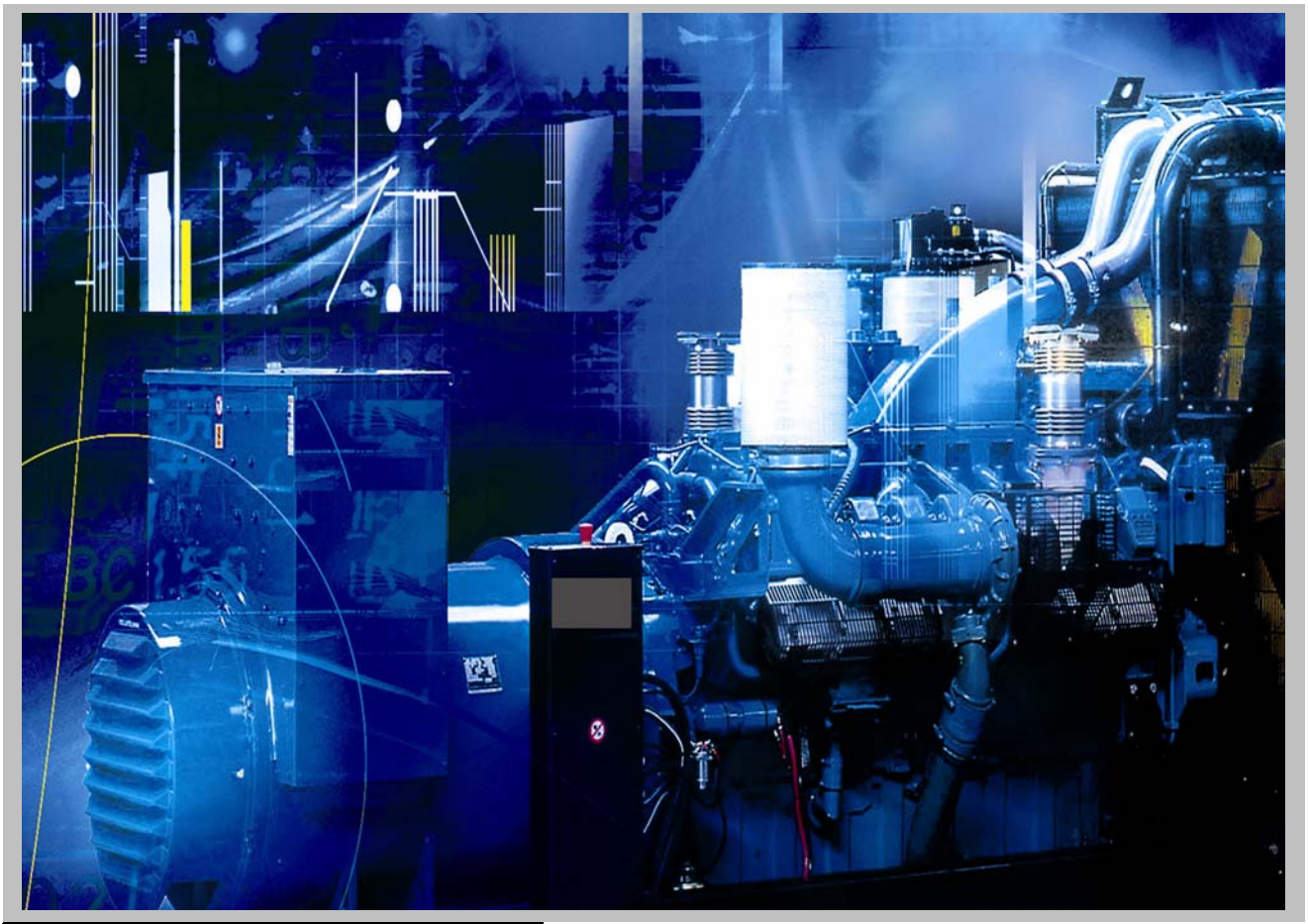
Users guide and maintenance manual for the generating sets

Model(s) : G22

Control device : Intellisys



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Réf. constructeur : 33501168001

Réf. GPAO : 33501168001NE

Revised (10-12)

Users guide and maintenance manual

All generating sets

General considerations

Safety instructions

Réf. constructeur : MUE-IR A	Réf. GPAO : 33522051901

Attached documents

User manual for the control unit
User and maintenance manual for the engine
User and maintenance manual and spare parts catalogue for the alternator
Wiring diagrams (supplied with the electrical generating set)
Genset parts catalog.

1. PREAMBLE

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.

Read the safety instructions carefully in order to prevent any accident, incident or damage. These instructions must always be followed.

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 adjustments and repairs are carried out by personnel who have received the appropriate training. The dealers are suitably qualified 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 all parts replacement, contact your nearest dealer representing our company who will have the necessary equipment and 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.

IMPORTANT
Some user manuals and maintenance manuals for the engines fitted to the electrical generator assemblies include information on the control units and detail the engine starting and stopping procedures.
As the electric generator assemblies are fitted with assembly-specific test and control panels, only the information in the documentation regarding the panels fitted to the assemblies should be taken into consideration.

1.1.2. Structure of the reference material

The reference material delivered with the generating sets enables you to get to know the equipment, operate it and maintain it, both on a daily basis and periodically.
The reference material for the engines and alternators fitted to the sets consists of engine user and maintenance manuals (from the manufacturer) and alternator user and maintenance manuals (from the manufacturer).

The reference material contains:

- the user and maintenance manual, containing among other things:
  - general recommendations and safety regulations to be adhered to
  - general recommendations for installing generating sets
  - tables of capacities (lubricants and coolants) and fuel tanks of different engines that may be fitted to the sets according to their configurations
  - general reference material for maintaining starter batteries
- user and maintenance manual for the engine fitted to the set
- maintenance manual for the alternator fitted to the set
- user manual for the control panel
- wiring diagrams (these diagrams are delivered with the generating set)

1.2. Pictograms and their meanings

Warning danger

Warning, risk of electric shock

Warning, toxic materials

Warning, pressurised liquids

Warning, high temperature, risk of burns

Publications delivered with the generating set must be referred to

Protective clothing must be worn

Your eyes and ears must be protected

Periodic maintenance must be carried out

Battery level must be checked

Warning, rotating or moving parts (risk of getting caught in the machinery)

Warning, corrosive product

Warning, risk of explosion

Entry prohibited to non-authorised persons

Power

Earth

Lifting point required

Stacking point required

Naked flames and unprotected lights prohibited.
No smoking

Exctinction by water prohibited

When on a trailer, earth the set before starting it

Emergency cut-out

Application of EU Machine Directive 98/37 of 22 June 1998 in relation to generating sets.

- access restricted to authorised personnel only according to the legislation in force
- live installation: possible automatic start-up.

1.3. Safety instructions and regulations

THESE SAFETY PRECAUTIONS 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.

1.3.1 General advice

- Read and understand the manuals provided with the generating set in full.
- Do not wear loose clothing and do not go near the machines when operating. Note that the fans are not clearly visible when the engine is running.
- Warn all people present to keep well back during operation.

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- The generating set should always be controlled by an experienced person.
- Always test the generating set from the control panel.
- Follow the maintenance table and its directions.
- Never let anyone else use the generating set without having first given them the necessary instructions.
- Do not run the engine without having refitted the protective covers.
- Engine with turbocharger: never start the engine without fitting the air filter. The rotating compressor wheel in the turbocharger can cause severe physical injury. Foreign objects in the intake duct can cause mechanical damage.
- Engine with air preheating (starter components): never use starter aerosol or similar product as starter assistance.
  When it comes into contact with the starter component, an explosion may occur in the inlet manifold and lead to physical injury.
- Never let a child touch the generating set, even when not in use. Avoid using the generating set in the presence of animals (can distress the animal).
- Never start the engine without an air filter or exhaust.
- Always follow current local regulations regarding generating sets and use of fuel (petrol and gas) before using your generating set.
- Never use sea water or any other electrolitic or corrosive product in the coolant circuit.

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- Disconnect the battery and pneumatic starter (if there is one) before carrying out any repair, to prevent the engine from starting accidentally. Fit a panel over the controls to prevent any attempt at starting.
- Do not modify the engine.
- Only use the correct techniques for turning the crankshaft to rotate the crankshaft manually. Do not try to rotate the crankshaft by pulling or exerting force on the lever on the fan. This method can cause serious physical or material harm or damage the fan blade (s), leading to premature breakdown of the fan.
- Always use tools in good condition. Check that you have understood how to use them before starting a procedure.
- Only fit original spare parts.
- Use tools that correspond to the work being carried out.
- Clean all traces of oil or coolant with a clean cloth.
- Never use petrol or other flammable substances to clean parts. Use only approved cleaning solvents.
- Do not use a high-pressure cleaner for cleaning the engine and fittings. The radiator, hoses, electrical components etc. could be damaged.
- Avoid accidental contact with parts that reach high temperatures (exhaust manifold, exhaust)
- Engage the parking brake when the generating set on its trailer is installed on the operating site.
- When setting on a slope; check that no-one is behind the trailer.
- Protective eyewear must be worn when handing during maintenance operations. Operators should remove watches, chains, etc.

1.3.2 Risks related to feed gas (concerns gas sets)

WARNING – 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.

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- Gas installations must be installed, maintained and repaired by recognised specialists.
- Do not attempt to open, unseal or intervene in gas supply pressure relief valves and on the gas line in general.

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- Gas supply procedures must be carried out in fresh air (outside) in accordance with local regulations, in an area well away from fire, people or animals.

1.3.3 Risks related to exhaust gases and fuels

WARNING - DANGER

generating sets should not be operated in unventilated areas.

- Always follow the local regulations in force regarding generating sets and use of fuel (petrol, diesel and gas) before using your generating set.
- Fuel filling should be carried out when the engine is stopped (except for sets with an automatic filling system)
- Engine exhaust gases are toxic: Do not operate the generating set in non ventilated areas. When installed in a ventilated area, the additional requirements for protection against fire and explosions must be observed.
- If a burnt gas exhaust leaks, the generating set may become more noisy. In order to be sure of its efficiency, you should periodically examine the burnt gas exhaust.
- Pipes must be replaced as soon as their condition requires it.

1.3.4 Risks related to toxic products

WARNING – DANGER

The corrosion inhibitor contains alkali. This substance should not come into contact with the eyes. Avoid any prolonged or repeated contact with skin. It should not be swallowed. In the event of skin contact, wash thoroughly with water and soap. In the event of contact with eyes, rinse immediately with plenty of water for at least 15 minutes. CALL A DOCTOR IMMEDIATELY. KEEP THE PRODUCT OUT OF THE REACH OF CHILDREN.

The anti-rust product is toxic and dangerous if absorbed. Avoid any contact with skin or eyes. Read the instructions on the packaging.

Glycol is a toxic product and dangerous if absorbed. Avoid any contact with skin or eyes. Read the instructions on the packaging.

- Never expose the equipment to liquid splashes or rainfall, and do not place it on wet ground.
- Always use the recommended fuels. Using low quality fuels risks damaging the engine and altering performance
- 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 **.**

1.3.5 Risk of fire, burns and explosion

WARNING – DANGER

The engine should not be operated in areas containing explosive products. There is a risk of sparks forming where all electrical and mechanical components are not shielded.

- Beware of creating sparks or flames and do not smoke near batteries as the electrolyte gases are highly flammable (especially when the battery is being filled). Their acid is also harmful to the skin and particularly the eyes.
- Never clean, lubricate or adjust an engine when it is in operation (unless you are qualified to do so, in which case extreme care must be taken to avoid accidents)
- Never make adjustments that you are not familiar with.
- Never cover the generating set with any material while it is working or just after it stops (wait until the engine has cooled)
- Do not touch hot components such as the exhaust pipe and do not put combustible material on them.
- Keep all flammable or explosive products (petrol, oil, cloth, etc.) well away when the set is running.

- Good ventilation is required for your generating set to work properly. Without ventilation, the engine will quickly reach an excessive temperature that could lead to accidents or damage to the equipment and surrounding items.
- Do not take off the radiator cap when the engine is hot and the coolant is pressurised due to risk of burns.
- Depressurise the air, oil and coolant circuits, before removing or disconnecting any unions, ducts or connected components. Be aware of any possible pressure that might be present when disconnecting a device from a pressurised system. Do not look for pressure leaks manually. High pressure oil can cause physical accidents.
- Some preservative oils are flammable. Also, some are dangerous to inhale. Check that ventilation is good. 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 when the oil filling cap is off as oil may be ejected.
- Never start or run the engine when the oil filling cap is off as oil may be ejected.
- Never cover the generating set with a fine layer of oil for anti-rust protection.
- Never fill up the oil or coolant when the generating set is running or when the engine is hot.

1.3.6 Risks related to electrical networks

- The electrical equipment supplied with the generating set complies with standard NF C15.100 or the standards of the relevant countries
- 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 naked wires or disconnected 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.

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- Any procedure on the equipment must be carried out voltage free.
- Electrical connections must be made in accordance with current standards and regulations in the country.
- Do not use faulty, poorly insulated or provisionally connected wires.
- Do not invert the positive and negative terminals of batteries when connecting them. Such an inversion can lead to 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 public distribution network. In specific cases where there is a reserve connection to existing electrical networks, it must only be carried out by a qualified electrician, who should take the operating differences of the equipment into account, according to whether the public distribution 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.
- Due to strict mechanical specifications you should only use flexible resistant rubber sleeved wires, in compliance with CEI 245-4 or equivalent wires.

1.3.7 Dangers presented by electric currents (first aid)

First aid

In the event of an electric shock, cut off the voltage immediately and activate the set's emergency stop. 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 extreme care to avoid the electric arc that results from 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.

1.3.8 Risks related to moving the set

- Use lifting units to lift the generating set. Always make sure that the lifting equipment is in good condition and has a sufficient lifting capacity.
- In order to work in complete safety and prevent the components fitted to the top of the engine from being damaged, the engine should be lifted with an adjustable boom. All chains and cables should be parallel to one another and as perpendicular as possible to the top of the set.
- If other equipment fitted to the generating set alters its centre of gravity, special lifting devices may be required to maintain the correct balance for working in total safety.
- Never carry out work on a generating set that is suspended on a lifting device only.

1.3.9 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.

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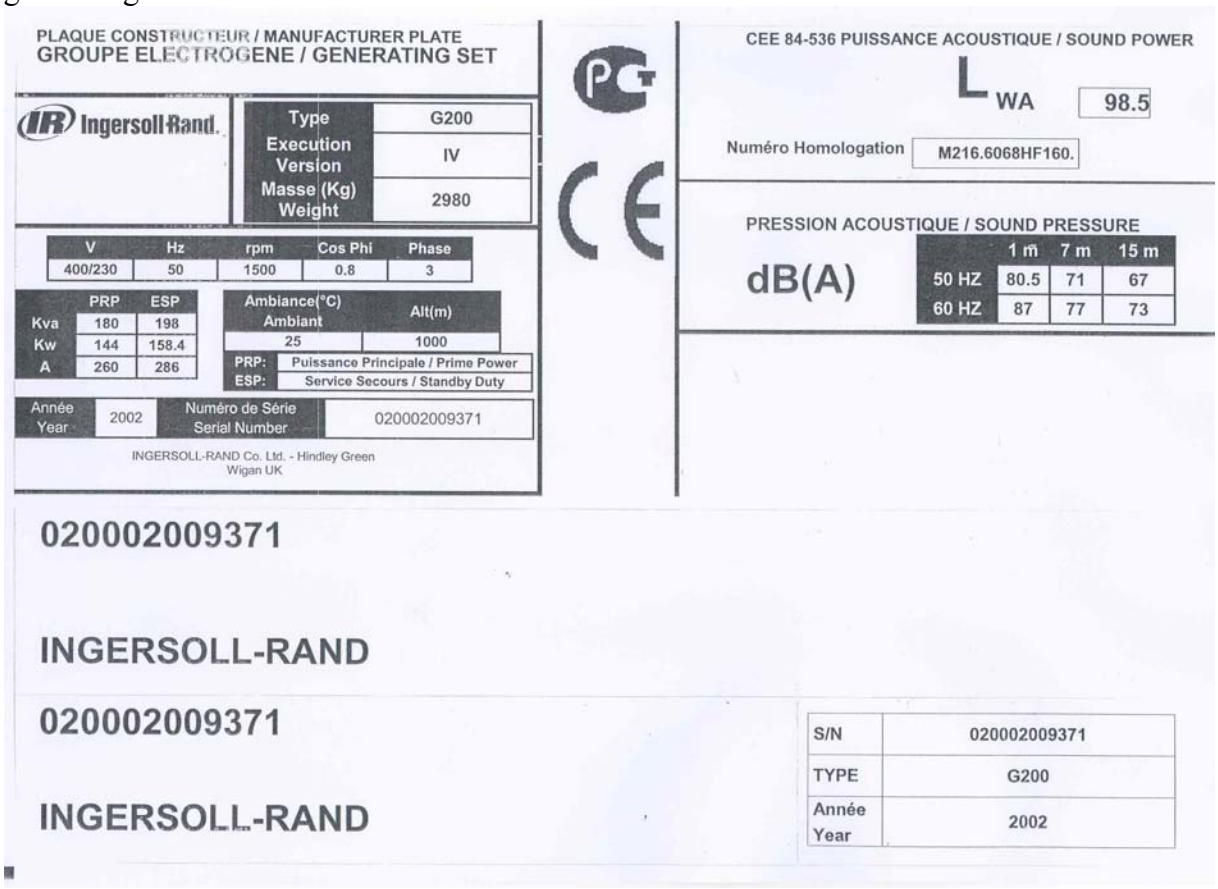
- Manufacturers' notes should be available to technical staff, on site if possible.
- Written operating instructions must be available for operations that involve dangerous handling procedures and driving installations. In particular, these instructions prescribe:
    - Operating modes
    - Frequency of testing for safety devices and devices for handling pollution and other harmful substances generated by the installation
    - Methods for maintenance, checking and use of adjustment equipment and safety devices.
- 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.
- 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).

1.4. Identifying sets

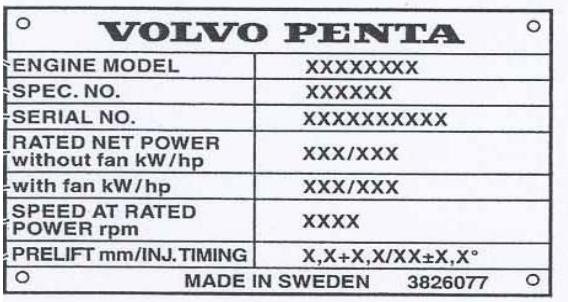
generating sets and their components are identified by means of identification plates.
The precise rules for identifying each major component (engine, alternator etc.) are set out in each manufacturer's documents contained in this manual.

Examples of identification plates

generating set



Engines



Alternator


LEROY SOMER
ALTERNATEURS PARTNER® ALTERNATORS
LSA 44.2S7 C 6/4
Date 01/14
N° 117204 / 9
60 Hz
Min-¹/R.P.M. 1800
Protection IP23
Cos Ø /P.F. 0,8
Cl.ther./Th.class H
Régulateur/A.V.R. R438 LS/C AREP
Altit. < 1000m
Masse/Weight 440 Kg
Rlt AV/D.E bearing
Rlt AR/N.D.E bearing 6309 2RS
Graisse/Grease Esso UNIREX N3
Valeurs excit/Excit.values 480 V / 40°C
en charge / full load 17,70 V / 3,84 A
à vide / at no load 0,95 A
PUISSANCE / RATING
Tension Voltage 480 440 416 240 208 240 V
Phase 3 3 3 3 3 1
Conn. Y Y Y Δ Δ ZZ
Cont. 150 135 130 150 130 78 kVA
Base 120 108 104 120 104 62.4 KW
40°C 180 177 180 361 361 325 A
Secours 165 150 144 165 144 87 kVA
Std by 132 120 115 132 115 69.6 KW
27°C 198 197 200 397 400 363 A
Made by Leroy Somer - 1 024 930/a
LR 57008
CE
Conforme à C.E.I 34-1(1994). According to I.E.C 34-1(1994).

2. INSTALLATION

2.1. Unloading

2.1.1 Safety during unloading

In order to unload generating sets from their transport mountings, under optimum conditions of safety and efficiency, you should check that the following points are being followed correctly.
- Suitable lifting vehicles or equipment for the work.
- Slings positioned in the rings provided for this procedure or lifting arms resting fully underneath the frame cross beams.
- Suitable ground to accommodate the load of the set and lifting vehicle, without strain (if not, put down sufficiently strong and stable boards).

Remove the set as close as possible to its place of use or transport, in a clear space with free access.

2.1.2 Example of material

- crane, slings, lifting beam, safety hook, shackles.
- fork lift truck.

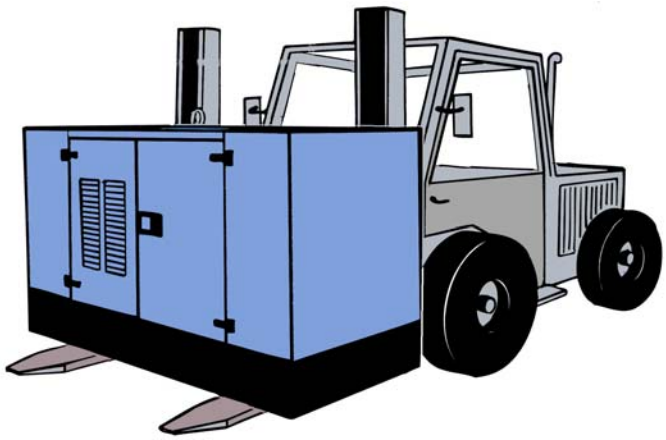
2.1.3 Instructions for unloading

2.1.3.1 Slings

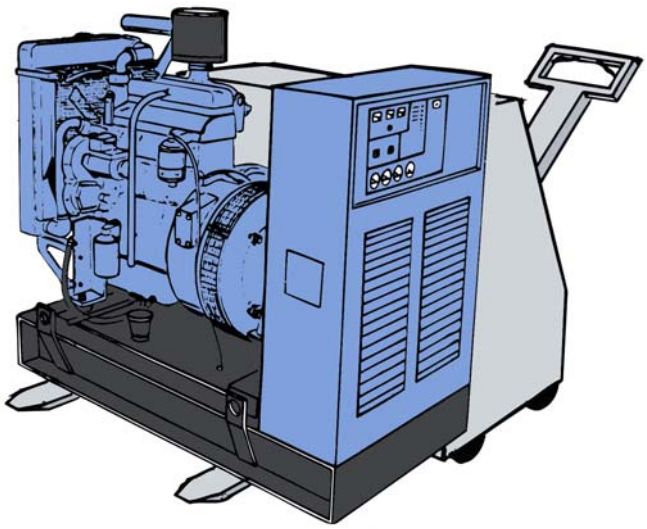
- attach the lifting vehicle slings to the rings on the generating set designed for this procedure.
- hang the slings carefully.
- check that the slings are correctly attached and the equipment is solid.
- lift the generating set carefully.
- direct and stabilise the set towards the chosen position.
- carefully set down the equipment while continuing to position it.
- release the slings, then detach and remove the lifting rings.

2.1.3.2 Fork lift truck

- position the arms of the fork lift under the frame, making sure that only the cross beams are resting on the arms.
- lift and handle the equipment carefully.
- set down the generating set in its unloading position.



It is recommended to use a fork lift truck with arms that are longer than the width of the frame

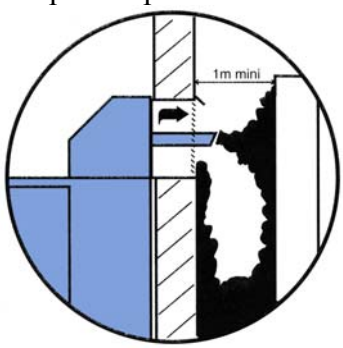


3. INSTALLATION OF MOBILE SITE SETS

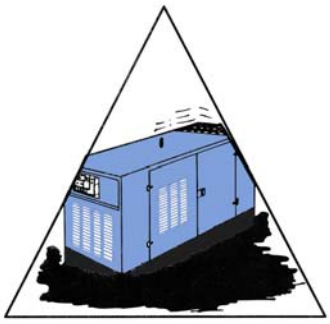
3.1 Specific arrangements

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 if there are different objects close by. It will cause abnormal heating and reduced power.
Burnt gas evacuation will take place in such a way that there is no reaspiration into the air filter or cooling system.
The generating set's neutral speed must be used to protect people.
Earthing is carried out using a metal post buried deeply in the ground.
These sets are to be covered or protected from bad weather by a suitable construction (see previous sections).

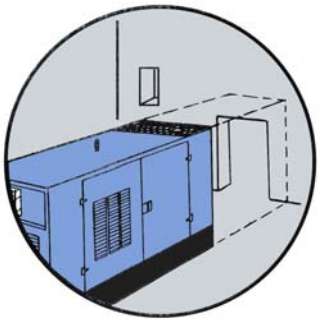
Examples of problems that may be encountered :



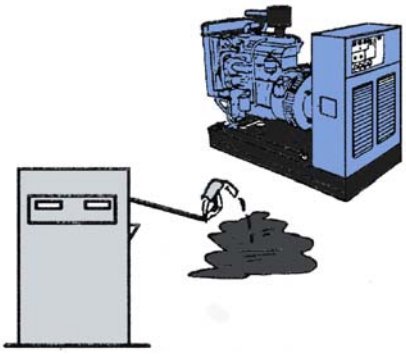
Incorrect exhaust and ventilation



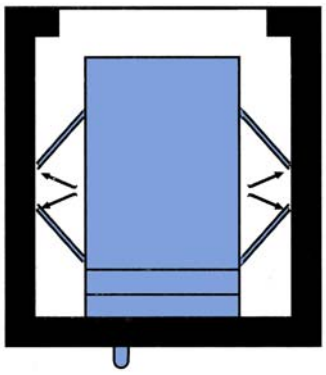
Ground too uneven or soft. Set incorrectly positioned



Reduced access



Fuel filling impossible



Opening cover doors impossible

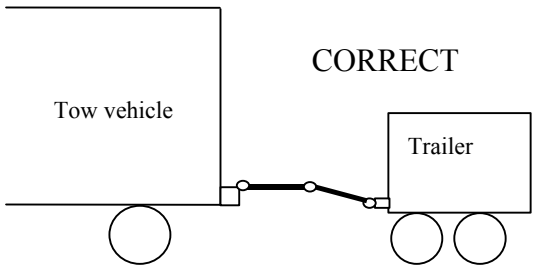
4. ROAD TRAILER

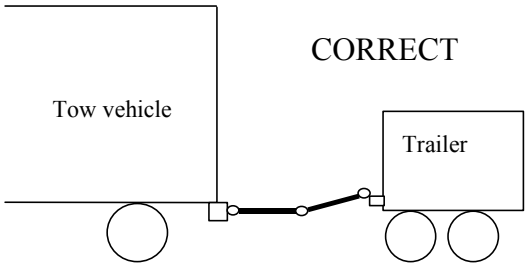
4.1 Trailer linkage

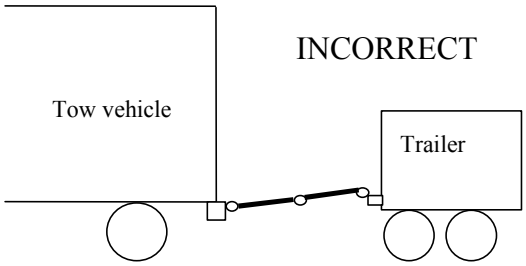
Before attaching the trailer, check the trailer hook on the tow vehicle; it should fit the trailer ring perfectly.

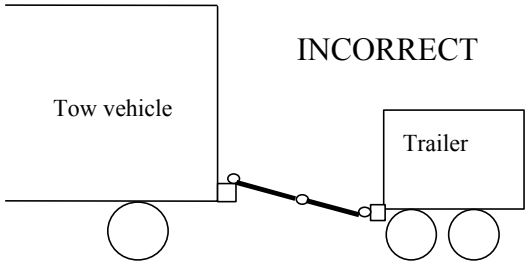
WARNING – DANGER
Trying to tow a trailer with a non-matching device (bar, wires, cords, etc.) could lead to serious accidents.
Also check:
- no incipient fractures or excessive wear on the hitching system.
- locking system is operating properly

To hitch the trailer, proceed as follows:
- lock the wheels to stop the trailer from moving
- lift up the rear trailer supports and lock them
- release the parking brake
- release the locking levers for the draw bar arms and adjust the ring to the same height as the vehicle hook
- hitch the trailer, remove the locks on each side of the wheels then lift up the front wheel fullly using its handle
- connect the electrical circuit of the trailer to that of the tow vehicle
- hook the handbrake safety wire onto the hook on the tow vehicle.









4.2 Check before towing

Before towing carry out the following checks:
- wheel torquing
- lock trailer hook
- tyre pressure
- light signals working
- cover doors closed
- parking brake off
- front wheels and rear supports lifted.
- tightening and fixing the draw bar arms locking levers
- brake test for "road" type trailers
- fitting brake safety cable.

4.3 Driving

- "On-site" type trailer
These trailers are not fitted with a main brake and so cannot brake when operating; the tyres are designed for a speed of 17 mph (27 Km/h). Therefore, it is absolutely forbidden to exceed this speed .

- "Road" type trailer
The driving speed should be adapted to road conditions and the trailer handling.
Driving at sustained speed causes tyres to heat up; therefore it is important to stop from time to time to check them. Excessive heating can lead to a blow out and hence a serious accident.
When reversing, do not forget to lock the overrun brake.

NOTE
Particular attention must be paid to wheel torquing on new vehicles. Indeed, during the first few miles, heat build-ups on the wheel hubs and brake drums lead to reduced wheel torquing. It is therefore essential to check the torquing every 6 miles (10 kilometres) until no further loosening is noted.
The torque test should nevertheless be carried out before towing.

4.4 Unhitching the trailer

This operation should be carried out on horizontal, flat, stable ground.
- lock the wheels
- lower the front wheel
- disconnect the road signals wire
- refit the hitch using the wheel to release the hook ring from the tow vehicle,
- release the tow vehicle
- engage the handbrake.

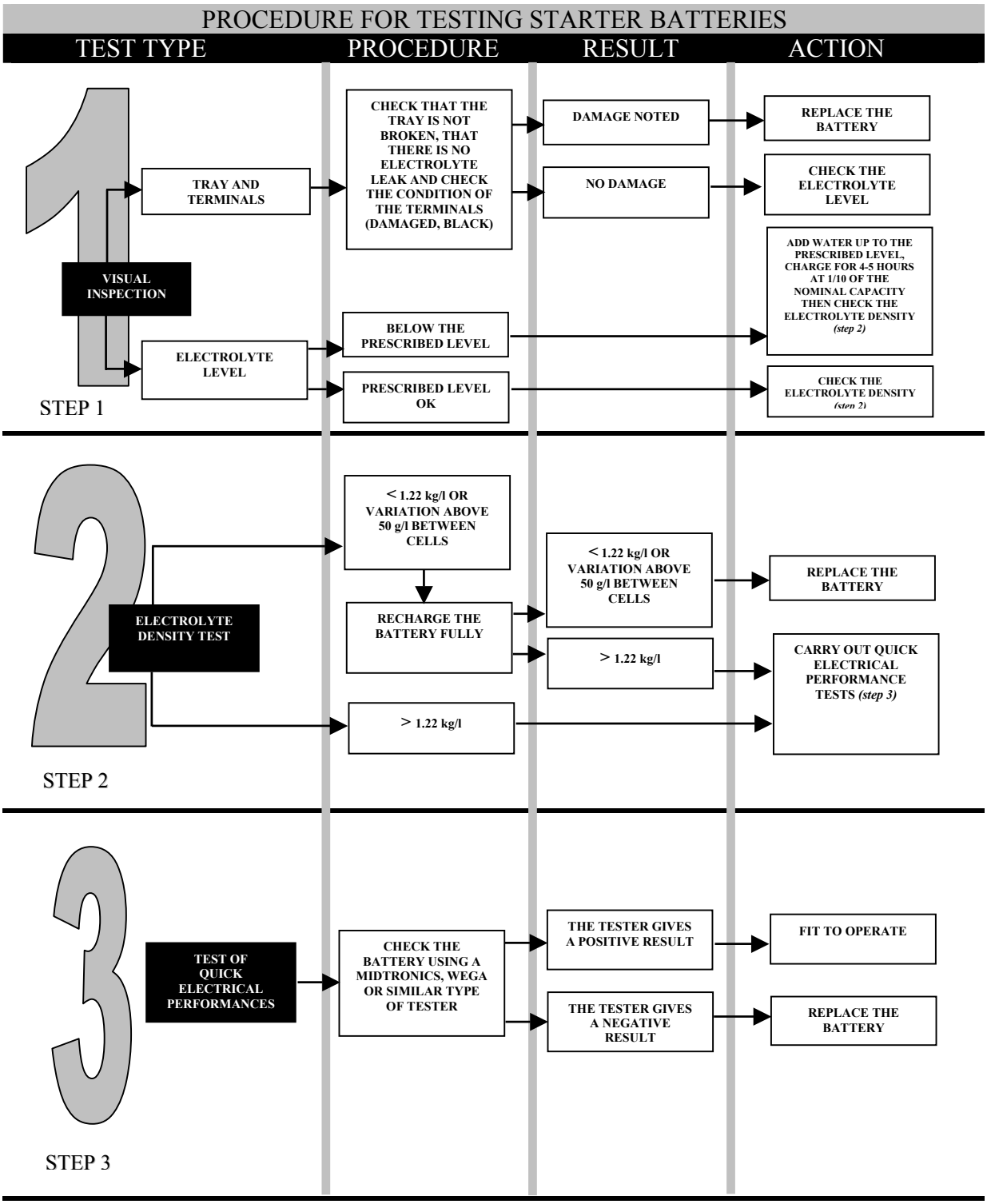
4.5 Implementation for installation

Procedures to be carried out:
- check that the ground is strong enough for the assembly not to sink into it
- using the front wheel, position the set as horizontally as possible
- engage the handbrake.
- lower the rear trailer supports and lock them

5. BATTERY MAINTENANCE

WARNING – DANGER

- install the battery so that it has the correct ventilation
- never place the battery close to a flame or fire
- use only insulated tools
- never use sulphuric acid or acid water to top up the electrolyte level.



6. FUEL AND CONSUMABLES

All specifications (product features) are given in the engine and alternator maintenance manuals attached to this manual.

6.1 Circuit capacities – Mitsubishi engines

Engines / CIRCUIT AND TANK CAPACITY	S4L2-SD (series SL)	S4Q2 (series SQ)	S4S (series SS)
MODEL	G 16	G 22	G 33
LUBRICATION (in litres)	5.4	5.5	10
COOLING (in litres)	4.9	8.1	8.9
FUEL (in litres)	100	100	100

6.2 Circuit capacities – john Deere engines

Engines / CIRCUIT AND TANK CAPACITY	3029TF120	4045TF120	4045HF120	6068TF220	6068HF120 (153kW@1500rpm)	6068HF160 (183kW@1500rpm)
MODEL	G 44	G 66 G 77	G 110	G 130	G 160	G 200
LUBRICATION (in litres)	6	13.5	13.5	21.5	21.5	31.5
COOLING (in litres)	16.1	23.6	20.2	27.3	25.8	25.8
FUEL (in litres)	100	175	200	410	410	410

6.3 Circuit capacities – Volvo engines

ENGINES / CIRCUIT AND TANK CAPACITY	TWD 740	TAD 740	TAD 1032	TAD 1242	TAD 1631
MODEL	G 220	G 270	G 330	G 440	G 550
LUBRICATION (in litres)	29	29	36	35	64
COOLING (in litres)	41.9	36.9	37.3	44	64
FUEL (in litres)	350	700	700	800	800

User's manual

Ingersoll Rand
Control unit
Intellisys
Level 1
1.06F

Réf. constructeur

Réf. GPAO : 33502013801

SAFETY SYMBOLS


Caution : danger


Caution : risk of electric shock


Caution : toxic substances


Caution : pressuried fluids


Caution : high temperature (risk of burning)


Caution : rotating or moving parts (risk of entanglement)


Caution : risk of corrosion


Caution : risk of explosion


Authorised personnel only


Power

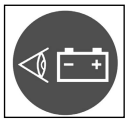

Earth


Caution, refer to the publications supplied with the Genset


Protective clothing required.


Eye and hearings protection necessary

Periodic maintenance required


Check battery charge


Recommended Lifting point


Fork lift stacking point


Naked flame and non protected lightining forbidden, no smoking


Do not use water based fire extinguishers


Trailer : link up the earth before starting the generator


Emergency stop

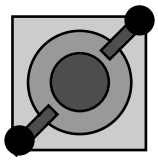
MACHINERY DIRECTIVE 98/37/CE INSTRUCTION FOR GENERATING SETS

- Access prohibited to unauthorized personnel
- Live installation, potencial automatic starting.

PRESENTATION

Key

ENGLISH
Control unit Generating set programmable controller
Panel light indicator Lighting for wall mounted or free standing panel
Emergency Stop The genset shuts down immediately and the control unit goes into STOP mode
MICS AMPG Device for electrical value display
Potentiometer volts Adjusts the alternator voltage
Dual fréquency switch 50/60 Hz to select the frequency
Potentiometer switch to select the voltage



FOREWORD

Control unit upgrade:

The software compatibility is ensured with the old interface boards, meaning it is possible to reprogram, on site, an interface board having a software index 1.01B with a software having an index 1.04D and 1.05E. However, a display defined for software version 1.2 and higher is required to use a software version 1.05E.
Software upgrade 1.04D comprises the following:
- Addition of functions and parameters
- Modification of standard value of certain parameters
- Modification of utilization limits of certain parameters
- Supervision and remote management
- Control/command of engines MTU 2000 and 4000
- Control/command compatible with standards NFPA110 and CSA C282
- Control/command compatible with French standards NF S 61-940 and NF E 37-312
- Control/command for Cummins engines type QST30
- Control/command for Nevada engines
- Generating sets with "multi-voltage" option
- Generating sets with "bi-frequency/bi-voltage" option
- Option 5 module (this module is only used with applications on MTU 2000/4000 engines and CUMMINS engines QST30).

The software version 1.06F used with the CB and CB12 I/O cards extends the functionality and working range of the Intellisys. A summary of the developments and changes incorporated into the new software is shown below. Each development is then described in detail in the subsequent paragraphs.

Compatibility with earlier I/O cards has been provided, and it is therefore possible to reprogram I/O cards originally using software versions 1.01B, 1.04D or 1.05E with version 1.06F, without having to remove the card.
Software version 1.06F includes the following features:
- Command and control of the JDEC electronics used with the John Deere 6081HF engines using the optional module 5.
- Command and control of the EDC III electronics used with Volvo D12 engines using the optional module 5.
- Changing the number of working hours for the generator (clear or preset) by entering a single access code.
- Option 4 of module 4, allowing operation at three different voltages (480V, 208V and 240V), may be fine tuned to reflect the customer's actual usage.
- The "low coolant level" LED of the optional module 6 comes on when either the 'low coolant level' or 'air cooling inadequate ' inputs are enabled (only for NFPA110 applications).
- For gas-powered generators, the "low gas pressure" fault condition now has a five-second fixed timer. This timer prevents the engine being switched off by sudden load changes. In practice, the gas pressure has a tendency to drop when the load increases sharply, before returning to its normal value.

Supervision and remote management:

Supervision and remote management is possible using the "wintelys" software on a PC computer under a Windows 95, 98; NT or 2000 environment.
A complete document describing the supervision and remote management features can be obtained from the "products and development" department.
Supervision and remote management are operational on software version 1.01B with a few restrictions as concerns the various data acquisition and display features. In this respect, with software version 1.01B, it will not be possible to:
- Control the generator set from a remote location
- Display the status of the alarm and fault LEDs on the front panel of the display or retro-information concerning the position of the Normal/Backup switch.

In addition, with software version 1.01B, the Intellisys is automatically reset when the generating set is configured from a remote location.
For optimum use of the supervision/remote management function, we recommend that you use software version 1.04D or later.

Supervision

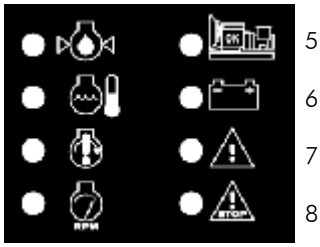
Remote management

Module 5:

Module 5 is simply module OPT345 configured as module 5.
This module is programmed specifically for the applications with engines using an integrated control electronics (MTU and Cummins engines).
The selection parameter for this module already exists in software version 1.01B.
However, a line has been added in the INPUTS and OUTPUTS screens to display the logical state of the inputs and outputs of the module according to its programming.

CONTENTS

PRESENTATION AND TECHNICALS CHARACTERISTICS



1. Oil pressure fault/shutdown (red LED on).
2. Water T° fault/shutdown (red LED on).
3. Overcranking fault/shutdown (red LED on).
4. Overspeed fault/shutdown (red LED on).
5. Genset on load or ready to take the load (green LED on).
6. Charge alternator fault/shtdwn (red LED on).
7. General alarm/warning (yellow LED flashing).
8. General fault/shutdown (red LED flashing).

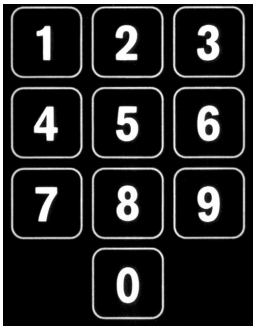
Power on after automatic shutdown (with LED).

Button to access the main menu (programming/display)

Button to validate a selection.

Button to exit a selection

Buttons to browse through menus and adjust contrast



Number pad

Button to display the voltages.

Button to display the currents

Button to display the frequency and hours counter

Button to display the engine parameters

Button to select Auto mode (with LED).

Button to select Test mode (with LED).

Button reset a fault.

Button to select Manu mode (with LED).

Button to select Manu mode (with LED).

Button to test the LEDs (except ON button LED).

1 - Features

- Display module (**DM**)
- Interface board available in 2 versions (**CB**, **CB12**) depending on customer optional equipment.
- Option 3 module, option 4 module and option 5 module **(OPT 345)**
- Block building system enabling multiple combinations.

Note: **DM** required in all combinations

2 - Display module (Fig. 2)

- LCD screen, 8 lines 21 characters, built-in back-light and keyboard adjustable contrast
- 26 momentary push buttons (two types; 10 and 13 dia.)
- 13 display LEDs (alarms/warnings, faults/shutdowns, status, operating modes)
- UL approved polycarbonate case supplied with cable and connector for connection to the interface board
- Dimensions 192x144x70
- Quick installation using brackets and nuts screws
- IP65 on panel face with seal (not supplied), IP20 inside
- Extremely user friendly man-machine interface: multiple-message screens, diagnostic, genset status, ...

3 - Interface board (Fig. 1)

- CB = Main board
- CB12 = Main board with option 1 and option 2 built in
- Electronics in a sheet steel case (base + lid)
- Dimensions : 435x263x31
- Voltage bus; alternator, mains and DC built into the printed circuit board (see paragraphs 7, 8 and 9)
- 16 bit microcontroller, (Flash, RAM and EEPROM) memories, real-time clock, battery backup for time and date
- Supply from 9 to 33Volts DC and from 6Volts DC, for voltage drop at start-up
- All connections are built into the printed circuit board on both sides with full screen printing

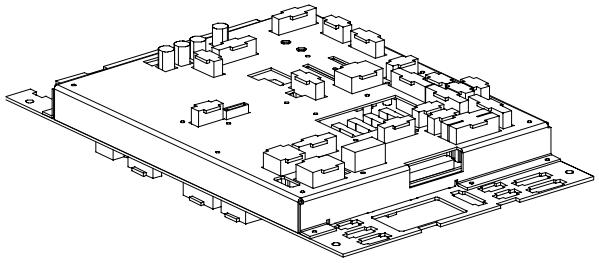


Fig. 1 - CB12 board

Fig. 2 - Display module

4 - Logical/analog I/O

All inputs and outputs are allocated to a specific use (see tables below).

Type	Logical output description	CB	CB12
F	oil pressure	x	x
F	water temperature	x	x
A or F	day tank low fuel level	x	x
F	emergency stop	x	x
A or F	overload or short-circuit	x	x
C	water heater thermostat	x	x
C	external start-up command	x	x
F	radiator low water level	x	x
C	Mains contactor home position	x	x
C	Stand-by contactor home position	x	x
F	external emergency stop	x	x
F	oil temperature		x
F	low oil level		x
A or F	water heater failure		x
A or F	battery charger failure		x
A or F	differential or CIC trip		x
F	differential relay available		x
F	Constant Insulation Check available		x
F	air cooler disconnection		x
F	air cooler low water level		x
A or F	fuel pump 1 disconnection		x
A or F	retention bund		x
C	bulk tank CF80		x
A or F	bulk tank low fuel level		x
C	EJP switch (*)		x
C	EJP start-up (*)		x
C	EJP advanced warning (*)		x

* : France only

Type	Logical output description	CB	CB12
T	fuel solenoid control	x	x
T	starter 1 contr ol	x	x
T	engine preglow control	x	x
T	water heater control	x	x
T	hooter control (general fault)	x	x
R	Mains contactor control	x	x
R	Stand-by contactor control	x	x
T	air damper control		x
T	starter 2 control		x
R	electro-flaps control		x
T	fuel pump 1 control		x
R	CIC remote contact		x

Type	Analogue input description	CB	CB12
Ω	oil pressure indication	x	x
Ω	water temperature indication	x	x
Ω	day tank low fuel level indication	x	x
Ω	oil temperature indication		x

Type	Specific I/|O	CB	CB12
ana.	charge alternator excitation	x	x

Note: Alarm or Fault selection via programming
Key:
A=Alarm, F=Fault, ana.=analog, C=Control
T=Transistor, R=Relay, Ω=resistive

5 - Option 3, 4 and 5 modules (OPT345)

- Modular case, dimensions : 160x90x58
- Programming specific to each module (dip-switch)
- 8 allocated inputs and 10 programmable outputs on option 3 for remote volt free contacts
- 8 programmable inputs and 10 programmable outputs on option 4 , with 24 preprogrammed options
- Specific programming of some entries

6 - Alternator current input

- 4-wire, unisolated, on current transformer with 5A secondary (not built into the electronics)
- Measurements in true root mean square values
- Measurement range: 60A to 5000A

7 - Alternator voltage input

- 4-wire (3ph + neutral), unisolated, with 12.5A-500Vac built in power bus in 50 and 60Hz
- Measurements in true root mean square values
- Frequency measurement on phase 1 for screen display and engine overspeed sensing

8 - Mains voltage mains 1

- 4-wire (3ph + neutral), unisolated, with 15A-600Vac built in power bus in 50 and 60Hz
- No voltage and frequency measurements

9 - Mains voltage mains 2

- 2-wire (1ph + neutral), unisolated, with 10A-240Vac built in power bus in 50 and 60Hz
- No voltage and frequency measurements

10 - Charge alternator input

- Charge alternator excitation and fault
- Starter hardware fail safe on software failure

11 - Communication

- RS485 serial port with J-Bus protocol (Mod bus RTU)
- 9-pin SUB-D connector
- Monitoring possible in local mode (≤ 1000meters)
- Remote management possible with 2 modems (>1000m)
- Optional monitoring/remote management software

12 - CAN Link

- Link between interface board and option module(s)
- Standard CAN bus version 2.0b, 9-pin SUB-D connector for CC supply to module
- 1 connector on CB and CB1, 2 connectors on CB12

13 - Fuse protection

- Fn, F1, F2, F3, 12.5A-500V fuses for alternator bus
- Mains bus protected by circuit breaker in the ATS
- F5, 10A fuse for the DC bus
- F7, 2.5A delayed action fuse for the interface board
- F6, 1A delayed action fuse for option 3 Module
- F8, 1A delayed action fuse for option 4, 5 Module (CB12 only)

14 - Connections

- Multi-pin (2 to 15 pins) connectors with polarizer
- Number of connectors varies with interface board
- Each connector has a specific use

15 - Programming options

- Multiple programming possibilities
- Access code required to read/program

16 - Options connected to the interface

Option description	CB	CB12
external start-up command	x	x
auto predisposition + external command	x	x
3ph+neutral or 1ph+N mains connection	x	x
battery charger (3 possible ratings)	x	x
water heater (3 poss. depending on supply V)	x	x
hooter	x	x
RS485 for monitoring or remote management	x	x
option 3 module / CAN bus connection	x	x
additional engine kit (9 options) (*)		x
electro-flaps (DC or AC)		x
anti-condensation heater		x
EJP (switch, adv. warning and start-up) French only		x
1ph or 3ph fuel pump (control & power)		x
Air cooler (low level, disconnection)		x
differential protection and MX coil control		x
CIC protection with remote contact and MX coil control		x
bulk tank fuel pump (CF80, low level, retention bund)		x
AMPG with optional RS485		x
option 4 module / CAN bus connection		x
three-alarm (OP,WT,OT) and module 4 kit		x

*)indication and fault/shutdown for oil temperature, low oil level, water heater failure and alarm/warning for, oil pressure, water temperature, oil temperature, air damper control, starter 2 control.

17 - Sorties relais

- Max switching voltage: 250Vac (277Vac for *)
- Mains and Stand-by contactor control outputs: 4.9A, 1500VA breaking capacity at cosφ=0.7
- Electro-flaps outputs: 500mA & CIC remote contact:1A
- MX coil control output (*): 4.9A (optional relay on baseplate)

18 - Transistor outputs

- Protected against short-circuit
- Output for fuel solenoid/panel lighting: 700mA
- Other outputs: 300mA

19 - Hardware configuration

- C14/C15 connector, auxiliaries voltage selection
- C7 dip-switch, RS485 terminator
- P3 dip-switch, CAN bus terminator
- Dip-switch selection for VDE option

20 - Environment and standards

- Operating temperature: -15°C to +60°C
- Storage temperature: -20°C to +70°C
- Resistance to shocks: IK01, vibration: to CEI68-2-6
- Salt mist resistance : 96 hours according to EN68011-2-11
- Humidity : 95 % of humidity at 45°C.
- EMC :
  - Generic standards EN50081-2 and EN50082-2
  - Emissions EN55011 Class A
  - Immunity EN61000-4.2, EN6100-4.3, EN61000-4.4, EN61000-4.6, EN61000-4.8, ENV50201
- CE mark, UL listed, CSA certified

1. FOREWORD

1.1. Precautions

❑ The control unit is connected to various AC voltage sources (alternator, mains, ...).

⚠ While the generating set is idle, any work inside the control equipment is strictly forbidden as some parts of the electric and electronic equipment stay live (mains voltage available).

❑ If work inside the control panel is required, it must be performed by staff authorised to work live.

⚠ When the generating set is running, the fuses marked **Fn**, **F1**, **F2**, **F3** are at a dangerous potential which can lead to electric shock when touched.

These fuses must be replaced when the generating set is in complete shutdown. For any voltage measurement on these four fuses, please use suitable equipment.

❑ The generating set can be equipped with a remote start-up (simple contact) or with an automatic starting system [mains failure + ATS (Mains/Stand-by changeover switch)] .

⚠ Beware of possible electric shock by contact with any live part, during the generating set start up.

1.2. Power connection

For power connection, make sure that flexible cables of suitable cross section are used to avoid overheating and a major in-line voltage drop. Depending on laying method, ambient temperature and proximity of other cables, the conductor's cross section may vary.

1.3. Electric connections (control)

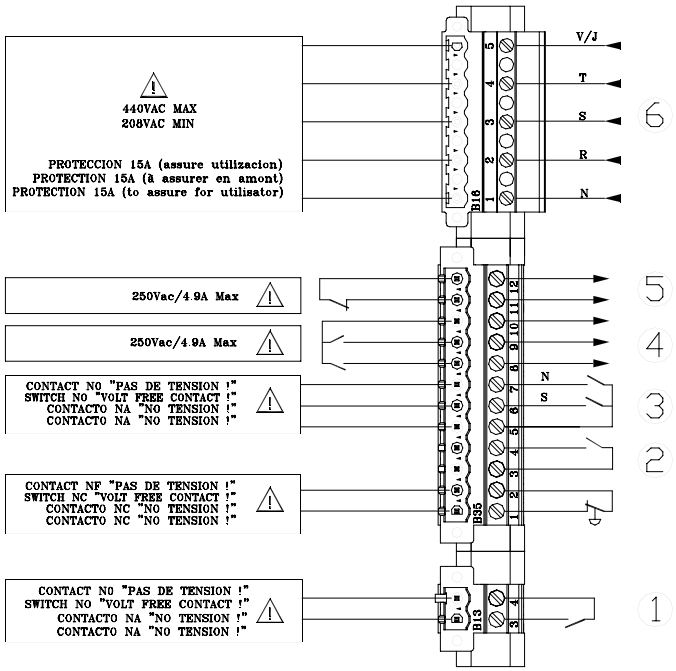
❑ **Generating set with manual start only** (from the control unit keyboard)
No external connection to make.

❑ **Generating set with remote (without mains) or automatic (with mains) start-up**
For proper operation, make the connections on the user terminal block as per the diagram below.

☞For DC signals, we recommend the use of a 5-core (5x1.5mm²) flexible cable between the ATS and the user terminal block.

☞For AC signals, we recommend the use of a 12-core (12G1.5mm²) flexible cable between the ATS and the user terminal block.
(G means cable with a Green/Yellow conductor)
Note: for a remote start only, a 2x1.5mm² flexible cable is sufficient (see ① overleaf)

⚠ The cross sections above are given as a guide as they can vary depending on the current to be drawn, length, temperature and control cable laying method.



① External command (mains sensing or client contact)
② Output C/B fault auxiliary signal contact
③ Mains and Stand-by contactors home position
④ Stand-by contactor control
⑤ Mains contactor control
⑥ 1 or 3 phase water heater

❑ If the user does not connect an ATS from our range, it is imperative to observe the board relay characteristics given below and to check that the coils power requirements are within these parameters.

Rated current=5A Rated voltage=250Vac
Maximum breaking capacity under a 0.7 cos φ: 1500VA

⚠ Not observing the above characteristics will damage or even destroy the board control relays.

1.4. Battery preliminary inspection and commissioning

The battery must be connected for the control unit to operate and the generating set to start, hence the need to check its connection:
- Red wire, positive polarity (+),
- Black wire, negative polarity (-).

Some generating sets are equipped with a battery isolator enabling the electric circuit to be isolated. Check that it is in the position enabling the operation.

⚠ The battery is supplied without electrolyte. Fill the battery with electrolyte at least 20 minutes before any start-up attempt (see maintenance manual).

1.5. Control unit first power-up

If the battery is connected and the electrolyte level correct, control unit powers up automatically and the initialisation screen below appears.

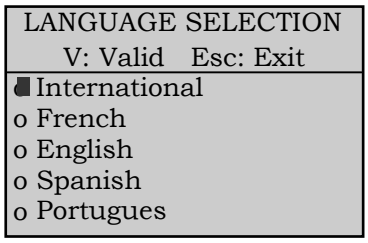
- This screen is visible for eight seconds. All LEDs are lit and will go out after 3 seconds except the **Power** button LED. When initialisation is complete, the **Stop** button LED comes on again.
- If other LEDs are lit or flashing, refer to paragraph 6.

Note: During initialisation, the display module software version appears on screen.

1.6. Welcome screens

❑ Screen 1

After the initialisation phase, the screen below appears. The operator is then able to choose in which language he wants the messages to be displayed on the control unit screen. Four languages are available: French, English, Spanish and Portuguese.



