modasa

GENSET OPERATION, MAINTENANCE AND INSTALLATION MANUAL

STATIONARY | MOBILES | SOUNDPROOF

MODASA GENSET
OPERATION, MAINTENANCE AND INSTALLATION MANUAL

1. - Introduction

This manual has been prepared in order to guide users in the correct installation and maintenance of Modasa gensets.
It is worth clarifying that Modasa, in its continuous search for improvement, may make modifications to this manual.
Pay special attention to the safety instructions, which must be followed at all times to avoid accidents and damages.
Maintenance operations must be carried out according to the periods indicated in the tables; In addition, the engine and alternator manuals provided by the manufacturer must be consulted.
If working in unfavorable conditions, the frequency of maintenance must be increased.
Preventive maintenance is performed to obtain better performance and extend the useful life of the genset.
Repairs and adjustments must be made by qualified people; Modasa has After Sales Service and Spare Parts departments, which are qualified to provide technical assistance and resolve any question.
Original spare parts and supplies should always be used; The use of non-original materials affects the useful life of the equipment, voiding the warranty provided by our company.

Your comments and suggestions are of interest to us, as they could allow us to improve this document; you can send any type of contribution to the email: **servicio@modasa.com.pe** or by contacting your salesperson directly.

1.1.- Abbreviations used in the manual

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ºC	degrees Celsius
DP	Depression
ºF	degrees Fahrenheit
ft-lb	foot-pound
H2O	water
Kg	kilogram
KW	kilovatio
L	liters
L/h	liters per hour
L/s	liters per second
m	meter
mm	millimeter
m^3/s	cubic meter per second
mmCA	millimeter of water column
N.m	Newton-meter
Psi	pound per square inch
SAE	Society of Automotive Engineers
rpm	revolutions per minute
T°	temperature
%	percentage
ISO	International Standards Organization
NEMA	National Electrical Manufacturers Association
BS	british standards
DIN	German Institute for Standardisation
UTE	Union of Technical Electricians
CEI	Italian Electricity Committee
VDE	Testing and Certification Institute
Cst	Centistoke

1.2.- Technical standards

Engine:	ISO 3046, BS5514, DIN 6271
Alternator:	UTE NFC 51-111-105-110, ICE 34-1, CEI 245-4, BS 5000-4999, NEMA MG 21, VDE 0530,
Electric control panel:	NEMA 1, CEI 245-4
Generator:	ISO 8528

1.3.- Pictograms and their meaning

1. - Genset

2.1.- Description of parts and components

A typical genset is shown below. However, the units may have slight variations depending on the size and configuration of the main components.

This section briefly describes the different parts of the genset; a more detailed description will be provided later.

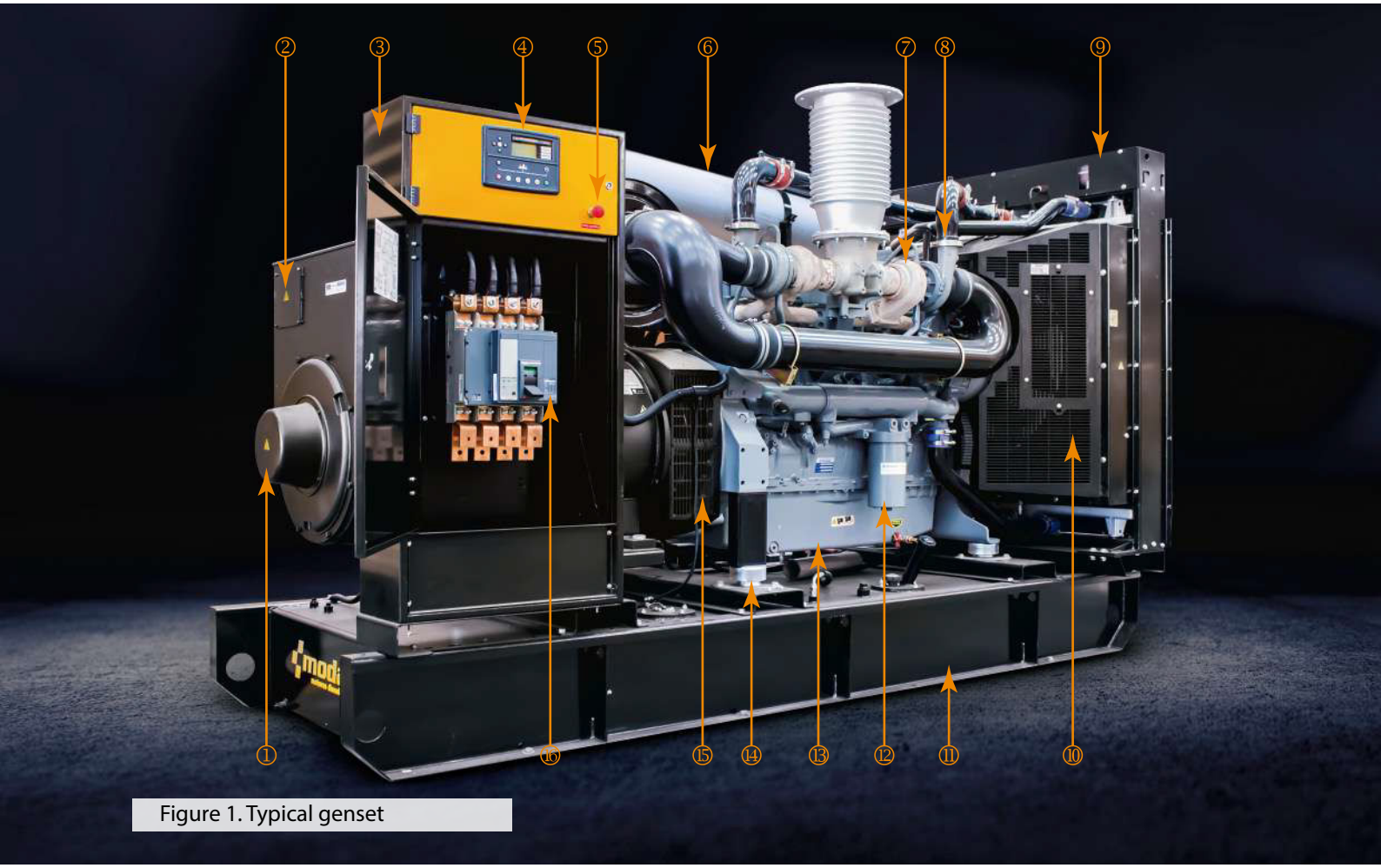


Figure 1. Typical genset

1.- Excitation system	9.- Radiator
2.- Generator	10.- Protection grid
3.- Control panel	11.- Fame
4.- Electronic module	12.- Oil filter
5.- Emergency stop	13.- Diesel engine
6.- Silencer	14.- Vibration isolators
7.- Turbocharger	15.- Electric harness
8.- Exhaust outlet	16. - Thermal magnetic switch

2.2.- Generator plate

Each genset carries a data plate, which is normally attached to the tank or frame. This plate contains the information necessary to identify the genset and its operating characteristics, i.e. the model, serial number, output characteristics such as nominal voltage and frequency, the output power in KVA and KW and the type of service, the limit working height in masl.,
etc.

Figura 2. Placa de grupo electrógeno

a.- Serial number
The serial number identifies the genset in particular and must be specified when ordering spare parts, servicing or warranty repairs.

b.- Model
Identifies the factory settings for power selection.

c.- Year
Year of manufacture as a genset.

d.- L. P. (List of Parts)
It is the set of components used for the manufacture of a genset.

e.- Power
ISO 8528 and ISO 3046 set the standards for gensets powered by a combustion engine.
Three types of power are defined:

Continuous power (COP):
Value of power that the genset can deliver continuously, without limit of hours of use. It allows an overload of 10% only for regulation purposes (transient loads) not for the normal power supply (applications where there is no commercial power network, the genset is the source of electricity).

Prime power (PRP):
Value of maximum power available for a variable power cycle that the generator can deliver for an unlimited number of hours per year. The average power over 24 hours must not exceed 80% of the prime power value. It allows a 10% overload only for transient loads, not for a normal power supply of the facility (surge suppression applications).

Stand-by fuel stop power (FTP):
Maximum available power value, for use with variable loads for 500 hours per year, with an average load factor of 90% of the stated stand-by power. It does not support overloading (backup applications in case of commercial power network failures).
For the same power value 200 kVA, depending on the application (continuous, prime, stand-by) three different devices are needed, however, a 200 kVA prime device can at the same time be used with 160 kVA continuous power or 220 kVA stand-by power.

f.- Other
» Voltage: it is important that it is selected according to the distribution voltage.
» Revolutions per minute (RPM): diesel engine rotation speed.
» Type of connection: it depends on whether it's three-phase or single-phase.
» Frequency: will be 60 Hz for 1800 RPM, with a 4-pole alternator.
» Power factor (cosø): should be no less than 0.8 and no more than 1; if working with a power factor of less than 0.8, the alternator power should be limited.

g.- Engine and alternator model
Necessary information when buying spare parts.

h.- Maximum altitude
Our equipment is configured for a maximum altitude of 1000 meters; to operate at higher altitudes, please consult the factory. The power indicated on the plate is reduced according to the altitude.

i.- Address
The address indicated on the plate is the one of our manufacturing plant.

2.3.- Diesel engine

The engine is of the industrial type, with high-performance 4-stroke and compression ignition, equipped with all the accessories that provide you with a reliable power supply.
These accessories may include, among others, a cartridge-type dry air filter, a turbocharger installed in the genset (element 7) and a mechanical or electronic engine speed regulator. Depending on the denset model, the engine may be injection or electronic controlled.

2.4.- Engine electrical system

The engine electrical system is negative to ground and 12 or 24 VDC, depending on the size of the unit. The system includes an electric starter motor, one or more batteries with support and an alternator to charge the battery or batteries. Most units are equipped with lead batteries; however, other battery types can be installed if requested.

2.5.- Cooling system

It includes a radiator (element 9), a large capacity fan, a thermostat, a circulating pump and antioxidant coolant.
The alternator cooling system consists of an internal fan to cool its own components. In the cooling of the generator, the air is taken in by the side of the alternator, passes along it, then along the engine and finally is pushed through the radiator.

2.6- Alternator

The output electrical energy is produced by a shielded, splash-proofed alternator with standard IP23 protection, self-excited and self-regulated, precisely coupled to the diesel engine.
The terminal box is located at the top of the alternator.

2.7.- Fuel tank and frame

The engine and alternator are coupled and mounted on a heavy-duty steel frame (element 11). It includes a fuel tank.

It has drainage connectors for purging, either after a good time of use or when the operator considers it.

A larger capacity tank can be included to provide the operating hours requested by the customer according to requirements and regulations.

2.8.- Vibration isolation

The gennset is equipped with four or six vibration isolators (element 14) designed to reduce the vibrations transmitted by the engine to the foundation on which the generator is installed. These isolators are placed between the base of the engine-alternator and the frame.

2.9.- Silencer and exhaust system

The exhaust silencer is supplied separately (element 6) for subsequent installation in the case of open type genenset. The silencer and the exhaust system reduce the emission of noise produced by the engine, leading the exhaust gases to the outside, extinguishing the combustion flames.

In soundproof generators, the silencer is typically installed inside the unit's cabin.

2.10.- Control system

The control systems that we supply with our equipment (modules 7320, 4520 and 8610) allow the autonomous operation of the equipment, continuously monitoring the behavior of the engine and alternator.

In general, the control systems of our equipment have the following functions:

Main features of module 4520

- Ratio of size to maximum characteristic.
- Automatic transfers between power network (utility) and generator (DSE4520 only).
- The hour meter provides information for monitoring and maintenance periods.
- Design thought to facilitate its use, with an easy to understand configuration.
- Multiple parameters are simultaneously monitored and clearly shown on the backlight display, the largest in its class.
- The module can be configured to suit a wide range of applications.
- It uses DSE Configuration Suite PC software, which simplifies configuration.
- It is compatible with a wide range of CAN engines.
- Unlicensed PC software.
- The IP65 rating (optional) offers increased resistance to water ingress.
- Alternator frequency and CAN speed detection in one variant
- Heated display option.
- Largest backlighting display in its class.
- The real-time clock provides an accurate record of events.
- Fully configurable through the fascia or PC via USB communication.
- Extremely efficient power-saving mode.
- Detection of the three-phase generator.
- Three-phase network detection (utility, DSE4520 only).
- Compatible with nominal systems from pH to 600 V pH.
- Monitoring of the generator/charging power (kW, kV A, kV Ar, pf).
- Cumulative power monitoring (kW h, kVA h, kVAr h).

- Generator overload protection (kW)
- Monitoring and protection of the generator/charge current
- Three engine maintenance alarms.
- Engine speed protection.
- Engine hour meter.
- Engine preheating.
- Engine run time programmer.
- Engine idle control for starting and stopping.
- Battery voltage monitoring.
- Starting with low battery voltage.
- Configurable remote start input.
- An alternative configuration.
- Integral warning and electrical tripping or shutdown protection in case of failure.
- LCD alarm indication.
- Event log (50).

Main features of module 7320

DSE7320 is an automatic failure control module suitable for a wide variety of diesel or gas generator applications.

By monitoring a large number of engine parameters, the modules will show warnings, shutdown and engine status information on the backlit LCD display, illuminated LEDs, remote PC and text messages (with external modem).

The DSE7320 will also monitor the supply of the power network. The modules include USB, RS232 and RS485 ports, as well as dedicated DSENet® terminals for system expansion.

Both modules are compatible with electronic (CAN) and non-electronic (magnetic pickup/alternator) engines and offer a large number of flexible inputs, outputs and engine protections so that the system can be easily adapted to the most demanding industry.

The extensive feature list includes enhanced event and performance monitoring, remote communications and PLC functionality.

- High temperature LED coolant protection.
- Low-oil pressure protection with LED.
- Low speed protection with LEDs.
- Over speed protection with LEDs.
- Starting failure alarm with LED.
- Three starting attempts.
- Automatic starting by means of two wires in contact: NC and NA.
- General alarm.
- Engine battery voltage.
- Operating time.
- Oil temperature.
- Fuel temperature.
- Turbo pressure.
- Fuel level.
- Engine maintenance programming (if configured)
- Generator voltage.
- Generator power factor.
- Generator frequency.
- Generator current.

- Generator load (KW).
- Auxiliary sensors (if installed and configured).

Main features of module 8610

The DSE8610 is an easy-to-use automatic synchronization control module that can be used in a multi-generator load system, designed to synchronize up to 32 generators, including electronic and non-electronic engines.

The DSE8610 monitors the generator and indicates the operational status and failure conditions, automatically starting or stopping the engine depending on the load demand or failure condition.

System alarms are announced on the LCD display (multiple language options available) with an illuminated LED and audible siren.

The event log will store up to 250 events for easy maintenance. A large number of fixed and flexible monitoring, measuring and protection functions are included, as well as extensive communication and system expansion options. The use of the DSE PC Configuration Suite software allows easy modification of operating sequences, timers and alarms. With all communication ports capable of being active at the same time, the DSE8610 is ideal for a wide variety of demanding load-sharing applications.

- Full synchronization and load sharing capabilities.
- Built-in regulator and AVR control.
- Base-load functionality (kW export).
- Export control (kV Ar positive and negative).
- Network decoupling protection (utility).
- Generator control (kW, kV Ar, kV A and pf).
- Overload protection (kW and kV Ar).
- Reverse power protection (kW and kV Ar).
- Unbalanced load protection.
- Independent ground failure protection.
- Advanced integral PLC editor.
- Eleven configurable inputs.
- Eight configurable outputs.
- Flexible and configurable sensor inputs.
- DSENet® expansion compatibility.
- User-configurable RS232, RS485 and Ethernet communications.
- Remote Scada monitoring through various DSE software applications.
- Modbus RTU and TCP support.
- User-configurable Modbus pages.
- Advanced control of SMS and failure messages (an additional GSM modem is required).
- Easily accessible diagnostic pages, including modem diagnostic pages.
- Data and trend recording.
- CAN speed, MPU and frequency detection.
- Support for level 4 CAN engine.
- Function "Protections disabled".
- Front panel editing with PIN protection.
- Fully configurable with the DSE Configuration Suite PC software via USB
- Four-line LCD text backlit display.
- LED Indicator and LCD alarm.
- Configurable display languages.
- USB connectivity.
- Customizable status displays.

- Five key menu navigations.
- Three configurable maintenance alarms.
- Planner of multiple running dates and times.
- Manual control of the fuel pump.
- Fuel consumption monitor and low fuel level protection.
- Protection against load alternator failure.
- Load change (load control and dummy load control).
- Configurable event logging (up to 250).
- Real-time clock backup.

2.11.- Protection switch

To protect the genset, a thermal switch (element 16) is installed, suitable for the model and the electrical power requested.

Its function is to open the electrical system when there is an overload or short circuit in the electrical networks connected to the generator.

3.- Installation of the soundproof genset

3.1.- General

This section explains the factors to be taken into account for the correct and safe installation of the genset.

Installation, operation and transport are simplified when the genset is equipped with a cabin, which can be of two types:

1. The first type is a cabin that fits the generator. The customer can request a rainwater proof, designed for noise reduction, with elements for hoisting or transporting with a forklift, among other factors, according to his/her needs.

2. The other type is a container similar to those used for sea freight. These can also be to requested to be waterproof, noise-proof or other factors required by the customer.

These cabins provide a genset that has several advantages: can be easily transported and moved to different working locations, involves minimal installation work, is protected against natural agents (can work outdoors) and has protection against unauthorized handling of its parts and a system for reducing the noise produced in the unit.

3.2.- Generator transfer

The frame of the Modasa genset is specially designed to be easily moved.

A number of methods and means of transport can be used to move soundproof gensets

3.2.1.- Air transport

For gensets that are to be lifted by cranes or other hoisting equipment, the customer can order specially designed clamping elements from the factory. The following aspects must be taken into account at the time of lifting:

» Fix the lifting cables or slings in the holes designed for lifting.
» Slightly tension the lifting cables.

» Ensure the correct fixing of the lifting cables and the solidity of the equipment.
» Slowly lift the genset
» Direct the unit to the chosen operating location and stabilize it.
» Slowly put it down on the ground.
» Loosen the lifting cables and then release and remove them.

Figure 3. Air transportation of genset

Warnings:

» Never lift the gense from the engine or alternator.
» Ensure that the lifting equipment and supporting structure are in good condition and have adequate capacity to support the weight of the generator.
» Check the condition of the slings or cables before use.
» When the generator is lifted, keep all personnel away from the area of influence.
» It is recommended not to lift the unit if there is a lot of wind in the area.
» If possible, keep the genset horizontal during the maneuver, which should be carried out by qualified personnel.

3.2.2.- Forklift

- Place the arms of the forklift under the frame, making sure that only the crossbars rest on the arms
- Slowly raise and manipulate the generator set.
- Place the genset in its discharge location.

Figure 4. Transportation of genset with a forklift

Warnings:

- Verify the load capacity of the forklift.
- Ensure that the forklift is in good condition.
- Keep in mind that the unit, due to its size, can take away the driver's visibility.
- If possible, drive in reverse so that you have a better view of the road.
- The forklift operator must be a qualified driver.

3.3.- Generator location

An important part of the installation is the selection of the place where the geneet is to be placed. The following factors should be taken into account in determining their location:

- Proper ventilation.
- Protection against natural agents such as rain, snow, blizzards, landslides, floods, direct sunlight and freezing temperatures or excessive heat.
- Protection against dust, fiber particles, smoke, lubricant mist, vapors, engine exhaust gases or other pollutants.
- The ground must be level (flat) and compact.
- Protection against impacts produced by the passage of forklifts or other portable equipment.
- The space where the genset is located must be large enough to allow for the dissipation of the heat produced in the generator and access for maintenance: at least one meter around the generator and a minimum height of two meters above the generator is recommended.
- Access to bring the entire generator into the facility; air inlets and outlets can be removed to provide an access point.
- Access restricted to unauthorized personnel.
- The soundproof unit comes with factory mounted silencer and exhaust.
- The combustion gases must be discharged to the outside; if the unit is in a room, the gases must be transported by means of ducts to the outside. It is important to check the engine manual for the permissible back pressure and to be able to dimension the appropriate gas exhaust duct.

