# User guide and maintenance manual

SDMO

Generating set

General considerations
Safety instructions
Installation
Special maintenance advice

# 1. Preface

## 1.1. Introduction

### 1.1.1 General recommendations

Thank you for choosing an electrical generating set from our company.

This manual has been designed to help you operate and maintain your electrical generating set correctly.
The information contained in this manual is taken from technical data available at the time of print. In line with our policy of continually improving the quality of our products, this information may be amended without warning.

Read the safety instructions attentively in order to prevent any accidents, faults or damage. These instructions must always be followed.

You are likely to encounter several warning symbols in this manual.

| | |
|---|---|
|  Danger | This symbol indicates an immediate danger to human health and life in case of exposure. Failure to follow the corresponding advice entails serious consequences for human health and life in case of exposure. |

| | |
|---|---|
|  Warning | This symbol draws attention to the potential risks to human health and life in case of exposure. Failure to follow the corresponding advice entails serious consequences for human health and life in case of exposure. |

| | |
|---|---|
|  Important | This symbol indicates a dangerous situation if the warning is not heeded.<br>Failure to follow the corresponding advice risks resulting in minor injury of personnel or damage to any other object in case of exposure. |

In order to obtain optimum efficiency and the longest possible life for the electrical generating sets, maintenance operations must be carried out according to the periods indicated in the attached preventative maintenance tables. If the electrical generating set is used under dusty or unfavourable conditions, some of these periods will be shorter.

Ensure that all repairs and adjustments are carried out by personnel who have received appropriate training. Dealers have this qualification, and can answer all of your questions. They can also supply you with spare parts and other services.

The left and right sides can be seen from the back of the electrical generating set (the radiator is at the front).

Our electrical generating sets have been designed so that damaged or worn parts can be replaced by new or reconditioned parts thereby reducing the out of action period to a minimum.
For any replacement of parts, contact your nearest dealer for our company who will have the necessary equipment and can offer properly trained and informed staff to carry out maintenance, parts replacement and even total reconditioning of generating sets.

Contact your local dealer for the available repair manuals and to make the necessary arrangements for training personnel in implementation and maintenance.

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|---|---|
|  Important | Some user and maintenance manuals for the engines fitted to generating sets cover control units and include the start-up and shutdown procedures for the engines.<br>As the generating sets are fitted with control units that are specific to the generating sets, only the information that appears in the documentation for the generating sets' control units should be taken into consideration.<br>In addition, according to the manufacturing criteria of the generating sets, some engines may be fitted with specific electrical wiring different to that described in the engine documentation. |

### 1.1.2 Description of the reference material

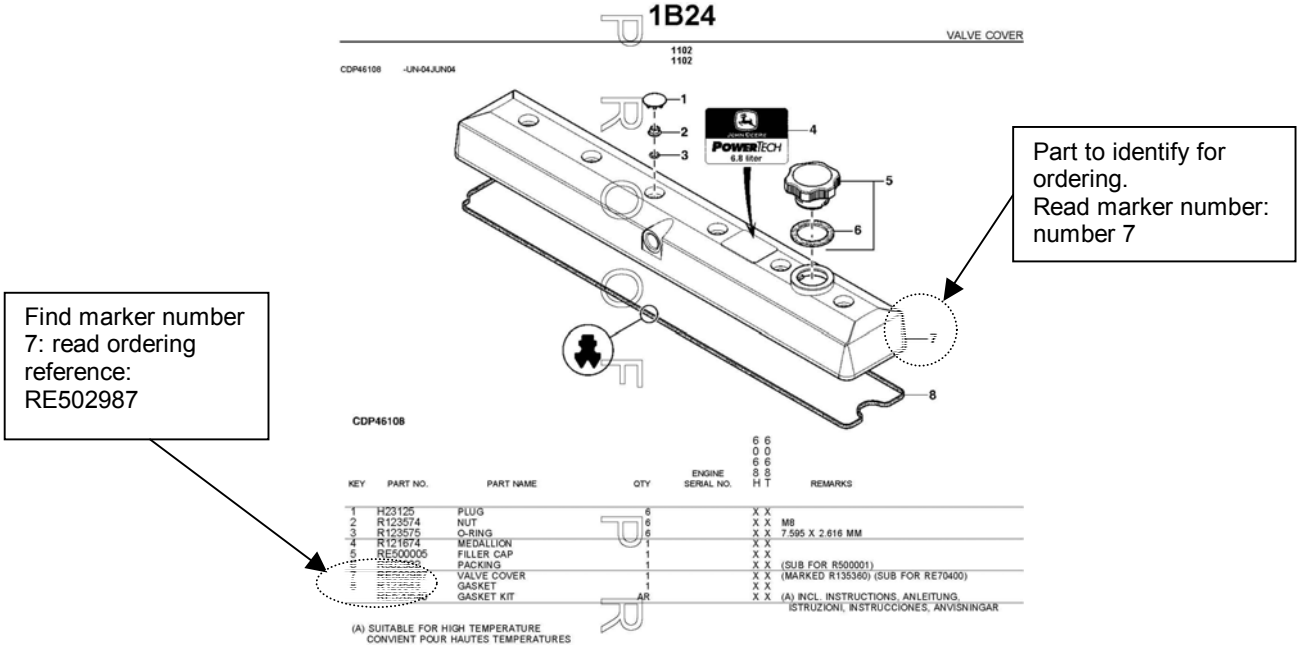
The documentation delivered with the generating sets defines all of the use and servicing operations for the generating set or power plant.
This reference material enables you to get to know the equipment, operate it and maintain it, both on a daily basis and periodically.
The documentation for the engines and alternators fitted to the generating sets consists of engine user and maintenance manuals (from the manufacturer), and alternator user and maintenance manuals (from the manufacturer).

The documentation contains:

- ✓ The user and maintenance manual, containing among other things:
  - o General recommendations and safety rules to be observed.
  - o General rules for installing generating sets.
  - o General instructions for preparing generating sets prior to commissioning.
  - o Tables of capacities (lubricants and coolants) and fuel tanks for the various engines that can be fitted on the generating sets according to their configurations.
  - o Special maintenance advice.
  - o The descriptions and/or maintenance instructions for certain optional equipment.
- ✓ User manual for the control unit (if fitted).
- ✓ Wiring diagrams (these diagrams are supplied with the documentation or delivered with the generating set).
- ✓ The user and maintenance manual for the engine fitted to the generating set.
- ✓ The maintenance manual for the alternator fitted to the generating set.

This documentation may be supplemented by:

- ✓ The spare parts catalogue for the engine fitted to the generating set, which enables a qualified user to identify a part and order it.
  Composition: list (marker, name, reference, …) and illustrations (marker).
  **These parts catalogues are primarily available in English, regardless of the engine manufacturer**. However, this fact does not prevent identification of a part for subsequent ordering. The part can always be identified using the illustrations contained in these catalogues, and the order is made via the reference of the part found in the corresponding parts list (see example below).




- ✓ The workshop/repair manual contains the information required for major servicing of the generating set or power plant, enabling an experienced user to repair equipment after damage.
  Composition: Illustrated text (marker, commentary, procedure, operation time, level required…) and tools list.
  **This reference material exists mainly in English regardless of the engine manufacturer.**

## 1.2. Pictograms and their meanings

Safety notices are clearly mounted on the equipment to draw the operator's or maintenance technician's attention to the potential dangers and explain the action to be taken in the interest of safety. These notices are reproduced in this publication for ease of identification by the operator.
Replace any notice that is missing or illegible.

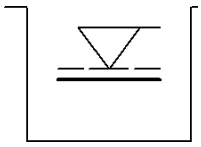
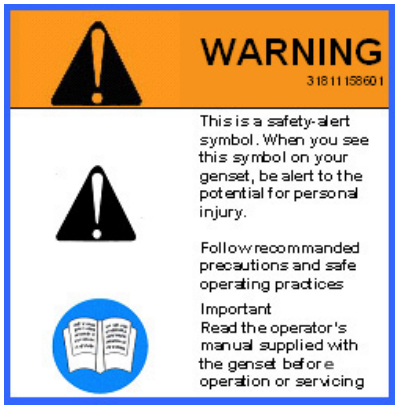
| | | |
|---|---|---|
|  Caution: danger |  Publications delivered with the generating set must be referred to |  Caution: risk of explosion |
|  Caution: risk of electric shock |  Protective clothing must be worn |  Naked flames and unprotected lights prohibited.<br>No smoking |
|  Caution: toxic materials |  Eyes and ears must be protected |  Entry prohibited to non-authorised persons |
|  Caution: pressurised fluids |   Periodic maintenance must be carried out |  Jet washing prohibited |
|  Caution: high temperature, risk of burns |  Battery level must be checked |  Earth |
|  Caution: rotating or moving parts (risk of getting caught in the machinery) |  Lifting point must be used |  Caution: corrosive product |
|  Fork pockets for lifting |  Retention tank level high | |
|  ① ② | ① Important: refer to the documentation accompanying the generating set.<br>② Important: emission of toxic exhaust gases. Do not use in a confined or badly ventilated area. | |

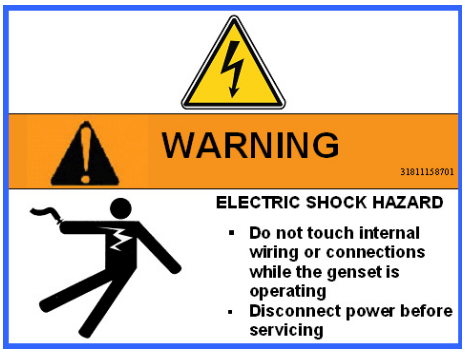
**Figure 1.1**: Pictograms and their meanings




WARNING: DANGER

This symbol warns of a safety hazard. The presence of this symbol indicates a risk of injury.
Observe the safety instructions and precautions for use.

Important:
Carefully read the instructions supplied with the generating set before using or servicing the equipment.




WARNING: DANGER

Risk of electrocution
- Do not touch the cables or connections when the generating set is in operation.
- Switch off the generating set for maintenance operations.


DANGER

Use diesel fuel only.
- The fuel is highly flammable, handle with care. Do not smoke near the generating set or expose it to a naked flame or sparks.
- Shut down the generating set engine before filling the fuel tank. Fill with fuel outside.
- To prevent fire risks, clean the generating set regularly. Wipe away any dirt and traces of grease or fuel.


WARNING: DANGER

- The exhaust gases from the engine are toxic and can affect health or even cause death.
- Use the generating set outdoors only, in well ventilated areas, or fit an exhaust extension to discharge the exhaust gases outside.

**Figure 1.2**: Pictograms and their meanings


WARNING: DANGER

- Hot coolant can cause serious burns.
- Switch off the engine. Do not remove the filler cap until it is completely cold.
- Do not open the radiator when it is hot.


DANGER

- Rotating parts can cause serious injury.
- Do not operate the generating set with the doors open.
- Do not remove the enclosures.
- Shut down the generating set before any maintenance or servicing operation.


DANGER

- Avoid any contact with the exhaust pipes, turbochargers and silencers. Keep flammable materials away from hot parts.
- Wait for the machine to cool down completely before touching it.

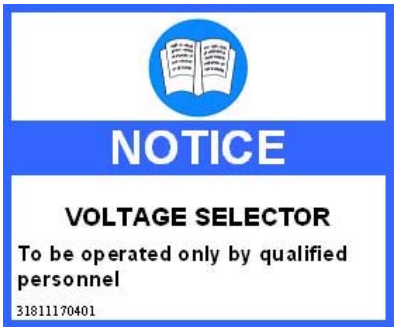

WARNING: DANGER

- The gas from the battery electrolyte is explosive. Keep the batteries away from any flames.
- The battery electrolyte (sulphuric acid) is toxic. Risk of poisoning.

**Figure 1.2 (continued)**: Pictograms and their meanings

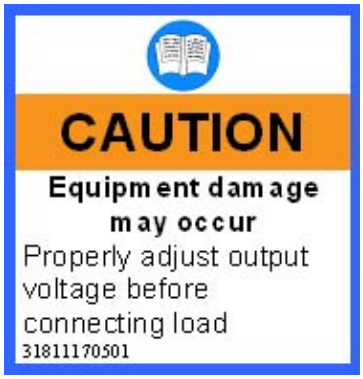

WARNING: DANGER

- A poor earth connection can lead to serious injuries or death.
- Always connect the earth terminal of the generating set to an external earth terminal.




WARNING

Voltage selector
This function should be used by qualified persons only.




WARNING

Adjust the output voltage correctly before connecting a load.


WARNING

The voltage selector must not be used when the generating set is operating.

**Figure 1.2 (continued)**: Pictograms and their meanings

## 2. Safety

**THESE SAFETY GUIDELINES ARE IMPORTANT**

If you do not understand or have any questions about any point in this manual, contact your dealer who will explain it to you or give you a demonstration. A list of risks and precautionary measures to take follows. You should also refer to any local and national regulations that apply in accordance with your own jurisdiction.

**KEEP THIS MANUAL**

This manual contains important instructions which must be followed when installing or carrying out maintenance on a generating set or batteries.

### 2.1. General advice

Use

- ✓ The operating and safety instructions must be made known to operating personnel. They will be regularly updated.
- ✓ Read and understand the manuals provided with the generating set, pump unit or lighting column properly. The manufacturer's instructions must remain at the disposal of technicians, if possible in situ.
- ✓ The facility must be operated under the direct or indirect supervision of a person appointed by the operator, who is familiar with the operation of the facility, and the dangers and drawbacks of the products used or stored in the facility.
- ✓ Do not wear loose clothing, or get close to machines in operation. Note that the fans are not clearly visible when the engine is running.
- ✓ Warn personnel present to keep their distance during operation.
- ✓ Do not run the generating set, pump unit or lighting column without refitting the protective covers and closing all the access doors.
- ✓ Never let a child touch the generating set, pump unit or lighting column, even when shut down.
- ✓ Avoid operating the generating set, pump unit or lighting tower in the presence of animals (disturbance, scares, etc.).
- ✓ Engage the parking brake when the generating set or lighting tower on its trailer is installed on the operating site. When chocking the trailer on a slope; ensure that there is nobody in the path of the trailer.
- ✓ Never start the engine without an air filter or exhaust.
- ✓ Engine with turbocharger: never start the engine without fitting the air filter. The compressor wheel rotating inside the turbocharger may cause serious bodily injury. Foreign objects in the inlet pipe may cause mechanical damage.
- ✓ Engine with air preheating (starting components): never use a starting spray or any other similar starter assistance product. Upon contact with the starting component, an explosion may occur in the inlet tube, causing bodily injury.
- ✓ Do not touch the lighting column lights when they are switched on.

Maintenance

- ✓ Follow the maintenance table and its instructions.
- ✓ Always use tools in good condition which are suited to the work to be done. Ensure you have understood the instructions before beginning any operation.
- ✓ Goggles should be worn when carrying out maintenance operations and watches, bracelets etc. should be removed.
- ✓ Fit only original parts.
- ✓ Disconnect the battery and the pneumatic starter (if fitted) before undertaking any repairs, to prevent the engine from starting accidentally. Fit a panel over the controls to prevent any attempt to start.
- ✓ Only use the correct crankshaft turning techniques for turning the crankshaft manually. Do not try to turn the crankshaft by pulling it or levering the fan. This method may cause serious bodily or material damage, or damage the vanes of the fan, reducing the service life of the fan.
- ✓ Clean off any trace of oil, fuel or coolant using a clean cloth.
- ✓ Do not use a soapy solution containing either chlorine or ammonia, as these two chemicals prevent bubble formation.
- ✓ Never use petrol or other inflammable substances to clean the parts. Use only approved cleaning solvents.
- ✓ Do not use a high pressure cleaner for cleaning the engine and equipment. The radiator, hoses, electrical components, etc. may be damaged.
- ✓ Avoid accidental contact with parts at high temperatures (exhaust manifold, exhaust).
- ✓ Before any maintenance operation on a lighting column light, cut the electrical power supply and wait for the bulbs to cool down.

Consumables

- ✓ Observe regulations in force concerning use of fuel before using your generating set, pump unit or lighting tower.
- ✓ Under no circumstances use seawater or any other corrosive or electrolytic product in the cooling circuit.

Environment

- ✓ The operator must take the necessary measures to comply with the aesthetics of the site of use. The whole site must be maintained in a good state of cleanliness.
- ✓ The premises must be kept clean, and be regularly cleaned so as to avoid accumulation of dangerous materials or pollutants and dust, which could ignite or cause an explosion. The cleaning equipment must be suited to the risks posed by the products and dust.
- ✓ The presence of dangerous or combustible materials inside premises housing combustion devices shall be limited to the operating requirements.
- ✓ Facilities must be operated under the constant supervision of a qualified person, who must regularly check that the safety devices are operating correctly and ensure that the combustion devices have the correct fuel supply.
- ✓ Apart from the combustion devices, it is prohibited to use fire in any form. This restriction must be clearly displayed.
- ✓ Spreading of waste water, sludge and waste is prohibited.
- ✓ The fuels to be used must correspond to those featured in the declaration file and the specifications recommended by the combustion device manufacturer.
- ✓ The fuel is considered to remain in the same physical state as when it is introduced into the combustion chamber.
- ✓ Burning of waste in the open air is prohibited.
- ✓ Always protect your hands when checking for leaks. Pressurised liquids may penetrate body tissue and cause serious damage. Risk of blood contamination.
- ✓ Drain and dispose of engine oil in a specially provided container (fuel distributors can collect your used oil).
- ✓ Except by special agreement, once closed, the gas supply main unit must only be re-opened by the gas distributor. However, the user may access it under certain conditions. Check these for each site.

## 2.2. Risks relating to supply gases (applies to gas generating sets)

| | |
|---|---|
|  Danger | The gas is explosive. It is forbidden to smoke, go near or create sparks when the tank is being filled and near to the generating set. |

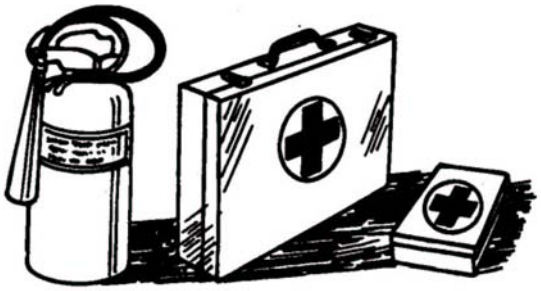
- ✓ Request the user technical notes and LPG or NG safety data sheets from your gas supplier.
- ✓ Gas installations must be installed, maintained and repaired by recognised specialists.
- ✓ Do not attempt to open, unseal or operate on gas supply pressure relief valves, and on the gas line in general.
- ✓ Gas supply procedures must be carried out in the open air (outside) in accordance with local regulations, in an area well away from fire, people or animals.
- ✓ Check the sealing of the gas supply circuit using soapy water with the circuit pressurised, or using a leak detector.

## 2.3. Risks related to exhaust gases and fuels

| | |
|---|---|
|  Danger | The carbon monoxide present in exhaust gases may cause death if the concentration levels in the air breathed are too high.<br>Always use generating sets, pump units or lighting towers in a well-ventilated place where gases cannot accumulate.<br>In case of indoor use:<br>✓ Be sure to evacuate exhaust gases outdoors.<br>✓ Provide appropriate ventilation so that personnel present are not affected. |

- ✓ Observe the local regulations in force for generating sets, pump units or lighting towers, as well as local regulations for use of fuel (petrol, diesel fuel and gas) before using your generating set, pump unit or lighting tower.
- ✓ Fuel filling should be carried out when the engine is off (except for generating sets with an automatic filling system).
- ✓ Engine exhaust gases are toxic: do not run the generating set, pump unit or lighting column in unventilated premises. If installed in a ventilated room, additional requirements for fire and explosion protection must be observed.
- ✓ A leaking burnt gas exhaust may increase the sound level of the generating set, pump unit or lighting column. To check on its efficiency, regularly examine the burnt gas exhaust.
- ✓ Pipes must be replaced as soon as their condition demands it.

## 2.4. Risks related to toxic products

| | | |
|---|---|---|
|  | The corrosion inhibitor contains alkali.<br>Do not swallow it.<br>This substance should not come into contact with the eyes. In the event of contact with the eyes, rinse immediately with plenty of water for at least 15 minutes.<br>Avoid prolonged or repeated contact with the skin. In the event of contact with the skin, wash thoroughly with water and soap. CONSULT A DOCTOR IMMEDIATELY. KEEP THE PRODUCT OUT OF THE REACH OF CHILDREN**.**<br><br>The anti-rust product is toxic and dangerous if absorbed. Avoid all contact with the skin and eyes. Read the instructions on the packaging. | Glycol is a toxic product and dangerous if absorbed. Avoid all contact with the skin and eyes. Read the instructions on the packaging.<br>  |
| Warning | | |

- ✓ Caution: fuels and oils are dangerous to inhale. Ensure proper ventilation, and use a protective mask.
- ✓ Never expose the equipment to liquid splashes or rainfall, and do not place it on wet ground.
- ✓ The battery electrolyte is harmful to skin and especially eyes. If splashes get into eyes, rinse immediately with running water and/or a 10% diluted boric acid solution.
- ✓ Wear protective eyewear and strong base resistant gloves for handling the electrolyte.

## 2.5. Risk of fire, burns and explosion

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|---|---|
|  | The engine should not be operated in environments containing explosive products. As not all of the electrical and mechanical components are shielded, there is a risk of sparks forming. |
| Danger | |




- ✓ Make sure not to create sparks or flames, and not to smoke near the batteries, as the electrolyte gases are highly flammable (especially if the battery is charging). Their acid also poses a risk to the skin, and in particular to the eyes.
- ✓ Never cover the generating set, pump unit or lighting tower with any material during operation or just after shutdown (wait for the engine to cool).
- ✓ Do not touch hot parts such as the exhaust pipe, or put combustible materials on it.
- ✓ Keep all flammable or explosive materials (e.g. petrol, oil, cloth, etc.) out of the way when the set is running.
- ✓ Proper ventilation is required for your generating set, pump unit or lighting column to work properly. Without this ventilation, the engine would very quickly rise to an excessively high temperature, causing accidents or damage to the equipment and to surrounding property.
- ✓ Do not remove the radiator cap if the engine is hot and the coolant is pressurised, due to risks of burns.
- ✓ Depressurise the air, oil and cooling circuits before removing or disconnecting all the fittings, pipes or connected components. Watch out for the possible presence of pressure when disconnecting a device from a pressurised system. Do not try to find pressure leaks by hand. Oil at high pressure can cause bodily damage.
- ✓ Some preservative oils are flammable. Also, some are dangerous to inhale. Ensure proper ventilation. Use a protective mask.
- ✓ Hot oil causes burns. Avoid contact with hot oil. Check that the system is no longer pressurised before carrying out any procedures. Never start or run the engine with the oil filler cap off (oil may splash out).
- ✓ Never coat the generating set, pump unit or lighting column with a thin layer of oil to protect it from rust.
- ✓ Never top up the oil or coolant if the generating set, pump unit or lighting column is running, or if the engine is hot.
- ✓ A generating set can only operate when stationary, and cannot be installed on a vehicle or other mobile equipment, without a prior study taking into account the various specific features of using the generating set.

## 2.6. Risks related to electrical networks

- ✓ The electrical equipment supplied with the generating set complies with standard NF C15.100 (France), or with the standards of the countries in question.
- ✓ The earth connection must be installed in accordance with the standards in force in each country in question, and with the neutral system sold.
- ✓ Read the manufacturer's identification plate carefully. The values for voltage, power, current and frequency are shown. Check that these values match the supply use.
- ✓ Never accidentally touch stripped cables or loose connections.
- ✓ Never handle a generating set with wet hands or feet.
- ✓ Maintain electrical wires and connections in good condition. Using equipment in poor condition can lead to electrocution and damage to equipment.

■

- ✓ Always disconnect the power to the equipment or facility (generating set voltage, battery voltage and network voltage) before any operation.
- ✓ The electrical connections must be made in accordance with current standards and regulations in the country of use.
- ✓ Do not use faulty, poorly insulated or provisionally connected wires.
- ✓ Never reverse the positive and negative terminals on batteries when connecting them. This could cause severe damage to the electrical equipment. Follow the wiring diagram supplied by the manufacturer.
- ✓ The generating set should not be connected to any other power sources, such as the mains supply network. In specific cases where there is to be a connection to existing electrical networks, this must only be installed by a qualified electrician, who should take the operating differences of the equipment into account, according to whether the mains supply network or generating set is being used.
- ✓ Protection against electric shocks is ensured by an assembly of specific equipment. If this needs to be replaced, it should be by components with identical nominal values and specifications.
- ✓ If the protective plates (blanking covers) need to be removed to route cables, the protector (blanking cover) must be refitted when the operations are finished.
- ✓ Due to high mechanical stresses, use only strong flexible wiring with rubber sheathing, compliant with IEC 245-4, or equivalent wiring.

## 2.7. Dangers presented by electric currents (first aid)

First aid

In the event of an electric shock, shut off the power immediately and activate the emergency stop on the generating set or lighting column. If the voltage has not yet been cut off, move the victim out of contact with the live conductor as quickly as possible. Avoid direct contact both with the live conductor and the victim's body. Use a dry plank of wood, dry clothes or other non-conductive materials to move the victim away. The live wire may be cut with an axe. Take great care to avoid the electric arc that will be generated by this.

Begin emergency procedures

Resuscitation

If breathing has stopped, begin artificial respiration at once in the same place the accident took place unless the victim or operator's life could be endangered by this.

In the event of cardiac arrest, carry out cardiac massage.

## 2.8. Risks related to moving the set

To unload the generating sets, pump units or lighting columns from their transport support brackets under optimum safety and efficiency conditions, you must ensure that the following points are observed:

- ✓ The lifting machinery or equipment is suited to the work required, in good condition and with sufficient lifting capacity.
- ✓ The slings are positioned in the rings provided for this operation, the forklift arms are resting fully underneath all of the base frame cross-beams, or the lifting bars are inserted in the apertures provided for this purpose in the base to lift the entire generating set (according to models).
- ✓ For completely safe working conditions and to prevent damage to the components fitted on the upper edge of the set, pump unit or lighting column, the generating set, pump unit or lighting column must be lifted up with an adjustable boom. All the chains and cables must be parallel with each other, and as perpendicular as possible with the upper edge of the generating set, pump unit or lighting column.
- ✓ If other equipment fitted on the generating set, pump unit or lighting column alters its centre of gravity, special lifting devices may be necessary to maintain correct balance and completely safe working conditions.
- ✓ The ground must be able to withstand the load of the generating set, pump unit or lighting column and its lifting machinery without stress (otherwise, put down beams of sufficient strength in a stable configuration).
- ✓ Position the generating set, pump unit or lighting column as close as possible to its place of use or transport, in a clear space with free access.
- ✓ Never perform work on a generating set, pump unit or lighting tower just hanging from a lifting device.

## 2.9. Recommendation for the operator and environment

- ✓ Operating personnel should be aware of the safety and operating instructions. These will be regularly updated.
- ✓ Operating should be monitored, directly or indirectly, by someone designated by the operator who is familiar with the installation and dangers and problems regarding products stored and used in the installation.
- ✓ No-one from outside the establishment should be able to access the installations freely, unless designated by the operator.
- ✓ The user should check the service pressures of the different pressure stages, making sure that they are in accordance with the prescribed operating requirements. The user is also responsible for making the apparatus adjustments according to the manufacturer's instructions and should check that the apparatus is operating correctly.
- ✓ The user should create or obtain a document describing modifications and showing alterations made to the installations in relation to the original document.

■

- ✓ Manufacturers' notes should be available to technical staff, on site if possible.
- ✓ The internal network diagram should be displayed as close as possible to the access points showing all the individual points. Internal and external network information can be contained in a single distribution diagram.
- ✓ A sign on the door identifies and gives details of the operating company and includes the telephone number for the gas supplier emergency department.
- ✓ Personnel should be aware of the layout of the premises and they should be identified on site to simplify procedures. In the event of a problem, this type of knowledge about installations is crucial when poor identification of the premises might make a situation worse.
- ✓ Written operating instructions must be available for operations that involve dangerous handling procedures and driving installations. In particular, these instructions prescribe:
  - o Operating modes
  - o Frequency of testing for safety devices and devices for handling pollution and other harmful substances generated by the installation
  - o Methods for maintenance, checking and use of adjustment equipment and safety devices.