The language selection screen is then displayed. The cursor flashes by default on "international". If no action is taken while the four squares are displayed in the small overlaid window, the Intellisys is automatically positioned on the international language. You then have around 6 seconds to change the language by pressing the ➔ button then the **Enter** or **Exit** button (*).
(*) By pressing the **Enter** button, you store the selected language in memory meaning that the next time you power up the unit, the cursor will automatically go to the previously selected language. In addition, when you press the **Enter** button, the system goes to the next screen for modification of the date and time.

(*) If you press the **Exit** button, the selected language is not stored in memory. The next time the unit is powered up, the cursor will automatically be positioned on the international language.

- By pressing ➔ or ←, the operator places the cursor over the required language. Note : Depending on the cursor position, the text of the two upper lines changes to enable the operator to know where he is.

Press **Exit** to go directly to the " overview " screen (see paragraph 1.7).
There, the language used will be the one where the cursor was positioned.

Example : Cursor positioned over **English**. Pressing **Exit** configures the control unit in English. Any messages will appear be in English.

- If neither **Enter** nor **Exit** is pressed, the " overview " screen (see paragraph 1.7) appears automatically after three minutes. There, the language used will be the one where the cursor was positioned.

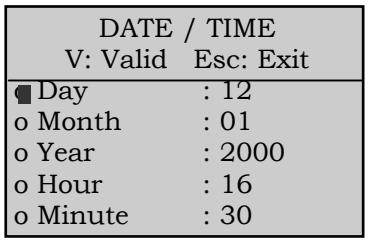
Not until the appearance of the " overview " screen will it be possible to start the generating set, however all inputs stay active (example: appearance of a fault).

- Press **Enter** to go to the second welcome screen, in the language where the cursor was before pressing **Enter**.

Note: If the "international" language is selected, refer to the "international language" appendix.

❑ Screen 2

Screen 2 will allow the date and time to be modified. This is only required when the clocks change because the internal clock is kept active by a lithium battery while control unit is powered off.



- The cursor ■ flashes over the **o** sign of the first line.
- Press ➔ to move the cursor to the next line, except if it flashes next to **Minute**.
- Press ← to move the cursor to the previous line, except if it flashes next to Day.
- By pressing ➔ or ←, the operator places the cursor on the line to be changed.

By following the instructions below, it is possible to change, line after line, the day, month, year, hours and minutes.

- Press **Enter** to take the cursor to the first digit after the : sign. By pressing one of the ten buttons **0** to **9**, the first digit is modified and the cursor is automatically moved to the second digit.
  The cursor can be moved to the second digit by pressing ➔ instead of one of the ten digits **0** to **9**. Afterwards, it can be moved back to the first digit by pressing ←.

Note: the year has four digits.

- Press **Enter** again to take the cursor back to **o** and to validate the entry made.
- When the cursor is positioned over one of the digits, press **Exit** to bring it back to **o**, without saving the entry made or without changing the previous value if there was no entry.
- Press **Exit** without any entry to go to the " overview " screen (see paragraph 1.7). There, the date and time taken into account will be the ones appearing on the screen before **Exit** was pressed.

⚠ When the clocks change, if you press **Exit** without changing the date and time, the generating set alarms, faults and status will not be correctly date and time stamped.

- Press **Exit** after changing one of more parameters (hour, minute,...) to go to the " overview " screen (see paragraph 1.7). There, the time and date taken into account will be those which were modified on screen before **Exit** was pressed.

If neither **Enter** nor **Exit** is pressed, the " overview " screen appears after three minutes. There, the time and date will be those of the previous screen (before going automatically to the " overview " screen).

Note : Not until the appearance of the " overview " screen will it be possible to start the generating set, however all engine protection shutdowns stay active (*example:* appearance of a fault).

1.7. " Overview " screen

The " overview " screen is the screen which appears systematically by default.

Using the four buttons: **V**, **A**, **Hz**, **Engine**, you can access all " overview " type screens (see paragraphs 4 and 5) which give details on:

- Electrical values and engine parameters
- Generating set alarms and faults
- Status of the generating set and its auxiliaries, date and time

❑ Normal operation

Following the language selection screen and/or possible date and time modification screen, the " overview " screen below appears during normal operating conditions.

Fuel Lev(%)	**50**
E.Speed(RPM)	**0**
Batt. (Volts)	**24.2**
ext command=0	16:45
gen stopped	12/01/00

- The first line indicates the fuel level, in %, in the day tank.
- The second line indicates the engine speed in RPM.
- The third line indicates the battery voltage in Volts.
- The fourth and fifth lines indicate the generating set status, the time, date and various other messages (see paragraph 9).

- If the cabling of the fuel level analogue input is faulty or if the sensor itself is faulty, there will be no digital indication on screen. However, the wording **Fuel Lev(%)** will appear (see also paragraph 5). This particular display is used to perform a quick diagnostic on the physical status of the input (sensor and cabling).
- If the fuel level analogue sensor is not available on the day tank, there will be no display on screen (see paragraph 5). This is the case for the Pacific range generating sets where the fuel level is read directly from a mechanical gauge.

Note 1 : Press successively one of the four buttons previously mentioned to modify the screen above (see paragraphs 4 and 5).

Note 2 : the date is given in day/month/year

❑ Abnormal operation

During abnormal operating conditions (presence of an alarm or fault, several alarms or faults or a mixture of both), the previous screen is replaced by the following one:

Fuel Lev(%)	10
E.Speed(RPM)	0
Batt. (Volts)	24.2
Alarm Low fuel level	
ext command=0	17:25
gen stopped	12/01/00

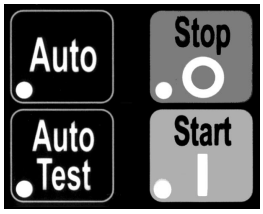
- Two extra lines are inserted to display the malfunctions (alarms and/or faults).
- Engine parameters and electric values appear on screen in a shortened form.
- The two lower lines stay unchanged.

The display of the generating set alarms and faults is detailed in paragraph 8.

2. OPERATING MODES

The control unit has four operating modes which can be accessed via the buttons (**Stop, Start, Auto, Auto Test**) on the display module:

- Mode **Stop**
- Mode **Manu**
- Mode **Auto**
- Mode **Test**



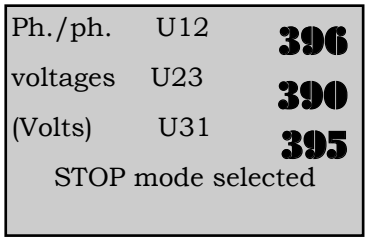
2.1. Stop Mode

After powering up (initialization, language selection and/or possible time and date update), the control unit automatically goes into **Stop** mode. The red LED associated with the button comes on and the "overview screen" appears.

Fuel Lev(%)	**50**
E.Speed(RPM)	**0**
Batt. (Volts)	**24.2**
ext command=0	16:45
gen stopped	12/01/00

Example of " overview " screen in **Stop** mode.

• In this operating mode, any event appearance (alarm, fault, external command, ...) is signalled on screen. However, the generating set is stopped and automatic start-up is not possible.



• When the generating set is running and whatever the current mode (**Auto, Test, Manu**), press the **Stop** button to stop it instantly without any cooling down. A message appears on screen for two seconds to signal that the button has been taken into account (see screen opposite).

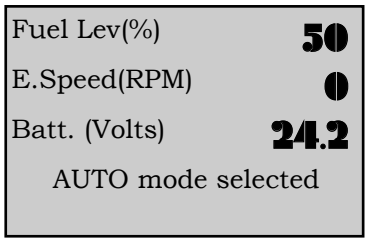
Note: if the engine is equipped with a water heater, the latter is not powered in **Stop** mode.

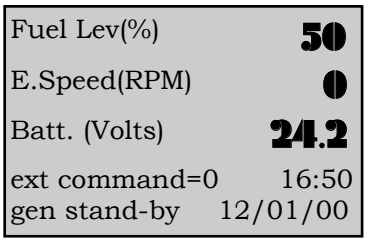
2.2. Manu Mode

• The **Manu** mode provides local control from the keyboard, ie, the operator is wholly in control of the start procedure.
-This mode may be accessed from the **Stop** or **Auto** modes.
The generator starts in **Manu** mode after a single press on the **Start** key. Using this function:
- The red LED usually associated with the **Start** key does not flash,
- The message confirming the selection of **Manu** mode does not appear.

2.3. Auto Mode

Auto mode can be accessed from **Stop**, **Manu** or **Test** mode. Press the **Auto** button to select the mode and to display the left-hand side screen below for two seconds. The red LED associated with the button comes on, then the right-hand screen appears. This screen corresponds to the standby state of the generating set.





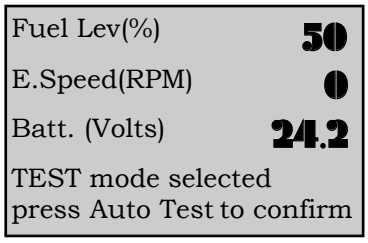
• From the waiting screen, the generating set start-up is conditioned by:
① Logical status change of the 'external command' input
② Logical status change of the 'EJP advance warning' or 'EJP start-up' inputs (France only)
③ Activation of the clock mode built into (if the mode is programmed).

Example: the right-hand side screen above informs of the logical status of the external start-up command (abbreviation ext **command=0** or ext **command=1**):
- External command = 0, no start-up
- External command = 1, imminent start-up possible

• When one of the three start-up conditions changes from 0 to 1 (for ① and ②) or from inactive to active (for ③), a new message informs the operator, then the generating set enters into an automatic start-up phase.
• When one of the three start-up conditions changes from 1 to 0 (for ① and ②) or from active to inactive (for ③), a new message informs the operator, then the generating set enters into an automatic shutdown phase.
• In **Auto** mode, the ATS toggle is completely automatic.

2.4. Test Mode

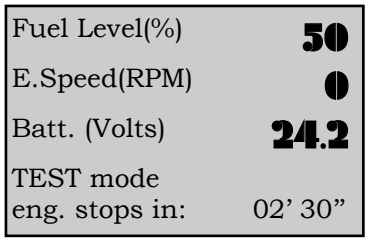
Test mode can only be accessed from **Auto** mode. If one of the inputs ; external command, EJP advance warning, EJP start-up, is in logical status 1 or if the clock is active, **Test** mode cannot be selected.
• If the inputs; external command, EJP advance warning, EJP start-up, are in logical status 0 or if the clock is inactive, press **Auto Test** button to select the mode and to bring up the screen below. The red LED associated with the button flashes.



• Press **Auto Test** button again to confirm the mode, the associated red LED comes on continuously and the generating set then enters into an automatic start-up phase.
• When the red LED flashes (waiting for confirmation), the mode can be changed by selecting **Stop** mode or **Auto** mode.

• If you do not press **Auto Test** to confirm, **Auto** mode is automatically selected after two minutes.

• In **Test** mode, the ATS cannot be toggled, this is a no-load operation. The generating set operating time is indicated on screen by a time displayed in minutes and seconds which counts down automatically. When the delay elapses, the generating set shuts down without cooling and automatically goes into **Auto** mode.



Example of " overview " screen in **Test** mode
There are two minutes and thirty seconds of operation left before the generating set stops and the control unit goes into **Auto** mode.

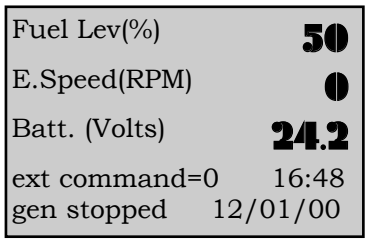
- During operation, if one of the inputs ; external command, EJP advance warning, EJP start-up, changes logical status (from 0 to 1) or if internal clock is activated, a screen message is displayed to indicate the status change or the clock activation. The **Test** mode timer is bypassed, automatically goes into **Auto** mode, the ATS toggles and you are then back in normal **Auto** mode operation.

3. SLEEP MODE AND AUTOMATIC SHUTDOWN

Is equipped with a sleep mode and an automatic shutdown.

3.1. Sleep mode

Sleep mode is possible when is in **Stop** mode or **Auto** mode with the generating set on stand-by (*). The sleep mode starts automatically after an adjustable time if there is no status change on one of the system logical inputs, no communication with a PC or no keystroke.
In this case, the back-light switches off and goes into a minimum consumption mode.



Example of a " overview " screen in sleep mode, the various indications stay visible on screen.

(*) Genset stopped with no external command, no EJP start-up and no clock activation.
- If one the system logical inputs changes status (alarm, fault, thermostat, external command, ...), the messages appear and the back-light switches back on.
- On the appearance of an alarm or a fault not generated by the change of state of an entry, the back-lighting does not come on again.

Note : if a low/high battery voltage alarm or fault or a CAN bus fault appears, the back-light will not switch itself back on.

3.2. Automatic shutdown

Automatic shutdown is only possible when is in **Stop** mode. In **Stop** mode, even if the back-light is switched off, the battery discharges slowly (electronics consumption) in cases where the generating set is not equipped with a battery charger.
To avoid the battery from discharging and thus the generating set from not being able to start, will shut down automatically after a delay.
After shutdown, the internal clock stays active. The generating set alarm, fault and status event log is kept unchanged.

⚠ Following an automatic shutdown, can be powered up again by simply pressing the **Power** button. Initialisation is carried out in the same conditions as with a first power-up.

After powering up via the **Power** button, automatically goes into **Stop** mode and brings up the " overview " screen (see paragraph 1.7) in the language used before the automatic shutdown. This way, the operator does not need to reselect the language and press **Exit** to return to the " overview " screen.

3.3. Special case

- On the appearance of any fault condition whatsoever, the Intellisys automatically sets itself into the **Stop** mode but, at the end of the 'auto cut-off' timer (setting 108 in the Timer menu), the Intellisys remains switched on. This function is particularly useful for those applications fitted with :
- An OPT345 module, programmed for Option 3
- An optional module 6
- The Wintelys supervision and remote management software.

This feature ensures that the signals provided by these modules (free potential contact, remote module 6 control) and the monitoring software will remain available for remote operating.

4. VIEWING THE ELECTRICAL VALUES

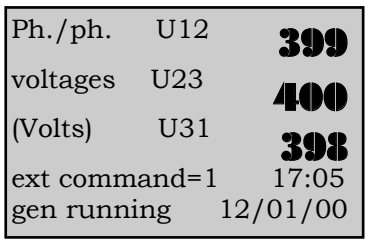
4.1. Voltages

You can view the various AC voltages by pressing the **V** button successively. Their values are expressed in true root mean square Volts. Depending on the client's needs (type of electrical installation), several screens are possible:

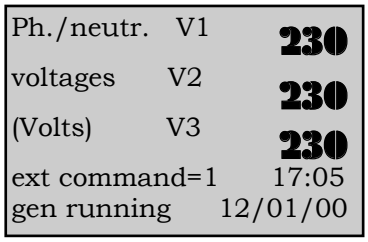
- 3 phase with neutral (3ph+N)
- 3 phase without neutral (3ph)
- 2 phase (2ph+N)
- 1 phase (1ph+N)

Note: one of the four choices above has been factory programmed as per the client's specification.

❑ 3 phase with neutral (3ph+N)

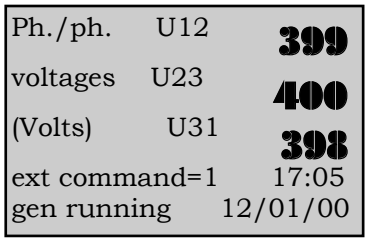


- Press **V** to get the three phase-to-phase voltages:
  U12 = voltage across phase 1 and phase 2
  U23 = voltage across phase 2 and phase 3
  U31 = voltage across phase 3 and phase 1



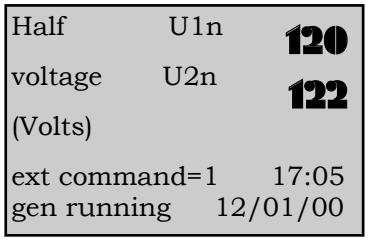
- Press **V** again to get the three phase-to-neutral voltages:
  V1 = voltage across phase 1 and neutral
  V2 = voltage across phase 2 and neutral
  V3 = voltage across phase 3 and neutral
- Press **V** again to bring up the first screen and so on...

❑ 3 phase without neutral (3ph)

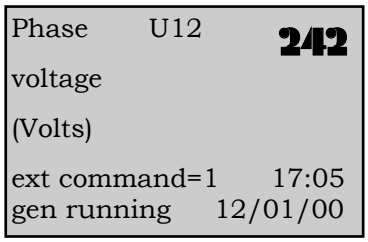


- Press **V** to get the three phase-to-phase voltages:
  U12 = voltage across phase 1 and phase 2
  U23 = voltage across phase 2 and phase 3
  U31 = voltage across phase 3 and phase 1
- If you press **V** nothing changes.

❑ 2 phase (2ph+N)

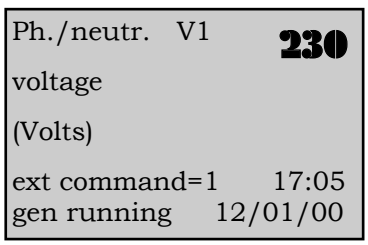


- Press **V** to get the two half voltages:
  U1n = voltage across phase 1 and neutral
  U2n = voltage across phase 2 and neutral



- Press **V** again to get the voltage across the two phases:
  U12 = voltage across phase 1 and phase 2
- Press **V** again to bring up the first screen and so on ...

❑ 1 phase (1ph+N)



- Press **V** button to get the voltage across phase and neutral:
  V1 = voltage across phase 1 and neutral
- If you press **V** again, nothing changes.

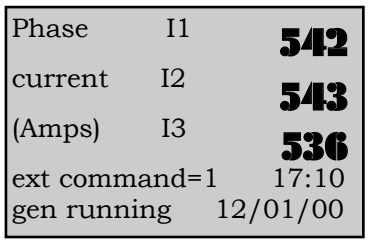
4.2. Currents

To view the various AC currents, press the **A** button successively. The values are expressed in true root mean square Amps. Depending on the client's needs (type of electrical installation), several screens are possible:

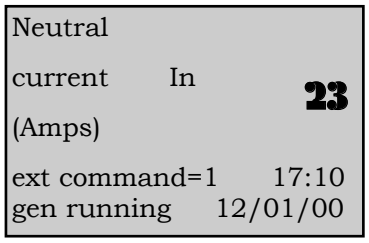
- 3 phase with neutral (3ph+N)
- 3 phase without neutral (3ph)
- 2 phase (2ph+N)
- 1 phase (1ph+N)

Note: one of the four choices above has been factory programmed as per the client's specification.

❑ 3 phase with neutral (3ph+N)



- Press **A** to get the three phase currents:
  I1 = current in phase 1
  I2 = current in phase 2
  I3 = current in phase 3

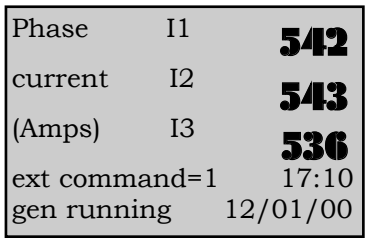


- Press **A** again to get the neutral current:
  In = current in the neutral

Note : the neutral current is calculated by vector summation of the three phase currents..

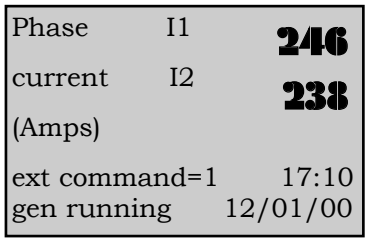
- Press **A** again to bring up the first screen and so on ...

❑ 3 phase without neutral (3ph)



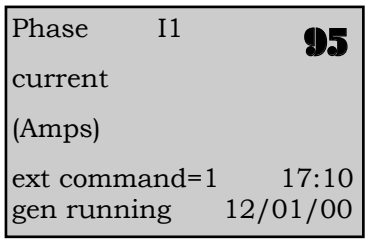
- Press **A** to get the three phase currents:
  I1 = current in phase 1
  I2 = current in phase 2
  I3 = current in phase 3
- If you press **A** again, nothing changes.

❑ 2 phase (2ph+N)



- Press **A** to get the two phase currents:
  I1 = current in phase 1
  I2 = current in phase 2
- If you press **A** again, nothing changes.

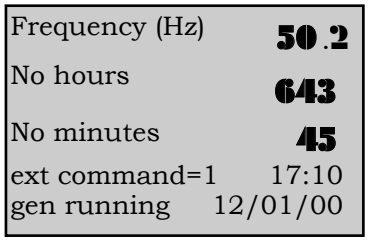
❑ 1 phase (1ph+N)



- Press **A** to get the 1 phase current :
  I1 = 1 phase current
- If you press **A** again, nothing changes.

4.3. Frequency and hours counter

To view the generating set frequency and number of running hours, press the **Hz** button. Values are expressed in Hertz (Hz) and in hours respectively.



The minutes are counted from 0 to 59 minutes; on the 60th minute, the number of hours is incremented and the number of minutes goes to 0.
Example of "overview" screen showing frequency and number of generator running hours and minutes.

Note: a maximum of 32767 running hours can be displayed. The display is in whole hours.

5. VIEWING THE ENGINE PARAMETERS

To view the engine parameters, press the **Engine** button successively. Three different screens can be viewed.
The values that can be displayed on these three screens are indications only.

❑ **Screen 1 :** Press the **Engine** button to get the following screen.

Fuel Lev(%)	**65**
E.Speed(RPM)	**1502**
Batt. (Volts)	**12.3**
ext command=	17:15
gen running	12/01/00

- The first line indicates the fuel level, expressed in %, in the day tank.
- The second line indicates the engine speed expressed in RPM.
- The third line indicates the battery voltage expressed in Volts.

❑ **Screen 2 :** Press **Engine** a second time to get the following screen.

Oil Pr.(Bar)	**6**
Oil T.(°C)	**90**
WaterT.(°C)	**75**
ext command=1	17:15
gen running	12/01/00

- The first line indicates the oil pressure expressed in Bar.
- The second line indicates the oil temperature expressed in degrees Celsius (°C).
- The third line indicates the water temperature expressed in degrees Celsius (°C).

❑ **Screen 3 :** Press **Engine** a third time to get the following screen.

Oil Pr. (PSI)	**90**
Oil T.(°F)	**194**
WaterT. (°F)	**167**
ext command=1	17:15
gen running	12/01/00

- The first line indicates the oil pressure expressed in PSI (pound per square inch).
- The second line indicates the oil temperature expressed in degrees Fahrenheit (°F).
- The third line indicates the water temperature expressed in degrees Fahrenheit (°F).

- Press **Engine** again to bring up the first screen and so on ...

The first screen is the one which appears by default after the has powered up (see paragraph 1.7) or after pressing **Exit** to exit the display mode.

- If one of the sensors is not declared available (optional sensor and/or factory programming), there will be no display on screen on the line corresponding to the undeclared sensor (see screen 1).
- If the cabling of one the analogue inputs is faulty or if a sensor is faulty, there will be no digital indication on screen on the line of the corresponding sensor (see screen 2).

Oil Pr. (Bar)	**6**
WaterT. (°C)	**75**
ext command=1	17:15
gen running	12/01/00

screen 1

Oil Pr. (Bar)	
Oil T.(°C)	**90**
WaterT.(°C)	**75**
ext command=	17:15
gen running	12/01/00

screen 2

6. DISPLAY LEDS AND LAMP TEST

On the display module panel face, fifteen LEDs are used to display various generating set status, alarms and faults.

❑ A set of eight LEDs are used to display the following alarms, faults and statuses:


Oil pressure fault/shutdown (red)

Genset ready to take load (green)


Water temperature fault/shutdown (red)


Charge alternator fault/shutdown (red)


Overcranking/Fail to start shutdown (red)


General alarm (yellow)

Overspeed fault/shutdown (red)

General fault (red)

All these LEDs are identified by an ISO symbol. The last two LEDs are flashing lights. The " general fault " LED flashes on appearance of any fault and the " general alarm " LED flashes on appearance of any alarm.

- ❑ Each blue coloured function button (**Stop, Start, Auto, Auto Test**) is associated with a LED. The operation of these four LEDs is described in paragraph 2.
- ❑ The **0** and **1** buttons are each associated with a LED.
- ❑ The **Power** button is associated with a LED. This LED is used to display the powering up (see paragraphs 1.5 and 3.2).

Press the **Lamp Test** button to light all the LEDs for six seconds. This is only possible on the " overview " type screens.

7. SCREEN CONTRAST

On the various " overview " type screens, the contrast of the characters displayed on screen can be adjusted via the ➔ and ← buttons:

- Press ➔ to increase the contrast on screen
- Press ← to reduce the contrast on screen.

Note: le The contrast obtained after using the ➔ and ← button is not saved when if powered down. The only way the contrast value, modified by the ➔ and ← buttons, can be saved is via the **Contrast** menu.

- Contrast adjustment is especially useful when is used in severe conditions (-15°C or +60°C).
- When temperature is above +60°C, the screen is very dark. It is therefore necessary to reduce the contrast by pressing ←.
- When temperature is below -15°C, the screen is very light. It is therefore necessary to increase the contrast by pressing ➔.

8. DISPLAYING THE ALARM AND FAULT MESSAGES

All alarms and faults are clearly viewed on screen. Two lines are dedicated for their display (see screens below).

8.1. Appearance of messages on screen

As soon as an alarm or fault appears, the electrical values and engine parameters are displayed on screen in a shortened form.

- The first alarm is displayed on screen over the first of the two lines (screen 1).
- The first fault is displayed on screen over the first of the two lines (screen 2).

Ph./ph.	U12	400
voltages	U23	401
(Volts)	U31	398
Alarm Low Fuel Level		
ext command=1		17:30
gen stopped		12/01/00

screen 1

Ph./ph.	U12	0
voltages	U23	0
(Volts)	U31	0
Fault Emergency Stop		
ext command=1		17:32
gen stopped		12/01/00

screen 2

Ph./ph.	U12	400
voltages	U23	401
(Volts)	U31	398
Alarm Retention Bund		
Alarm Low Fuel Level		
ext command=1		17:35
gen stopped		12/01/00

screen 3
As soon as another alarm appears on screen 1, the first alarm message slides down to the second line and the message of the new alarm positions itself on the first line (see screen opposite).
(example : **Alarm Retention Bund**)

Ph./ph.	U12	0
voltages	U23	0
(Volts)	U31	0
Fault Low Fuel Level		
Fault Emergency Stop		
ext command=1		17:38
gen stopped		12/01/00

screen 4
As soon as another fault appears on screen 2, the first fault message slides down to the second line and the message of the new fault positions itself on the first line (see screen opposite).
(example : **Fault Low Fuel Level**)

Ph./ph.	U12	0
voltages	U23	0
(Volts)	U31	0
Fault Emergency Stop		
Alarm Low Fuel Level		
ext command=1		17:35
gen stopped		12/01/00

screen 5
If an alarm appears on screen 2, the fault message stays on the first line and the alarm message is displayed on the second line (see screen opposite).
(example : ***Alarm Low Fuel Level***)
Priority is given to fault messages.

- If a fault appears on screen 3, the message on the second line disappears from the screen, the message on the first line slides down to the second line and the fault message takes the first line.
- If a third fault appears on screen 4, the message on the second line disappears from the screen, the message on the first line slides down to the second line and the third fault message takes the first line.
- If an alarm appears on screen 4, the message relating to that alarm will not appear.
- If a new alarm appears on screen 5, the message relating to that alarm will replace the alarm message on the second line.

8.2. Removing messages on screen

- If all the faults, displayed on screen or not, are no longer active (circuit-breaker pressed in, emergency stop unlocked, logical input inactive, connection restored, ...), press the **Reset** button to reset the last fault present on screen or in other words, the last recorded fault. This way, the previous fault(s) is/are moved forward one line.

The example below shows the screen changes with two faults displayed on screen and one fault not displayed but recorded. In order of appearance, the following faults are:
- Module 3 CAN
- Emergency stop
- Day tank low fuel level

The three faults are considered as no longer active (fuel level above low level, emergency stop unlocked, CAN connection restored on the option 3 module).

Ph./ph.	U12	0
voltages	U23	0
(Volts)	U31	0
Fault Low Fuel Level		
Fault Emergency Stop		
ext command=1		17:45
gen stopped	12/01/00	

Messages **Fault Low Fuel Level** and **Fault Emergency stop** are then displayed. Press **Reset** to reset the low fuel level fault (the message disappears).

Ph./ph.	U12	0
voltages	U23	0
(Volts)	U31	0
Fault Emergency Stop		
Fault module 3 CAN		
ext command=1		17:46
gen stopped	12/01/00	

The message **Fault module 3 CAN** then appears on the second line (see screen opposite).
Press **Reset** to reset the emergency stop fault (the message disappears).

Ph./ph.	U12	0
voltages	U23	0
(Volts)	U31	0
Fault module 3 CAN		
ext command=1		17:47
gen stopped	12/01/00	

The message **Fault module 3 CAN** then appears on the second line (see screen opposite).
Press **Reset** to reset the emergency stop fault (the message disappears).

Ph./ph.	U12	
voltages	U23	
(Volts)	U31	
ext command=1		17:48
gen stopped	12/01/00	

There are no more faults but is still in **Stop** mode. As the external command is still available, the operator must select the **Auto** mode for the generating set to restart automatically.

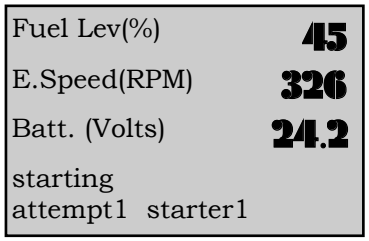
- An alarm message will automatically disappear when the alarm input is no longer in logical status 1.

9. DISPLAYING THE STATUS MESSAGES

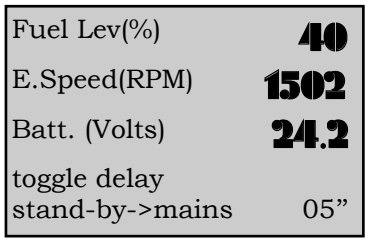
All status relating to the operation of the generating set and its auxiliaries are clearly viewed on the two lower lines.
As well as the date and time, the operator will be able to view:
- Operating mode selected (**Stop**, **Manu**, **Auto**, **Test**)
- Water heater control logical status (active or inactive)
- External command logical status (0 or 1)
- built-in mains failure and mains return delays
- Generating set status (genset on stand-by, stopped or running)
- Engine preglow period
- Cranking period (with attempt number and starter number)
- Starter rest period between two starting attempts, with possible indication of engine preglow
- Starter tripping (indicating starter number)
- RPM and Volts stabilising period
- Authorisation to close the Stand-by contactor in **Manu** mode

- ATS toggle delay: Mains➔Stand-by and Stand-by➔Mains, and closure confirmation of the Mains and Stand-by contactors- Motorised C/B opening and closure
- Engine cooling down time in **Auto** mode
- Operating time in **Test** mode
- Delayed shutdown on water temperature fault or overload/short-circuit fault
- Appearance of commands ; EJP J-1, EJP advance warning, EJP start-up
- Clock activated operation indicating time range number
- Shutdown bypass via switch (complying with French standard NFC 61940))

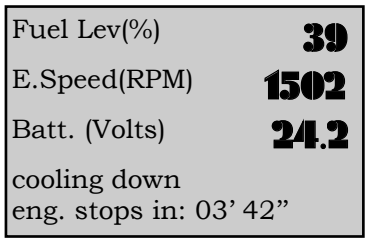
The three screens below show three examples of status messages displayed over the two last lines.



Starting period: attempt 1 on starter 1



S➔N toggle: Toggle from Stand-by contactor to Mains contactor in 5 seconds



Engine cooling down: Engine to stop in 3 minutes and 42 seconds in **Auto** mode

APPENDIX - SOFTWARE VERSION 1.05E OR LATER: "INTERNATIONAL" LANGUAGE

1 - Introduction

Software version 1.05E or later used with interface boards CB and CB12 enable you to use the Intellisys in a language which is different from the four standard languages already implemented. This language is based on the use of pictograms. Compatibility is ensured with the old interface boards. This means it is possible to reprogram, on site, an interface board having software index 1.01B or 1.04D with a software having an index 1.05E. However, use of a software version 1.05E requires a display defined for software version 1.2 (see paragraph 2).

2 - Starting up the Intellisys

When the Intellisys is powered up, the initialization screen indicates the display software version.
The initialization phase takes no more than 5 seconds.

Note: A display flashed to version 1.2 can be used with no problem with an interface board version 2.01B or 1.04D.

Next, the language selection screen is displayed. The cursor flashes by default on "International". If no action is taken while the four squares are displayed in the small overlaid window, the Intellisys automatically goes to the international language.

You then have around 6 seconds to change the language by pressing the ➔ button then the **Enter** or **Exit** (*) buttons.

(*) By pressing the **Enter** button, the selected language is stored, meaning that the next time the unit is powered up, the cursor will automatically go to the previously selected language. In addition, by pressing the **Enter** button, the system goes to the next screen to modify the date and time.
(*) If you press the **Exit** key, the selected language is not stored in memory. The next time the unit is powered up, the cursor will automatically be positioned on the international language.

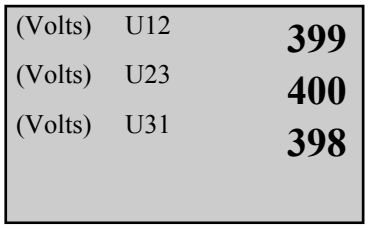
3 - Modifying display with international language

When the international language is selected on power up or during use:
- The time and date are no longer displayed on the screen. The time-stamped record of alarms, faults and statuses is however preserved.
- The comfort messages described in paragraph 9 of the user instructions manual, levels 1, 2 or 3, disappear. These messages are displayed on the last two lines of the screen.
- The alarms and/or faults are no longer displayed in plain language on the screen on the two lines located directly above the comfort messages, but are displayed in the form of codes in place of the time and date (see list of codes in paragraph 6).
- When an alarm or fault appears, the size of the electrical and mechanical value displays are not compressed.
- The programming display screens are accessed in the same way, the only difference is that all the screens are systematically in English.

4 - Display of electrical values

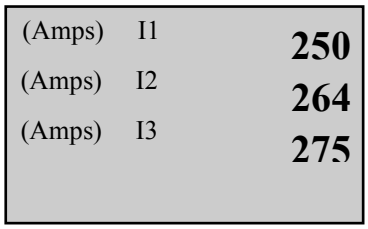
To facilitate understanding, the electrical values are not represented by pictograms.

■ Press the **V** button to display the line voltages and the single voltages by pressing the button successively.



The notations such as **U12**, **U23**, **U31**, etc. are preserved. For more information concerning the meaning of the notations, refer to the user paragraph 4.1. The Volt is the unit of measurement for the electrical voltages at the alternator terminals (screen display: **Volts**).

■ Press the **A** button to display the phase currents and the neutral current by pressing the button successively.



The notations such as **I1**, **I2**, **I3**, In, etc. are preserved. For more information concerning the meaning of the notations, refer to the user paragraph 4.2.

(Amps) In	22

The Ampere is the unit if measurement of the currents output by the alternator (screen display: **Amps**).

- Press the **Hz** key to display the generating set frequency and running hours and minutes.

(Symbol 1) (Hz)	50.2
(Symbol 2)	643
(Symbol 2)	45

Hz is the abbreviation for **Hertz**. Symbols 1 and 2 are represented in the table below.

Symbol number	Pictogram	Description
Symbol 1 (sinewave)		frequency of voltage output by alternator
Symbol 2 (hourglass)		number of generating set running hours and minutes

5 - Display of mechanical values

By pressing the Engine button successively, the following is displayed: oil pressure, water temperature, oil temperature, battery voltage, engine speed and fuel remaining in daily tank.

(symbol 3) (%)	50
(symbol 4) (RPM)	1500
(symbol 5) (Volts)	24.2

The notations: %, RPM and Volts are preserved. For more information on the meaning of the notations, refer to the user paragraph 5.

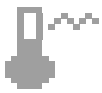
(symbol 6) (Bars)	6
(symbol 7) (°C)	90
(symbol 8) (°C)	75

The notations: Bars and C° are preserved. For more information on the meaning of the notations, refer to the user paragraph 5.

A third screen can be accessed using the **Engine** button with Anglo-Saxon notations for the oil pressure (PSI), the water temperature (°F) and the oil temperature (°F).

Note: if the oil temperature is not selected (Sensors menu) or if the analog pack has not been selected, the symbol(s) will not appear on the screen.

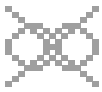
All the symbols related to the engine parameters are represented in the table below.

Symbol number	Pictogram	Description
Symbol 3 (fuel pump)		Fuel level in daily tank
Symbol 4 (galvanometer)		Engine speed
Symbol 5 (generating set battery)		Battery voltage
Symbol 6 (oil can)		Engine oil pressure
Symbol 7 (thermometer with oil drop)		Engine oil temperature
Symbol 8 (thermometer with cooling fluid level)		Cooling fluid temperature

6 - Other symbols

■ Loss of system voltage (symbol 9)

Loss of the system voltage (or loss of mains) is represented on the screen by a crossed-out transformer. The micro-cutout time-delay (parameter 103 of **Timing** menu) is displayed next to this symbol and decrements automatically from the adjustment setting to 0.



(symbol 3) (%)	**50**
(symbol 4) (RPM)	**0**
(symbol 5) (Volts)	**24.2**
(symbol 9) : 12"	

Example of screen showing system voltage is no longer available. 12 seconds remain prior to startup of the generating set (micro-cutout time delay).

■ Return of system voltage (symbol 10)

Return of the system voltage (or mains voltage) is represented on the screen by a transformer. The mains return time delay (parameter 104 of Timing menu) is displayed next to this symbol and decrements automatically from the adjustment setting to 0.

(Amps) 11	**645**
(Amps) 12	**680**
(Amps) 13	**653**
(symbol 10) : 2" 15"	

Example of screen showing system voltage is again available. Two minutes and fifteen seconds remain prior to automatic switchover from the generating set to the system (mains return time delay).

Note: The two previous symbols can only be displayed provided the type 2 control parameter is at 1 (see user paragraph 2.1.1).

■ Spark plug preheating (symbol 11)
If the generating set is ready to be started on an external command and if the "spark plug preheating" parameter is set to 1 (Factory menu), a symbol representing a solenoid appears on the screen during the spark plug preheating period prior to the first startup and also between two startup attempts.

(symbol 3) (%)	**50**
(symbol 4) (RPM)	**0**
(symbol 5) (Volts)	**24.2**
(symbol 11)	

Example of screen showing that spark plug preheating is in operation; generating set will start in a few seconds.

■ Engine cooling (symbol 12)
When the mains return time delay is completed, the emergency contactor opens, the normal contactor closes and the engine begins its cooling period which is displayed by the symbol shown opposite. The cooling time delay (parameter 10 of timing menu) is displayed next to the symbol and decrements automatically from the adjustment setting to 0.

(Volts) U12	**399**
(Volts) U23	**400**
(Volts) U31	**398**
(symbol 12) : 3" 10"	

Example of screen showing that three minutes and ten seconds remain for cooling of the generating set prior to complete shutdown.

7 - Alarms and fault codes

The alarms and faults are displayed on the right hand side of the two lower lines. As a general rule, a fault or alarm is displayed on the screen as follows:

XX-Y XX is a number between 00 and 99
Y takes two values: 0 to indicate an alarm, 1 to indicate a fault (same method used in **Options** menu).

Special case 1: for a single number, it is possible to display: XX-0 or XX-1. This means that the **Options** menu must be programmed to have one or the other on the screen.
Special case 2: if the alarm or fault are possible at the same time (two different sensors used on engine), the XX numbers are different (example: engine oil pressure fault = 02-1, engine oil pressure alarm = 64-0).
Note: When the word "impossible" appears in the table on the following page, this means that the alarm or fault does not exist (example: generating set emergency stop only managed for fault and not for alarm).

(symbol 3) (%)	**50**
(symbol 4) (RPM)	**0**
(symbol 5) (Volts)	**24.2**
	06-1

Example of screen showing "overload or short-circuit" fault designated 06-1.

(Volts) U12	**380**
(Volts) U23	**382**
(Volts) U31	**381**
	12-0

Example of screen showing "alternator min voltage " alarm designated **12-0**.

(símbolos 3) %	**50**
(símbolos 4) RPM	**0**
(símbolos 5) Volts	**24.2**
	00-1
	08-0

Example of screen showing "max. battery voltage" alarm designated **08-0** and "emergency stop" fault designated **00-1**.

The alarms and faults are displayed in the same way as for versions 0.01B and 1.04D:

- Up to two codes (max.) displayed on screen
- Fault takes priority over alarm
- Faults are reset in order of appearance

For more details, refer to paragraph 8.
All the alarms and faults which can appear on the Intellisys screen are listed in the table below.a.

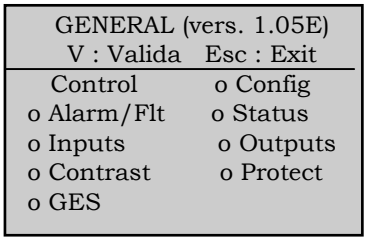
Wording	Alarm	Fault	Generated on
Generator set emergency stop	impossible	00-1	CB, CB12
External emergency stop	impossible	01-1	CB, CB12
Engine oil pressure	impossible	02-1	CB, CB12
Engine water temperature	impossible	03-1	CB, CB12
Daily fuel tank level low	04-0	04-1	CB, CB12
Radiator water level low	impossible	05-1	CB, CB12
Alternator overload or short-circuit	06-0	06-1	CB, CB12
Engine overspeed	impossible	07-1	CB, CB12
Min. battery voltage	08-0	08-1	CB, CB12
Max. battery voltage	09-0	09-1	CB, CB12
Lithium battery absent	10-0	impossible	CB, CB12
Generator set no start	impossible	11-1	CB, CB12
Min. alternator voltage	12-0	12-1	CB, CB12
Max. alternator voltage	13-0	13-1	CB, CB12
Min. alternator frequency	14-0	14-1	CB, CB12
Max. alternator frequency	15-0	15-1	CB, CB12
Option 3 module CAN bus	impossible	16-1	CB, CB12
Option 4 module CAN bus	impossible	17-1	CB12
Option 5 module CAN bus	impossible	18-1	CB12
Option 6 module CAN bus	impossible	19-1	CB12
Spare			
RS485 communication	21-1	impossible	CB, CB12
Hardware watchdog	impossible	22-1	CB, CB12
Spare			
Spare			
Normal contactor open (system side)	25-0	impossible	CB, CB12
Emergency contactor open (generating set side)	26-0	impossible	CB, CB12
Oil temperature	impossible	27-1	CB, CB12
Oil level low	impossible	28-1	CB12
No water preheating	29-0	29-1	CB12
Differential trigger	30-0	30-1	CB12
Permanent insulation monitor trigger	31-0	31-1	CB12
Differential relay connection	impossible	32-1	CB12
Permanent insulation monitor connection	impossible	33-1	CB12
Battery charger fault	34-0	34-1	CB12
Air cooler trip	impossible	35-1	CB12
Air cooler low level	impossible	36-1	CB12
Fuel pump 1 trip	37-0	37-1	CB12
Retention tank	38-0	38-1	CB12
Fuel tank low level	39-0	39-1	CB12
Water flow	impossible	40-1	module 3
Fire detection	impossible	41-1	module 3
Oil leak	impossible	42-1	module 3
Fuel leak	impossible	43-1	module 3
Air cooler compartment door open	impossible	44-1	module 3
MCPS door open	impossible	45-1	module 3
Main circuit breaker open	46-0	46-1	module 3
Overload	47-0	impossible	CB12
MTU engine oil pressure	impossible	48-1	module 5
MTU engine HV water temperature	impossible	49-1	module 5
MTU engine overspeed	impossible	50-1	module 5
MTU engine general fault	impossible	51-1	module 5

Wording	Alarm	Fault	Generated on
MTU engine general alarm	52-0	impossible	module 5
QST30 engine overspeed	impossible	53-1	module 5
QST30 engine general fault	impossible	54-1	module 5
QST30 engine general alarm	55-0	impossible	module 5
Engine oil high level	56-0	impossible	module 4
Engine oil high level	impossible	57-1	module 4
Startup battery min. voltage	58-0	impossible	module 4
Startup battery charger	59-0	impossible	module 4
MX coil	impossible	60-1	module 4
Damping valve	impossible	61-1	module 4
Starter air pressure	62-0	impossible	module 4
Magneto-thermal relay	63-0	impossible	module 4
Engine oil pressure	64-0	impossible	module 4
Engine water temperature	65-0	impossible	module 4
Engine oil temperature	66-0	impossible	module 4
Fuel low level (combined in option No. 16)	67-0	impossible	module 4
Fuel high level	68-0	impossible	module 4
Fuel very low level	impossible	69-1	module 4
Fuel very high level	impossible	70-1	module 4
Oil low level	71-0	impossible	module 4
Cylinder head temperature	impossible	72-1	module 4
Thermostat water inlet temperature	impossible	73-1	module 4
No water circulation	impossible	74-1	module 4
Bearing temperature	75-0	impossible	module 4
Bearing temperature	impossible	76-1	module 4
Stator temperature	77-0	impossible	module 4
Stator temperature	impossible	78-1	module 4
Fuel pump 2 trip	79-0	79-1	module 4

(*) Special case: the "engine oil high level" indication is possible as an alarm and as a fault with two different numbers (56-0 and 57-1).

8 - Access to programming and language change functions

The programming/browsing functions are always accessed using the **Menu** button. However, the various menus and parameters are always displayed in English only (when international language is selected).



The software version number appears on the first line next to **GENERAL**. All the texts are in English.

By pressing the **Menu** button for at least three seconds, the first screen is displayed to allow you to change the language, and possibly the time and date.

Users guide and maintenance manual

Mitsubishi

SQ series

Réf. constructeur :
Version 02/2003

Réf. GPAO : 33522050201 ind1

INTRODUCTION

This publication covers the standard specification model for the Mitsubishi SQ-Series diesel engines. The information, specifications, and illustrations in this publication are based on the information that was current at the time this issue was written.

This manual contains operation instructions, lubrication and maintenance information.

The OPERATION section is a reference for the new operator and a refresher for the experienced operator. Read — study — and keep it handy. Illustrations guide the operator through correct procedures of checking, starting, operating, and stopping the engine. Operating techniques outlined in this manual are basic. Skills and techniques develop as the operator gains knowledge of the engine.

The MAINTENANCE section is a guide to engine care. The illustrated, step-by-step instructions are grouped by service intervals. Items without specific intervals are listed under "When Required." Items in the Lubrication and Maintenance Chart are referred to in the detailed instructions which follow.

Notice that the technical information in this manual depends on the specification of the engine and the accessories. All specifications are subject to change without any prior notice.

For items other than those in this publication, please refer to the operation manual of the equipment in which this engine is installed.

Operation Manual
Mitsubishi SQ-Series diesel engines
Version 02/2003

WARNING SIGNS

The following safety related signs are used in this manual to emphasize important and critical instructions:

⚠ DANGER — Indicates the most serious specific potential hazard which could result in serious personal injury or death.

⚠ WARNING — Indicates a specific potential hazard which could result in personal injury.

⚠ CAUTION — Indicates operating procedures, practices, etc. which could result in personal injury or damage causing destruction to the engine. Some of the CAUTION signs also indicate a specific potential hazard which could result in serious personal injury or death.

⚠ NOTE — Indicates procedures, conditions, etc. which are important to highlight.

Symbols

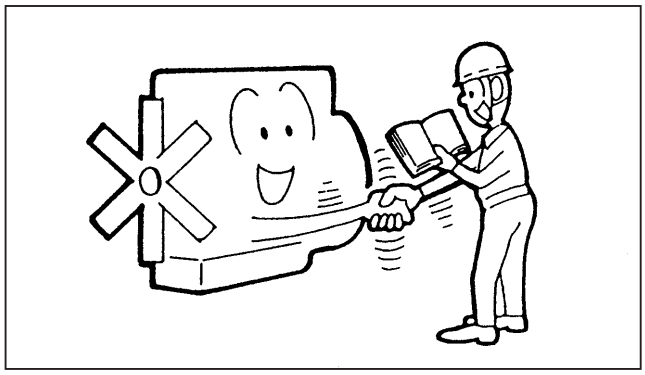
✓ Indicates a proper action or "DO".

⊘ Indicates a prohibited action or "DON'T".

Recommendation of daily operation records

It is obvious to every engine user and operator that an engine should not be run to destruction. Daily recording is a preventive maintenance program and will serve as a guide for:

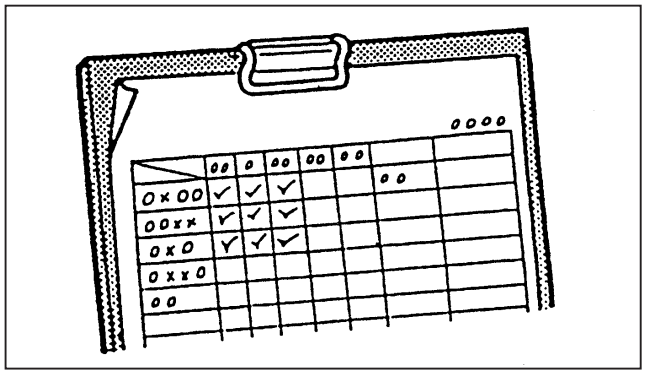
- Effective troubleshooting (to help a serviceman from your Mitsubishi dealer to pin-point a problem).
- Quick service and less downtime (to help a serviceman from your Mitsubishi dealer save time (and costs for service))
- Grasp of operating conditions (to help you recognize conditions, signs or indications of approaching trouble)



Items to be recorded

The following items are recommended to be recorded:

1. Operating hours (service hour meter reading)
2. The amount of oil, fuel, and coolant (soft water) required for refilling
3. Oil and coolant change intervals
4. Engine oil pressure, exhaust temperature, coolant temperature, and inlet air temperature
5. Parts serviced, kinds of service (adjustment, repairs or replacement), and the results of each service
6. Changes in operating conditions (for example, "Exhaust smoke turned black," etc.)



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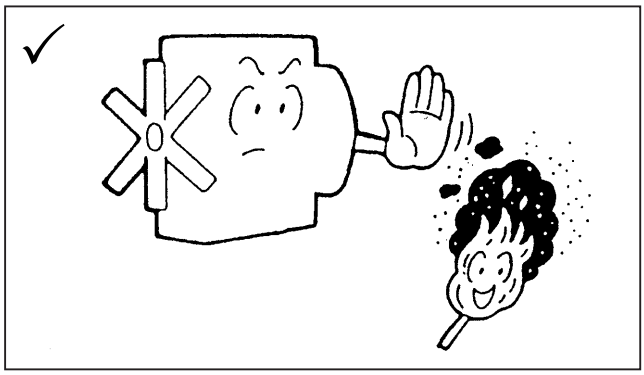
1 SAFETY

1.1 Preventing fire and explosions

⚠ **Fire hazards!**

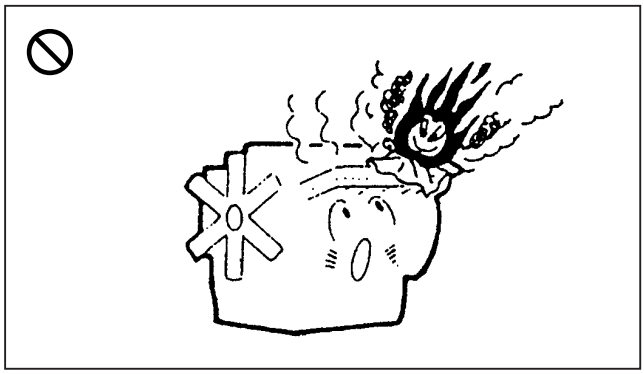


Do not smoke while refueling, or when handling fuel containers. Do not use gasoline or diesel fuel for cleaning parts. Good quality commercial, non-flammable, and non-toxic solvents are recommended. Do not spill any fuel on hot surfaces. Clean up any spillage immediately.

⚠ **Do not fill fuel tank while the engine is running!**

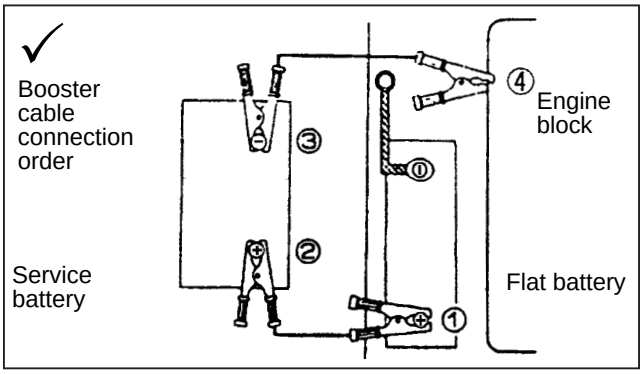
Shut off the engine when fueling and use extra caution if the engine is hot.

⚠ **Do not bring close to flammable materials!**



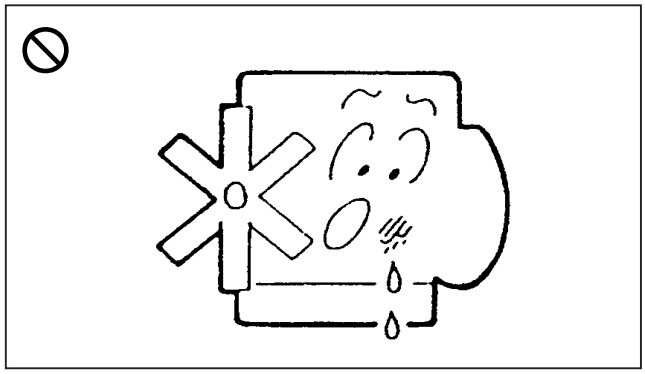
Do not put flammable materials on hot parts of the exhaust pipe. Keep them away from the pipe. In addition, do not operate the engine in areas where flammable materials are present.

⚠ **Connect the battery earth cable carefully!**



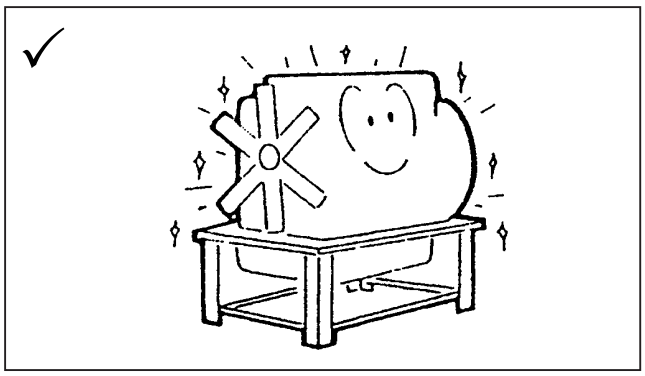
Finally, connect the earth cable (negative terminal) to the engine block, when starting the engine using another battery. If it is accidentally connected to the negative terminal of the mounted battery, a spark may occur, igniting the explosive gas produced by the battery. After starting the engine, first disconnect the earth cable.

⚠ **Always be alert to any fuel or oil leaks!**



If you discover any leaks, take counter-measures immediately. If there are fuel or oil spills on the hot engine, fire may occur, resulting in personal injury or damage to the equipment.

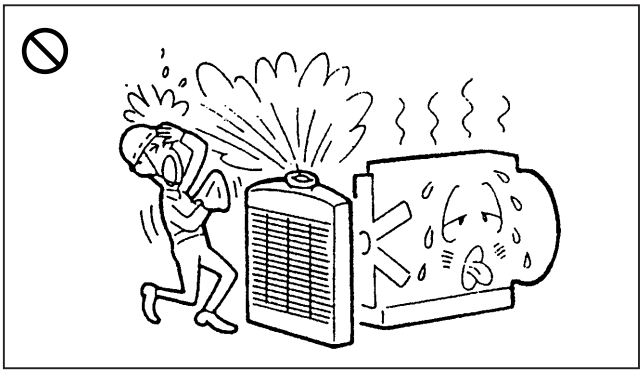
⚠ **Keep the engine and its compartment clean!**



Remove all flammable materials such as fuel, oil, and other debris, before they accumulate on the engine.