- The genset can be located in many types of spaces. If noise level and starting speed are not essential in the selection, it can be installed under a simple structure that protects it from the weather.

Figure 5. Soundproof Genset

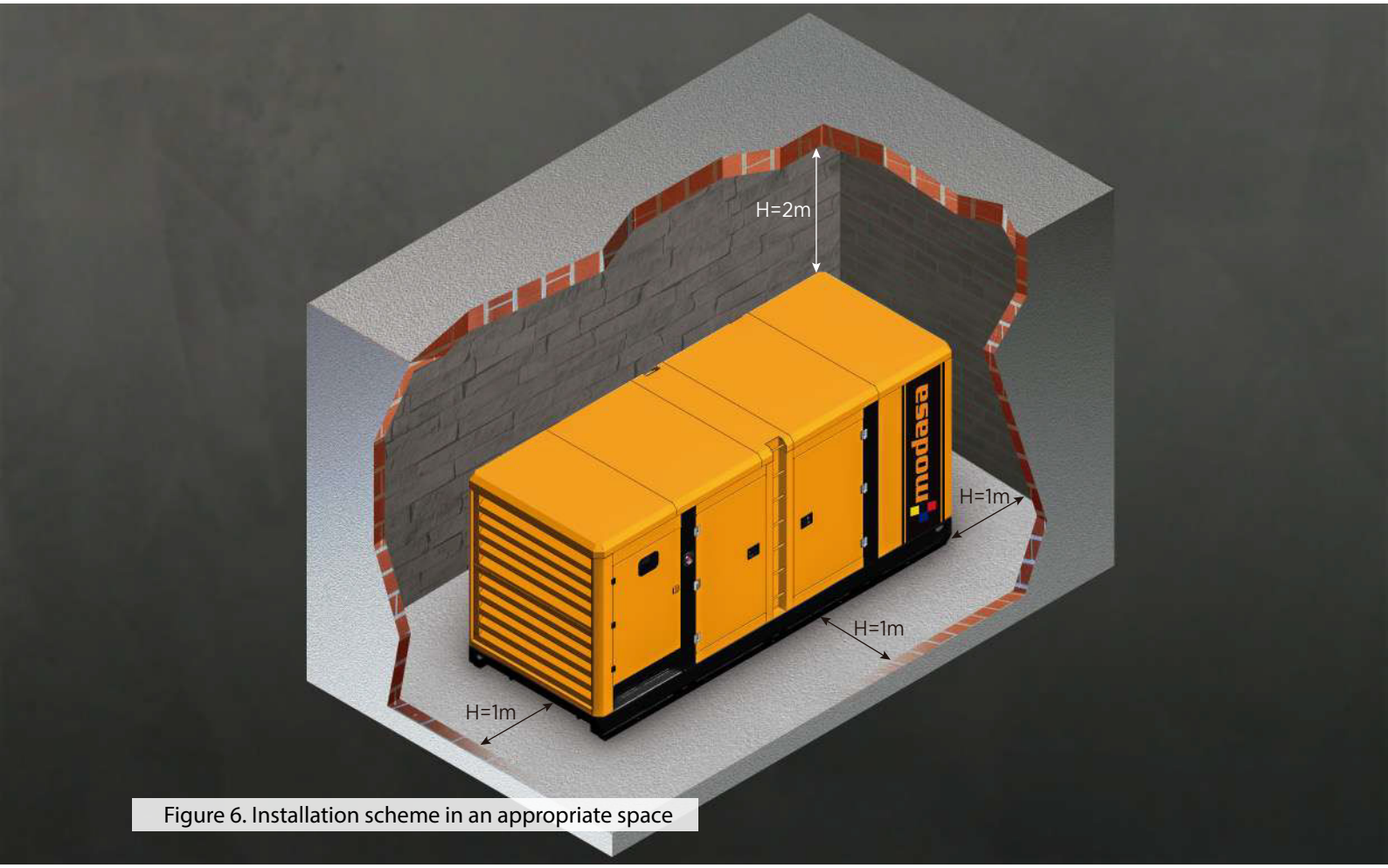


Figure 6. Installation scheme in an appropriate space

Examples of problems that may arise

Incorrect ventilation and exhaust.

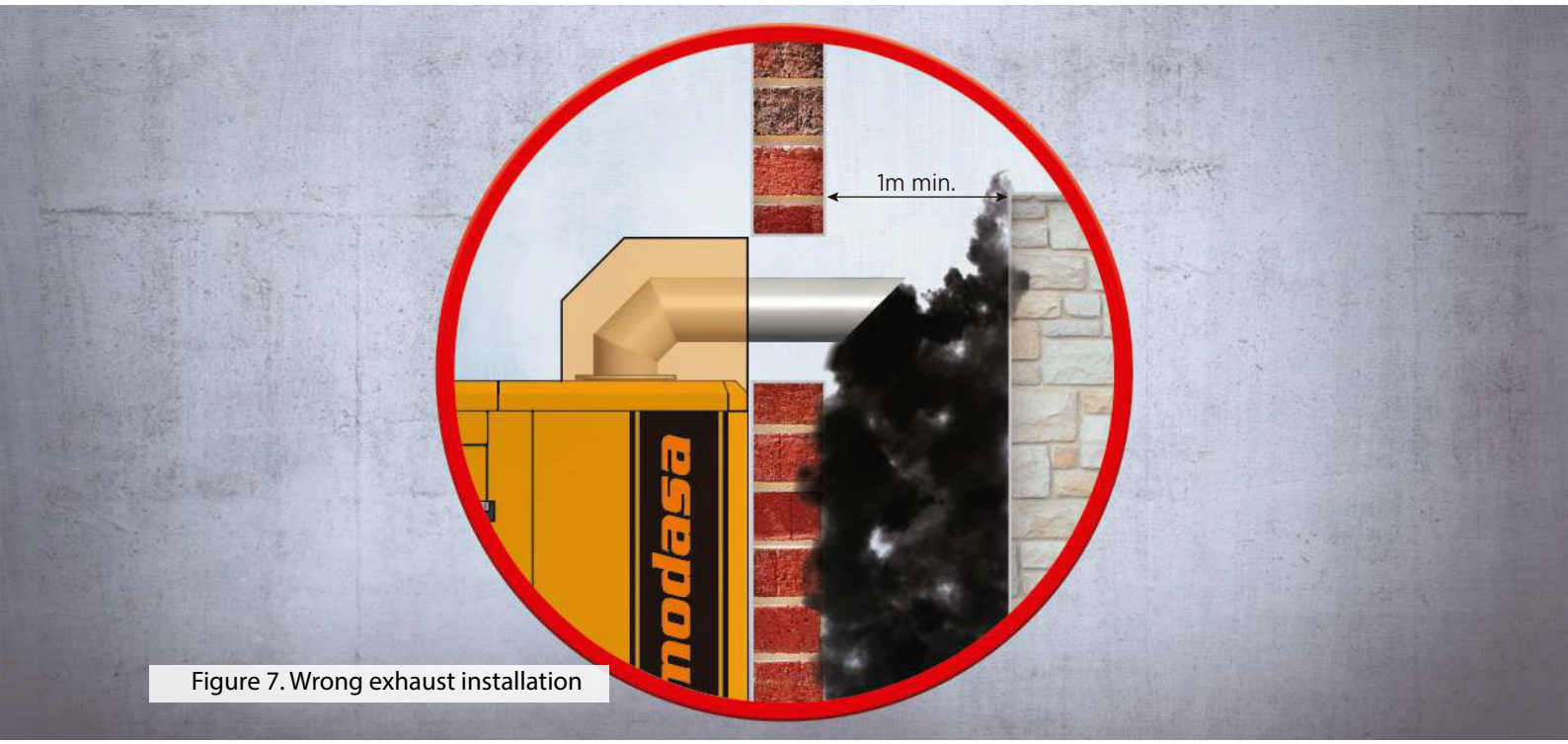


Figure 7. Wrong exhaust installation

The engine's ducts and exhaust must be designed in such a way as to minimize the back pressure as this has a negative effect on the unit's performance.

- Too uneven or loose terrain.
- Incorrect placement of the genset.
- The unit must work at 0° level; if this is not the case, it complicates lubrication and oil level control.

Figure 8. Installation scheme in an appropriate space

- Reduced access dimensions.

Figure 9. Narrow space

- Impossibility to open the soundproofing doors.

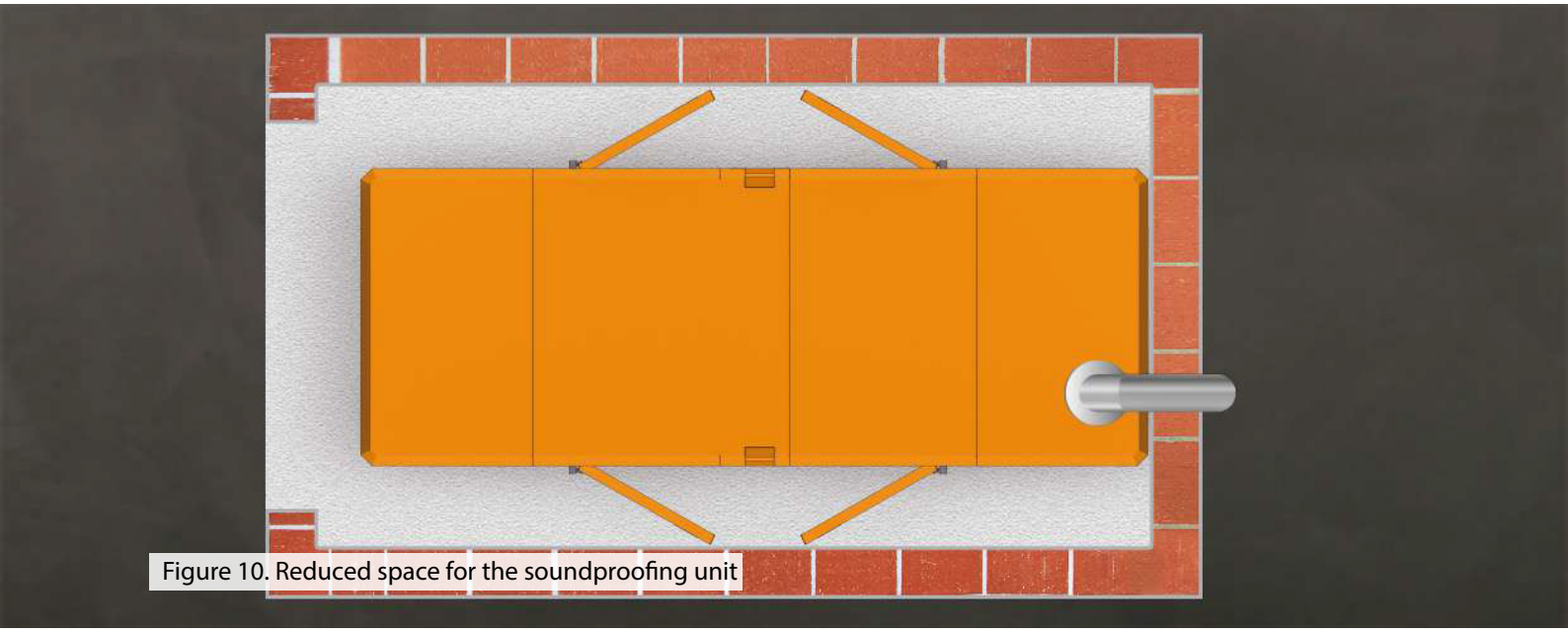


Figure 10. Reduced space for the soundproofing unit

4.- Installation of open type units in booths

An open type unit is one that does not have a factory booth. These units need a series of special considerations for their installation; Modasa does not guarantee the correct operation of the open type genset in outdoor work.

4.1.- Basic principles for installation

If the specifications are not respected, the genset is exposed to abnormal wear that affects its proper operation.
The procedure described below covers the main considerations for the installation of a genset, which should be considered as general principles.
In case of special applications or doubts, the technical service will be able to advise you and will study the specific installation conditions.

4.1.1.- Air intake for combustion

The air for combustion must be clean and as cold as possible. Normally this air is taken in from the area around the genset through the engine air filter.
In some cases, however, due to dust, dirt or heat, the air around the unit is not suitable, which is why an air intake duct must be installed. This conduction has to come from a clean air source (outside the building, from another room, etc.) to the engine air filter.
The engine air filter cannot be removed and then reassembled at a separate location, as this would increase the risk of dirt being introduced into the air duct and therefore into the engine. To ensure that this type of installation does not have a negative effect on the operation of the genset, the design of the air intake duct must be approved by the factory.

4.1.2.- Cooling and ventilation

A thermal engine generates a certain amount of heat, which must be dissipated outside the room for the correct operation of the unit.
The heat released by the unit comes from a variety of sources:

- Cylinder cooling.
- Radiation from the engine block and the exhaust duct.
- Alternator cooling.

This is why it is necessary to equip the room with air inlet and outlet openings adapted to the conditions of use and the cooling system; an insufficient ventilation causes an increase in the ambient temperature, which in turn can lead to everything from a loss of engine power to the shutdown of the generator.
In the premises housing the unit, the air should circulate in the following direction:

alternator → engine → radiator

This circulation allows the released heat to be evacuated and also allows the amount of fresh air needed for combustion to be obtained. A correct air flow is shown in Figure 11, where the air enters through the end of the alternator, passes along the engine and, through the radiator, exits to the outside through an air duct.

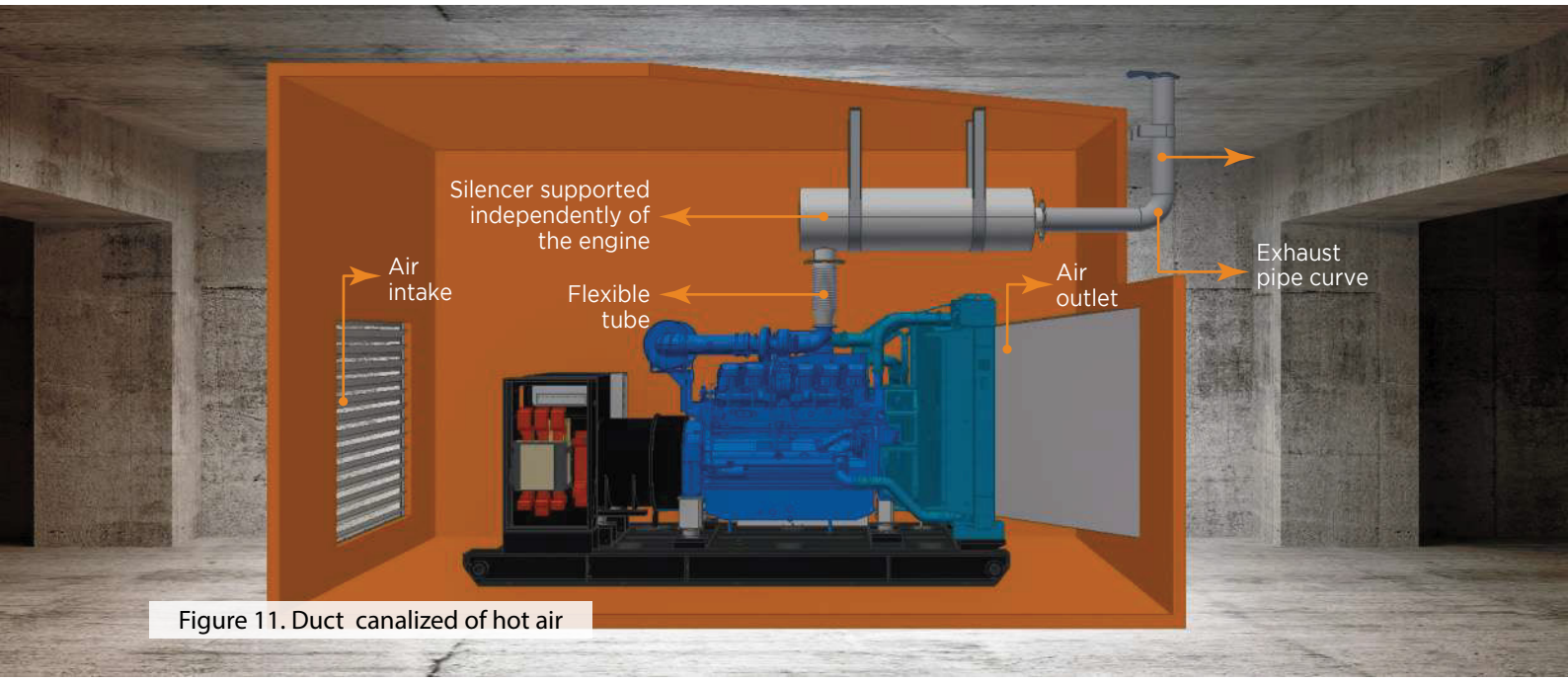


Figure 11. Duct canalized of hot air

Without this duct that channels and extracts the hot air from the room, the fan would send the air around the radiator, expelling it without orientation and producing hot air recirculation, thus reducing the efficiency of the cooling, raising the temperature of the room and causing power loss and failure due to high temperature.
The air inlet and outlet openings should be large enough to ensure good air flow to and from the outside. As a guideline, each opening should have an area 1.5 times that of the radiator surface.
Both the inlet and outlet openings must be equipped with shutters to protect them from the weather. These can be fixed, but in cold climates it is recommended that they be poratble so that when the genset is not running they can be closed; this will allow the room to be kept warm, which will benefit the starting of the genset and the acceptance of the load.
When using a remote radiator or a cooling system with a thermal exchanger, the heat radiated by the genset must also be extracted from the room.

4.1.3.- Exhaust system

The purpose of the engine's exhaust system is to direct the exhaust gases to a place and height where they do not cause inconvenience or danger, while reducing the noise caused by the engine. A suitable silencer should be incorporated in the exhaust pipe to reduce the engine noise level; it can be placed outside or inside the building.

- The gases must be directed against the engine's intake system.
- Gensets with a cabin include an in-cab exhaust system.
- The open type gensets are supplied with a separate industrial type silencer.

Warnings

When designing an exhaust system, the primary consideration is not to exceed the back pressure allowed by the engine manufacturer; excessive back pressure will seriously affect the performance, life and fuel consumption of the engine. To limit the back pressure, the exhaust pipes should be as short and straight as possible.

General aspects

The study of the evacuation of exhaust gases from a genset should not be considered as a minor operation because a pipe can always be installed, even in the most inaccessible places. Certain factors must be taken into account, such as pressure losses caused by the exhaust, insulation, suspension, sound or noise level and air pollution. It should be taken into account that the more tortuous a circuit is, the more pressure loss or back pressure there is, so the circuit will have more diameter and weight and the silencers and supports will be more expensive.

4.1.4.- Engine exhaust system elements

If it is necessary to make bends in the tubes, these must have a radius of at least twice the diameter of the tube.

Elbows

- The elbows should have a radius of curvature of at least 2D, if possible in a single element. If the elbow is made of sheet metal or welded sheet metal it must have at least three sectors in the case of 90° elbows.