■

- ✓ The operator should make the necessary arrangements to satisfy site aesthetic requirements. The whole site must be kept clean and in good condition.
- ✓ The premises must be kept clean and cleaned regularly with in order to avoid piles of dangerous or pollutant material or dust that could be susceptible to catching fire or causing an explosion. The cleaning equipment must be adapted to accommodate the risks presented by such products and dust.
- ✓ The presence of dangerous or combustible materials on premises where combustion apparatus is sheltered is limited to what is required for the operation.
- ✓ The installations must be operated under the constant supervision of a qualified person. This person should periodically check that the safety devices are working properly and ensure the correct fuel supply to the combustion apparatus.
- ✓ Apart from combustion apparatus, flames in any form are prohibited. This should be displayed in bold on a sign.
- ✓ Residual water, mud and waste spray is prohibited.
- ✓ The fuels to be used should correspond to the ones in the declaration file and the specifications prescribed by the combustion apparatus manufacturer.
- ✓ The fuel is considered as being in the physical state that is introduced into the combustion chamber.
- ✓ Burning waste in the open air is prohibited.
- ✓ Except for where a specific agreement has been made, once the gas supply main unit has been closed, it can only be reopened by the gas distributor. However the user may conditionally have access to it. Check for each site.
- ✓ Always protect your hands when detecting leaks. Pressurised fluids can enter body tissues and cause severe harm. Risk of blood poisoning.
- ✓ Drain and discard engine oil in a designated container (the fuel distributors can collect your used oil).

## 2.10. Risks related to noise

| | |
|---|---|
|  | **Dangerous noise**<br>**Risk of hearing loss**  |
| Important | |

Non-enclosed generating sets generate an airborne noise level of over 85 dBA of sound pressure level at a distance of 1 metre.
Prolonged exposure to this level of noise may cause permanent damage to hearing.
Therefore, it is recommended that ear defenders are used when working in close proximity to a generating set which is in operation.

# 3. General description

## 3.1. Generating set without enclosure

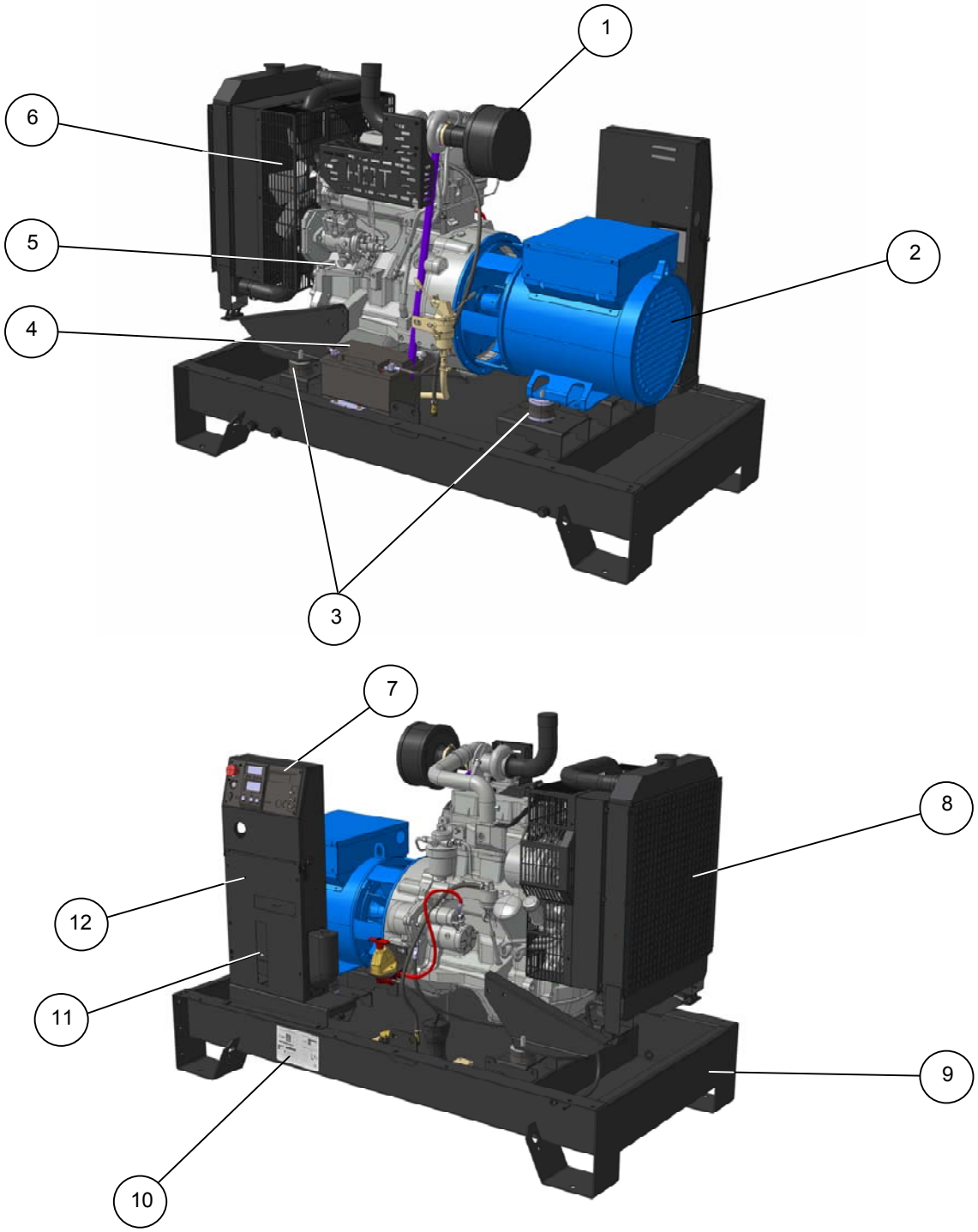



**Figure 3.1:** General description of a generating set without enclosure

| | | | | | |
|---|---|---|---|---|---|
| 1 | Air filter | 5 | Engine | 9 | Base frame |
| 2 | Alternator | 6 | Protective grille for rotating parts | 10 | Identification plate |
| 3 | Suspension mounts | 7 | Control unit | 11 | Circuit breaker |
| 4 | Starter battery | 8 | Radiator | 12 | Console |

## 3.2. Enclosed generating set

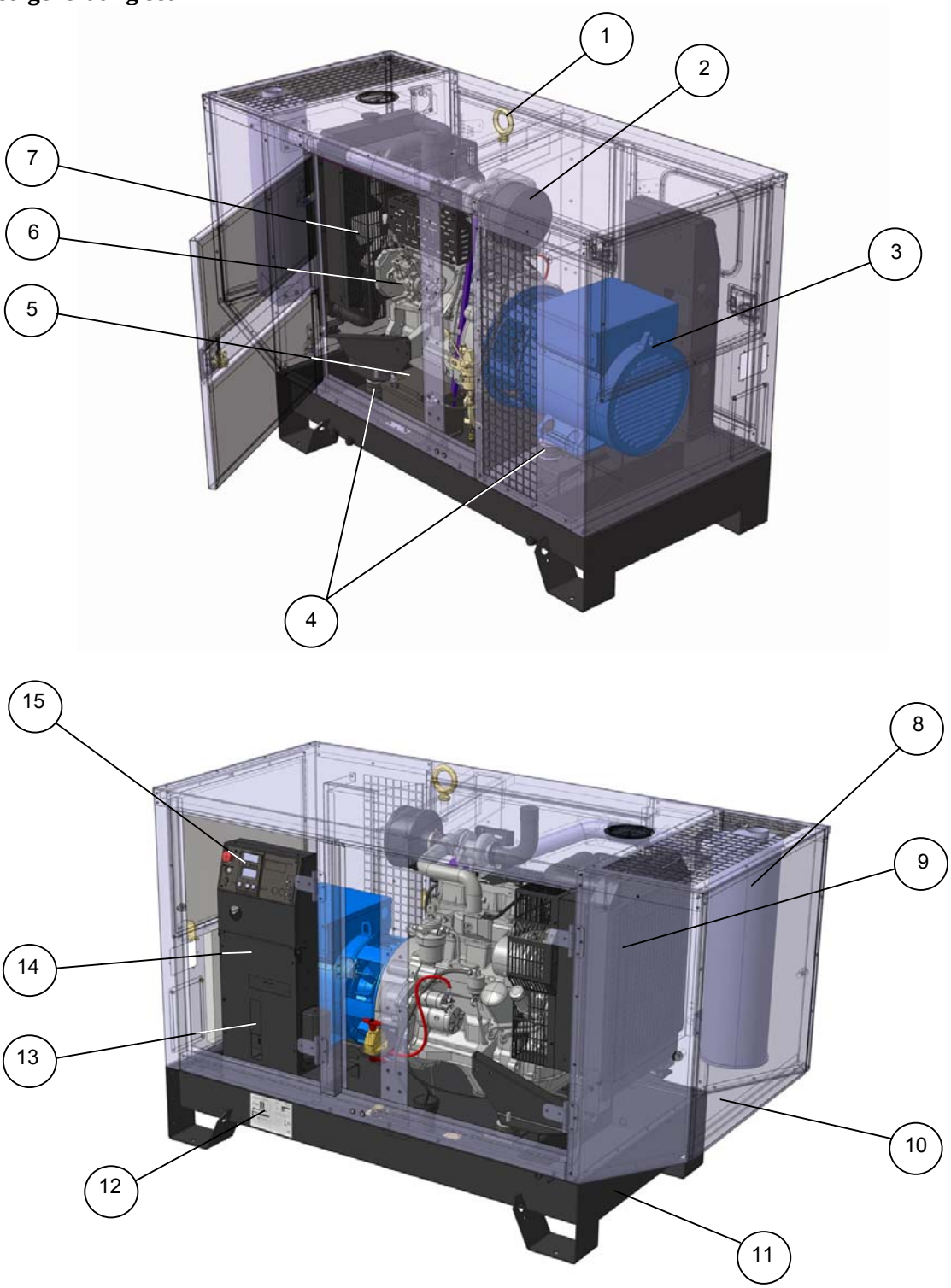



**Figure 3.2**: General description of a generating set with enclosure

| | | | | | |
|---|---|---|---|---|---|
| 1 | Lifting ring | 6 | Engine | 11 | Base frame |
| 2 | Air filter | 7 | Protective grille for rotating parts | 12 | Identification plate |
| 3 | Alternator | 8 | Exhaust | 13 | Circuit breaker |
| 4 | Suspension mounts | 9 | Radiator | 14 | Console |
| 5 | Starter battery | 10 | Cover | 15 | Control unit |

## 3.3. Container

The name "container" is a generic term used for a box[1] designed for transporting merchandise, sufficiently solid for repeated use, generally stackable and equipped with components enabling intermodal transfer.
There are 3 types of container:

- ✓ Miscellaneous containers (dry, open top, open side, base, flat, etc.):
  - o "Dry" containers are containers for dry merchandise.
  - o "Open top" containers have a tarpaulined top.
  - o "Flat" containers have a simple frame.
- ✓ Isothermal containers.
- ✓ Tank containers.

### 3.3.1 High capacity containers (HC: High Cube)

These are ISO standard containers in length and width, but have a height of 9'6" (2.90 m) instead of 8'6" (2.59 m). These high containers have been standardised by ISO.
SDMO containers are high capacity containers.

Some nominal dimensions of common containers (ISO dimensions)

| Name of container | length | width | height |
|---|---|---|---|
| 1AA | 40 feet (12.192 m) | 8 feet (2.438 m) | 8 feet 6 inches (2.591 m) |
| 1AAA (HC) | 40 feet (12.192 m) | 8 feet (2.438 m) | 9 feet 6 inches (2.896 m) |
| 1CC | 20 feet (6.058 m) | 8 feet (2.438 m) | 8 feet 6 inches (2.591 m) |
| 1CCC (HC) | 20 feet (6.058 m) | 8 feet (2.438 m) | 9 feet 6 inches (2.896 m) |

### 3.3.2 SDMO range containers

The SDMO CONTENENERGY energy range comprises 3 types of container:
1 – ISO 20 and ISO 40.
2 – CIR 20.
3 – EUR 40.

All these containers come with fittings. The types used are 1AAA (40') and 1CCC (20').
The names ISO, CIR and EUR are SDMO trade names.

#### 3.3.2.1. ISO 20 and ISO 40

ISO 20 and ISO 40 20' and 40' containers comply with the ISO/TC104 standards and are CSC certified[2], i.e. authorised for shipping.

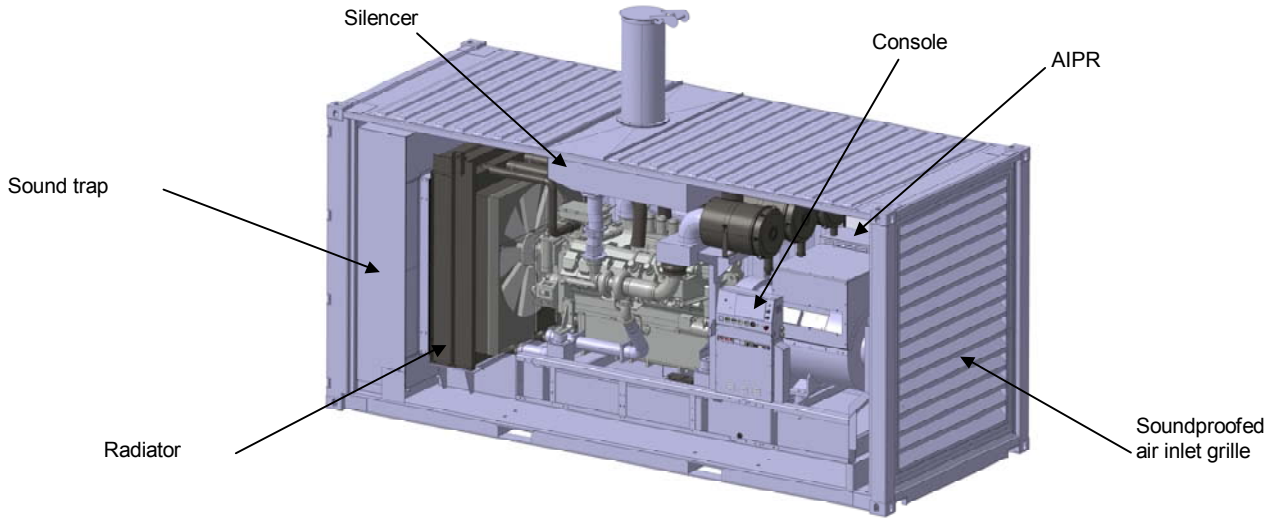



**Figure 3.3**: Example of an ISO 20 container

[1] In the jargon of international transport, a container is often referred to as a "box".
[2] CSC: Container Safety Convention

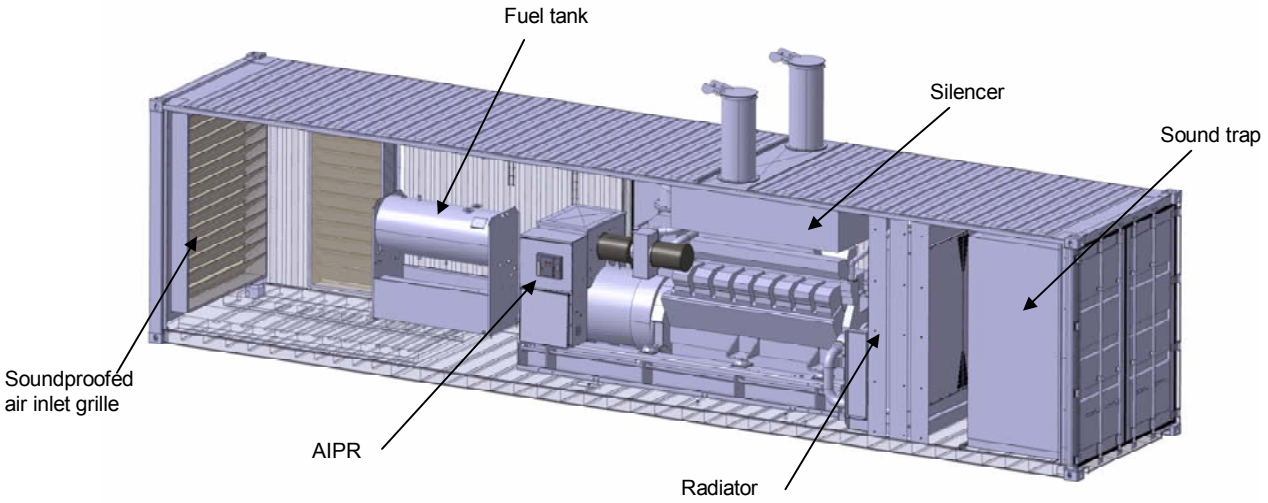



**Figure 3.4**: Example of an ISO 40 container

### 3.3.2.2. CIR 20

CIR 20 containers are built based on ISO 20 containers (not CSC certified) – compliant with ISO/TC104 on request. These low noise level containers are well suited to mobile and rental applications.

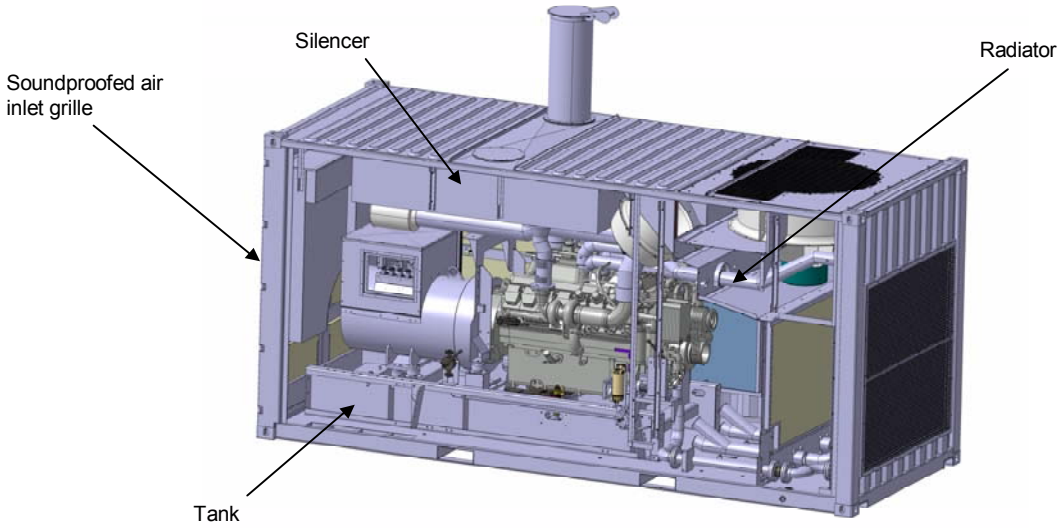



**Figure 3.5**: Example of CIR 20 container

### 3.3.2.3. EUR 40

EUR 40 containers are available in 40' only (not CSC certified). These containers designed for generating sets equipped with series 4000 MTU-DDC engines come with 2 soundproofing versions: Silent and Supersilent.

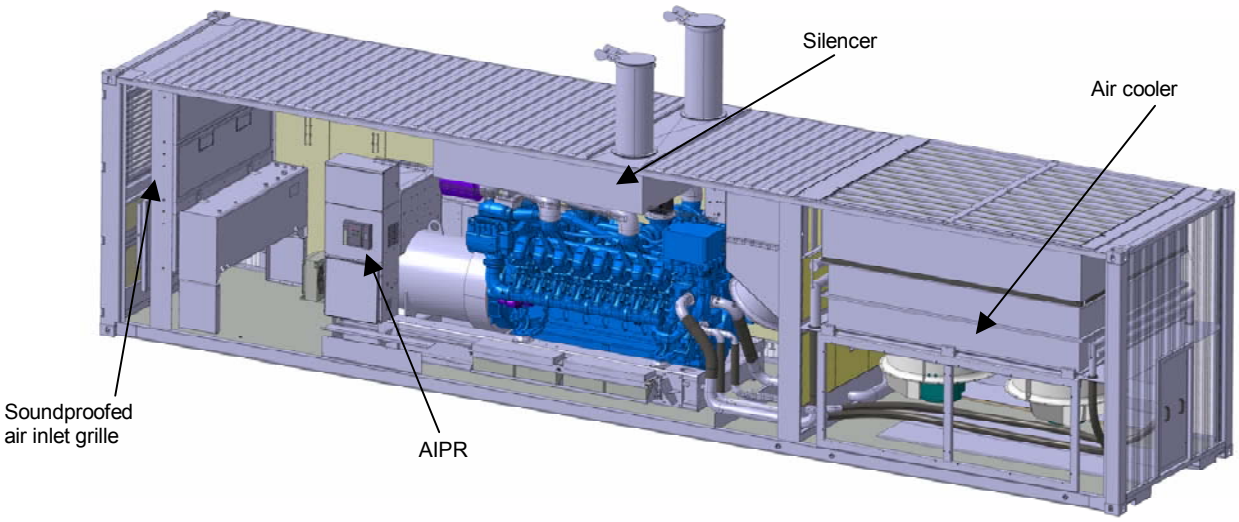



**Figure 3.6**: Example of a EUR 40 container

## 3.4. Identifying sets

Generating sets and their components are identified by means of identification plates.
The precise rules for identifying each major component (engine, alternator etc.) are set out in each manufacturer's documents contained in this manual.

### 3.4.1 Generating set with and without enclosure

Generating sets with and without enclosures are identified via identification plates attached to the base frame.

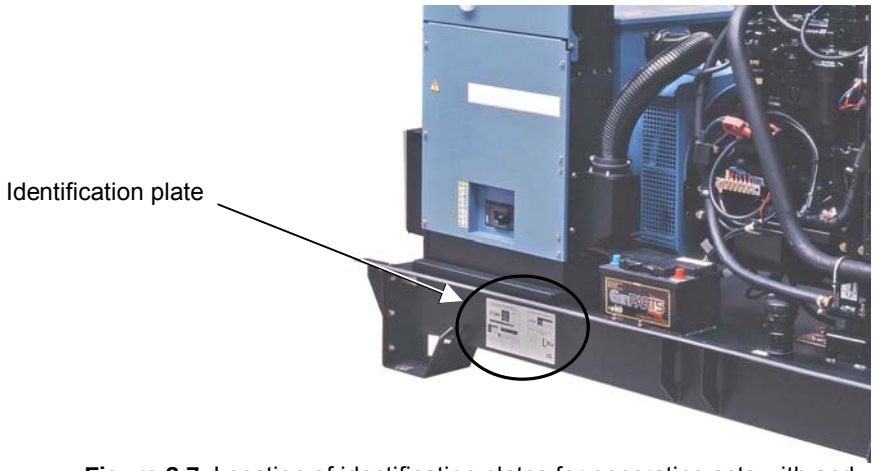
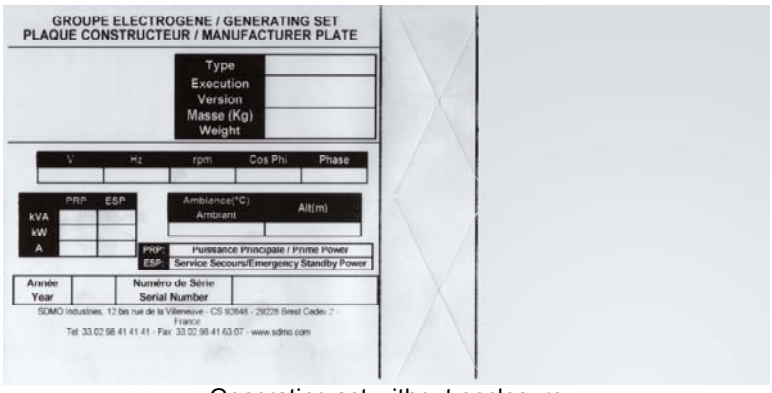


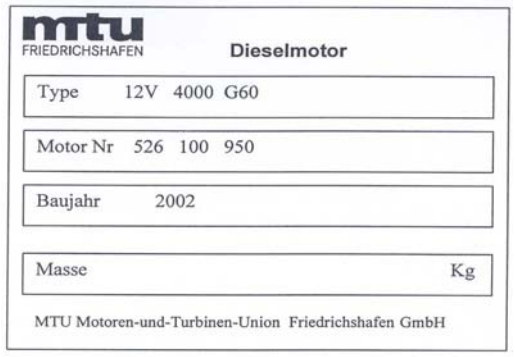

**Figure 3.7**: Location of identification plates for generating sets with and without enclosures



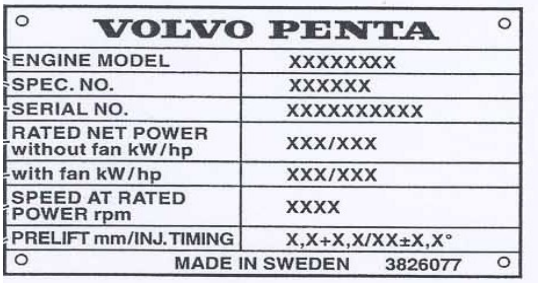

Generating set without enclosure


Enclosed generating set and container

GENERATING SET

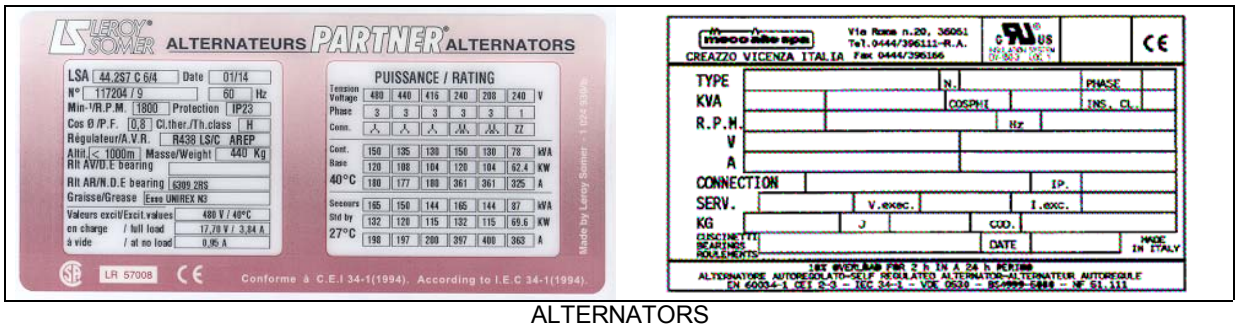




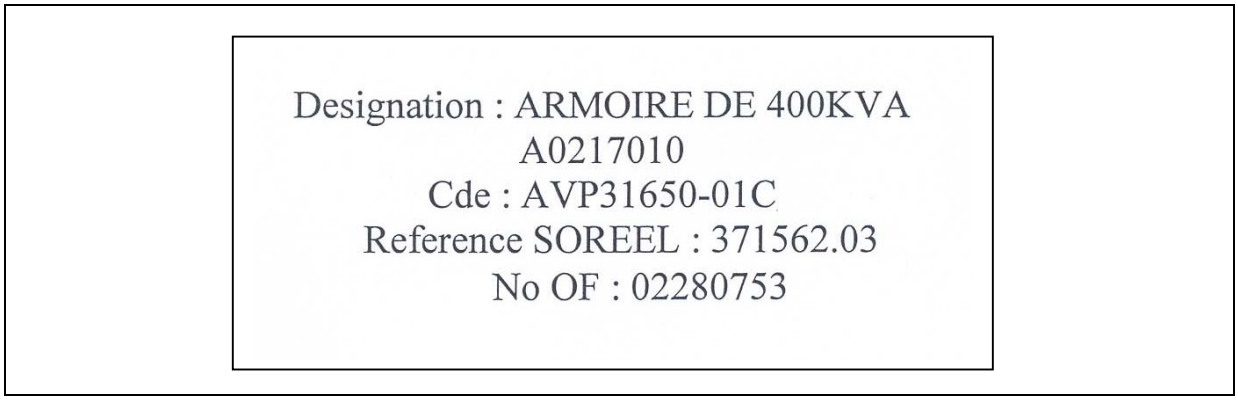




ENGINES

**Figure 3.8**: Examples of identification plates




ALTERNATORS




ELECTRICAL CABINET

**Figure 3.9**: Examples of identification plates

### 3.4.2 Container

Generating sets in containers are identified via identification plates attached close to the emergency stop.

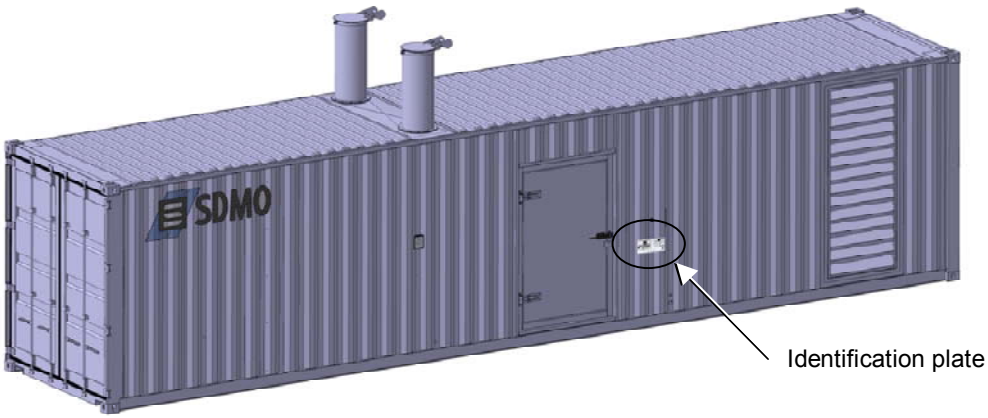



**Figure 3.10**: Location of identification plates for generating sets in containers

The description of the plates is given in paragraph 3.4.1 "Generating set with and without enclosure".