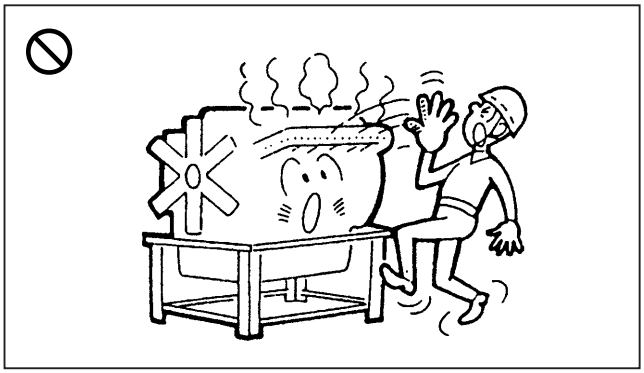
1.2 Prevent burns

⚠ **Remove the radiator filler cap carefully!**



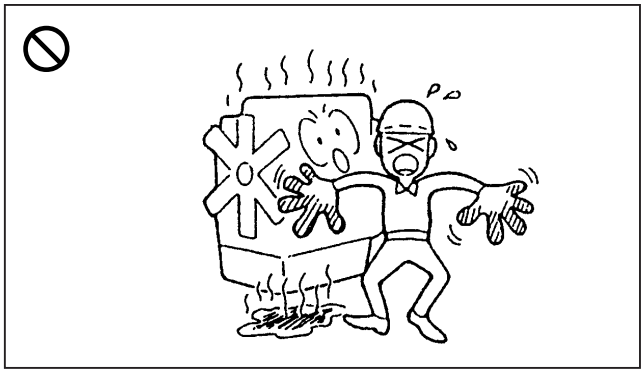
Under operating temperatures, the engine coolant is hot and under pressure. The steam can cause personal injury. Check the coolant level only after the engine has been turned off and the filler cap is cool enough to touch with your bare hands. If necessary grip the cap with a cloth and remove it slowly in order to gradually relieve the pressure.

⚠ **Do not touch any hot components!**



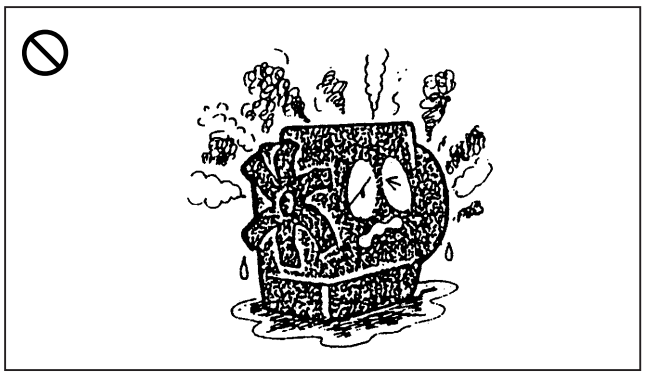
At operating temperature, the engine components become very hot. Avoid any contact during operation. Service the engine only after it has been stopped and the components are cool enough to touch with your bare hands.

⚠ **Avoid burns!**



Immediately after completing operations do not change the oil or the coolant. Hot oil or coolant may burn the skin. Allow the engine to cool down to room temperature before replacement.

⚠ **Turn off the battery switch before servicing!**

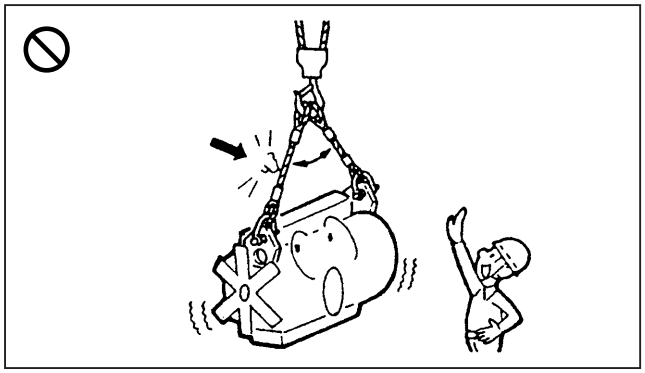


Be sure to turn OFF the battery switch before servicing.

If electrical equipment, including the starter or alternator, is serviced with the battery switch turned ON, it may be shortcircuited by the current from the battery's positive terminal, resulting in burns or in fire.

1.3 Lifting precautions

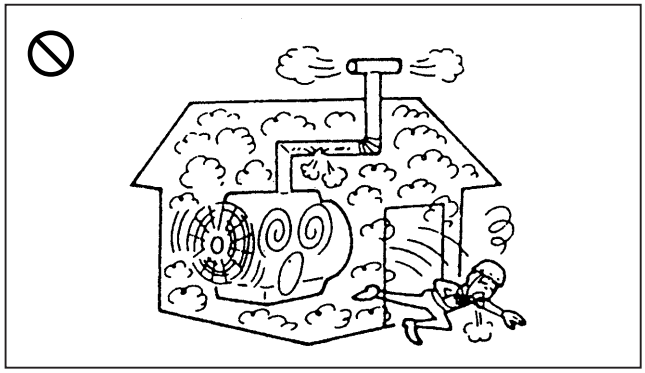
⚠ **Lift the engine carefully!**



Never allow anyone to walk or stand underneath a suspended engine. Operate the hoist carefully without jerking it. Remember, sudden impact of loads can cause serious accidents.

1.4 Exhaust fumes

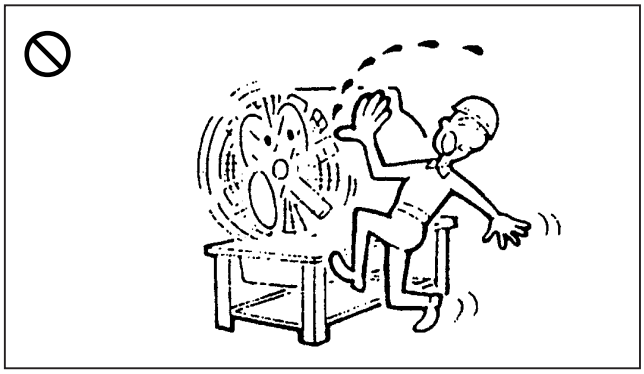
⚠ **Exhaust fumes**



Operate the engine in safe areas only! Operate the engine in a well ventilated area. Never operate it in an enclosed area. In particular, do not operate it near an air inlet port on the downwind side.

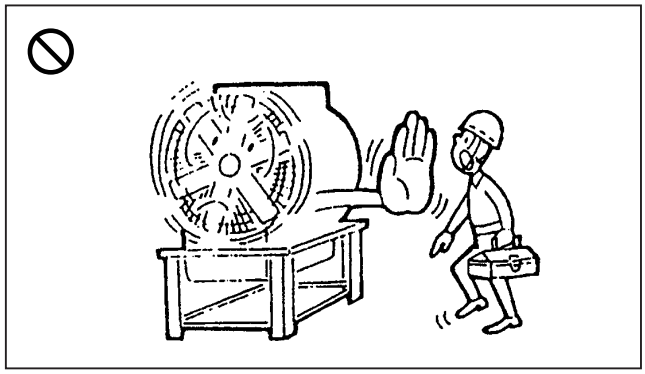
1.5 Prevention of cuts and other injuries

⚠ **Stay clear of all rotating and moving parts!**



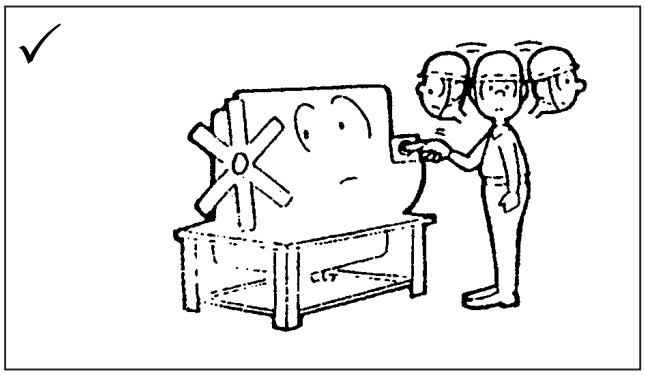
The rotating parts of the engine are dangerous. Always stay clear of them during operation.

⚠ **Use care during checking and servicing!**



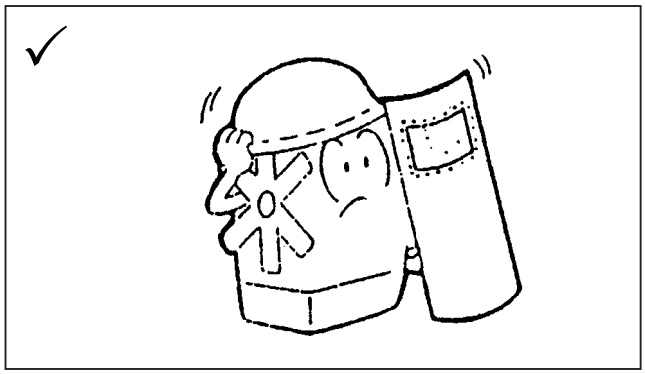
Before performing maintenance, remove the starter switch key and turn OFF the battery switch. Attach a "DO NOT OPERATE" or similar warning tag to the starter switch.

⚠ **Ensure that everything is in order before restarting the engine!**



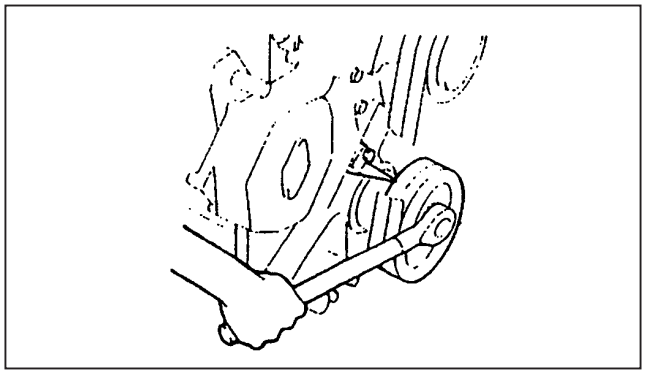
Before starting the engine, make sure that no one is working on or close to the engine. Remove all foreign material from the engine, such as debris, oil, tools, and other items which are not part of the engine.

⚠ **Install the protective covers!**



To prevent personal injury, make sure all protective covers and guards are placed on the rotating parts.

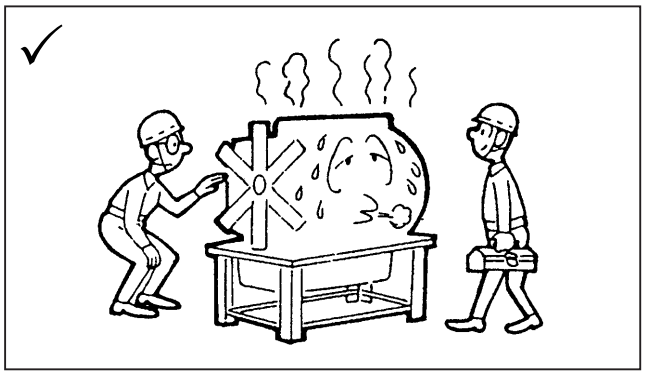
⚠ **Keep the turning tool disengaged when it is not in use!**



When not in use, properly lock the turning gear in the disengaged position. Failure to follow this recommendation can cause personal injury and engine damage.

1.6 Maintenance precautions

⚠ **Stop the engine before servicing it!**

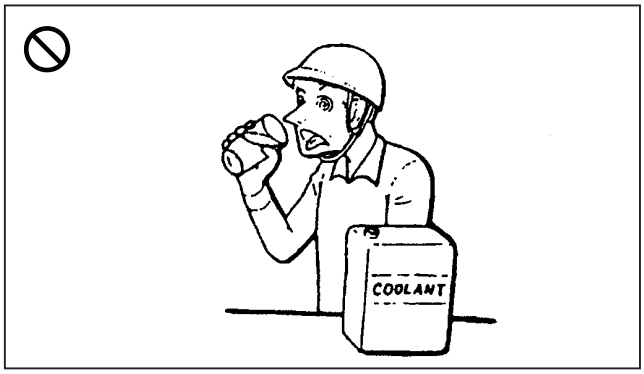


Always stop the engine before adding or changing oil, coolant, or fuel. Check the coolant level only after the engine has been stopped and the radiator filler cap is cool enough to remove it with bare hands. Never attempt to adjust the fan belt while the engine is running.

⚠ **Handle battery electrolyte carefully!**

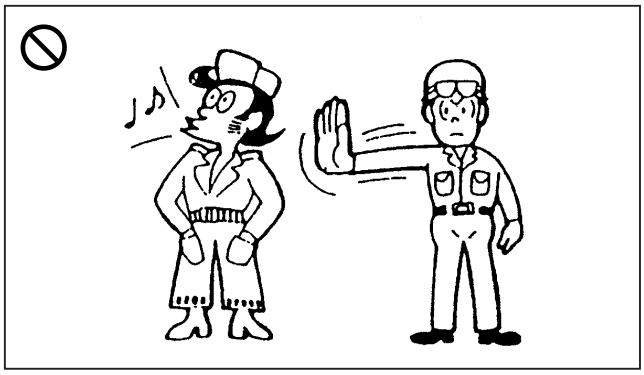
If battery electrolyte comes into contact with the eyes or skin, wash them clean immediately by using plenty of water. If it comes into contact with the eyes, wash out your eyes immediately and then see a doctor.

⚠ **Handle antifreeze carefully!**



If you accidentally drink antifreeze, make yourself vomit and see a doctor immediately. If antifreeze comes into contact with the eyes, immediately wash them clean by using plenty of water and then go and see a doctor.

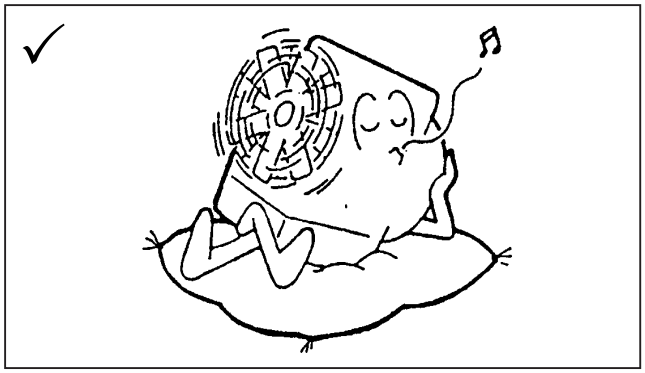
⚠ **Dress properly for the job!**



For your own protection, you may need any number of special items - hard hat, face shield, safety shoes, goggles, heavy gloves, ear protectors, etc. Please do use these when required.

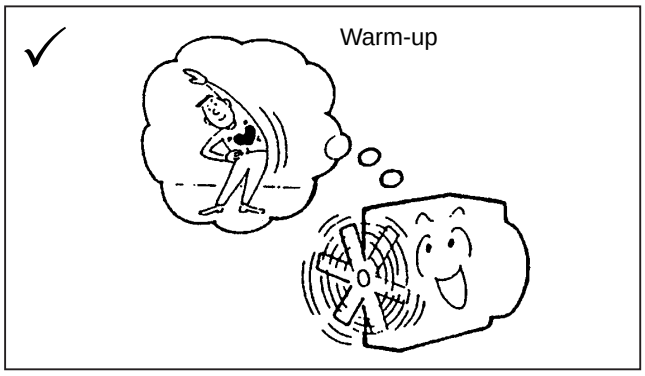
1.7 Operating precaution

⚠ **Be sure to break in the engine!**



During the first 50 hours of operation, break in the engine by using lighter loads and lower speeds than normal. A proper break in contributes to the maximum service life of the engine.

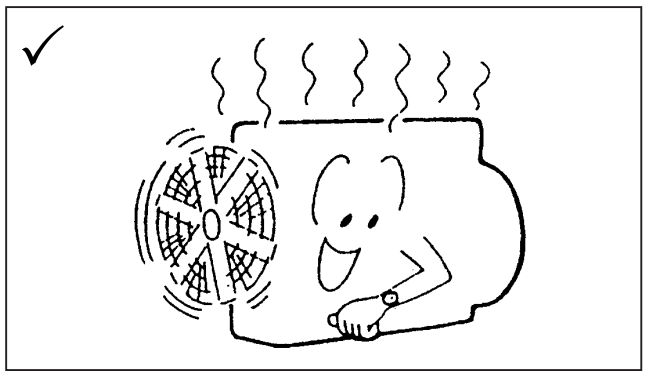
⚠ **Warm up the engine before operation!**



After starting the engine, leave it idling for 5 to 10 minutes before operating under full load, for maximum engine life.

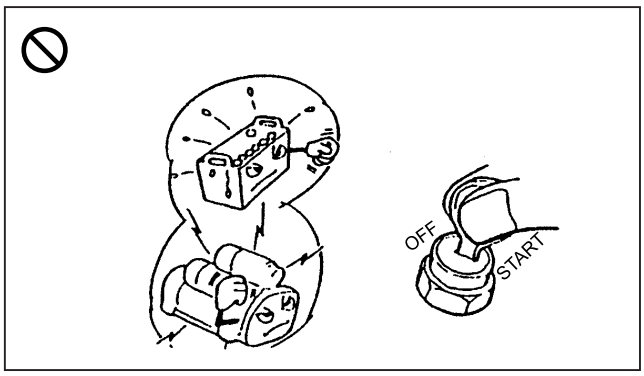
NOTE: Long periods of warming up the engine are not recommended. They can deposit carbon in cylinders and cause incomplete fuel combustion.

⚠ **Stop the engine only after it has cooled down!**



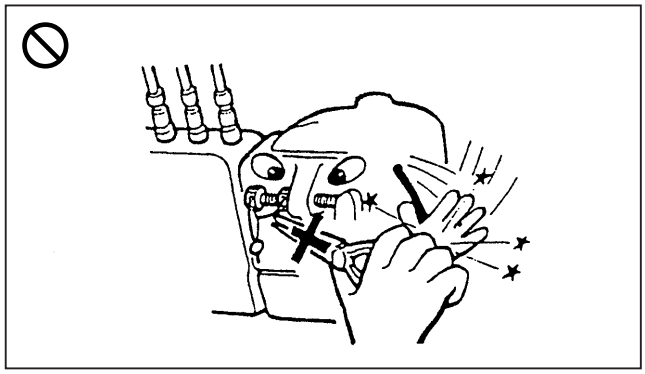
Stopping the engine immediately after it has been working under a load, can result in overheating and accelerated wear of the engine components. Before stopping the engine, leave it idling for 5 to 10 minutes. This allows the hot areas in the engine to cool down gradually, which extends engine life. While the engine is running, make a walk-around inspection to make sure everything is functioning properly.

⚠ **Use the starting motor correctly!**



When starting the engine, do not crank it for more than 10 seconds at a time. After every 10 seconds of engine cranking, allow 30 seconds for the starting motor to cool before cranking it again.

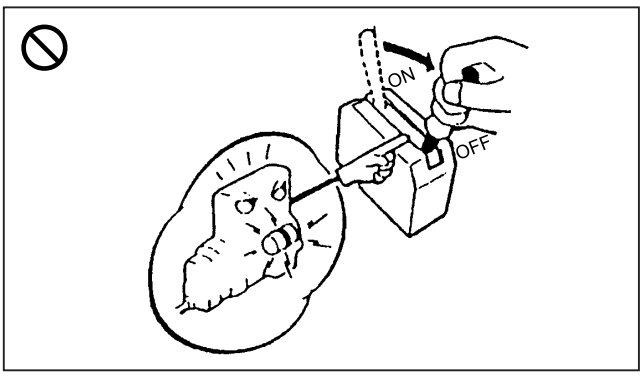
⚠ Do not break any seals for settings!



Never attempt to break the seals of the fuel injection pump (governor) controlling injection quantity and minimum and maximum speed settings. Breaking these seals and varying settings could result in:

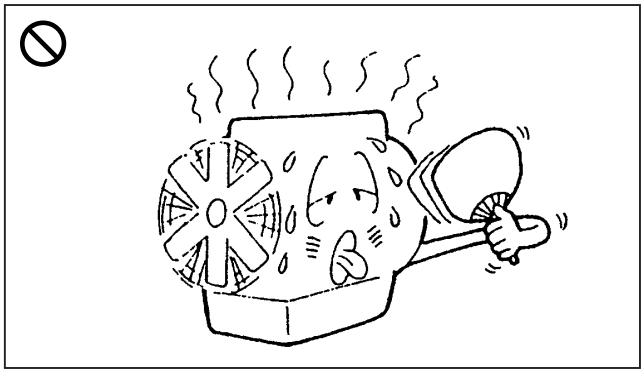
- Accelerated wear of the engine components
- Seizure of or damage to the engine components
- Increase in fuel and oil consumption
- Maladjusted injection quantity and poor engine performance
- Violation to emission regulations

⚠ Do not turn OFF the battery switch during operation!



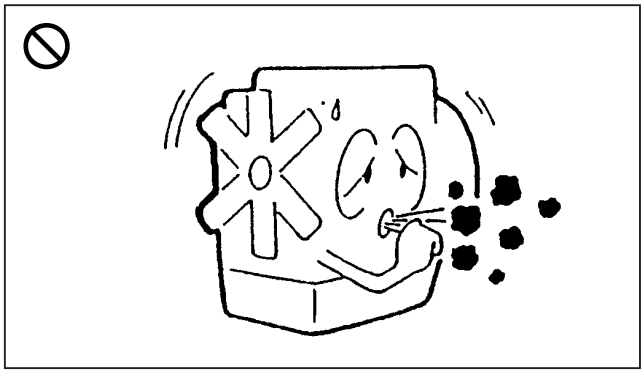
To avoid damage to the alternator diodes and the transistors, do not turn OFF the battery switch when the engine is running. This could also result in a failure of instruments to work properly.

⚠ Always keep the engine compartment well ventilated!



Unless the engine compartment is properly ventilated, the air supply will be inadequate, resulting in a shortage of air for fuel combustion and the loss of power.

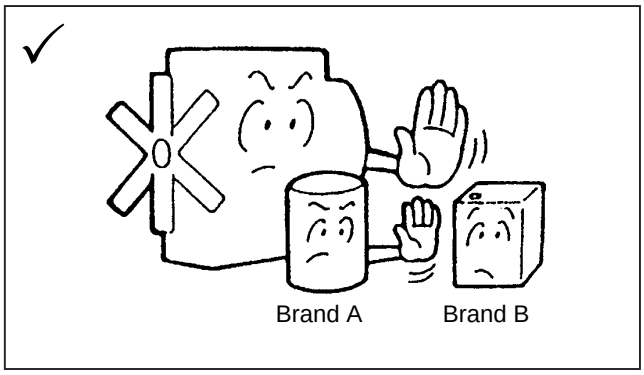
⚠ Avoid overloading!



Overloading can cause incomplete combustion, often indicated by black smoke, high fuel consumption, and carbon deposits in the combustion chambers, adversely affecting the engine lifespan.

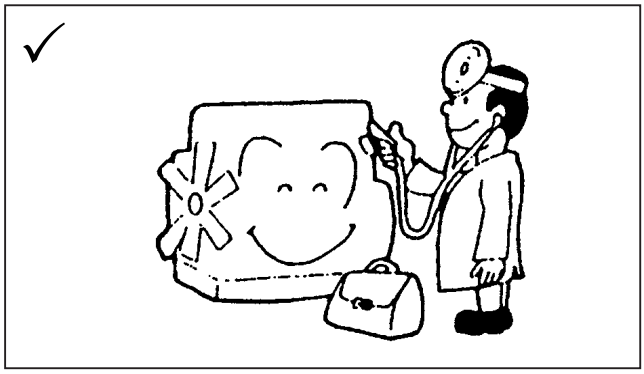
1.8 Maintenance precautions

⚠ **Use the recommended fuel, oil, and coolant!**



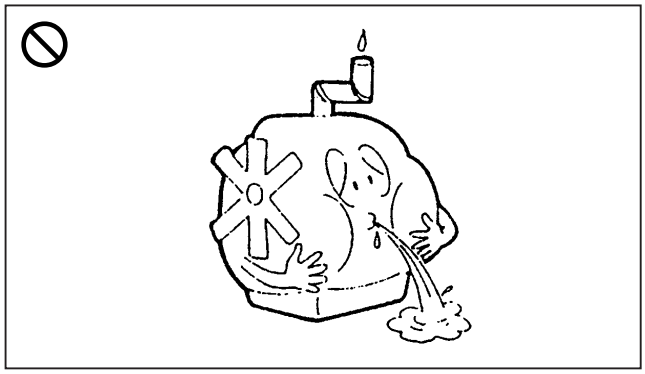
Use of any other fuel, oil, or coolant can cause engine damage and reduce the engine service life.

⚠ **Perform all recommended inspections!**



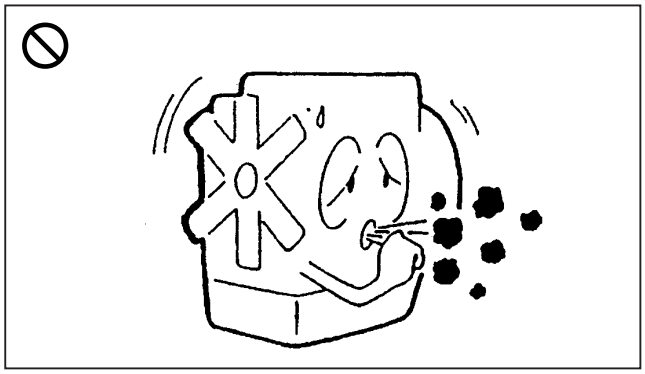
Perform pre-start inspection and periodic inspection on items listed in this manual. Failure to follow this recommendation can cause engine damage, injury, or death.

⚠ **Keep water out of the engine!**



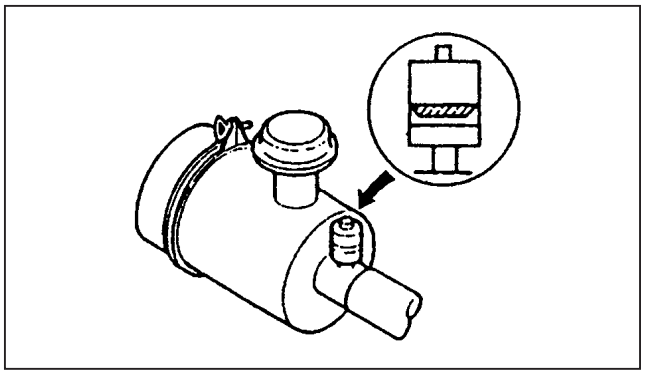
When washing the engine, cover the air inlet and exhaust opening with tape to prevent water or cleaning agent from getting inside the engine. Do not wash the engine while it is running. If water or cleaning agents get inside the combustion chambers, the hammering action of water can damage the engine.

⚠ **Keep grit-laden air out of the engine!**



Dust and dirt entering the engine will cause early wear of the moving parts. This could result in a loss of power, high oil consumption, starting problems, or other failures. Service the air filter as instructed.

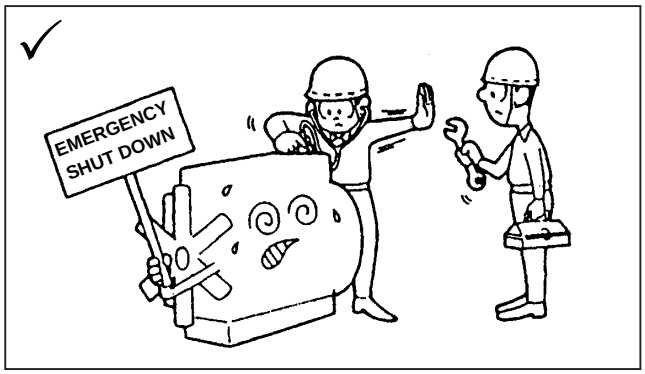
1. Do not service the air filter while the engine is running.
2. When removing the air filter element for service, prevent any dust from entering the air intake to the cylinders.



3. Service the air filter equipped with a dust indicator when red is shown. Under-frequent service can cause damage.

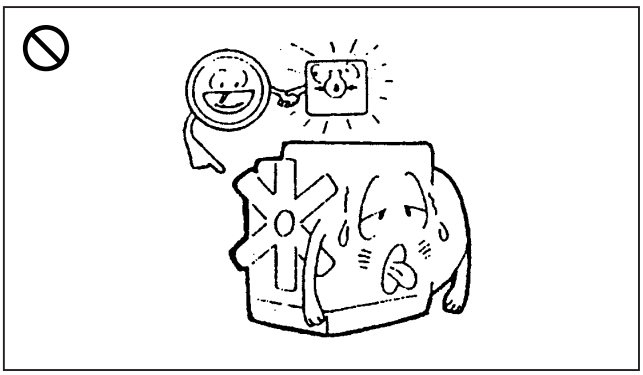
1.9 If any trouble should occur

⚠ If the engine suddenly stops:



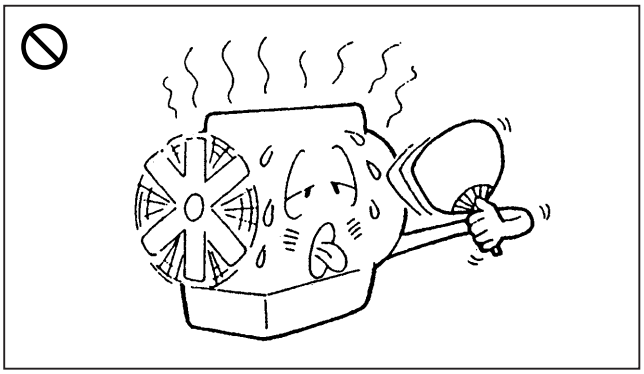
Do not restart the engine immediately after it has suddenly stopped. Check for the cause and make the necessary repairs before restarting the engine. A failure to follow this precaution can cause serious engine problems.

⚠ If the engine oil pressure is low:



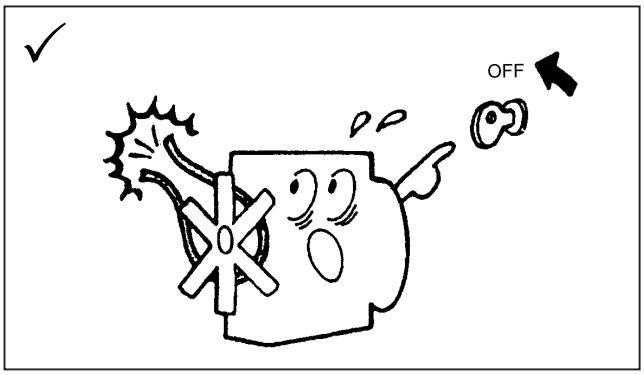
Stop the engine immediately and check the lubrication system. Operating the engine with low oil pressure can cause bearings and other parts to seize.

⚠ If the engine overheats:



If the engine overheats, do not turn it off immediately. Suddenly stopping an overheated engine can result in a steep rise in the coolant temperatures and the seizure of running parts. First leave the engine idling to allow the hot areas in the engine to cool down, then gradually add the coolant. Remember, adding coolant to an overheated engine can cause damage to the cylinder head.

⚠ If the fan belt is broken:



Stop the engine immediately. Operating the engine with a broken fan belt can cause engine overheating, which, in its turn, can cause the coolant to burst out of the reservoir tank and the radiator cap.

2 IMPORTANT INFORMATION

2.1 Operating the engine properly

1. Never attempt to break the seals of the injection pump governor for maximum speed and maximum injection quantity settings. Breaking these seals and varying the settings could result in:
   - Accelerated wear of engine components
   - Increase in fuel and oil consumption
   - Maladjusted injection quantity and poor engine performance
   - A violation to emission regulations
2. Always keep the engine room well ventilated. If it is not properly ventilated, the air supply will be inadequate, resulting in lack of air for fuel combustion and loss of power.
3. Start the engine properly. After every 10 seconds of engine cranking, allow 30 seconds for the starting motor to cool before cranking it again.
4. After starting the engine, leave it idling for 5 to 10 minutes before operating it at full load, for maximum engine life.

> ⚠ **NOTE**
> Long periods of warming up the engine are not recommended. They can result in carbon deposits in the combustion chambers and incomplete fuel combustion.

5. To avoid damage to the alternator, do not turn OFF the battery switch when the engine is running.
6. Avoid overloading. Overloading can cause incomplete combustion, often indicated by black exhaust, high fuel consumption, and carbon deposits in the combustion chambers, affecting engine lifespan.
7. It is advised to break in the engine within the first 50 hours of operation. The way to do this is by operating the engine under a lighter load and lower speeds than normal. When an engine is properly broken in, it contributes to the maximum service life of the engine.
8. Stopping the engine immediately after it has been working under load can result in accelerated wear of engine components. Before stopping, leave the engine idling for about 5 minutes. This allows hot areas of the engine to cool down gradually, extending the engine life. Whilst the engine is running, make a walk-around inspection and check for oil, fuel, or coolant leaks.

2.2 Service the engine properly

1. Use the recommended fuel, oil, and coolant listed in this manual. The use of any other fuel, oil, or coolant can result in higher maintenance costs and can reduce the engine service life.
2. Be sure to perform pre-start inspection and periodic service on items specified in this manual. Improper inspection or service is dangerous and could result in damage to the engine, injury, or death.
3. At the end of each day of operation, check the engine for broken, defective, or missing parts. If you discover any items that need attention, repair, replacement, or adjustment after your daily check, report it as soon as possible. Keep in mind that even minor defects could result in very serious trouble.
4. When washing the engine, cover the air inlet and the exhaust openings with tape to prevent water or cleaning agent from getting inside the engine. Do not attempt to wash the engine when it is running. If water or cleaning agent gets inside the combustion chambers, the hammering action of water could cause damage to the engine.
5. Clean air is essential to a satisfactory engine operation and to a long engine life. This is also the reason why it is very important to service the air cleaner properly. The air cleaner prevents dust and grit-laden air from getting into the engine. Dust and dirt entering the engine will cause rapid wear of piston rings, cylinders, and pistons, resulting in loss of power and high oil consumption. Also, if dust and dirt are allowed to build up in the air cleaner passages, then this will eventually restrict the air supply to the engine and result in heavy carbon deposits on the pistons and valves due to an incomplete combustion. Therefore:
   - Do not service the air cleaner when the engine is running.
   - When removing the air cleaner from the engine for servicing, prevent dust from entering the air passage to the cylinders.
   - Service the air cleaner element at reasonable intervals, or whenever the signal of the indicator is visible. That is, if your engine is equipped with an indicator signal.
   - Do not use the element if any tears, rips, or damage are evident.

2.3 If any trouble should occur

1. If the engine stops abruptly, try to find the problem and its source and make the necessary repairs before starting the engine again.
2. If the engine overheats, a warning light will come on and, at the same time, the engine will stop. When this happens, do not ever add coolant to the overheated engine. First allow the engine to cool down, then add the coolant gradually.
3. If the engine oil pressure becomes low, stop the engine and check for the cause. Operating the engine while the oil pressure is low can cause seizure of the bearings and other parts.

3 SPECIFICATIONS[1]

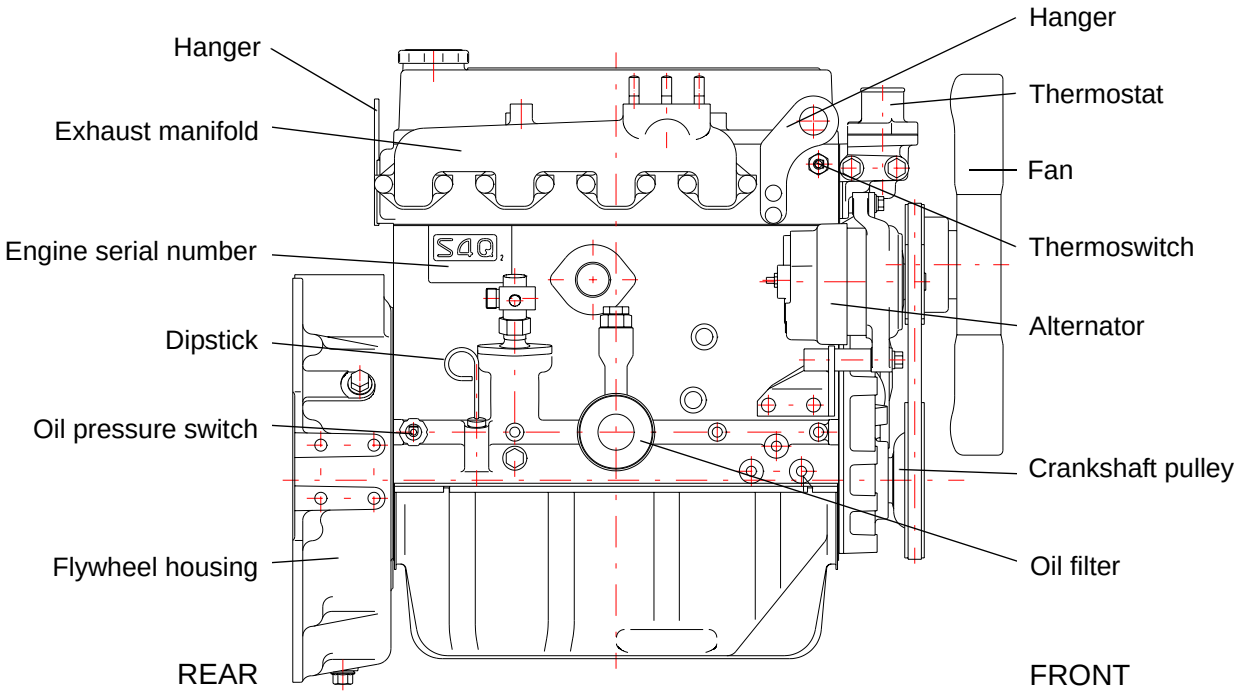
System	Item	Model	
		S4Q	S4Q2
ENGINE PROPER	Type	4-cycle, water-cooled, vertical, overhead valve, diesel engine	
	Combustion chamber	Swirl chamber type	
	No. of cylinders	4	
	Bore x Stroke (mm)	88x95	88x103
	Total displacement (*l*)	2.311	2.505
	Compression ratio	22	
	Firing order	1 - 3 - 4 - 2	
	Dry weight (kg)	195	
LUBRICATING SYSTEM	Lubricating method	Forced lubrication	
	Oil pump	Trochoid pump	
	Oil filter	Paper element type	
	Oil capacity: FULL level/EMPTY level (*l*) (Exclusive of oil filter capacity 0.5 *l*)	Shallow type oil pan: 5.5/4.0 Deep type oil pan: 7.0/5.5	
FUEL SYSTEM	Fuel injection pump	Bosch A or VE type	
	Nozzle	Throttle type	
	Fuel injection pressure	120 kgf/cm^2	
	Fuel to be used	Diesel fuel; see chapter 7	
	Governor	Centrifugal weight type	
INTAKE SYSTEM	Air cleaner	Paper-element type	
COOLING SYSTEM	Cooling method	Forced circulation of water	
	Water pump	Centrifugal type	
	Coolant capacity (*l*) (Engine proper only)	4	
ELECTRICAL SYSTEM	Starter (V - kW)	12 - 2.0	
	Alternator (V - A)	AC generator (12 - 50)	
	Glow plug	Sheathed type	
	Battery (capacity depends on application)	12V, 100 Ah or more	

Table 1 Specifications

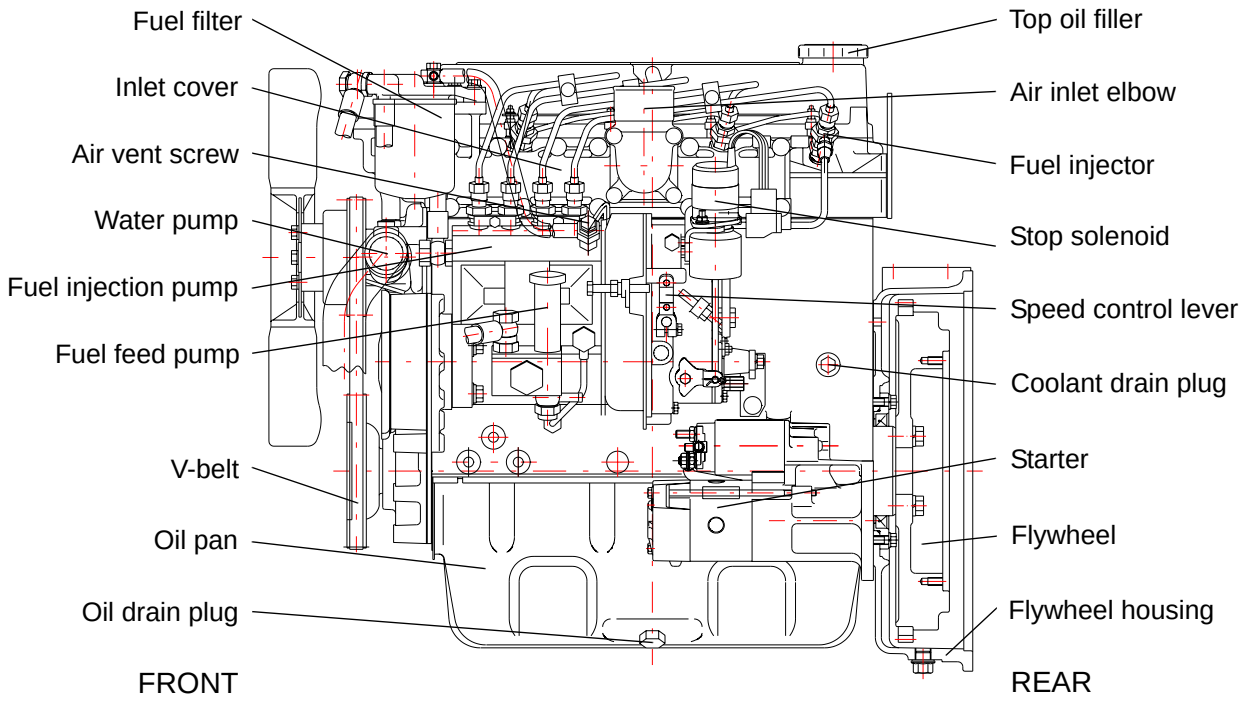
1 All specifications are subject to change without any prior notice.

4 NOMENCLATURE

4.1 Engine S4Q/S4Q2



RIGHT SIDE VIEW



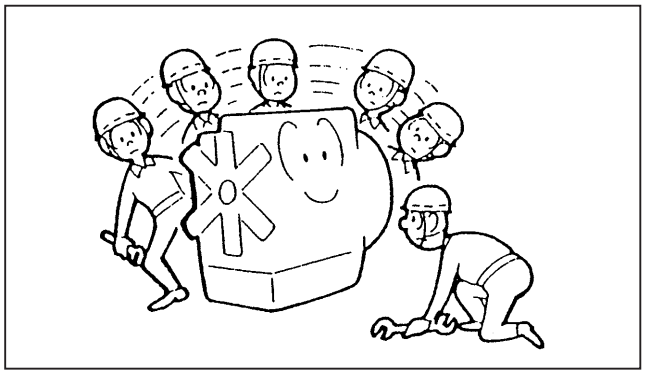
LEFT SIDE VIEW

5 OPERATION

5.1 Pre-start inspection

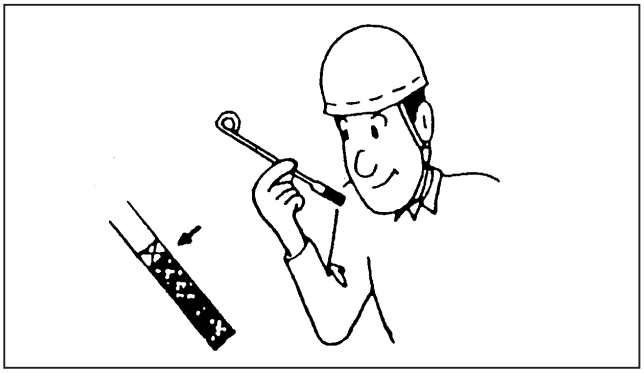
5.1.1 Walk-around Inspection

Look around for items such as loose bolts, debris build-up, oil, fuel, or coolant leaks, broken or worn parts.



5.1.2 Check engine oil level

Maintain the engine oil level between the MAX and MIN marks on the dipstick. Add oil if necessary (see page 31).

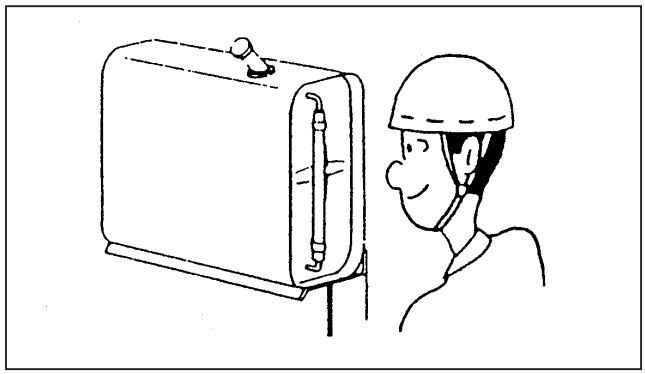


⚠ NOTE

The engine should be put in the horizontal position to check the oil level. The dipstick should be withdrawn, wiped clean, re-inserted in the oil level guide for 2 seconds, and again withdrawn so that the oil level on the dipstick can be seen.

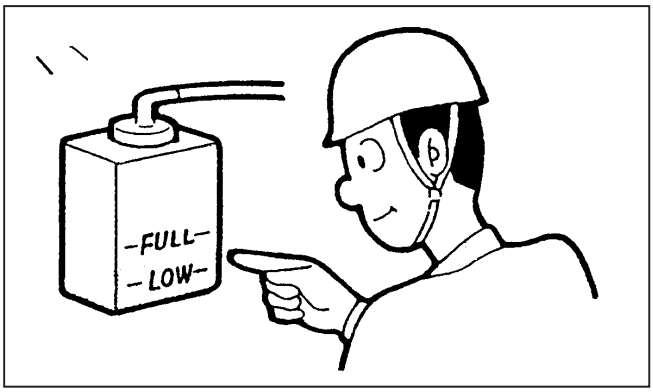
5.1.3 Check fuel level

Make sure that the fuel level is at the FULL mark in the sight gauge.



5.1.4 Check the coolant level

Maintain the coolant level to the FULL mark on the reservoir tank (when the engine is cold). Add coolant when necessary.



⚠ NOTE

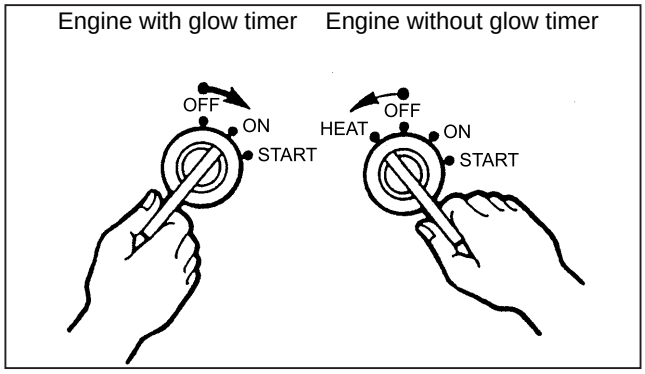
When adding coolant, maintain the recommended concentration of Long Life Coolant (see page 33). Do not add water. This dilutes Long Life Coolant and adversely affects the freeze protection.

⚠ CAUTION

Check the coolant level only when the engine is cold.

5.2 Starting the engine

The engine can be equipped with or without a glow timer. For starting instructions, please consult the chapter which specially applies to your engine.



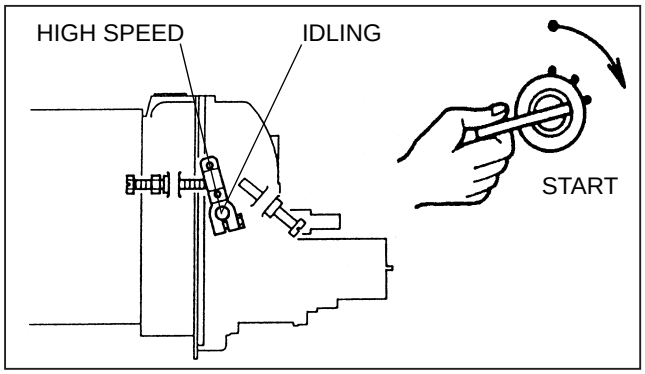
5.2.1 Engine with glow timer

1. Move the speed control lever to the HIGH SPEED position.
2. Turn the starter switch key to the ON position and make sure that the oil pressure, coolant temperature, and glow plug indicators are lit. See Table 2 Starting Aid Chart for heating time.

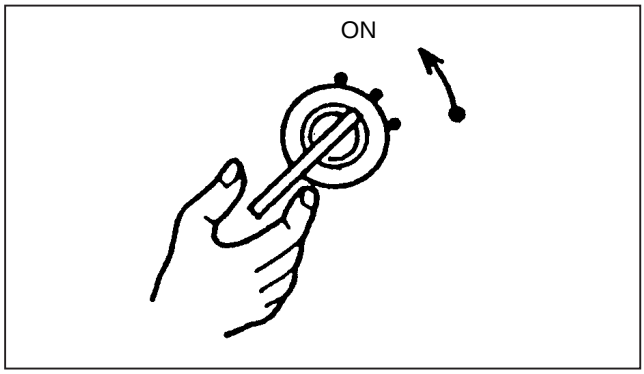
Glow plug type	Coolant temperature	Heating time
Quick-heating type	Below 5°C (41°F)	About 3 seconds
	Above 5°C (41°F)	About 1 second
Standard type	Normally	About 6 seconds

Table 2 Starting Aid Chart

3. When the glow plug indicator goes off, turn the key to the START position.



4. Release the key when the engine starts. The key will return to the ON position when released.



5. Move the speed control lever to the idling position.

5.2.2 Engine without glow timer

1. Move the speed control lever to the FULL THROTTLE position.
2. Turn the starter switch key to the HEAT position and continue to hold it there for approximately 6 seconds. Do not use the glow plugs for more than 15 seconds at a time.
3. Turn the key to the START position and release the key when the engine starts. The key will return to the ON position when released.
4. Move the speed control lever to the idling position.

⚠ WARNING

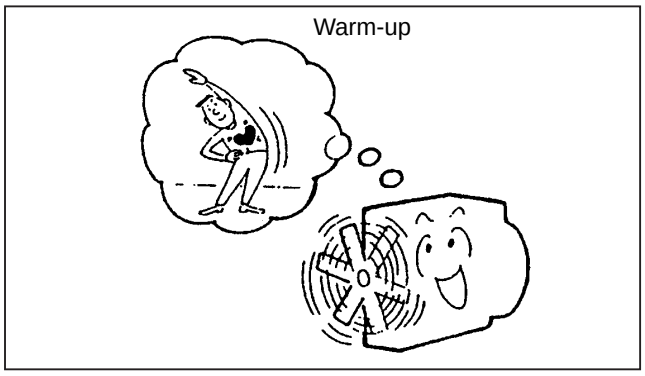
Before starting the engine, make sure that no one is working on or close to the engine. Keep the engine free of foreign material such as debris, oil, tools, and other items which are not part of the engine.

⚠ CAUTION

- After every 10 seconds of engine cranking, allow 30 seconds for the starter to cool down before cranking again.
- To avoid damage to the starter, do not turn the starter switch key to the START position while the engine is running.
- When cranking the engine for starting, do not apply any load to the engine (disengage the clutch if the engine is equipped with a clutch).

5.3 Warming up the engine

Allow the engine to leave it idling for 5 to 10 minutes. A proper warm-up is absolutely essential to a maximum service life and performance and it minimalizes the operation costs of the engine.



⚠ NOTE

Long periods of warming up the engine are not recommended. They can result in carbon deposits in the combustion chambers and incomplete fuel combustion.

5.4 Starting the load

When the engine has been running long enough to warm up, apply the load. During the operation, check that:

1. All alarm indicators are OFF.
2. The engine is free from any abrupt noises and vibrations.
3. Exhaust smoke is normal.

⚠ WARNING

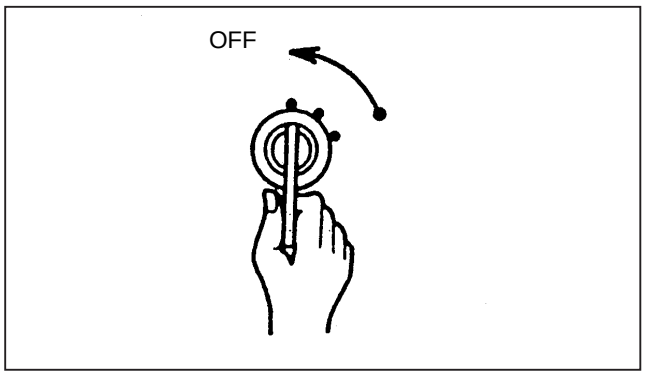
- Stay clear of all rotating and moving objects during the operation.
- At operating temperature, the engine is very hot. Any contact with the engine can cause severe burns.

⚠ CAUTION

- Always keep the engine room well ventilated. Unless it is properly ventilated, the air supply will be inadequate, resulting in lack of air for fuel combustion and a loss of power.
- During the first 50 hours of operation, operate the engine under a lighter load and lower speed than normal. A proper break in contributes to the maximum service life of the engine.
- Avoid overloading. This can cause incomplete combustion, often indicated by black exhaust smoke, high fuel consumption, and carbon deposits in the combustion chambers, affecting the engine's lifespan.
- To avoid damage to the alternator, do not turn OFF the battery switch when the engine is still running.
- To avoid damage to the starter, do not turn the starter switch key to the START position when the engine is still running.

5.5 Stopping the engine

5.5.1 Engine with a keystop device



Turn the starter switch key to the OFF position. The engine will take approximately 5 seconds to stop after the key has been turned to the OFF position.

⚠ CAUTION

- Leave the engine idling for 5 minutes. This allows hot areas in the engine to cool down gradually, which extends engine life. While the engine is still running, make a walk-around inspection, and check for oil, fuel, or coolant leaks.
- If the engine stops abruptly, try to find the problem and its source and make the necessary repairs before starting it again. After starting the engine, check to be sure that the engine has no problems.
- Remove the key from the starter switch, because leaving it in the ON position after the engine has stopped, can cause the battery to discharge.

6 MAINTENANCE

1. Service the engine in accordance with the "Lubrication and Maintenance Chart." Under extreme, severe, or dusty operating conditions, service the engine more frequently than is specified in the "Lubrication and Maintenance Chart."
2. Perform service on items at multiples of the original requirement. For example, at Every 500 Service Hours, also service those items listed under Every 250 Service Hours, Every 50 Service Hours and Every 10 Service Hours [pre-start inspection].
3. For special items marked with an asterisk (*), rely on the expert knowledge of the service men and the service facilities offered to you at your Mitsubishi dealer.