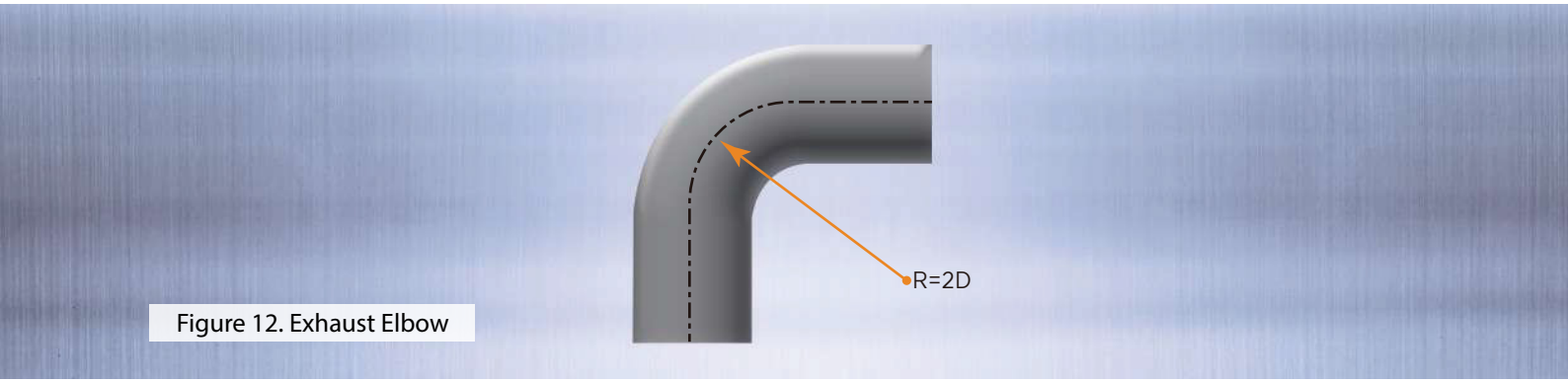


Figure 12. Exhaust Elbow

- An exhaust system whose length exceeds 7 meters must be approved by the factory.
- Exhaust system components, including turbochargers, can reach a very high temperature and must be protected to prevent accidental contact.

Flexible tube

- A flexible connection between the engine exhaust and the pipe system carrying the gases to the outside should be used to prevent the transmission of engine vibration to the pipes, also taking into account the effects of thermal expansion.
- Flexible tubes allow longitudinal displacements to be absorbed and lateral displacements caused by dilations.

Figure 13. Flexible tube

Hanger

- Generally a hanger consists of an adjustable iron clamp fixed to the ceiling; the suspension system allows free expansion of the pipe.
- It must be ensured that the silencer and all pipes are well supported to limit stress on the connections that could cause cracks or leaks; the weight of the pipes or silencer must never be placed on the exhaust manifold.

Figure 14. Exhaust pipe hangers

Fork support

- The fork frame or frame with pins is used in the vertical parts and allows the dilation of piping, keeping it held laterally.

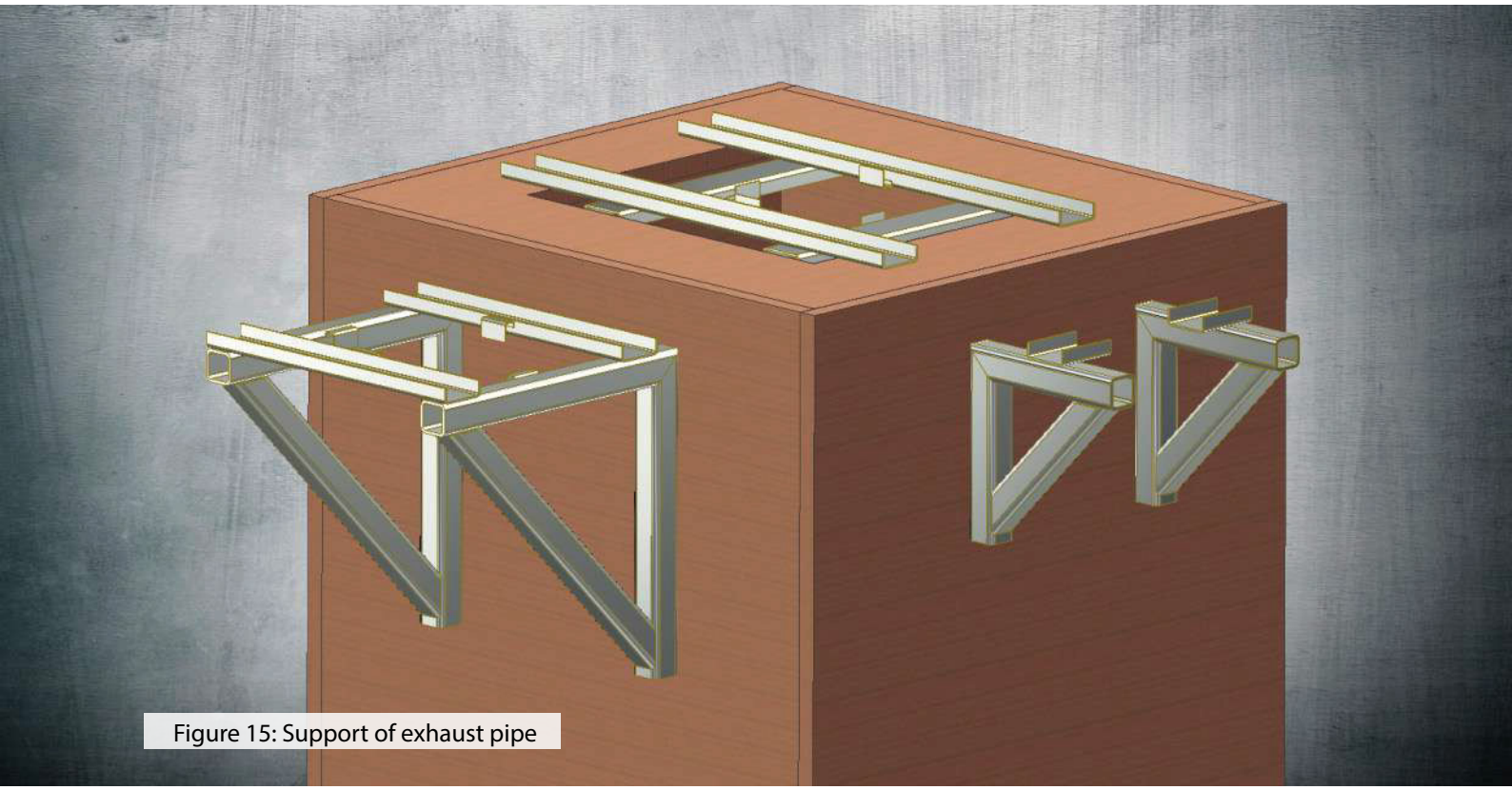


Figure 15: Support of exhaust pipe

Foot of column

- It is used to support the weight of the vertical pipe.

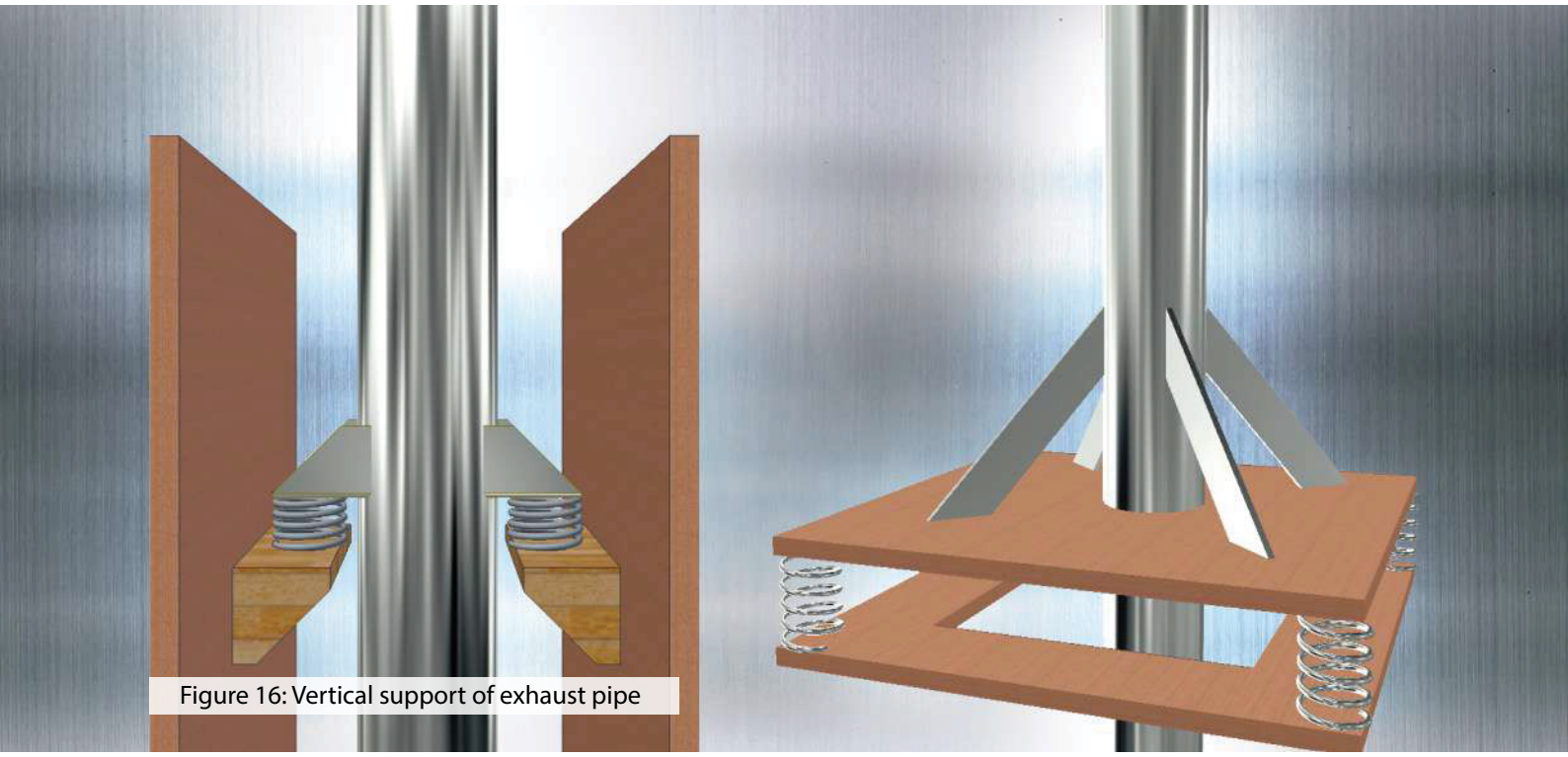


Figure 16: Vertical support of exhaust pipe

Suspension of silencers

- They serve to support the weight of the silencers; they can be vertical or horizontal

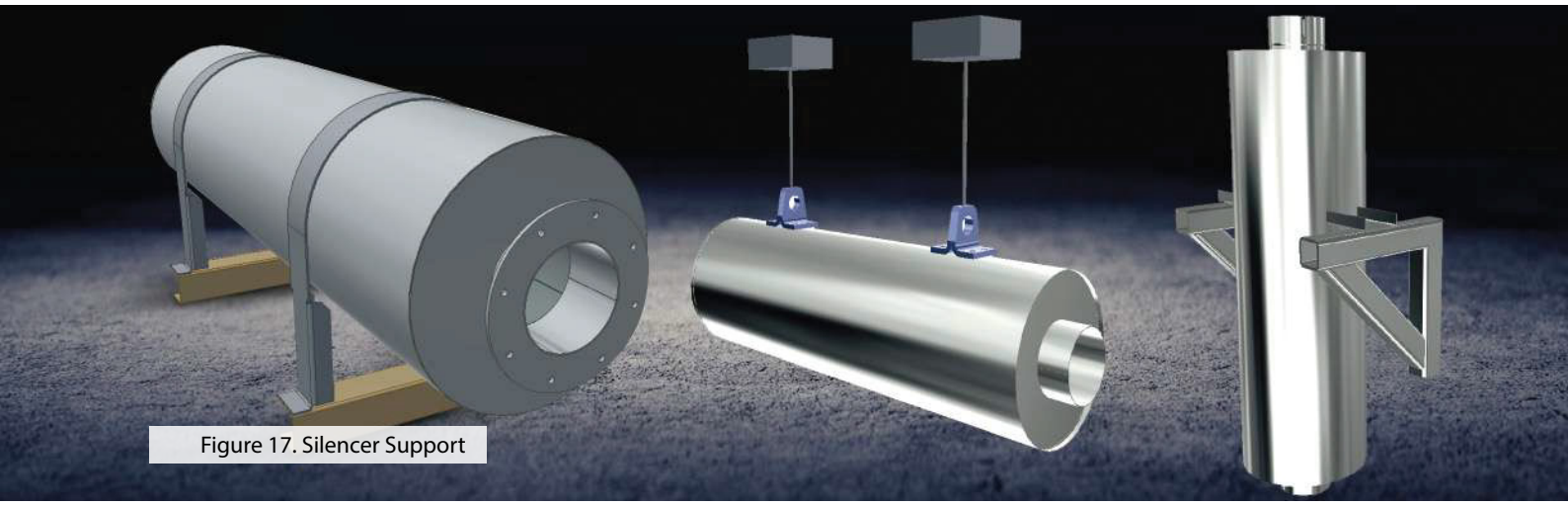


Figure 17. Silencer Support

Thermal insulation

- Exhaust components inside the genset room must be insulated to reduce heat radiation and noise levels. The pipes and silencer, whether located inside or outside the building, must be kept away from any combustible materials.

Figure 18. Gas outlet through thermal insulation

Depending on the type of installation, it may be necessary to isolate the heat released into the building (which has a negative impact on cooling).
Once the insulation has been carried out, the surface temperature must be less than 70 °C. It is recommended to use rock wool (except asbestos).
It can also be covered with woven fiberglass fabric, aluminum, sheet metal or galvanized sheet metal to improve the aesthetics of the installation and the performance of the heating material.
At least 50 mm thick glass wool should be considered.

Wall and ceiling partitioner

- It must be placed at each point of passage through a wall partition and at the exit through the ceiling.
- When going through a wall or ceiling it is advisable to put protection to the exhaust pipes to avoid possible damage.

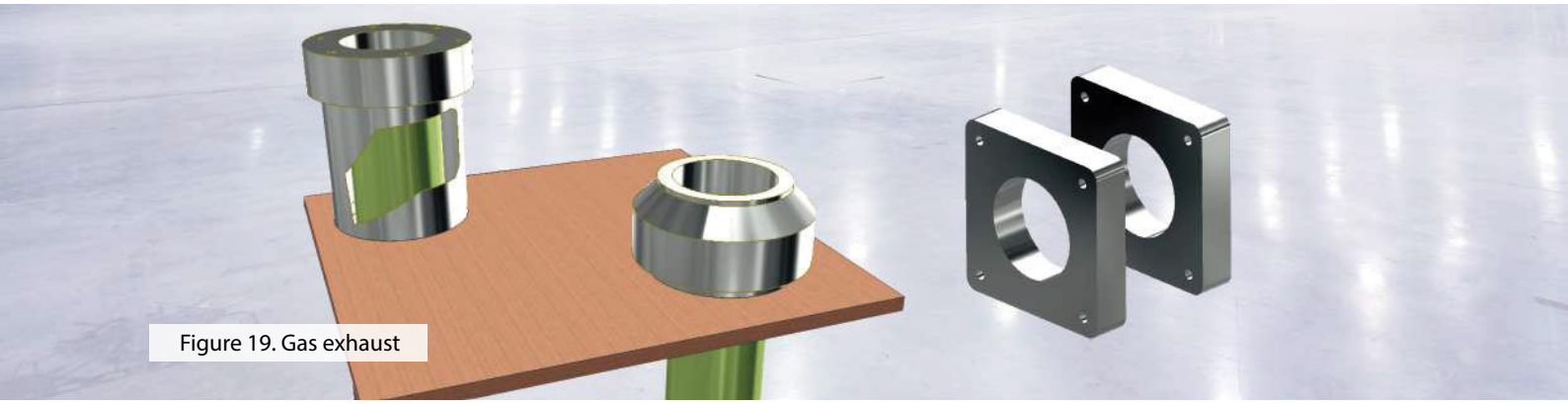


Figure 19. Gas exhaust

In small booths it is advisable to install the silencer outside the room.

Traps

- Any long horizontal or vertical pipe should have an angle to the engine and be fitted with drainage points at its lowest points to prevent water from entering the engine as a result of condensation.

Figure 20. Outlet drain

Exhaust outlet

- Exhaust outlets serve to expel gases into the atmosphere and to protect the inside of the pipe from the weather.
  If the outer end of the exhaust pipe is in a horizontal position, it must be cut at 60° to the horizontal plane; if it is in a vertical position, a cap must be fitted to it to prevent rain and snow from entering the exhaust system.

Figure 21. Gas exhaust

The exhaust pipe must not be connected to the exhausts of other gensets
Use only high temperature resistant paint in the exhaust system; the application of undercoats or other paints not indicated may cause them to burn when operating the gensets.

Piping

- The use of seamless pipes is recommended; however, to lighten the weight, sheet metal or rolled metal pipes can be used. Welding "bars" inside the duct should be avoided.
- The pipe must not be smaller in diameter than the unit (consult the manufacturer if it is very long) and must be laid in such a way that no gas returns into the building.
- The pipe must be fixed so that the compensator or flexible tube does not have to

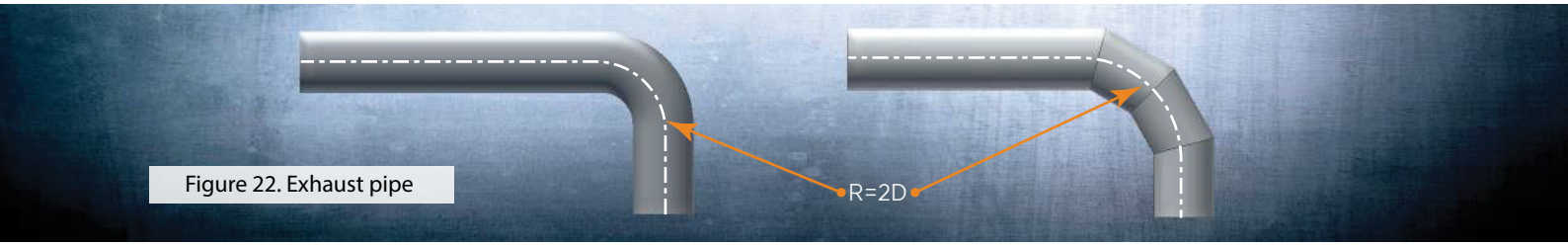


Figure 22. Exhaust pipe

4.1.5.- Silencer

General

This element attenu
ates noise by absorbing or shifting sound waves. The exhaust must have adequate suspension and the supports must not rest on the unit (except for the original assemblies).
A compensator or flexible exhaust tube shall be mounted at the engine outlet.

Types of silencers:

- Industrial silencer.
- Residential or critical silencer.
- Hospital or super critical silencer.