# 4. Handling

## 4.1. Safety during handling

To unload electrical generating sets from their transport supports with optimum safety and efficiency, you must ensure that the following points are observed:

- ✓ The lifting machinery or equipment is suitable for the work required.
- ✓ The slings are positioned in the rings provided for this operation, the lifting arms are resting fully underneath the base frame cross members, or the lifting bars are inserted in the apertures provided in the base to lift the entire generating set (depending on the model).
- ✓ The ground is able to bear the load of the generating set and its lifting machinery without stress (otherwise lay down stabilising beams of sufficient strength).
- ✓ The generating set is put down as close as possible to its place of use or transport, in a clear space with free access.

## 4.2. Example of equipment used

- ✓ Crane, slings, lifting beam, safety hook, shackles.
- ✓ Fork lift truck.

## 4.3. Handling instructions

### 4.3.1 Generating set with and without enclosure

#### 4.3.1.1. Slinging of generating set without enclosure

- ✓ Attach the lifting machine's slings to the rings on the generating set provided for this operation.
- ✓ Tension the slings slightly.
- ✓ Make sure that the slings are correctly attached and the equipment is solid.
- ✓ Lift the generating set carefully.
- ✓ Direct the generating set towards the chosen location, and stabilise it.
- ✓ Carefully set down the equipment while continuing to position it.
- ✓ Slacken the slings, then detach and remove the lifting rings.

| | |
|---|---|
|  Important | The slings must be perpendicular to the chassis to ensure they do not damage the generating set (no friction). |

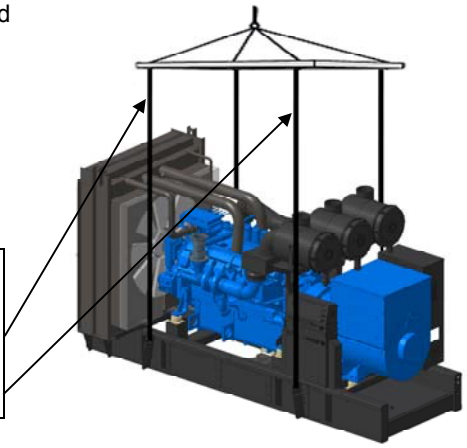


**Figure 4.1:** Slinging a generating set

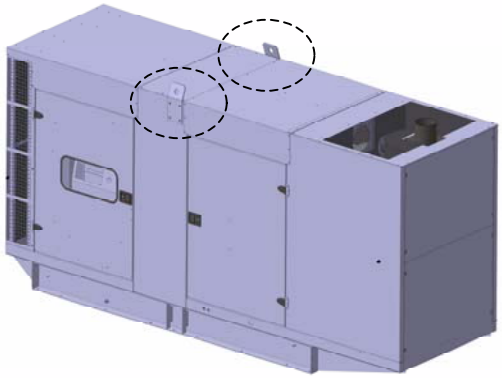
### 4.3.1.2. Slinging of enclosed generating set

The enclosure makes an enclosed generating set easier to handle.

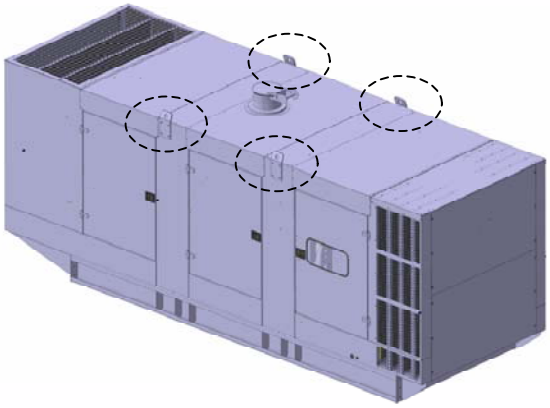
- ✓ Attach the lifting machine's slings to the rings or brackets on the generating set provided for this operation.
- ✓ Tension the slings slightly.
- ✓ Make sure that the slings are correctly attached and the equipment is robust.
- ✓ Lift the generating set carefully.
- ✓ Direct the generating set towards the chosen location, stabilising it.
- ✓ Carefully set down the equipment while continuing to position it.
- ✓ Slacken the slings, then detach and remove the lifting rings.

The sling attachment points differ according to the enclosure models. 3 different configurations are available:

Enclosure with 1 lifting ring



Enclosure with 2 lifting brackets



Enclosure with 4 lifting brackets (M427)

**Figure 4.2:** Sling attachment points on an enclosed generating

| | |
|---|---|
|  Important | The lifting rings or brackets are intended for lifting the generating set only.<br>Do not lift a generating set on a trailer with these rings or brackets. |

#### 4.3.1.3. Fork lift truck

- ✓ Position the forklift arms under the base frame (except with generating sets fitted with "forklift pockets", in which case position the forklift arms in these pockets), making sure that only its cross-members are resting on the arms.
- ✓ Lift the equipment, handling it gently.
- ✓ Set down the generating set in its unloading position.

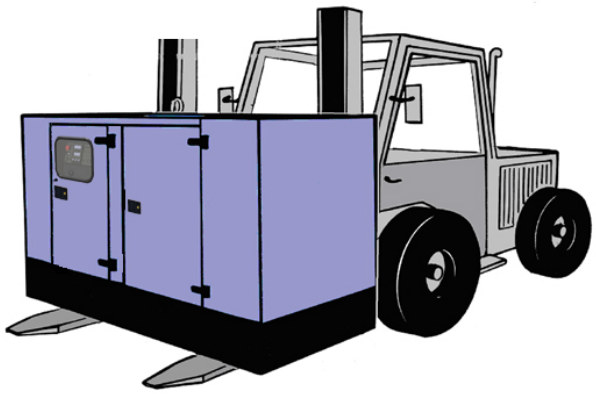


**Figure 4.3**: Transporting a generating set using a forklift truck

#### 4.3.1.4. Handling instructions

- ✓ Lift up the edge on the engine side slightly with 2 jacks, then slide 3 rollers under the base frame.
- ✓ Leave the base frame resting on the rollers, then move the generating set manually.
- ✓ As the generating set is moved, re-use the freed rollers by sliding them in turn under the base frame.
- ✓ When it has reached its final location, position the generating set then lift it up using jacks, and support it on chocks.
- ✓ Withdraw the rollers and lower the generating set, checking that it is in the correct position, then remove the jacks.

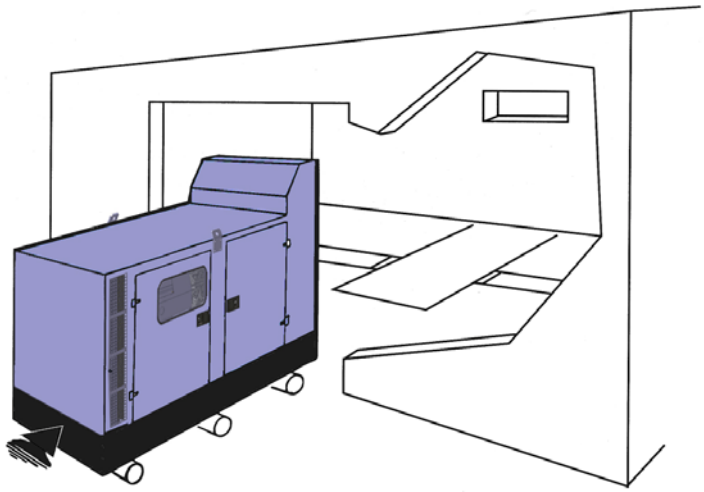


**Figure 4.4:** Handling a generating set using rollers

| | |
|---|---|
|  Important | Only generating sets that do not have brackets built into the base frame can be moved using rollers. The base frame support surface on the rollers must be free from deformations. |

It is recommended to use a forklift truck with arms that are longer than the width of the base frame.

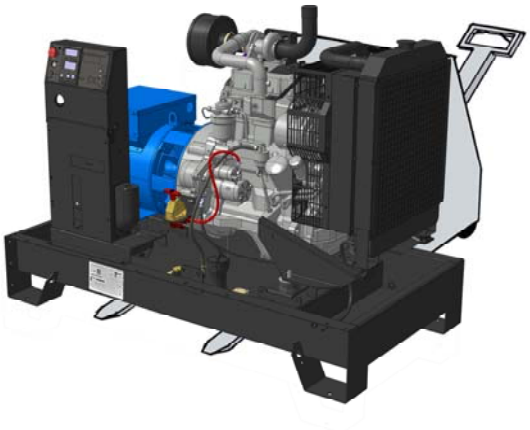


**Figure 4.5:** Handling a generating set using a forklift truck

If you are using a rail or mobile winch once the generating set is in position, continue in the same way as described in the "hoisting" section

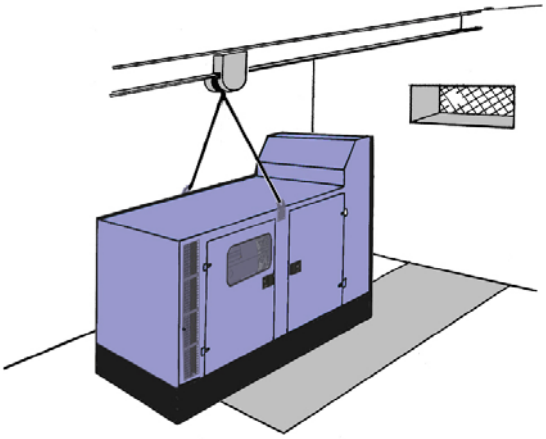
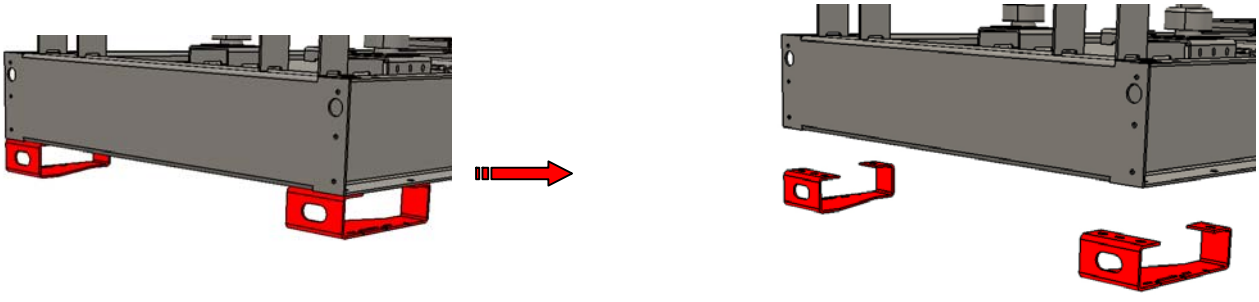


**Figure 4.6:** Handling a generating set using a mobile winch

| | |
|---|---|
| Important | Some generating sets are equipped with transport brackets, which are red, facilitating their movement. These brackets must always be removed when the generating set is being installed. |



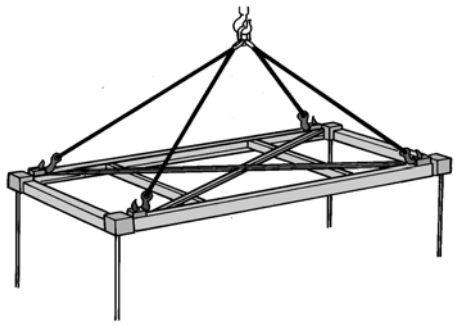
### 4.3.1.5. Stacking

| | |
|---|---|
| Warning | Generating sets must not be stacked. |

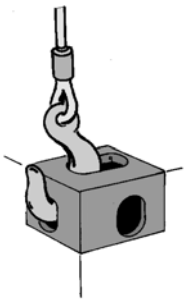
### 4.3.2 Container

#### 4.3.2.1. Container slinging

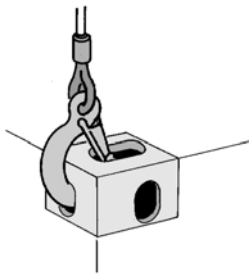
- ✓ Attach the lifting machine's slings to the handling rings on the container.
- ✓ Slightly tension the slings without lifting the container.
- ✓ Check that the sling hooks are correctly attached, and that the equipment used is solid.
- ✓ Lift the container carefully and without jerking.
- ✓ Direct the container towards its final position, keeping it stable.
- ✓ Manoeuvre the container to its final position, while still off the ground.
- ✓ Carefully set down the container without jerking, while continuing to position it.
- ✓ Once the container is on the ground and correctly positioned, release the slings, check that the container is stable and correcting it if necessary.
- ✓ Detach the slings and remove them from the lifting rings.



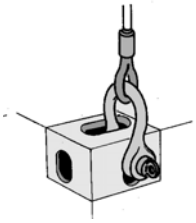
Example of container lifting using a lifting beam fitted with hooks, shackles or manually coupled locks.



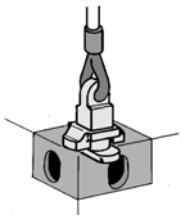
Example of attachment by an ordinary hook



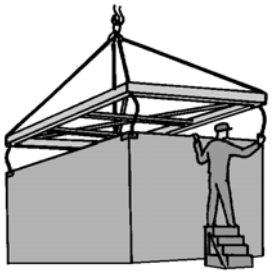
Example of attachment by a safety hook



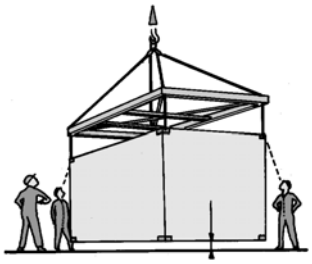
Example of attachment by shackle



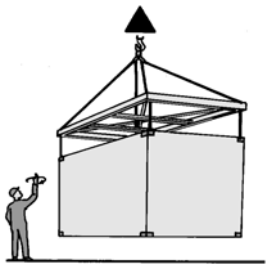
Example of attachment by a manually coupled lock



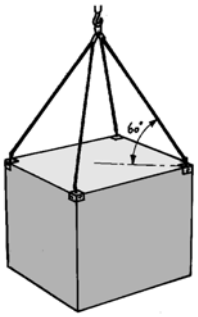
Attachment of lifting device



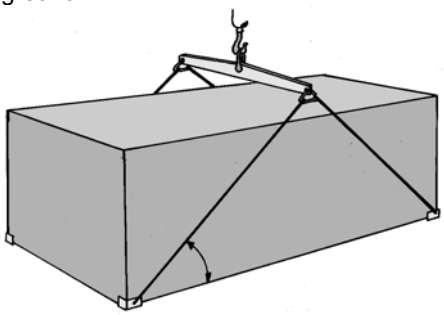
Checking the attachment when the container is still on the ground



Lifting




Example of lifting



Example of a container lifted by four parts in the bottom corners

**Figure 4.7**: Examples of handling equipment

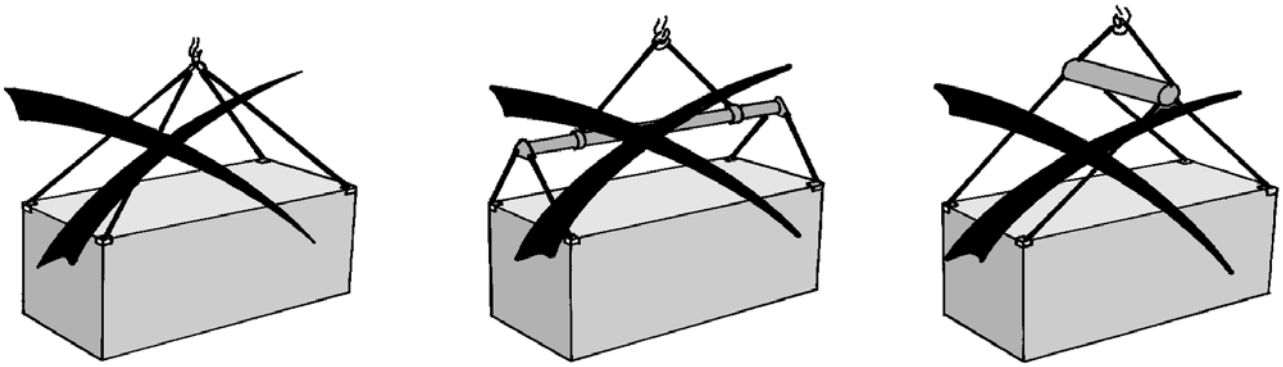


**Figure 4.8**: Examples of lifting methods which should not be used

#### 4.3.2.2. Fork lift truck

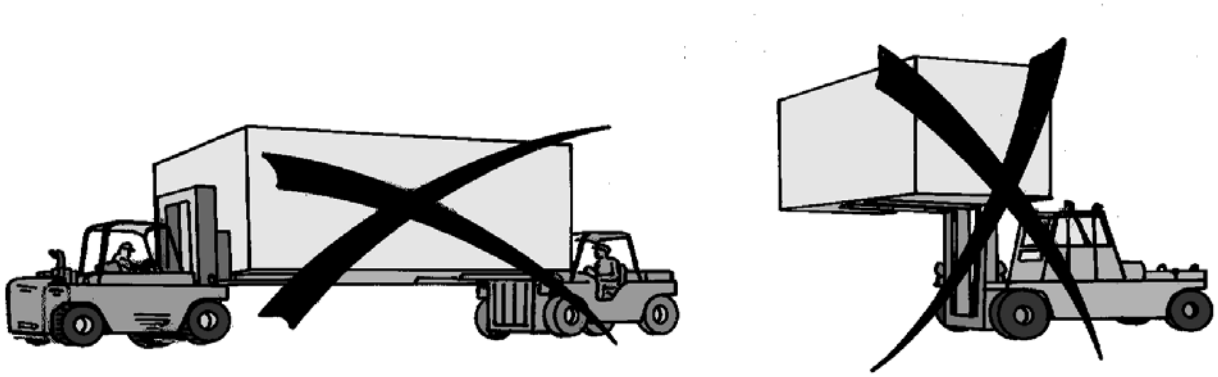


**Figure 4.9**: Examples of handling methods which should not be used

#### 4.3.2.3. Stacking

| | |
|---|---|
|  Important | Containers that cannot bear additional loads (stacking prohibited):<br>✓ CIR 20<br>✓ EUR 20 |

# 5. Moving / Transport

## 5.1. General recommendations

For transporting generating sets, the following instructions must be observed:
- ✓ Close the tap on the oil make up tank outlet,
- ✓ Fill up the oil make up tank with oil,
- ✓ Fill up the crankcase with oil,
- ✓ Fill up the on-board tank with fuel,
- ✓ Have the batteries fitted and charged with electrolyte.

## 5.2. Generating sets on trailers

### 5.2.1 Hitching and unhitching the trailer

#### 5.2.1.1. "On-road" trailer

Before hitching the trailer, check the hitching hook of the towing vehicle; it must be perfectly suited to the trailer.

| | |
|---|---|
|  Warning | Any attempt to tow a trailer with a non-compliant device (bar, cables, lashing, etc.) runs the risk of serious accidents.<br>Also check:<br>✓ That there are no incipient ruptures or significant wear on the hitching system.<br>✓ That the locking system is working properly. |

Coupling a trailer fitted with a hitching ring

❶ Drive the towing vehicle or move the trailer (after releasing the parking brake, if fitted) to the coupling position.
❷ Put the trailer in the horizontal position using the guide wheel (jockey wheel).
❸ Put the hitching ring above the towing vehicle hook, and then lower the adjustable towbar (if fitted) or lower the front of the trailer to secure the ring in the hook; the trailer must remain in the horizontal position after this adjustment. Make any necessary height adjustments using the jockey wheel to enable coupling.
❹ Once this has been done, raise the jockey wheel until it is lifted off the ground slightly and is not bearing any load.
❺ Fix the release cable to the attachment point on the hitching plate (figure 5.1), and then connect the electrical cable plug controlling the lights, indicators, etc. to the socket on the towing vehicle.
❻ Lift up the jockey wheel completely and lock it in position, making sure that it is not impeding the brake rod or the release cable.
❼ Ensure that the parking brake (if fitted) is completely disengaged by pushing its handle down fully. If necessary, remove the wheel chocks and store them.

| | |
|---|---|
|  Warning | If the hitching ring is not correctly connected to the hitching hook, the trailer will become separated from the towing vehicle. The release cable engages the parking brake (acting as an emergency brake) should the trailer detach from the towing vehicle. For the braking system to fulfil its role effectively, it is essential to observe the following advice:<br>1) The release cable **MUST NOT** be wound around the guide wheel, as this would prevent the emergency brake from working.<br>2) The release cable **MUST** run as straight as possible, without being impeded at any point.<br>3) The release cable must be long enough to allow turning, and it must not be stretched or impeded in use, as this would engage the parking brake while the vehicle is being towed. |

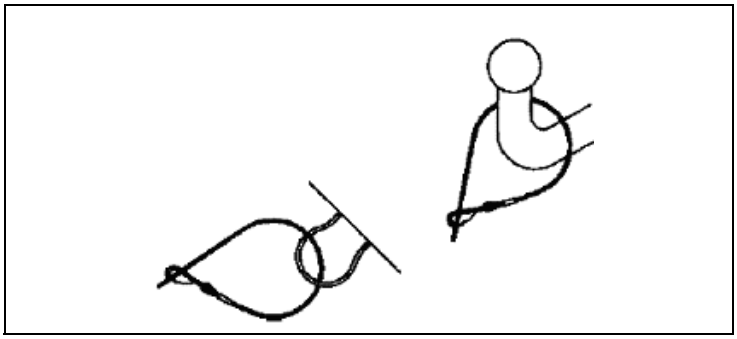


**Figure 5.1**: Release cable

Coupling a trailer fitted with a coupling head

❶ Drive the towing vehicle or move the trailer (after releasing the parking brake, if fitted) to the coupling position.
❷ Open the coupling head. To do so, pull the coupling handle (figure 5.2) in the direction of the arrow.
The coupling mechanism can remain open as long as the coupling head is not resting on the hitching joint.
❸ Put the trailer in the horizontal position using the guide wheel (jockey wheel), and then mount the open coupling head on the hitching joint by lowering the adjustable towbar, if fitted, or by lowering the front of trailer. This must remain in the horizontal position after this adjustment.
If necessary, adjust the height using the jockey wheel. The coupling head will be engaged automatically, accompanied by a clearly audible click; then lower the coupling handle.. The coupling mechanism will then be engaged, and the coupling handle cannot adopt a lower position (when manoeuvred by hand).
❹ Once this has been done, raise the jockey wheel until it is lifted off the ground slightly and is not bearing any load.
❺ Attach the release cable to the attachment point on the hitching plate (figure 5.1) then connect the electrical cable plug controlling the lamps, indicators, etc. to the socket on the towing vehicle.
❻ Lift up the jockey wheel completely and lock it in position, making sure that it is not impeding the brake rod or the release cable.
❼ Ensure that the parking brake (if fitted) is completely disengaged by pushing its handle down fully. If necessary, remove the wheel chocks and store them.

| | |
|---|---|
|  <br>Warning | If the coupling head is not correctly attached to the hitching joint, the trailer will separate from the towing vehicle. The release cable engages the parking brake (acting as an emergency brake) should the trailer detach from the towing vehicle. For the braking system to fulfil its role effectively, it is essential to observe the following advice:<br>1) The release cable **MUST NOT** be wound around the guide wheel, as this would prevent the emergency brake from working<br>2) The release cable **MUST** run as straight as possible, without being impeded at any point.<br>3) The release cable must be long enough to allow turning, and it must not be stretched or impeded in use, as this would engage the parking brake while the vehicle is being towed. |

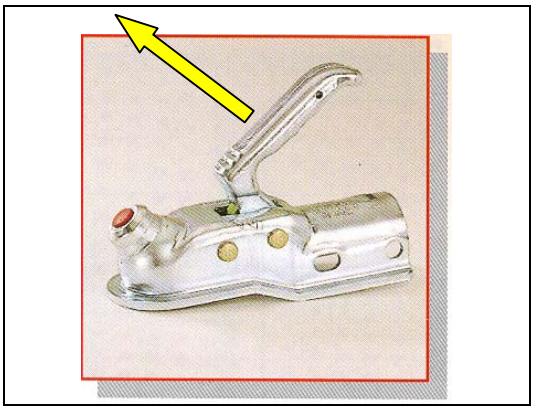


**Figure 5.2**: Example of coupling head

Uncoupling a trailer fitted with a hitching ring

❶ Immobilise the trailer by placing chocks under the wheels, with the parking brake fully engaged (if fitted).
❷ Release the hitching ring using the jockey wheel. The jockey wheel retraction mechanism (if fitted) must lock automatically before the wheel touches the ground. When you are sure that the mechanism is locked and that the jockey wheel can bear the load, you can unhitch the trailer from the vehicle.
❸ Disconnect the electrical cable plug controlling the lights, indicators, etc. from the socket on the towing vehicle.
❹ Remove the release cable from the hitching plate.

Uncoupling a trailer fitted with a coupling head

❶ Immobilise the trailer by placing chocks under the wheels, after engaging the parking brake (if fitted) fully.
❷ Open the coupling handle and lift up the coupling head, using the jockey wheel, to release it from the hitching joint. The jockey wheel retraction mechanism (if fitted) must lock automatically before the jockey wheel touches the ground. When you are sure that the mechanism is locked and that the wheel is bearing the load, you can uncouple the trailer from the vehicle.
❸ Disconnect the electrical cable plug controlling the lights, indicators, etc. from the socket on the towing vehicle.
❹ Remove the release cable from the hitching plate.

**NB**: wear indicator (on certain models)
The coupling head has a wear indicator (figure 5.3) that tells you whether the wear limit of the towing vehicle's hitching joint or of the towed vehicle's coupling has been reached.
To use this indicator, couple the trailer and drive the towing vehicle around 500 m, so that the coupling head is positioned. When you have done this, check the wear as indicated below.

