❑ Low battery charge.
❑ Check if the battery is more than 2 years old.
❑ If the battery is new, check if it has the recommended performance.
❑ Check the circuit for a short or shunt to positive.
❑ Electrolyte level too low.
❑ Poor electrical connection. Check loose connections at terminals.

**Terminal appears fused.**

❑ Loose connection at the terminals.
❑ Broken terminal ring.
❑ Excessive current.

**The battery discharges very fast.**

❑ Old battery. Sulfation.
❑ Small battery for the application.
❑ Too many deep discharges. With each deep discharge it loses its carrying capacity.
❑ Dirty electrolyte.

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# 13. WARRANTY TERMS

CAROD guarantees all new equipment from its manufacture for a period of one year from its start-up; Said start-up must be communicated in writing within a maximum period of 60 days from the invoice date. In the absence of this communication, the effective beginning of the guarantee period will coincide with the date of the invoice.

The guarantee covers the replacement or repair of damaged parts due to a proven manufacturing or assembly defect. It does not cover damage due to misuse or application, negligence, wear, unauthorized design alterations, or causes beyond the normal operation of the equipment.

Failure to observe or incorrectly follow the instructions for installation, use and maintenance contained in the instruction manual will be sufficient cause for the loss of the equipment guarantee.

Travel expenses, subsistence allowances and displacements of the personnel that carry out the services under guarantee will always be borne by the client, including the expenses of assembly, disassembly, and accessibility to the equipment.

Carod reserves the right to request the recovery of the damaged equipment or element subject to guarantee, the transportation costs of both the equipment and the defective parts and, where appropriate, replaced will be borne by the client.

The decision to accept or deny a guarantee corresponds to Carod, in the event of failure of components not manufactured by Carod, these are subject to the guarantee conditions of their manufacturer.

The repair or replacement of materials in the equipment will not renew or extend the duration of its warranty period.

If any of the warranty clauses described does not comply with the laws established in a country from which the equipment is to be imported, the importer has the obligation to notify CAROD before carrying out the purchase-sale operation.

*Compliance with this manual is intended to be a help guide and does not exempt from compliance with current regulations. Carod is not responsible for any discrepancy that may arise between what is written here and the mandatory regulations.*

*Revision n$^{er}$ 0 – Date April 2023*

OTHER DOCUMENTS:

DECLARATION OF CONFORMITY CE
WIRING DIAGRAMS – INTERCONECTION WITH C/O BOARD
DATA SHEET OF THE GROUP
SPECIFICATIONS AND USER GUIDE OF THE CONTROL CARD
SPECIFICATIONS AND USER GUIDE OF THE ENGINE
SPECIFICATIONS AND USER GUIDE OF THE ALTERNATOR


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# NOTES





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