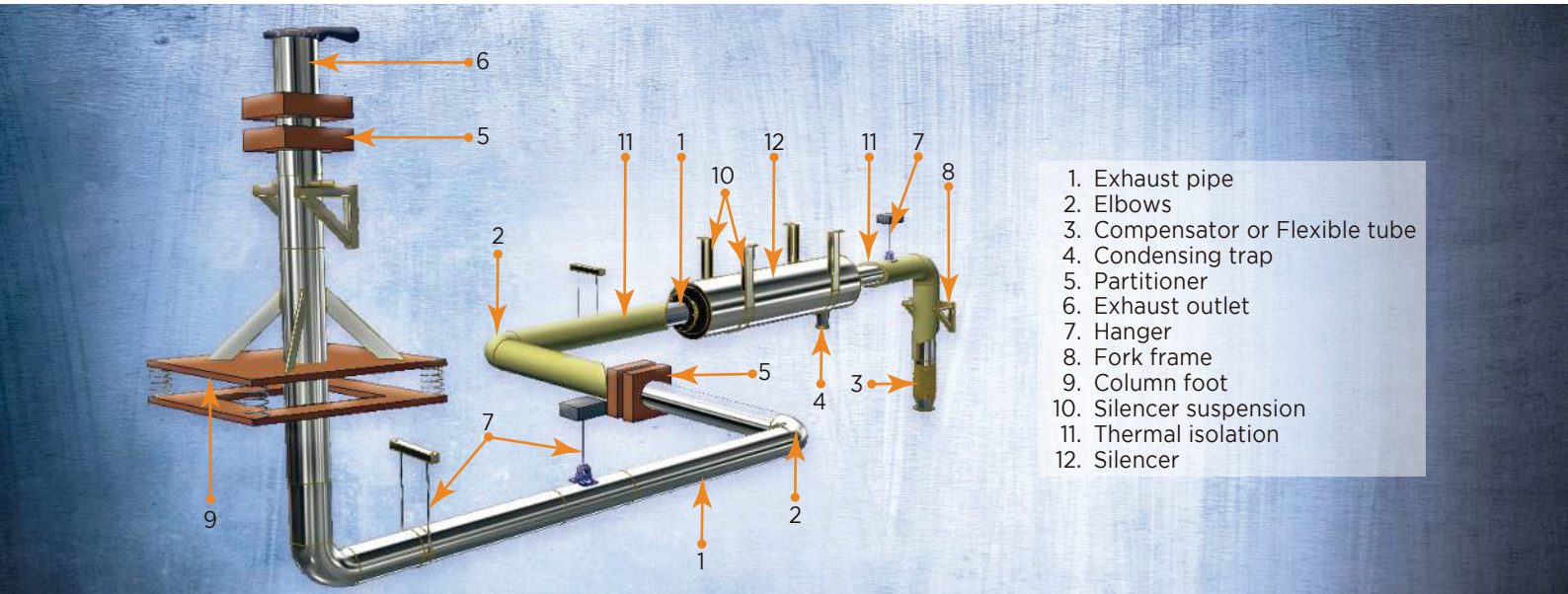


Figure 23. Schematic of the basic assembled exhaust system for the operation of a genset inside a booth

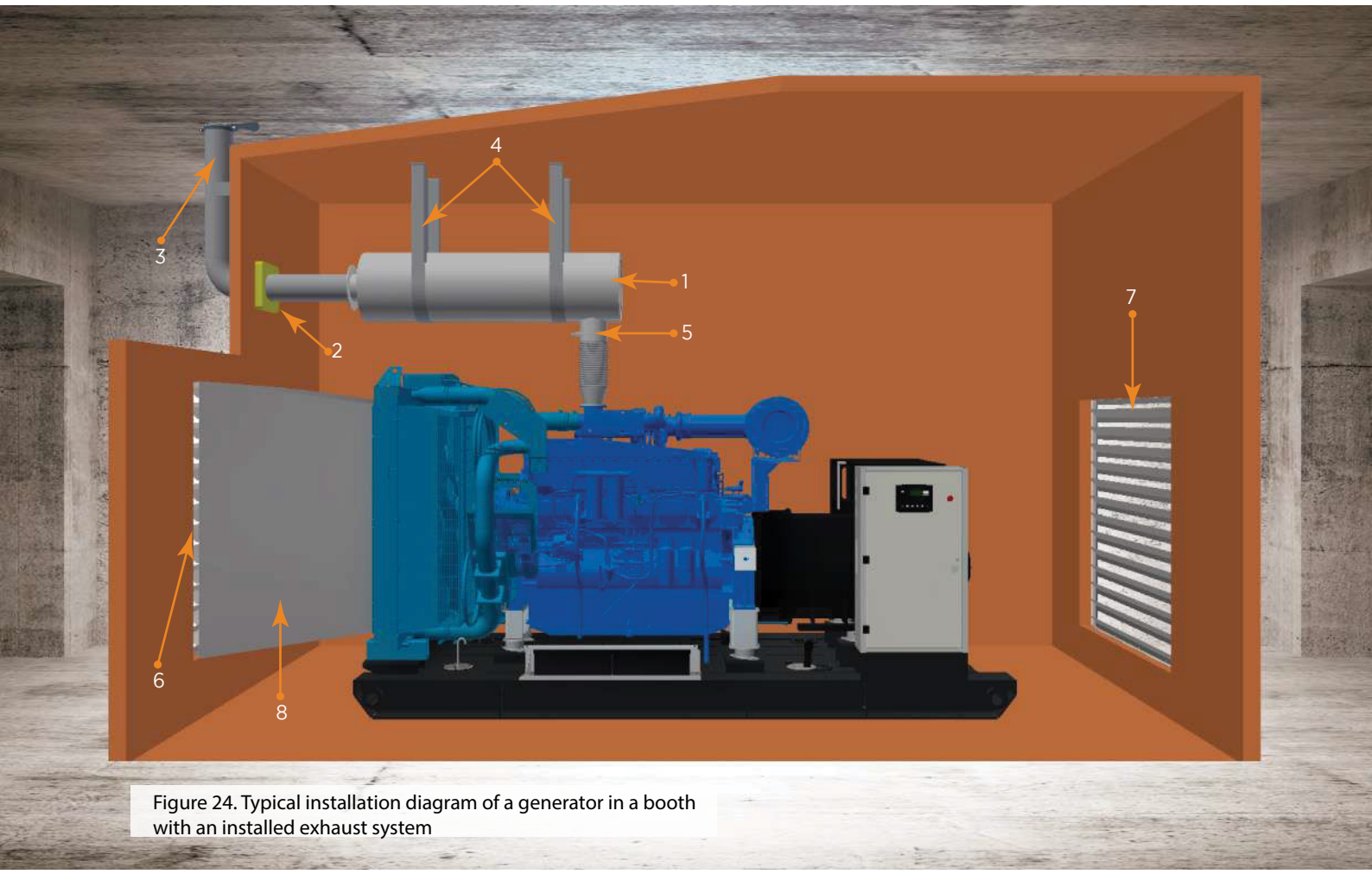


Figure 24. Typical installation diagram of a generator in a booth with an installed exhaust system

1.- Silencer
2.- Wall pass joint
3.- Cap against the entrance of rain or objects
4.- Exhaust system supports
5.- Flexible coupling of the exhaust system
6.- Hot air outlet
7.- Air intake
8.- Flexible canalized joint (canvas)

4.2.- Fuel system

The fuel system for the genset must be capable of providing the engine with a continuous and clean fuel supply. For most installations this system will consist of a small tank for daily use with an autonomy of approximately 8 hours (normally incorporated in the frame); they can also have a large tank for fuel storage with its respective pumps and pipes.

Warnings

- For stationary gensets with remote fuel storage systems, ensure that such systems are installed in accordance with the relevant specifications, standards or other requirements.
- Never connect a remote fuel storage system to the fuel tanks built into the frame of small generators without ensuring adequate aeration tubing at the tank loading speed.

4.2.1.- Large storage tanks

A separate large storage tank will be required for longer operation. This is particularly appropriate for emergency gensets, as it is not advisable to rely on frequent fuel deliveries.
The incident requiring the use of the emergency unit may also interrupt fuel delivery.
As a general rule, the large storage tank should be installed outside the building, in a place suitable for refilling, cleaning and inspection. However, it should not be exposed to frost, as the flow of fuel would be affected by an increase in viscosity due to low temperatures. The tank can be installed underground or at ground level.
A vent must be installed in the large storage tank to release the air pressure created when filling the tank or due to fuel evaporation and expansion. This will also prevent a vacuum from occurring as the fuel is consumed.
The bottom of the tank should be round and installed at an angle of 5° so that water and sediment are deposited in one place.
A sediment trap valve should be placed at the lowest point to allow frequent removal of water and sediment, which should be regularly pumped into the tanks installed underground.

4.2.2.- Supply lines

Supply lines can be made of any material compatible with the fuel, such as steel pipe or flexible hoses that will tolerate environmental conditions.

Warnings

Do not use galvanized pipes or accessories in the fuel system.
The supply and return lines should be at least the same size as the engine couplings and the overflow pipe should be of a larger size. In case of longer pipes or low ambient temperatures, the size of these lines should be increased to ensure adequate flow. Flexible tubing should be used to connect the engine, which would prevent damage or leakage caused by engine vibration.
The fuel supply line should suck in fuel at a point no less than 50 mm from the bottom of the tank at its highest point (away from the drain plug).
The fuel return line should be as far away from the suction as possible, since fuel re-entering the tank has higher temperature and air turbulence.

4.2.3.- Manual filling tank

This solution is valid for a generator with manual starting and under visual monitoring. This tank, which is often integrated into the chassis, consists of a mechanical level indicator, a filling channel and an emptying hole.

4.2.4.- Automatic Filling Tank

This solution can be used with automatic starting generators. The tank is filled mechanically by an electric pump that takes the fuel from a main storage tank. This installation is regulated by a set of rules and must be equipped with a retention vessel capable of collecting the leakage with a capacity at least equal to that of the tank. An overflow pipe back to the tank is also mandatory; this pipe must be at least twice the diameter of the supply pipe. The tank, to prevent the system from increasing pressure, is mounted with a slight load in relation to the diesel engine (except in covered parking areas). This tank must also be equipped with a fuel shut-off valve, the control of which must be located outside the premises.

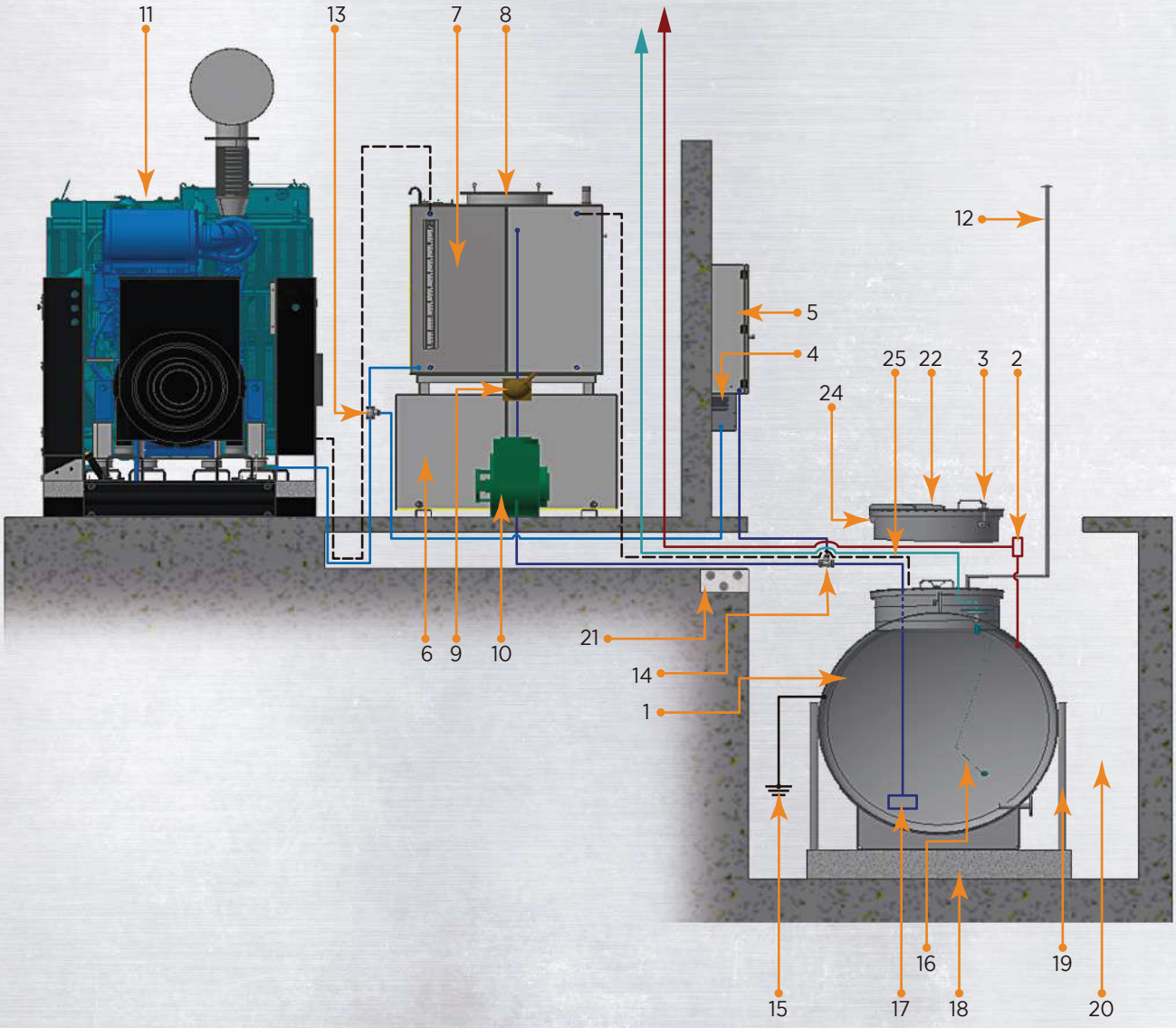


Figure 25. Main parts of automatic filling tank

1. Double wall storage tank
2. Leakage control cell
3. Filling hole
4. Fuel shut-off valve control box
5. Valve and pump control box
6. Storage container of 600 liter
7. Daily tank of 500 liters
8. Level control system
9. Manual pump
10. Electric pump
11. Generator
12. Breathhole
13. Pump control valve
14. Fuel shut-off valve
15. Grounding
16. Electric fuel level control
17. Retention valve with filter
18. Concrete base
19. Fixing bar (1 m)
20. Excavation
21. Passage of the channels
22. Manhole cover
23. Overflow
24. Minimum registration of 0.70 x 0.70
25. Filling pipe

4.3.- Soundproofing

The soundproofing of the premises is done following two procedures:

4.3.1.- Insulation

It consists of preventing noise from passing through the walls; in this case, the most important element is the thickness of the wall.

4.3.2.- Absorption

It is the materials that absorb the sound energy; this procedure will be used in the ventilation openings and its result is the increase of the air inlet and outlet sections.
The internal walls of the facility can also be covered with sound-absorbing material to reduce the noise level in the room, and maze grilles or filters can be fitted to the walls, ventilation openings and the door.

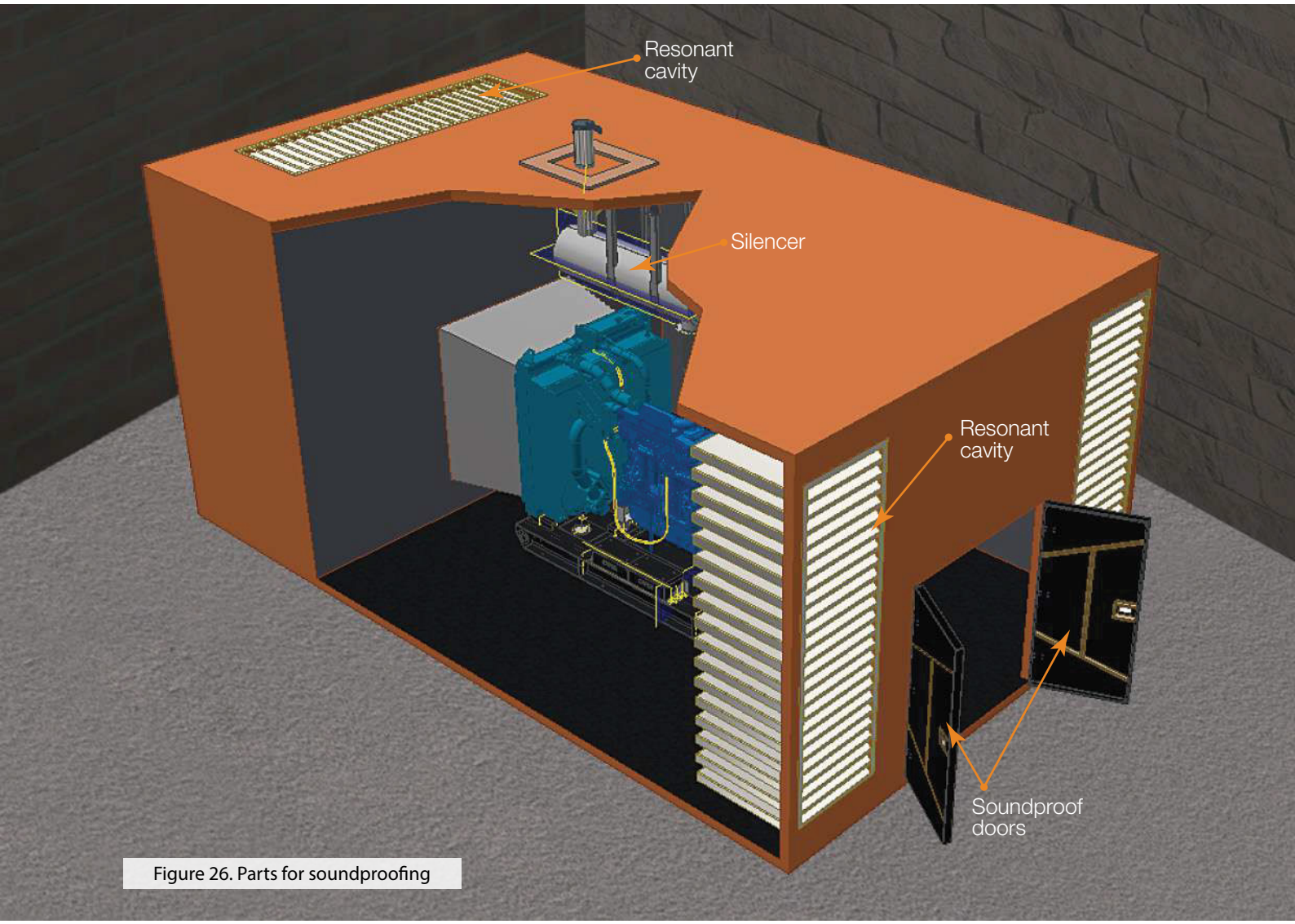


Figure 26. Parts for soundproofing

4.4.- Engine crankcase ventilation

Engine crankcase vapors should preferably be discharged outside the room where the genset is located to prevent them from accumulating in the radiator, as they can contaminate it, resulting in reduced cooling capacity.

5.- Genset placement

A running genset generates a certain amount of vibratory energy, which is transmitted to the floor or building structure through the frame.

To reduce this to a minimum, the unit must be installed on a foundation without direct connection to the ground, possibly insulated by an elastic material. This solution is mainly used in high power genesets.

5.1.- Foundations

The best foundation for the generator is a reinforced concrete block, as it provides a rigid support that prevents deflection and vibration. The foundation should be 300 to 400 mm thick and at least as wide and long as the genset.

The ground or surface under the foundation must be properly prepared and able to structurally support the weight of the concrete block and the generator. If the generator is installed on an upper floor the structure of the building must be able to support the weight of the generator plus the fuel and accessories.

The rules applicable to this case in the building must be consulted and complied with in full. It is recommended that the foundation of the genset be above ground level, which will provide a dry surface in the event of flooding and ensure that the generator is dry in all eventualities.

5.2.- Vibration isolation

To minimize the vibrations that the engine transmits to the building, the generator is equipped with vibration isolators. These isolators are installed between the engine/alternator assembly and the frame, allowing the latter to be rigidly bolted to the foundation; the units must always be bolted firmly to the foundation to prevent any movement.

Vibration isolation of the generator and its external connections is also necessary; this is achieved by using flexible connections in the fuel pipes, the exhaust system, the radiator air discharge pipe, in the cable ducts for the control and transmission of electrical power and in any other system connected to the outside.

It is important to note that the genset should only be placed on the base plate when the foundation has hardened completely.

5.3.- Anchoring

The generator must be rigidly fixed to the concrete foundation by means of fasteners such as:

- J-type studs fixed in conjunction with concrete casting, washers and nuts.
- Suitable expansion bolts.
- Studs fixed by means of epoxy anchors after the concrete is poured, washers and nuts.