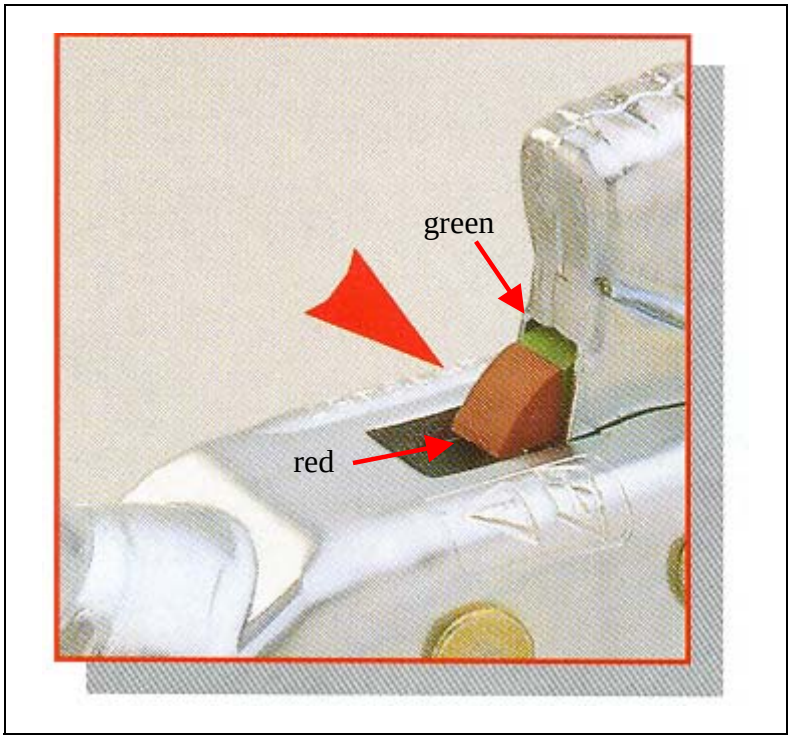



**Figure 5.3**: Wear indicator

If the green section of the indicator can be seen on the coupling (secured), the coupling head is in good condition, or the hitching joint wear is less than the prescribed limit.
If the green section of the indicator is completely masked, and only the red section is visible, it can be assumed either that the hitching joint has reached the wear limit (diameter < 49.61 mm), or that the coupling head and hitching joint both show signs of wear, or finally that the hitching joint is in good condition (diameter 50 mm), but that the coupling head is worn.

| | |
|---|---|
| Important | In these conditions, the coupling head may come free from the hitching joint, and the trailer detach from the towing vehicle. Therefore, the coupling head and hitching joint must be checked before they are reused. Any defective part must be replaced. |

### 5.2.1.2. "Site" trailer

Before hitching the trailer, check the hitching system of the towing vehicle; it must be perfectly suited to the trailer.

| | |
|---|---|
|  Warning | Any attempt to tow a trailer with a non-compliant device (bar, cables, lashing, etc.) runs the risk of serious accidents.<br>Also check:<br>✓ That there are no incipient ruptures or significant wear on the hitching system.<br>✓ That the locking system is working properly. |

Coupling a trailer fitted with a hitching ring

❶ Drive the towing vehicle or bring the trailer up to the coupling point.
❷ Put the trailer in the horizontal position using the guide wheel (jockey wheel).
❸ Place the hitching ring above the towing vehicle hook, and then lower the trailer to secure the ring in the hook. Make any height adjustments necessary to enable coupling using the jockey wheel.
❹ Once this has been done, raise the jockey wheel until it is lifted off the ground slightly and is not bearing any load.
❺ Lift up the guide wheel and lock it in position.

| | |
|---|---|
|  Warning | If the hitching ring is not correctly connected to the hitching hook, the trailer will become separated from the towing vehicle. |

Coupling a trailer fitted with a coupling head

❶ Drive the towing vehicle or bring the trailer up to the coupling point.
❷ Open the coupling head. To do so, pull the coupling handle (figure 5.1) in the direction of the arrow.
The coupling mechanism can remain open as long as the coupling head is not resting on the hitching joint.
❸ Put the trailer in the horizontal position using the guide wheel (jockey wheel) and then mount the open coupling head on the hitching joint; the trailer must remain in the horizontal position.
If necessary, adjust the height using the jockey wheel. The coupling head will be engaged automatically, accompanied by a clearly audible click; then lower the coupling handle. The coupling mechanism will then be engaged, and the coupling handle cannot adopt a lower position (when manoeuvred by hand).
❹ Once this has been done, raise the jockey wheel until it is lifted off the ground slightly and is not bearing any load.
❺ Lift up the jockey wheel fully and lock it in position.

| | |
|---|---|
|  Warning | If the coupling head is not correctly attached to the hitching joint, the trailer will separate from the towing vehicle. |

Uncoupling a trailer fitted with a hitching ring

❶ Immobilise the trailer by placing chocks under the wheels.
❷ Release the hitching ring by lowering the jockey wheel. When you are sure that the wheel can bear the load, you can unhitch the trailer from the vehicle.

Uncoupling a trailer fitted with a coupling head

❶ Immobilise the trailer by placing chocks under the wheels.
❷ Open the coupling handle and lift up the coupling head, while lowering the jockey wheel, to release it from the hitching joint. When you are sure that the wheel can bear the load, you can unhitch the trailer from the vehicle.

### 5.2.2 Check before towing

Before towing, check the following:

- ✓ Tightness of the generating set enclosure bolts.
- ✓ Wheel tightness.
- ✓ Hitching hook locked.
- ✓ Tyre pressure.
- ✓ Signalling lights working, for "on-road" trailers.
- ✓ Enclosure doors closed.
- ✓ Parking brake released, for "on-road" trailers.
- ✓ Guide wheels (jockey wheels) and stands lifted (if fitted).
- ✓ Towbar arm locking levers tightened and pinned (if fitted with an adjustable towbar).
- ✓ Brake test, for "on-road" trailers.
- ✓ Safety cable fitted, for "on-road" trailers.

### 5.2.3 Operation

"On-site" trailer

These trailers are not fitted with a main brake, and so cannot be braked in motion; the tyres allow for a maximum speed of 27 km/h. So it is absolutely prohibited to exceed this speed.
Nor are these trailers fitted with signalling lights. On-road use is prohibited.

"On-road" trailer

The driving speed must be suited to the condition of the road and the handling of the trailer.
Driving at high speed causes heating of the tyres; so it is important to stop from time to time, and check them. Excessive heating may cause a puncture, and therefore a serious accident. For reversing manoeuvres, remember to lock the inertia brake.

| | |
|---|---|
| Warning | Particular attention must be paid to the tightness of the wheels on new vehicles.<br>In the first few miles' driving, heating of the brake hubs and drums will actually reduce the wheel tightness. It is therefore essential to check the tightness every 6 miles (10 kilometres) until no further loosening is noted. Nonetheless the tightness must be checked whenever you are about to tow the trailer. |

Lights/signalling (only for "on-road" trailers)

Warning lights are obligatory for on-road driving. Signalling must comply with regulations in force in the country of use.

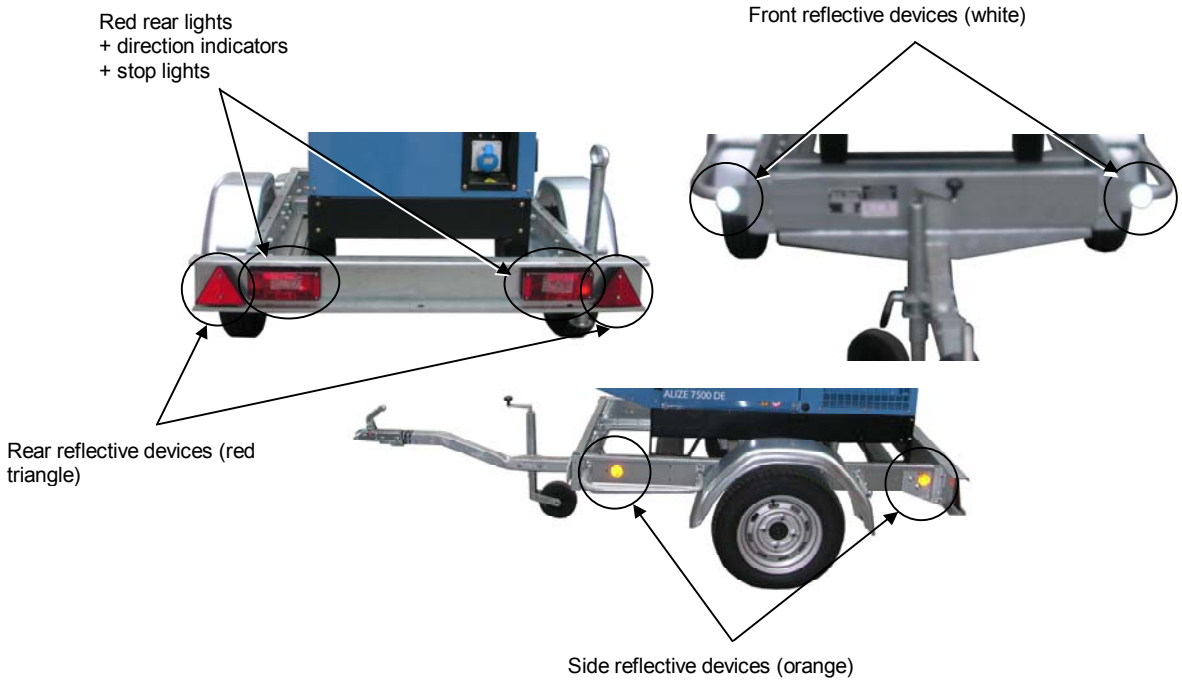



**Figure 5.4**: Example of French signalling

## 5.3. Road transport

### 5.3.1 Generating set with/without enclosure

Road transportation of generating sets must be carried out in accordance with the regulations of the countries concerned.
The transport equipment (trailer, semi-trailer, etc.) must be suitable for this usage and have all the safety guarantees in terms of load bearing capacity and of the securing devices.
Driving should also be on truck roads of sufficient quality not to damage the generating sets on board.
Put a plastic cover over non-enclosed generating sets during transportation. Chock and fix the generating sets on the lorry floor, and strap them down.

| | |
|---|---|
|  Warning | Generating sets must not be stacked.<br><br>Generating sets must not be operated during transport. |

For the recommendations to be observed during transportation of generating sets, refer to section 5.1. "General recommendations".

### 5.3.2 Container

Road transportation of containers must be carried out in accordance with the regulations of the countries concerned.
The transport equipment (trailer, semi-trailer, container carrier, etc.) must be suitable for this usage and have all the safety guarantees in terms of load bearing capacity and of the securing devices.
Driving must also be on truck roads of sufficient quality not to damage the container and its contents.
Blanking of apertures (air inlets and outlets, exhaust…) is obligatory for containers used in road transport.

| | |
|---|---|
|  Warning | Containers must not be stacked.<br><br>Generating sets must not be operated during transport. |

For the recommendations to be observed during transportation of generating sets, refer to section 5.1. "General recommendations".

## 5.4. Rail transport

### 5.4.1 Generating set with/without enclosure

Rail transport of generating sets must be carried out in accordance with the specific rules of rail transport.
The transport equipment must be appropriate for this usage, and have all the safety guarantees both in terms of load-bearing capacity and of the securing devices.
Put a plastic cover over non-enclosed generating sets during transportation.

| | |
|---|---|
|  Warning | Generating sets must not be stacked.<br><br>Generating sets must not be operated during transport. |

For the recommendations to be observed during transportation of generating sets, refer to section 5.1. "General recommendations".

### 5.4.2 Container

Rail transport of containers must be carried out in accordance with the specific rules of rail transport.
Containers must receive the necessary approvals for rail transport.
The transport equipment must be appropriate for this usage, and have all the safety guarantees both in terms of load-bearing capacity and of the securing devices.
Blanking of apertures (air inlets and outlets, exhaust…) is obligatory for containers used in rail transport.

| | |
|---|---|
|  Warning | Generating sets must not be stacked.<br><br>Generating sets must not be operated during transport. |

For the recommendations to be observed during transportation of generating sets, refer to section 5.1. "General recommendations".

## 5.5. Shipping

### 5.5.1 Generating set with/without enclosure

Generating sets must be transported in a shipping container.
Transportation must be carried out in accordance with the rules of shipping. The transport equipment must be appropriate for this usage, and have all the safety guarantees (load, securing device).
In the case of a grouped load container, SEI cases must be used for packing.

| | |
|---|---|
|  Warning | Generating sets must not be stacked.<br><br>Generating sets must not be operated during transport. |

For the recommendations to be observed during transportation of generating sets, refer to section 5.1. "General recommendations".

### 5.5.2 Container

CSC certified containers may be stacked in a cellular ship, and have top grips. Most of these containers are "ISO containers", which meet the standards stipulated by the International Organisation for Standardisation ISO.
Blanking of apertures (air inlets and outlets, exhaust…) is obligatory for containers with or without CSC certification.

**Container Safety Convention (CSC)**
International convention governing container safety (or CSC convention), which was rendered in France by Decree no. 80-837 of 20 October 1980 and the orders issued for its application.
These orders define the process for obtaining CSC approval, and list the bodies authorised to issue this approval. This approval, which comes in the form of a standardised plate permanently fixed on each approved container, is obligatory for authorisation of sea transportation. The stacked load that the container can bear is indicated on this plate.
This approval is obtained by the manufacturer, for each container model, by submitting a technical file, subject to validation of standard tests by the approved body.

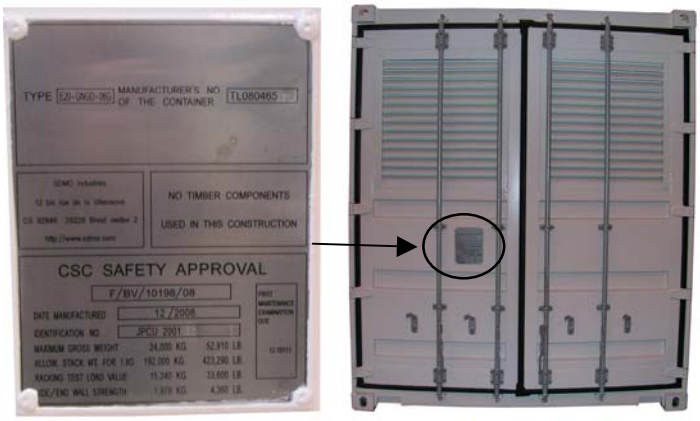



**Figure 5.5:** Example of a CSC plate.

**CSC approval**
1 - "ISO" type
ISO 20' and 40' containers are basic ISO "boxes" to which modifications have been made (doors, intake grille, exhaust outlet).
These containers, in spite of their modifications, have received CSC approval, i.e. are authorised for shipping.
2 - "CIR" and "EURO" type
The modifications made to these containers relating to the basic ISO "box" (doors, apertures for cooling, exhaust, etc.) disqualify them from CSC approval, and therefore prohibit them from being shipped as a container. In this case special transport is recommended (flat container carrier).

| | CSC approval | |
|---|---|---|
| Version | YES | NO |
| CIR 20 | | X |
| EUR 20 | | X |
| ISO 20 | X | |
| ISO 40 | X | |

| | |
|---|---|
|  Important | Our CIR 20 and EUR 20 containers cannot bear additional loads **(stacking prohibited)**.<br><br>Shipped with chocks. |

For control boxes, packing in a SEI 4 C case (solid case with waterproof cover) is obligatory.

## 5.6. Air transport

The UN has classified generating sets as "dangerous goods" listed under UN code 3166 - class 9 - "Engine, internal combustion (flammable liquid powered)".
Any air shipment of generating sets must be subject to prior declaration to the air freight company, in accordance with form MOD3909.

For control boxes, packing in a SEI 4 C case (solid case with waterproof cover) is obligatory.

### 5.6.1 Generating set with/without enclosure

Air transport of generating sets must be carried out in accordance with the specific rules of air transport.
The transport equipment must be appropriate for this usage, and have all the safety guarantees both in terms of load-bearing capacity and of the securing devices

| | |
|---|---|
|  Warning | Generating sets must not be stacked.<br><br>Generating sets must not be operated during transport. |

For the recommendations to be observed during transportation of generating set, refer to section 5.1. "General recommendations".

### 5.6.2 Container

Air transport of containers must be carried out in accordance with the specific rules of air transport.
The transport equipment must be appropriate for this usage, and have all the safety guarantees both in terms of load-bearing capacity and of the securing devices

| | |
|---|---|
|  Warning | Generating sets must not be stacked.<br><br>Generating sets must not be operated during transport. |

For the recommendations to be observed during transportation of generating sets, refer to section 5.1. "General recommendations".

## 6. Installation

| | |
|---|---|
| Warning | The contents of this chapter are only general recommendations.<br>It is recommended that professionals are employed to ensure correct installation and start-up.<br>The company cannot be held responsible for breakdowns related to the conditions of installation. |

### 6.1. Fixed generating set

**NOTE**

If you do not follow the basic principles, the installation assembly will suffer damage and abnormal wear. The procedure described gives the main requirements for installing a "conventional" generating set made up of a heat engine, a generator and electric panel. These requirements are general principles to be observed. For any specific applications or if you have any doubts, our technical departments will advise you and look at your specific conditions of installation. The current regulations, provisions and laws in installation locations must be adhered to.

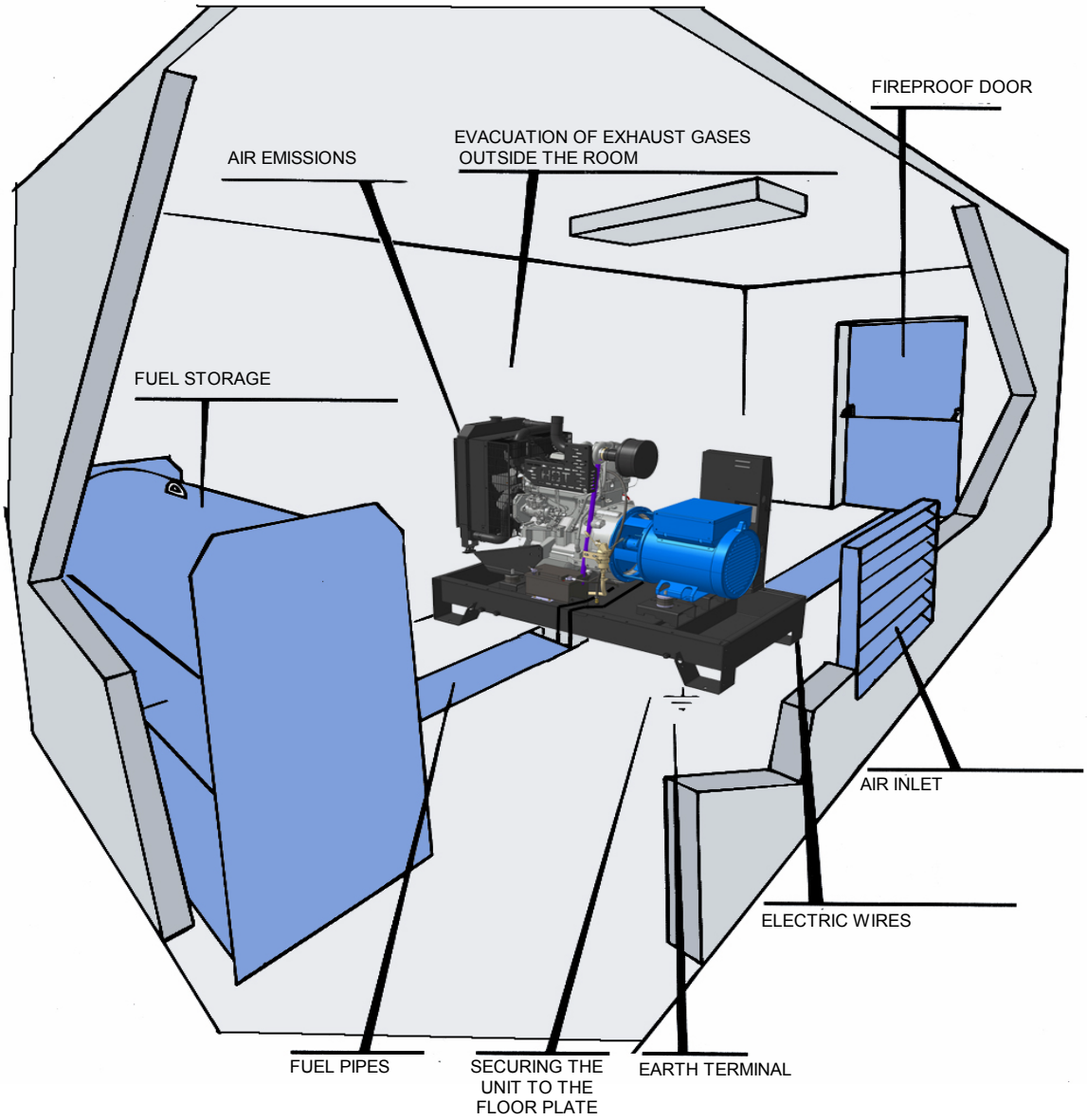


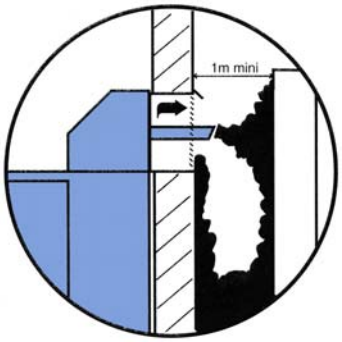

**Figure 6.1:** Example of a generating set site

### 6.1.1 Indoor installation of a generating set with or without enclosure

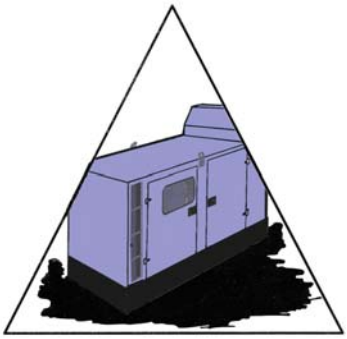
#### 6.1.1.1. Position

It should be determined on the basis of use. There are no specific rules governing the choice of location, other than proximity to the electric distribution panel and disturbances caused by the noise. However, fuel supply, burnt gas evacuation, and the direction of these gases and the noises emitted should be taken into account.
The choice of its position will be based on carefully considered compromise!

Examples of problems that may be encountered:

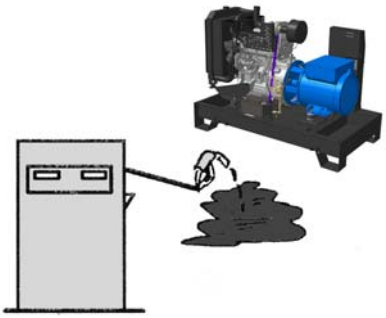



Incorrect exhaust and ventilation

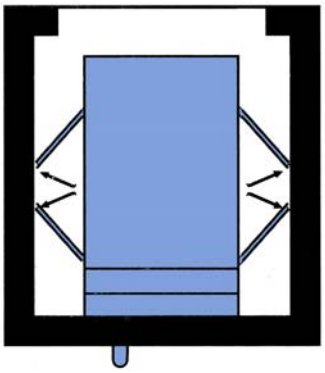


Ground too uneven or soft.
Set incorrectly positioned

Reduced access



Fuel filling impossible



Opening cover doors impossible

**Figure 6.2**: Examples of problems that may be encountered

#### 6.1.1.2. Measurements and layout

These are governed by two types of requirement:

**Static requirements**

These are the dimensions of the equipment installed and its surroundings, namely: daily service fuel tank, cabinet, silencer, batteries etc.

**Dynamic requirements**

These are the dimensions which must be left around each piece of equipment to allow for any servicing and dismantling. About a 1 metre space around the set is considered the minimum required for carrying out problem-free maintenance. This will give enough space to check that the doors of covered sets open fully, that equipment can be accessed for maintenance and that full removal of the set can be carried out.

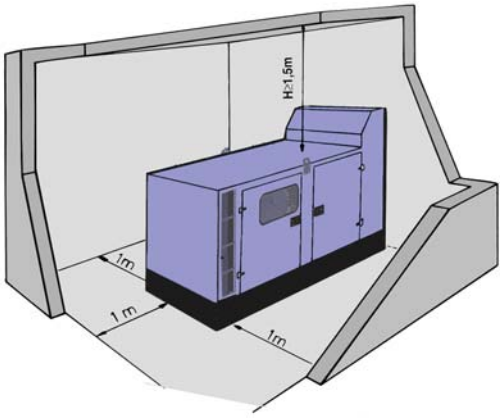



**Figure 6.3**: Example of the size of a site for a generating set with enclosure

## Construction

All sorts of shelters can be designed to house a generating set.
If noise level and speed of starting are not the main considerations in your choice, it can be installed under a basic shelter to protect it from bad weather (rain, snow, storms, etc.).
If a low noise level and fast start are important criteria, (e.g.: emergency set or noise sensitive area), particular attention will be given and the room will be built of framing concrete or solid concrete blocks 20 cm minimum, covered in absorbent fireproof and insulating material.

| | |
|---|---|
| Warning | The fire test should comply with current legislation according to the type of building. |

## Base of the set

An operating generating set generates a certain amount of vibratory energy. This vibratory energy makes its way to the floor plate via the frame. Mounted on elastic mountings, our generating sets do not require a special floor plate in principle. However, a floor plate will be sufficiently strong and detached from the rest of the construction. It will also be level, smoothed by the flow and unshackled.
If there is a risk of vibrations being transmitted, the set can be mounted on a separate floor plate insulated if necessary by a resilient material.
This solution is mainly used with very powerful generating sets.

## Openings

The room should include a certain number of openings which are required for it to operate:

- ✓ A door, giving access to the generating set and its accessories, preferably in line with the set's floor plate
- ✓ Ventilation openings (fresh air inlet and hot air outlet) located so that scavenging takes place in the direction from the alternator towards the engine. Their surfaces depend on the power of the generating set being installed, general atmospheric conditions, the cooling system selected and the soundproofing procedure.

## Lifting

The lifting system should usually be an integral part of the construction. It is made up of an H or I steel rail, embedded in the walls and ceiling, and a crab. It should be easy to handle and is generally used on top along the longitudinal axis of the set and directed towards the exit.

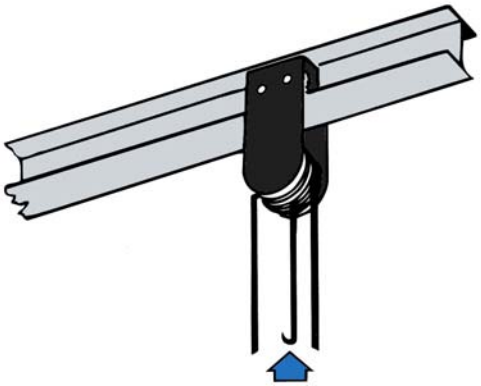


**Figure 6.4**: Example of a lifting system

## Soundproofing

The room is soundproofed using two procedures:

Insulation:

This prevents the noise from crossing the walls, and in this case, it is the weight then thickness of the wall that is important.

Absorption:

These are materials that absorb sound energy and this procedure will be used on ventilation openings. As a result of this, the air inlet and outlet sections are increased.

The internal lining of the room can also be covered with absorbent material designed to lower the sound level in the room, and consequently through the walls, ventilation openings and door.

General arrangements

- ✓ Building structure made from framing concrete or solid concrete blocks, 20 cm thick minimum
- ✓ Anti-vibrating floor plate under the generating set when adjoining sensitive areas.
- ✓ Ceiling and walls covered if necessary with absorbent materials
- ✓ Choice of adapted exhaust silencer(s).
- ✓ Soundproofed door for access to the room and, if required, to the pressure lock, for a very low sound level.
- ✓ Sound traps fitted to the air inlet and outlet sleeves.

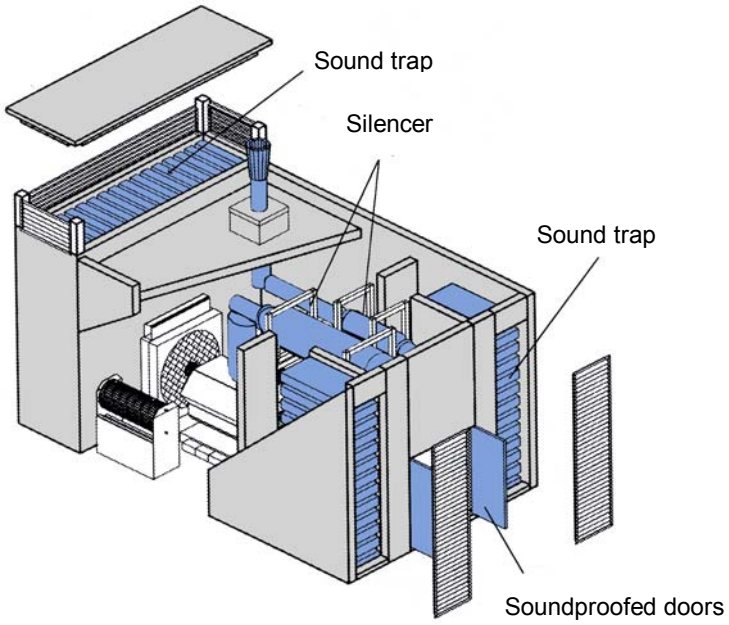



**Figure 6.5**: Example of an installation

## Ventilation

A heat engine generates a certain amount of heat, which must be evacuated outside the room to ensure the set works properly.

The heat released by the set originate from different sources:

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

Also the room must be fitted with air inlet and outlet openings suitable for the conditions of use and cooling system. As you know, insufficient ventilation will cause the atmospheric temperature to rise and lead to problems ranging from, at least, a loss of engine power to the set stopping altogether.

Air must flow through the set room from alternator ⇨ engine ⇨ radiator.

This solution also supplies the quantity of fresh air needed for combustion. The openings should be of ample size.

Air intake and emission will be as direct as possible. The cooling system will be connected to a sealed emission sleeve or cover to prevent hot air from being recycled. The air inlet and emission openings should not be located close to one another.

| | |
|---|---|
|  Warning | Crankcase ventilation<br>The vapours from the crankcase should preferably be removed outside the room in which the generating set is located, to prevent these vapours from being deposited on the radiator, causing it become dirty and thereby reducing its cooling capability. |

## Fuel

Since the fuel is classed as a "dangerous product", certain regulations for storage and distribution must be followed. It is also necessary to consult current laws when carrying out the installation.
It is usual to fit fixed installations with a daily service tank and storage tank. These two tanks can be joined into one if the generating set consumption is low.

| | |
|---|---|
| Important | Do not used galvanised receptacles or brass coated receptacles for storing fuel. |

Manual filling tank
Solution for a manual starting generating set that is visually monitored. This tank is often part of the frame and has a mechanical gauge, filler neck and drain port.