Interval	Item	Remarks (specifications)	Page
Every 10 Service Hours [Pre-Start Inspection]	Walk-around inspection		18
	Check engine oil level		18
	Check fuel level		18
	Check coolant level		18
Every 50 Service Hours	Drain water and sediment from the fuel tank and water separator		23
	Check the battery electrolyte level and specific gravity		23
First 50 Service Hours of New or Reconditioned Engine	Change engine oil	See SPECIFICATIONS (page 16)	24
	Change oil filter		24
	Retighten nuts and bolts		*
Every 250 Service Hours or once a year	Change engine oil	See SPECIFICATIONS (page 16)	24
	Change oil filter		24
	Clean fuel filter element	After cleaning, prime (page 28)	25
	Clean radiator fins		25
Every 500 Service Hours	Check and adjust valve clearance	0.25 mm (0.0098 in.) for both inlet and exhaust valves	*
	Change fuel filter element	After changing, prime (page 28)	25
	Check and adjust injection pressure	See SPECIFICATIONS (page 16)	*
	Check and adjust fan belt	Deflection: 13 mm (0.5 in.)	26
	Check glow plugs		*
Every 1000 Service Hours	Retighten nuts and bolts		*
	Check starter		27
	Check alternator		27
Every 2 Years	Change coolant	See SPECIFICATIONS (page 16)	27

Table 3 Lubrication and maintenance charts

Interval	Item	Remarks (specifications)	Page
When Required	Prime fuel system		28
	Clean air cleaner element		29
	Change air cleaner element		29

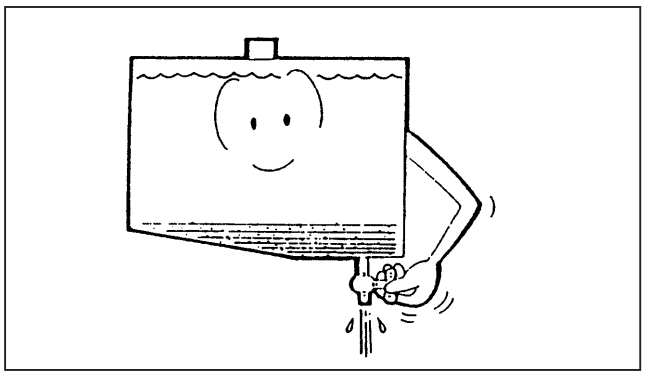
Table 3 Lubrication and maintenance charts

6.1 Every 50 service hours

6.1.1 Drain water and sediment from the fuel tank and water separator

Remove the drain plug and allow any water and sediment to drain. Drain at least 1 or 2 liters (0.3 to 0.5 U.S. gal) of fuel to remove the water and sediment.

It is evident that invisible particles of dirt in sediment which might pass through the filter will damage the finely finished parts of the fuel injection system.



⚠ DANGER

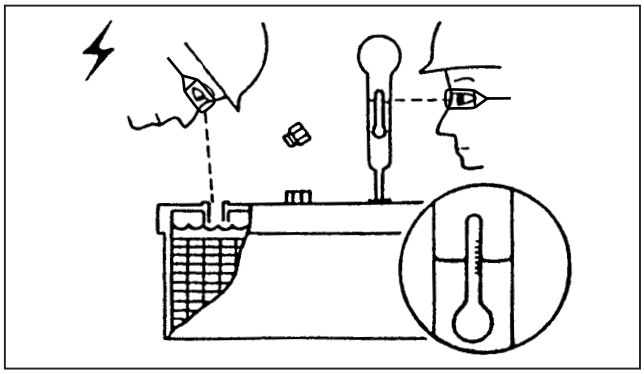
Do not smoke while draining out the water and sediment. Keep flames and sparking devices away from this area. Clean up any spillage before starting the engine.

6.1.2 Check the battery electrolyte level and specific gravity

1. Maintain the electrolyte level between UPPER and LOWER marks on the case. If the battery has not got any level marks, maintain the level 10 to 15 mm (0.4 to 0.6 in.) above the cells. Remove the filler caps and add distilled water when necessary.
2. Test the specific gravity of the battery electrolyte with a battery hydrometer. The following chart of specific gravity reading gives a general idea of the battery condition.

Specific gravity at 20°C (68°F)	Battery condition
1.26 to 1.28	Fully charged
1.22 to 1.26	Three-fourths charged (To be recharged)
Below 1.22	One-fourth charged (To be recharged)

Table 4 Specific gravity reading



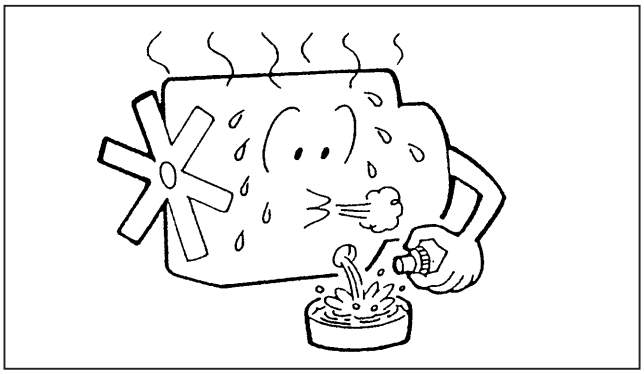
⚠ WARNING

- Battery gives off flammable fumes that are explosive.
- Do not smoke when observing the battery electrolyte level.
- Electrolyte is an acid and can cause personal injury if it comes into contact with the skin or eyes.
- Always wear goggles when working with the battery.

6.2 Every 250 service hours or once a year

6.2.1 Change engine oil and oil filter; draining oil

To avoid burns, drain the oil after the engine has cooled down to the extend that it can be touched with your bare hands. Allow the oil to drain into a container.



⚠ DANGER

Hot oil and components can cause personal injury. Do not allow hot oil or components to come into contact with the skin.

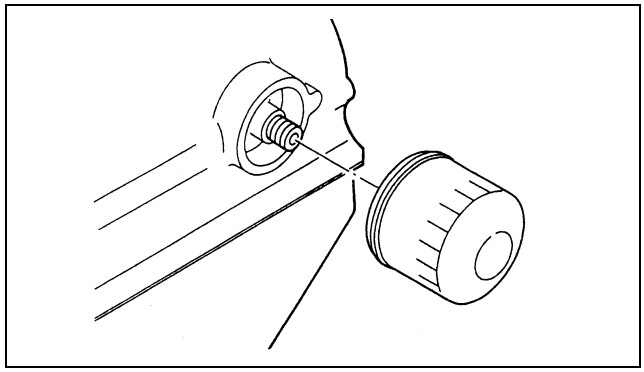
6.2.2 Changing the oil filter

1. Remove the used oil filter with a filter wrench.

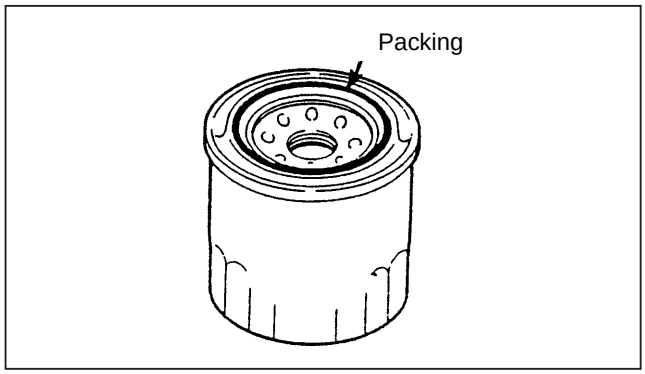
⚠ NOTE

Check particles collected in the used oil filter. If they are metallic particles, you should consult your Mitsubishi dealer.

2. Make sure that the formerly used packaging is removed from the filter base and clean the base with a clean cloth.



3. Check the new oil filter and make sure that the packing is fitted in the groove.
4. Apply a thin coat of engine oil to the packing of the new filter.
5. Install the new filter by hand until its packing touches the base. Tighten it by 3/4 to 1 turn.



6.2.3 Filling with oil

1. Install the drain plug and tighten it to the specified torque.

Torque
4.5 ± 0.5 kgf/m (33 ± 4 lbf/ft) [44 ± 5 N/m]

Table 5 Specified torque

2. Fill the crankcase with oil.

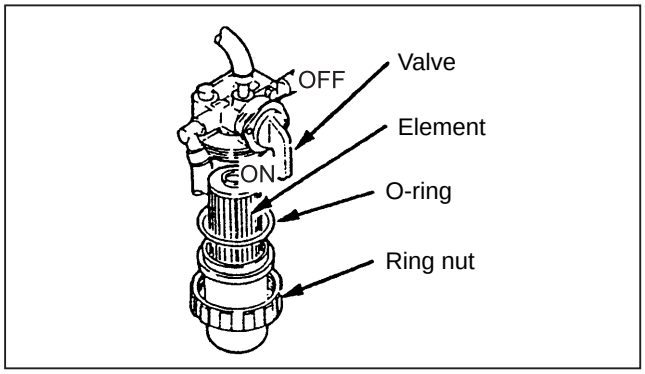
Refill capacity	See SPECIFICATIONS
API Service Classification	CF or CF-4

Table 6 Fill crankcase

3. Start the engine, leave it idling for a few minutes, and check for leaks. Re-tighten the filter in case of leakage.
4. Stop the engine and leave it inert for about 30 minutes; then re-check the oil level. Maintain the oil level between the MAX and MIN marks on the dipstick. Add oil only if necessary.

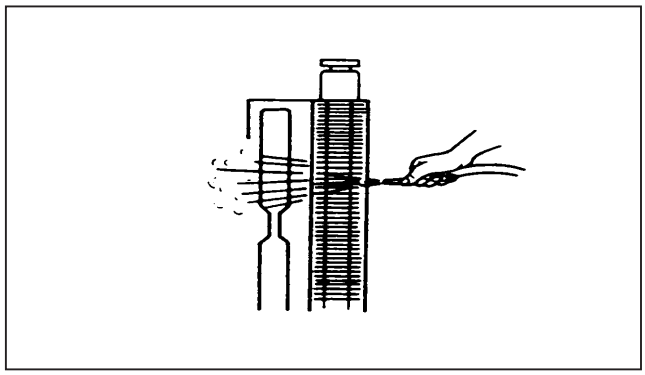
6.2.4 Cleaning the fuel filter with cut off valve

1. Turn the valve to the OFF position.
2. Loosen the ring nut and remove the cup.
3. Wash the element in kerosene or diesel fuel.
4. Put the cleaned element in the cup and install the cup, making sure the O-ring is properly fitted into place. Tighten the ring nut.
5. Turn the valve to the ON position and prime the fuel system (see page 28).



6.2.5 Clean the radiator

Direct the pressurized air to the fins in the opposite direction of the fan's air flow.

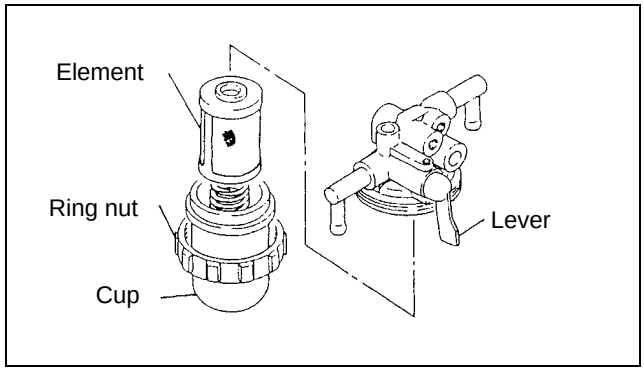


6.3 Every 500 service hours

6.3.1 Change fuel filter element

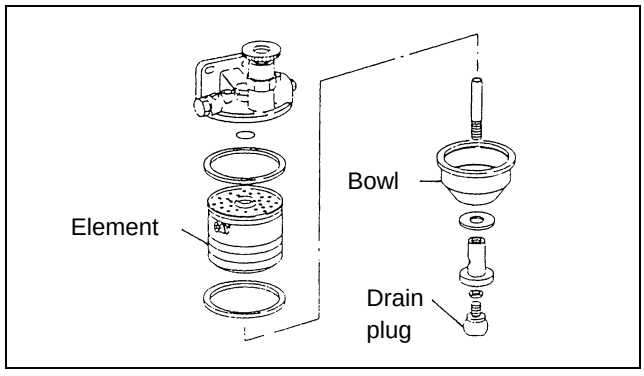
Water separator element

1. Turn the lever to CLOSE (C) position to shutt off fuel supply.
2. Loosen the ring nut and remove the cup.
3. Remove and discard the element.
4. Put the new element in the cup and install the cup, making sure the O-ring is properly fitted in place. Tighten the ring nut.
5. Turn the lever to OPEN (O) position.



Fuel filter element (A-type)

1. Loosen the drain plug and allow the fuel to drain.
2. Loosen the plug that holds the bowl and element. Remove the bowl and element. Discard the element.
3. Install the new element and bowl with the plug. Make sure the seal rings are properly fitted in place.
4. Tighten te drain plug.



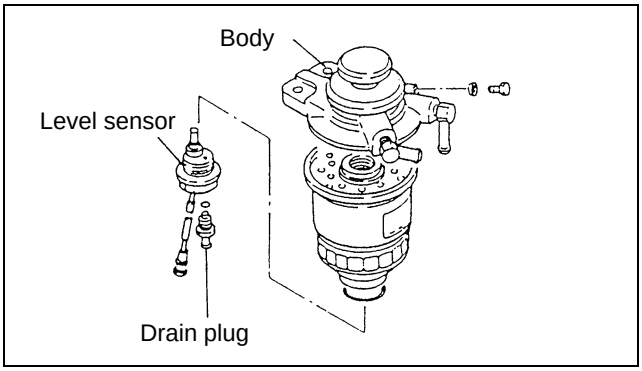
Fuel filter element (B-type)

1. Loosen the drain plug and allow the fuel to drain.
2. Loosen the connector from the level sensor.
3. Remove the element from the body.

4. Remove the level sensor from the element. Discard the element.
5. Install the level sensor to the new element.
6. Install the new element to the body.
7. Install the connector to the level sensor.
8. Tighten te drain plug.

⚠ NOTE

After replacing the elements, be sure to prime the fuel system. See page 28 for priming.

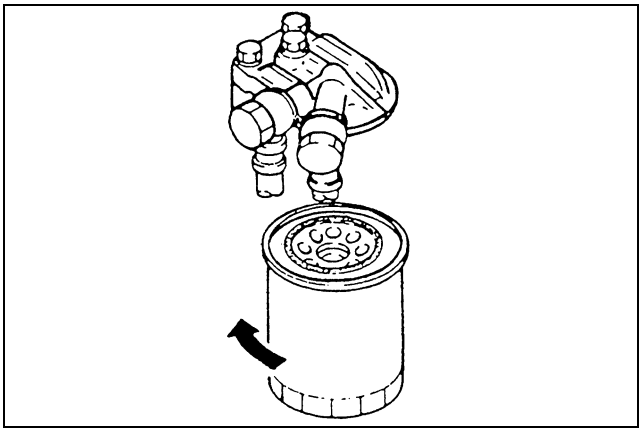


Fuel filter (cartridge type)

1. Remove the cartrigde with a filter wrench.
2. Apply a small amount of fuel to the O-ring of the new cartrigde.
3. Install new cartrigde by hand.
4. After replacing the cartridge, be sure to prime the fuel system. See page 28 for priming.

⚠ NOTE

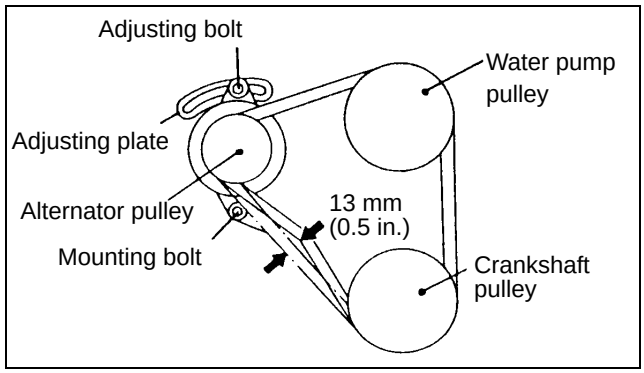
Do not add fuel to the new cartridge. Invisible particles of dirt which might get inside the injection pump can damage its finely finished parts.



6.3.2 Check and adjust the fan belt

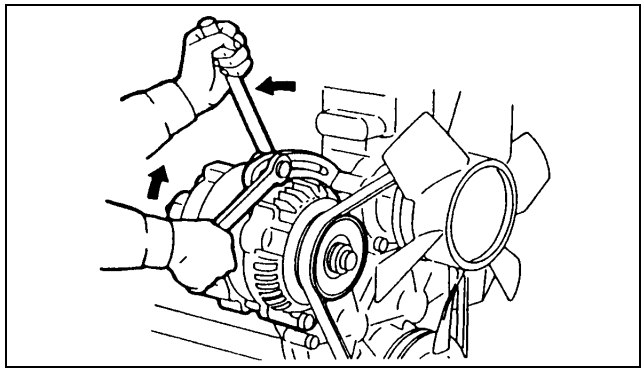
Checking

Correct adjustment exists when the belt can be pushed inward about 13 mm with 100 N thumb pressure exerted midway between the alternator and crankshaft pulley as shown.



Adjusting

1. Loosen the adjusting plate bolt and the mounting bolt.
2. Insert a bar between the alternator and the cylinder block to move the alternator to obtain the required belt deflection.
3. Tighten the mounting bolt and the adjusting bolt.



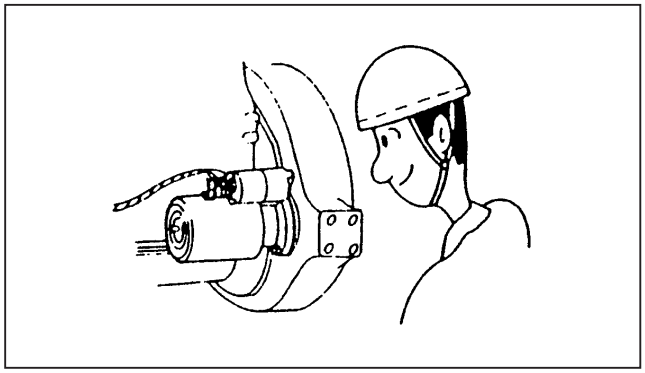
⚠ CAUTION

- If the fan belt is too tight, excessive stress is put on to the fan bearings and belt, which might shorten the life of both. If it is too loose, it will slap against the pulleys, causing unnecessary wear and tear to the belt, which could cause possible slipping, to the extent that the engine will overheat.
- Keep the belt free from oil or grease.

6.4 Every 1000 service hours

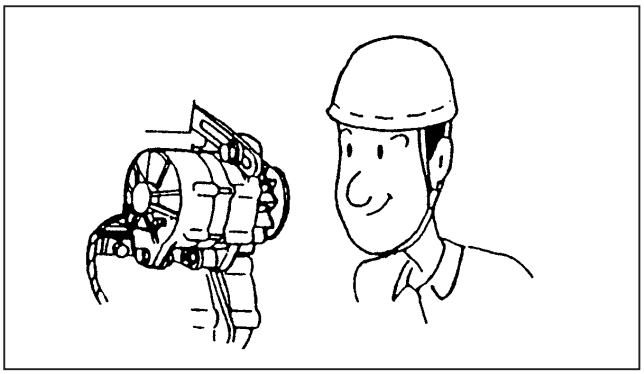
6.4.1 Check the starter

1. Check for visual defects.
2. Check to see if the pinion is shifted into mesh with the flywheel ring gear when the starter is energized. If the pinion does not shift properly, consult your Mitsubishi dealer.



6.4.2 Check the alternator

1. Check for visual defects.
2. Remove the belt from the alternator. Turn the pulley by hand to check the alternator for smooth rotation. If the alternator fails to rotate smoothly, consult your Mitsubishi dealer.



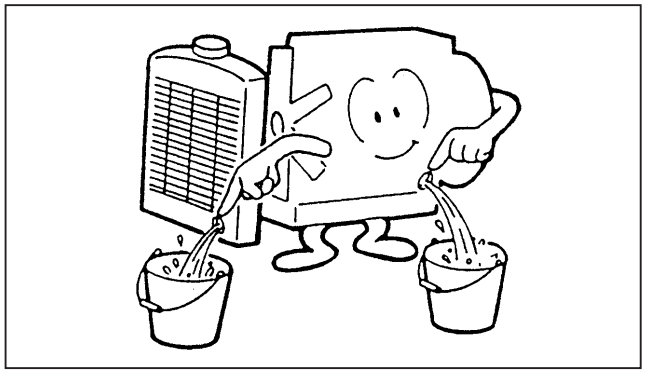
6.5 Every 2 years

6.5.1 Change coolant

Long Life Coolant (LLC) used in your engine retains its efficiency for 2 years. Be sure to change the coolant every 2 years.

6.5.2 Draining

1. Start and operate the engine until the coolant temperature is 70°C to 80°C (158°F to 176°F). Then stop the engine.
2. Remove the filler cap only after the engine has been stopped and the cap is cool enough to remove with your bare hands.
3. Open the radiator drain valve and remove the engine drain plug. Then allow the coolant to drain into the containers.



6.5.3 Flushing

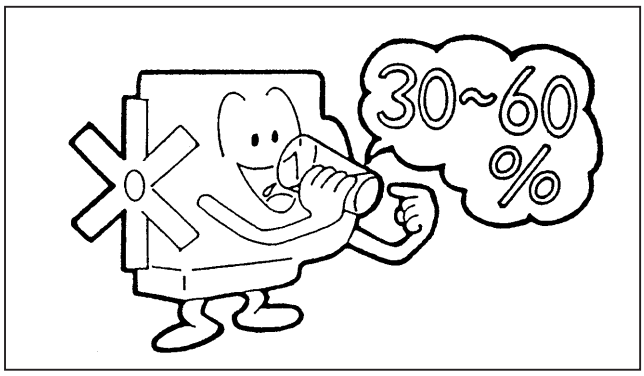
1. Close the radiator drain valve and install the engine drain plug.
2. Fill the cooling system with a cleaning solution which does not chemically attack rubber or metal surfaces. Start and operate the engine at 800 to 900 rpm and let the engine run for 15 minutes. Stop the engine and drain the cleaning solution.
3. Fill the system with clean water and operate the engine at 800 to 900 rpm for 10 minutes. Continue to flush the system until the draining water is clear.

6.5.4 Refilling

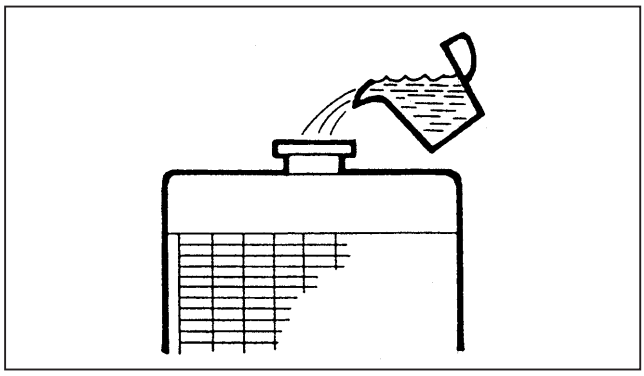
1. Tighten the radiator drain valve and the engine drain plug.
2. Pour pure, undiluted LLC into the radiator. The recommended concentration of LLC is illustrated in the chart below:

Ambient Temperature, °C (°F)	-10 (14)	-20 (-4)	-30 (-22)	-45 (-49)
LLC concentration, %	30	40	50	60

Table 7 Recommended LLC Concentrations (reference)



3. Add coolant to the radiator slowly to help avoid air pockets in the system. See COOLANT AND ANTIFREEZE SPECIFICATIONS on page 33.



4. Start and operate the engine until the coolant temperature is between 70°C and 80°C (158°F to 176°F). Then stop the engine.
5. Check the coolant level in the reservoir tank and add water if the coolant level is low. Maintain the coolant level to FULL line on the tank when the engine is cold.

6.6 When required

6.6.1 Prime fuel system

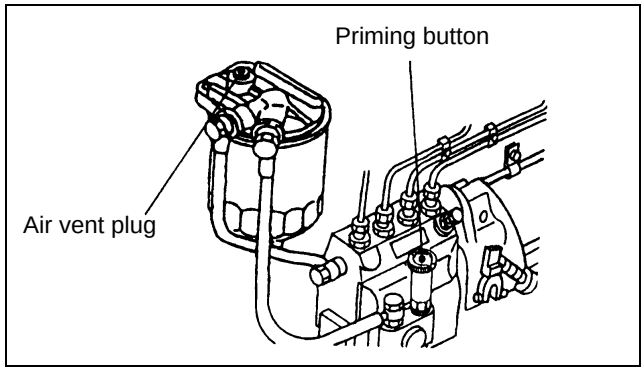
Air in the lines may cause the fuel system to become air bound, resulting in an inability to start the engine or the misfiring of one or more cylinders. Prime the fuel system:

1. After the engine has been fueled for the first time after installation.
2. After the engine has been refueled after running out of fuel.
3. After the fuel filter element has been cleaned or replaced.

6.6.2 Procedure

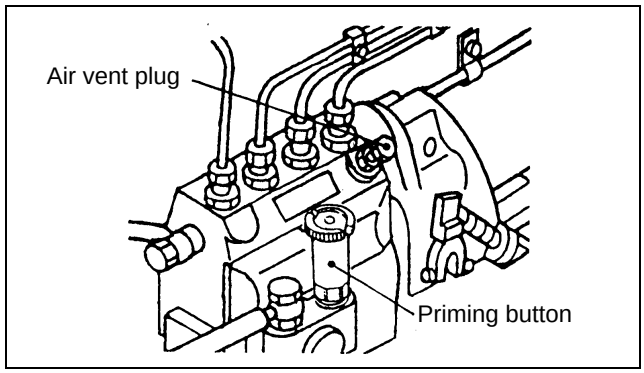
Fuel filter

1. Loosen the air vent plug on the fuel filter (by turning it 1.5 turns).
2. Unlock the priming pump plunger by turning it to the left, and operate the pump.
3. Tighten the air vent plug when the fuel flows free of bubbles.



Fuel injection pump

1. Loosen the air vent plug on the injection pump (by turning it 1.5 turns).
2. Unlock the priming pump plunger by turning it to the left, and operate the pump.
3. Tighten the air vent plug when the fuel flows free of bubbles.



⚠ NOTE

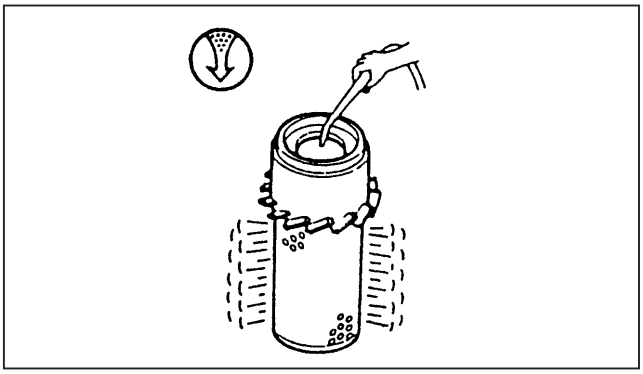
1. If the vent plug is tightened before the priming pump plunger is locked, fuel pressure acts on the feed pump, making it difficult to restore the plunger.
2. Clean up fuel spillage.

6.6.3 Clean/change air cleaner element

Service the air cleaner only when it is necessary, or when the dust indicator indicates RED.

6.6.4 Cleaning

1. Direct air — 7 kgf/cm^2 (100 psi) [686 kPa] maximum — inside the element along the length of pleats.
2. Insert a light inside the clean element and check. Replace the element if rips or tears are found.



⚠ NOTE

Replace the element if it is excessively dirty.

⚠ CAUTION

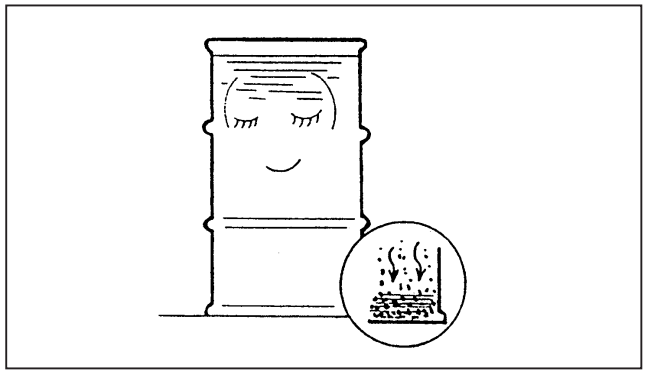
- Never service the air cleaner when the engine is running. Without the air cleaner, dust and dirt can enter the engine and can cause rapid wear of the engine parts resulting in loss of power and high oil consumption.
- Do not clean the element by bumping or tapping it.

⚠ WARNING

When using compressed air for cleaning, wear a protective face shield, protective clothing, and protective shoes.

7 FUEL SPECIFICATIONS

7.1 Recommended types of fuels

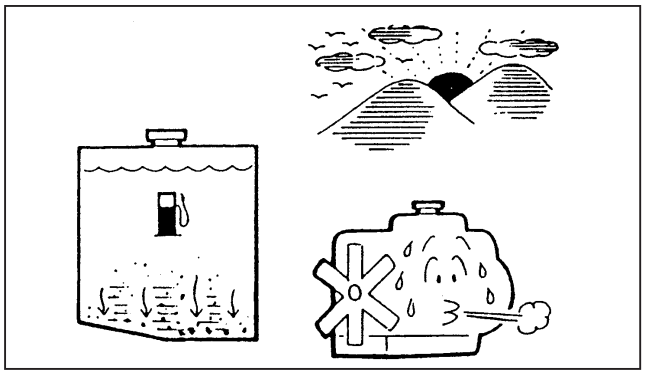


The quality of fuel is a very important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels.

This engine is designed to burn fuels marketed to meet ASTM Designation D 975 (grade No. 2-D).

7.2 Caring for the diesel fuel tank

Fill the diesel fuel tank at the end of the day, because the incoming fuel will drive out the moisture-laden air and prevent condensation. Before starting the engine after 50 service hours, remove the drain plug and drain off any sediment or water which may have accumulated.



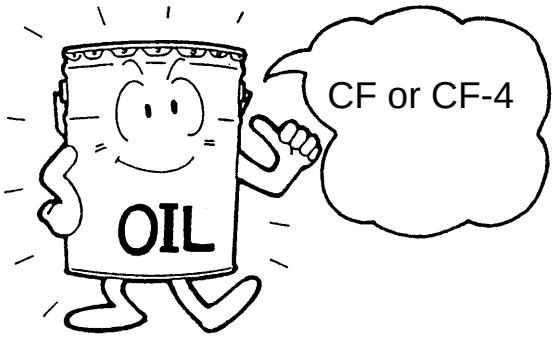
7.3 Caring for the fuel supply

It is important to buy clean fuel and keep it clean. Natural settling is an effective method of cleaning fuel. Allow the fuel to stand for at least 10 days in the fuel storage tank after the tank has been filled and before the fuel is transferred to the diesel fuel tank. Be sure to drain all the water and sediment that has settled in the bottom of the tank before the tank is refilled. Occasionally, drain all of the fuel and clean the tank thoroughly.

8 LUBRICANT SPECIFICATIONS

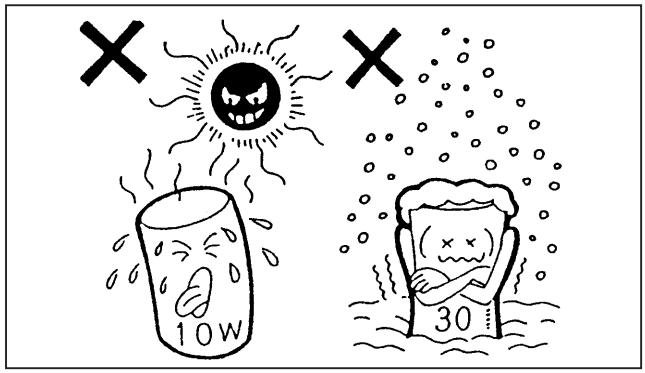
8.1 Recommended types of engine oils

Use oils that meet the API engine oil classification CF or CF-4 class. Proper oil selection assures cranking ability by maintaining an oil film on the cylinder walls and bearing surfaces in conditions which provide low friction and therefore less cranking effort to achieve cranking speeds necessary for reliable starting. Improper oil selection may result in congealed oil film on the cylinder walls and the bearing surfaces. This can result in high friction loads and more cranking effort, thus standing in the way of achieving sufficient cranking speeds for reliable starting and affecting engine life.



8.2 Recommended oil viscosities

There are two important considerations related to satisfactory engine operation under ambient temperature conditions — (1) the ability to crank the engine fast enough to assure starting, and (2) adequate lubrication of internal wearing surfaces during starting and warm-up. These considerations can be adequately met through proper grade selection. Recommended oil viscosities are shown in the chart below:



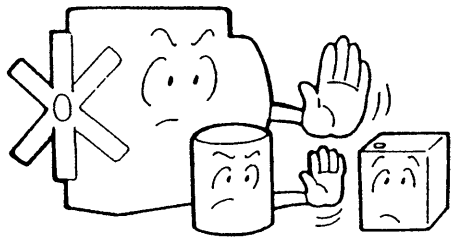
Starting temperature, °C (°F)	-30 (-22)	-25 (-13)	-20 (-4)	-15 (5)	-10 (14)	-5 (23)	0 (32)	10 (50)	20 (68)	30 (86)	40 (104)
Oil viscosities						SAE 30					
											SAE 40
								SAE 15W-40			
							SAE 10W-30				
					SAE 5W-20						

Table 8 Recommended oil viscosities

Mitsubishi recommends the all-season type engine oil of SAE 10W-30.

⚠ CAUTION

Avoid mixing oils with different brands. In most cases, oils with different brands are not compatible and, when mixed, they can seize parts such as piston rings, cylinders, etc. and cause wear to moving parts. It is best to stick with the same brand and one type of oil at successive service intervals.



8.3 Limiting requirements for engine oils

If a used oil analysis program is conducted in order to determine the condition of the oil, consult the chart below. Change the oil if any of these requirements are not met.

⚠ NOTE

- Oil change intervals depends on the fuel properties. Be sure to use the recommended fuels only.
- The limit of total base number is 1/2 of that of a new oil in case of a perchloric-acid analysis method.

Property	Unit	Test Method	Limit
Viscosity	cSt @ 100°C (212°F)	JIS K 2283	+30% / -15% , max. of new oil
Total base number (HCl)	mgKOH/g	JIS K 2501	2.0, min.
Total acid number	mgKOH/g		+3.0, max. of new oil
Water content	Vol%	JIS K 2275	0.2, max.
Flash point	°C (°F)	JIS K 2265	180 (356), min.
Pentane insolubles	Wt%	ASTM D 893	0.5, max.
Pentane insolubles coagulated	Wt%		3.0, max.

Table 9 Limiting requirements for engine oils

9 COOLANT AND ANTIFREEZE SPECIFICATIONS

9.1 Coolant specifications

Water used in the engine cooling system must be soft, or as free from scale forming minerals as possible and it has to meet the requirements shown in the "Coolant Specifications" chart.

⚠ NOTE

Harmful chemical properties and substances contained in water (as coolant) must not exceed the Mitsubishi limits. They are tolerable up to the limits shown in the chart below.

Item	Chemical symbol	Unit	Recommended limit	Main malign effect	
				Corrosion and rust	Scale formation
pH, 25°C (77°F)	-	-	6.5 to 8.5 (6.5 to 8.0)	O	O
Electrical conductivity, 25°C (77°F)	-	μΩ/cm	< 400 (< 250)	O	O
Total hardness	$CaCO_3$	PPM	< 100 (< 95)	-	O
M alkalinity	$CaCO_3$	PPM	< 150 (< 70)	-	O
Chlorine ion	Cl^-	PPM	< 100 (< 100)		-
Sulfuric acid ion	SO_4^{2-}	PPM	< 100 (< 50)	O	-
Total iron	Fe	PPM	< 1.0 (< 1.0)	-	O
Silica	SiO_2	PPM	< 50 (-)	-	O
Residue from evaporation	-	PPM	< 400 (< 250)	-	O

Table 10 Coolant specifications

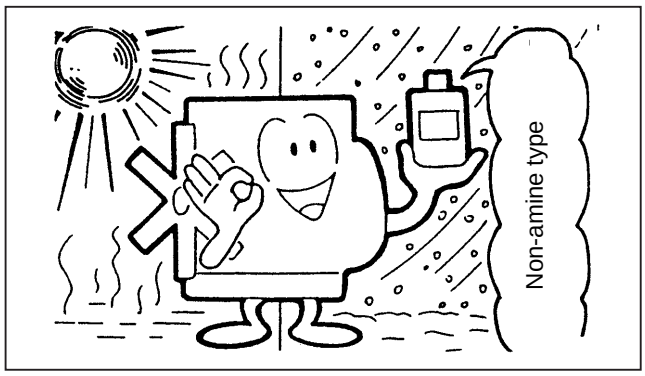
The values indicated in ( ) are the limits set forth by Mitsubishi. In addition to the items specified above, turbidity is specified to be <15 mg/*l*.

9.2 Recommended types of LLC's (Long Life Coolant)

For Mitsubishi diesel engines, all-season, non-amine type LLC's or equivalents are recommended.

9.2.1 Features of recommended brands

- No amines (methyl amines, ethyl amines, n-propyl amines, etc., all being derivatives of ammonia, NH_3) are contained.
- Silicate and borate are not contained.
- Close to neutral on the pH scale, and hence, slightly basic (alkaline).
- Balanced additive ingredients; some being substitutes for amines.
- Long life (the coolant with 30% concentration, for example, retains its effectiveness for more than 2 years).



⚠ WARNING

LLC is toxic and can cause personal injury if it comes into contact with the skin or the eyes. If LLC gets in your eyes, wash them with water immediately and see a doctor at once.

9.3 How to use non-amine type LLC

1. The engine coolant with any of the recommended additives should be changed every 2 years.

⚠ NOTE

When using any other LLC, refer to the coolant mixture chart shown on the container.

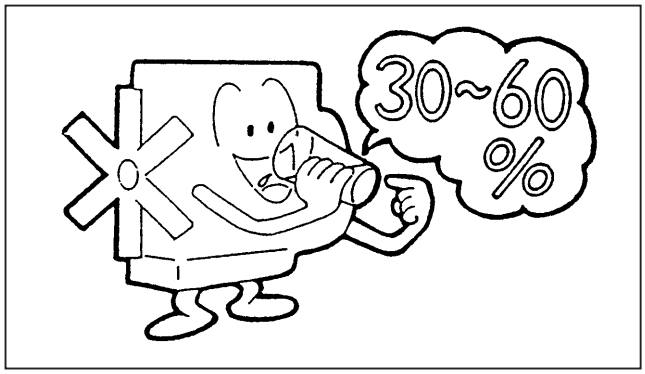
⚠ WARNING

Consult your Mitsubishi dealer for disposal of a used coolant containing LLC.

2. The proper concentration of LLC is from 30% to 60% all year round. Aim at a temperature level which is 5°C (9°F) lower than the expected lowest temperature. LLC of less than 30% concentration does not provide sufficient corrosion protection. Concentrations over 60% adversely affect freeze protection and heat transfer rates. When adding coolant, use LLC of the same concentration.

Ambient temperature, °C (°F)	-10 (14)	-20 (-4)	-30 (-22)	-45 (-49)
LLC concentration, %	30	40	50	60

Table 11 Recommended LLC concentrations (reference)



9.4 Why LLC?

Today's full-blown trend is toward smaller and more lightweight engines, higher output, lower fuel consumption, and lower exhaust emission levels. Engine application has also expanded. In most applications, the engine coolant is compelled to withstand severe conditions such as continuous high-power operation with a higher coolant temperature and a higher speed of coolant recirculation in the cooling circuit. Many materials involved in the circuit (such as steel, aluminum, copper, solder, and rubber) are also subject to severe servicing. These materials differ in ionizing tendency and this difference promotes cavitation and deterioration through the medium of engine coolant. The ideal of breaking the link between cause and effect to preserve the circuit can be realized by using LLC.

9.5 How LLC works

LLC contains several chemicals in such proportions as to produce a chemical reaction that suppresses corrosion of the engine parts in contact with coolant. "Corrosion" is the result of a phenomenon called "ionization."

The power of LLC to defeat the ionic reaction is generally subject to wear and the engine coolant becomes increasingly weak at that time.

Moreover, if its chemicals are not properly proportioned to match the circuit metals which

they are meant to protect, they are used up due to aging and this allows some metals to precipitate into the coolant or to form new compounds which can result in rusty surface deposits. Some chemicals, calculated to inhibit this ionic reaction, might accelerate the reaction of those metals that have already begun to react.

The worse case scenario is that the process of the ionic reaction or corrosion will go on faster than when the coolant is straight water without additives, if there is not a good match between the chemical proportions and the circuit metals.

9.6 Practical reported cases of circuit trouble for which additive is blamed

Case 1:

Amines are generally effective in suppressing the rusting of ferrous metals but are said to be problematic for copper and cupric metals because of copper involvement in pittings reported on Fe metals. The mechanism of Fe-surface pitting may be explained as that of galvanic or local-cell action. Suppose a cluster of copper molecules precipitates and deposits itself on a surface of Fe, a base metal relative to copper. The copper deposit introduces a localized galvanic cell which, by its ionic action, rapidly eats into the Fe surface to result in a pit.

Case 2:

A silicate (there are several types of silicate) is highly effective in protecting aluminium against rusting. This compound of silicon is unstable in a solution whose pH is 9 or less: it is prone to turn to gel and settle down in the solution. For this reason, the pH is usually specified to be 10 or so. This means that the silicate has to be used in a high-alkalinity coolant. When the silicate is used up, the high alkalinity starts chemically attacking the aluminium.

Example

The mechanical seal of the water pump may rapidly wear down as the secondary effect of silicate gel in the above context.

Case 3:

As the additive as a whole deteriorates or when its concentration in the coolant is too low, its anti-corrosion performance falls and consequently the circuit metals begin to corrode. Of those metals badly affected in such a condition, brass and solder — the materials used in the cores of the radiator — become particularly victimized. The cause of coolant leakage from and clogging of the coolant circuit in the radiator is usually traceable to such a malcondition of the coolant.

10 STORAGE

10.1 Storage of the engine in a non-operational condition

10.1.1 Preparation

1. Drain the engine oil and put a preservative into the engine (up to the high level on the dipstick).
2. Make a mixture of preservative and fuel oil in a 50-to-50 ratio and put the mixture into the fuel tank.
3. Start and leave the engine idling for 5 to 10 minutes.
4. Stop the engine and spray volatile preservative (VCI) into the opening of the air inlet.
5. Drain the preservative-fuel mixture.
6. Apply a coat of preservative to the exposed machined surfaces of the engine.
7. Cover the air inlet, the exhaust openings, and the breather by taping them.
8. Loosen the fan belt.
9. Tape the starter and the alternator terminals. Cover the starter and alternator with a polyethylene sheet and put a desiccant inside.
10. Disconnect the cables from the battery and charge the battery. Flush the top of the battery with clean water and coat the poles with acid-free vaseline to prevent further corrosion. Keep the battery in a cool, dry place.
11. Cover the engine to protect it against the weather.

⚠ NOTE

- Store the engine in a well-ventilated room.
- It is not necessary to drain the coolant if it contains LLC.
- Attach a "DO NOT OPERATE" sign or similar warning tag to the starter switch or any of the controls.
- New engine oil may be used instead of preservative.

10.1.2 Service during storage

Charge the battery at least once a month.

10.1.3 Remove the engine from storage

1. Remove the covers from the engine.
2. Connect a fully charged battery to the engine.
3. Remove the covers from the starter and the alternator.
4. Adjust the fan belt.
5. Remove the covering and the taping from the various ports.
6. Drain the preservative and fill the engine with the recommended engine oil.
7. Fill the fuel tank and prime the fuel system.
8. Check under and around the engine for items such as loose or missing bolts, oil, fuel, or coolant leaks.
9. Remove the rocker cover and lubricate the valve mechanism.
10. Crank the engine 3 times, 10 seconds each time, at intervals of 1 minute, with the fuel supply shut off.
11. Make sure the engine oil pressure rises properly.
12. Open the fuel supply valve and start the engine.
13. Allow the engine to leave it idling.
14. When the engine has run long enough to warm up, apply the load and bring it to an operating speed.

10.2 Storage of the engine in an operational condition

10.2.1 Follow steps 1 through 3 mentioned below once a month:

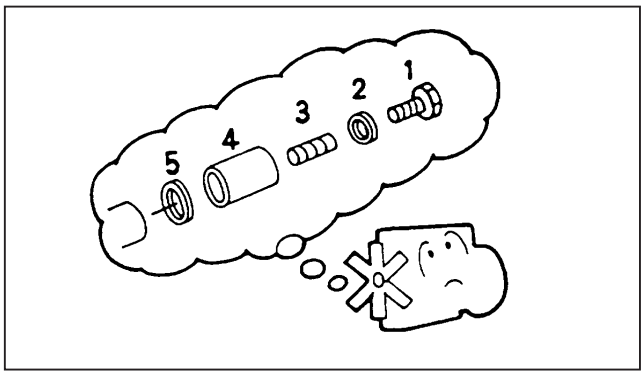
1. Crank the engine 2 times, for 10 seconds each time, with the starter at intervals of 30 seconds, with the fuel supply shut off. Open the fuel supply valve afterwards.
2. Start and operate the engine at 800 rpm under no-load condition for 5 minutes.
3. Increase the engine speed from 1000 to 1200 rpm and operate the engine under no-load condition for 10 minutes.

11 TROUBLESHOOTING

11.1 General

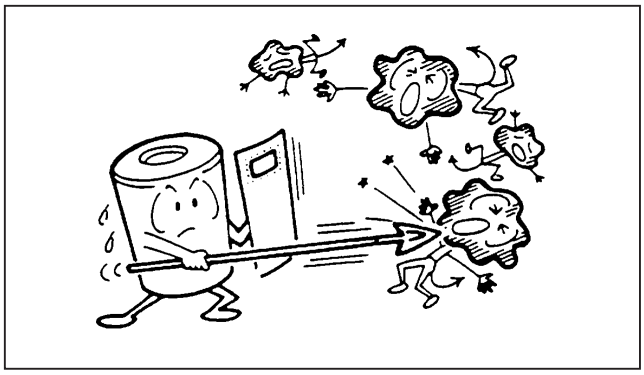
11.1.1 Think before you act

Upon noting a defective indication, recall what you did the last time when you came across the same indication. If what you did was correct and successful, do the same again. If the symptom noted is new to you, think of a possible cause in accordance with the troubleshooting procedure which follows.



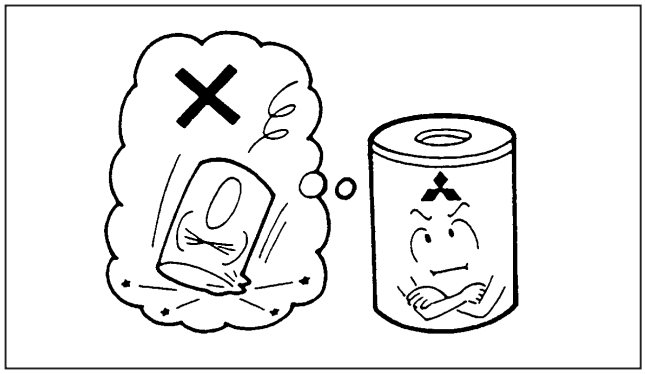
11.1.2 Dust and dirt are often the main causes

"Wear" is usually the result of abrasive particles. When disconnecting or disassembling a part or component, be sure to keep out dust and dirt.



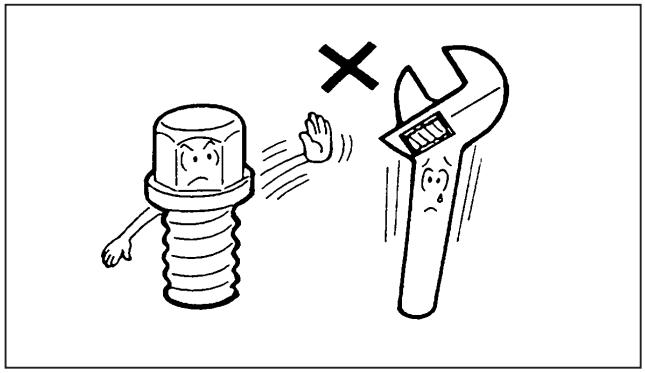
11.1.3 Use original parts

Use only original parts to replace those that have failed or reached their service limits. When ordering, specify the needed replacement parts by referring to the Parts Catalogue.



11.1.4 Perform servicing work safely

Use the right kind of hand tools to carry out each working step in repair work. Avoid injury to yourself and damage to the parts by using proper tools. When lifting or carrying a part that is too heavy for one person to handle, get another person's help and, if necessary, use a jack or a hoisting device.



⚠ CAUTION

- Never attempt to break the seals of the governor for maximum speed setting or maximum injection quantity setting.
- The maximum injection quantity of the injection pump has been set on the basis of the output power of each engine verified at the bench test. Never attempt to vary this injection quantity in the field.

11.2 Problems

For special servicing jobs on your engine, rely on the expert knowledge of the servicemen and the service facilities provided by your Mitsubishi dealer.

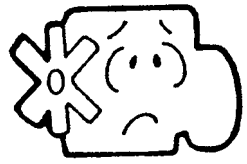
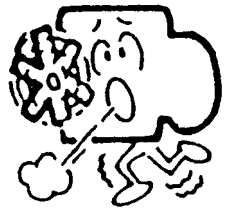
Problem	Cause	Correction
Engine will not start 	Fuse off	Replace
	Defective starter switch	Repair or replace*
	Slow cranking speed	Recharge battery
	Wrong viscosity grade of oil	Change correct oil
	Seized running parts	Repair*
	Air in fuel system	Prime
	No fuel in tank	Refuel
	Bad quality fuel	Change fuel
	Clogged fuel filter	Clean or replace
	Defective fuel injection pump	Repair or replace*
	Defective control timer unit	Replace*
	Clogged air cleaner	Clean or replace
	Defective starter or relay	Repair or replace*
	Open electrical circuit	Repair
Not enough power 	Wrong viscosity grade of oil	Change oil
	Clogged air cleaner	Clean or replace
	Clogged fuel filter	Clean or replace
	Defective fuel injection pump	Repair or replace*
	Defective fuel injection nozzles	Repair or replace*
	Wrong injection timing	Adjust*
	Bad quality fuel	Change correct fuel
	Overheating	Flush cooling system and replace parts
	Wrong valve clearance	Adjust
	Poor compression (cylinders, piston, rings, etc. worn)	Repair or replace*

Table 12 Troubleshooting

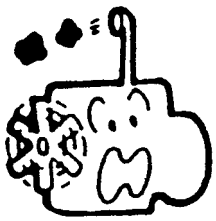
Problem	Cause	Correction
Overheating 	Not enough coolant in system	Add coolant
	Leaks in cooling system	Retighten or repair
	Loose fan belt	Adjust
	Restriction to air flow through radiator	Remove restrictions
	Defective water pump	Replace
	Defective thermostat	Replace
	Defective fan	Replace
	High LLC concentration	Adjust LLC concentration
Too much white or blue smoke 	Too much oil in engine	Drain to correct level
	Oil viscosity too low	Change oil
	Defective thermostat (coolant temperature too low)	Replace
	Defective fuel injection nozzles	Repair or replace*
	Wrong injection timing	Adjust*
	Wrong fuel cetane number	Change fuel
	Poor compression (cylinders, piston rings, etc. worn)	Repair or replace*
Too much black or gray smoke 	Bad quality fuel	Change fuel
	Defective fuel injection pump	Repair or replace*
	Defective fuel injection nozzles	Repair or replace*
	Wrong injection timing	Adjust*
	Clogged air cleaner	Clean or replace
	Wrong valve clearance	Adjust
	Poor compression (cylinders, piston rings, etc. worn)	Repair or replace*
Fuel consumption too high 	Bad quality fuel	Change fuel
	Defective fuel injection pump	Repair or replace*
	Defective fuel injection nozzles	Repair or replace*
	Wrong injection timing	Adjust*
	Clogged air cleaner	Clean or replace
	Poor compression (cylinders, piston rings, etc. worn)	Repair or replace*

Table 12 Troubleshooting

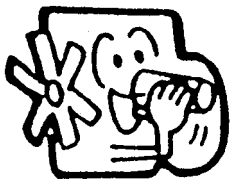
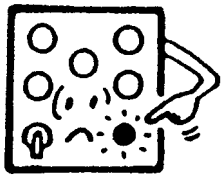
Problem	Cause	Correction
Oil consumption too high 	Too much oil in engine	Drain to correct level
	Oil viscosity too low	Change oil
	Leaks in lubrication system	Repair or replace
	Worn cylinders and piston rings	Repair or replace*
	Worn valve stem seals	Replace*
Oil pressure too low 	Not enough oil in engine	Add oil
	Oil viscosity too low	Change oil
	Clogged oil filter	Replace
	Defective oil pump	Repair or replace*
	Defective relief valve	Adjust or replace*
	Defective pressure switch	Replace*

Table 12 Troubleshooting

Remarks:

1. Consult your Mitsubishi dealer for items marked with an asterisk (*).
2. Consult your Mitsubishi dealer for any items other than those listed in the table.
3. When communicating with your Mitsubishi dealer, specify the engine model name, the engine serial number, the application, the rating, and service hour meter reading of your engine.

MITSUBISHI DIESEL ENGINES TURBOCHARGERS CORRUGATING MACHINERY

MEE MHI EQUIPMENT EUROPE B.V.

To whom it may concern

EC-declaration of incorporation
(Directive 98/37/EC, Annex II, sub B)
Ban on putting into service

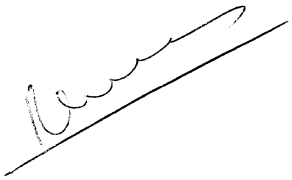
MHI Equipment Europe B.V.
Damsluisweg 2
1332 EC Almere
The Netherlands

herewith declares that:

the Mitsubishi diesel engine, SQ-series type

is destined to be incorporated in other machines or to be combined with other machines, and is not (entirely) in compliance with the Machinery Directive (98/37/EC).