6.- Electrical system

6.1.- Connections: General aspects

As in the case of low-voltage electrical installations, the execution and maintenance are subject to the corresponding standard of each country.

6.2.- Power Cables

They can be unipolar or multipolar type, depending on the power of the generator. They shall preferably be installed in a cable channel or tray reserved for such use.

6.3.- Battery cables

The battery or batteries must be installed next to the electric starter.
The cables shall be connected directly from the battery terminals to the starter terminals.
The first rule to respect is to ensure that the polarities of the battery and the starter correspond.

• Never reverse the positive and negative terminals of the batteries when connecting them, as this seriously damages the electrical system of the generator.
• The minimum diameter of the cables shall be 70 mm^2, although this may vary depending on the power of the starter as well as on the distance between the batteries and the unit (line voltage drops).

7.- Transport of portable units

General aspects

They must also comply with certain special provisions for portable units.

7.1.- Special provisions

- An area must be reserved for the installation of the genset: This area must be flat and strong enough to prevent the unit from collapsing. The foundation base must also be strong and can be made of concrete or spruce wood of considerable diameter and assembled together.
- The portable genset must be correctly positioned in its location (chassis or trailer) so that it is not subjected to vibrations that could cause significant damage to the equipment.
- The location of the portable unit will be chosen on the basis of the ease of fuel supply and distribution of electrical power to users.
- For safety reasons, the accesses to the portable genset must be free at all times, which also facilitates maintenance operations.
- The ventilation of the generator must not bet interrupted at any time by any kind of object, as this would cause abnormal heating and a decrease in power.
- The exhaust gases shall be discharged freely, so that there is no return to the air filter or cooling system.
- The grounding of the genset must be respected to ensure the protection of persons.

7.2.- Trailer hitch coupling

In order to avoid accidents when towing a trailer, you should take this into account:

- Do not use inappropriate devices (bars, cables, ropes, etc.).
- Check that the hook of the towing vehicle is perfectly adapted to the towing system of the trailer before coupling it.
- Check the absence of a breakage start as well as the correct locking system.
- To attach the trailer, proceed as follows:

a. Chock the wheels to prevent the trailer from moving.
b. Raise the rear supports and lock them.
c. Remove the parking brake.
d. Loosen the locking levers on the drawbar arms and position them at the same height as the towing vehicle.
e. Attach the trailer, remove the chocks on each side of the wheels and raise the small front wheel completely by means of its crank.

Figure 27. Proper trailer handling

7.3.- Precautions for handling the trailer

The following checks must be carried out before performing a maneuver:
a. The tightening or torque of the wheels.
b. The hitch hook lock.
c. Tire pressure.
d. The operation of the light signals.
e. The closing of the roof doors in the case of soundproof units.
f. The parking brake is loose.
g. That the front small wheel and the rear supports are raised.
h. Tightening and locking of the drawbar arm locking levers with pins.
i. The braking attempt in the case of "road" type trailers.
j. Placement of the safety brake cable.

7.4.- Driving

Road type trailer

A driving speed of 40 km/h is determined according to the condition of the road and the behaviour of the trailer.
Driving at a sustained speed causes tyres to heat up, so it is essential to stop from time to time to check their condition; excessive heating can cause the tyre to burst, which could lead to a serious accident.

8.- Operation of gensets

The gensets can be operated through the control module located on their electrical panels. There are a number of models that are used according to the customer's requirements and the features they provide; the operation of the modules is indicated below. For more information on the use of the controllers check the manual included with the equipment.

Recommendations
Before starting the generator, it must be checked:

- The oil level of the equipment.
- The fuel level.
- The condition and charge of the batteries.
- Make sure there are openings for air intake.
- The proper escape of gases to the outside environment.
- The condition of the fuel and air filters.

8.1.- DSE 4520 module

8.1.1.- Description of the controller

Control buttons

- **Stop/Reset**

This button puts the module into its Stop/Reset mode. It will clear any alarm conditions for which the activation criteria have been removed. If the engine is running and the module is in stop mode, it will automatically instruct the switching device to unload the generator. The fuel supply is turned off and the engine stops. If a remote start signal is present while operating in this mode, no remote start will occur.

• **Auto**

This button puts the module in automatic mode, which allows the module to control the function of the genset automatically. The module will monitor the remote starting input and the supply status of the network; once a start request has been made, the equipment will automatically start and be placed under load. When the start signal is removed, the module will automatically transfer the load from the generator and close the descent by observing the stop delay timer and the cool down timer as required. The module will then wait for the next start event.

• **Start**

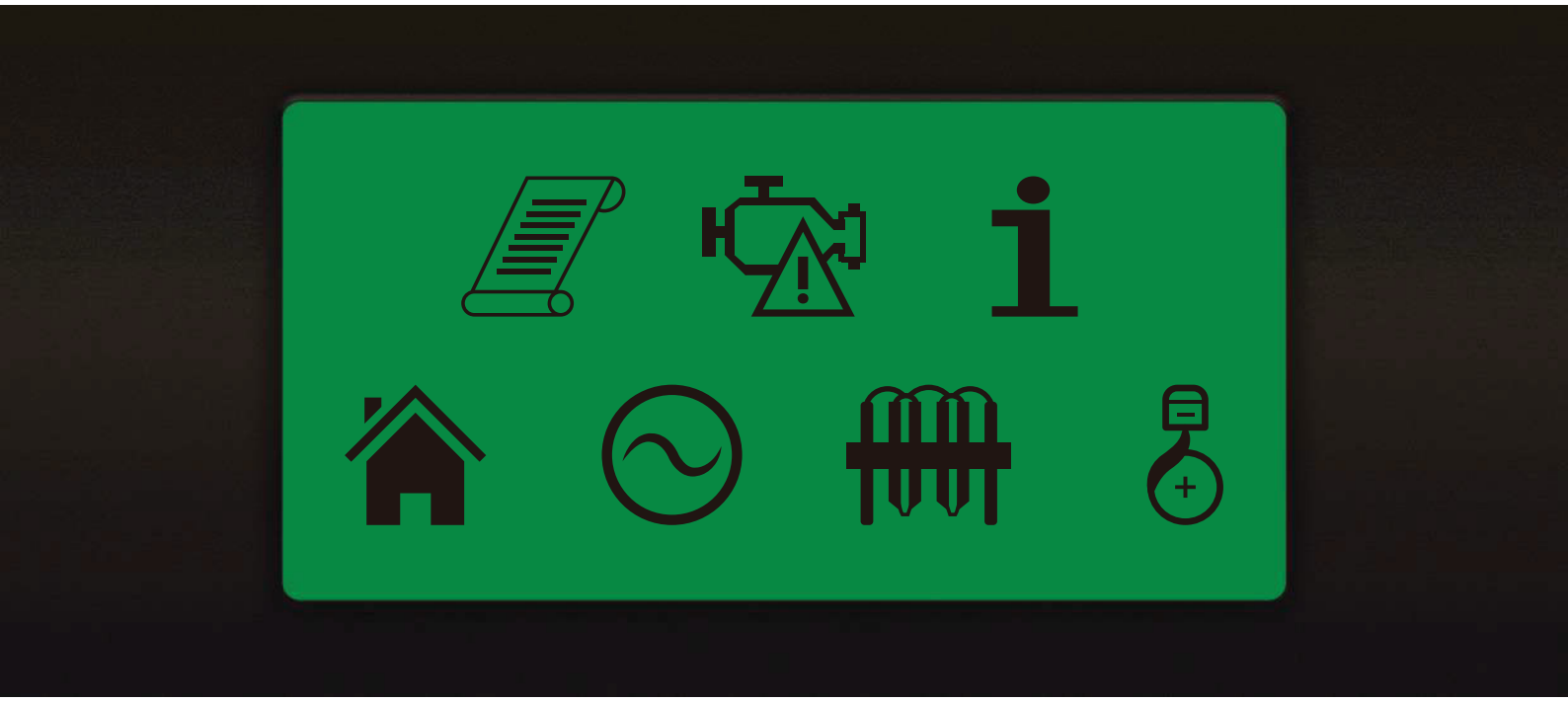
This button is only active in Stop/Reset mode; pressing it in manual or test mode starts the motor and executes the load (manual) or on load (test).

• **Navigation buttons**

It is used to navigate the instrumentation, event log and configuration screens.

Screen

It is possible to scroll to show the different information screens by repeatedly pressing the scroll buttons.
Once the screen is selected, it will remain on the LCD until the user selects a different one, or after a long period of inactivity (display delay timer) the module will return to the home screen. Alternatively, it is possible to enter the menu by pressing and holding both buttons (up and down) simultaneously.
The menu will then be displayed. Press the Up or Down button to select the desired icon, then press Auto to enter the page.
If an alarm is triggered during the status page display, the display will show the Alarms page to draw the operator's attention to it.



ICON	DESCRITION
	Home
	Generator
	Power network
	Load
	Engine
	Information
	Problem diagnosis, codes
	Event

Home

- This is the screen that is displayed when no other screen is selected and the page that is automatically displayed after a period of inactivity (display delay timer).

Alternator

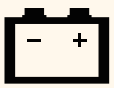
- It contains the electrical values of the generator (alternator) measured or derived from the module voltage and current inputs.
- Generator voltage (pH-N).
- Generator voltage (pH-pH).
- Generator frequency.
- Generator current.
- Total generator load (kW).
- Generator load (KW).
- Total generator load (kVA).
- Generator power factor.
- Average generator power factor.
- Generator load (kWh, kVAh, kVArh).

Power network
- Network voltage (pH-N).
- Network voltage (pH-pH).
- Network frequency.

Engine
- Engine speed.
- Oil pressure.
- Temperature.
- Engine battery voltage.
- Engine operating time.
- Engine maintenance: oil (if configured).
- Engine maintenance: air (if configured).
- Engine maintenance: fuel (if configured).

Information
- Model.
- Identification number.
- Engine type.
- Date and time.
- Configuration of the programmer.

Problem diagnosis
The following alarm conditions are shown on the display:

ICON	DESCRIPTION
	Engine failure (not specified)
	Overspeed
	Low speed
	Low-oil pressure
	High coolant temperature
	High or low load
	Low fuel
	High or low battery charge

Event
• It contains a list of the last five events that occurred in the generator.

8.1.2.- Operating modes

Automatic mode
The generator starts operating by a remote signal if the button has been pressed; the icon will be displayed when the automatic mode is enabled.
Operation in automatic mode will start if there is:

• Scheduled starting (configure the controller).
• Power network failure.

The automatic mode will allow the generator to operate fully automatically, starting and stopping without any user intervention.
The genset will be connected to the charge if no fault alarm occurs after the waiting time.

Once the engine is running and all the start timers have finished, the animated icon is displayed. The genset will be placed on charge if it is configured to do so.
If all starting requests are deleted, the stop sequence will start; once the automatic starting conditions are deleted, the generator will stop.
If there are no starting requests at the end of the delay, the charge is removed from the generator to the power network and the cooling timer is started, which allows the assembly to run off charge and cool down sufficiently before it is stopped. This is especially important when installing turbo chargers in the engine.
After the cooling timer has expired, the appliance stops.

Manual mode

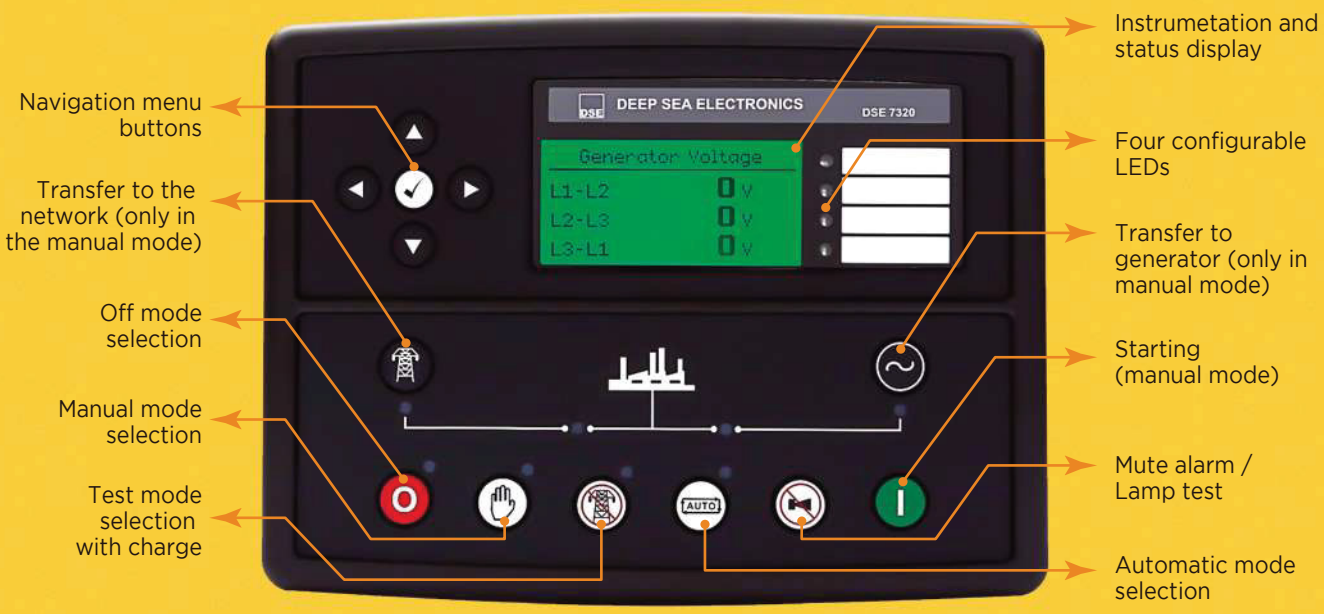
The manual mode allows the operator to start and stop the assembly manually and, if necessary, change the status of the charge switching devices.
The module mode is active when the Stop button is pressed.
The starting sequence is initiated by pressing the Start button: if Protected Start is off, it will start immediately; if it is on, the icon to indicate manual mode will be displayed and the manual LED will flash. Then, the Start button must be pressed once more to begin the starting in manual mode, the charge is not transferred to the generator unless a charge request is made, which can come from several sources:

• From an out-of-bounds network supply (DSE4520 only)
• From the activation of an auxiliary input configured for remote start on charge.
• From the activation of the built-in programmer if it is configured.

To turn off the generator, press the Stop button.

8.2 DSE 7320 module

8.2.1 Description of the controller



Control buttons

- **Stop/Reset**

This button puts the module in stop/reset mode; this erases any alarm conditions, for which the activation criteria must be removed. If the engine is running and the module is in stop mode, the controller automatically instructs the transfer unit to remove the charge from the generator, the fuel supply is de-energized and the engine stopped; if there is a remote start signal in this mode, it will not occur.

• **Manual**

This mode allows the operator to control the generator manually. In this mode the starting responds to the Start button: the engine starts and operates without charge. If the generator is running without charge in manual mode and there is a remote starting signal, the module will instruct the transfer unit to take charge; when the remote starting signal is removed the generator will remain under charge until the Stop/Reset or Auto button is pressed.

• **Auto**

This button sets the module to automatic, which allows you to control the function of the generator automatically. The module will monitor the remote starting input and the network supply status; once a starting request has been made, the equipment will automatically start and be placed under charge. When the starting signal is removed, the module will automatically transfer the charge from the generator and stop the engine, observing the stop delay timer and the cool down timer as necessary; the module will then wait for the next start event.

• **Test**

This button puts the module in test mode, allowing charge tests on the generator; it will respond to the Start button and the engine will start and the generator will take charge.

• **Start**

This button is only active in Stop/Reset and Manual modes; pressing it starts the engine and operates at no charge (in manual mode) or at charge (in test mode).

• **Mute alarm / LEDs test**

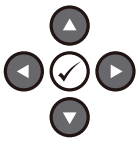
This button silences the audible alarm and illuminates the notification LEDs as a test.

• **Transfer to the generator**

Allows the operator to transfer charge to the generator (manual mode only).

• **Transfer to network**

Allows the operator to transfer charge to the generator (manual mode only).



• **Navigation menu**

Used to navigate the control module screen.

8.2.2.- Operating modes

Manual mode
It is used to start and stop the genset.
It is activated by pressing the Manual button; to initiate the starting sequence the Start button must be pressed and to transfer charge, a charge request can be made:

- by pressing the Transfer to Generator button,
- with an out-of-bounds power network supply,
- with a remote starting signal,
- by activating the power-up timer.

To restore power to the network, press the Transfer to Network button or press the Auto button to return to automatic mode.
To stop the generator, press the Stop button.

Automatic mode

This mode is activated by pressing the Auto button; an LED indicator will confirm the start of the mode.
In this mode the generator controls its start and stop without the intervention of an operator.
The starting sequence initiates with a starting request, which can be:

- with an out-of-bounds power network supply,
- with a remote starting signal,
- by activating the power-up timer.

Once the engine is running the warm-up timer will activate (if selected), allowing the engine to stabilize before taking a charge.
If all starting requests disappear, the stop sequence will be initiated.
The retransfer timer operates to ensure that the starting request is completely eliminated; if there is another charge request during the cool-down timer period, the system will retake charge.
The cooling time allows the system to cool down sufficiently before stopping; after this time, the engine stops.

Test Mode

To start the starting sequence, the Start button must be pressed.
Once the engine is running, the warm-up timer (if selected) starts, allowing the engine to stabilize before taking a charge.
The charge will be automatically transferred from the power network to the generator.
To stop the system immediately press the Stop button, or press Auto to have the system watch for starting requests and stop timers before starting the stop sequence.

8.3.- DSE 8610 module

8.3.1 Description of the controller

Control buttons

• Stop/Reset

This button puts the module into its Stop/Reset mode, which will eliminate any alarm conditions for which the activation criteria have been removed. If the engine is running and the module is in stop mode, it will automatically instruct the switching
device to unload the generator (Close Generator becomes inactive if used). The fuel supply is turned off and the engine stops.
If a remote starting signal is present while operating in this mode, it will not occur.

• Manual

This mode allows manual control of the generator functions. Once in this mode the module will respond to the start button, which will start the engine, and will discharge. If the engine is running off charge in manual mode and a remote start signal is present, the module will instruct the switching device to place the generator on charge (Close Generator is activated if used). Once the remote starting signal is removed, the generator remains on charge until the Stop/Reset or Auto modes are selected.

• Auto

This button sets the module to automatic, which allows you to control the function of the generator. The module will monitor the remote starting input and the supply status of the network; once a starting request has been made, the equipment will automatically start and be placed under charge. When the start signal is removed, the module will automatically transfer the charge from the generator and close the descent by observing the stop delay timer and the cool down timer as required.
The module will then wait for the next starting event.

• Start
This button is only active in Stop/Reset and Manual modes; pressing it starts the engine and operates at no charge (in manual mode) or at charge (in test mode).

• Mute alarm / Led Test

This button silences the audible alarm and illuminates the notification LEDs as a test.

• Transfer to the generator

Allows the operator to transfer charge to the generator (manual mode only).

• Open generator

Allows the operator to open the generator switch (only when in manual mode).

• Navigation menu

It is used to navigate the control module screen.

8.3.2.- Operating modes

Automatic
This mode is activated by pressing the Auto button; a LED next to the button confirms this action.
The mode allows the generator to operate fully automatically, starting and stopping as needed, without operator intervention.
If a starting request is made, this sequence will start. Starting applications can be from the following sources:

- an auxiliary input configured for remote on-charge or off-charge start,
- an out-of-bounds power network supply,
- a request from the DSE 8660 network controller or another DSE 8610 controller via the MSC link,
- the activation of the built-in task scheduler,
- an instruction from external remote telemetry devices using the RS232 or RS485 interface.