Automatic filling tank located in the room
This type of installation is subject to regulations.
Solution for automatic starting generating sets. The tank is automatically filled by an electric drawing pump in a main storage tank. Moreover, it should be fitted with a retention container capable of collecting leaks with a capacity at least equal to that of the tank. There must be an overflow pipe going back to the main tank. Its section should be at least twice that of the supply pipes.
To prevent unpriming, the tank is fitted slightly filled in relation to the diesel engine (except in covered parking areas).
This tank must also be fitted with a shut-off valve for which the control must be located outside the room.

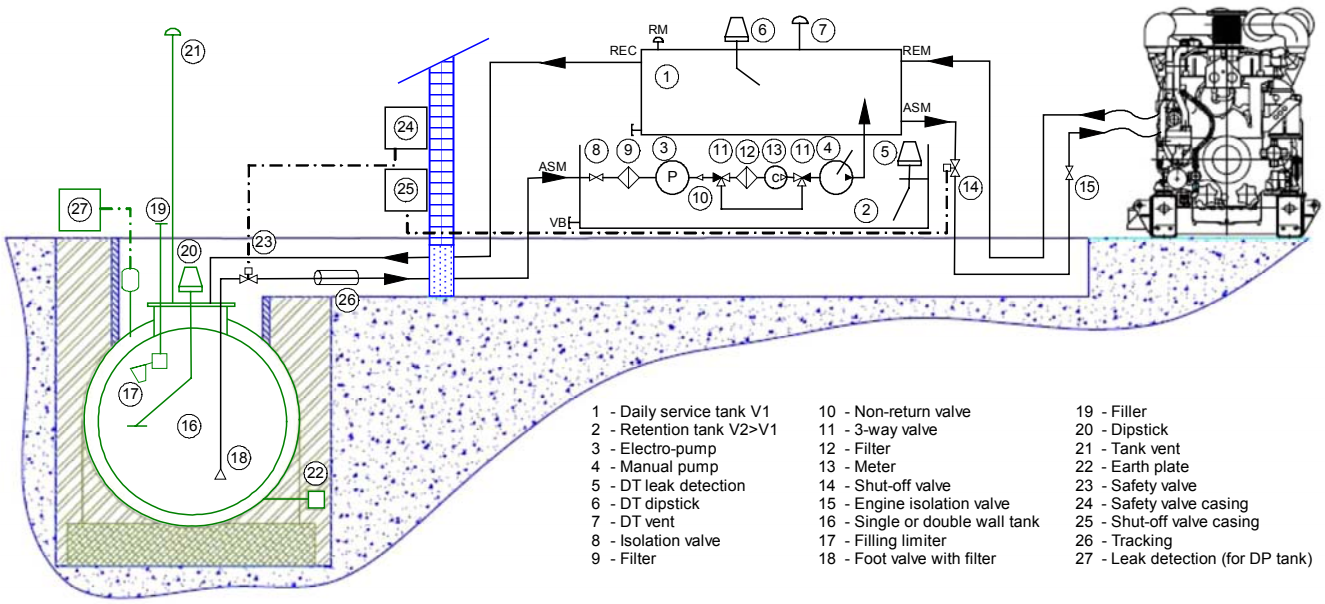



**Figure 6.6**: Example of an installation

## Fluid retention

Any outflow of the fluids contained in the generating sets (fuel, oil and coolant, or rainwater or condensation) will be collected in a retention container if the generated set is fitted with this option.
The containers have a capacity which allows 110% of the fluids contained in the generating set fitted with this option to be collected.
Three different fittings are available.

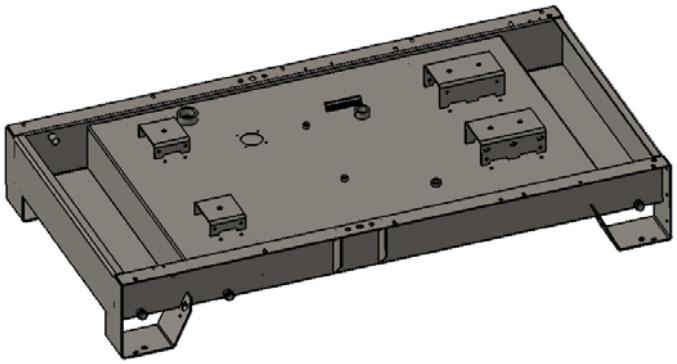


**Figure 6.7**: Fluid retention container integrated into the tank chassis.

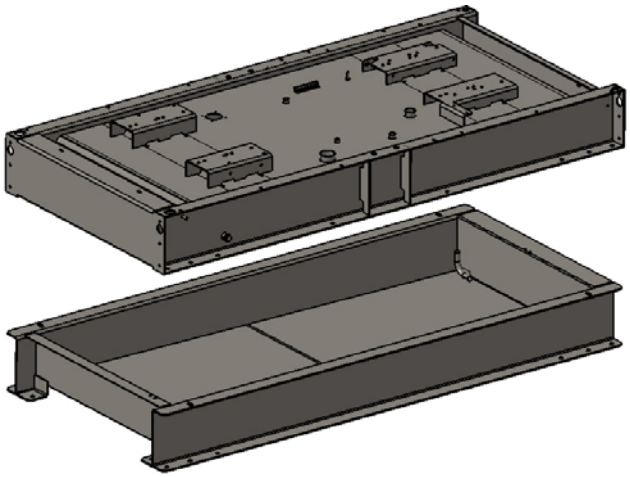


**Figure 6.8**: Offset fluid retention container underneath the generating set chassis.

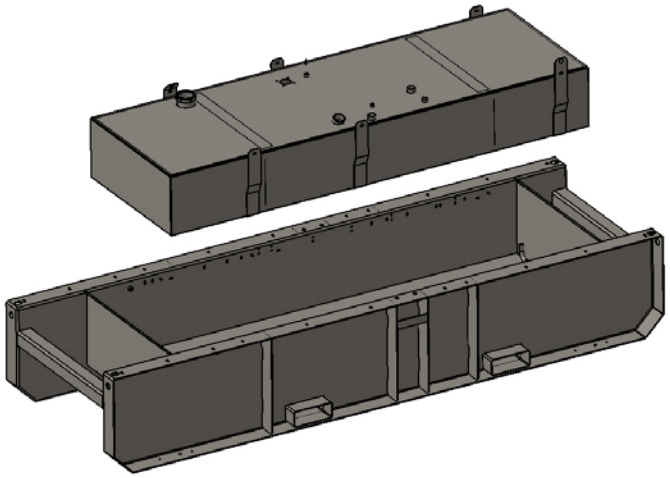


**Figure 6.9**: Offset fluid retention container integrated into the chassis and tank.

Generating sets fitted with the option shown in diagram 6.9 above are also equipped with a high level indicator in the retention container.

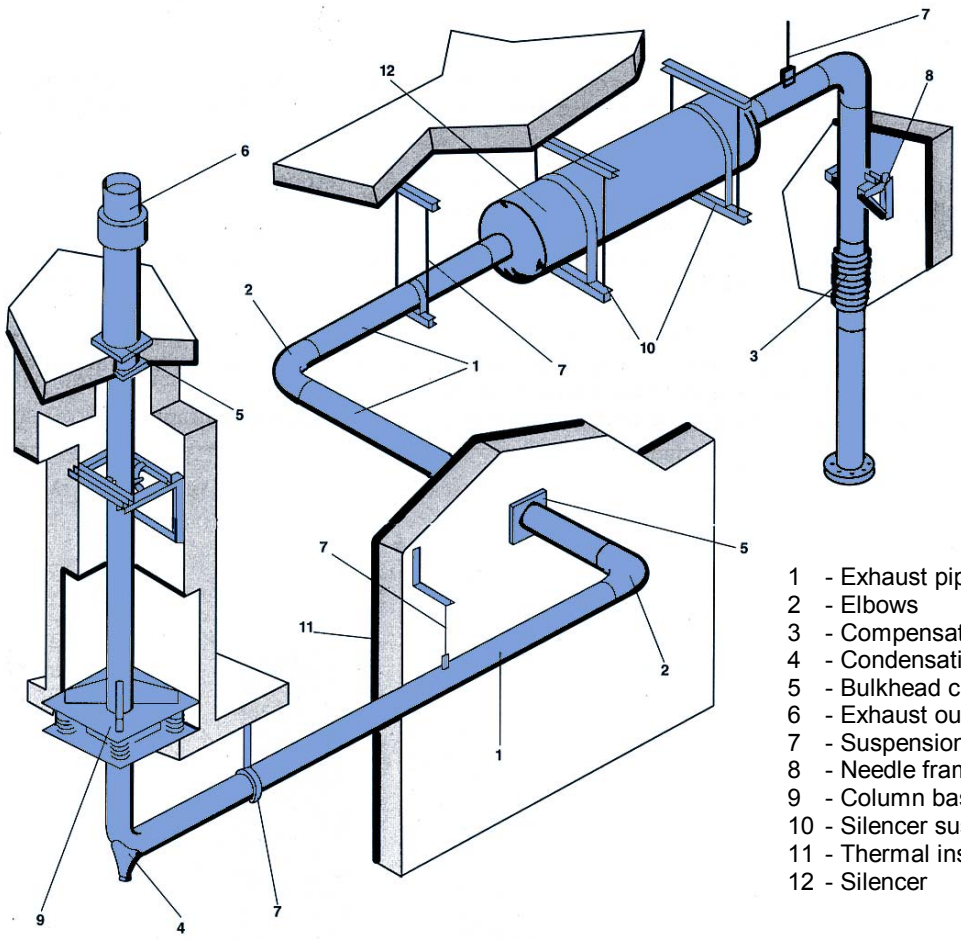
In all cases, the retention containers must be regularly checked to ensure they contain no fluid (fuel, oil and coolant, or rainwater or condensation). If necessary, drain the containers either via the drain port or by using the drain pump (for containers fitted with this pump).

✓ NOTE: Never allow these fluids to drain onto the ground; ensure they are collected in a designated container.

## Exhaust

Studying the evacuation of burnt gases by a generating set should not be seen as a minor detail due to the fact that a pipe can always be installed, even in the most inaccessible areas. In fact, there are certain constraints to be considered, such as pressure drops caused by the exhaust, insulation, suspension, noise level and air pollution. It should be noted that the more complicated a circuit, the more it causes drops in pressure and consequently, its diameter will be large and heavy and its supports and silencers expensive.

**NOTE**
Generating sets with a silencer fitted in the enclosure must be fitted with an exhaust compensator. This compensator or hose will be fitted to the exhaust outlet in the cover.




1 - Exhaust pipe
2 - Elbows
3 - Compensator
4 - Condensation bleed
5 - Bulkhead crossing - roof outlet
6 - Exhaust outlet
7 - Suspension line
8 - Needle frame
9 - Column base
10 - Silencer suspension
11 - Thermal insulation
12 - Silencer

**Figure 6.10**: Example of an installation

The installer must check that none of the components installed on the exhaust pipe cause pressure drops greater than the engine's admissible pressure.

## Pipework

Marker 1: Pipes
It is recommended that you use seamless pipes. However, for weight reasons, rolled steel pipes can be used. In any event, welded "bars" inside the duct are to be avoided.

Marker 2: elbows
Elbows must have a minimum curve radius equal to 2 times the diameter of the pipe, if possible in a single part. If the elbow is made of welded steel, check that it includes at least 3 sectors for 90° elbows.

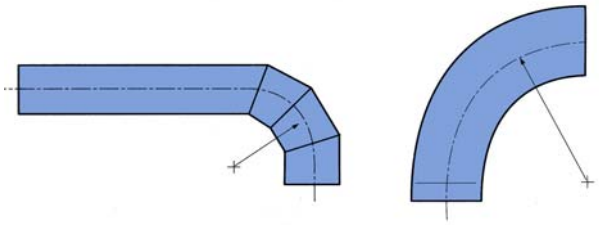


**Figure 6.11**: Pipes and unions

Marker 3: expansion bellows and hoses
- ✓ The compensator absorbs longitudinal movements due to expansion (approx. 1 mm/metre/100°C).
- ✓ The hose allows for considerable sideways travel, but with low longitudinal amplitude.

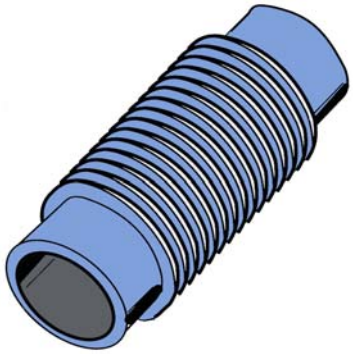


**Figure 6.12**: Compensators and hoses

Marker 4: condensation and rainwater bleed
To be allowed for in the lower section of the installation, to protect the silencer and engine or for any changes in horizontal/vertical travel.

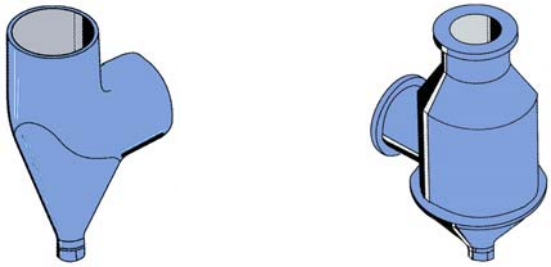


**Figure 6.13**: Bleed valves

Marker 5: bulkhead crossing - roof outlet
For each bulkhead passage and roof outlet.

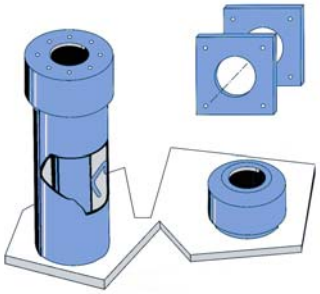


**Figure 6.14**: Bulkhead connectors

Marker 6: exhaust outlet
The exhaust outlets disperse the gases in the atmosphere and protect the inner section of the pipes from bad weather.

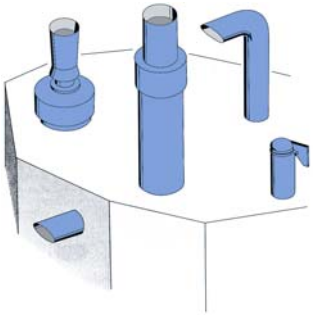


**Figure 6.15**: Exhaust outlet

## Pipework and silencer fixtures and suspensions

Marker 7: suspension line
Generally made up of a flat iron ring attached to the ceiling. The suspension line enables the pipes to expand freely.

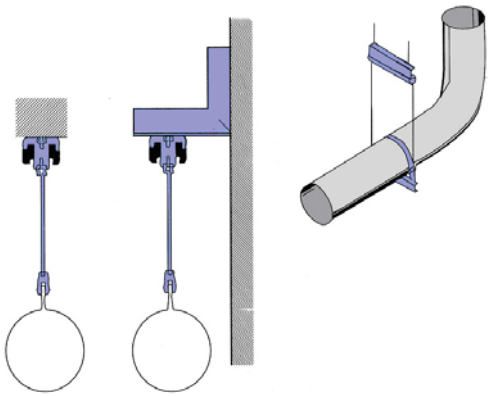


**Figure 6.16**: Suspension lines

Marker 8: needle frame
Used for vertical sections, the needle frame allows the pipes to expand while holding them laterally.

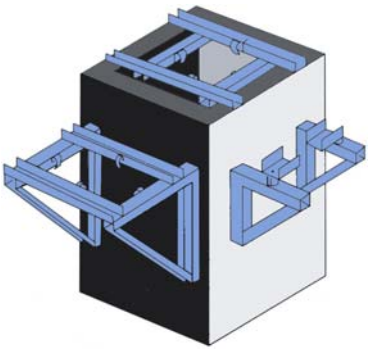


**Figure 6.17**: Needle frame

Marker 9: column base
The column base is designed to hold the weight of the vertical pipes.

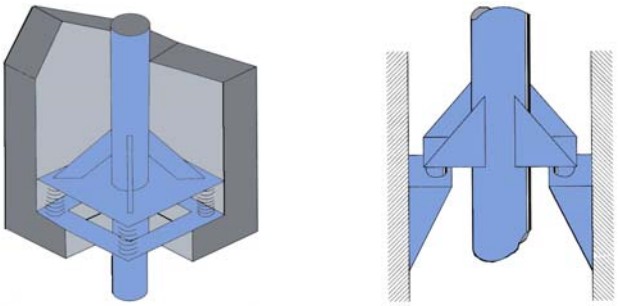


**Figure 6.18**: Column bases

Marker 10: silencer suspension
The silencer suspensions are designed to hold the weight of the silencers; they can be vertical or horizontal.

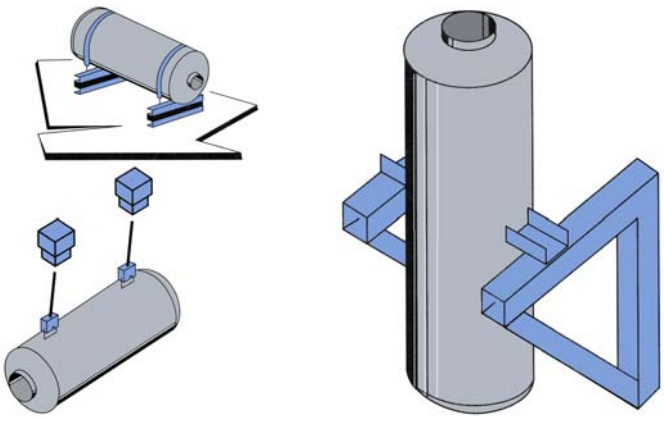


**Figure 6.19**: Suspensions

## Thermal insulation

Figure 11: heat insulation
Depending on the type of installation, you may have to insulate the heat released in the room.
Once it has been insulated, the surface temperature should not exceed 70 °C. The recommended material is rock wool (excluding asbestos) and eventually it can be recovered with aluminium sheets to improve the look of the installation and the thermal insulation.
50 mm thick glass wool should be considered a minimum requirement.

## Silencer

Figure 12: silencers
These reduce noise by absorbing or causing phase differences in the sound wave. An exhaust should be effectively suspended, the supports should never rest on the set (except for original fittings). An exhaust compensator will be fitted to the engine outlet. The pipes will never have a diameter less than the set (refer to us about vermin ) and be directed so that gas cannot return to the room.
The pipes should be fixed so that their weight is not supported by the compensator.
It should be perfectly straight (any misalignment could lead to a rupture).

"Adapted" silencer
The "adapted" silencer is fitted directly to the set or cover. It is an absorption type silencer.
A compensator is fitted between the engine and exhaust in the covered version.

**Figure 6.20:** Adapted silencer

Absorption silencer
The gas passes through a sound proof duct made of acoustic high efficiency absorbent material protected by a perforated metal sheet.

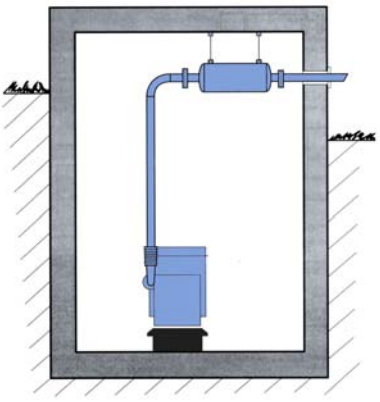


**Figure 6.21:** Absorption silencer

Absorbent reactive silencer
The gas enters an expansion chamber lined with absorbent material, supported by perforated metal sheets then into an absorbent sound proof duct.

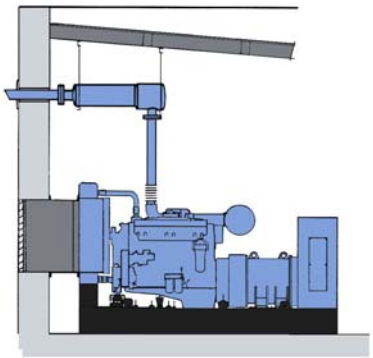


**Figure 6.22**: Absorbent reactive silencer

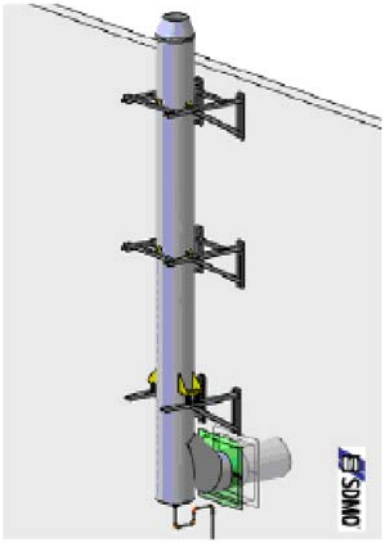
## Exhaust chimney

There are various types of exhaust chimney.

**Self-supporting**

Chimney mounted on a concrete foundation on the ground, with load support on the building.

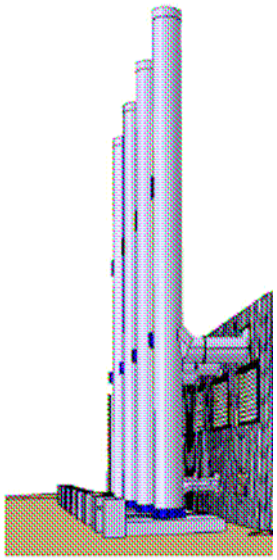
**Wall-mounted**



**Free-standing**

Chimney standing solely on a concrete foundation on the ground.

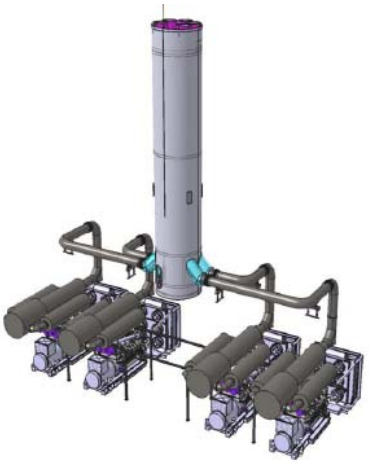
The sizing of the chimney's support must factor in the constraints of the site, and in particular the forces generated by the wind.



**Shared chimney**

In the case of a facility with several generating sets, it is possible to route the various ducts to a single chimney.

It is preferable to use multi-duct or telescoping chimneys. If there is no other solution than evacuating the smoke emitted in a single duct, each engine duct must be fitted with a non-return valve.



**Roof outlet**

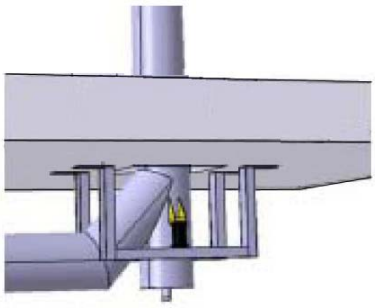


**Figure 6.23**: Examples of exhaust chimneys.

## Cooling

Four types of produced heat must be dissipated:
- ✓ Heat from the engine cooling circuit(s).
- ✓ Heat radiation from the engine and exhaust.
- ✓ Room ventilation air.
- ✓ Exhaust gases.

The systems described below evacuate and channel the heat produced by the engine cooling circuit.

a) Ventilated radiator
The engine cooling circuit is connected to a tubular ribbed radiator at the end of the frame in order to implement this procedure. This radiator is cooled by the fan controlled directly by the engine.
In all cases the air is blown in the direction from the fan to the radiator.
Cooling is ensured by the circulation of air across the room.
An expansion vase can compensate for the variations in the volume of coolant fluid according to the temperature.

b) Air cooler
The engine cooling circuit is connected to an air cooler located inside or outside the room in order to implement this procedure.
When located in the room, it operates in the same way as a ventilated radiator. The fan or fans are either coupled to the diesel engine or driven by one or more electric motors. If the air cooler is moved outside, on the roof or in another room, the coolant pipes are extended, meaning that ventilation of the room is separate from the cooling. In these installations the degassing conditions should be considered even more carefully than for a radiator.
In all cases, the air cooler is cooled by the fan(s).

For cooling by radiator or air cooler in the room, the increase in temperature due to heat radiation for the sizing of the installation should be taken into account.

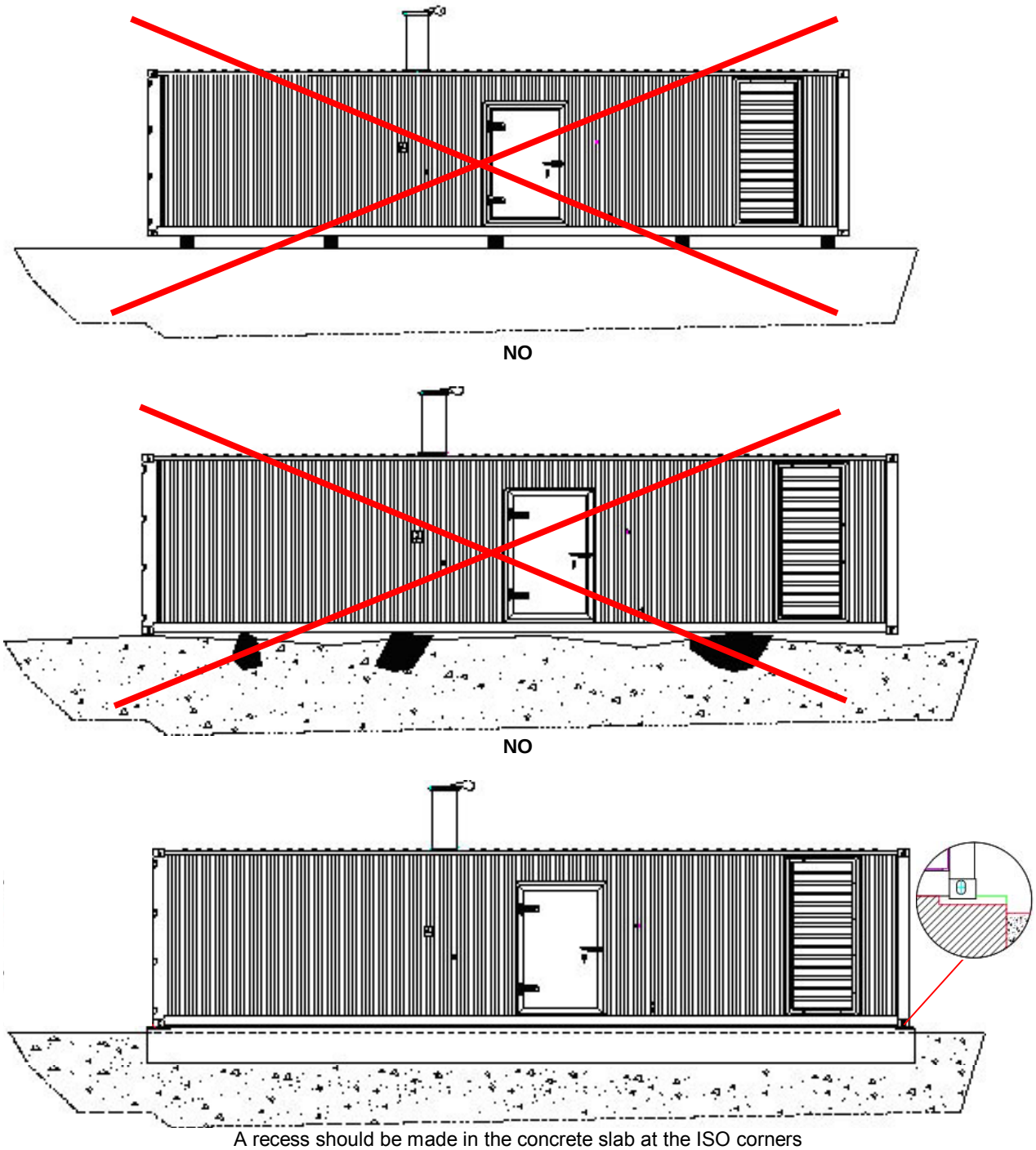
c) Lost water exchanger
This type of cooling consumes a sizeable amount of water and hence there is an operating cost to be taken into account. This the solution when local provisions ensure the flow of water and do not allow the ventilation provisions required for cooling by a ventilated radiator or air cooler to be enacted.
These lost water installations consist mainly of an exchanger, with one of its circuits fitted with an expansion receptacle, connected to the engine cooling circuit. The latter's water pump ensures circulation. The second exchanger circuit, known as raw water, is connected between the building's water supply and the drain. A valve fitted upstream of the exchanger can enable and cut off circulation. With automatic sets, this valve should also come with an electric control (solenoid valve).
This system's heat exchange ensures engine cooling. The room will require a ventilation system and this type of installation requires a detailed study.

d) Ventilation of the room
Extractor fans and/or air blowers can evacuate heat radiated from the engine and supply fresh air to the room and equipment in the case of external air coolers or lost water exchangers.
If fans are being used, several fans will regulate the temperature than one large one fan.
Ventilation of the premises requires a detailed study and should take into account the atmospheric air temperature and loss of pressure of components located in the air inlet and outlet (grilles, sound traps etc.) in particular.