Almere, December 17th 2002



R.A.G.L. Manders
General Manager
Engine Division

GENERATOR PARTS LISTS

GENERATOR MODEL G22

SALES OFFICES

Sales Office United Kingdom
Facility details

Ingersoll-Rand European Sales Ltd
Swan Lane
Hindley Green
Wigan WN2 4EZ
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Fax +44 (0) 1942 523 417

Structure de l'Organisation en France
Coordonnées du Site

Ingersoll-Rand Portable Power
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LES CLAYES SOUS BOIS Cedex 78236
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Téléphone +33 1 30 07 68 62
Fax +33 1 30 07 68 71

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Unternehmensdetails

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Fax +49 208 99 94 111

Dirección de la organización en España
Dirección

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Spain
Teléfono +34 91 627 74 07
Fax +34 91 627 74 08

Sales Office The Netherlands
Facility details

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Produktieweg 10
2382 PB Zoeterwoude-Rijndijk
The Netherlands
Phone +31 (0)71 58 23456
Fax +31 (0)71 58 23400

PARTS LIST INDEX

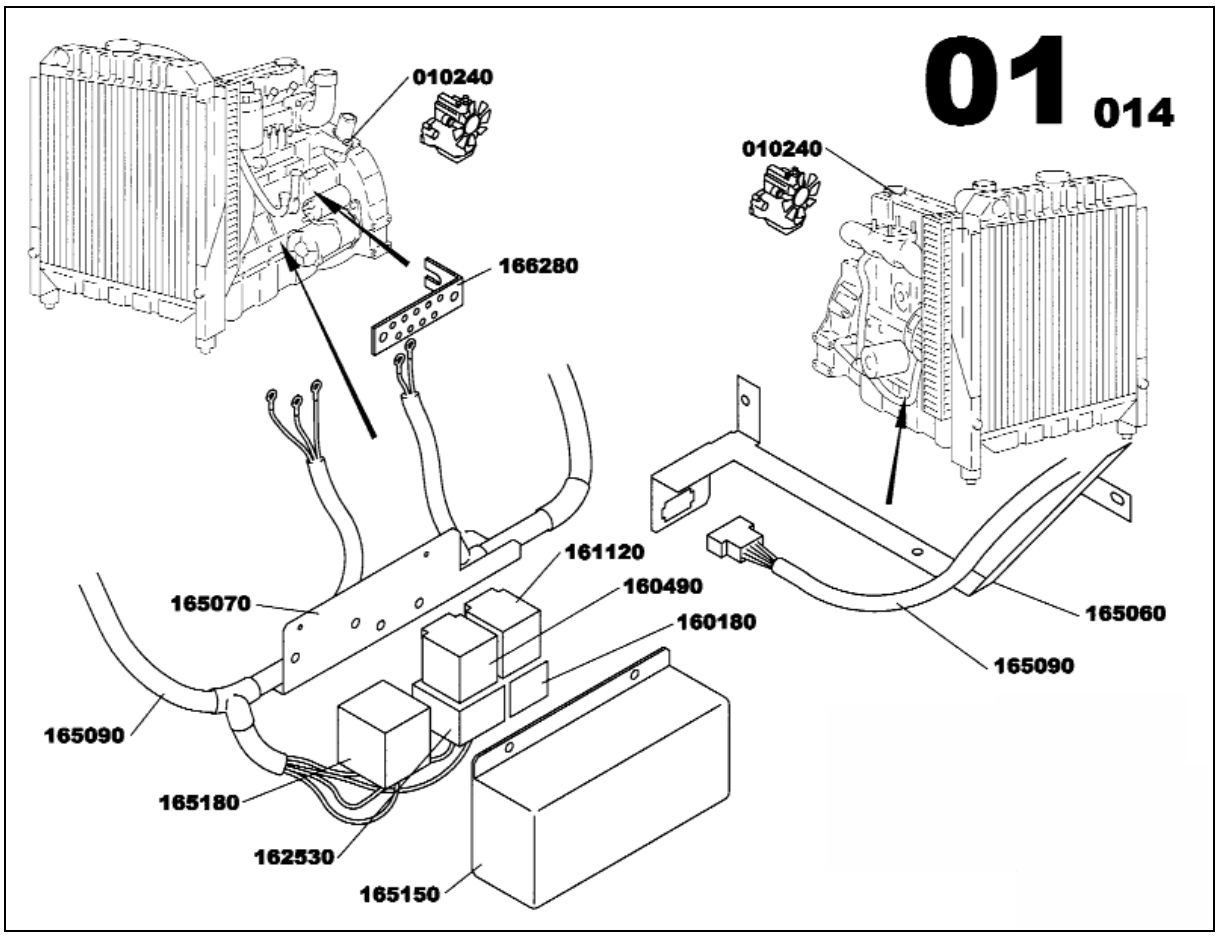
A breakdown view exists for this item

A supplier spare parts documentation exists for this item.

Some items drawing on the breakdown view are not mounted on this genset, so they are not in the part list.

ENGINE ASSEMBLY

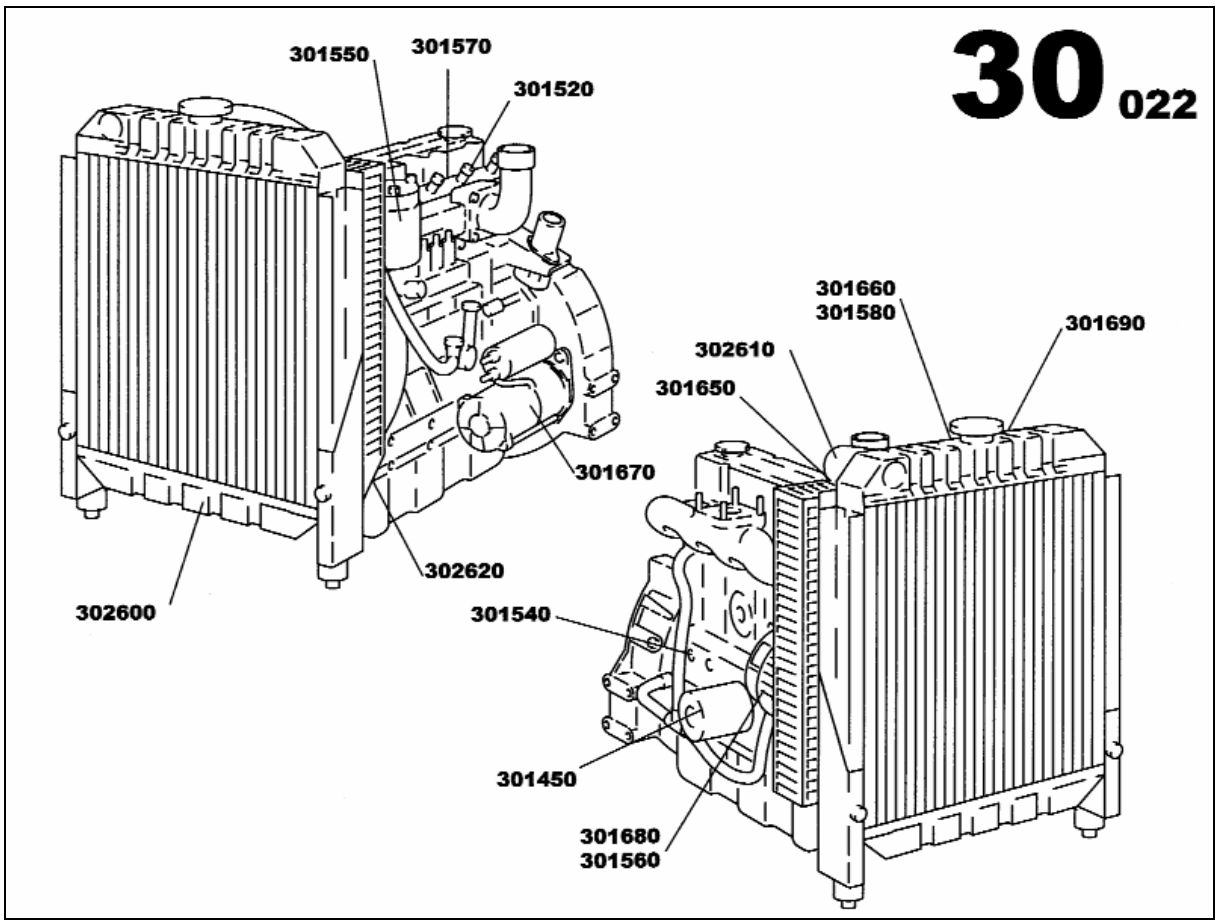
F01014



Item	Part number	Description	Quantity	Units
010240	85413938	MITSUBISHI ENGINE S4Q2 SAE 4/7.5	1.0	UN
166280	85499408	COPPER BAR 5x25	1.0	UN
165060	85415966	WIRING BRACKET MI S4Q2	1.0	UN
165070	85415974	WIRING BRACKET MI S4Q2	1.0	UN
165090	85413391	ENGINE WIRING LOOM MITSU-S4Q2	1.0	UN
165150	85416279	STARTING RELAY PROTECTION PANEL	1.0	UN
165180	85415792	STARTING RELAY	1.0	UN
160490	85408888	RELAY 12V 70A WITH BRACKET	1.0	UN
161120	85408904	RELAY 12V 15A WITH FUSE AND BRACKET	1.0	UN
162530	85413292	AUTOMOBILE RELAY BASE	1.0	UN
160180	85408912	AUTOMOBILE RELAY BASE	1.0	UN

ENGINE DETAILS

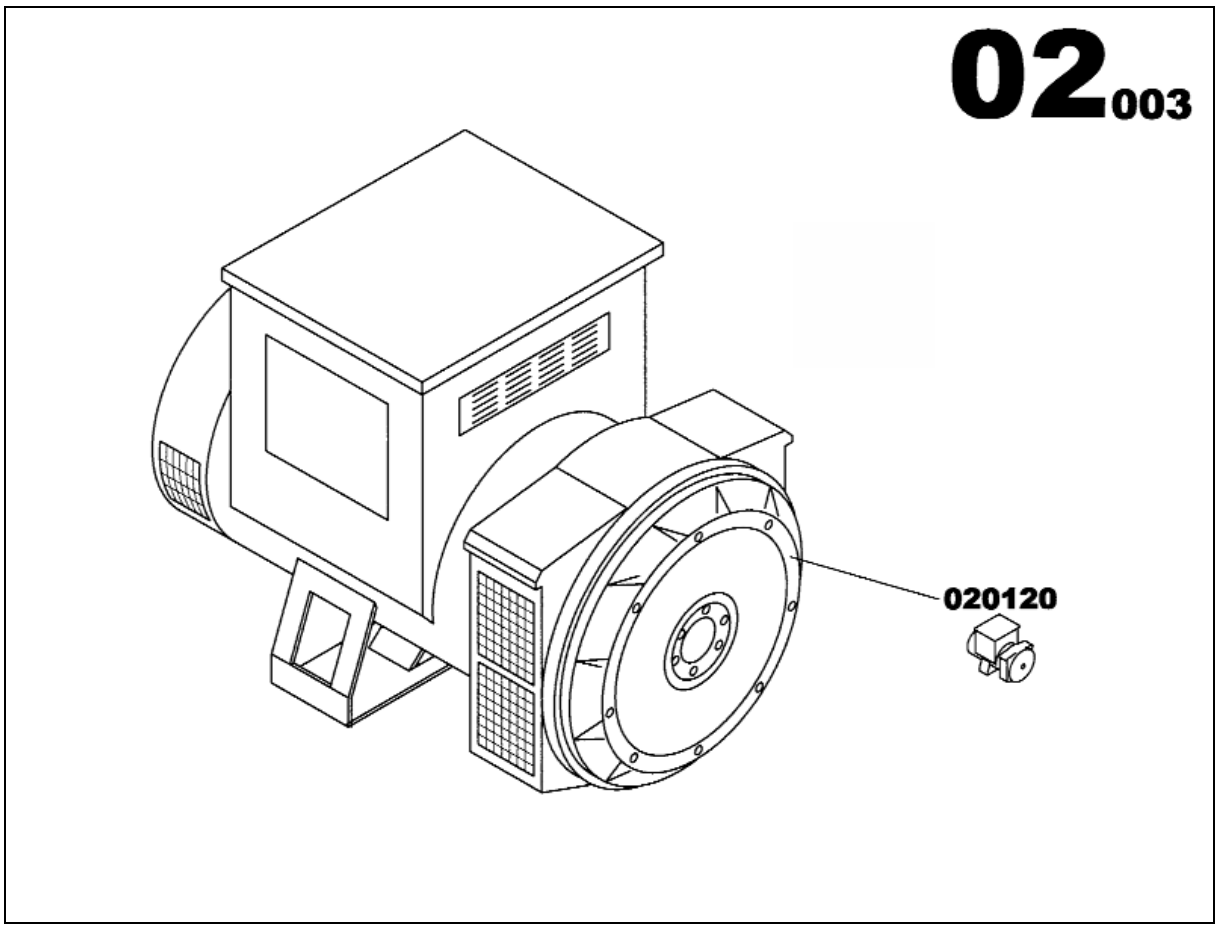
F30022



Item	*Part number*	*Description*	*Quantity*	*Units*
301450	85426856	OIL FILTER	1.0	UN
301550	85426823	FUEL FILTER	1.0	UN
301560	85400265	BELT	1.0	UN
301520	85400216	INJECTOR	4.0	UN
301670	85400570	STARTER	1.0	UN
301680	85400588	CHARGING ALTERNATOR	1.0	UN
301690	85400604	WATER PUMP	1.0	UN
301540	85508182	PRESSURE SWITCH	1.0	UN
301650	85400505	TEMPERATURE SWITCH	1.0	UN
301660	85400513	THERMOSTAT SEAL	1.0	UN
301580	85400281	THERMOSTAT	1.0	UN
301570	85400273	ROCKER COVER GASKET	1.0	UN
302600	85400067	RADIATOR	1.0	UN
302610	85400620	RADIATOR TOP HOSE	1.0	UN
302620	85400638	RADIATOR BOTTOM HOSE	1.0	UN

ALTERNATOR ASSEMBLY

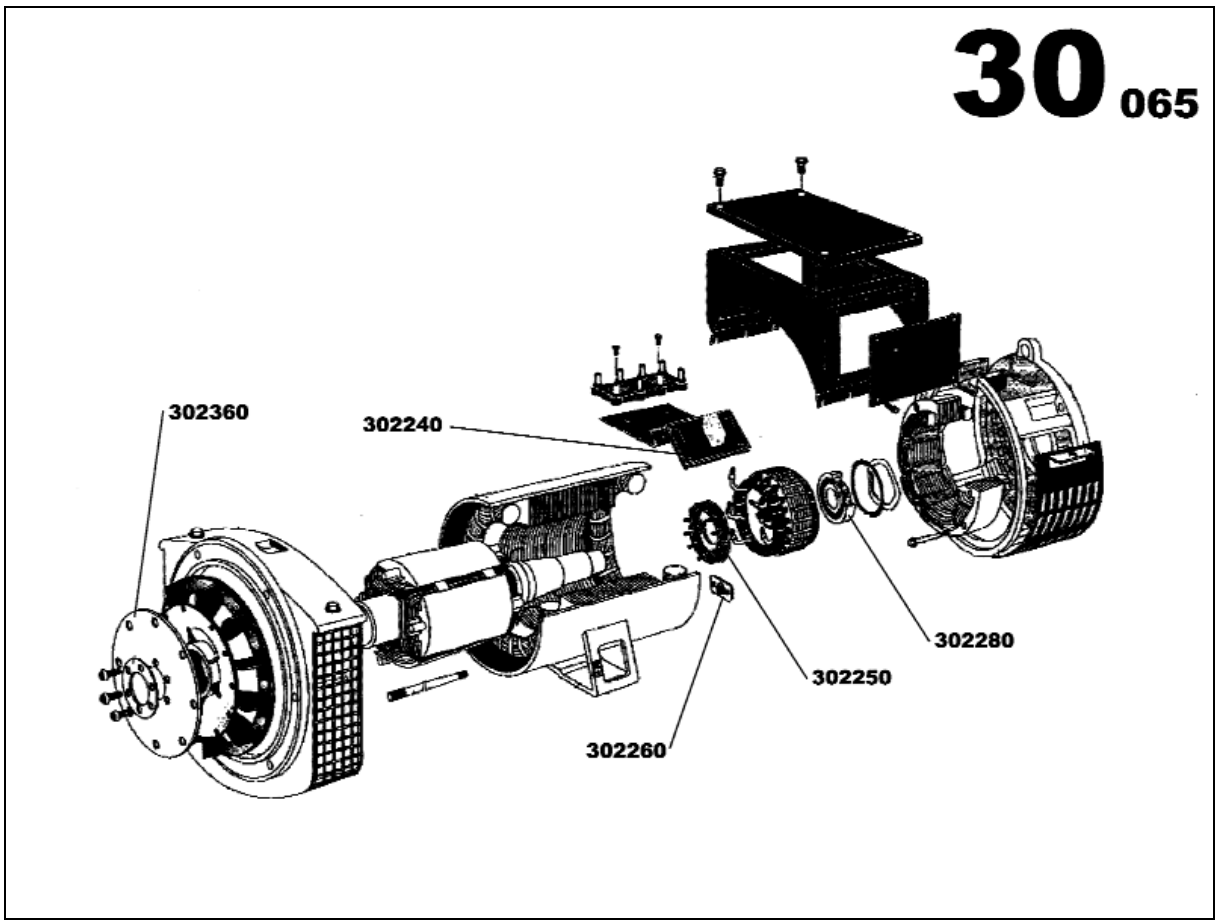
F02003



Item	Part number	Description	Quantity	Units
020120	85425833	LS 422S5 ALTERNATOR	1.0	UN

ALTERNATOR DETAILS

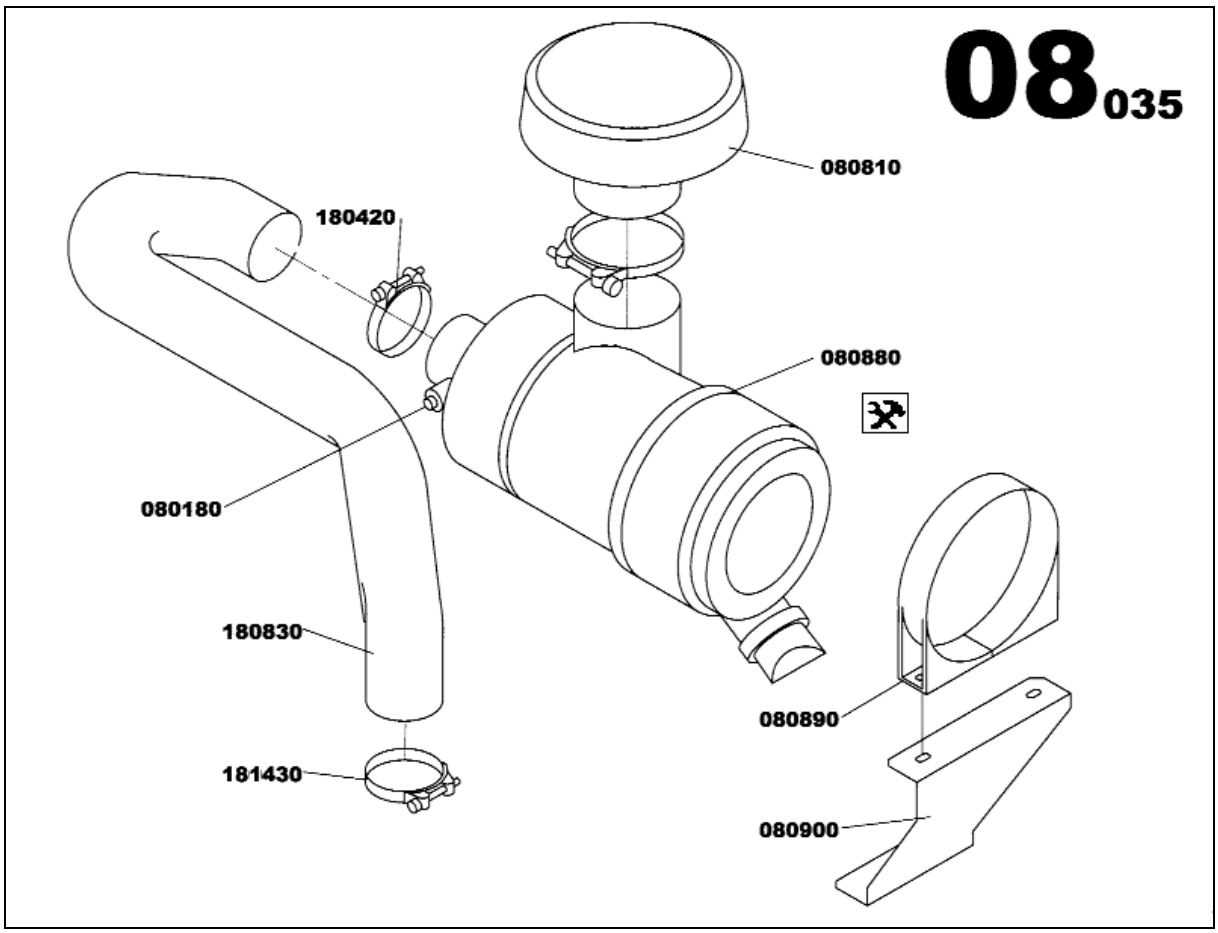
F30065



Item	*Part number*	*Description*	*Quantity*	*Units*
302240	85402451	VOLTAGE REGULATOR	1.0	UN
302280	85425882	BEARING	1.0	UN
302360	85425965	DRIVE DISC	1.0	UN
302250	85425858	DIODE BRIDGE	1.0	UN
302260	85425866	SURGE SUPPRESSOR	1.0	UN

AIR FILTER HEAVY DUTY ASSEMBLY

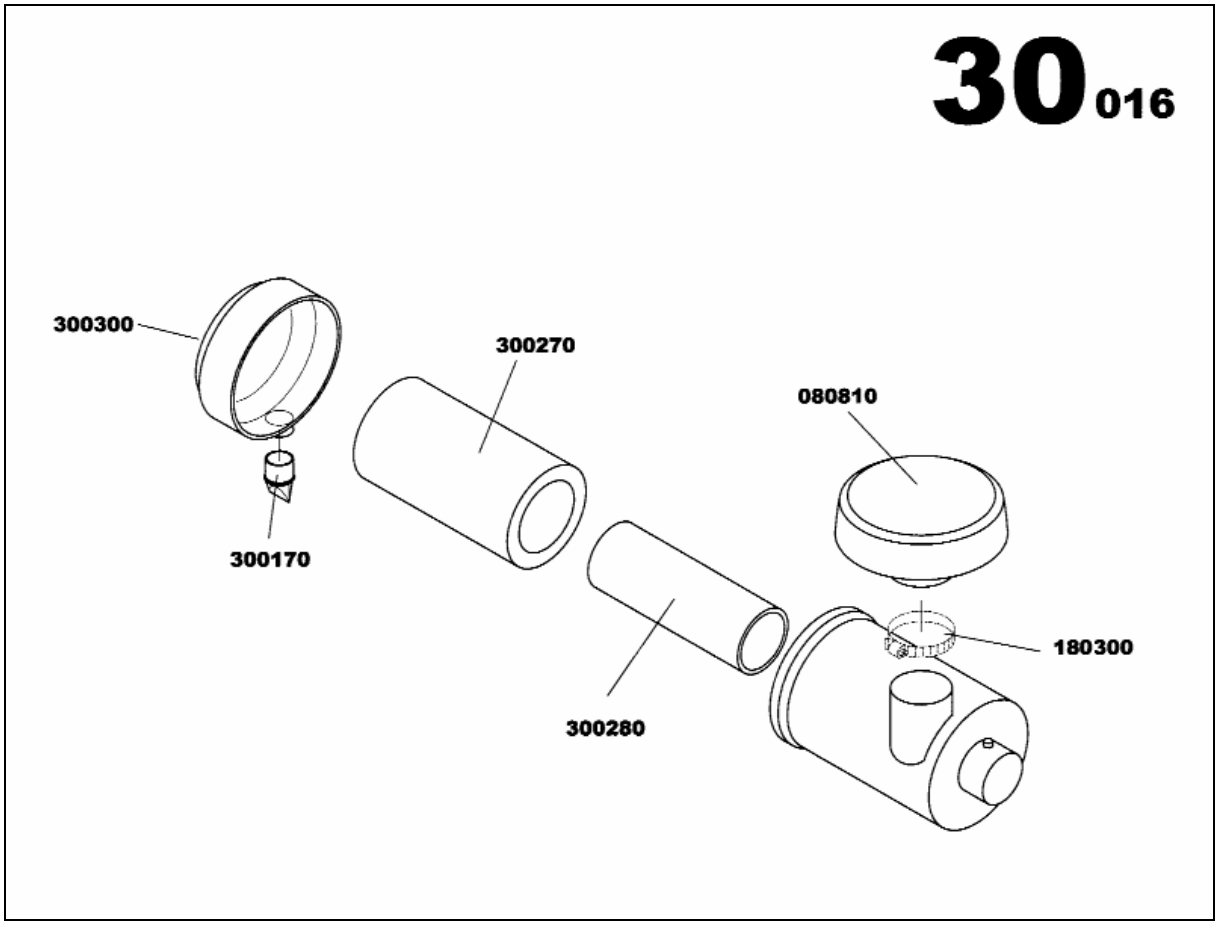
F08035



Item	Part number	Description	Quantity	Units
080810	85412815	RAIN CAP	1.0	UN
080880	85413441	AIR FILTER HEAVY DUTY	1.0	UN
080890	85412898	CLAMP D102	1.0	UN
080180	85404119	AIR RESTRICTiON INDICATOR	1.0	UN
080900	85425403	AIR FILTER BRACKET S4Q2/S4S	1.0	UN
181430	85412922	HOSE CLIP D50/70	1.0	UN
180420	85409407	HOSE CLIP D70/90	1.0	UN
180830	85425411	RUBBER HOSE ELBOW D58x76	1.0	UN

AIR FILTER 080880 DETAILS

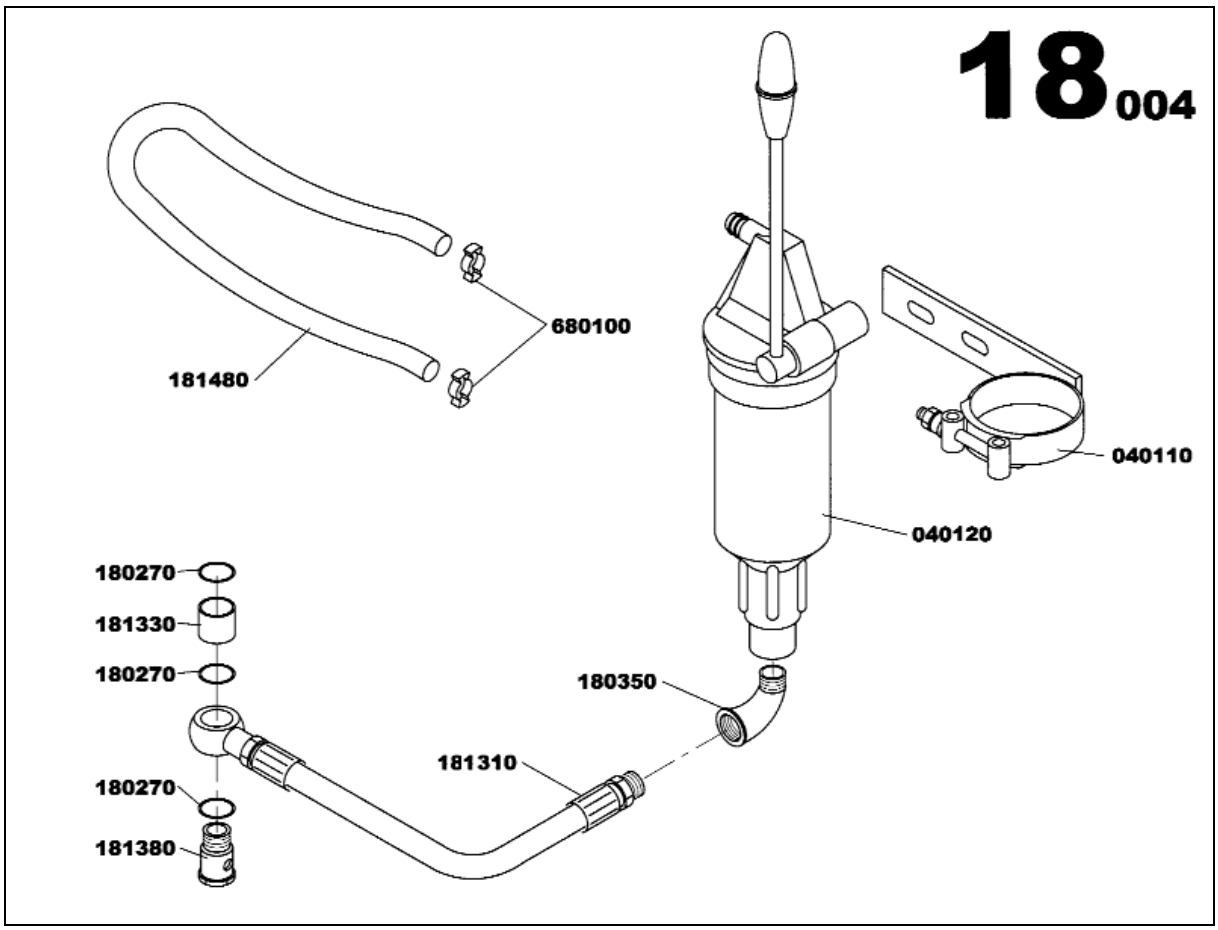
F30016



Item	*Part number*	*Description*	*Quantity*	*Units*
300270	85400679	OUTER AIR FILTER	1.0	UN
300280	85400703	INNER AIR FILTER	1.0	UN
300170	85501252	VACUATOR VALVE	1.0	UN
300300	85501336	DUST CUP	1.0	UN
080810	85412815	RAIN CAP	1.0	UN
180300	85409399	HOSE CLIP D60/80	1.0	UN

SUMP DRAIN PUMP ASSEMBLY

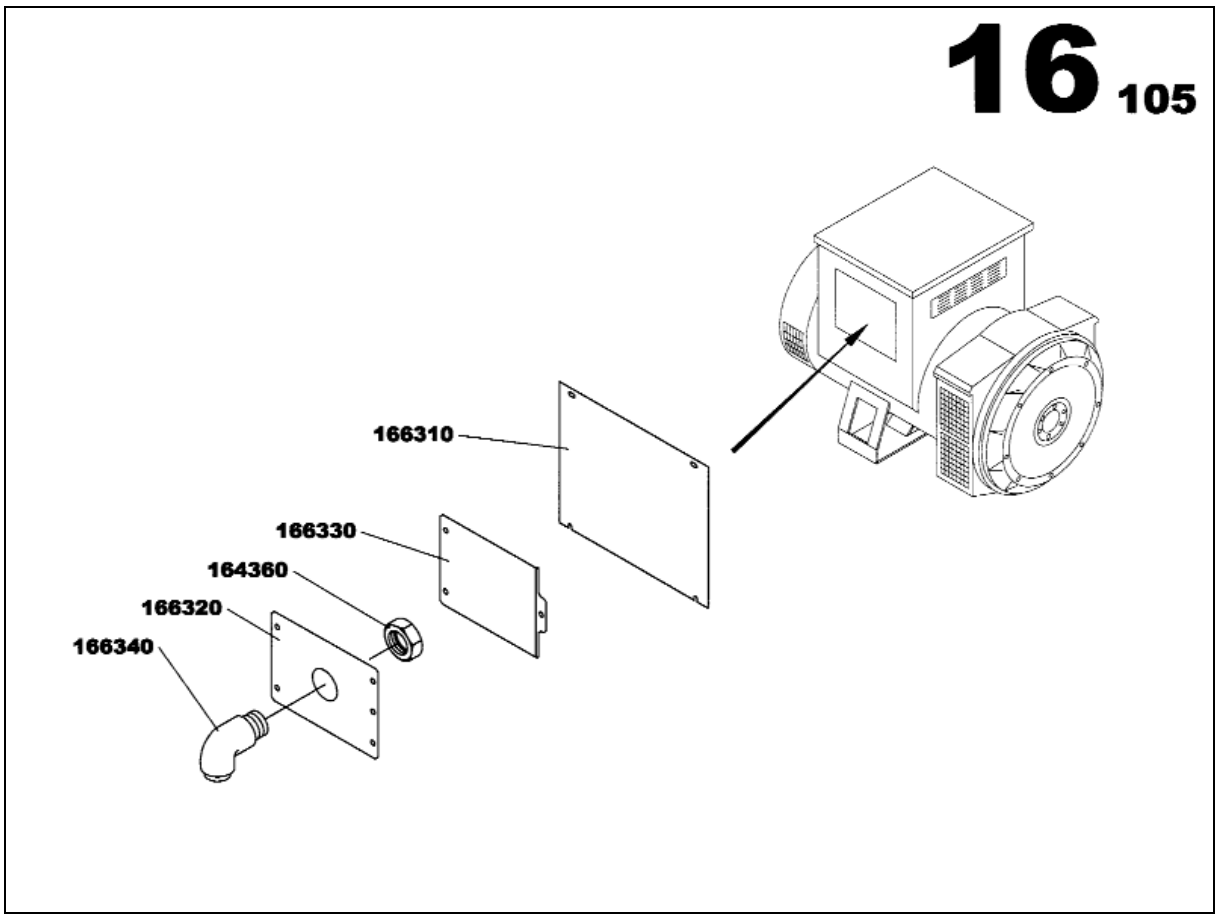
F18004



Item	Part number	Description	Quantity	Units
040110	85403426	OIL SUMP PUMP BRACKET	1.0	UN
040120	85403434	MANUAL PUMP	1.0	UN
181310	85413474	HYDRAULIC HOSE L450	1.0	UN
181330	85413359	SPACER Th14 D22 d15	1.0	UN
181380	85416493	BANJO SCREW M14X150 L41	1.0	UN
180350	85409308	PIPE UNION ELBOW 90° MAL/FEM 3/8G	1.0	UN
180270	85409522	GASKET D14x20 Th1.5	3.0	UN
181480	85416436	FLEXIBLE HOSE D8x14	0.7	ML
680100	85410090	HOSE CLIP	2.0	UN

OUTPUT CABLES ALTERNATOR LSA432 ASSEMBLY

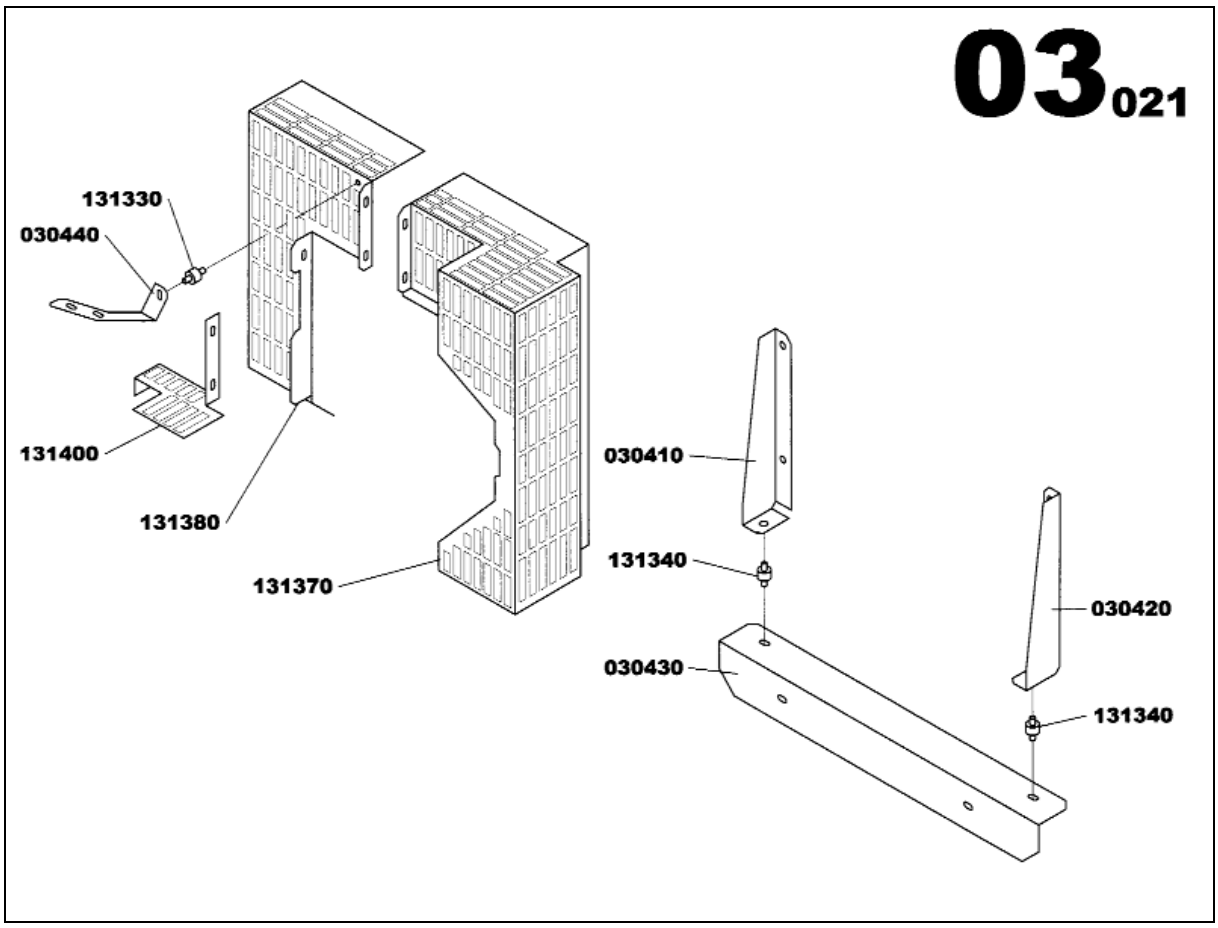
F16105



Item	*Part number*	*Description*	*Quantity*	*Units*
166310	85501435	CABLE OUTLET PLATE LSA411/461 ALTERNATOR	1.0	UN
166320	85501443	CABLE OUTLET PLATE LSA432	1.0	UN
166330	85501450	REGULATION ACCESS PLATE LSA432	1.0	UN
164360	85408680	GLAND NUT PG36	1.0	UN
166340	85501468	ELECTRIC PIPE UNION REDUCER ELBOW PG36	1.0	UN

RADIATOR S4Q2 ASSEMBLY

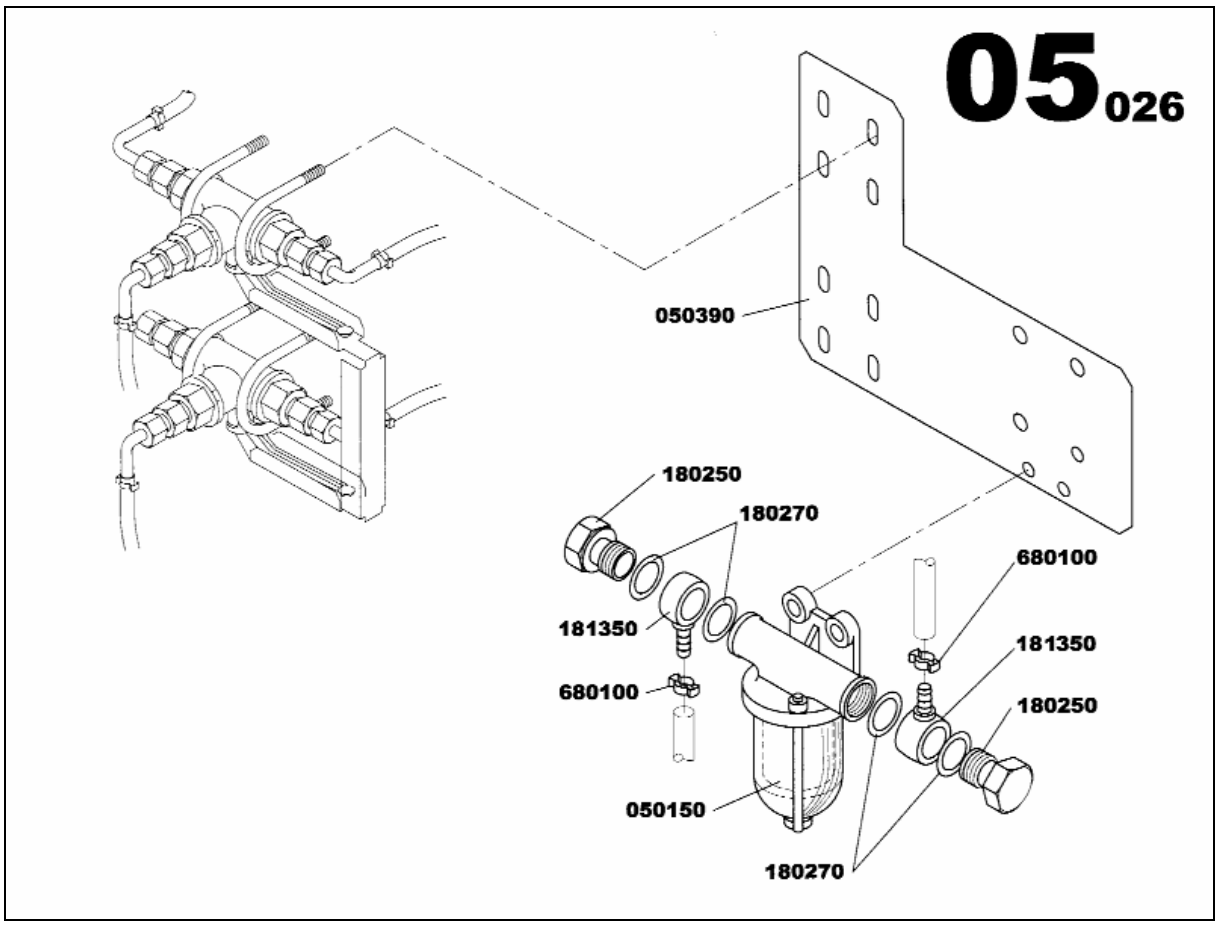
F03021



Item	*Part number*	*Description*	*Quantity*	*Units*
030410	85416204	RADIATOR BRACKET RHS MITSU-S4Q2	1.0	UN
030420	85416212	RADIATOR BRACKET LHS MITSU-S4Q2	1.0	UN
030430	85416220	RADIATOR BRACKET CENTRE MITSU-S4Q2	1.0	UN
030440	85415438	RADIATOR BRACKET ENGINE MI S4Q2	1.0	UN
131330	85400018	ANTI-VIBRATION MOUNT D25 h22	1.0	UN
131340	85400026	ANTI-VIBRATION MOUNT D40 h28	2.0	UN
131370	85415677	RADIATOR GUARD MITSU-S4Q2	1.0	UN
131380	85415685	RADIATOR GUARD MITSU-S4Q2	1.0	UN
131400	85415693	RADIATOR GUARD MITSU-S4Q2	1.0	UN

FUEL PREFILTER KIT ASSEMBLY

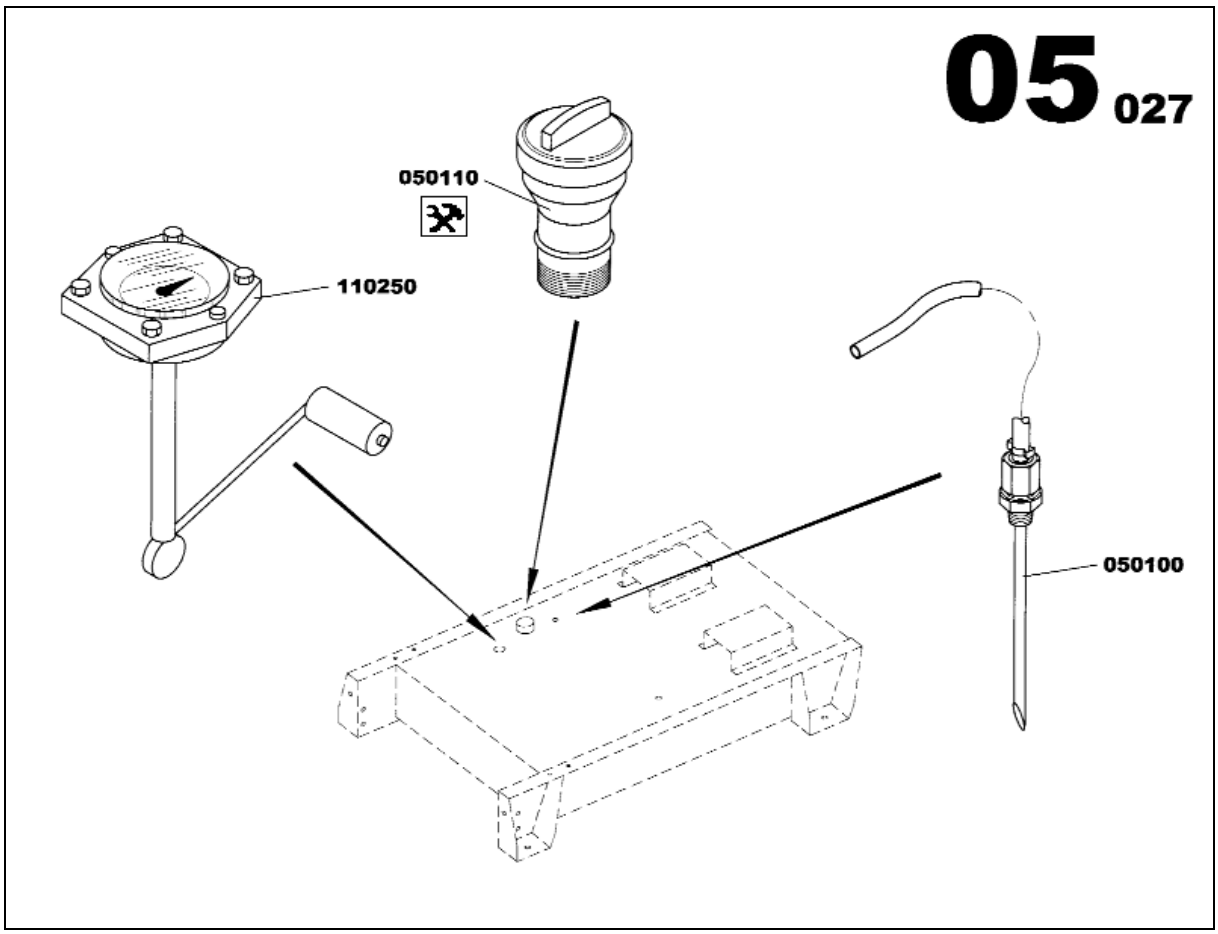
F05026



Item	Part number	Description	Quantity	Units
050150	85403525	FUEL FILTER SEPARATOR	1.0	UN
050390	85425361	FUEL FILTER SEPARATOR/ 3 WAY FUEL VALVE BRACKET	1.0	UN
181350	85415727	BANJO CONNECTOR MALE D06	2.0	UN
180250	85409282	BANJO SCREW M14X150 L26	2.0	UN
180270	85409522	GASKET D14x20 Th1.5	4.0	UN
680100	85410090	HOSE CLIP	2.0	UN

FUEL TANK M107 ASSEMBLY

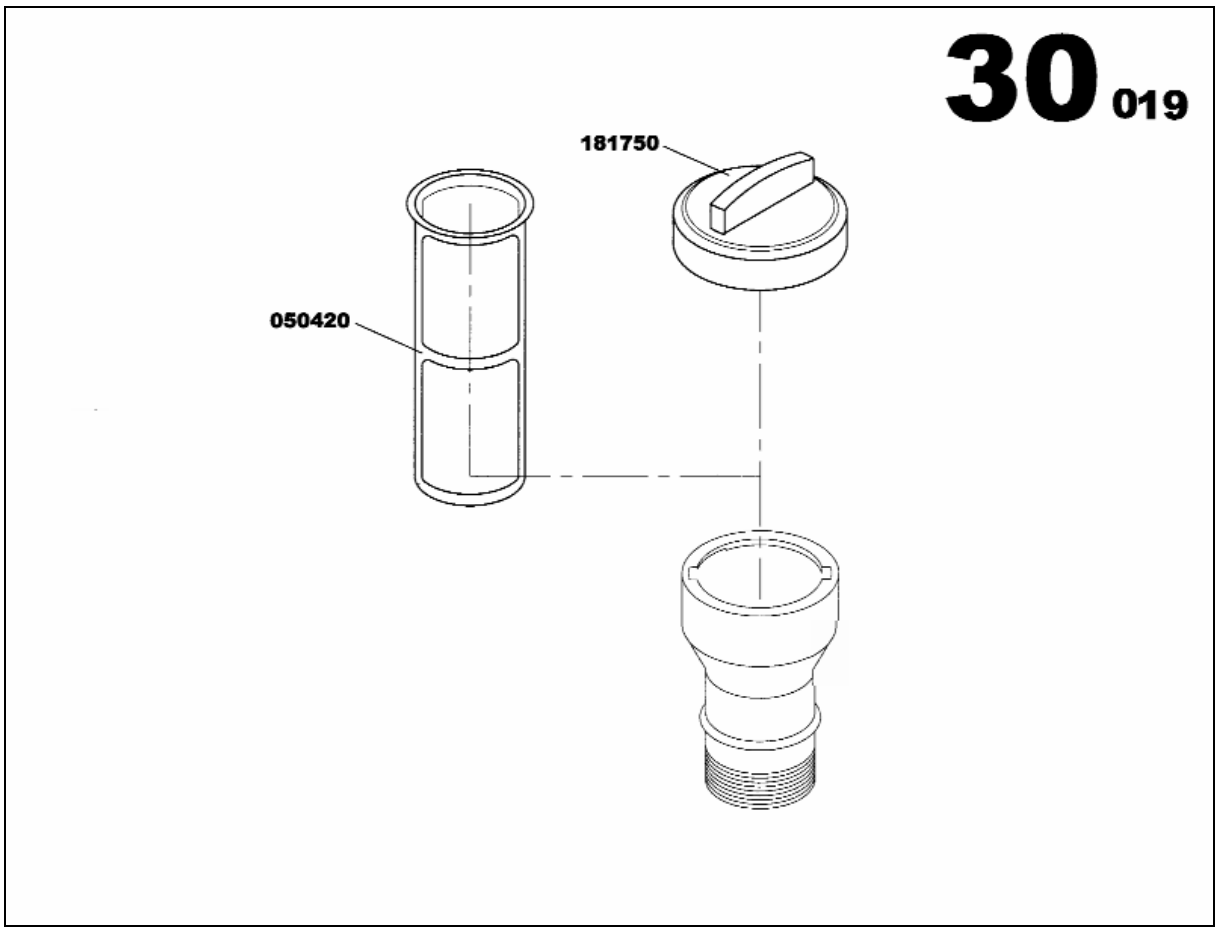
F05027



Item	*Part number*	*Description*	*Quantity*	*Units*
050100	85403467	FUEL SUCTION PIPE L215 D8 3/8G	1.0	UN
050110	85403517	FUEL FILLER BASE FUEL TANK	1.0	UN
110250	85413714	BASE TANK FUEL GAUGE	1.0	UN

FUEL FILLER 050110 DETAILS

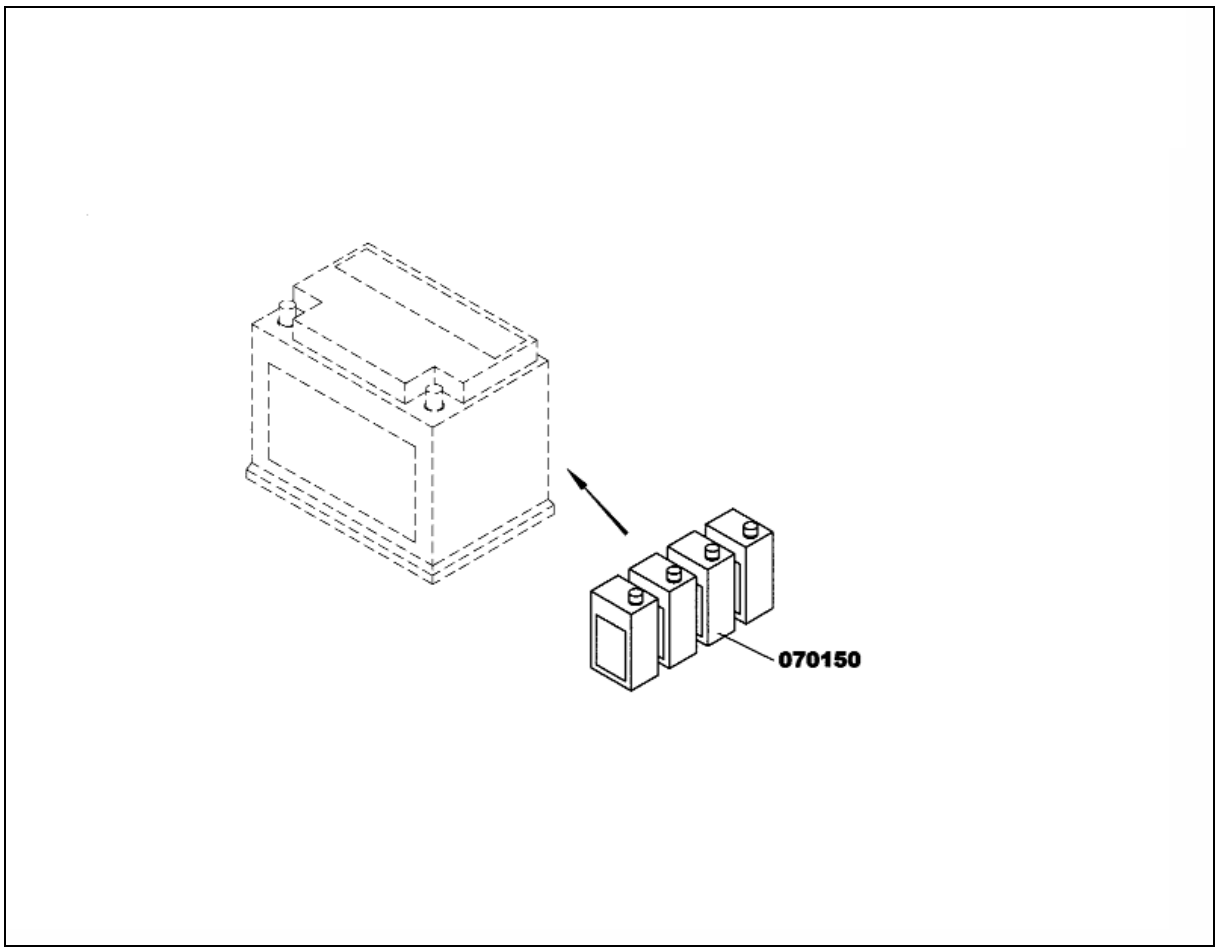
F30019



Item	*Part number*	*Description*	*Quantity*	*Units*
181750	85503035	TANK PLUG	1.0	UN
050420	85431120	FUEL FILTER	1.0	UN

BATTERY ELECTROLYTE

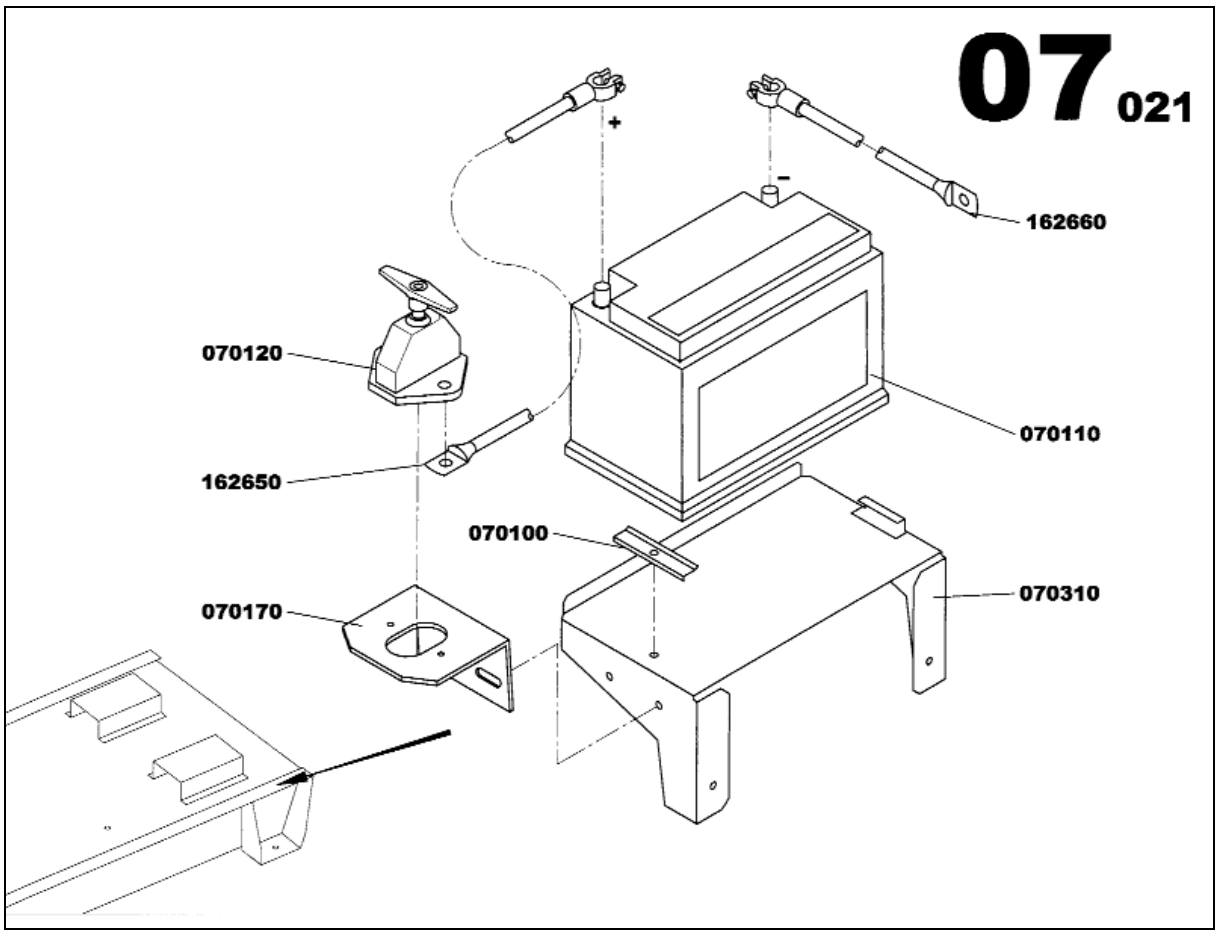
F99002



Item	*Part number*	*Description*	*Quantity*	*Units*
070150	85403756	BATTERY ELECTROLYTE	1.0	UN