To allow for "false" starting requests, such as network voltage drops, the start delay timer starts; there are individual start delay timers for each of the different start request types.
If all starting requests are deleted during the starting delay timer, the drive will return to a standby state.
If there is still a starting request at the end of the start delay timer, the fuel relay is energized and the engine is started.
The return delay timer works to ensure that the starting request has been permanently deleted and is not a short-term deletion. If another starting request is made during the cooling period, the equipment will reload; if there are no starting requests at the end of the return delay timer, the charge opens the circuit breaker and the cooling timer starts, which allows the assembly to run off charge and cool down sufficiently before it is stopped. This is especially important when installing turbo chargers in the engine.
If the assembly is called to reload before the cooling timer has expired, the engine operation will be followed again.
After the cooling timer has expired, the appliance stops.

Manual

The manual mode is activated by pressing the button  . An indicator LED next to the button confirms this action. The manual mode allows the operator to start and stop the assembly manually and, if necessary, change the status of the charge switching devices.

In this mode the device does not start automatically; to initiate the starting sequence press the Start button.
The fuel relay is energized and the engine is started. If the engine does not start during the start attempt, the engine is decoupled for the duration of the crank rest, after which the next starting attempt is made. If this continues to happen, the starting sequence will end and the display will show "Fail to Start".
In manual mode the charge is not transferred to the generator unless a charge request is made, which request can come from several sources:

- from pressing the transfer to the generator key (),
- from the DSE 8660 network controller or another DSE 8610 controller via the MSC link,
- from the activation of an auxiliary input configured for remote starting on charge,
- from activating the built-in exercise planner (if it is configured for runs in charge).

If the common bus is measured as "dead bus", the charge switch is closed; if it is measured to be "live bus", the synchronization has to be done before the switch is closed. Once the charge has been transferred to the generator, the charge breaker will not open automatically unless:

- the Open Generator button is pressed (DSE 8610/DSE 8610 only),
- is returned to automatic mode.

In manual mode the unit will continue to operate until the stop button is pressed (the unit will stop immediately) or the auto button is pressed; the assembly will observe all requests to start the auto mode and the stop timers before starting the auto mode stop sequence.

9.- Maintenance and safety

9.1.- Safety during maintenance

Before carrying out any work on the Modasa genset, press the emergency stop button or select the Stop mode on the control module.
For major maintenance or parts replacement, turn off the battery charger and then disconnect it. It is important to use the emergency stop button only when the situation requires it and not for normal engine shutdown; after the emergency stop, do not start the engine until the problem that caused it has been corrected.

REMEMBER WE DON'T HAVE STOCK OF HUMAN PARTS, ONLY ENGINES

9.1.1.- Fire and burns hazard

- Do not smoke when supplying or handling fuel containers.
- Do not use fuels to clean parts; good quality, non-flammable and non-toxic solvents are recommended.
- Do not spill fuel on hot surfaces and if it happens, clean it up immediately.

Figure 28: Fire risk

- Do not fill the fuel tank with the generator running.
- When filling the fuel tank, do so with the engine off and cold.
- Do not bring flammable materials near the engine.
- Do not put flammable materials in contact with hot parts of the exhaust pipe.
- Do not operate the genset in areas where flammable materials are present.
- Always be on the alert for fuel or oil leaks.
- If the genset leaks while it is running, the engine would shut down due to lack of fuel, which could result in loss, injury or damage to the generator and connected electrical equipment. In addition, there is the possibility of a fire hazard.

Figure 29. Signal of fuel leakage

Avoid burns:

- Do not change the oil or coolant while the engine is running or has just been turned off; wait for it to cool down to room temperature.
- Check the coolant, oil, and fuel level after the engine has been stopped and once it has cooled; remove the radiator filler cap only when the engine is at room temperature.

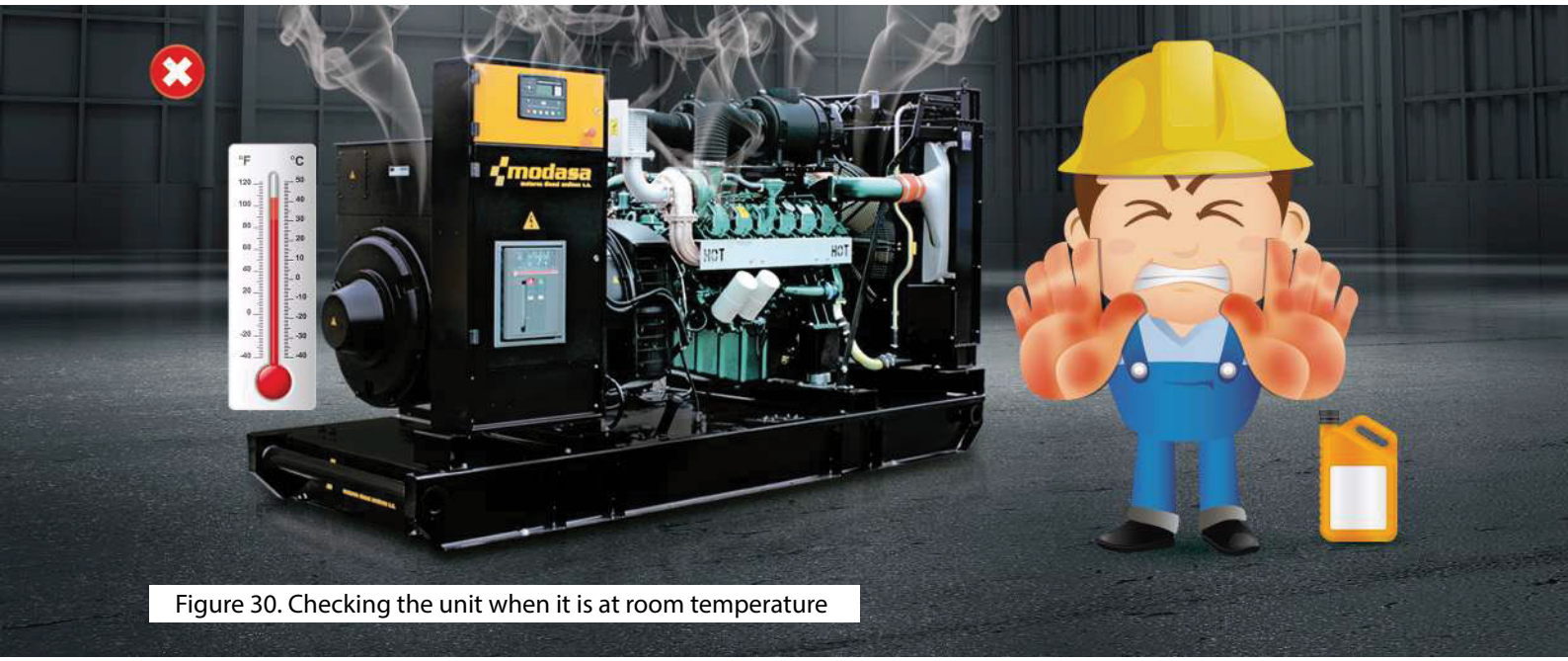


Figure 30. Checking the unit when it is at room temperature

9.1.2.- Prevention of mechanical and human injuries

- Keep away from all moving or rotating parts; rotating engine and alternator parts are dangerous, so it is recommended that you keep away from them while the genset is running

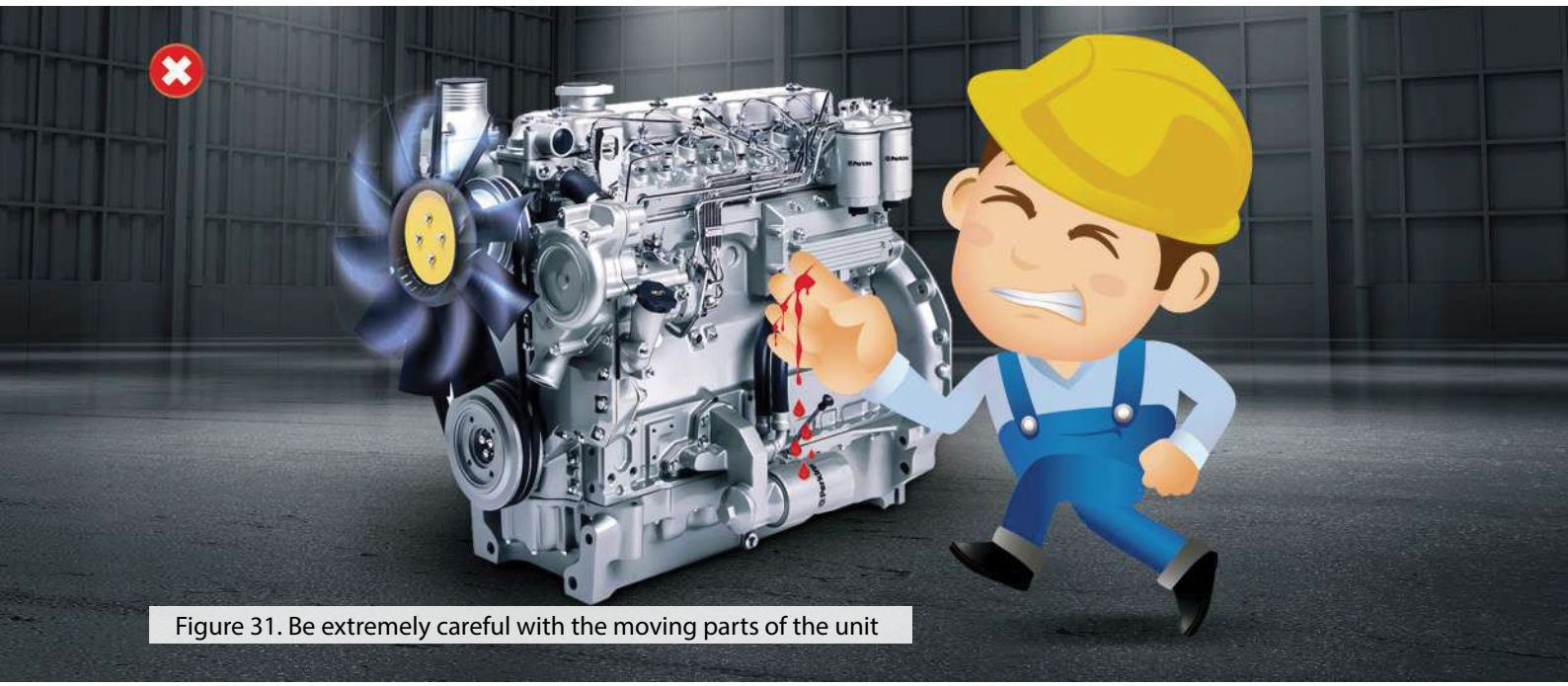


Figure 31. Be extremely careful with the moving parts of the unit

- Carefully remove the radiator filler cap (never do this when the engine is hot).
- Check the coolant level only after the generator has been turned off.
- Only remove the filler cap when the engine is at room temperature.

Figure 32. Negligence when removing radiator

- Handle battery electrolyte carefully and wear protective glasses and gloves when handling it, as it is hazardous to the skin. In case of contact with eyes or skin, rinse immediately with plenty of running water and seek medical advice.

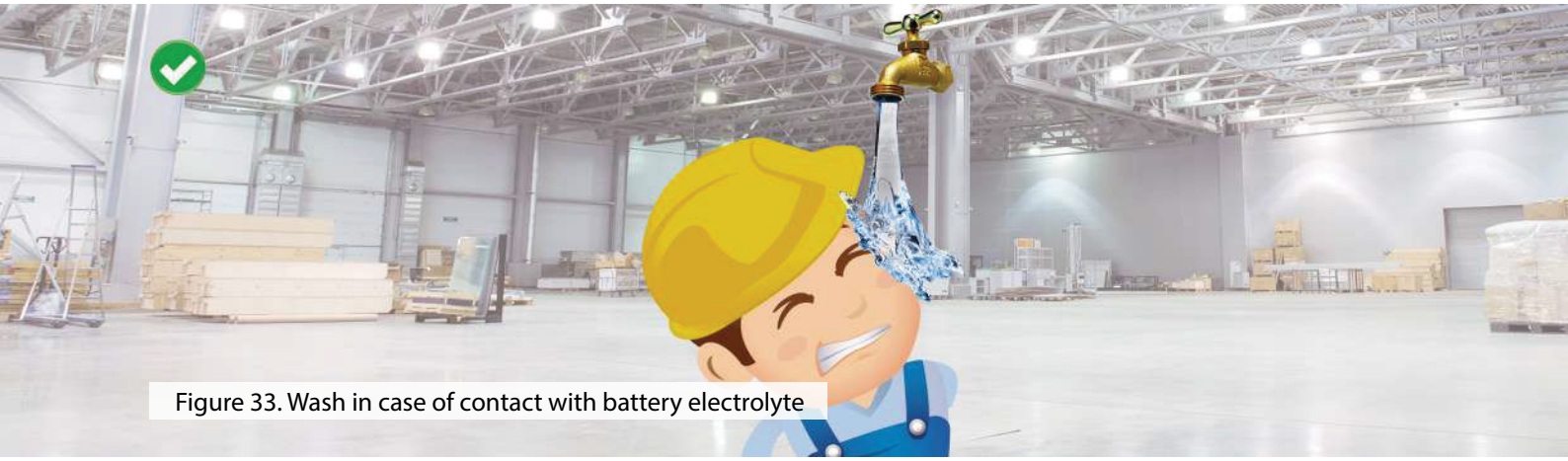


Figure 33. Wash in case of contact with battery electrolyte

- Handle antifreeze carefully.
- If you drink antifreeze by mistake, induce vomiting and consult a doctor.
- If the antifreeze comes in contact with your eyes, rinse them immediately with plenty of water and see a doctor.

Figure 34. Do not consume antifreeze

- Wear the right clothes for the job.
- Use, whenever necessary, safety implements such as helmet, mask, safety shoes, goggles, thick gloves, hearing protectors, etc.
- Avoid wearing chains, watches and loose clothing, as well as long hair.

Figure 35. Considering the recommendations

- Do not break any setting seals.
- Do not break the seals of the fuel injection pump or those of the regulator that controls the injection dosage settings and the maximum and minimum speed; breaking these and changing their settings may cause:

1. Accelerated wear of engine components.
2. Jamming or damage to engine components.
3. Increased fuel and oil consumption.
4. Incorrect injection dosage and poor engine performance.
5. Non-compliance with emission standards.

This improper procedure results in the loss of the warranty on the generator.

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Figure 36. Do not attempt to repair failures without first calling your supplier

- Do not disconnect the battery switch while the engine is running, as this may damage the diodes and transistors of the engine's dynamic alternator, causing the instruments to malfunction.
- Disconnecting the terminal can damage the electrical components of the generator connected to the battery in VDC.

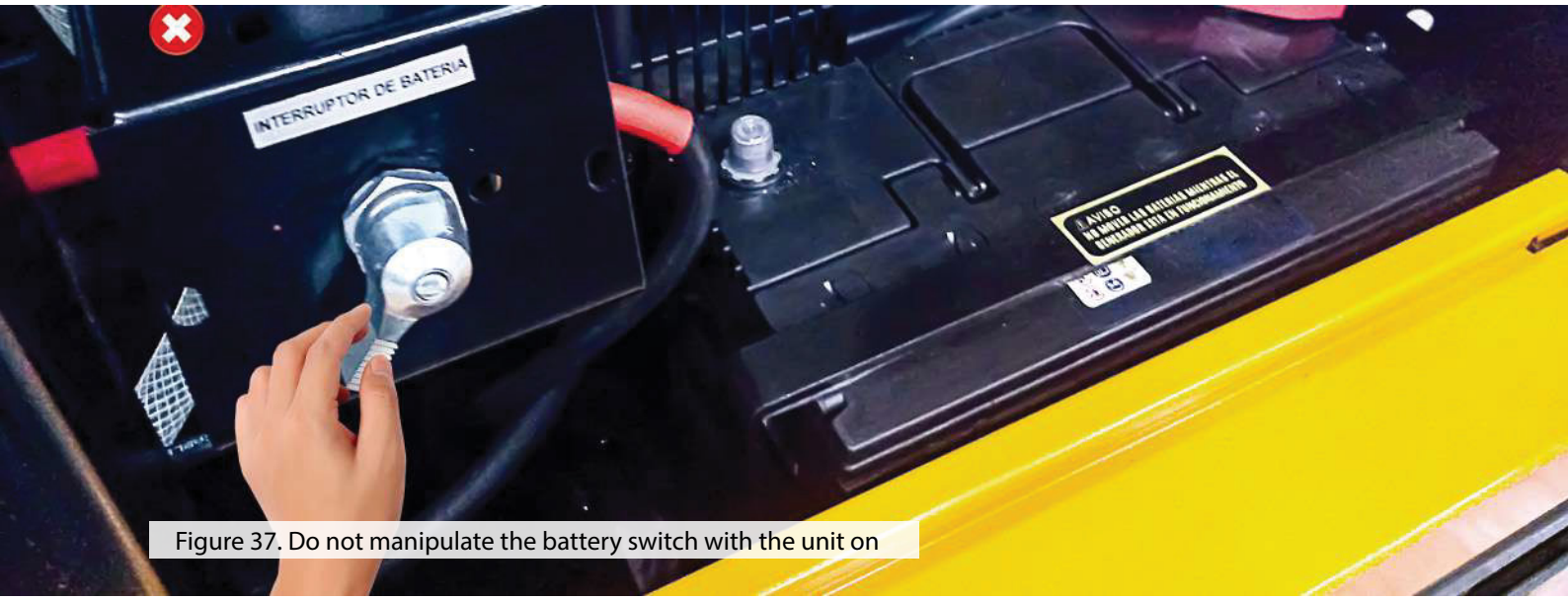


Figure 37. Do not manipulate the battery switch with the unit on

- Prevent water from reaching the generator, as it may end up damaging it.
- If water or cleaning agent gets inside the combustion chambers, the hammering action of the water could cause engine damage. Cover the intake and exhaust pipes with tape when washing the engine to prevent this from happening.
- Do not wash the engine while it is running.

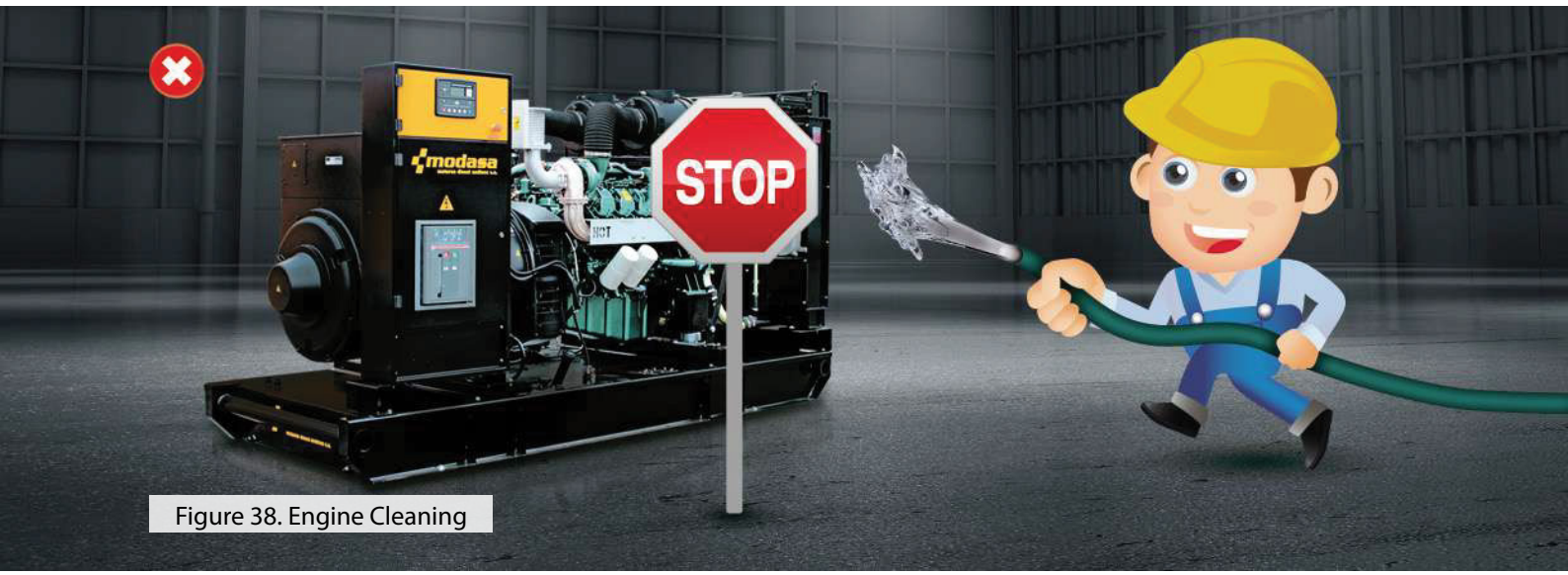


Figure 38. Engine Cleaning

- Avoid the penetration of air with impurities into the engine, which can cause premature wear of moving parts resulting in loss of power, high oil consumption, starting problems and other failures.
- Maintain the air filter as indicated and always use the air filter recommended by the manufacturer; the use of an alternative air filter may result in premature engine wear.