### 6.1.2 Container

#### 6.1.2.1. Location

The position should first be considered in relation to the electricity distribution centre, fuel storage, the general environment and type of ground before the equipment can be accommodated.
The installation area should be flat enough for the frame to rest level on it and strong enough so that the container does not sink down.



**NO**

**NO**

A recess should be made in the concrete slab at the ISO corners
(above all the container must not rest on the ISO corners).
**YES**

**Figure 6.24**: Positioning containers

### 6.1.2.2. Acoustics

The environmental impact should also be analysed so that the disturbances to be caused by the equipment will not affect those living close by.
Therefore, it is essential to be aware of the regulations in force, in order not to be vulnerable to future legal action.
On this subject, the sound level of the set and reverberation effects on buildings must be taken into account .

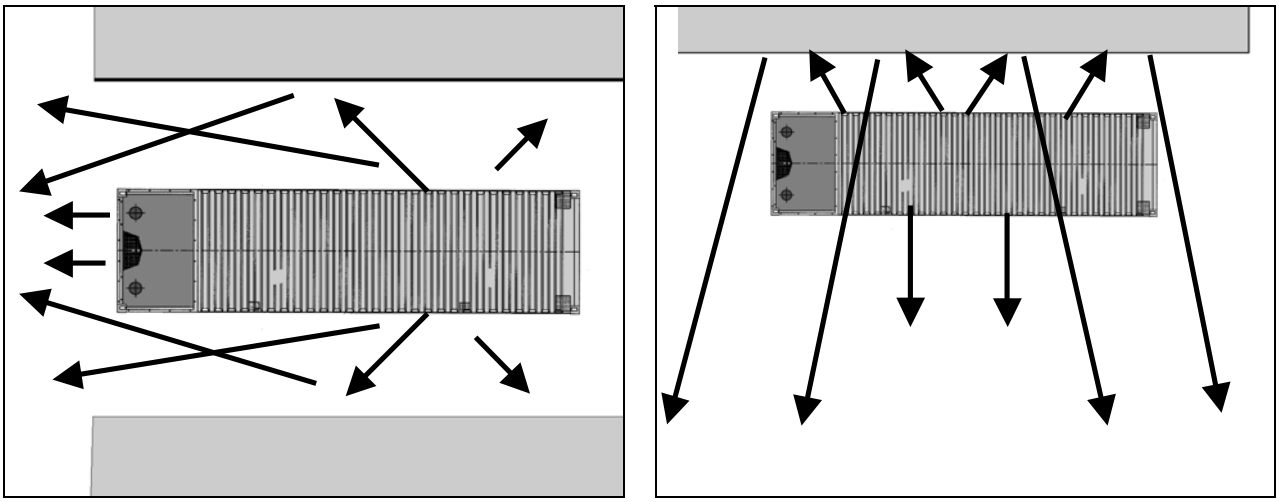


**Figure 6.25**: Examples of increase in sound level caused by reverberations and the sound directivity.

### 6.1.2.3. Ventilation

The installation of the equipment must also be carried out taking the prevailing winds into account; the air inlets must be facing away to ensure there are no difficulties in adverse weather conditions (entry of air, snow, sand, etc.).

The container air inlets and outlets must not be blocked. A minimum distance of 2 metres must be kept between the container air inlets and outlets and any obstacle to ventilation.

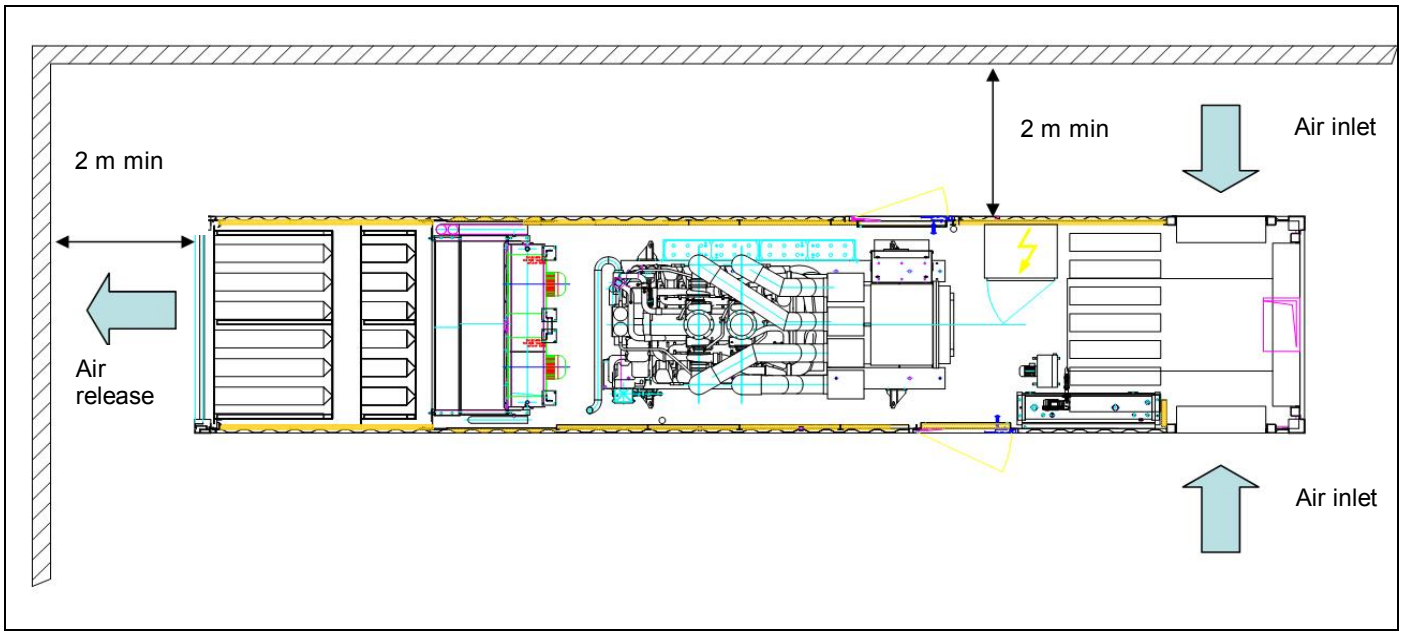



**Figure 6.26**: Positioning constraints

### 6.1.2.4. Exhaust

The equipment should also be installed taking the prevailing winds into account; the air inlets must be facing away to ensure there are no difficulties in adverse weather conditions (intake of air, snow, sand etc.).

| | |
|---|---|
| Warning | Be sure to remove the blanking cover(s) from the exhaust outlet(s) (used for transport), and replace them with the extension(s) provided with the generating set. |

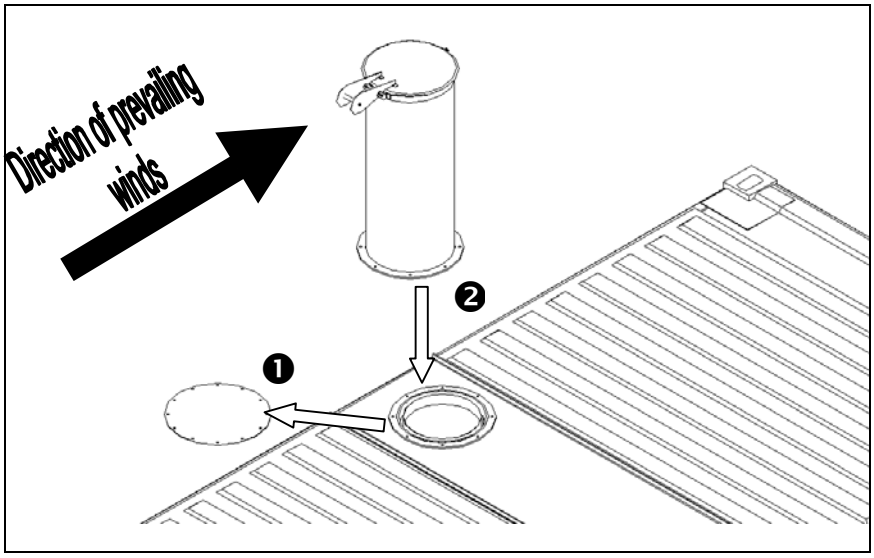



**Figure 6.27**: Removing the blanking cover.

If using a high chimney, it is preferable to use a free-standing chimney installed beside the container.

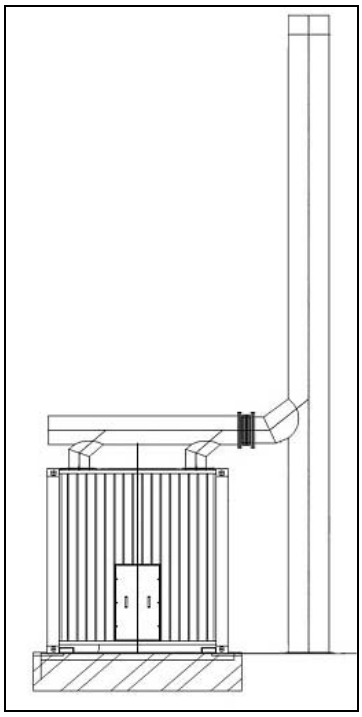


**Figure 6.28:** Free-standing chimney for container installation

## 6.2. Mobile generating set

### 6.2.1 General information

Besides the rules and advice given for fixed generating sets, certain special provisions must be observed for "mobile" generating sets.

### 6.2.2 Positioning/Location

An area will be reserved to install the generating set. Its should be flat and strong enough so that the generator does not sink into it. It could be made of concrete or even large planks fitted together.
It should be noted that a generating set that does not rest correctly on its base (frame or trailer) will be subject to vibrations that could cause damage to all the equipment.
The location of the set on site should be chosen for ease of fuel supply and distribution of current to the users.
Access to the set's doors should be available at all times for safety and maintenance reasons.
Ventilation of the generating set should not be affected by objects in the vicinity. This would cause abnormal heating, and power loss.
Burnt gas evacuation should take place in such a way that there is no reaspiration into the air filter or cooling system.
While adhering to current regulations, the neutral system of the generating set must be observed, in order to ensure protection of personnel.
The generating set will need to be earthed. To do this, use a copper wire, with a minimum cross-section of 25 $mm^2$ for a stripped cable, and 16 $mm^2$ for an insulated cable, connected to the generating set earth socket, and a galvanised steel earthing rod embedded vertically into the ground (see 7.1 "Connection").
These sets are to be covered or protected from adverse weather by a suitable construction (see previous sections).

### 6.2.3 Generating set on trailer

#### 6.2.3.1. Implementation for installation

Operations to be carried out:
- ✓ Ensure that the ground is strong enough for the assembly not to sink into it.
- ✓ Unhitch the trailer as per paragraph 5.2.1 "Hitching and unhitching the trailer".
- ✓ Immobilise the trailer by placing chocks under the wheels.
- ✓ Fully engage the parking brake (if fitted).
- ✓ Using the front wheel, position the generating set as close to horizontal as possible.
- ✓ Lower the stands (if fitted), and lock them.

### 6.2.4 Enclosed generating set

Installation of a mobile generating set with enclosure is the same as indoor installation of a generating set with enclosure (refer to paragraph 6.1.1.).

### 6.2.5 Container

Operations to be performed for installation:
- ✓ The installation area should be flat enough for the container to rest level on it, and strong enough so that the container does not sink down.
- ✓ The equipment will also have to be installed taking the prevailing winds into account; the air inlets must be facing away to ensure there are no difficulties in adverse weather conditions (intake of air, snow, sand etc.). Exhaust valves must be fitted in the same direction as the prevailing winds (see figure 6.27).
- ✓ The operator must not be subject to exhaust fumes when operating the console (prevailing winds at their back).
- ✓ The container air inlets and outlets must not be blocked. A minimum distance of 2 metres must be kept between the container air inlets and outlets and any obstacle to ventilation.
- ✓ The container must not be positioned in the immediate vicinity of residences, to avoid causing a disturbance (excessive noise).

## 6.3. Applicable regulations

### 6.3.1 Fuel

The regulations for fuel are specific to each country. So the rules in force in the country of use must be observed.

Example of regulations in force in France:
Order of 10/08/98[1].
Order of 19/11/01 – Article EL7[2].

- ✓ Fuel daily service tank:
  The maximum capacity of the DT (daily service tank) in the generating set room is 500 L, in the case of a Public Assembly Building.
  If the DT is greater than 500 L, it must be situated in a separate room.

- ✓ The capacity of the retention tank must be equal to or greater than the DT capacity.

- ✓ Fuel pipe:
  If pipe under load and underground: double lining.
  Safety valve between Tank and DT.
  Shut-off valve between DT and engine.
  Hoses are prohibited in ERPs.

### 6.3.2 Location of an underground fuel tank

Regulations on the location of underground fuel tanks are specific to each country. Refer to the rules in force in the country in question.

Example of location of an underground fuel tank in accordance with regulations in force in France:
Order of 22/06/1998[3] articles 9 and 11.

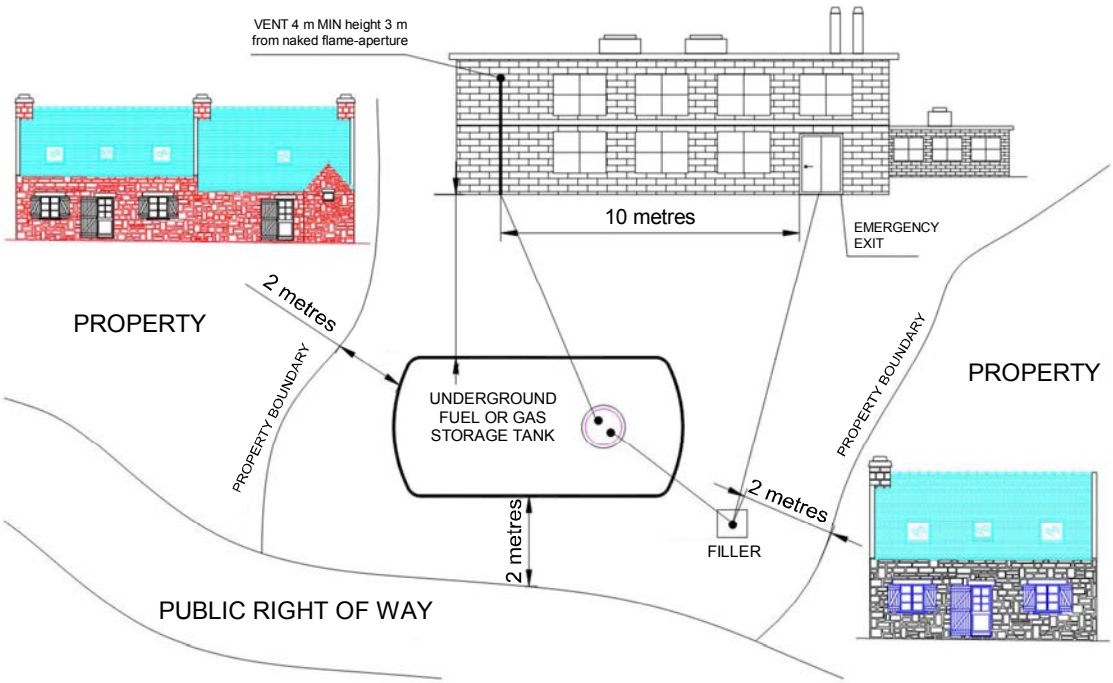



**Figure 6.29**: Example of location of a fuel tank in France

[1] Order of 10 August 1998 modifying the order of 25 July 1997 on general prescriptions applicable to installations classified for environmental protection subject to the declaration under section no. 2910 (Combustion).

[2] Order of 19 November 2001 relating to approval of provisions supplementing and amending the fire and panic risk safety regulations in public assembly buildings. Article EL 7 relating to the location of generating sets.

[3] Order of 22/26/1998 on underground flammable liquid tanks, and their ancillary equipment.

### 6.3.3 Acoustics

The applicable regulations are specific to each country. Refer to the rules in force in the country in question.

Example of regulations in force in France:
Order of 25/07/97 section 2910[1] - 8.1

✓ Noise emissions produced by the facility must not, in regulated noise emergence zones, cause emergent noise greater than the permissible values specified in the table below:

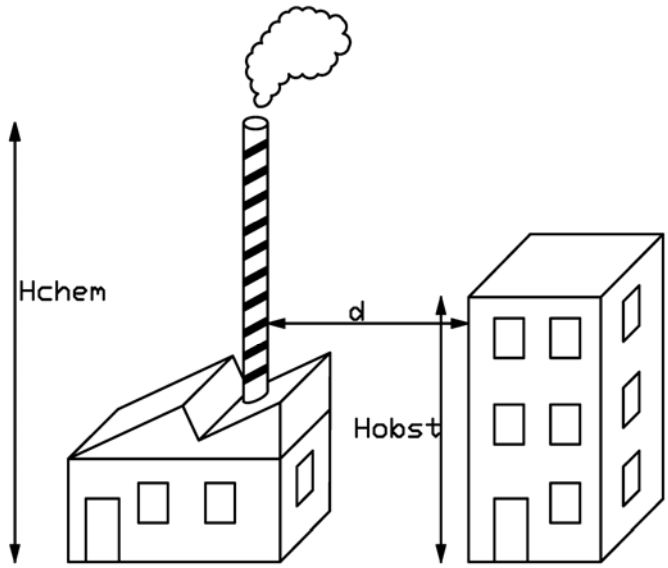
| Existing ambient noise level in regulated noise emergence zones (including establishment noise) | Emergent noise permissible for the period from 07.00 to 22.00, except for Sundays and public holidays | Emergent noise permissible for the period from 22.00 to 07.00, as well as Sundays and public holidays |
|---|---|---|
| Greater than 35 dB(A) and equal to or less than 45 dB(A) | 6 dB(A) | 4 dB(A) |
| Greater than 45 dB(A) | 5 dB(A) | 3 dB(A) |

### 6.3.4 Chimney height

The regulations regarding chimney height are specific to each country. So the rules in force in the country in question must be observed.

Example of regulations in force in France:

Min ejection speed: 25 m/s




✓ Back-up operation of main power supply:
Order of 25/07/97 section 2910 - 6.2.2.E
- The height of the evacuation chimney must be 3 metres higher than the buildings within 15 m of the facility, but cannot be less than 10 metres.

d<15 m Hchem=Hobst + 3

[1] Order of 25/07/97 on general prescriptions applicable to installations classified for environmental protection subject to the declaration under section no. 2910 Combustion.

✓ Production operation:
Order of 25/07/97 section 2910 - 6.2.2.D

- **2 MW* < Power plant < 10 MW***
  d<25 m Hchem=Hobst + 5
  25<d<125 m Hchem=1.25(Hobst+5)(1-d/125)

- **10 MW* < Power plant < 20 MW***
  d<40m Hchem=Hobst + 5 m
  40<d<200 m Hchem=1.25(Hobst+5)(1-d/200)

If no obstacles within a 200 m radius.

| | 2< <4 MW* | 4< <6 MW* | 6< <10 MW* | 10< <15 MW* | 15< <20 MW* |
|---|---|---|---|---|---|
| Hchem | 9 m | 13 m | 15 m | 18 (27) m | 20 (30) m |

In brackets: cities of over 250,000 inhabitants.

* The powers are the maximum total thermal consumptions of the facility, expressed in kW.

### 6.3.5 Exhaust emission

The regulations for exhaust emissions are specific to each country. So the rules in force in the country in question must be observed.

Example of regulations in force in France:
Engine with thermal power consumption of over 2000 kW.
Order of 25/07/97 section 29.10 modified by the order of 15/08/00.

✓ Fuel engine
Values expressed in mg/nm$^3$ at 5% dry O2

| | CO | NOx | Unburnt hydrocarbons | SO2 | Dust |
|---|---|---|---|---|---|
| Back-up | X | X | X | 320* | X |
| Production < 500 h | 650 | 2000 | 150 | 320* | 100 |
| Production > 500 h | 650 | t>1200 rpm: 1500<br>t<1200 rpm: 1900 | 150 | 320* | 100 |

*(160 from 2008)

✓ Gas engine
Values expressed in mg/nm$^3$ at 5% dry O2

| | CO | NOx | Unburnt hydrocarbons | SO2 | Dust |
|---|---|---|---|---|---|
| Back-up | X | X | X | 30 | X |
| Production < 500 h | 650 | 500 | 150 | 30 | 50 |
| Production > 500 h | 650 | 350 | 150 | 30 | 50 |

## 7. Electrical connection

### 7.1. Connection

a) Connections - general information

As with low voltage electrical installations, use and maintenance is governed by standard NFC 15.100 (France) or by the standards in the relevant country, based on international standard IEC 60364-6-61.

They must also adhere to the regulations in the NFC 15.401 application guide (France) or to the regulations and standards in the relevant country.

b) Power cables

These can be unipolar or multipolar according to the power of the generating set.

Power cables should preferably be installed in ducts or on a cable tray for this purpose.

The cable cross-section and number of cables should be determined according to the cable type and the current standards to be observed in the country of installation. The choice of conductors must comply with international standard IEC 30364-5-52.

**Three phase - Calculation hypothesis**

Fitting method = wiring in cable runs or non perforated trays.
Permissible voltage drop = 5%
Multiconductors or single conductor joined when precision 4X…(1)
Cable type PVC 70°C (e.g. H07RNF).
Ambient temperature = 30°C.

| Circuit breaker calibre (A) | Cable sizes | | |
|---|---|---|---|
| | 0 - 50m | 51 - 100m | 101 - 150m |
| | mm²/AWG | mm²/AWG | mm²/AWG |
| 10 | 1.5 / 14 | 2.5 / 12 | 4 / 10 |
| 16 | 2.5 / 12 | 4 / 10 | 6 / 9 |
| 20 | 2.5 / 12 | 4 / 10 | 6 / 9 |
| 25 | 4 / 10 | 6 / 9 | 10 / 7 |
| 32 | 6 / 9 | 6 / 9 | 10 / 7 |
| 40 | 10 / 7 | 10 / 7 | 16 / 5 |
| 50 | 10 / 7 | 10 / 7 | 16 / 5 |
| 63 | 16 / 5 | 16 / 5 | 25 / 3 |
| 80 | 25 / 3 | 25 / 3 | 35 / 2 |
| 100 | 35 / 2 | 35 / 2 | 4X(1X50) / 0 |
| 125 | (1) 4X(1X50) / 0 | 4X(1X50) / 0 | 4X(1X70) / 2/0 |
| 160 | (1) 4X(1X70) / 2/0 | 4X(1X70) / 2/0 | 4X(1X95) / 4/0 |
| 250 | (1) 4X(1X95) / 4/0 | 4X(1X150) / 2350MCM | 4X(1X150) / 2350MCM |
| 400 | (1) 4X(1X185) / 0400MCM | 4X(1X185) / 0400MCM | 4X(1X185) / 0400MCM |
| 630 | (1) 4X(2X1X150) / 2x 2350MCM | 4X(2X1X150) / 2x 2350MCM | 4X(2X1X150) / 2x 2350MCM |

**Single phase - Calculation hypothesis**

Fitting method = wiring in cable runs or non perforated trays.
Permissible voltage drop = 5%
Multiconductors.
Cable type PVC 70°C (e.g. H07RNF).
Ambient temperature = 30°C.

| Circuit breaker rating (A) | Cable sizes | | |
|---|---|---|---|
| | 0 - 50m | 51 - 100m | 101 - 150m |
| | mm²/AWG | mm²/AWG | mm²/AWG |
| 10 | 4 / 10 | 10 / 7 | 10 / 7 |
| 16 | 6 / 9 | 10 / 7 | 16 / 5 |
| 20 | 10 / 7 | 16 / 5 | 25 / 3 |
| 25 | 10 / 7 | 16 / 5 | 25 / 3 |
| 32 | 10 / 7 | 25 / 3 | 35 / 2 |
| 40 | 16 / 5 | 35 / 2 | 50 / 0 |
| 50 | 16 / 5 | 35 / 2 | 50 / 0 |
| 63 | 25 / 3 | 50 / 0 | 70 / 2/0 |
| 80 | 35 / 2 | 50 / 0 | 95 / 4/0 |
| 100 | 35 / 2 | 70 / 2/0 | 95 / 4/0 |
| 125 | 50 / 0 | 95 / 4/0 | 120 / 2250MCM |

c) Battery cables
Install the battery or batteries in the immediate vicinity of the electric starter motor. The cables will be connected directly from the battery terminals to the starter motor terminals.
The primary instruction to follow is to ensure that the polarities between the battery and starter motor match. Never reverse the positive and negative battery terminals when connecting them. This could cause severe damage to the electrical equipment.
The minimum cross-section of the cables will be 70 $mm^2$. It varies according to the power of the starter motor but also the distance between the batteries and the set (voltage drops on the line).

d) Safety guidelines
References: NFC 15-100:2002 (France) - IEC: 60364-5-54

In order to protect personnel against electric shocks, this generating set is equipped with a differential residual current protector "factory" set to trigger instantly, with a sensitivity of 30 mA.

| | |
|---|---|
|  <br>Important | Any modification to this setting could endanger personnel. Any modification would render the user liable, and must only be performed by qualified and authorised personnel.<br>When the generating set is disconnected from a facility after use, the master differential protector must be returned to its "factory" settings, and this must be checked by trained personnel. |

For effective protection against electric shocks, the generating set needs to be earthed. To do this, use a copper wire, with a minimum cross-section of 25 $mm^2$ for a stripped cable and 16 $mm^2$ for an insulated cable, connected to the generating set earth socket and a galvanised steel earthing rod embedded vertically into the ground.

The earthing rod resistance value should comply with the values shown in the table below.
Note: use the highest differential setting from the installation as a guideline.

The resistance value is calculated in the following way: $R = \frac{Ul}{I\,\Delta n}$

Maximum resistance value of the earth socket R (Ω) according to the differential unit operational current (operation time should not be longer than 1 second).

| I Δn differential | Earth R (Ω) Ul: 50 V | Earth R (Ω) Ul: 25 V |
|---|---|---|
| ≤ 30 mA | 500 | > 500 |
| 100 mA | 500 | 250 |
| 300 mA | 167 | 83 |
| 500 mA | 100 | 50 |
| 1A | 50 | 25 |
| 3A | 17 | 8 |
| 5A | 10 | 5 |
| 10A | 5 | 2.5 |

The Ul value: 25 V is required for work site installations, and livestock buildings, etc.

For a default voltage of 25 V and a default current of 30 mA, this rod must be of a minimum length of: see table below

| Nature of ground | Length of rod in metres | |
|---|---|---|
| Thick arable land, moist compact ballast | 1 | |
| Lean arable land, Gravel, coarse ballast | 1 | |
| Bare stony soils, dry sand, impermeable rock | 3.6 | To obtain an equivalent length, you can use several earthing rods connected in parallel and set apart by at least their length.<br>Example: 4 interconnected 1 metre rods separated by 1 metre. |

Note: For the United States (National Electrical Code reference NFPA-70).
The generating set must be earthed. To do this, use a copper wire with a minimum cross-section of 13.3 mm² (or AWG 6, at most) connected to the generating set earth socket and a galvanised steel earthing rod fully embedded into the ground vertically.
This earthing rod embedded fully in the ground must have a minimum length of 2.5 m.

## 7.2. Neutral system

### 7.2.1 General information

The **Earthing system**, or **SLT** (formerly **Neutral system**) of the electrical facility defines the situation of the generating set neutral in relation to earth and the grounds of the electrical facility at the user end.

The purpose of the earthing systems is to protect personnel and equipment by managing risks posed by insulation defects. For safety reasons, any live conducting part of a facility must be insulated from the earth. This insulation may be achieved by distance, or by using insulating materials. But with time, insulation may deteriorate (due to vibrations, mechanical impacts, dust, etc.), and therefore generate an earth with dangerous potential. This defect poses risks for personnel and property, but also continuity of service.