ELECTRIC STARTER M107 ISOLATED ASSEMBLY

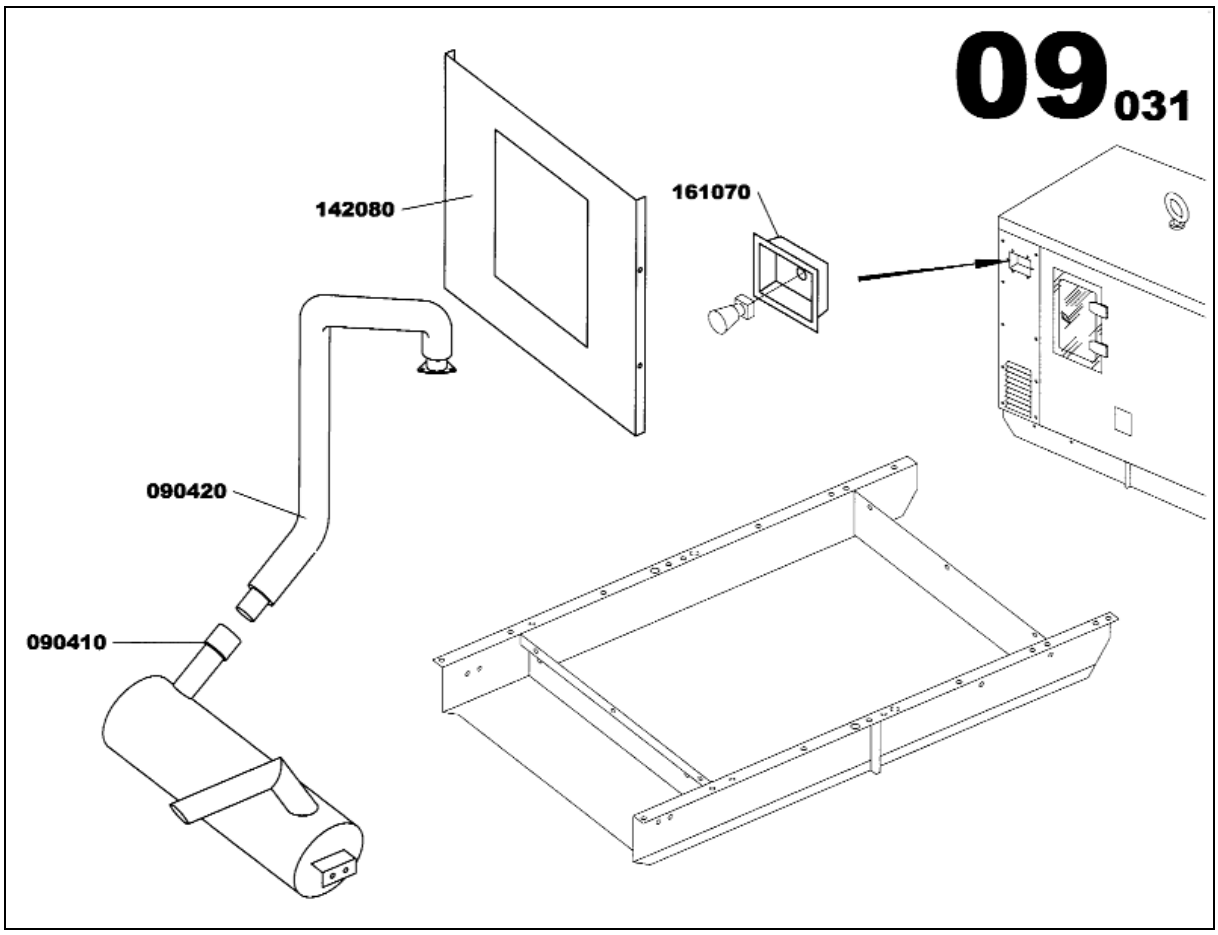
F07021



Item	*Part number*	*Description*	*Quantity*	*Units*
070100	85403699	BATTERY FIXING BRACKET	1.0	UN
070170	85403707	BATTERY ISOLATOR BRACKET	1.0	UN
070310	85415891	BATTERY SUPPORT BRACKET M107	1.0	UN
070110	85403715	STARTING BATTERY 12V 70Ah 400A	1.0	UN
070120	85403723	BATTERY ISOLATOR SWITCH	1.0	UN
162650	85412658	BATTERY CABLE(+) 35mm2 L900 RED	1.0	UN
162660	85412633	BATTERY CABLE(-) 35mm2 L1200 BLACK	1.0	UN

EXHAUST SYSTEM M107 ASSEMBLY

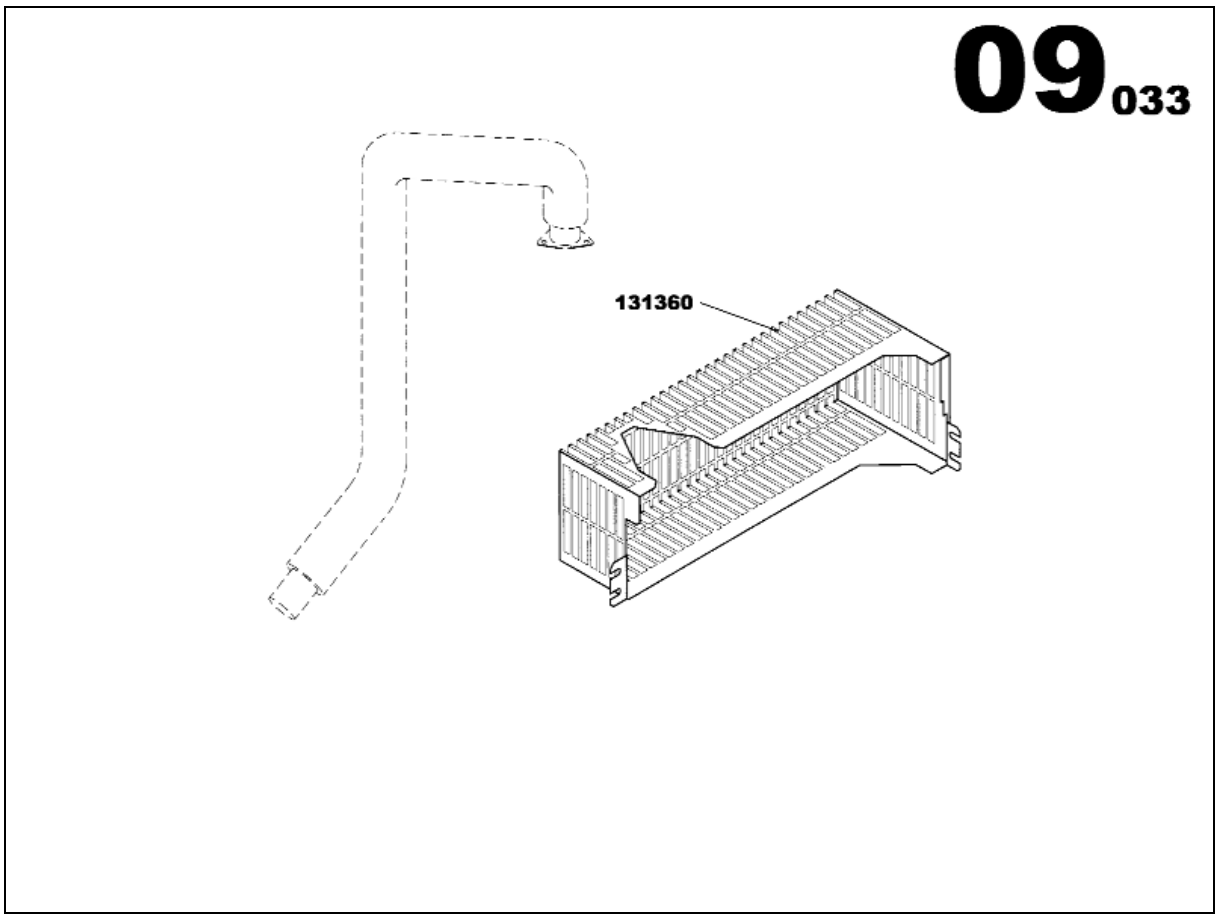
F09031



Item	Part number	Description	Quantity	Units
090410	85415859	23dB MUFFLER	1.0	UN
090420	85413813	EXHAUST PIPE M107 D50 MITSU	1.0	UN
142080	85416329	RADIATOR PANEL M107 MI S4Q2	1.0	UN
161070	85407294	EMERGENCY STOP PANEL	1.0	UN

EXHAUST GUARDS MI S4Q2 ASSEMBLY

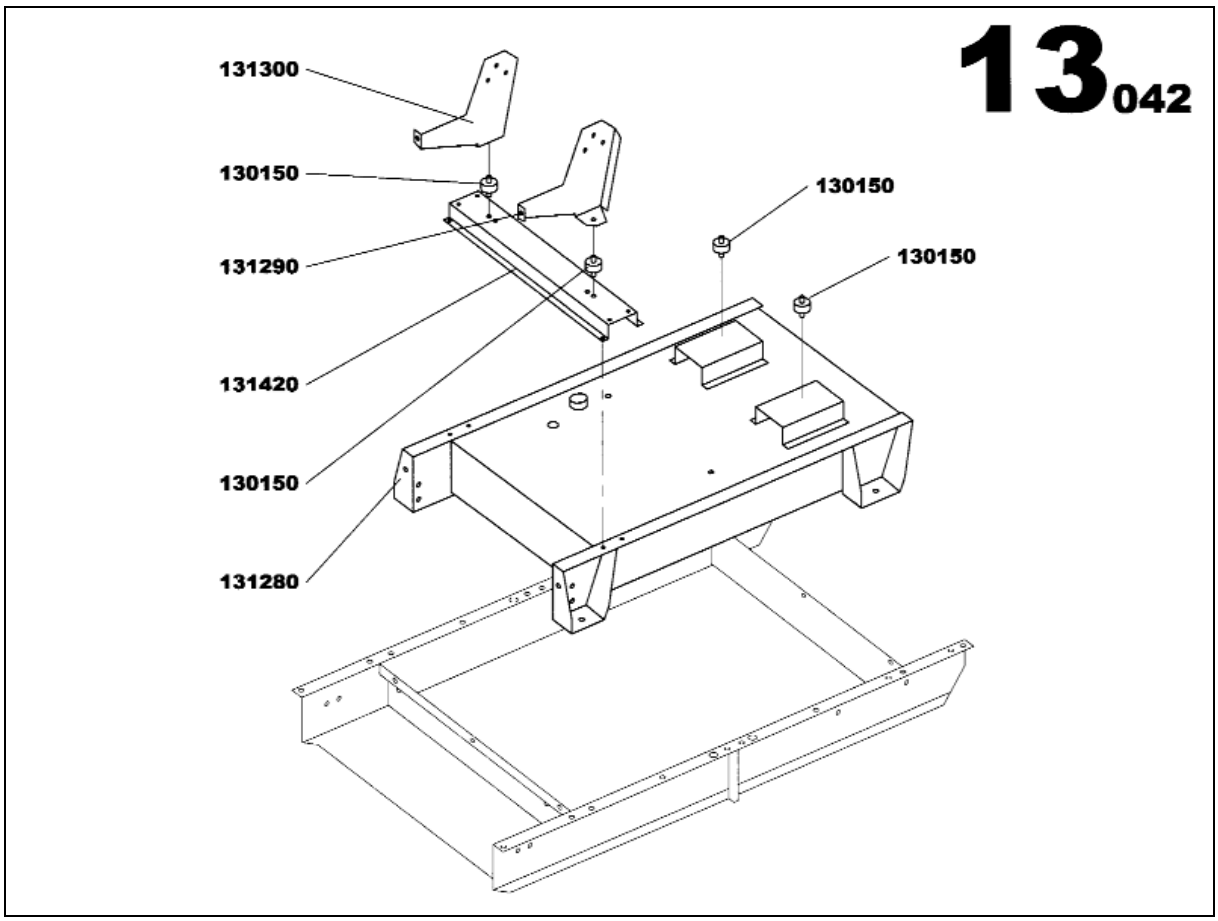
F09033



Item	*Part number*	*Description*	*Quantity*	*Units*
131360	85415586	EXHAUST GUARD MI S4Q2	1.0	UN

FRAME Ex2 MI S4Q2 ASSEMBLY

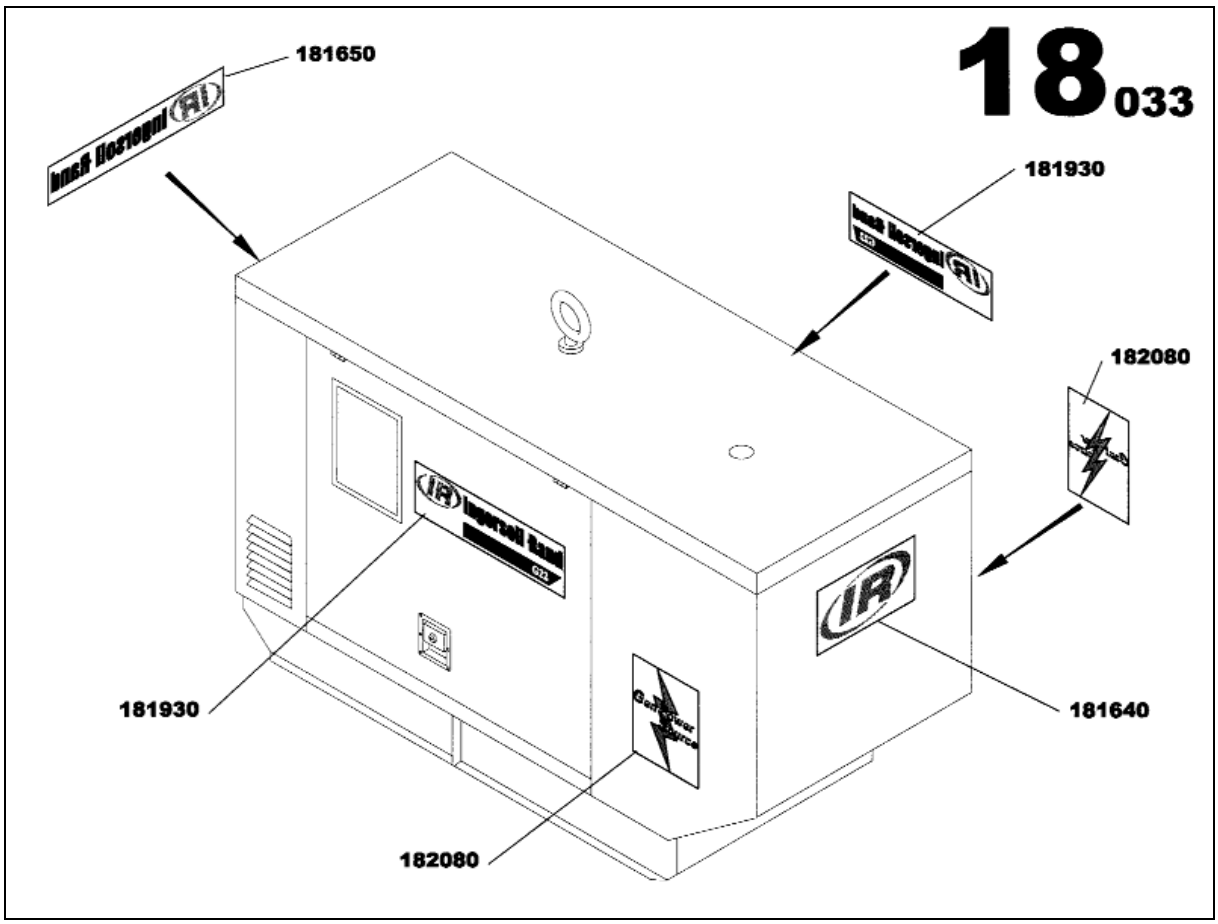
F13042



Item	*Part number*	*Description*	*Quantity*	*Units*
131280	85412849	FRAME TANK FOR MITSU S4L2/S4Q2/S4S ENGINE	1.0	UN
131290	85416071	ENGINE SUPPORT MI-S4Q2 LEFT	1.0	UN
131300	85416089	ENGINE SUPPORT MI-S4Q2 RIGHT	1.0	UN
130150	85401032	ANTI-VIBRATION MOUNT 600daN 8mm	4.0	UN
131420	85416352	ALTERNATOR TRAVERSE FRAME TANK	1.0	UN

G22 DECALS

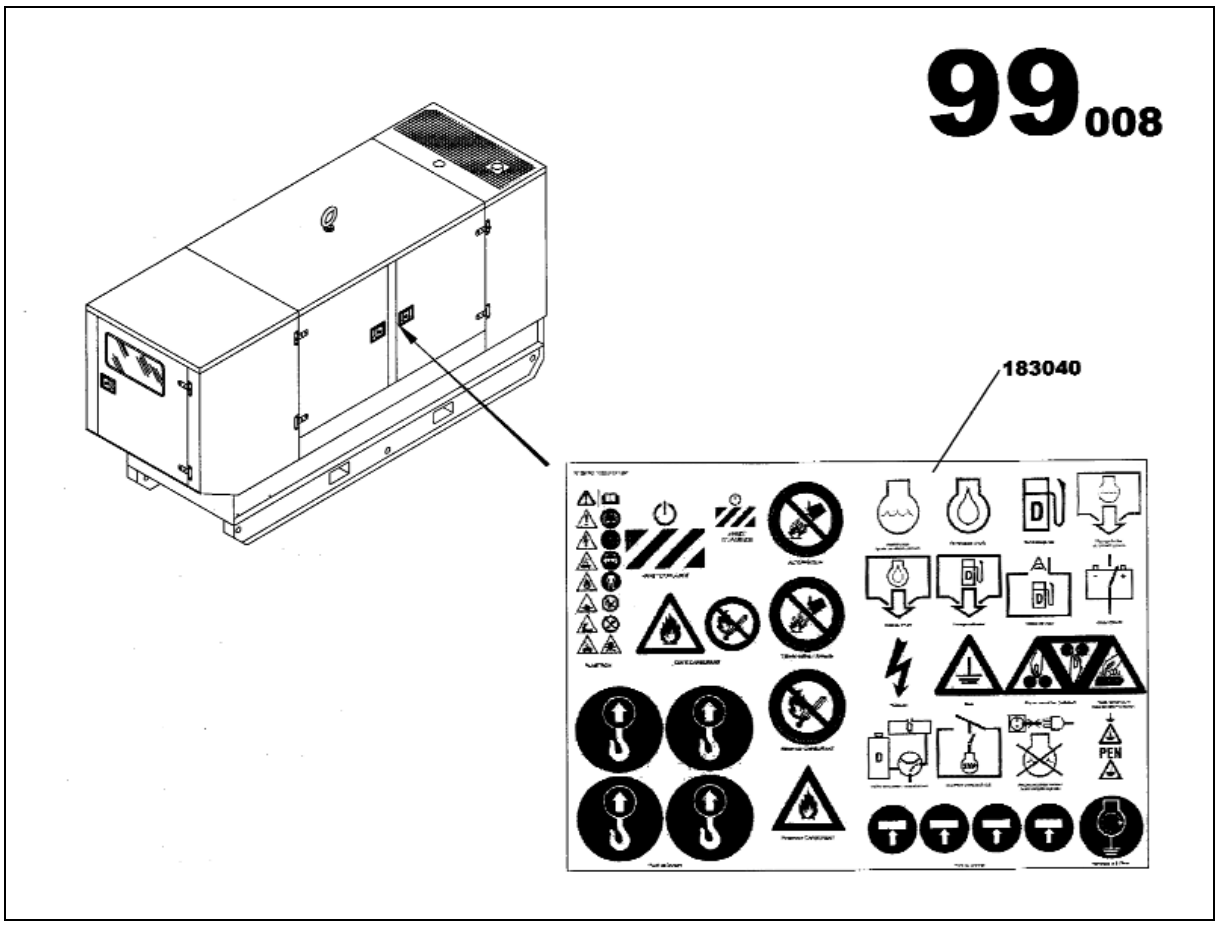
F18033



Item	Part number	Description	Quantity	Units
181640	85500197	ROUND STICKER D215	1.0	UN
181650	85500221	RECTANGULAR STICKER 550x110	1.0	UN
181930	85503753	RECTANGULAR STICKER 680x200	2.0	UN
182080	85503902	RECTANGULAR STICKER 250x300	2.0	UN

SAFETY DECALS ASSEMBLY

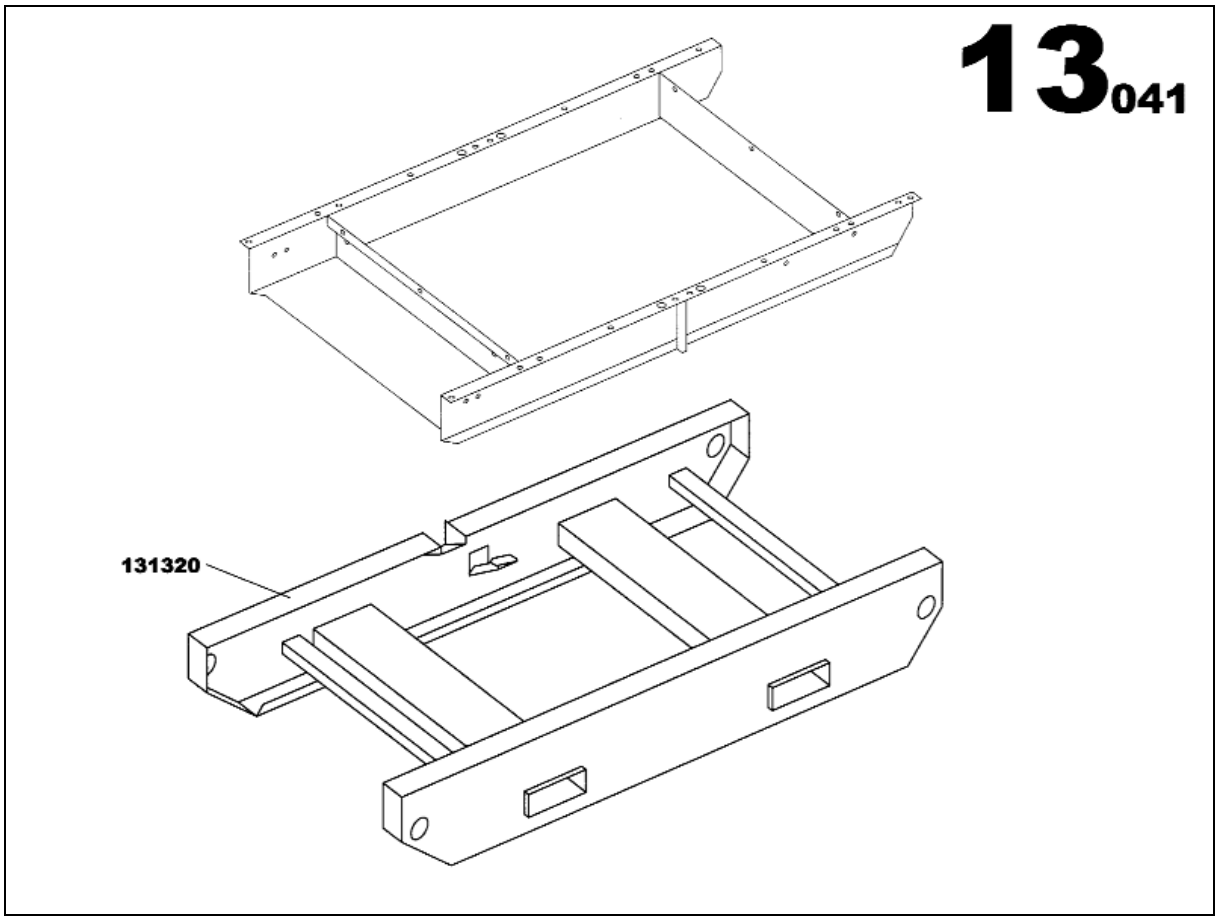
F99008



Item	*Part number*	*Description*	*Quantity*	*Units*
183040	85506467	SAFETY DECAL	1.0	UN

FRAME SKID M107 ASSEMBLY

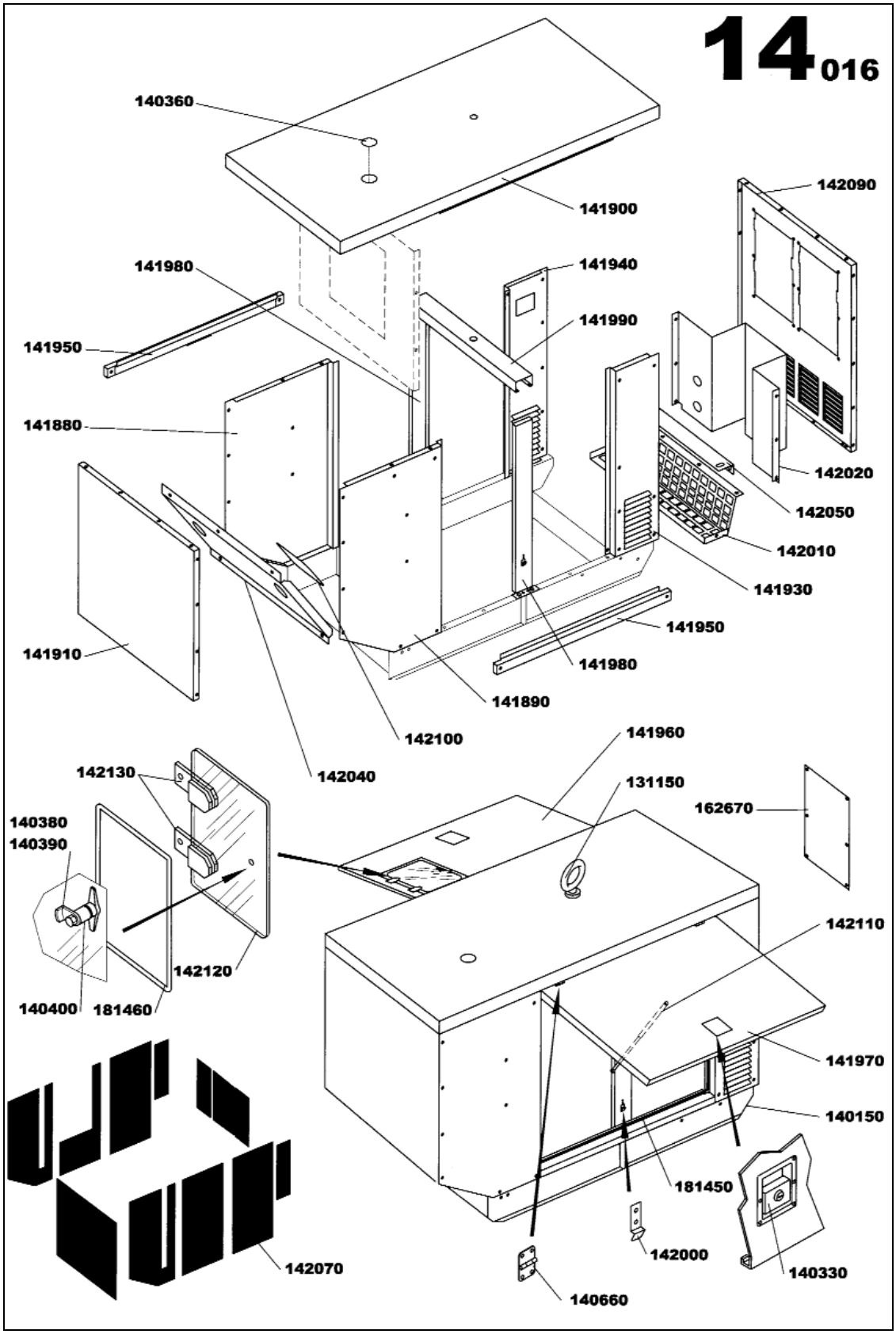
F13041



Item	*Part number*	*Description*	*Quantity*	*Units*
131320	85412864	SKID BASE M107	1.0	UN

M107 ENCLOSURE ASSEMBLY

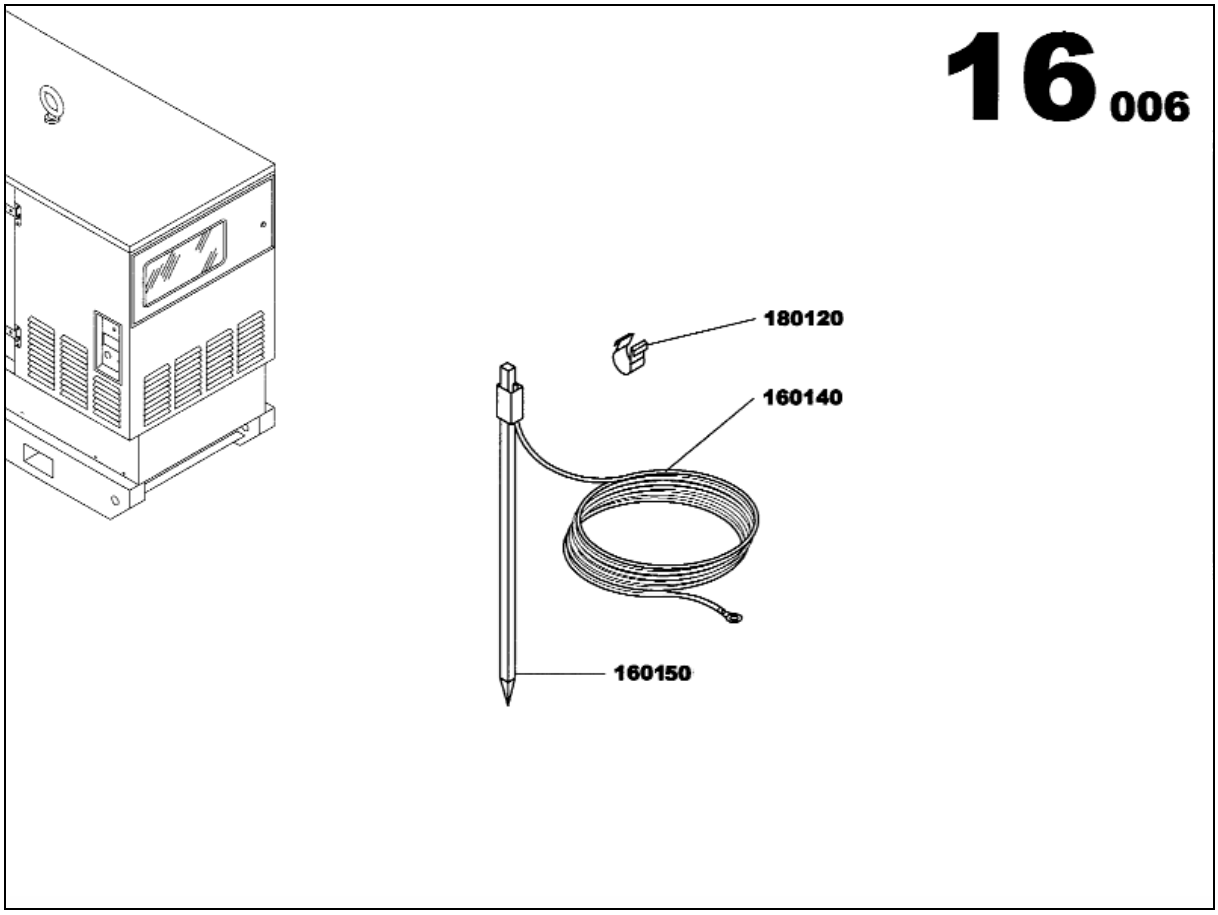
F14016



Item	Part number	Description	Quantity	Units
131150	85492700	LIFTING EYE D58 2500daN	1.0	UN
140150	85412856	M107 FRAME	1.0	UN
141880	85501401	M107 CANOPY RIGHT FRONT PANEL	1.0	UN
141890	85501419	M107 CANOPY LEFT FRONT PANEL	1.0	UN
141900	85416253	CANOPY TOP M107	1.0	UN
141910	85415347	M107 CANOPY FRONT PANEL	1.0	UN
141930	85415339	M107 CANOPY LEFT REAR PANEL	1.0	UN
141940	85415321	M107 CANOPY RIGHT REAR PANEL	1.0	UN
141950	85415370	CANOPY LATERAL PANEL M107	2.0	UN
141960	85415511	HINGES M 107 RIGHT DOOR	1.0	UN
141970	85415529	HINGES M 107 LEFT DOOR	1.0	UN
141980	85412484	SIDE SUPPORT ARCH UPRIGHTS M107	2.0	UN
141990	85412492	TRANSVERSE ARCH SUPPORT M107	1.0	UN
142000	85413516	STRIKER PLATE M107 CANOPY DOOR	2.0	UN
142010	85413524	REAR AIR INTAKE LOUVER M107 CANOPY	1.0	UN
142020	85413151	AIR DEFLECTOR M107 CENTRAL REAR	1.0	UN
142040	85416261	RADIATOR PANEL M107	1.0	UN
142050	85412617	CHASSIS FIXING BRACKET M107	1.0	UN
142070	85413888	SOUNDPROOF PANELS BATCH M107	1.0	UN
142090	85415313	M107 CANOPY REAR PANEL	1.0	UN
142100	85416295	M107 CANOPY RADIATOR PANEL	1.0	UN
140660	85406130	DOOR HINGE h50XL50	4.0	UN
140330	85406148	CANOPY DOOR LOCK KEY LOCK	2.0	UN
140360	85406205	PLUG D100	1.0	UN
142110	85416477	GAS FILLED DAMPER 70kg ROD ND10	2.0	UN
142120	85416501	SECURITY PANE M107	1.0	UN
142130	85412831	DOOR HINGE h80XL102	2.0	UN
140380	85406221	SLAM SHUT DOOR LATCH	1.0	UN
140390	85406239	SLAM SHUT LATCH HANDLE	1.0	UN
140400	85406247	SLAM SHUT FASTENER	1.0	UN
181450	85413722	LINEAR SEAL Th5	8.3	ML
181460	85413730	LINEAR SEAL Th10	1.25	ML
162670	85429355	M107 CANOPY REAR PANEL	1.0	UN

EARTH ROD WITH CABLE M100/200 CANOPY ASSEMBLY

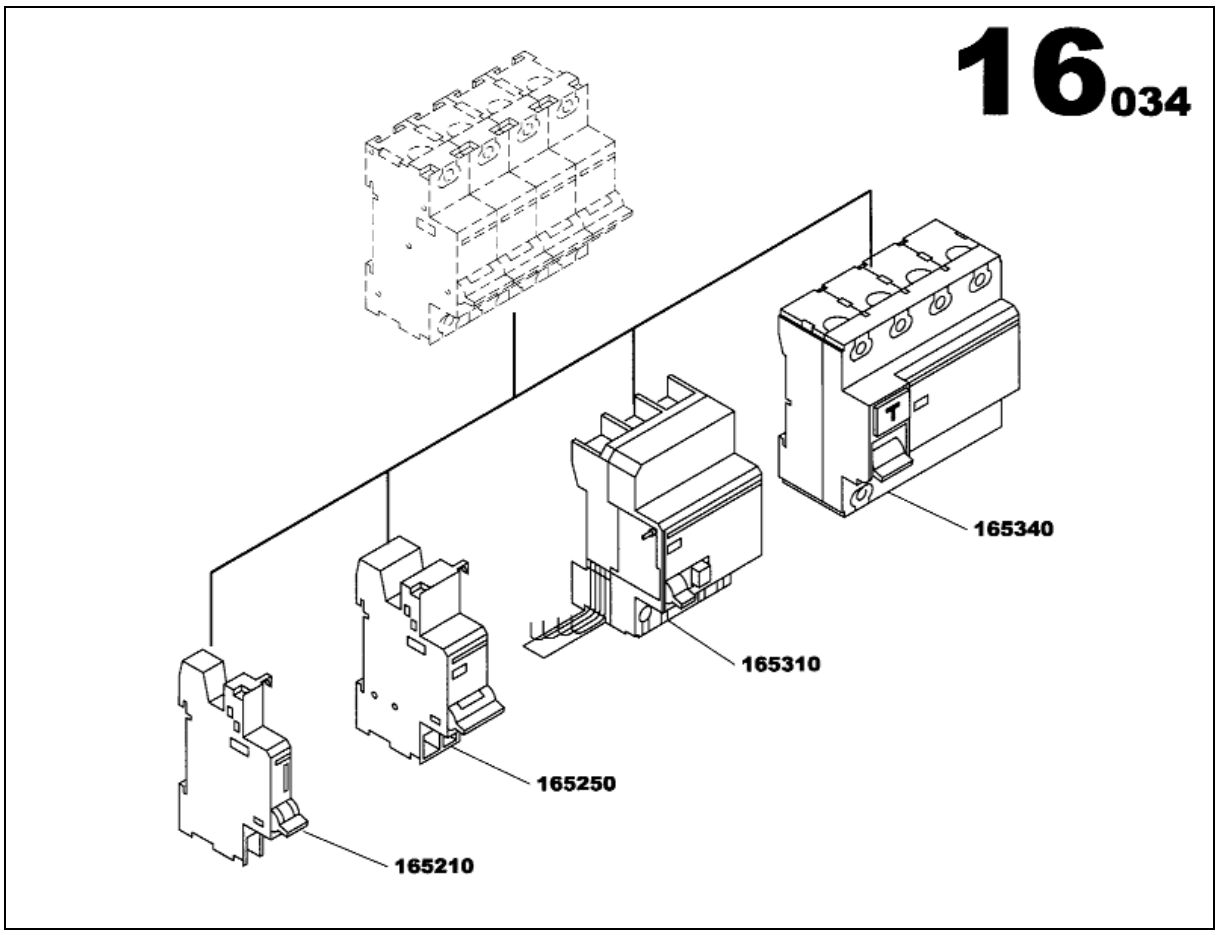
F16006



Item	*Part number*	*Description*	*Quantity*	*Units*
160140	85408227	NEUTRAL/EARTH SYSTEM CABLE 25mm2 L10000 Gr/Ye	1.0	UN
160150	85408334	EARTH ROD L1000	1.0	UN
180120	85409191	CLIP-ON BRACKET	2.0	UN

CIRCUIT BREAKER ACCESSORIES

F16034

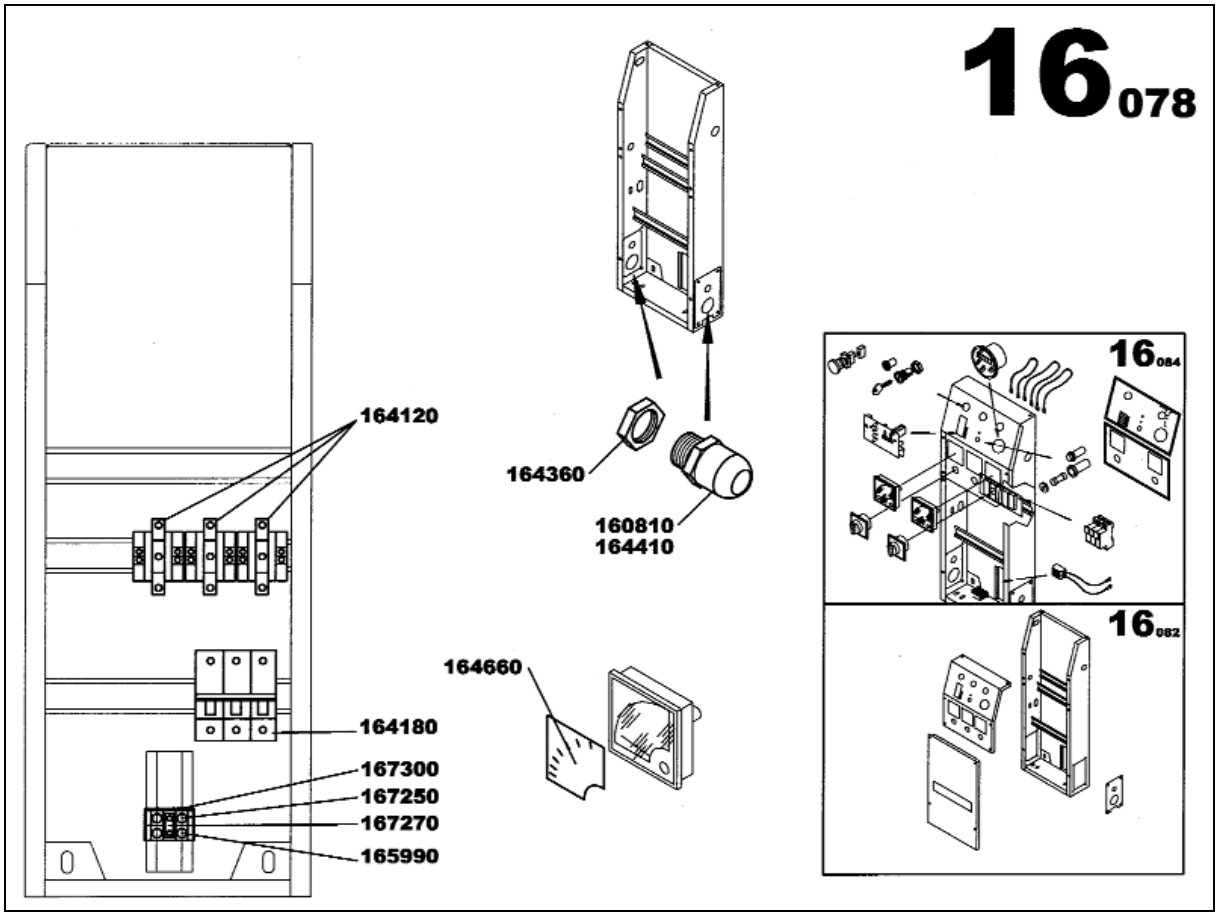


Item	Part number	Description	Quantity	Units
165340	85413631	DIFFERENTIAL SWITCH 4P 40A 30mA	1.0	UN

Part number listed is the only part used in this model.

ANALOGUE INSTRUMENT CONTROL PANEL ASSEMBLY

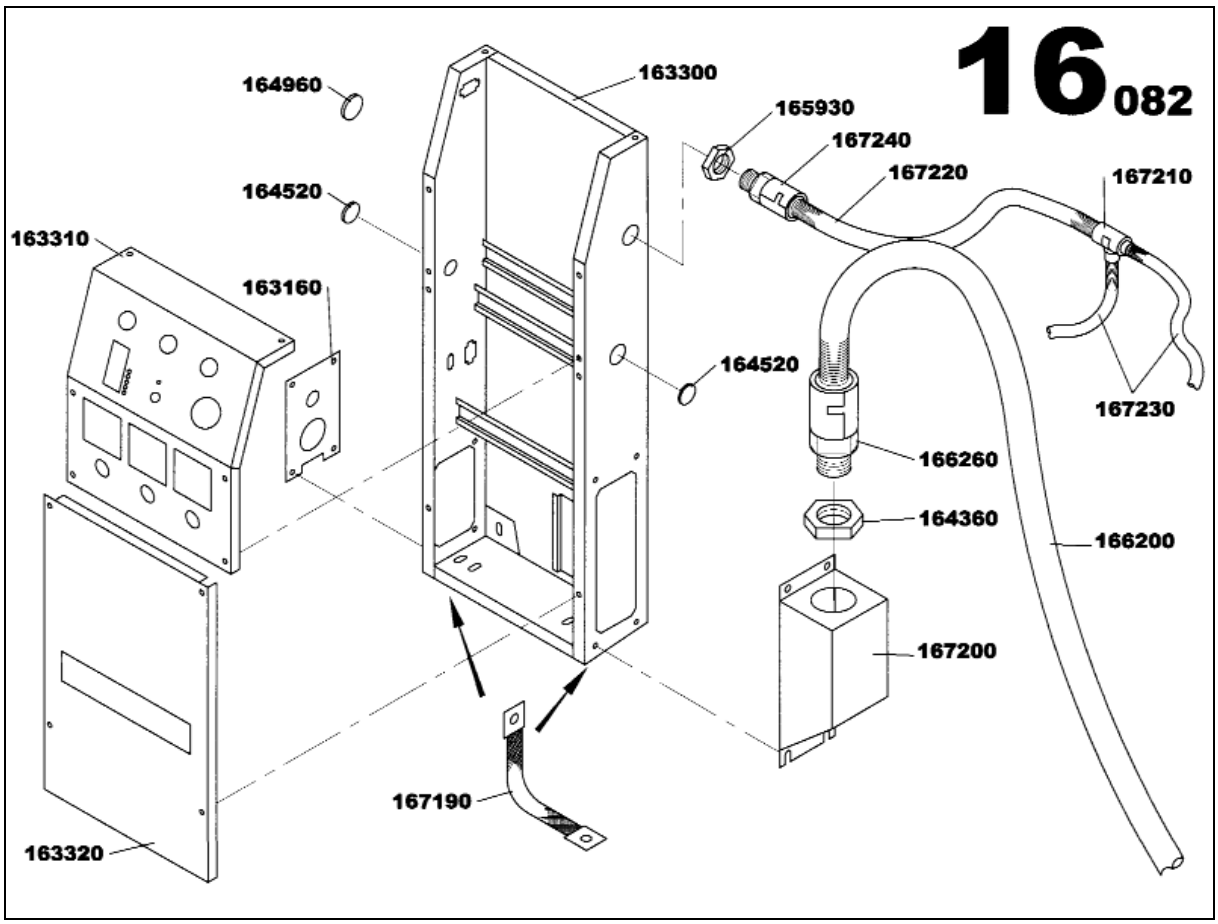
F16078



Item	Part number	Description	Quantity	Units
164120	85408417	CURRENT TRANSFORMER 60/5	3.0	UN
164180	85408466	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
160810	85408631	GLAND NUT PG21	2.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
164410	85415768	GLAND NUT REDUCER 36X21	2.0	UN
164660	85413243	AMMETER SCALE 30/5A DIN72 90°	1.0	UN
167300	85505675	PLASTIC COVER TERMINAL BLOCK BLUE	1.0	UN
165990	85426229	TERMINAL BLOCK 1x16mm2 Gr/Ye	1.0	UN
167250	85505642	BLUE TERMINAL CONNECTION	1.0	UN
167270	85505618	TERMINAL BLOCK	1.0	UN

HOUSING ANALOGUE CONTROL PANEL ASSEMBLY

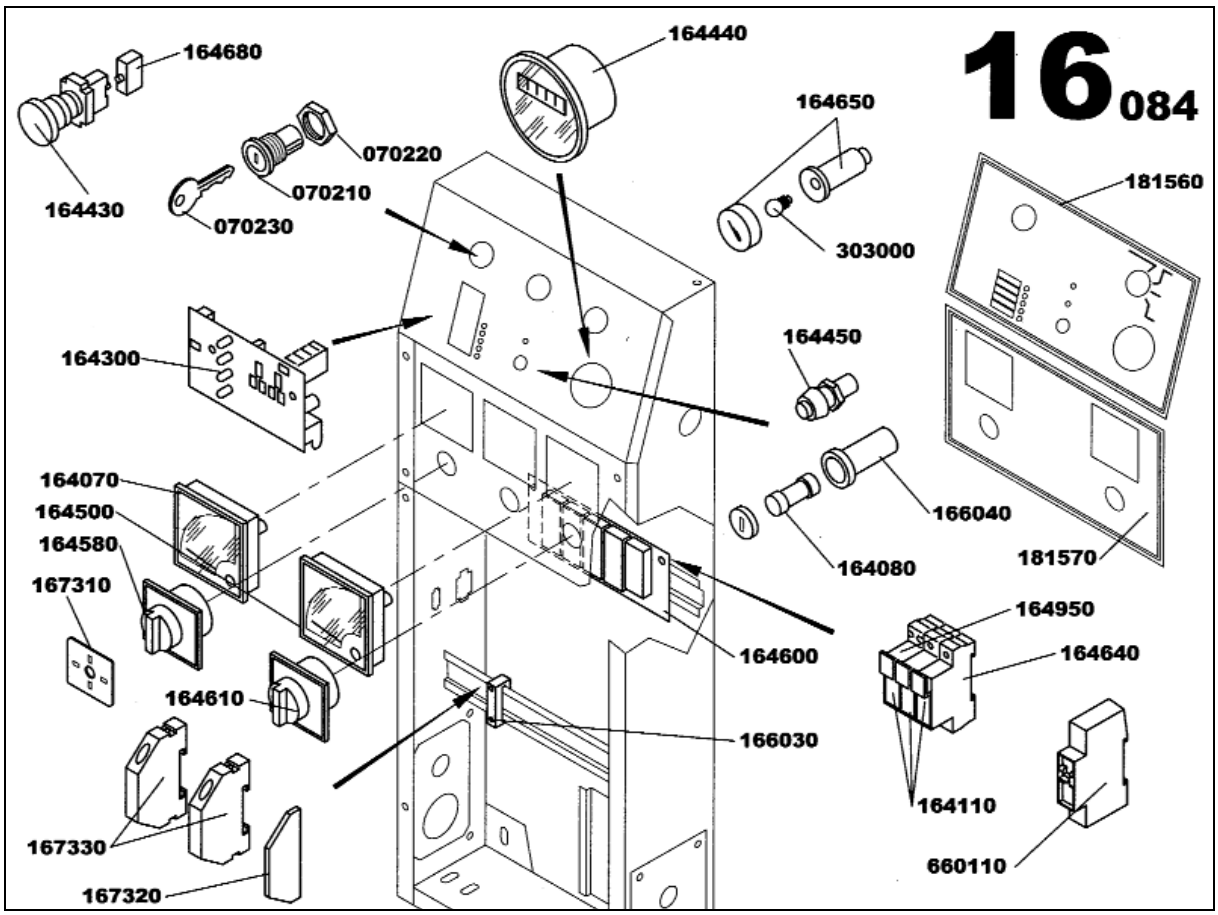
F16082



Item	Part number	Description	Quantity	Units
163160	85416121	GLAND NUT PLATE CONTROL PANEL	1.0	UN
163300	85416238	CHASSIS PANEL BRACKET CONTROL PANEL	1.0	UN
163310	85413136	DASHBOARD HOOD SUPERIOR CONTROL PANEL	1.0	UN
163320	85413144	DASHBOARD HOOD INFERIOR CONTROL PANEL	1.0	UN
167200	85505550	SHAFT ADAPTOR	1.0	UN
167190	85505543	GROUND WIRES 16mm2	2.0	UN
164520	85415388	RUBBER GROMMET D22	4.0	UN
164960	85415396	RUBBER GROMMET D18	2.0	UN
167210	85505568	TE 16x13x13 ELECTRICAL SHAFT	1.0	UN
167220	85505576	ELECTRICAL SHAFT D16	0.44	ML
167230	85505584	ELECTRICAL SHAFT D13	0.98	ML
167240	85505592	ELECTRICAL PIPE UNION PG16	1.0	UN
165930	85408664	GLAND NUT PG16	1.0	UN
166260	85501575	PIPE UNION PG36	1.0	UN
164360	85408680	GLAND NUT PG36	1.0	UN
166200	85499440	ELECTRICAL SHAFT D36	1.0	UN

ANALOGUE CONTROL PANEL ASSEMBLY

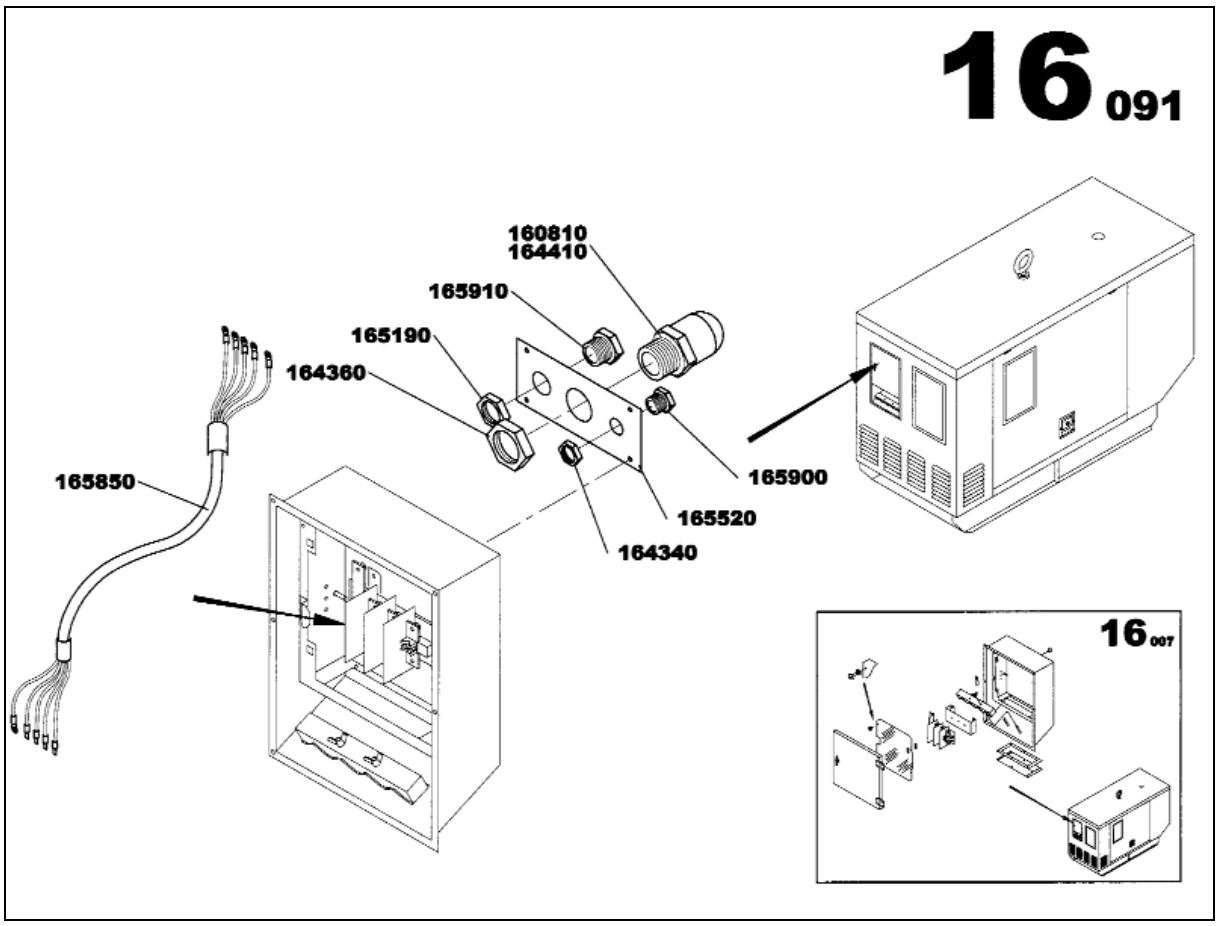
F16084



Item	*Part number*	*Description*	*Quantity*	*Units*
070210	85412948	KEY SWITCH	1.0	UN
070220	85413268	SWITCH NUT	1.0	UN
070230	85412872	KEY SWITCH	1.0	UN
164070	85416519	VOLTMETER 0/500V	1.0	UN
164080	85413482	FUSE CYLINDRICAL 5A	1.0	UN
164110	85413490	FUSE CYLINDRICAL 6A	3.0	UN
164300	85402527	PGS CARD 12/24V	1.0	UN
164430	85412591	EMERGENCY STOP PUSH BUTTON D22	1.0	UN
164440	85412963	HOUR METER 10/30VDC	1.0	UN
164450	85412609	PUSH BUTTON D12	1.0	UN
164500	85402477	AMMETER WITH NEEDLE 72x72	1.0	UN
164580	85412955	VOLTMETER SWITCH 7 POSITIONS D22	1.0	UN
164600	85402576	RD2 CARD 12VCC	1.0	UN
164610	85412930	AMMETER SWITCH 4 POSITIONS D22	1.0	UN
164640	85415503	FUSE HOUSING	1.0	UN
164650	85416527	WARNING LIGHT CYLINDRIC D22	1.0	UN
164680	85508638	AUXILARY CONTACT EMERGENCY STOP	2.0	UN
181560	85505634	PLASTIC PLATE L260xh140	1.0	UN
181570	85413797	PLASTIC PLATE L260xh140	1.0	UN
164950	85413508	CYLINDRICAL FUSE NEUTRAL	1.0	UN
303000	85402519	LAMP	1.0	UN
166040	85490472	FUSE HOUSING	1.0	UN
660110	85500379	MOULDED CASE CIRCUIT BREAKER 1x6A	1.0	UN
167310	85505659	VOLTMETER INDICATOR PLATE	1.0	UN
167320	85505683	PLASTIC COVER TERMINAL BLOCK	1.0	UN
167330	85505691	TERMINAL CONNECTION	2.0	UN
166030	85408854	STOP	7.0	UN