Figure 39. Use original spare parts

- Never remove the air filter element with the engine running.
- When removing the air filter element, prevent dust from entering the air intake duct of the cylinders.
- Perform air filter maintenance when the air restriction indicator is red; reducing the maintenance frequency can cause damage.
- Do not use the air filter element if it has obvious tears, cuts or damage.
- Never operate the engine without an air filter.
- Replace the filter and avoid cleaning it with compressed air, which could damage it or cause it to become clogged.

Figure 40. Do not clean air filter, replace it with a new one

- If there is a sudden stop, do not start the engine immediately, but first find out the cause of the failure and make the necessary repairs; failure to follow the recommended precautions can cause serious engine problems.

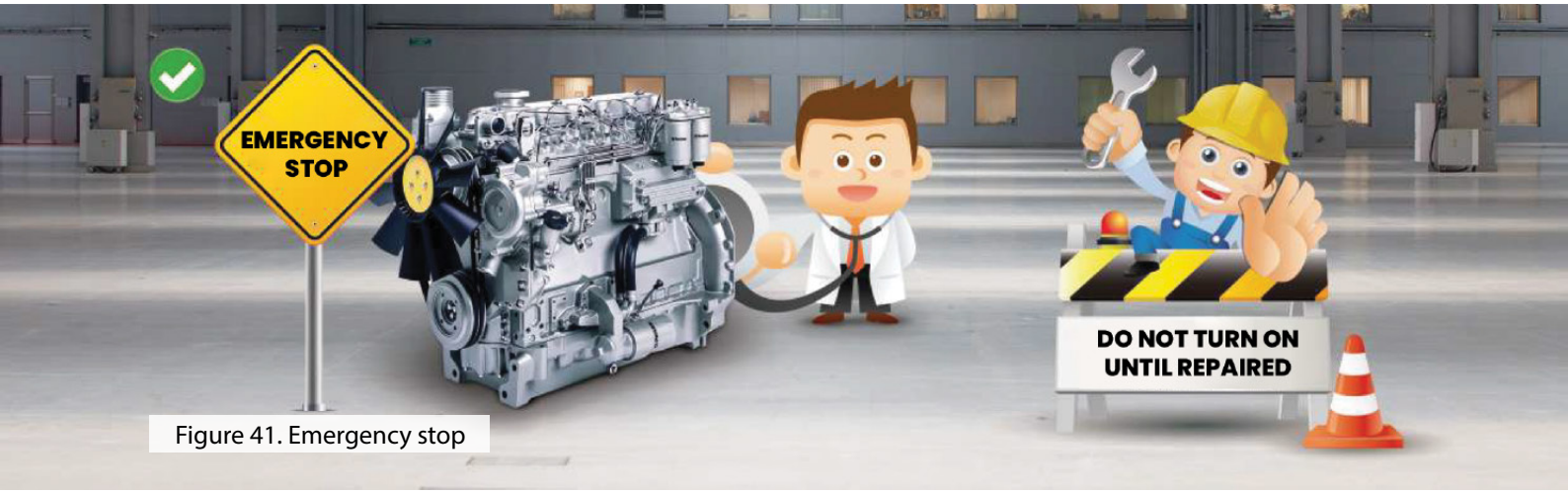


Figure 41. Emergency stop

- If the unit is operating under charge, do not turn it off immediately, as there may be an excessive increase in coolant temperature and moving parts may jam.

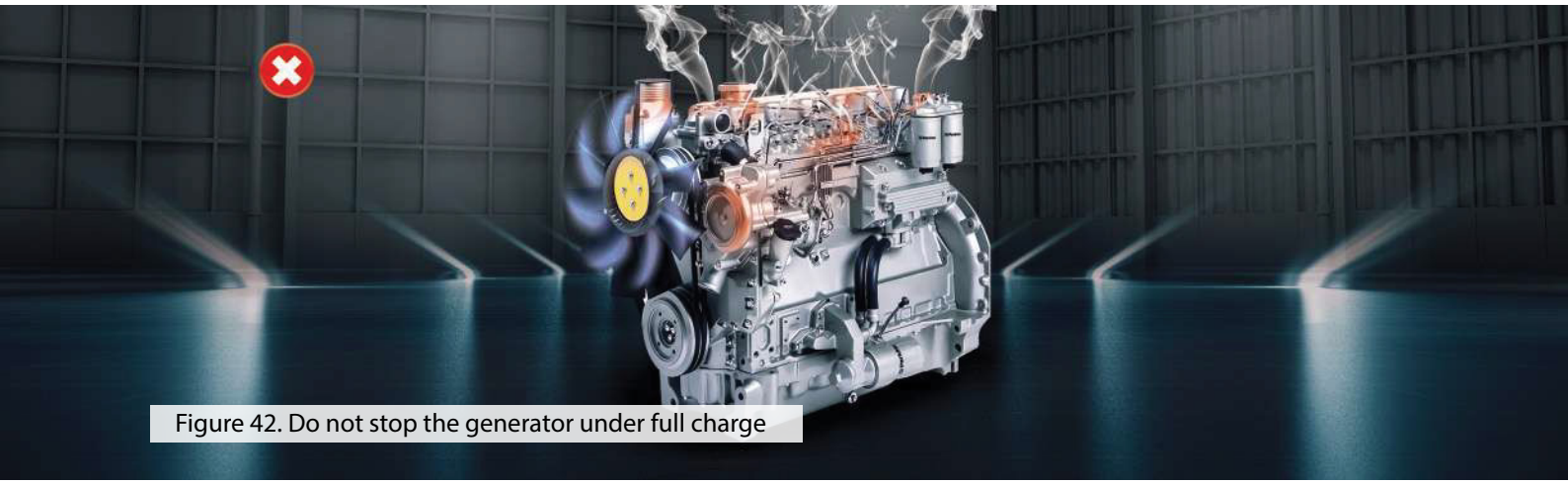


Figure 42. Do not stop the generator under full charge

- Stop the engine immediately if the fan belt breaks; running the engine under these conditions could cause the engine to overheat, which could result in the radiator cap and coolant being ejected if the temperature switch does not work.

Area of operation

- Respect the working altitude.
- The electrical machine was designed to guarantee the rated power at an ambient temperature of no more than 40 °C and an altitude of less than 1000 m above sea level, unless otherwise indicated on the plate of the genset.
- Consult the manufacturer for different conditions.

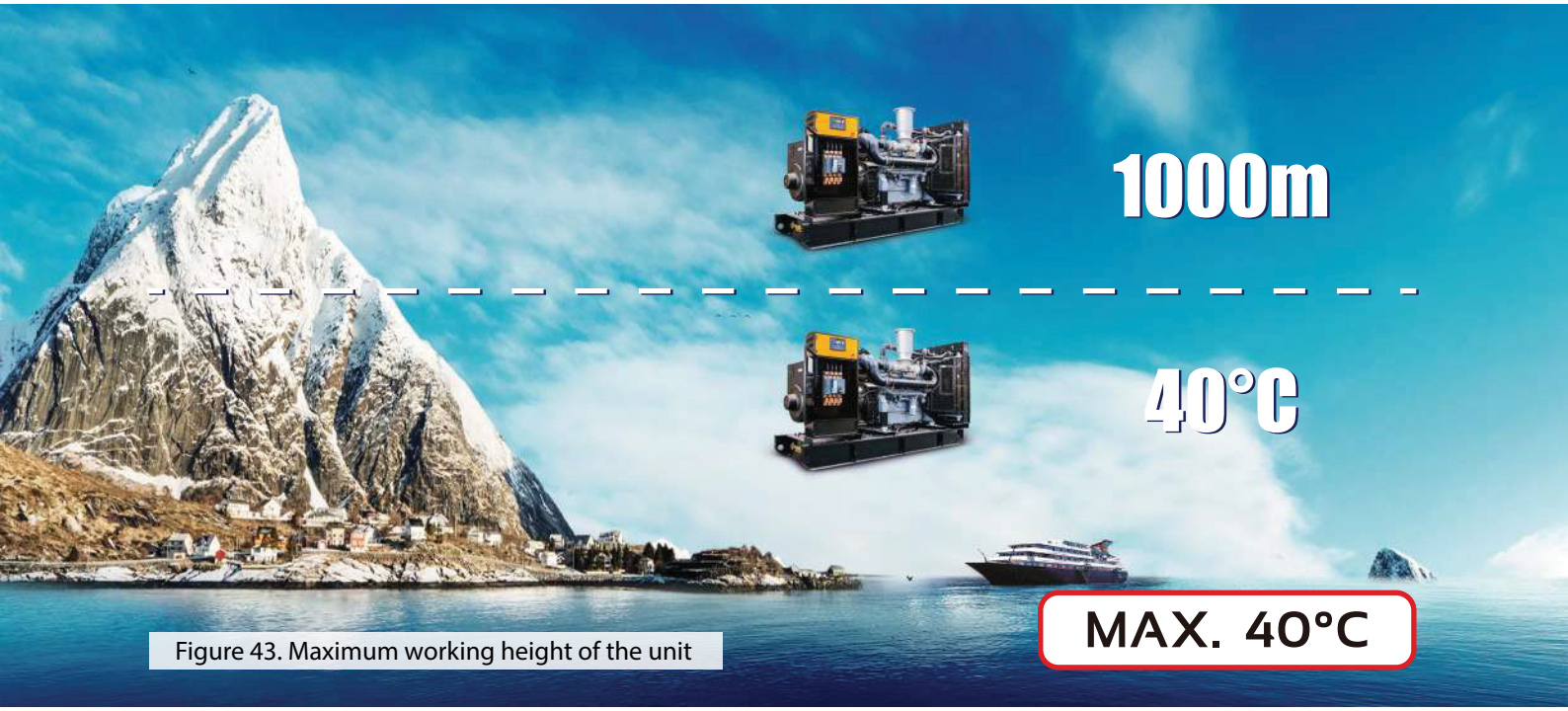


Figure 43. Maximum working height of the unit

- The alternators produce heat, which can be high depending on the power generated, so do not touch the machine unless you are wearing protective gloves and it has been a while since it reached room temperature.

Figure 44. Do not remove the alternator grid

Danger of short circuit

The alternator is built to IP 23 protection class.
Replacement parts must be made by a qualified technician using original spare parts.

10.- Engine maintenance

Each engine includes an operation manual for proper maintenance; this section mentions general considerations. Use the fuel, oil, coolant, and parts specified by the manufacturer; failure to do so will result in increased maintenance costs and shortened engine life.
Check the genset every day for possible faulty or missing parts and arrange for repairs to be carried out as quickly as possible; even minor defects can cause very serious problems.

10.1.- Engine lubrication

10.1.1.- Oil level control

The engine must be leveled horizontally and ensure that the level is between the Min. and Max. marks on the dipstick; if the engine is hot, wait 3-5 minutes after turning off the engine.

1. Always observe the oil change interval recommended in the manual and replace the filter at the same time using original spare parts.
2. Add oil to the correct level; do not exceed the Max.

10.1.2.- Engine oil level check

The purpose of this check is to keep the oil between the maximum and minimum of the dipstick. To carry out this check, the engine must be placed in a horizontal position and the dipstick removed, cleaned with a cloth and then reinserted in the oil level guide for two seconds; after this procedure the dipstick is removed again to see the current oil level and if necessary oil must be added while maintaining the SAE.

Figure 45. Checking the oil level

Always use original filters
Use the fuel, oil, coolant, and filters recommended by the factory; failure to do so can damage the engine and shorten its life.
Use only original spare parts that correspond to the make and model of your engine. While the warranty is in effect, the use of original spare parts is mandatory; go to the Spare Parts section for spare part codes.

Figure 46. Use only original spare parts

10.1.3.- Lubricant specifications

Recommended oil types

Use oil that meets the conditions of class CF or CF-4, according to the API engine oil classification. The selection of a suitable oil ensures good starting by reducing friction through the oil film adhering to the cylinder walls and bearing surfaces, thus reducing the strain on the engine to reach the speeds required for reliable starting; incorrect selection can cause these films to freeze, which means greater effort is required to overcome friction, making it difficult to reach sufficient speeds for proper starting and adversely affecting the life of the engine.

Recommended oil viscosity

There are two important aspects to consider for satisfactory engine operation at room temperature: the ability to rotate the engine at sufficient speed to ensure starting and lubrication of internal surfaces, which are subject to wear during starting and heating; both of these factors can be solved with proper oil grade selection.

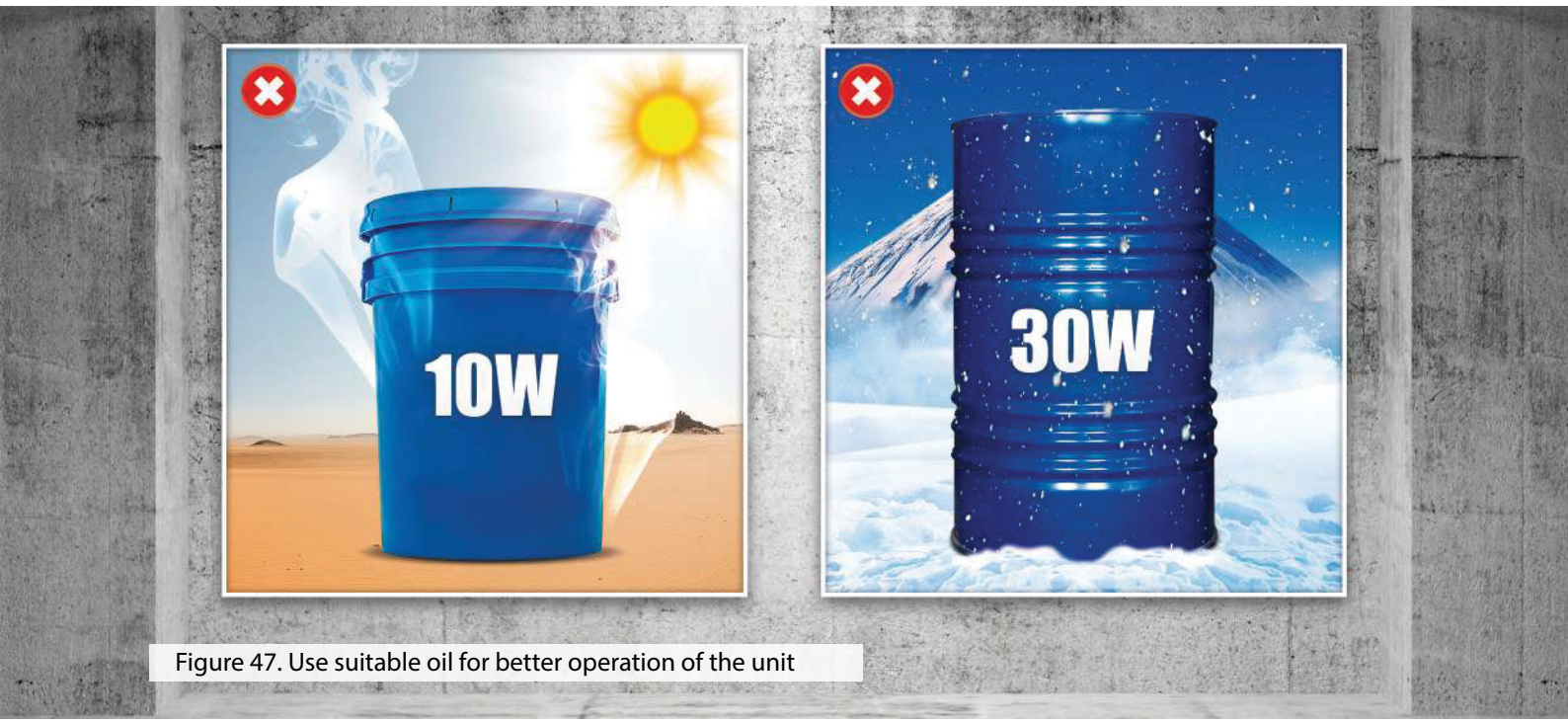
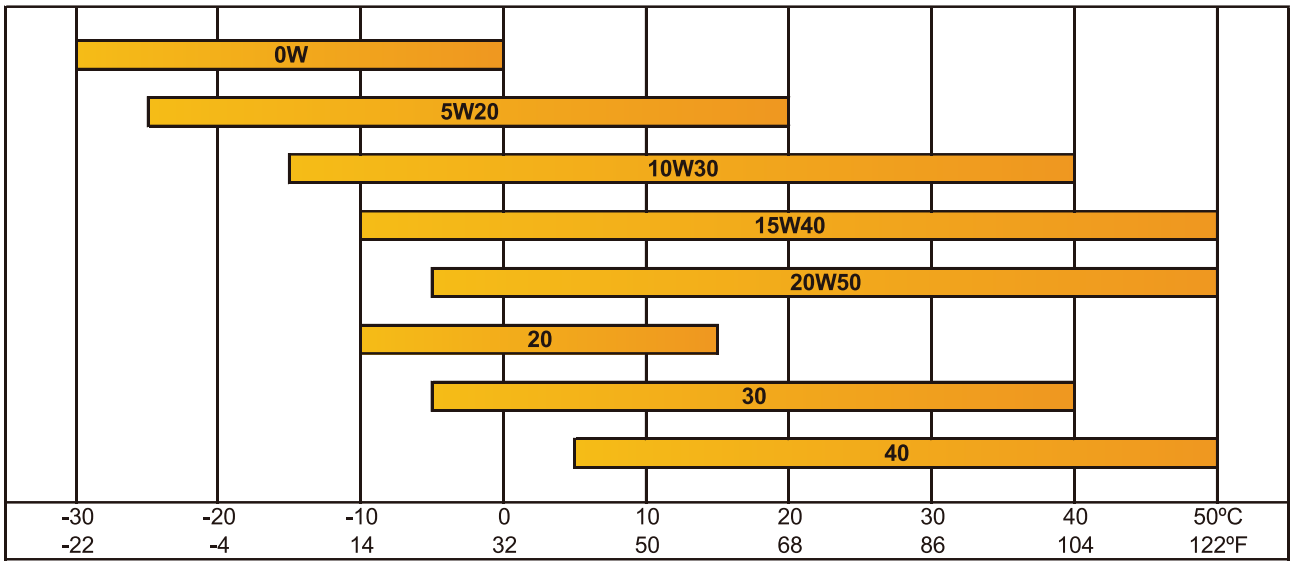


Figure 47. Use suitable oil for better operation of the unit

The following table shows the viscosities recommended by the SAE for the oil at different ambient temperatures:



Caution
Do not mix oils of different brands; most are not compatible and when mixed can cause seizure of piston rings and cylinders, among other parts, as well as wear of moving parts. It is best not to change the brand or type of oil.