Earthing systems are codified by two letters that define the connections:

✓ The first letter defines the neutral connection:

| | |
|---|---|
| I | Insulated or earthed via an impedance device |
| T | Connected to earth |

✓ The second letter defines the grounding situation of the electrical facility:

| | |
|---|---|
| T | Connected to earth |
| N | Connected to neutral |

E.g.: IT = Isolated Neutral + Ground earthed

| Speed | | Number of conductors | Detection | Note |
|---|---|---|---|---|
| TT | | 4 poles | Measurement of residual current | Triggering of 1st fault by RCD |
| TN | C | 3 poles | No measurement of residual current | Triggered by overcurrent protection upon 1st fault |
| | S | 4 poles | | |
| IT | SN | 3 poles | Insulation resistance measurement | Triggered upon 2nd fault by overcurrent protection |

### 7.2.2 TT system

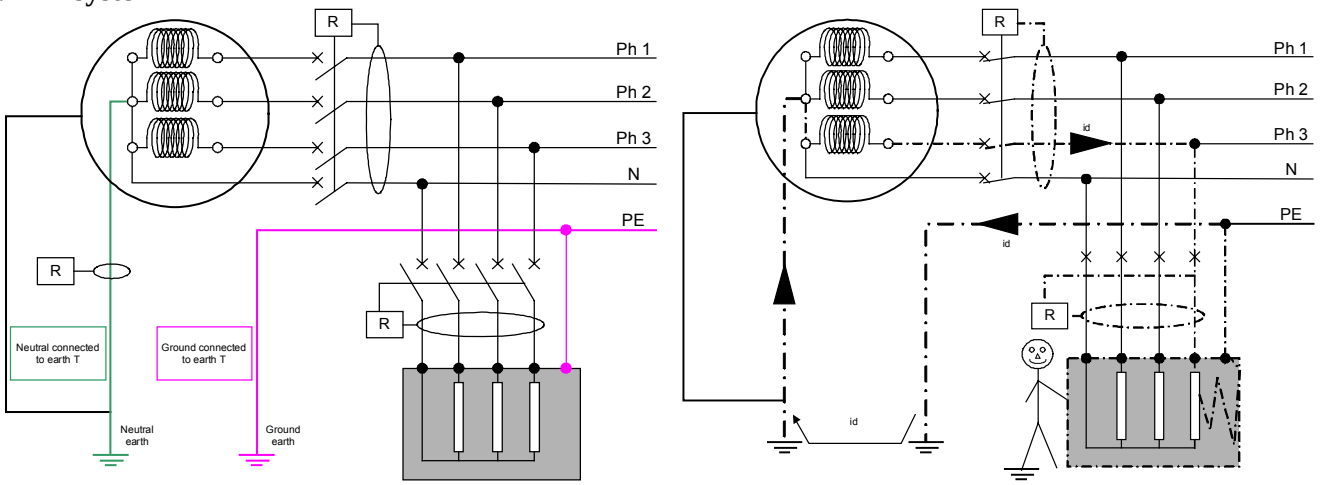



**Figure 7.1**: TT neutral system.

The alternator neutral is earthed, and the grounds of the user equipment have their own earth connection.

This earthing system is the most frequent in the private sector in France.
In the TT system, automatic power cut-off via a Residual Current Device (RCD) is obligatory at the upstream part of the facility, to ensure protection of personnel (with a maximum 30 mA device on outlet circuits).

### 7.2.3 TNS system

In the TN system, the alternator neutral is earthed and the user grounds are connected to the main protective conductor (PE), itself connected to the earth socket.

✓ TN-S (earth and neutral separated).

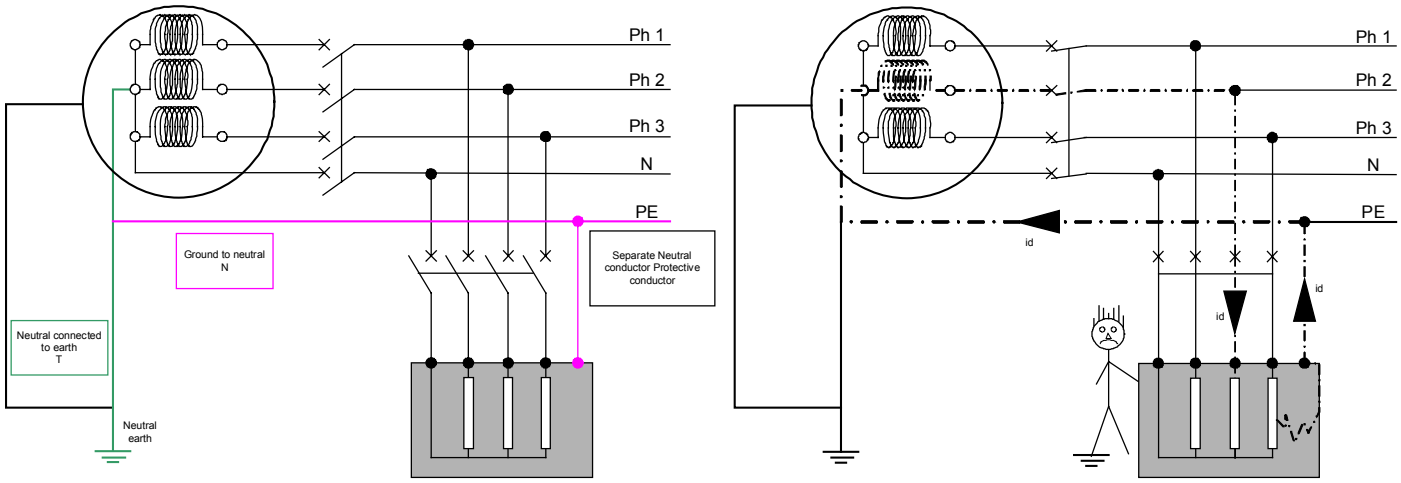



**Figure 7.2**: TNS neutral system.

In the TN-S system, the power supply is automatically cut by the opening of the over-current protection circuit breaker protecting the faulty circuit.

✓ TN-S is obligatory for networks with conductors of cross-section ≤ 16mm$^2$, Aluminium.

### 7.2.4 IT system

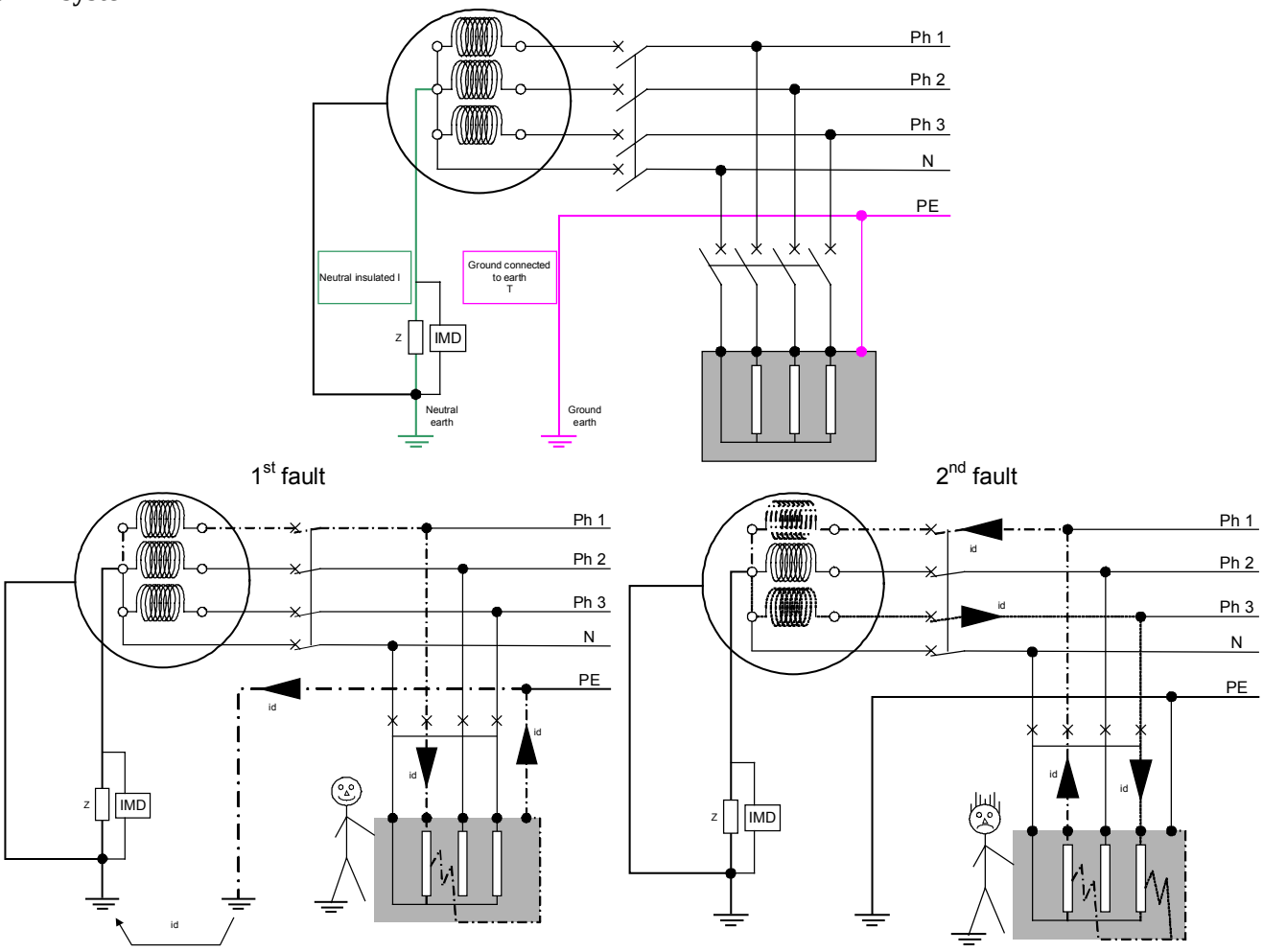



**Figure 7.3**: Neutral system IT.

In the IT earthing system, the alternator's neutral is earthed via an impedance device (Z) greater than 1000 Ohms, or insulated (Z=∞). The facility's grounds are earthed (see diagram above). It should be noted that an IMD (Insulation Monitoring Device) is connected in parallel to this impedance device Z to monitor the circuit's insulation at all times.

Upon a first fault nothing happens; the current flowing through the metal frame passes through the neutral impedance device Z, which means a very low current (or practically zero if neutral is insulated), so the contact voltage is not dangerous. That is why hospitals, concert halls, etc. use this system to avoid outages in the case of a first fault. The IMD (Insulation Monitoring Device) detects this leak and reports it via an indicator light and/or an alarm.

However upon a second fault both conductors concerned by insulation faults are interconnected, leading to a short-circuit. The power supply is automatically cut by the opening of the over-current protection circuit breaker, as in the TN system. It should be noted that the IT neutral system must not be used if you do not have a technician on call 24/7.

For the IT neutral system, in the case of a 20 kV/400V step-down transformer, it is necessary to provide overvoltage protection for the 400V network. This protection must be mounted between earth and the neutral point, if available, or a phase if not available.

For an LV generating set with IT system, this protection is not necessary, as the voltage cannot be over 500V.

The network's insulation voltage must be the value of the phase-phase voltage.

## 7.3. Overvoltage

Generating sets are not fitted with protection against power surges caused by drops in atmospheric pressure or manoeuvring.
The company does not accept any responsibility regarding damage caused by these occurrences.
However, lightning conductors can be installed, on the understanding that this does not give total protection.

## 8. Preparation before starting

| | |
|---|---|
|  Warning | The inspections referred to in this section enable the electrical generating set to operate.<br>Specific skills are required to carry out these operations.<br>They must only be entrusted to personnel with the necessary skills.<br>**Failure to follow these instructions in any way could lead to incidents or very serious accidents.** |

| | |
|---|---|
|  Important | For generating sets fitted with 4000 series MTU engines: it is essential to remove the flywheel locking device (crankshaft protection during transportation) when commissioning the generating set (**before first start-up**). |

### 8.1. Installation checks

- ✓ Check that the general recommendations from section 6 "Installation" (ventilation, exhaust, fluids, etc.) are followed.
- ✓ Carry out level checks (oil, coolant, diesel, battery).
- ✓ Ensure that the generating set earth socket is earthed.

### 8.2. Connection checks

- ✓ Check the remote controls by section and number (sector, auxiliaries, LVCCP, etc.).
- ✓ Power up the auxiliaries to check the following components (non-exhaustive list):
  - o Fuel pump (consumption and direction of rotation).
  - o Water preheating (amperage and voltage).
  - o Battery charger.
  - o Etc.
- ✓ For generating set fitted with connectors for supply from an external tank, monitor the first complete filling cycle after connecting to make sure that anti-overflow mechanism is working properly.

### 8.3. Operations before start-up

- ✓ Carry out the safety checks (emergency shutdown, oil pressure, coolant temperature, etc.).
- ✓ Open the oil make up tap (if fitted).

## 9. Checking after start-up

- ✓ Mechanical checks (oil pressure, coolant temperature, absence of noise, etc.).
- ✓ Rotary field check.
- ✓ Voltage, frequency and amperage check.
- ✓ Check on Normal/Emergency Inverter switching or coupling (if fitted).

## 10. Maintenance

### 10.1. Maintenance plans

The user should continuously check that the installation is in good working condition. The maintenance operations outlined in the documentation supplied with the generating set must be also carried out.
In addition, regular checks and tests are recommended as these will ensure the correct operation of the installation.
The regular checks and tests may require the test report to be filled in, including the following information: interval, nature of the inspection and/or test performed, date and time carried out, report of operations, name and signature of technician.

The maintenance plans (periodic maintenance tables) are outlined in the respective documentation (maintenance manual) for the engines, alternators and for some accessories. As a general rule, these plans make a distinction between use under continuous operation and use under emergency operation.
They also take the consumables used into account, for example: the sulphur content of the diesel or the grade of lubricant oil.
These maintenance plans must be referred to as soon as the generating set is received so that, taking the aforementioned elements into account, the service intervals to be adopted can be defined.

In addition to the maintenance plans mentioned above, it is also recommended that the following checks are carried out (the checks must be carried out by specialist personnel):

- ✓ Mechanical:
  - o Mechanical checks (mechanical adjustments, belt tension, etc.).
  - o Check of the cooling equipment.
  - o Check of the equipment mountings (correctly tightened), retightening of the bolts.
- ✓ Electrical:
  - o Electrical checks, check of the automatic and safety functions.
  - o Check of the electrical regulation devices.
  - o Check of the alternator insulation.
  - o Retightening of the alternator bus bars.
  - o Check of the auxiliaries insulation and their current consumption.
  - o Check of the starter battery charge system.
  - o Check of the batteries.

These checks must be carried at the following recommended intervals (or in accordance with the manufacturer's instructions):

- ✓ Operation of the generating set in emergency (≤ 100 hours per year): once per year.
- ✓ Operation of the generating set in emergency (≤ 500 hours per year): 3 times per year.
- ✓ Continuous operation of the generating set:
  - o Mechanical checks: during oil changes.
  - o Electrical checks: every 6 months.

## 10.2. Enclosure sealing

A seal is used between the cover and the chassis, and between the chassis and the retention cover to ensure leaktightness. This seal must always be replaced whenever the cover is removed.

## 10.3. Container servicing

- ✓ Lubricate the hinges and locks regularly.
- ✓ Lubricate the joints with silicone grease.
- ✓ Wash and clean the bodywork using products designed for car bodywork.
- ✓ Check the condition of the bodywork and retouch any scratches straight away (to prevent the start of corrosion).

## 10.4. Operation

Notes on operation at no load and under load:

When operating at no load or low load (< 30% of nominal power), the operating conditions do not allow optimum running of the engine. The main causes are as follows:

- ✓ The low volume of fuel burned in the combustion chamber leads to incomplete combustion; the resulting thermal energy means that the optimum engine operating temperature cannot be reached.
- ✓ Overheated engines have lower compression ratios (low compression ratio without turbocharging), which are defined for full load and not suitable for good combustion at low load.

All of these factors lead to choking of the engine, in particular the piston rings and valves, which leads to:

- ✓ Accelerated wear and glazing of the cylinder liners.
- ✓ Loss of sealing of seats, and sometimes sticking of valve stems.

Consequently, operating any turbocharged engine at low load (< 30%) can only have adverse repercussions on an engine's operation and its service life. Maintenance intervals will have to be shortened to accompany harsh operating conditions. Shortening draining intervals, among other things, will enable you to change the oil more frequently, which will tend to be choked with unburnt particles and contaminated with fuel. Adding a load bench is generally used to limit low load phases, and obtain the periodic full loads necessary to unchoke the engine.

Finally, when operating under load, we advise vigilance towards the oil breather circuit, and more particularly towards engines which have the crankcase vent connected to the turbocharger inlet (risk of oil or oil vapour absorption and accelerated engine speed).

On load tests:

It is recommended to conduct an on load test on the generating set monthly, for a period of around 1 hour after stabilisation of the parameters.

The load must be greater than 50% of nominal power (ideally 80%), to ensure unchoking of the engine and to obtain a decent picture of the generating set operation.

Off load test (no load):

This test is not recommended; it must not exceed 10 minutes, and must not be repeated without a monthly on load test. This test only allows you to check for correct engine start-up. It does not allow you to check that the generating set is working properly.

## 11. Storage/Removal from storage

A generating set which is left unused may have a damaging effect on the engine and alternator. To reduce these effects, it is advisable to prepare and store the generating set correctly.

**Storing the engine:**
To preserve the engine, it must be cleaned and all the fluids replaced by protective fluids or fresh fluids.
For details of storage or removal from storage, refer to the manufacturer's documentation.

**Storing the alternator:**
When storing an alternator, moisture tends to condense on the coils. To reduce this condensation to a minimum, it is advisable to store the alternator in a dry place. Use of independent radiators is advised to keep the coils dry.
For details of storage or removal from storage, refer to the manufacturer's documentation.

**Storing batteries:**
See section 13.5.2. "Storage and transport" of batteries.

## 12. Fuel and consumables

All the specifications (product characteristics) and capacities are given in the engine and alternator maintenance manuals appended to this manual.
In addition, we recommend the consumables to be used in the "Specifications" section.

### 12.1. Specifications

#### 12.1.1 Oil grades

| Engine | | | |
|---|---|---|---|
| Make | Type | Make | Type |
| Cummins | All | GenPARTS | GENLUB TDX 15W40 |
| John Deere | All | John Deere | John Deere PLUS-50 |
| | | GenPARTS | GENLUB TDX 15W40 |
| MTU | 396 / 2000 / 4000 | GenPARTS | GENLUB TDX 15W40 |
| | 183 | GenPARTS | GENLUB TDX 15W40 |
| Mitsubishi | All | GenPARTS | GENLUB TDX 15W40 |
| Perkins | Fuel | GenPARTS | GENLUB TDX 15W40 |
| | Gas | MOBIL | PEGASUS 705 |
| Volvo | All | GenPARTS | GENLUB TDX 15W40 |
| Doosan | All | GenPARTS | GENLUB TDX 15W40 |

**GENLUB TDX 15W-40**
Top-of-the-range lubricant recommended for diesel engines: for generating sets under harsh service conditions.

**USES:**

- ✓ Particularly suited to the most modern engines, whether or not they are equipped with turbochargers, *intercoolers* or sophisticated injection systems (***HEUI*****,** unit injectors...)
- ✓ **All service types**: satisfies the most demanding applications
- ✓ **Clean engines:** compliant with EURO 2 and EURO 3 technologies and usable with all types of diesel fuel, especially eco-friendly diesel fuels with low sulphur content.

**PERFORMANCE:**

**ACEA E3**
**API CH-4**

- ✓ Meets level E3 of the specifications defined by European manufacturers in edition 98 of the ACEA standards.

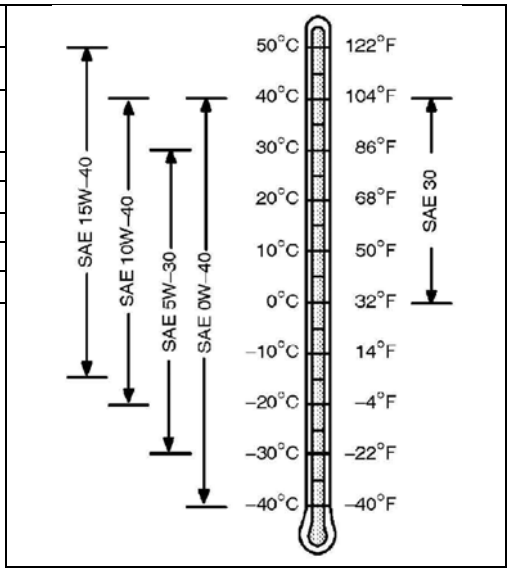
**ADVANTAGES:**

- ✓ **Long oil change intervals**: thousands of hours' on-site service in varied applications have confirmed the high quality properties of this product.
- ✓ **Compliance with new environmental legislation**: contributes to observance of anti-pollution stipulated for new EURO 2 and EURO 3 engines.

**CHARACTERISTICS:**

| SAE grade | 15W-40 | |
|---|---|---|
| Density at 15°C | 0.883 | |
| Kinematic viscosity at 40°C Kinematic viscosity at 100°C | 105<br>14.1 | mm2/s (cSt)<br>mm2/s (cSt) |
| Viscosity index | 140 | |
| Dynamic viscosity at -15°C | 3000 | mPa.s(cP) |
| Pour point | - 30 | °C |
| Flash point | 220 | °C |
| Sulphate ash content | 1.4 | % weight |

(Standard values given as a guide)




## 12.1.2 Specifications of cooling oils

| Engine | | | |
|---|---|---|---|
| Make | Type | Make | Type |
| Cummins | All | GenPARTS | GENCOOL PC -26°C |
| John Deere | All | GenPARTS | GENCOOL PC -26°C |
| MTU | All | GenPARTS | GENCOOL PC -26°C |
| Mitsubishi | All | Mitsubishi | LLC |
| | | GenPARTS | GENCOOL PC -26°C |
| Perkins | All | GenPARTS | GENCOOL PC -26°C |
| Volvo | All | GenPARTS | GENCOOL PC -26°C |
| Doosan | All | GenPARTS | GENCOOL PC -26°C |

**GenCOOL PC -26**
High-protection coolant, approved by manufacturers.
**GenCOOL PC -26** is a ready-to-use high-protection coolant, produced from an antifreeze approved by most European manufacturers.

- ✓ It is based on antifreeze and G 48 inhibitors.
- ✓ Freezing protection to -26°C.
- ✓ Free from nitrites, amines, phosphates.
- ✓ Limpid fluorescent orange liquid.

**REFERENCES/APPROVALS (of the basic antifreeze):**

| HEAVY GOODS VEHICLES | LIGHT VEHICLES |
|---|---|
| Approved by MTU, MERCEDES BENZ, MAN, KHD, GENERAL MOTORS<br><br>Compliant with VOLVO, IVECO, VAN HOOL and STAYR TRUCK specifications | Approved by BMW, VOLKSWAGEN, MERCEDES, PORSCHE<br><br>Compliant with specifications of: VOLVO, OPEL, SEAT and SKODA |

**Compliant with standard NF R 15.601**

**REINFORCED ANTI-CORROSION:**

- ✓ Protects **against hot corrosion** via oxidation of ethylene (cylinder head protection).
- ✓ Protects **against hot cavitation** (protection for the cylinder and water pump).
- ✓ Not corrosive for seals and hoses.
- ✓ Improved **efficiency and service life of cooling system.**
- ✓ **GenCOOL PC -26** is particularly recommended for engines fitted with aluminium or light alloy radiators.

## HIGH TEMPERATURE SPECIAL:

- ✓ Promotes heat exchange.
- ✓ Perfect stability at high temperature.
- ✓ **GenCOOL PC -26** is especially suited to engines with high power density.

## LONG LASTING PROTECTION:

- ✓ High alkaline reserve/stability and service life of corrosion inhibitors.
  - o Retains its technical properties in prolonged use at high temperature (neutralisation of acidic substances).
- ✓ Ensures maximum heat transfer without formation of deposits in the cooling circuit.
- ✓ **GenCOOL PC -26** ensures optimum protection against overheating and corrosion in extreme conditions of vehicle use.

## PACKAGING/STORAGE:

- ✓ **GenCOOL PC -26** is delivered in 210 l metal drums, with varnished interior.
- ✓ It can be kept in stock for 2 years in its original packaging.
- ✓ Avoid zinc-coated metal containers.

## ADVICE FOR USE:

- ✓ Compatible with the original fluid.
- ✓ It is advisable to completely drain the cooling circuit when replacing the liquid.

| SPECIFICATIONS | UNITS | SPECIFICATIONS | TEST METHODS |
|---|---|---|---|
| **Density at 20°C** | kg/m$^3$ | **1 059 +/- 3** | R 15-602-1 |
| **pH** | pH | **7.5 to 8.5** | NF T 78-103 |
| **Alkalinity reserve** | ml | **>=10** | NF T 78-101 |
| **Boiling point** | °C | **105 +/- 2** | R 15-602-4 |
| **Freezing point:** | °C | **-26 +/- 2** | NF T 78-102 |
| **Glassware Corrosion**: (test on basic antifreeze) | mg/specimen | | R 15-602-7 |
| - Copper | | **+/- 2.6** | |
| - Weld | | **+/- 0.5** | |
| - Brass | | **+/- 2.3** | |
| - Steel | | **+/- 1.6** | |
| - Cast iron | | **+/- 0.8** | |
| - Cast aluminium | | **+/- 1.0** | |
| **Hot Plate Corrosion** (test on basic antifreeze) | mg/(cm² week) | **+/- 0.17** | R 15-602-8 |

# 13. Additional equipment

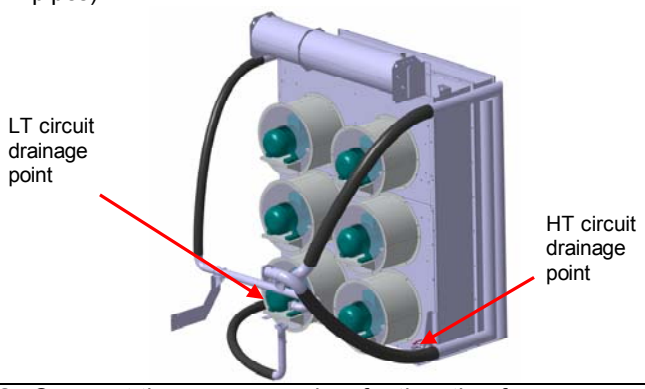
## 13.1. Air coolers

| | |
|---|---|
| Warning | Before any operation, check that the device is switched off.<br>Ensure that the power supply has been made safe.<br>**For an operation on the harness, lower the temperature and the pressure.**<br>Operations should only be carried out by qualified personnel. |

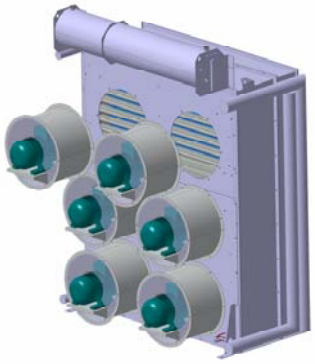
The cleanliness of the device is a factor which will determine its performance and length of service life. Regularly check that the harness fins are not clogged and clean as often as local conditions require.
As the engines are fitted with an oil vapour recirculation system, the harness should not get greasy. As a general rule, using compressed air directed parallel to the fins should be sufficient to clean the harness.
In all cases, cleaning should be undertaken with care to ensure the surface of the fins is not damaged.

| | |
|---|---|
| Important | The operating procedure described below is a theoretical operating procedure.<br>It will have to be adapted to the installation which is actually fitted. If in any doubt, please refer to a specialist. |

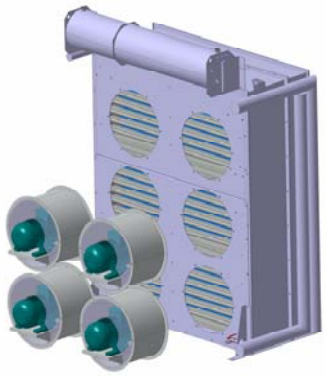
❶ Drain the high temperature (HT) and low temperature (LT) cooling circuits via tapping points in the lower section of the air cooler (drain lobe and vents provided on the manifolds or pipes).



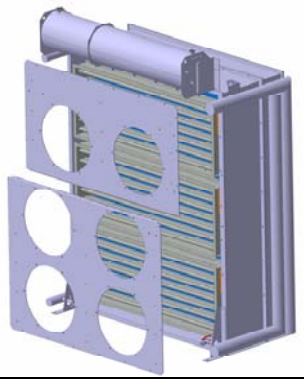

❷ Remove the engine connection hoses.
❸ Disconnect the wiring on all the extractor fans (after making the power supply safe), and then remove the fans, starting at the top of the air cooler.



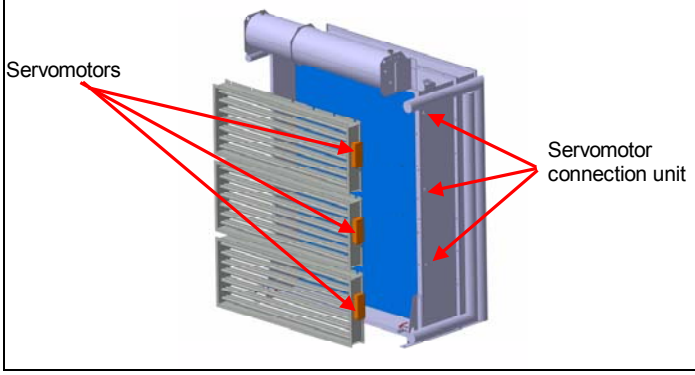
❹ Carry out the same procedure for the other fans.