TERMINAL CONNECTION BLOCK ASSEMBLY

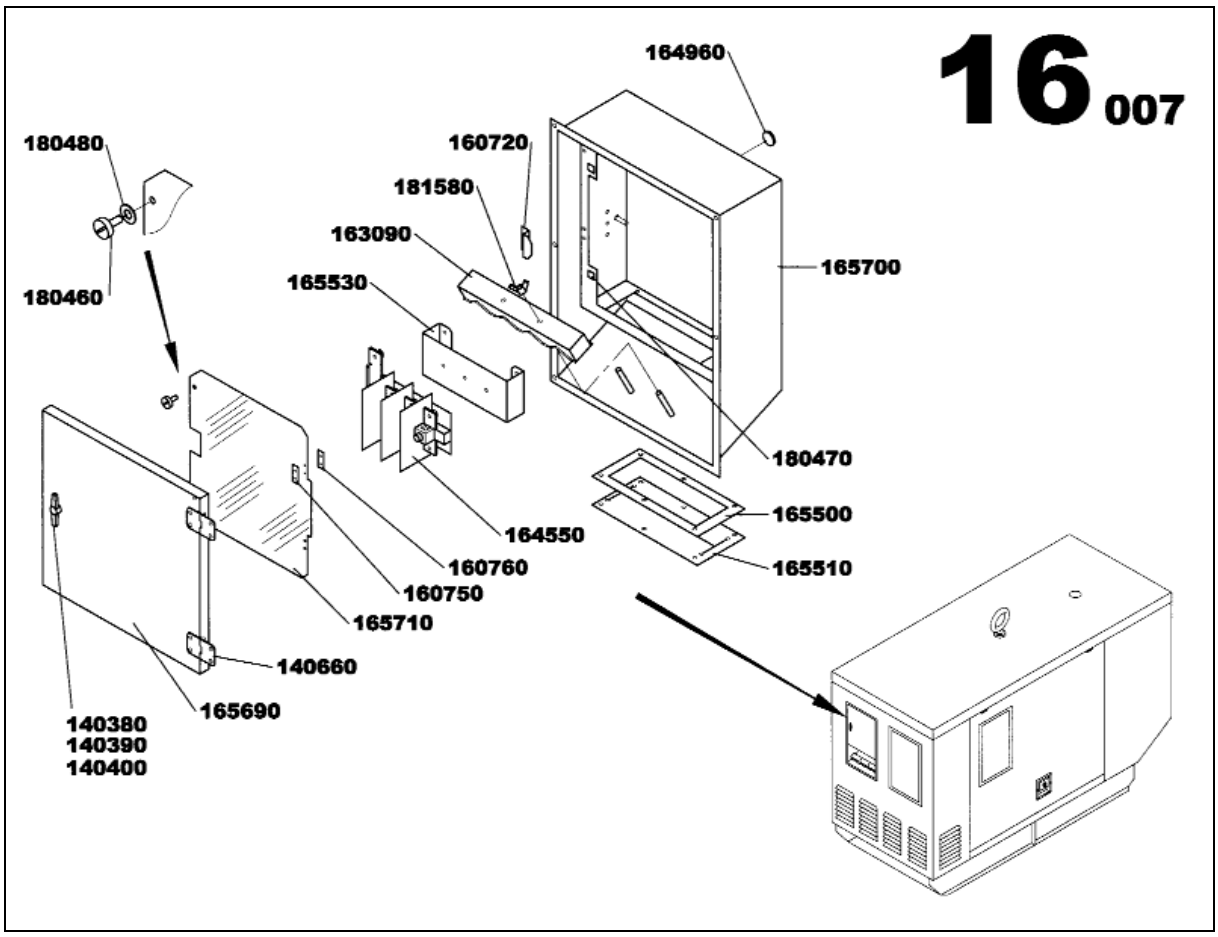
F16091



Item	Part number	Description	Quantity	Units
165520	85416113	GLAND NUT PLATE M202BL	1.0	UN
165850	85412724	POWER CABLE SINGLE CORE 4mm2 L1600	1.0	UN
165900	85429413	ELECTRIC PLUG D11	1.0	UN
165910	85412583	PLASTIC PLUG D22PG	1.0	UN
160810	85408631	GLAND NUT PG21	1.0	UN
164340	85413276	GLAND NUT PG11	1.0	UN
165190	85413284	GLAND NUT PG29	1.0	UN
164360	85408680	GLAND NUT PG36	1.0	UN
164410	85415768	GLAND NUT REDUCER 36X21	1.0	UN

CONNECTIONS M107 ASSEMBLY

F16007

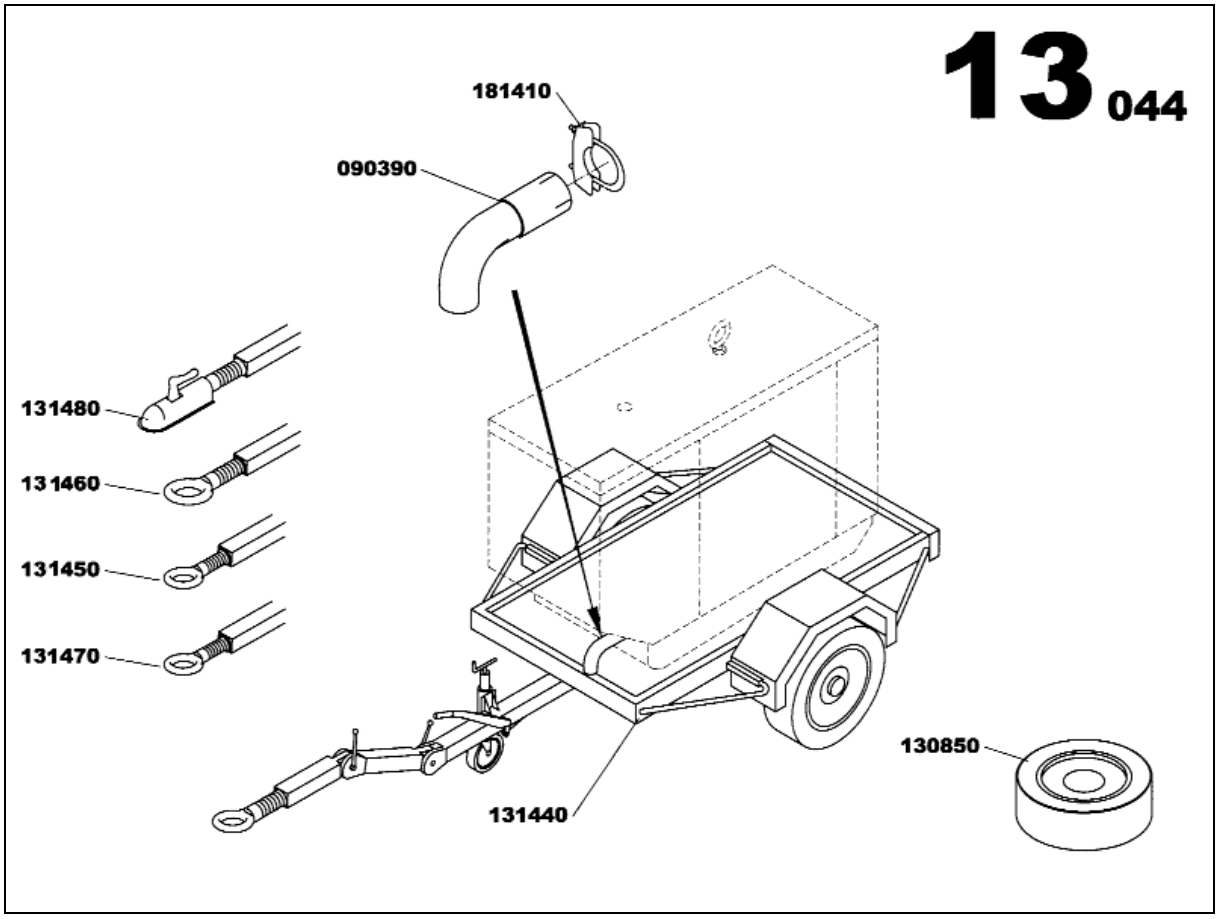


Item	Part number	Description	Quantity	Units
163090	85416030	CABLE FIXING BRACKET MCPS M202BL	1.0	UN
165500	85415982	WIRE BIB OUTPUT BRACKET M204BL	1.0	UN
165510	85412534	CABLE OUTPUT RUBBER SCREEN	1.0	UN
165530	85415933	TERMINAL BRACKET M202L	1.0	UN
140660	85406130	DOOR HINGE h50XL50	4.0	UN
140380	85406221	SLAM SHUT DOOR LATCH	1.0	UN
140390	85406239	SLAM SHUT LATCH HANDLE	1.0	UN
140400	85406247	SLAM SHUT FASTENER	1.0	UN
165690	85415537	TERMINAL CONNECTION DOOR M107L CANOPY	1.0	UN
160720	85407682	STRIKER PLATE M214BL CANOPY MCPS DOOR	1.0	UN
160750	85407690	SPACER FOR CB DOOR M214BL	2.0	UN
160760	85407708	HINGE FIXING PLATE M214BL	2.0	UN
165700	85416048	CONNECTIONS BLOCK BRACKET M107L	1.0	UN
165710	85415545	TERMINAL CONNECTION PERSPEX DOOR M107L CANOPY	1.0	UN
164550	85412559	HIRETECH POWER CONNECTION BLOCK	1.0	UN
180460	85409225	1/4 TURN SCREW D9	2.0	UN
180470	85409233	CAPTIVE NUT FOR 1/4 TURN BOLT	2.0	UN
180480	85409241	WASHER FOR 1/4 TURN FASTENER	2.0	UN
164960	85415396	RUBBER GROMMET D18	1.0	UN
181580	85410140	WING NUT	2.0	UN

ROAD TRAILER M107 OPTION

ROAD TRAILER M107

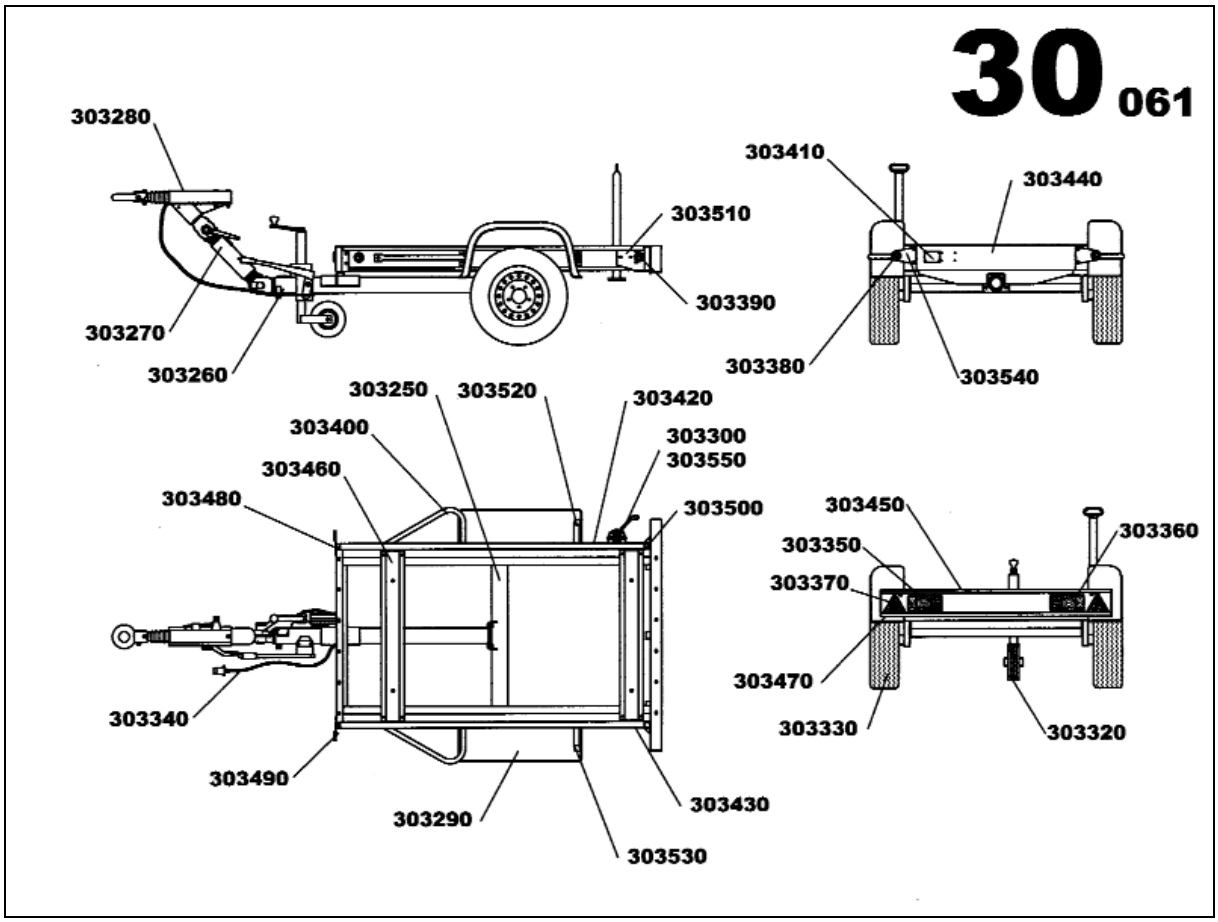
F13044



Item	*Part number*	*Description*	*Quantity*	*Units*
090390	85429199	MUFFLER EXTENSION D50	1.0	UN
181410	85429421	HOSE CLAMP D54	1.0	UN
131440	85429249	ROAD TRAILER M107	1.0	UN
131480	85429280	TOWING BALL D50	1.0	UN
131460	85429264	TOWING EYE 76x42	1.0	UN
131450	85429256	TOWING EYE 68x42	1.0	UN
131470	85429272	TOWING EYE DIN 40	1.0	UN
130850	85429322	SPARE WHEEL KIT FOR ROAD TRAILER M107	1.0	UN

ROAD TRAILER 131440 DETAILS

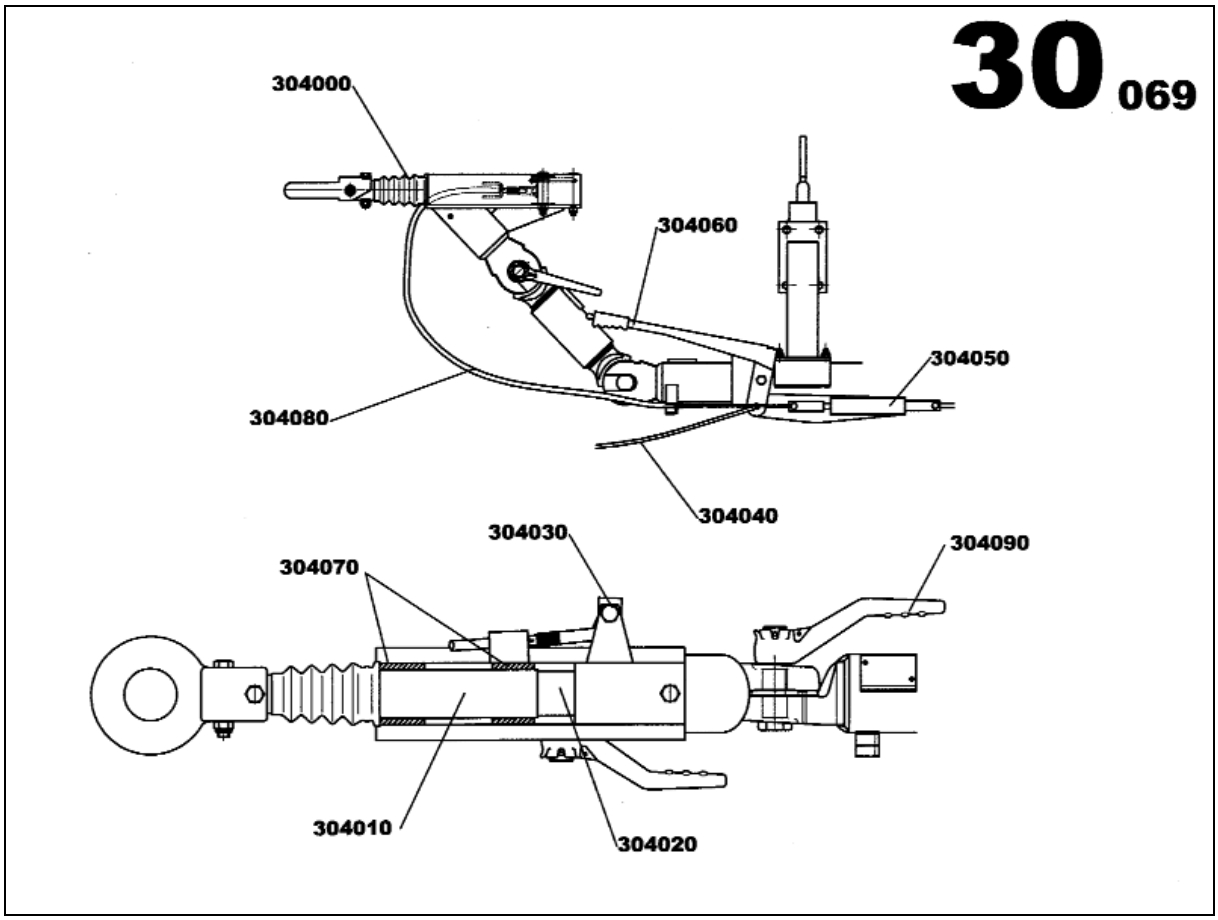
F30061



Item	Part number	Description	Quantity	Units
303250	85504322	AXLE	1.0	UN
303260	85504330	POLE	1.0	UN
303270	85504348	INTERMEDIARY ARMS	1.0	UN
303280	85504355	BRAKE GEAR	1.0	UN
303290	85504363	GALVANIZED MUDGUARD	2.0	UN
303300	85504371	HINGE RING	1.0	UN
303310	85504389	SLINDING SHORE	1.0	UN
303320	85504397	SQUARE JOCKEY WHEEL	1.0	UN
303330	85504405	COMPLETE WHEEL	2.0	UN
303340	85504413	ELECTRIC BEAM	1.0	UN
303350	85504421	LEFT REAR LIGHT	1.0	UN
303360	85504439	RIGHT REAR LIGHT	1.0	UN
303370	85504447	TRIANGULAR REFLECTOR	2.0	UN
303380	85504454	ROUND STICKY REFLECTOR WHITE	2.0	UN
303390	85504462	ROUND STICKY REFLECTOR ORANGE	4.0	UN
303400	85504470	STANDARD GALVANIZED CYCLIST-GUARD	2.0	UN
303410	85504488	ECIM PRODUCER PLATE	1.0	UN
303420	85504496	RIGHT SPECIAL SIDE MEMBER	1.0	UN
303430	85504504	LEFT SPECIAL SIDE MEMBER	1.0	UN
303440	85504512	FRONT CROSS MEMBER	1.0	UN
303450	85504520	LIGHTS CROSS MEMBER	1.0	UN
303460	85504538	INTERMEDIARY CROSS MEMBER	2.0	UN
303470	85504546	TRIANGLE SUPPORT	2.0	UN
303480	85504553	RIGHT FRONT BOUNDING	1.0	UN
303490	85504561	LEFT FRONT BOUNDING	1.0	UN
303500	85504579	RIGHT REAR BOUNDING	1.0	UN
303510	85504587	LEFT REAR BOUNDING	1.0	UN
303520	85504595	RIGHT MUDGUARD FIXATION	1.0	UN
303530	85504603	LEFT MUDGUARD FIXATION	1.0	UN
303540	85504611	FIXING CLIP WHITE LITE	2.0	UN
303550	85504629	STAND FIXATION ON SIDE MEMBER	1.0	UN

BRAKE GEAR 303280 DETAIL

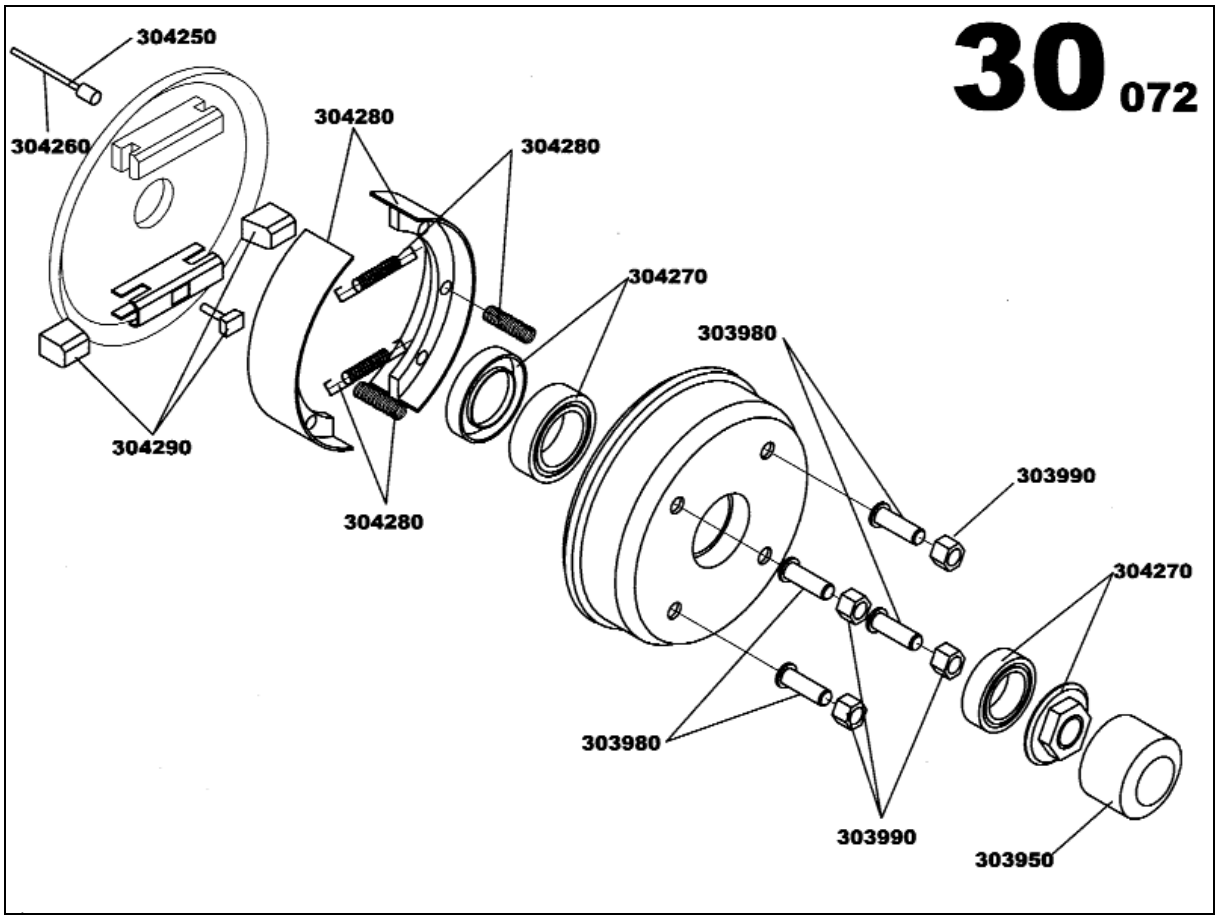
F30069



Item	Part number	Description	Quantity	Units
304000	85505220	BELLOW	1.0	UN
304010	85505238	TRACTION TUBE	1.0	UN
304020	85505246	SHOCK ABSORBER	1.0	UN
304030	85505253	CONNECTING ROD	1.0	UN
304040	85505261	BREAK DOWN CABLE	1.0	UN
304050	85505279	COMPENSATOR	1.0	UN
304060	85505287	HANDBRAKE LEVER	1.0	UN
304070	85505295	FRICTION COLLAR KIT	1.0	UN
304080	85505303	TRANSMISSION CABLE	1.0	UN
304090	85505311	LEVER AND AXLE	1.0	UN

AXLE 303250 DETAIL

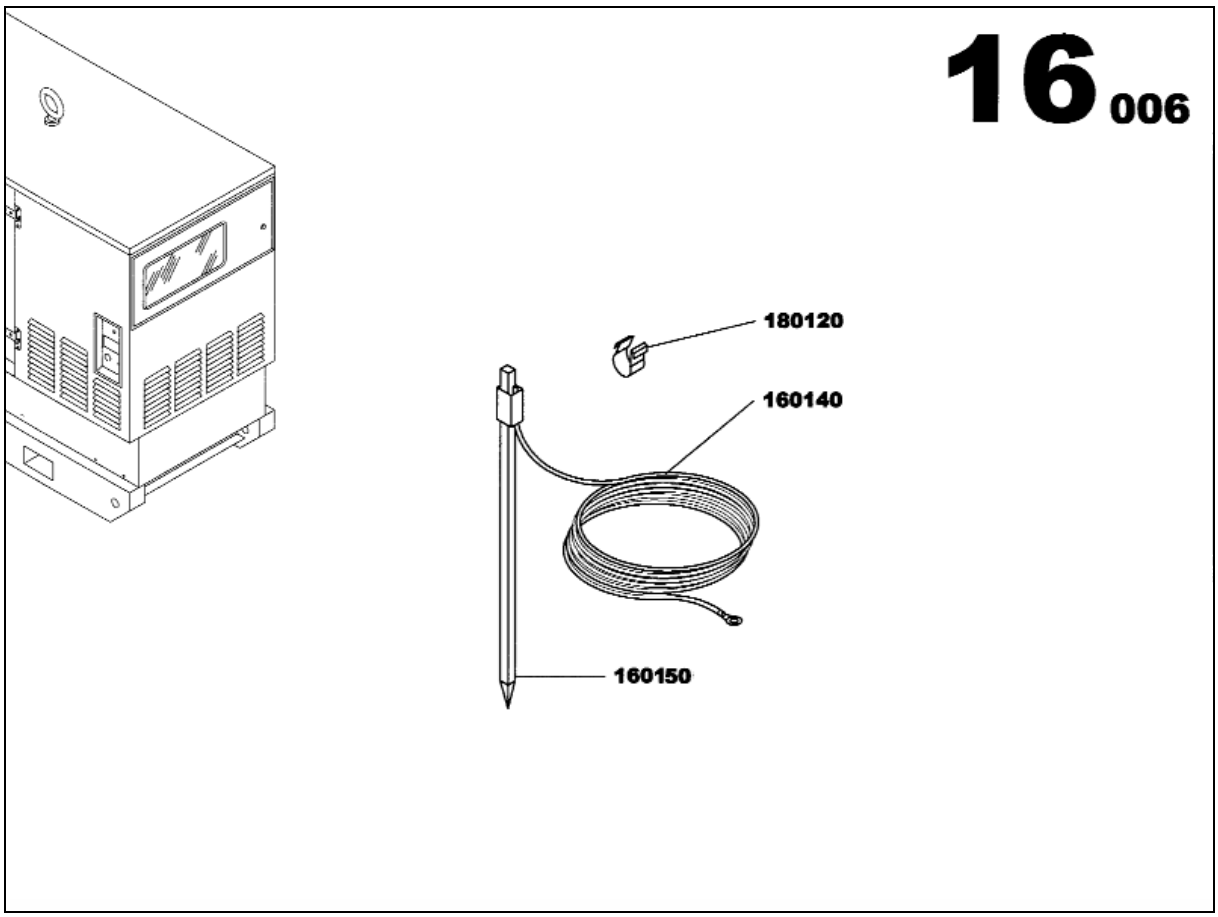
F30072



Item	*Part number*	*Description*	*Quantity*	*Units*
303950	85505170	HUB CAP	1.0	UN
304270	85505501	BEARING KIT	1.0	UN
303980	85505204	BOLTS KIT	1.0	UN
303990	85505212	NUTS KIT	1.0	UN
304280	85505519	BRAKE KIT	1.0	UN
304290	85505527	ADJUSTMENT KIT	1.0	UN
304250	85505477	BRAKE CABLE 1,40m KIT	1.0	UN
304260	85505485	BRAKE CABLE 1,60m KIT	1.0	UN

EARTH ROD WITH CABLE M100/200 CANOPY ASSEMBLY

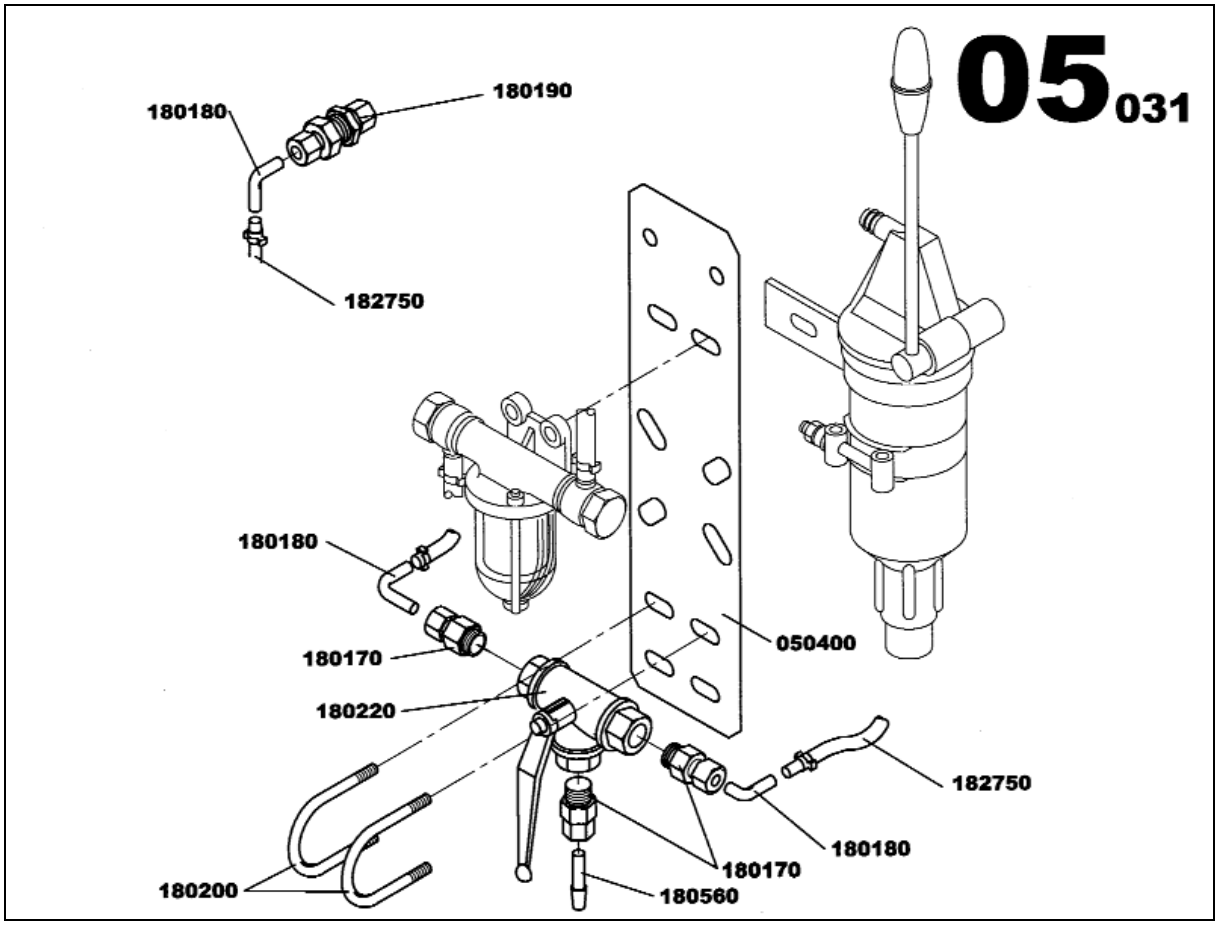
F16006



Item	*Part number*	*Description*	*Quantity*	*Units*
160140	85408227	NEUTRAL/EARTH SYSTEM CABLE 25mm2 L10000 Gr/Ye	1.0	UN
160150	85408334	EARTH ROD L1000	1.0	UN
180120	85409191	CLIP-ON BRACKET	2.0	UN

3-WAY FUEL VALVE OPTION

F05031

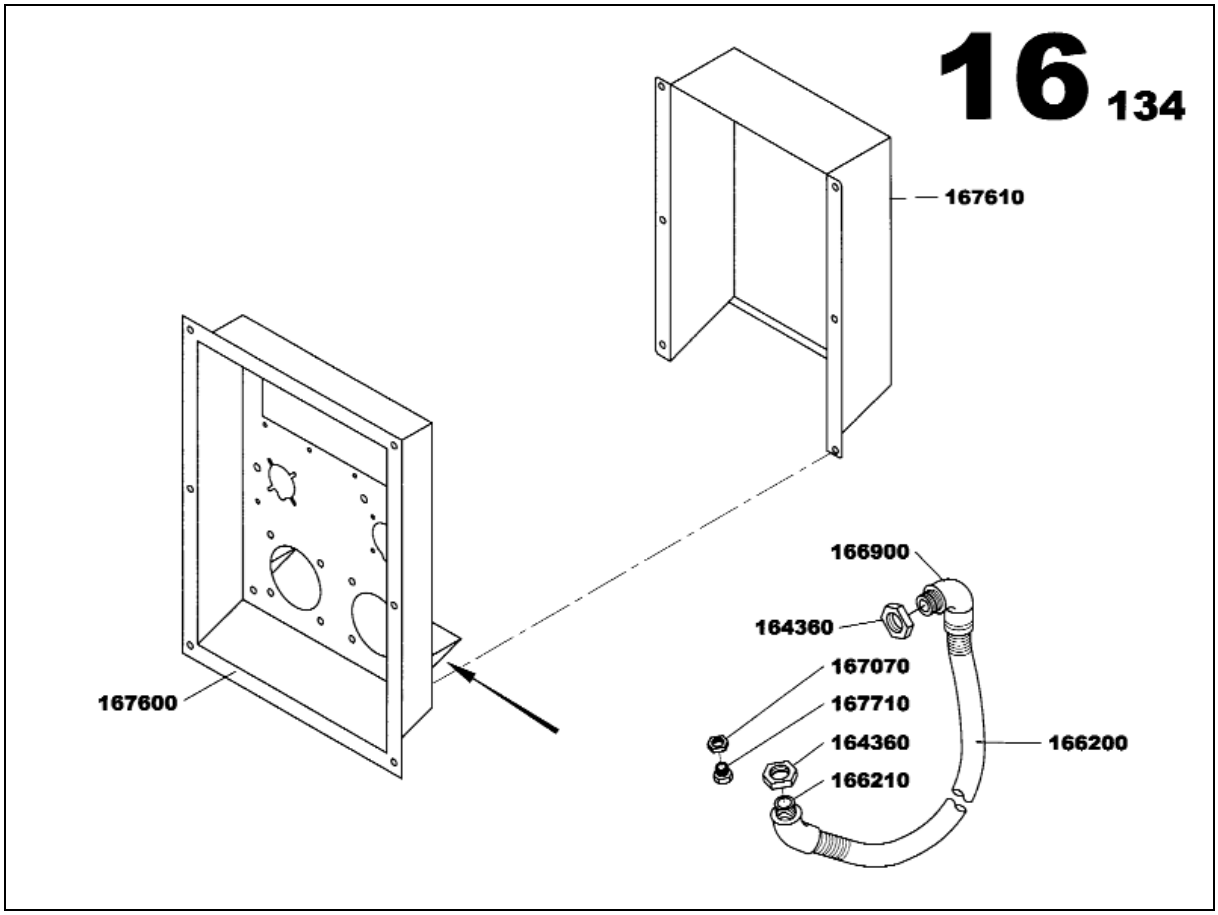


Item	Part number	Description	Quantity	Units
050400	85429165	FUEL FILTER SEPARATOR-3 WAY FUEL VALVE BRACKET	1.0	UN
180170	85409266	PIPE UNION REDUCER MAL/FEM 3/8G D08	3.0	UN
180560	85426377	PIPE UNION REDUCER MAL/MAL	1.0	UN
180180	85409290	PIPE UNION REDUCER ELBOW MAL/MAL D08	3.0	UN
180190	85409332	PIPE UNION FEM/FEM D08	1.0	UN
180200	85409464	HOSE CLAMP D36	2.0	UN
180220	85409530	3 WAY FUEL VALVE	1.0	UN
182750	85490860	FLEXIBLE HOSE D7,5	0.25	ML
182750	85490860	FLEXIBLE HOSE D7,5	0.4	ML

SOCKETS TYPE 1B OPTION

SOCKETS ASSEMBLY T1BL

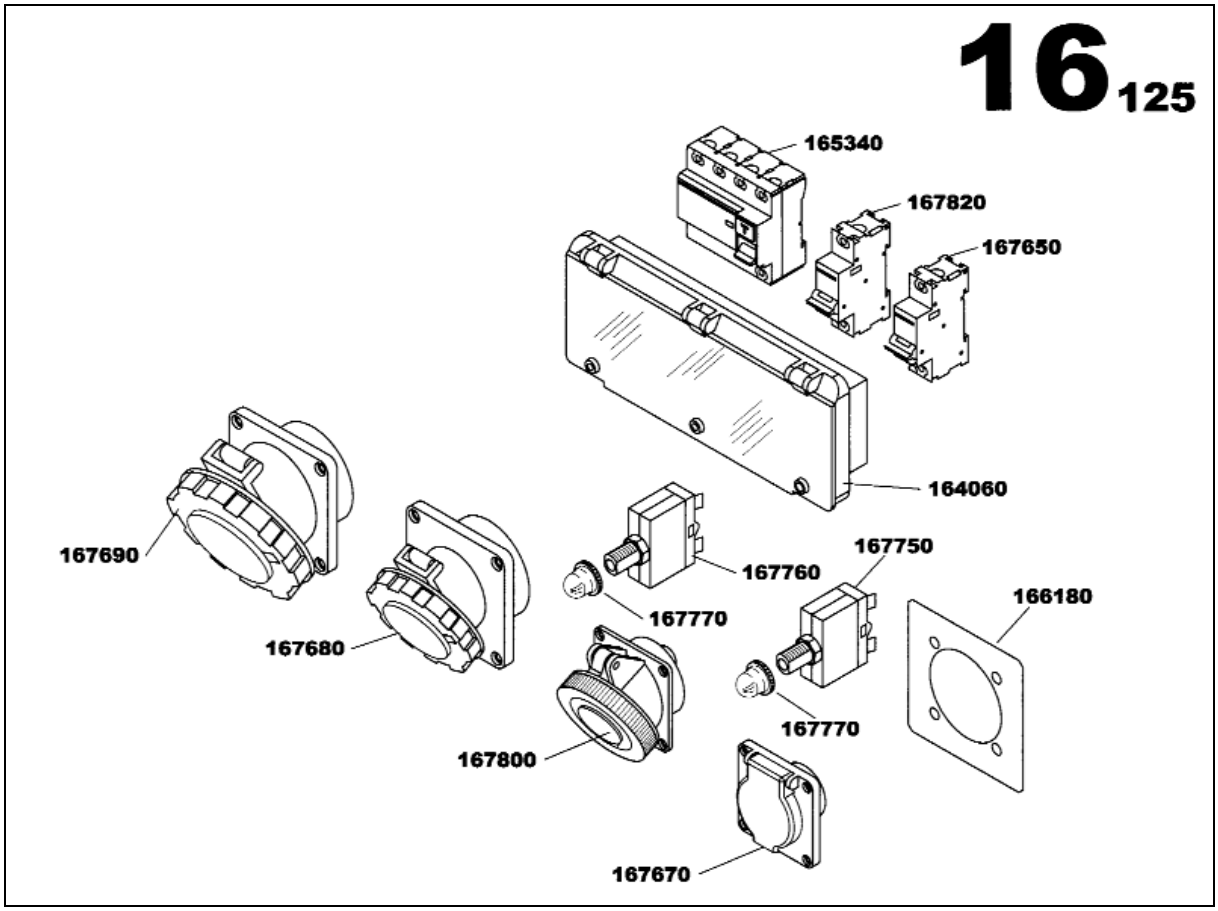
F16134



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
167710	85506053	PLASTIC PLUG D22	1.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
166900	85499689	PIPE UNION ELBOW 90° PG36	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16125

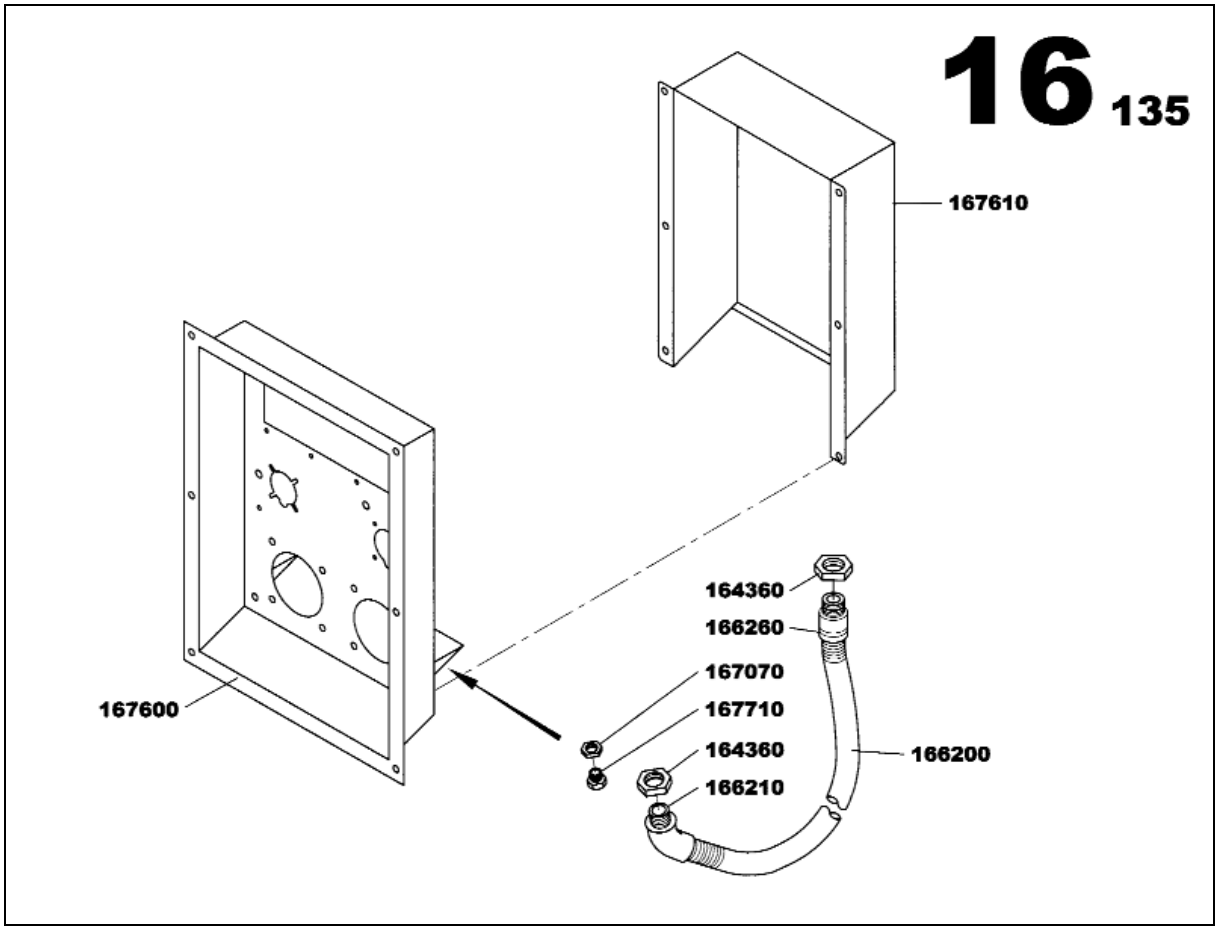


Item	*Part number*	*Description*	*Quantity*	*Units*
167750	85408748	COMPACT CIRCUIT BREAKER 1x10A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167760	85413169	COMPACT CIRCUIT BREAKER 1x15A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
166180	85501542	SOCKETS ADAPTATION PLATE	2.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167670	85408300	SOCKET GERMAN 230V 16A 2S+G	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167800	85506103	SOCKET EC 230V 16A 2S+G	1.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

SOCKETS TYPE 1 OPTION

SOCKETS ASSEMBLY T1SBL

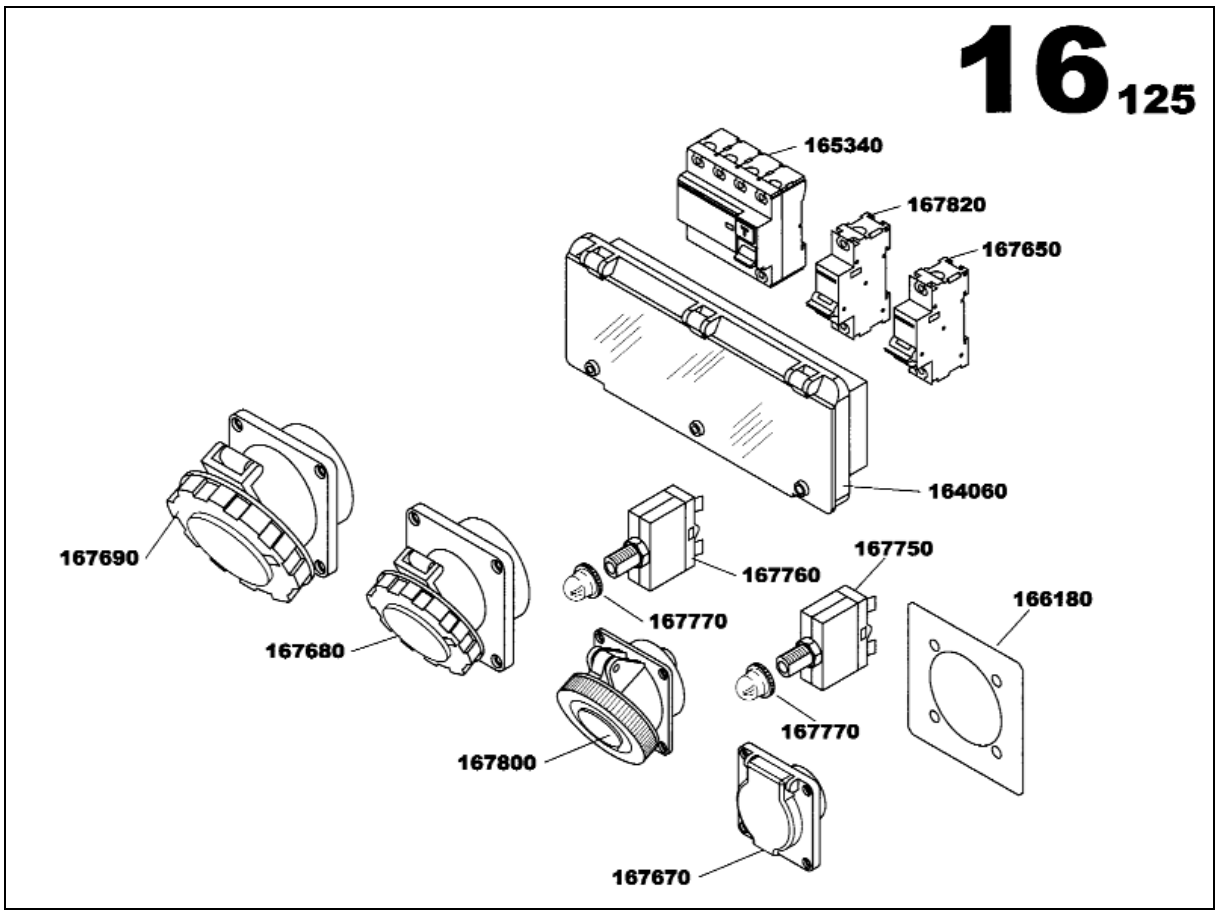
F16135



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
167710	85506053	PLASTIC PLUG D22	1.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
166260	85501575	PIPE UNION PG36	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16125

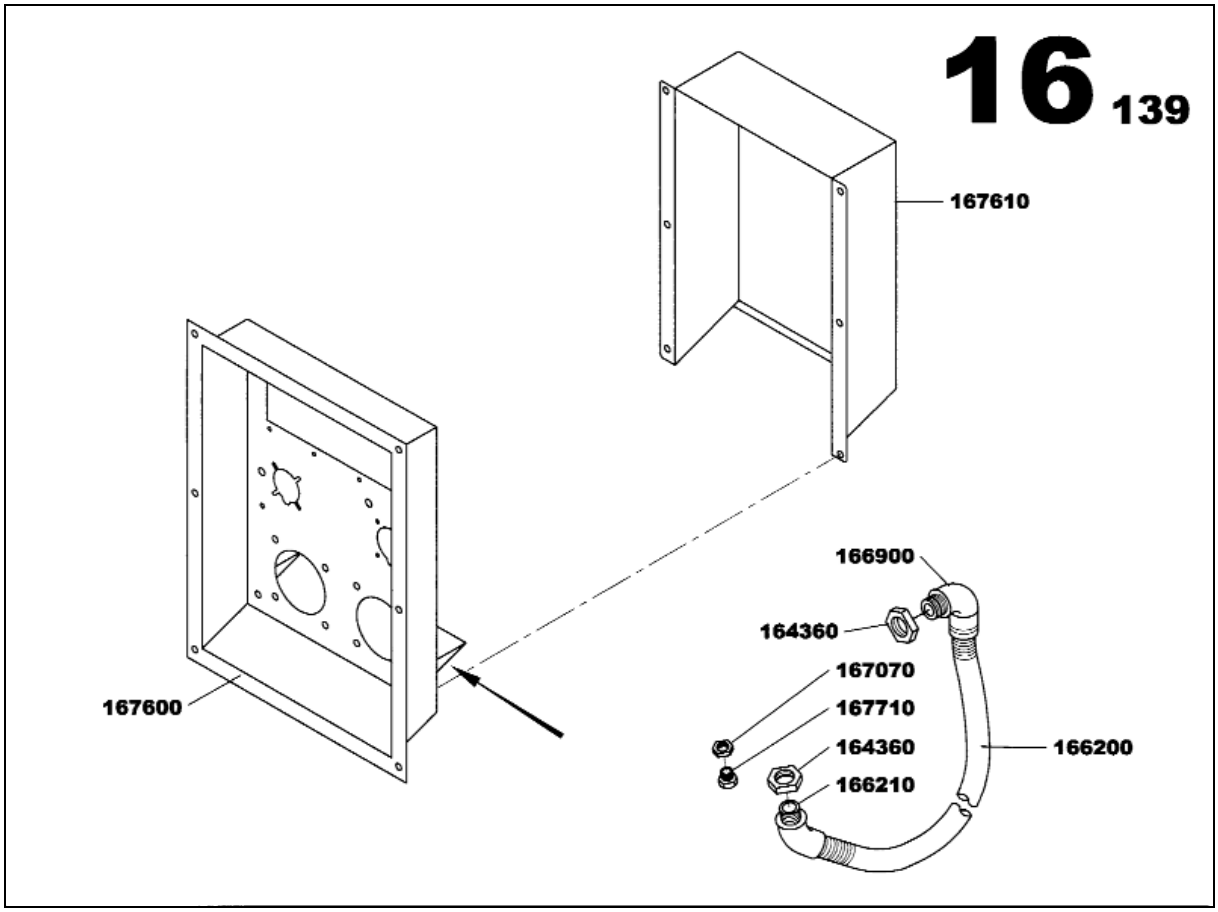


Item	*Part number*	*Description*	*Quantity*	*Units*
167750	85408748	COMPACT CIRCUIT BREAKER 1x10A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167760	85413169	COMPACT CIRCUIT BREAKER 1x15A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
166180	85501542	SOCKETS ADAPTATION PLATE	2.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167670	85408300	SOCKET GERMAN 230V 16A 2S+G	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167800	85506103	SOCKET EC 230V 16A 2S+G	1.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

SOCKETS TYPE 4B OPTION

SOCKETS ASSEMBLY T4BL

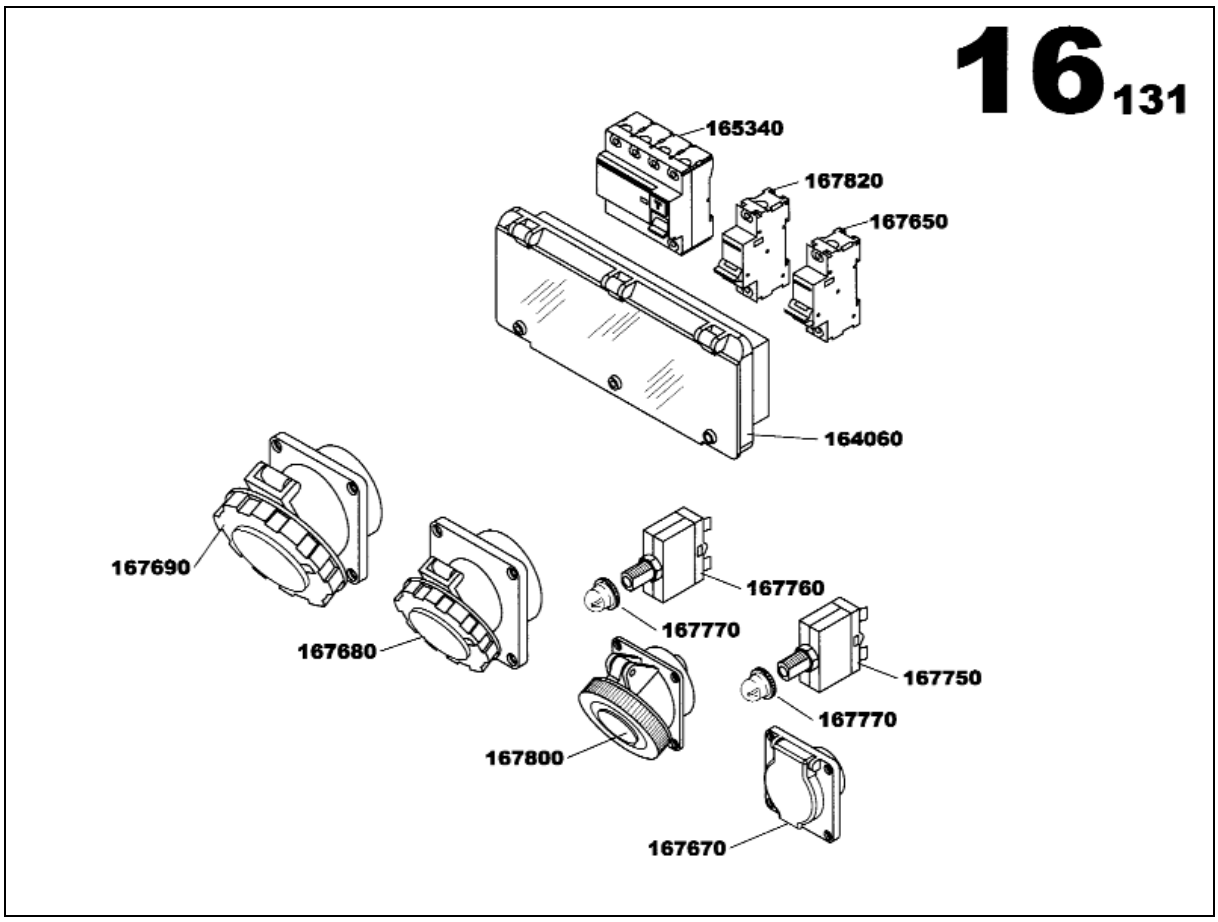
F16139



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
167710	85506053	PLASTIC PLUG D22	1.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
166900	85499689	PIPE UNION ELBOW 90° PG36	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16131