Requirements and limitations for oils
If a used oil analysis is performed to determine its condition, refer to the table below; change the oil if the one you are using does not meet any of these requirements.

Note: Oil change intervals depend on the properties of the fuel; be sure to use only the recommended fuels. The limit of the total number base (alkalinity of the lubricant) is one of the means of the new oil in the case of the perchloric acid analysis method.

Limiting requirements for engine oils

PROPERTY	UNIT	TEST METHOD	LIMIT
Viscosity	cst at 100C (212F)	JIS K2283	+30% / -15%, max. new oil
Total numbering base (HCl)	mg KOH/g	JIS K2501	2,0, min.
Total acidity index	mg KOH/g		+3,0, max. new oil
Water content	% in volume	JIS K 2275	0,2, max.
Flammability temperature	ºC (ºF)	JIS K 2265	180 (356), min.
Insoluble pentanes	% in weight	ASTM D893	0,5, max.
Coagulated insoluble pentanes	% in weight		3,0, max.

10.2.- Auxiliary element belts: verification and adjustment

Inspection and adjustment should be made after the engine has run, when the belts are hot. Loosen the screws before tightening them; the alternator belts should give way 10 mm between the pulleys.

Worn belts that work in pairs should be changed at the same time. The fan belts have an automatic tensioner and do not need to be adjusted; however, their condition should be checked.

10.3.- Air filter: verify/replace

The degree of contamination of the intake air filter depends on its size and the concentration of dust in the air. Therefore, cleaning intervals cannot be generalized but must be defined for eac individual case. This also depends on the environment in which the engine operates.

Clean air is essential for the proper operation and long life of the engine. That is why it is soimportant to properly maintain the air filter, which prevents dust and dirty air from entering the engine, which could cause rapid wear on piston rings, cylinders and pistons, resulting in power loss and high oil consumption. Also, dust and dirt that accumulates in the air filter ducts could obstruct the air supply to the engine, causing large carbon build-up on pistons and valves due to
incomplete combustion.

Do not service the air filter while the engine is running; when removing it for this purpose, prevent dust from entering the air duct that communicates with the cylinders.
Maintain the air filter at reasonable intervals or when you see the signal on the indicator.

- Do not use the air filter element if it has obvious tears, cuts or damage.
- Do not use alternative filters.
- Do not modify the air intake system.
- The air filter should not be cleaned with compressed air or washed with water.

10.4.- Cooling system

The cooling system must be filled with a coolant that protects the engine against internal corrosion and freezing if the weather demands it.
Never use water alone.
Anti-corrosion additives become less effective over time; therefore, the coolant must be replaced.

1. The cooling system must be flushed when replacing the refrigerant.
2. To wash the cooling system, see the engine manual.
3. Change the cooling system every year at the most or every thousand hours of operation.

10.4.1.- Coolant specifications

The water used in the engine cooling system must be soft, with as few minerals as possible that can produce flakes, and must comply with the requirements of the table below, which sets out the permissible limits.
Coolant specifications:

ELEMENT	CHEMICAL SYMBOL	UNIT	RECOMMENDED LIMIT	MAJOR ADVERSE EFFECT	
				CORROSION & OXIDATION	FLAKING
pH, 25C (77F)	-	-	6,5 a 8,5 (6,5 a 8,0)	0	0
Electrical conductivity, 25C (77F)	-	µΩ /cm	<400 (<250)	0	0
Total hardness	CaCO3	PPM	<100 (<95)	-	0
Alkalinity M	CaCO3	PPM	<150 (<70)	-	0
Chlorine ion	Cl-	PPM	<100 (<100)		-
Sulfuric acid ion	SO24	PPM	<100 (<100)	0	-
Total Iron	Fe	PPM	<100 (<100)	-	0
Silica	SiO2	PPM	<100 (<100)	-	0
Residues from evaporation	-	PPM	<100 (<100)	-	0

Note: The values indicated in brackets are the established limits. In addition to the above elements, the established turbidity is <15 mg.

Propylene/ethylene glycol
The quality of coolant used can greatly affect the efficiency and life of the cooling system; the recommendations described below can help to keep it in optimum condition and protect it from frost and corrosion.

Engine coolant is usually a mixture of ethylene or antifreeze based on propylene glycol and water.
The freezing point of the mixture will depend on the relative amount of glycol used. It is important to use the best water available, mixed with no more than 60 % ethylene glycol based antifreeze or no more than 50 % propylene glycol based antifreeze.

It is equally important never to use only water as an engine coolant, because at engine operating temperatures, water is corrosive.
Water quality is important; the following table shows the minimum acceptable characteristics for cooling system water according to a manufacturer:

PROPERTIES	LIMITS	ASTM TESTS
Chloride (Cl) gr/gal (ppm)	2.4 (40) max	D512B, D512d, D4327
Sulphate (SO4) gr/gal (ppm)	5.9 (100) max	D516b, D516d, D4327
Total hardness, gr/gal (ppm)	10 (170) max	D1126b
Total solids, gr/gal (ppm)	20 (340) max	D1888a
PH	5.5 - 9.0	D1293

10.5.- Fuel system

No dirt or contaminants should enter the fuel injection system.
Fuel replacement must be done with the engine cold to avoid a possible fire caused by spilling fuel on hot surfaces.
The changing time indicated in the manual for the filter is applied under conditions of high diesel purity; the filter life time depends on the diesel cleaning, it cannot be generalized.

10.5.1.- Fuel specifications

Recommended fuel types
Fuel quality is an extremely important factor in obtaining satisfactory engine performance, long life and acceptable levels of exhaust emissions.
The engines are designed to burn fuels meeting the ASTM D 975 (class No. 2-D) designation.

Fuel tank care
Fill the tank at the end of the day, as the incoming fuel will expel the moisture-laden air and prevent condensation.

After fifty hours in service, before starting the engine, remove the drain plug and drain any water or sediment that has accumulated.

Figure 48. Fuel tank maintenance

10.5.2.- Care of the fuel supply

Clean fuel must be purchased and kept clean; a good method for cleaning is natural sedimentation. Once the storage tank is full, keep the fuel there at least ten days before transferring it to the daily tank. Be sure to completely remove water and sediment from the bottom of the tank before refilling. From time to time, empty all the fuel and carefully clean the tank. Install an additional filter in case there is too much dirt or water.

Figure 49. Additional fuel filters

10.6.- Alternator maintenance

During routine maintenance, periodic attention to the condition of the following items is recommended:

Windings
The condition of the windings can be determined by measuring the isolation resistance to earth, i.e. the ohmic resistance of the machine housing to earth. This resistance is altered when there is moisture or

dirt on the windings, so the measurement of the generator isolation will indicate the current state of the winding.
The device used to measure isolation is the megohmmeter or Megger.
The AVR (automatic voltage regulator) card must be disconnected if the generator is of the selfexciting type.
As for the acceptable generator insulation value, it is recommended to follow the information in the manufacturer's manual; in general, the formula R (resistance in megohms) = nominal voltage in V/nominal power KW + 1000 is used.
If the insulation resistance is lower, it is essential to dry them.
Drying can be carried out with a heating fan or similar apparatus through the air inlet and outlet grilles of the generator, although another quick and effective method would be drying by means of a resistance heating oven.
If the alternator is impregnated with salt as a result of operating in areas with a sea breeze, it requires special maintenance. In this case, you should consult the workshop, since this environment rapidly deteriorates the insulation level, which can lead to a short-circuit in the generator.

Bearings or bushings

All bearings are permanently greased for maintenance-free operation. During a general inspection, however, it is recommended to check for wear and possible oil leakage and to replace them if necessary.
It is also suggested to check periodically if they overheat or produce excessive noise during their useful operation. If excessive vibrations occur after a certain time, it is because the bearing has worn out, in which case it should be analyzed for damage or loss of grease and replaced if necessary.
In all cases the bearings must be replaced after twenty thousand hours of operation.

10.7.- Batteries

A battery is an electrochemical device that transforms chemical energy into electrical energy and vice versa, its technical name is a lead-acid electric accumulator.

10.7.1.- Battery specifications

Maintenance-free batteries are classified as sealed and unsealed, the ones we use in the generators are maintenance-free unsealed i.e. under normal conditions of use they do not require the addition of water. They use alloys in the lead-calcium grids that decrease the corrosion and internal sulphate of the plates. They are of minimum Self-discharge and Gasification, the condensed gases return to the cells diminishing even more the water loss, better internal current conductivity for the ignition and 20% more of current capacity than the Lead-Antimony batteries.

10.7.2.- Recommendations for battery usage

Batteries give off combustible gases that can explode. A spark can cause gases to ignite and this can result in serious or fatal injury. Ensure adequate ventilation when in an enclosed space and follow proper procedures to help prevent electrical arcs and/or sparks near batteries.

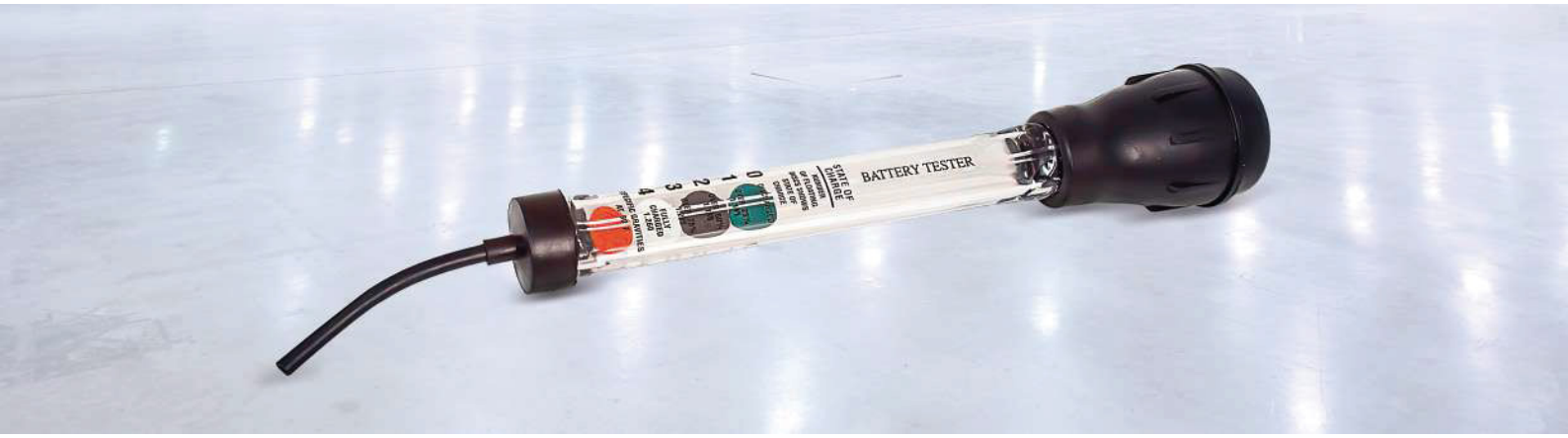
- Do not smoke when servicing batteries.
- The battery cables should not be removed when the battery covers are in place. Removing them when the cover is in place can cause an explosion resulting in personal injury.
- The battery cover must be removed before any service is performed.
- Do not dispose of batteries, return used batteries to a recycling facility.
- When a motor is operated for short periods only, the batteries may not be fully recharged.

- If the batteries are charged correctly the ammeter reading should be very close to zero.
- All lead batteries contain sulfuric acid that can burn skin and clothing.
- When working on or near batteries, wear protective clothing and a mask.

If the batteries have water evaporation, it must be refilled with distilled water. First, clean the battery to prevent dirt from entering and then remove the caps. Add distilled water until the level is 8 mm above the separators. Replace the separators.

Charge check
To check the charge of a battery a density meter is used which checks the density of the electrolyte; this should measure from 1250 to 1275. Any other reading is not correct.

DENSITY	STATUS	VOLTAGE
1100 - 1175	Discharged battery	11.57
1150 - 1175	Battery with 60% charge	12 - 12.19
1200 - 1225	Battery with 80% charge	12.2 - 12.4
1250 - 1275	Battery with 100% charge	12.6
1300	Overcharged battery	13



Note:
Manufacturer's recommended batteries must meet or exceed specifications of no more than 10% oforiginal equipment capacity.
Choosing a battery with a lower capacity or power will result in a shorter life and early battery failure. And a capacity > 10% will generate failures with the alternator and lead to a shorter service life.

SERVICE ACTIVITY	SERVICE INTERVAL											CONSIDERATIONS
	Daily	First 50 hours	Every 50 hours	Every 250 hours or 6 months	500 hours or every 12 months	Every 750 hours	1000 hours	1250 hours	1500 hours	1750 hours	Every 2000 hours or 24 months	
Check oil level	X											Responsible: Operator
Record oil pressure	X			X								
Check coolant level	X	X		X								
Check for fluid leaks (fuel, oil and/or coolant)	X											
Clean or empty the air filter manifold	X	X		X								
Check air filter indicator	X											
Drain sediment from the fuel filter	X											
Inspect around the machine (Generator/Power Plant)	X					X						
Check/Adjust tension of fan belt and/or charge alternator		X		X								Responsible: Qualified Technician
Drain water and sediment from frame (fuel tank)			X									Responsible: Trained Operator
Drain water and sediment from the separator filter			X									Responsible: Trained Operator
Replace oil filter				X	X							
Replace oil				X	X							
Replace fuel separator filter				X	X							
Replace primary/secondary fuel filter				X	X							
Check/Replace Coolant Heater Hoses and Clamps				X								Responsible: Qualified Technician
Battery replacement				X							X	
Check battery electrolyte level				X								
Check fan drive pulley tightness				X								
Replace air filter element					X		X		X		X	
Check/Replace Clamps and Hoses					X		X					
Clean/Wash radiator core					X		X				X	
Check/Adjust valve clearance (intake-exhaust)					X		X				X	
Check the antifreeze mixture					X		X					
Diagnostic scan(governance system: ECU/ECM)					X		X		X		X	
Clean engine crankcase breather					X		X		X		X	
Replace fan belt and/or charge alternator							X				X	
Grease fan drive pulley							X				X	
Replace coolant							X				X	
Check turbocharger end play							X				X	
Inspect water pump							X		X		X	
Check/Adjust Unit Injectors							X					
Check/Adjust Unit Injector Rocker Arms							X					
Check protection devices							X				X	
Check/Replace Shock Absorbers (Resilient)							X				X	
Check governor-actuator drive (steering system: electronic)							X				X	
Check/Clean Pick-up speed sensor (steering system: electronic)							X				X	
Adjust/Replace Unit Injectors											X	
Adjust/Replace Unit Injector Rocker Arms											X	
Check aftercooler core											X	
Check/Replace Charge Alternator											X	
Check/Replace starter motor (starter)											X	
Check/Replace Turbocharger											X	
Check/Replace water pump											X	

(*) We recommend reviewing the type of engine governance system of your equipment detailed in the technical sheet of the Generating Set, for this you can visit our website and obtain the technical sheet of your equipment (it is free to download) at the following link : https://www.modasa.com.pe/
(**) If the engine is conditioned to operate in a saline environment or close to the sea, it is the responsibility of the user to inspect the engine components, ensuring that they do not present corrosion or rust and avoid any defect or premature wear.
(***) Keep in mind that for more details on the activities to be carried out, it is important to review the O&M manual of the engine manufacturer.

Types of governance:
1) Mechanics
2) Electronics
3) ECM/ECU

System	SERVICE ACTIVITY	TYPE					SERVICE INTERVAL				
	STAMFORD power generation / WEG X= Necessary *= If necessary	Alternator in operation	Inspection	Test	Cleaning	Replacement	Commissioning	Every 250 hours or 6 months	Every 1000 hours or 12 months	At 10000 hours or 24 months	At 30,000 hours or 60 months
Alternator	Alternator speed		X				X				
	Bench arrangement		X				X				
	Coupling arrangement		X				X			*	X
	Ambient conditions and cleanliness (corrosion and rust)		X				X	X	X	X	X
	Ambient temperature (inside and outside)			X			X	X	X	X	X
	Complete machine. loose parts, damage and ground connections		X				X	X	X	X	X
	Guards, screens, warning and safety labels		X				X	X	X	X	X
	Access for maintenance		X				X				
	Rated Electrical Operating Conditions and Excitation	X		X			X	X	X	X	X
	Vibration	X		X			X	X	X	X	X
Windings	State of the windings (windings)		X				X	X	X	X	X
	Insulation resistance of all windings			X			X	*	*	X	X
	Insulation resistance of rotor, exciter and PMG			X				X	X		
	Thermometers	X		X			X	X	X	X	X
	State of the dehumidifying resistance			X			X	X		*	*
	Dehumidifying resistance energization			X			X	X		*	*
Bearings	Sealed bearings		X				X	every 4000 hours			
	Sealed bearings					X				*	X
	Thermometers	X		X			X	X	X	X	X
	Bearing temperature	X		X							
Terminal box	All alternator/user connections and respective wiring		X				X	X	X	X	X
Control and auxiliaries	AVR VOLTS potentiometer - output voltage adjustment (nominal)	X		X			X	X	X	X	X
	AVR STAB potentiometer stability adjustment for variable load	X		X			X	X	X	X	X
	Initial AVR and configuration of (PFC Power Fctor Controller)	X		X			X				
	AVR and PFC (Power Fctor Controller) settings	X		X				X	X	X	X
	Auxiliary connections of the assembler (Modasa)			X			X		X	X	X
	Auxiliary connections function			X			X	X	X	X	X
	Synchronization settings		X				X				
	Synchronization	X		X			X	X	X	X	X
	Stamford anti-condensation heater					X				*	X
Rectifier	Diodes and varistors		X				X	X	X	X	
	Three-phase rectifier (if included)		X				X	X	X	X	
	Diode and varistor plate					X					X
	Always review the safety section of the alternator manual before performing any intervention on the alternator										
Refrigeration	air inlet temperature	X		X			X	X	X	X	X
	Airflow (nominal capacity and direction)	X	X				X				
	fan status		X				X	X	X	X	X
	Air filter condition (where applicable)			X			X	X	X	X	X
	Air filters (where applicable)				X	X			*	*	*

(*) For equipment that is conditioned to operate in a saline environment or close to the sea, all preventive and/or corrective measures must be taken. The frequency of these reviews and repairs will depend on the degree of exposure of the quipment.

(**) Keep in mind that for more details on the activities to be carried out, it is important to review the O&M manual or owner of the alternator.

SERVICE ACTIVITY		SERVICE INTERVAL				
SIEMENS Schneider Electric ABB ComAp DSE DEEP SEA ELECTRONICS X= Required *=Replace		Monthly	Every 6 months	Every 12 months	Every 18 months	Every 24 months
CONTROL CIRCUIT	DIN switches inspection/relay status inspection, etc	X				
	Display of instrumentation on the controller	X				
	Inspection of the state of the emergency button	X				
	Inspection of the status of the relays	X				*
	Battery charger condition inspection	X				
	Inspecting the status of expansion modules	X				
	Inspection of the status of remote monitoring accessories (Gateway)	X				
	Inspection of the status of line fuses	X				*
	Connection and interconnection adjustment (terminals)		X			
	Controller Firmware Update		X			
	Controller Event Log Download			X		X
	Internal and external cleaning		X			
	Function test in AUTO mode	X				
FORCE CIRCUIT	ITM status inspection	X				
	Inspection of the condition of power cable terminals	X				
	ITM ON-OFF maneuver	X				
	ITM bolt readjustment		X			*
	Readjustment of ITM plate bolts				X	*
	Readjustment of plate bolts Neutral				X	*
	Readjustment of nuts and bolts of grounding points				X	*
	Internal and external cleaning		X			

(*) ITM = Thermomagnetic Switch

modasa

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W W W . M O D A S A . C O M . P E

Versión: **002**
Revisión: **AGO 23**