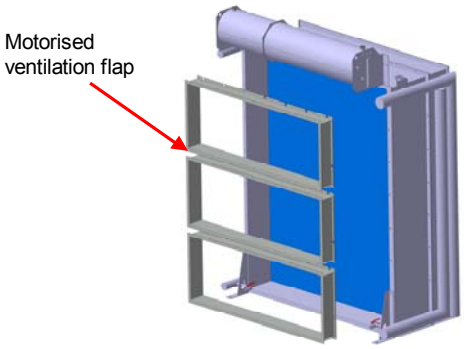
❺ Remove the fan support panels.



❻ Disconnect the servomotors from the motorised ventilation flap.




❼ Remove the motorised flap to gain access to the harness.

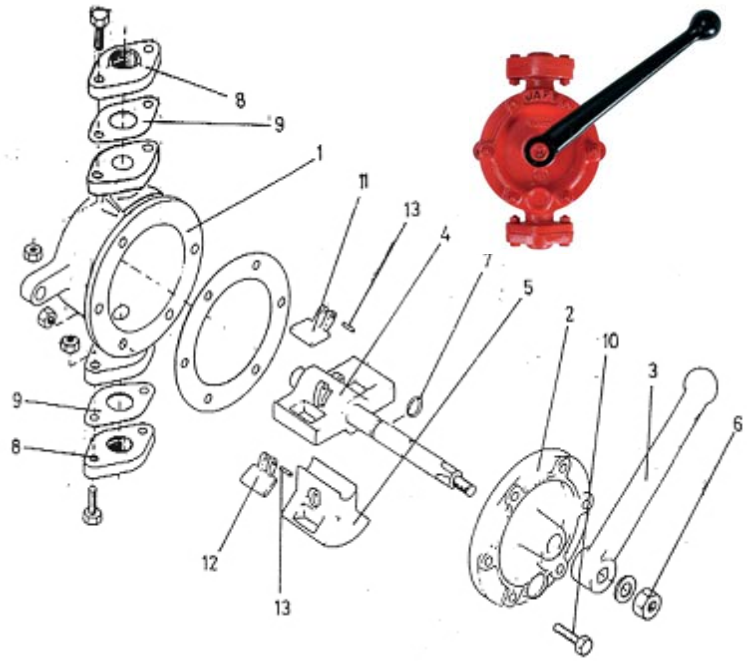



❽ Using an industrial vacuum cleaner, remove all foreign bodies that might obstruct the harness. Blow the harness with compressed air, if necessary.
❾ If there are any traces of grease, use commercial solvents to clean the harness.
❿ Refit the components in the reverse order to removal, then close the circuits and fill the harness with antifreeze coolant.

## 13.2. Japy pumps for clear fluids

### 13.2.1 Technical specifications

| Type | Use | Composition |
|---|---|---|
| EZ 254 | Diesel and petrol | Base block<br>Zamak piston, seat and valves<br>Steel shaft – against mounting clamps and lugs<br>O ring |
| HT 254 | Hydrocarbons<br>Max viscosity 300 cst | Base block<br>Brass piston, seat and valves<br>Steel shaft– against mounting clamps and lugs<br>O ring |




1 Pump body.
2 Cover.
3 Lever.
4 Piston.
5 Seat.
6 Lever nut.
7 O ring
8 Suction or discharge clamp.
9 Clamp joint.
10 Screw with nut for cover or bracket.
11 Piston valve.
12 Seat valve.
13 Valve split pin.

**Figure 13.1**: Pump components

### 13.2.2 Description

Suction:
Suction capacity is completely independent of the size of the pump.
These pumps may have a negative pressure suction head of up to 7 m to 7.50 m with cold water at sea level.
The suction pipes should always be positioned on an upwards slope from the fluid suction point to the pump installation point, with no top section and as few bends as possible; any bends needed must have a large radius.
For any suction over 2 metres, a foot valve must be installed (suction valve) to hold the fluid in the pipe. The pipe must not have any cracks or leaks.
The suction "pressure height" should not be confused with the vertical distance of the expanse of water to the pump.
Losses of pressure are inevitable and are related to:
- ✓ The length and diameter of the pipe used according to the flowrate.
- ✓ The presence of a non-return valve or elbows in this pipe.

A non-return valve or elbow causes a loss of pressure equivalent to 5 metres of straight pipes.
Above a certain length of pipework or suction height (or discharge height), a larger diameter pipe than usual should be used.

Discharge:
Pumps tested to a pressure of 1.5 kg to 2 kg may therefore be deployed for a discharge of 15 m. However, the force to be generated by the person operating the pump will increase with flowrate and elevation head (suction + discharge). Therefore with a low flow, the fluid can be raised higher than with a large flow pump.

Draining:
It is essential to fit a small tap or screw on the suction pipe, about 0.70 m below the pump.

Fitting:
The pump should be installed on a strictly vertical plane, with the Japy logo on the discharge side. Check that the mounting has a flat surface and that the nuts are tightened moderately and alternately to prevent distortion of the body.

### 13.2.3 Maintenance and repair

Faults:

The pump no longer sucks or discharges.
- ✓ There is air intake - check all the seals and the suction pipes.
- ✓ The foot valve (suction valve) no longer works, there is probably dirt or some waste under the valve that it stopping it from resting on its seat, check it.
- ✓ There is dirt inside the pump blocking the valves; remove the cover, clean inside and check that the valves move freely.

Cable gland leak:
- ✓ Tighten the two cable gland bracket nuts alternately by one or two turns. Otherwise, remove this bracket, take out the cable gland which is located in its housing. Clean this housing and remove the residual lining. Replace it with graphite braiding.
- ✓ If it is a pump without cable gland, model 254, remove the cover, replace the O-ring checking that the piston axis is not oxidised. If it is, clean it carefully. Also reline the groove with graphite braiding.

Frost:
The draining bolt is inefficient, and the Japy pump has not been supplied by it for a long time except for special requests using the control. On the other hand, it is indispensable if the pump is exposed to frost to use a small draining tap on the suction pipes about 0.75m above the pump. In any case, the pipes must be fitted with a foot valve. This device is necessary for draining the pump.
If there is a threat of frost, do not forget to open this tap while checking that the discharge port is free to let air in.
Draining should take place normally, but for increased safety, after the water has flowed out pull the lever two or three times to complete the draining.
If the body or cover is cracked by frost, do not try to repair it by autogenous welding as this would distort the part

Extended lack of use:
If the pump is not used for a while, it is recommended:
- ✓ If frost is not likely, to check that the pump chamber is always full of pumped fluid.
- ✓ If frost is likely, to:
  - o Drain and, if possible, pull the lever a few times to prevent the internal components from becoming blocked by oxidation, if not:
  - o Drain and add liquid paraffin, by spraying if possible, to prevent oxidation and the internal components from becoming blocked.

In the event of oxidation and blocking, never force the lever as this risks breaking the piston. Remove the cover, carefully clean the inside of the pump with an oiled cloth but never with abrasive material. Lightly oil before refitting.
The Japy pump does not normally require any lubrication.
After several years of service or after use for water or fluids that are full of impurities or slightly acidic, it becomes necessary to replace the main internal components. This procedure must be carried out by a mechanic.

In general, when pistons and seats need to be replaced we recommend a standard replacement pump.
To remove the lid and to check inside, begin by unscrewing the 6 bolts that attach the lid to the chamber . Then, to undo the lid, hit it preferably with a piece of wood, alternately on the discharge and suction manifolds, while keeping the other hand on the piston rod and the valve gland clamp. Do not carry out these removal procedures often.
Before refitting, carefully clean the whole of the inside with a cloth, lightly lubricate the internal parts of the chamber with liquid paraffin, put the piston back in place by pushing down slowly with a semicircular motion.
Check that the suction seat is held in place and that the felt pad is properly positioned.
Put the bolts back in position, retighten the blocks moderately and alternately until the cover is locked down.

## 13.3. Japy pump kit

### 13.3.1 Technical data

- ✓ Max flowrate: 37 L/min
- ✓ Max pressure: 2.2 bar (with coolant)
- ✓ Rotation speed: 2800 rpm
- ✓ Max suction head: 6 m
- ✓ Fitted with a bypass
- ✓ Operation with discharge cut off 2 to 3 mins max
- ✓ IP 55 protection.

**Figure 13.2:** Japy JEV pump

### 13.3.2 Electrical data

- ✓ Power: 0.37 kW
- ✓ Engine made for continuous work

- ✓ JEV 10/658 single phase: 50 Hz 220V – 2.4 A – 240V – 2.1 A
- ✓ JEV 10/658 single phase: 60 Hz 208V – 3.7 A – 277V – 3.3 A

- ✓ JEV 11/661 three phase: 50 Hz 380V – 0.8 A – 415V – 1 A
- ✓ JEV 11/661 three phase: 50 Hz 200V – 1.5 A – 240V – 1.6 A

- ✓ JEV 11/661 three phase: 60 Hz 380V – 0.9 A – 480V – 1.4 A
- ✓ JEV 11/661 three phase: 60 Hz 208V – 1.8 A – 240V – 2 A

| | |
|---|---|
| ⚠<br>Danger | The engines are not flame proof.<br>**Do not use them in locations where there may be flammable vapours.** |

### 13.3.3 Suitable fluids

- ✓ Water, fuel, diesel & light oil.
- ✓ Maximum viscosity of 10 cst at atmospheric temperature.

### 13.3.4 Prohibited fluids

| Fluids | Corresponding dangers |
|---|---|
| Petrol | Fire, explosion |
| Flammable fluids with PM below 55 degrees C | Fire, explosion |
| Supply fluids | Pollution of the fluids |
| Corrosive chemical fluids | Pump corrosion |
| Solvents | Damage to linings and joints |

### 13.3.5 Maintenance

The pumps do not require any specific maintenance.
Possible checking for leaks at the joints.

### 13.3.6 Faults and repairs

| The engine does not work | |
|---|---|
| **Possible causes** | **Actions** |
| No electric current | Check the connections |
| Blocked rotor | Take apart the engine pump.<br>Look for a possible foreign body |
| **No flow or insufficient pressure** | |
| **Possible causes** | **Actions** |
| Suction height too high | Move the pump nearer to the fluid to be pumped |
| Blocked foot valve | Clean or replace |
| Blocked filter | Clean the filter |
| Considerable losses of pressure | Increase the diameter of the pipes |
| Blocked by-pass valve | Clean or replace |
| Air in the suction pipes | Check that they are sealed |
| Fluid leak | Check the pipe connections.<br>Replace the seals |

## 13.4. REN-RAB automatic oil auxiliary adjuster

### 13.4.1 Application

The REN regulator type RAB 101 -70 is an oil level regulator for all engine powers. It keeps the oil level in the crankcase correct. Set to "engine running" oil level, it regulates the level in line with consumption.

### 13.4.2 Composition

The majority of models are equipped with a low level threshold alarm or stop feature to warn operators of a low supply of oil, a drop in the oil level in the sump and possibly an overflow of oil.
A built-in oil level threshold triggers an alarm or stops the engine to warn the user of a low supply of oil. The engine still consumes oil.

**Figure 13.3**: General view of regulator

### 13.4.3 Operation

When the oil level falls in the sump, the float moves down and opens a valve.
When the valve opens, oil can flow from the tank into the sump via the regulator.
As the sump fills, the float moves up and eventually closes the valve when the required oil level is reached, preventing oil from flowing into the sump.
The valve is designed to be able to clean itself and consequently cannot become clogged.
A 3 mm hole in the regulator is wide enough to enable the sump to be filled effectively.

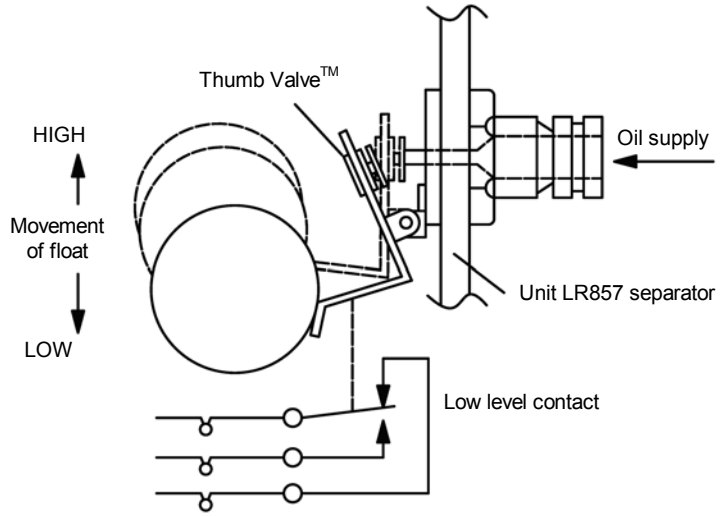



**Figure 13.4** : Simplified diagram of valve operation

### 13.4.4 Setting

After having fitted the unit as illustrated below, manually fill the engine to the "low" or "add" mark on the oil gauge, without starting the engine. Position the oil level regulator so that the oil level is in the centre of the front inspection window. Give the system some time to balance out the oil level between the regulator and the sump before the sump is finally fixed into position. This level depends on the level of use. Start the engine and wait a while for the regulator to replenish the measured oil circulating in the sump. When the engine is switched off, the return of oil from the engine causes the oil level to rise and this can be seen through the front inspection window on the regulator. This is normal and as soon as the engine is switched on again the oil level will return to the level required for use previously mentioned.

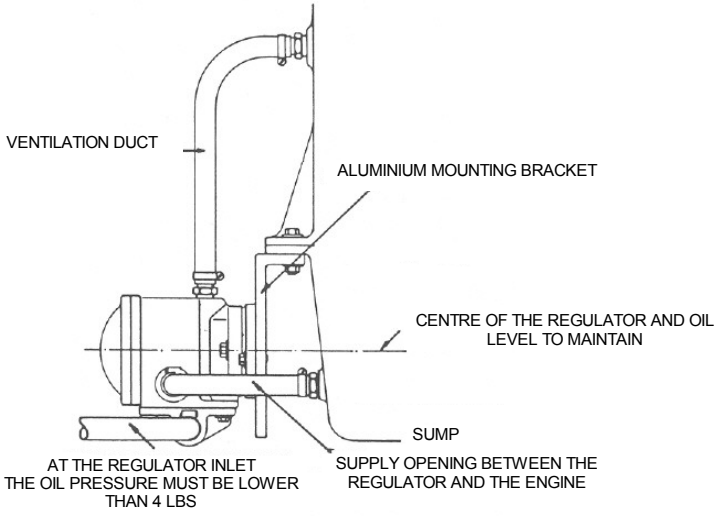



**Figure 13.5**: Oil make-up regulator

## 13.5. Battery maintenance

### 13.5.1 General information - Safety

| | |
|---|---|
|  | Fit the battery so that it is properly ventilated.<br>Maintenance should only be carried out by qualified personnel.<br>If replacing the batteries, use the same type of batteries. Do not throw the old battery in the fire.<br>Only use insulated tools (the operator should not be wearing a watch, chain or any metal object).<br>Never use sulphuric acid or acid water to top up the electrolyte level. Use an approved battery fluid.<br>Batteries release oxygen and hydrogen gas, which are flammable.<br>Never bring flames or sparks near the battery (risk of explosion).<br>Discharge any static electricity before handling the batteries by first touching an earthed metal surface.<br>Do not use the battery when the fluid level is below the minimum required level Using a battery with a low electrolyte level could result in an explosion.<br>Do not short the battery terminals with a tool or other metal object.<br>When disconnecting battery cables, remove the cable from the negative (-) terminal first. When reconnecting the battery, connect the positive lead (+) first.<br>Charge the battery in a well-ventilated place, with all the filler caps opened.<br>Ensure that the battery terminals are correctly tightened. A loose cable clamp can cause sparks that could result in an explosion. |
| **Danger** | Before servicing electrical components or performing electric welding, set the battery switch to the [OFF] position or disconnect the battery negative cable (-) to cut off the electrical current.<br>Electrolyte contains dilute sulphuric acid. Careless handling of the battery causing contact with sulphuric acid could damage your eyesight or cause burns.<br>Wear safety goggles and rubber gloves when working with the battery (topping-up fluid, charging, etc.)<br>If electrolyte comes into contact with your skin or clothes, wash it off immediately with plenty of water, then carefully wash the area with soap.<br>If electrolyte comes into contact with your eyes, rinse immediately with plenty of water and seek medical attention as soon as possible.<br>If electrolyte is accidentally swallowed, gargle with plenty of water and drink large quantities of water. Consult a doctor immediately.<br>Large quantities of electrolyte should be rinsed off using a neutralising agent. A common method is to use a solution of 500g of bicarbonate of soda diluted in 4 litres of water. The bicarbonate of soda solution should be added until the reaction has finished (lather). The remaining liquid should be rinsed off with water and left to dry. |

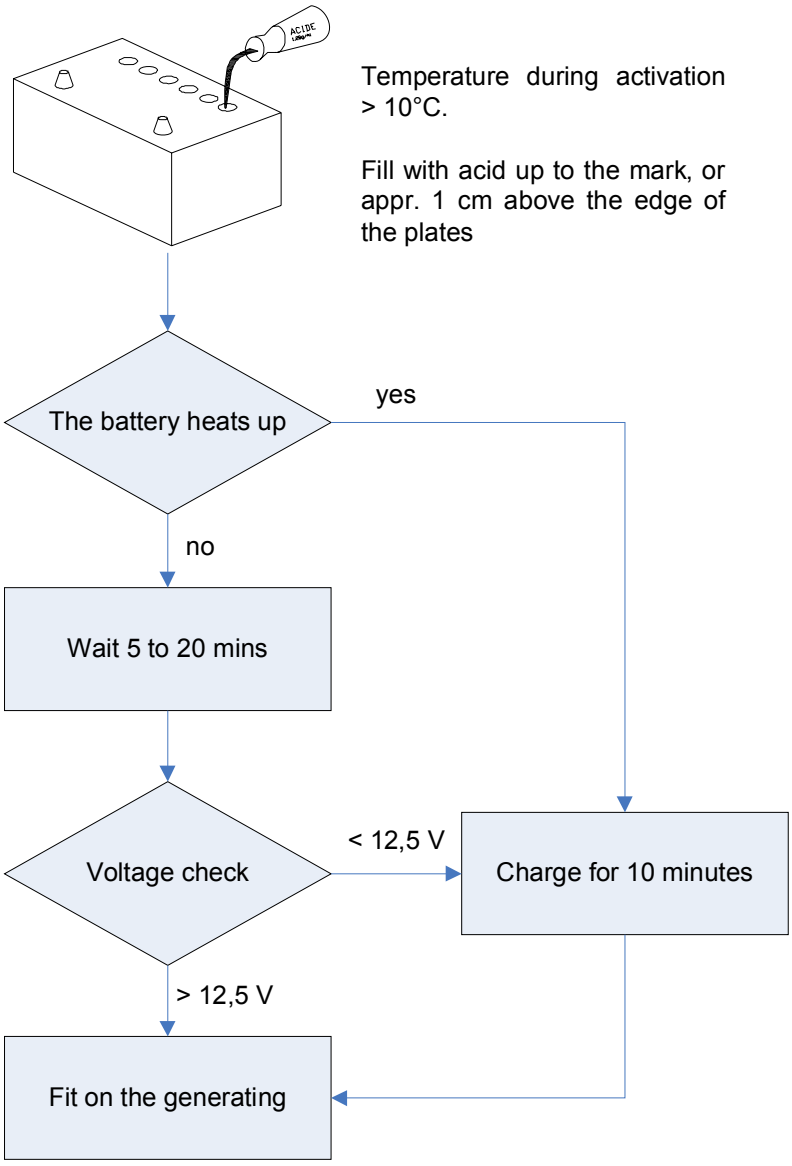
- ✓ Dry batteries do not require any servicing.
- ✓ Batteries ready for use must be recharged at the latest when the acid density drops below 1.20.

### 13.5.2 Storage and transport

- ✓ Batteries ready for use must be stored in a cool and dry place (frost-free) protected from the sun (self-discharge).
- ✓ Batteries must be transported and stored vertically (risk of acid spillage).
- ✓ Leave the terminal cover on the positive terminal.

### 13.5.3 Installation

- ✓ Batteries filled with acid have a density of 1.28 g/ml, and are charged.
- ✓ For dry batteries, fill each part of the battery with acid to the maximum level marker, or to 15 mm above the plates. Leave the battery to rest for 20 minutes.
- ✓ Before fitting the battery, switch off the engine and any current consumer; clean the terminals and coat them slightly with grease. When connecting, first connect the positive terminal (+) and then the negative terminal (-).




### 13.5.4 Check

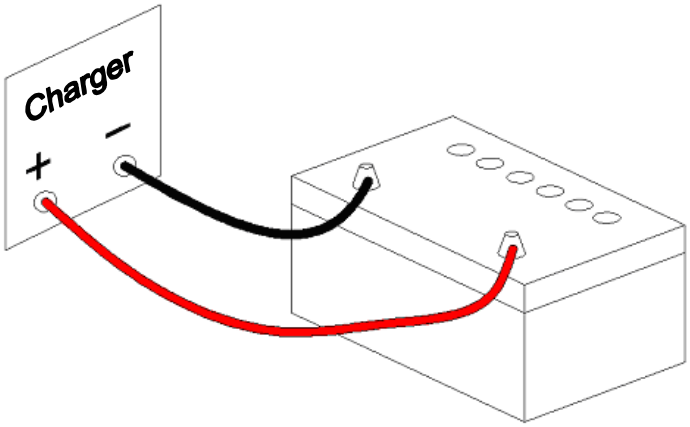
| Acid density | Charge status | Voltage when idle | |
|---|---|---|---|
| 1.27 | 100% | Above 12.60 V | |
| 1.25 | 80% | 12.54 V | |
| 1.20 | 60% | 12.36 V | **From 50 % recharge** |
| 1.19 | 40% | 12.18 V | **Risk of sulphation** |
| 1.13 | 20% | Under 11.88 V | **Unusable** |

### 13.5.5 Load preconization

✓ Highly discharged or sulphated batteries (formation of whitish lead sulphate deposit on the plates, which becomes hard and insoluble to acid; this deposit reduce the active surface of the plates, and increases their internal resistance) can no longer regenerate or be charged in a generating set.

| | |
|---|---|
| ⚠ Important | A discharged battery should be recharged immediately, or else it will suffer irreparable damage. |

Battery charge




When several batteries are connected together, the following points should be checked:
✓ Are the batteries connected in series?
✓ Has the correct voltage been chosen? 1 battery x 12 V , 3 x 36V batteries.
✓ Adjust the charge current to the lowest battery.
✓ The power difference between the batteries must be as low as possible.

Example of charge:
✓ 12V 60 Ah battery = charging current 6 A.
✓ Charge status: 50% (acid density 1.21/voltage when idle 12.30V).
✓ The battery is short 30 Ah, and this must be recharged.
✓ Charge factor: 1.2.
✓ Ah x 1.2 = 36 Ah to be charged.
✓ Charging current: 6A approximately 6 hours charging required.

Recharging is complete when the battery voltage and the acid density stop increasing.

→ The charging current must always be $1/10^{th}$ of the nominal capacity of the battery.

The power of the charger must be suitable for the battery to be charged and the charging time available.
You need to use an automatic charger able to provide a sufficient voltage and charging current, as well as a compensation voltage to handle spontaneous battery discharge.

### 13.5.6 Fault finding

| Fault observed | Probable origin | Measures or observations |
|---|---|---|
| The acid heats up when a new battery is filled | ✓ Incorrect composition<br>✓ Incorrect storage<br>✓ Prolonged storage in a damp place | ✓ Cool<br>✓ Charge<br>✓ Check the acid density |
| The acid escapes through the filler holes | ✓ Battery overflow during filling | ✓ Reduce the battery fluid level |
| Acid level too low | ✓ Battery tray not leaktight<br>✓ Significant gas formation caused by too high a charging voltage | ✓ Replace the battery<br>✓ Check the charger and repair if necessary. |
| Acid level too low<br>Incorrect operation from start-up | ✓ Insufficient charge<br>✓ Short circuit in the current circuit<br>✓ Consumption fault | ✓ Recharge<br>✓ Check the electrical installation |
| Acid density too high | ✓ The battery has been filled with acid instead of water | ✓ Reduce the acid level and fill with distilled water. Repeat the operation if need be. |
| Starting problems<br>Starting test incorrect | ✓ Battery empty<br>✓ Battery used up or faulty<br>✓ Capacity too low<br>✓ Battery sulphated | ✓ Recharge the battery<br>✓ Fit a new battery |
| Battery terminals melted | ✓ Incorrect electrical connection<br>✓ Incorrect battery wiring | ✓ Tighten the ends of the battery cables, or replace them if necessary |
| One or two cells release a lot of gas at high charge | ✓ Cell(s) faulty | ✓ Fit a new battery |
| The battery discharges very quickly | ✓ Charge status too low<br>✓ Short circuit in the current circuit<br>✓ High self-discharge (for example: through electrolyte contamination)<br>✓ Sulphation (storage of discharged battery) | ✓ Check the charge<br>✓ Replace the battery |
| Short service life | ✓ Incorrect battery part no.<br>✓ Too many repeated deep discharges<br>✓ Battery stored too long without charge | ✓ Define the correct battery part no. for the recommended use<br>✓ Think about charging the battery using a regulator |
| High water consumption | ✓ Overload<br>✓ Charging voltage too high | ✓ Check the charger (voltage regulator) |
| The battery explodes | ✓ Spark after battery charging<br>✓ Short circuit<br>✓ Connection or disconnection during charging<br>✓ Internal fault (for example: interruption) and low electrolyte level | ✓ Replace the battery (beware of fire and sparks)<br>✓ Ensure there is sufficient ventilation |

## 14. Glossary

| | |
|---|---|
| **AIPR** | Name given by SDMO to designate an electrical device (cabinet or box) housing the master circuit breaker (downstream of the power alternator) and the auxiliary outgoing terminals. The AIPR is generally mounted on the generating set base frame. It is used for housing circuit breakers of 800 A or more. |
| **Retention tank** | This is a vessel for collecting generating set leaks, to prevent them from polluting the environment. |
| **Welding seam** | This is a welding bead |
| **Box** | This is a common name given to an ISO container |
| **LT** | Low Voltage<br>Low voltage A: 50 V < LVA ≤ 500 V AC<br>Low voltage B: 500 V < LVB ≤ 1000 V AC |
| **IMD** | Insulation monitoring device |
| **CSC** | Container Safety Convention.<br>International convention governing container safety (or CSC convention), which was rendered in France by Decree no. 80-837 of 20 October 1980 and the orders issued for its application.<br>These orders define the process for obtaining CSC approval, and list the bodies authorised to issue this approval. This approval, which comes in the form of a standardised plate permanently fixed on each approved container, is obligatory for authorisation of shipping. The stacked load that the container can bear is indicated on this plate.<br>This approval is obtained by the manufacturer, for each container model, by submitting a technical file, subject to validation of standard tests by the approved body. |
| **RCD** | Residual Current Device |
| **Fuel tank filler** | This is the filling pipe for a fuel tank |
| **ERP** | Public Assembly Building |
| **Stacking** | This is the action of placing containers on top of each other |
| **HV** | High Voltage<br>High voltage A: 1000 V < HVA ≤ 50,000 V AC<br>High voltage B: 50,000 V < HVB AC |
| **Impedance** | Electrical impedance measures the opposition of an electrical circuit to passage of a sinusoidal alternating current.<br>The concept of impedance is a generalisation of Ohm's law in the study of alternating current circuits |
| **Forklift pockets** | These are the rectangular apertures in the lower part of a base frame where the forks are inserted to move the generating set. |
| **Exhaust head loss** | When a fluid is flowing in a pipe and energy is lost due to friction, we talk about head loss. |
| **DT** | Daily service tank |
| **Jockey wheel** | This is the wheel on the boom of a trailer. It may be swivelling and height adjustable. |
| **VLV** | Very Low Voltage<br>VLV ≤ 50 V AC<br>VLV ≤ 120 V AC |
| **LVCCP** | Low voltage central control panel.<br>This is a low voltage electric panel for large electrical facilities.<br>This panel forms the link between the supplier's incoming line and the customer network. |
| **Expansion bottle** | This is used for compensating for volume variations to which the mass of a fluid in the facility is subjected due to temperature fluctuations |