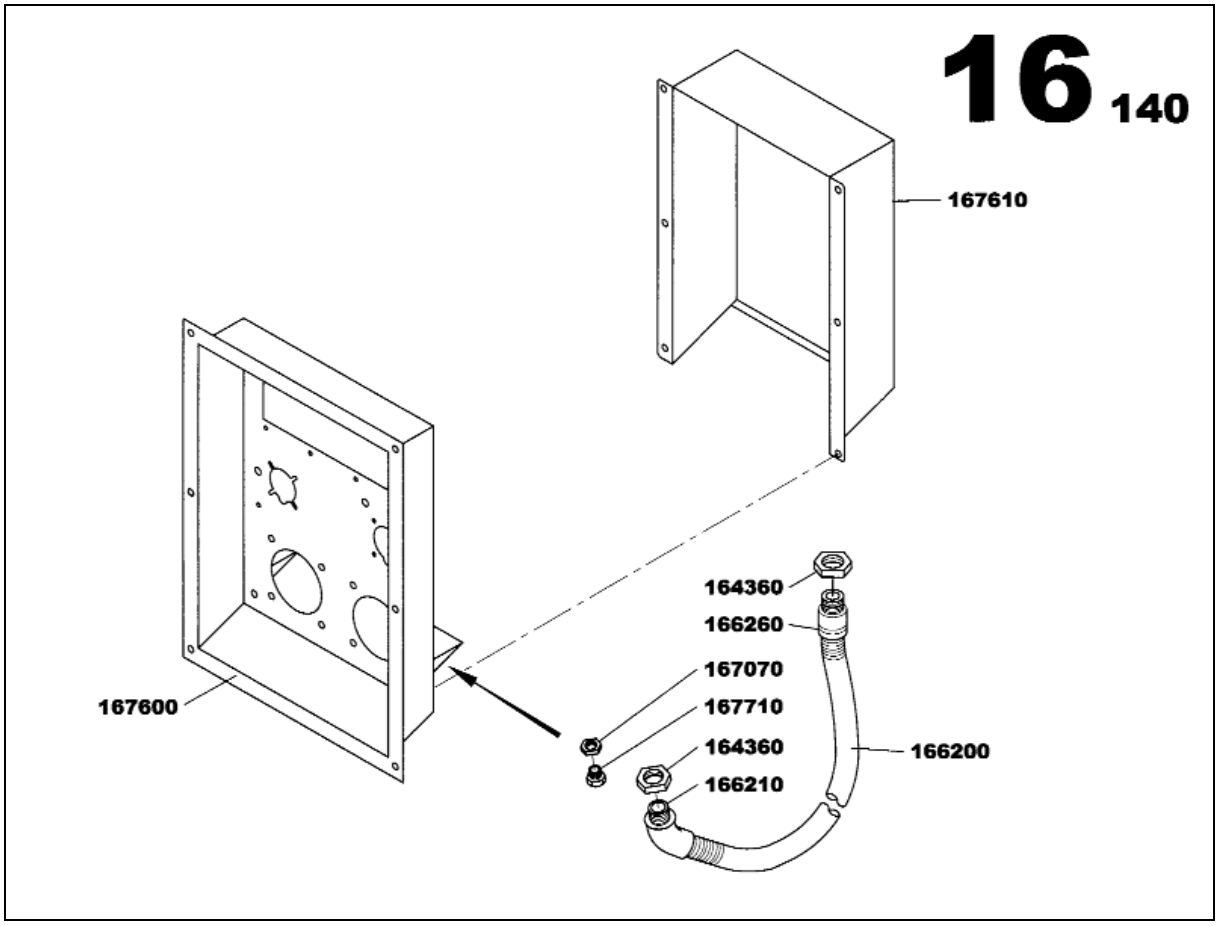


Item	*Part number*	*Description*	*Quantity*	*Units*
167750	85408748	COMPACT CIRCUIT BREAKER 1x10A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167760	85413169	COMPACT CIRCUIT BREAKER 1x15A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167670	85408300	SOCKET GERMAN 230V 16A 2S+G	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167800	85506103	SOCKET EC 230V 16A 2S+G	1.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

SOCKETS TYPE 4 OPTION

SOCKETS ASSEMBLY T4SBL

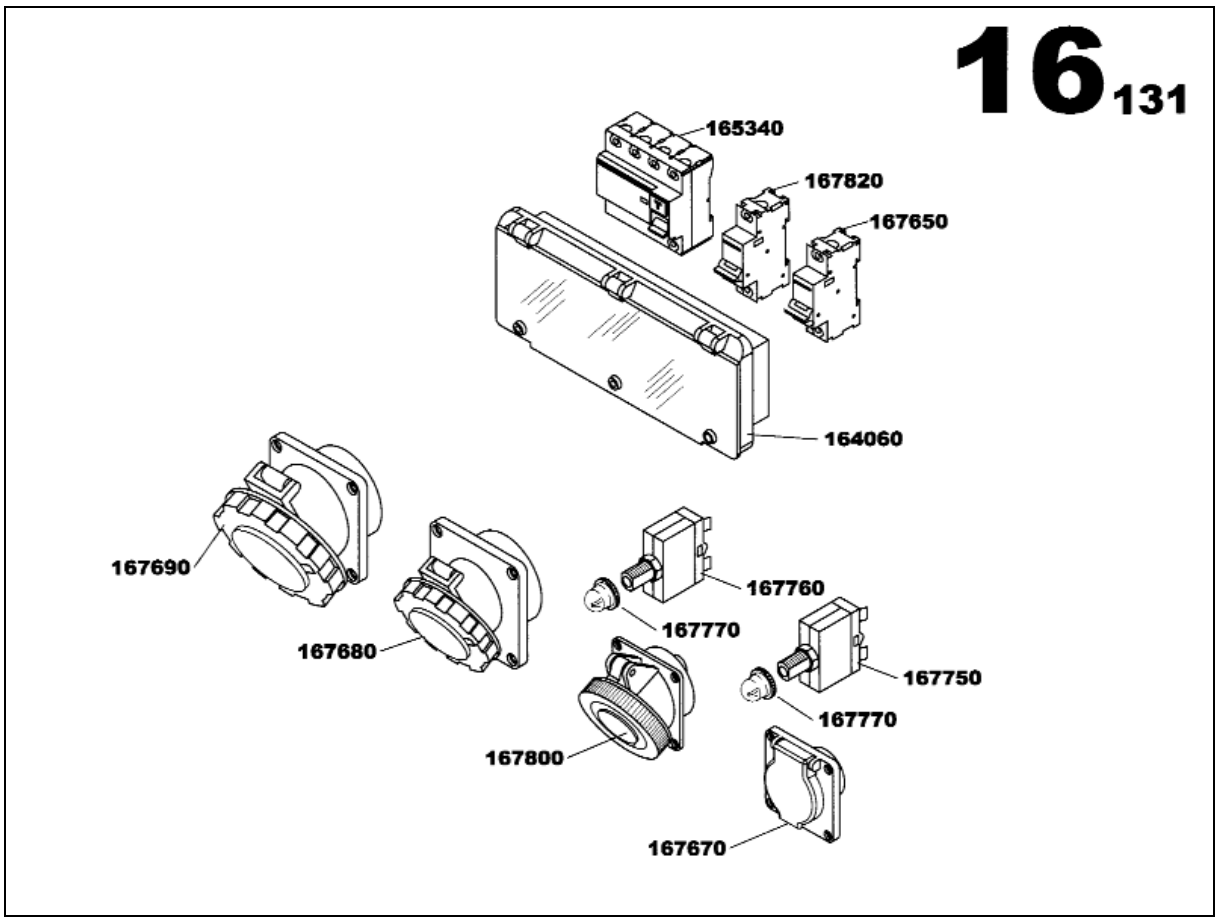
F16140



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
167710	85506053	PLASTIC PLUG D22	1.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
166260	85501575	PIPE UNION PG36	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16131

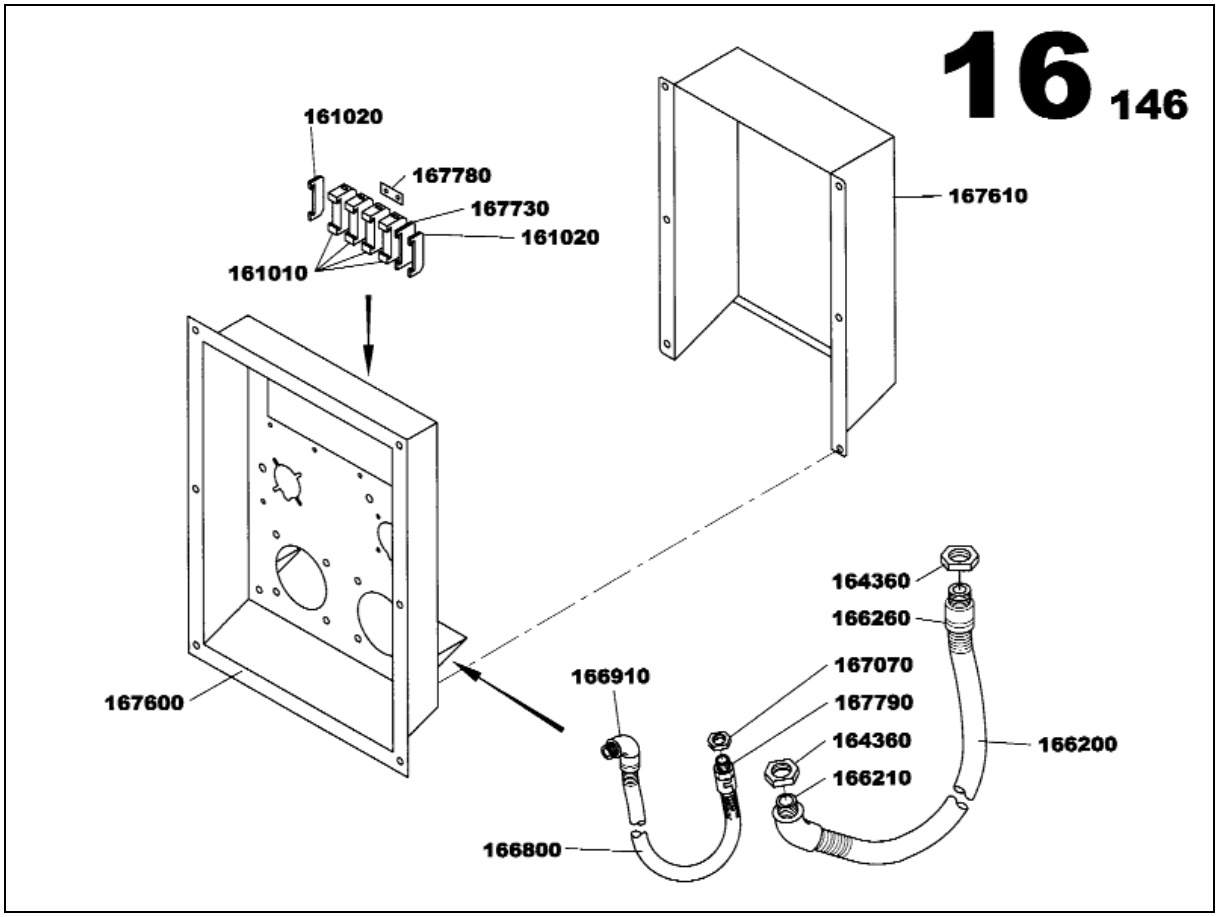


Item	*Part number*	*Description*	*Quantity*	*Units*
167750	85408748	COMPACT CIRCUIT BREAKER 1x10A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167760	85413169	COMPACT CIRCUIT BREAKER 1x15A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167670	85408300	SOCKET GERMAN 230V 16A 2S+G	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167800	85506103	SOCKET EC 230V 16A 2S+G	1.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

SOCKETS TYPE 5B OPTION

SOCKETS ASSEMBLY T5BL

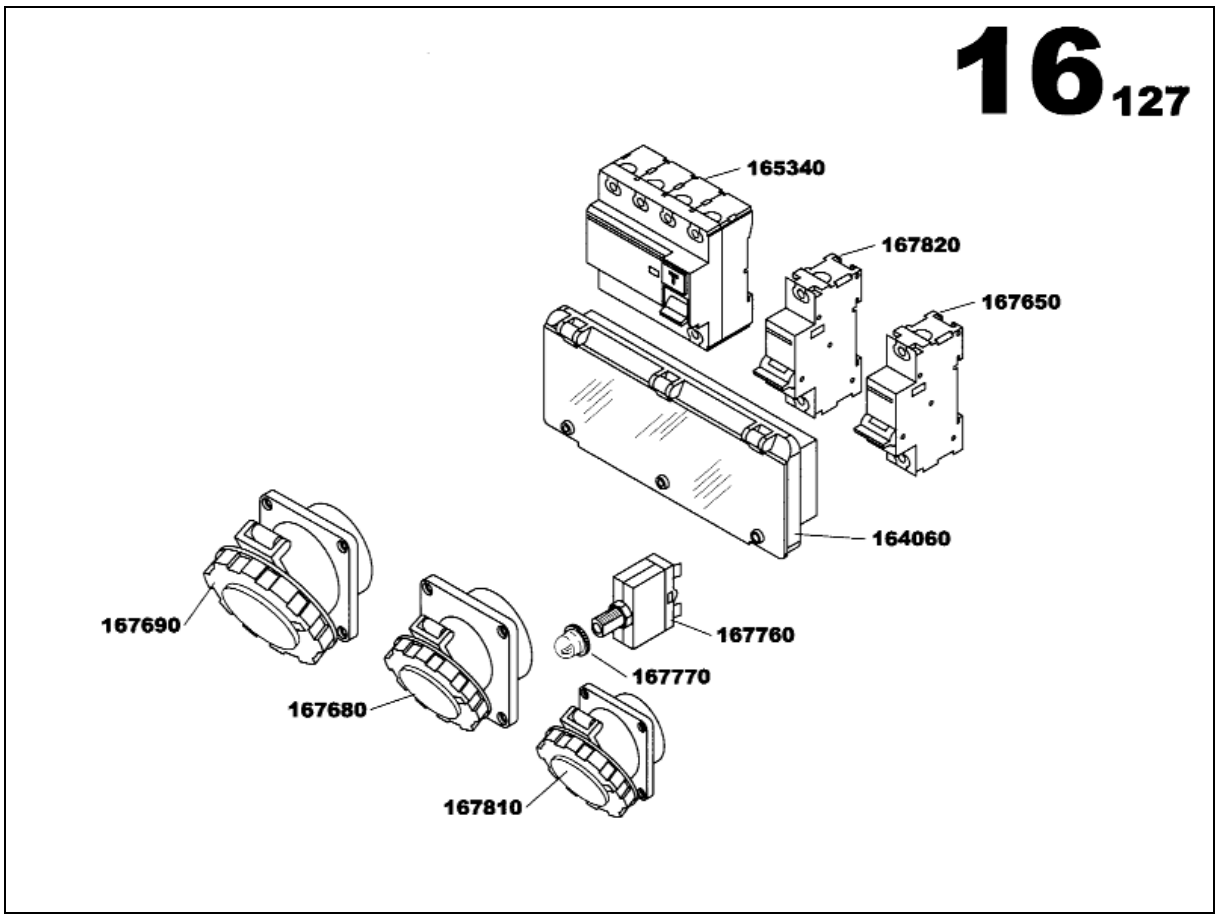
F16146



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166800	85499283	ELECTRICAL SHAFT D10	1.5	ML
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
161010	85408375	TERMINAL BLOCK 1x2.5mm2 GREY	4.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
161020	85408706	STOP	2.0	UN
167730	85413466	PLASTIC COVER TERMINAL BLOCK	1.0	UN
167780	85506095	TERMINAL BLOCK	0.4	UN
167790	85499663	PIPE UNION PG9	1.0	UN
166900	85499689	PIPE UNION ELBOW 90° PG36	1.0	UN
166910	85500494	PIPE UNION ELBOW 90° PG9	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16127

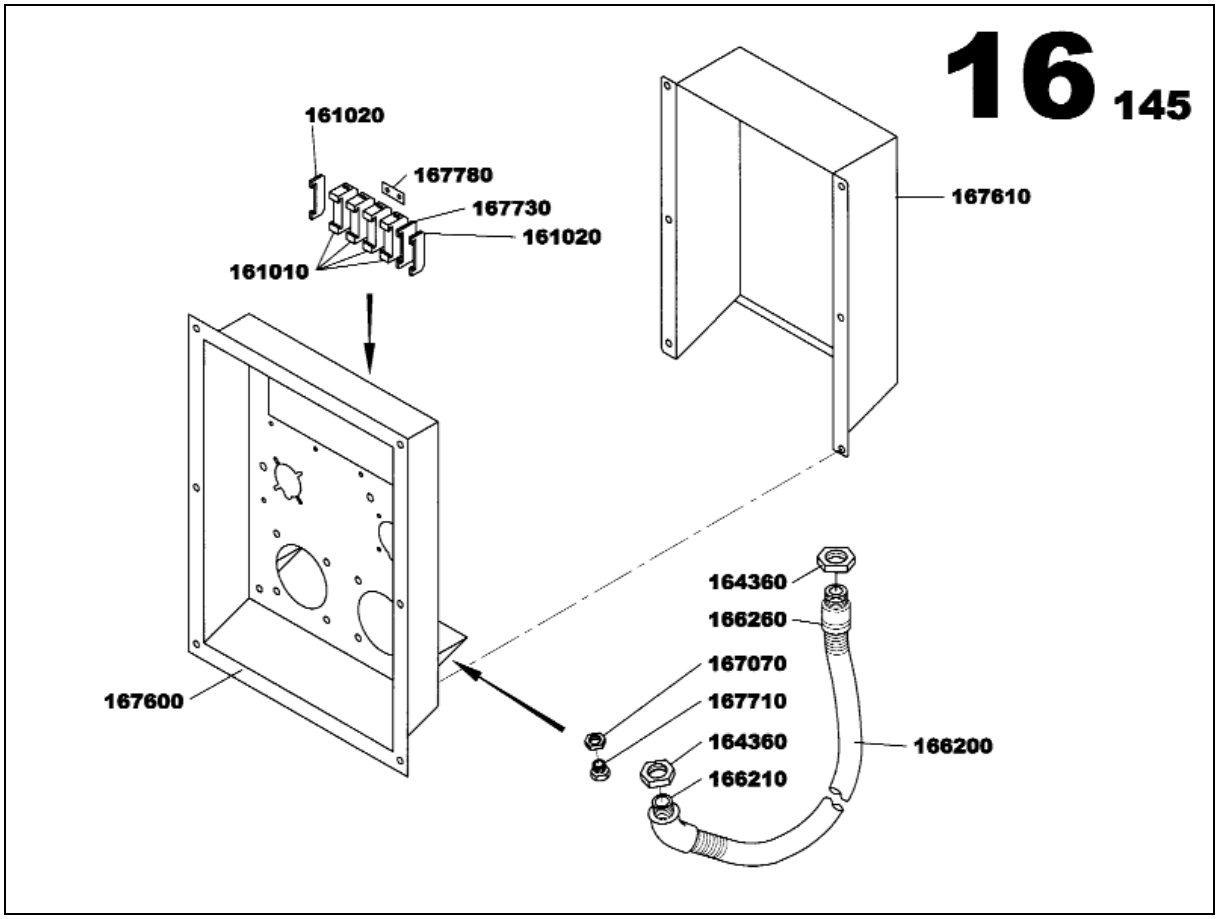


Item	*Part number*	*Description*	*Quantity*	*Units*
167760	85413169	COMPACT CIRCUIT BREAKER 1x15A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167810	85506111	SOCKET EC 110V 16A 2S+G	2.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

SOCKETS TYPE 5 OPTION

SOCKETS ASSEMBLY T5SBL

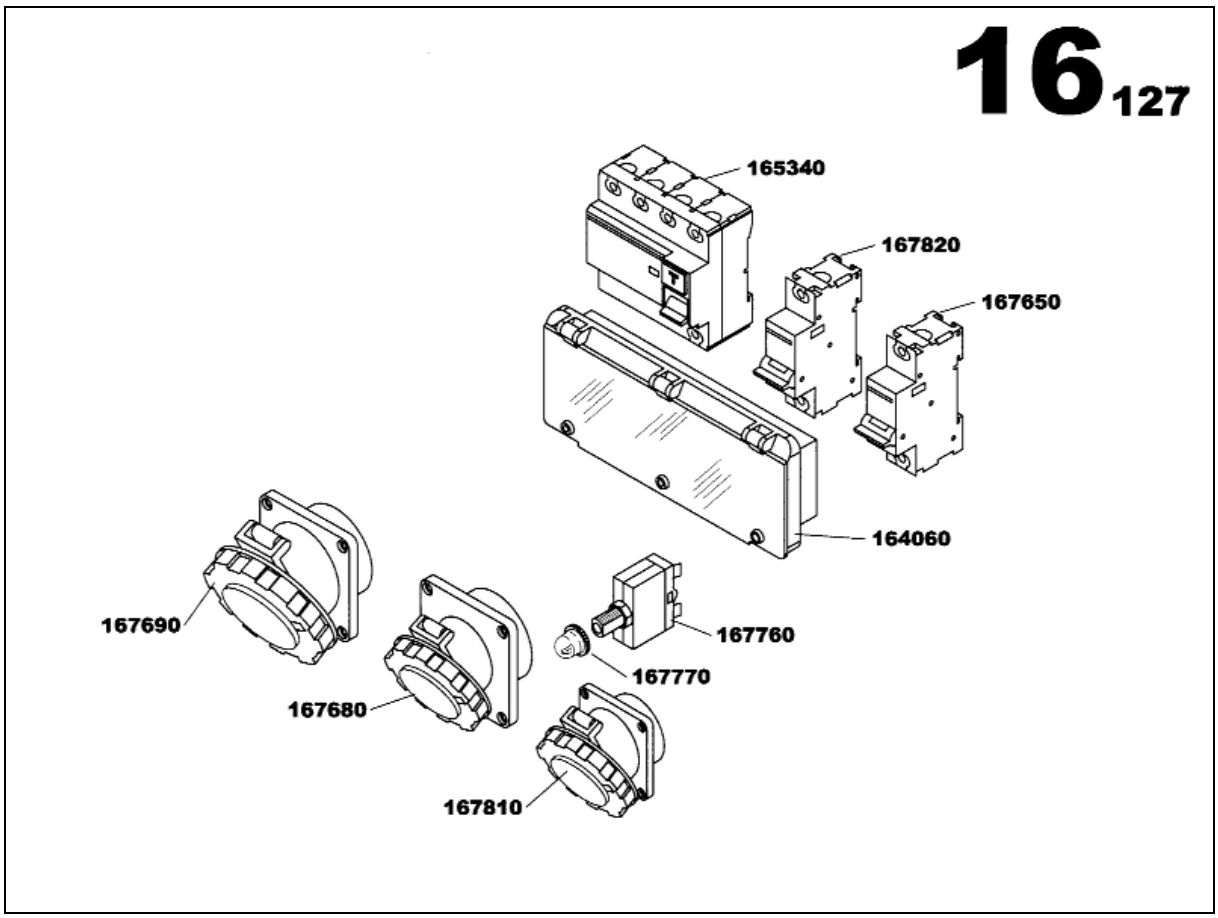
F16145



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
161010	85408375	TERMINAL BLOCK 1x2.5mm2 GREY	4.0	UN
167710	85506053	PLASTIC PLUG D22	1.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
161020	85408706	STOP	2.0	UN
167730	85413466	PLASTIC COVER TERMINAL BLOCK	1.0	UN
167780	85506095	TERMINAL BLOCK	0.4	UN
166260	85501575	PIPE UNION PG36	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16127

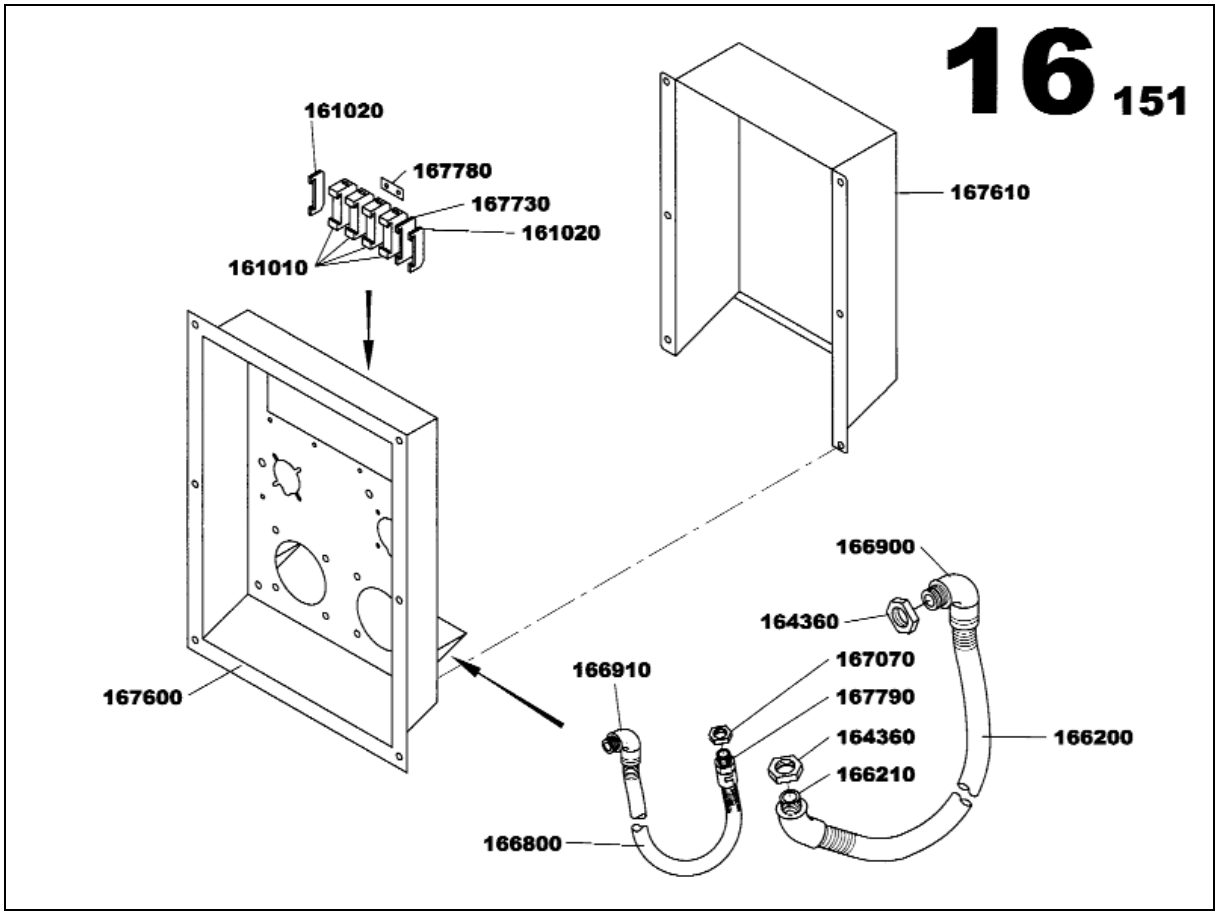


Item	*Part number*	*Description*	*Quantity*	*Units*
167760	85413169	COMPACT CIRCUIT BREAKER 1x15A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167810	85506111	SOCKET EC 110V 16A 2S+G	2.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

SOCKETS TYPE 8B OPTION

SOCKETS ASSEMBLY T8BL

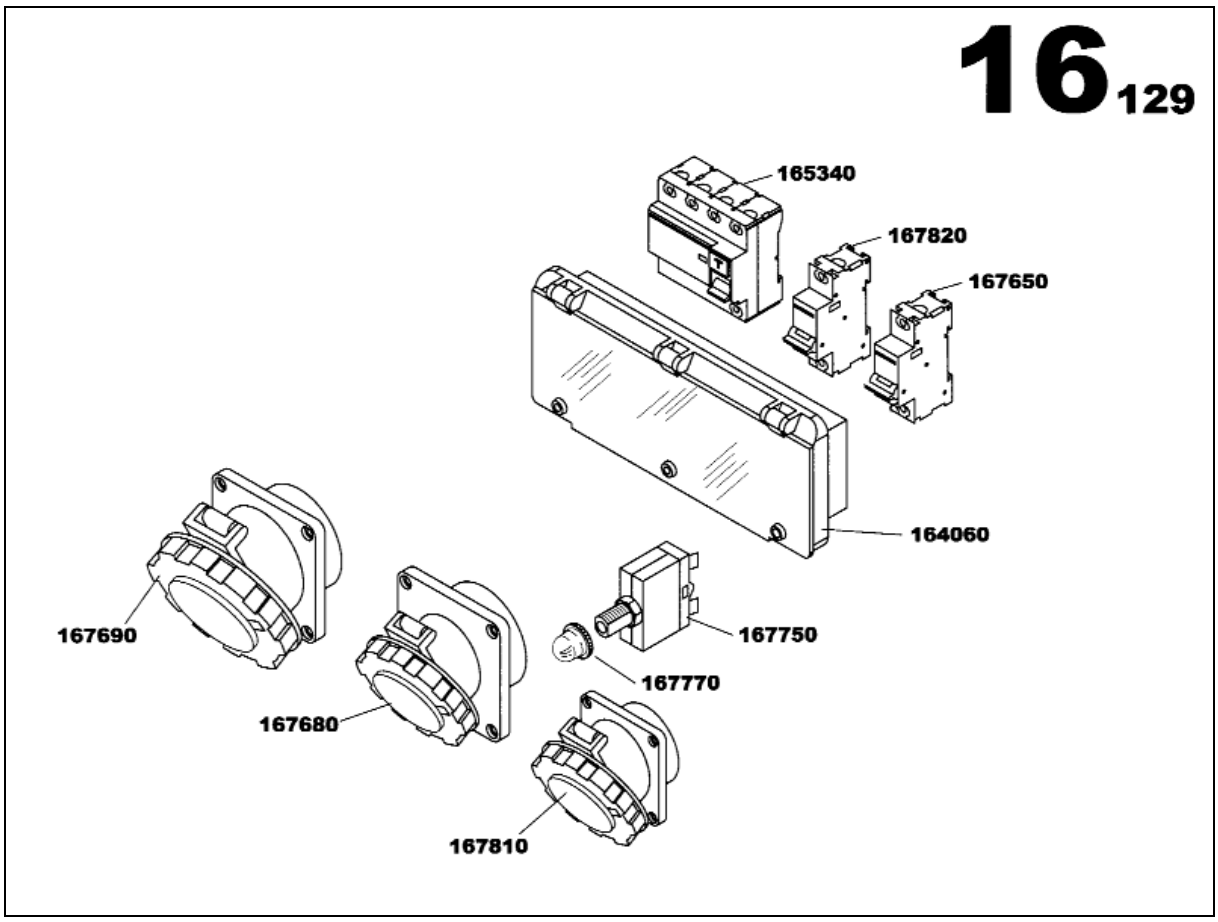
F16151



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166800	85499283	ELECTRICAL SHAFT D10	1.5	ML
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
161010	85408375	TERMINAL BLOCK 1x2.5mm2 GREY	4.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
161020	85408706	STOP	2.0	UN
167730	85413466	PLASTIC COVER TERMINAL BLOCK	1.0	UN
167780	85506095	TERMINAL BLOCK	0.4	UN
167790	85499663	PIPE UNION PG9	1.0	UN
166900	85499689	PIPE UNION ELBOW 90° PG36	1.0	UN
166910	85500494	PIPE UNION ELBOW 90° PG9	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16129

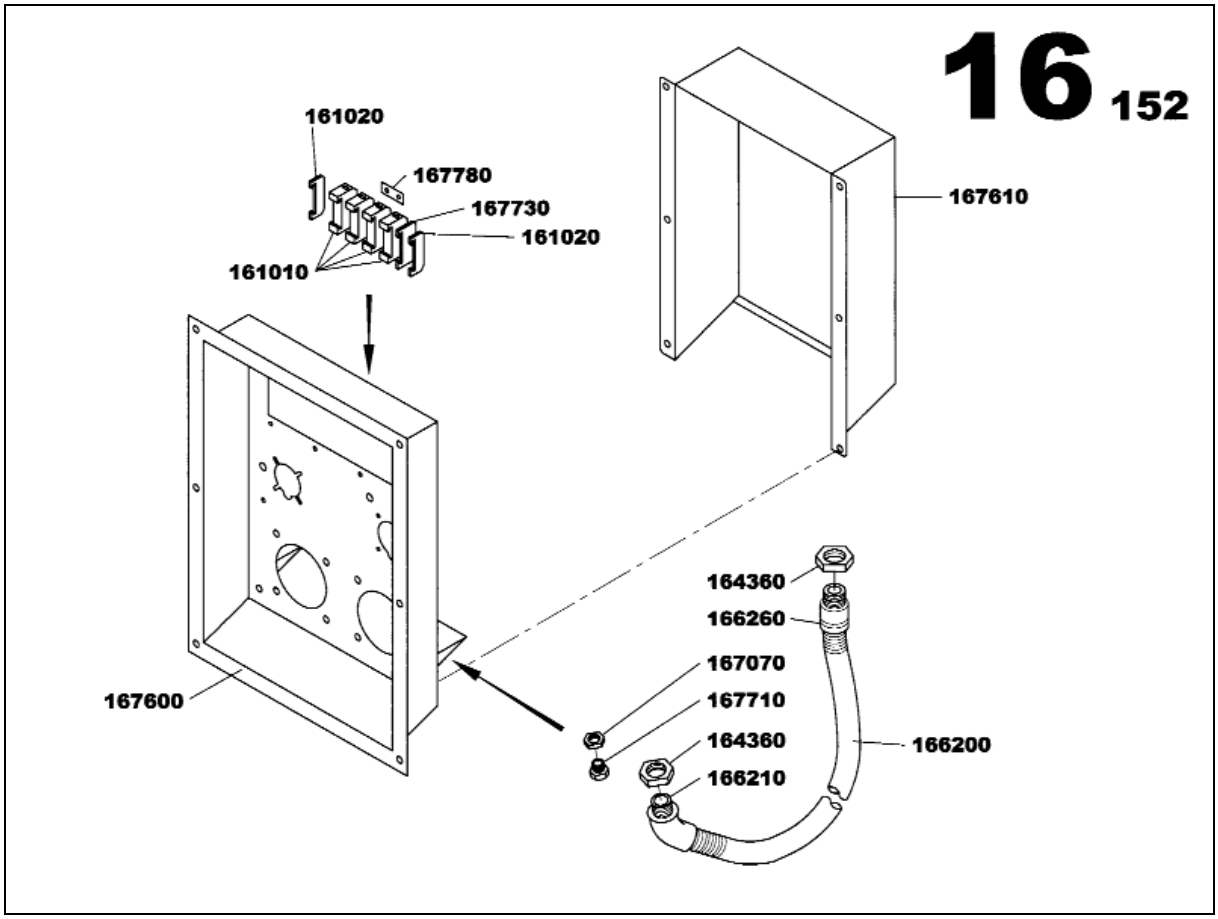


Item	*Part number*	*Description*	*Quantity*	*Units*
167750	85408748	COMPACT CIRCUIT BREAKER 1x10A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167810	85506111	SOCKET EC 110V 16A 2S+G	2.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

SOCKETS TYPE 8 OPTION

SOCKETS ASSEMBLY T8SBL

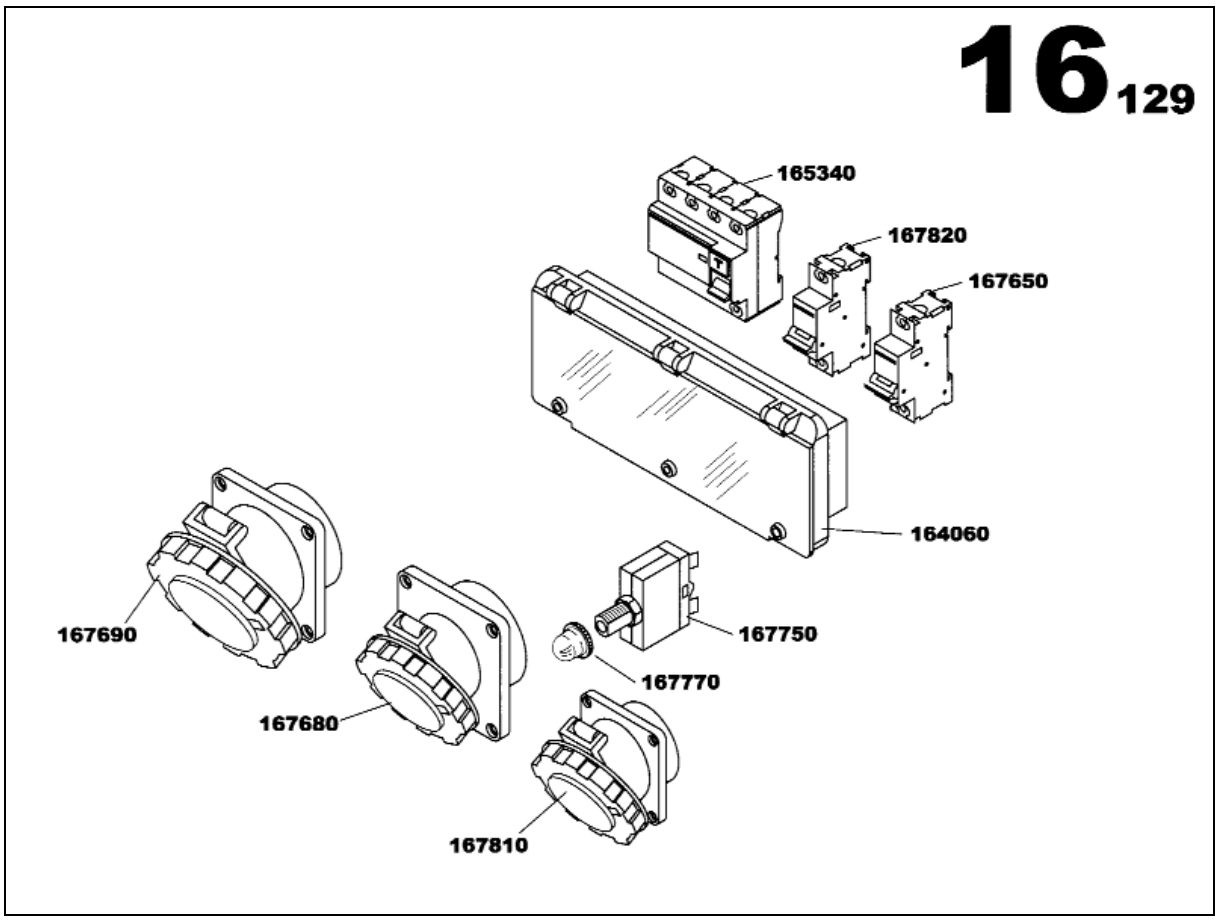
F16152



Item	*Part number*	*Description*	*Quantity*	*Units*
167600	85505840	SOCKET PANEL M107	1.0	UN
167610	85505857	ELECTRIC PANEL HOUSING COVER	1.0	UN
166200	85499440	ELECTRICAL SHAFT D36	0.8	ML
161010	85408375	TERMINAL BLOCK 1x2.5mm2 GREY	4.0	UN
167710	85506053	PLASTIC PLUG D22	1.0	UN
167070	85506061	GLAND NUT PG09	1.0	UN
164360	85408680	GLAND NUT PG36	2.0	UN
161020	85408706	STOP	2.0	UN
167730	85413466	PLASTIC COVER TERMINAL BLOCK	1.0	UN
167780	85506095	TERMINAL BLOCK	0.4	UN
166260	85501575	PIPE UNION PG36	1.0	UN
166210	85499697	PIPE UNION ELBOW 45° PG36	1.0	UN

SOCKETS ASSEMBLY

F16129

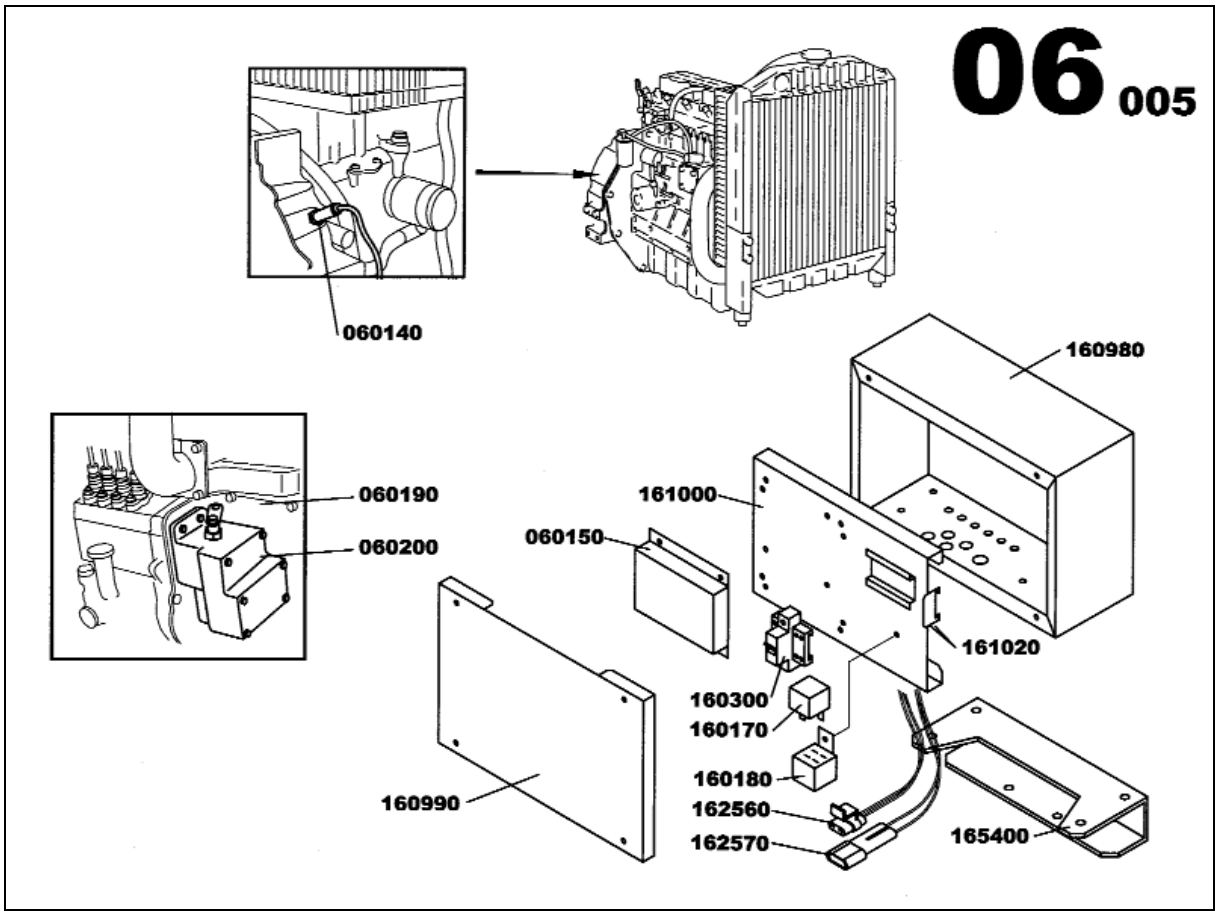


Item	*Part number*	*Description*	*Quantity*	*Units*
167750	85408748	COMPACT CIRCUIT BREAKER 1x10A	1.0	UN
167770	85408763	CIRCUIT BREAKER PROTECTION	1.0	UN
167650	85506020	MOULDED CASE CIRCUIT BREAKER 4x32A	1.0	UN
164060	85408284	CIRCUIT BREAKER SUPPORT PLATE 12 MODULES	1.0	UN
167680	85408318	EC SOCKET 400V 16A 3S+N+G	1.0	UN
167690	85408326	EC SOCKET 400V 32A 3S+N+G	1.0	UN
165340	85408771	DIFFERENTIAL SWITCH L 4P 63A 30mA	1.0	UN
167810	85506111	SOCKET EC 110V 16A 2S+G	2.0	UN
167820	85506434	MOULDED CASE CIRCUIT BREAKER 4x16A	1.0	UN

ELECTRONIC REGULATION OPTION

ELECTRONIC REGULATION ASSEMBLY

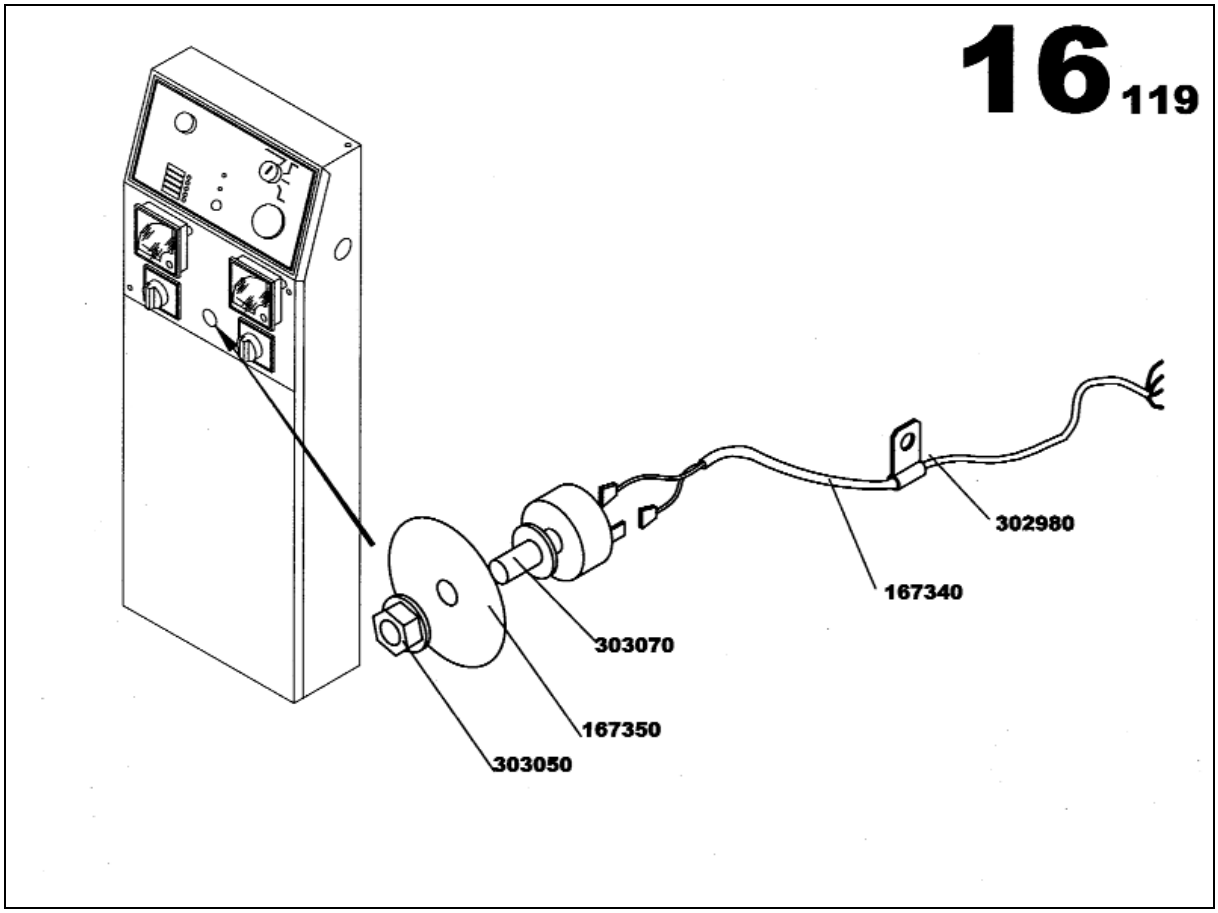
F06005



Item	*Part number*	*Description*	*Quantity*	*Units*
060140	85412773	MAGNETIC SPEED SENSOR L80 5/8UNF	1.0	UN
060150	85415784	ELECTRONIC GOVERNOR 12/24VCC	1.0	UN
060190	85412427	ELECTRONIC ACTUATOR	1.0	UN
060200	85413763	FITTING KIT S4Q/S4S MITSU PUMP	1.0	UN
160980	85407237	ELECTRONIC REGULATION HOUSING	1.0	UN
160990	85407245	HOUSING ELECTRONIC REGULATION	1.0	UN
161000	85407336	ELECTRONIC REGULATOR BRACKET	1.0	UN
161020	85408706	STOP	1.0	UN
160170	85408896	RELAY 12V 20/30A	1.0	UN
160180	85408912	AUTOMOBILE RELAY BASE	1.0	UN
160300	85408920	MOULDED CASE CIRCUIT BREAKER 1x16A	1.0	UN
162560	85412989	2 POLE CONNECTOR	1.0	UN
162570	85412997	2 POLE CONNECTOR	1.0	UN
165400	85415925	ELECTRONIC REGULATOR HOUSING BRACKET	1.0	UN

CONTROL PANEL OPTION SPEED POTENTIONMETER ASSEMBLY

F16119



Item	*Part number*	*Description*	*Quantity*	*Units*
302980	85504207	CLAMP D4.7	1.0	UN
303050	85504215	LOCK AXE SYSTEM	1.0	UN
167340	85505709	WIRING LOOM CONTROL PANEL SPEED POTENTIOMETER	1.0	UN
303070	85504223	POTENTIOMETER 4.7kOHMS	1.0	UN
167350	85505717	STICKER VOLTAGE ADJUST	1.0	UN

Users guide and maintenance manual

Leroy Somer
Alternators
LSA 42.2 - 2 & 4 Pole

Réf. constructeur : 3433 GB - 4.33/a - 01.01

Réf. GPAO : 33522019901

LSA 42.2 - 2 & 4 POLE
ALTERNATORS

This manual concerns the alternator which you have just purchased.

The latest addition to a whole new generation of alternators, this range benefits from the experience of the leading manufacturer worldwide, using advanced technology and incorporating strict quality control.

We wish to draw your attention to the contents of this maintenance manual. By following certain important points during installation, use and servicing of your alternator, you can look forward to many years of trouble-free operation.

SAFETY MEASURES

Before using your machine for the first time, it is important to read the whole of this installation and maintenance manual.

All necessary operations and interventions on this machine must be performed by a qualified technician.

Our technical support service will be pleased to provide any additional information you may require.

The various operations described in this manual are accompanied by recommendations or symbols to alert the user to potential risks of accidents. It is vital that you understand and take notice of the following warning symbols.

WARNING

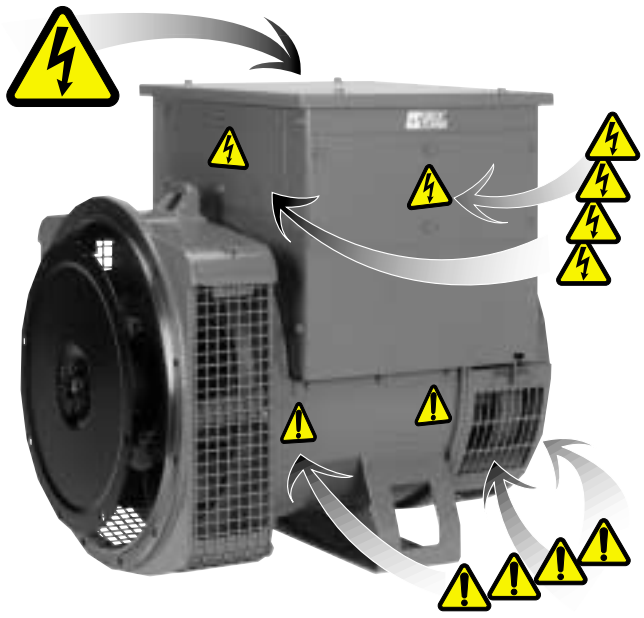
Warning symbol for an operation capable of damaging or destroying the machine or surrounding equipment.

Warning symbol for general danger to personnel.

Warning symbol for electrical danger to personnel.

WARNING SYMBOLS

A set of self-adhesive stickers depicting the various warning symbols is included with this maintenance manual. They should be positioned as shown in the drawing below once the machine has been fully installed.



Note : LEROY-SOMER reserves the right to modify the characteristics of its products at any time in order to incorporate the latest technological developments. The information contained in this document may therefore be changed without notice.

LSA 42.2 - 2 & 4 POLE
ALTERNATORS
CONTENTS

LSA 42.2 - 2 & 4 POLE
ALTERNATORS
RECEIPT

1 - RECEIPT

1.1 - Standards and safety measures

Our alternators comply with most international standards and are compatible with :
- the recommendations of the
International Electrotechnical Commission
IEC 34-1, (EN 60034).
- the recommendations of the
International Standards Organisation ISO 8528.
- the European Community directive 89/336/EEC on Electromagnetic Compatibility (EMC).
- the European Community directives 73/23/EEC and 93/68/EEC (Low Voltage Directive).
They are CE marked with regard to the LVD (Low Voltage Directive) in their role as a machine component. A declaration of incorporation can be supplied on request.
Before using your generator for the first time, read carefully the contents of this installation and maintenance manual, supplied with the machine. All operations performed on the generator should be undertaken by qualified personnel with specialist training in the commissioning, servicing and maintenance of electrical and mechanical machinery. This maintenance manual should be retained for the whole of the machine's life and be handed over with the contractual file.
The various operations described in this manual are accompanied by recommendations or symbols to alert the user to potential risks of accidents. It is vital that you understand and take notice of the different warning symbols.

1.2 - Inspection

On receipt of your alternator, check that it has not suffered any damage in transit. If there are obvious signs of knocks, contact the transporter (you may able to claim on their insurance) and after a visual check, turn the machine by hand to detect any malfunction.

1.3 - Identification

The alternator is identified by means of a nameplate fixed on the frame.
Make sure that the nameplate on the machine conforms to your order.
The machine name is defined according to various criteria (see below).
Example of description for : **LSA 42.2 S4 J6/4 -**
- LSA : name used in the PARTNER range
  M : Marine / C : Cogeneration / T : Telecommunications.
- 42.2 : machine type
- S4 : model
- J : field excitation system
  (C:AREP / J:SHUNT / E:COMPOUND)
- 6/4 : winding number / number of poles.

1.3.1 - Nameplate

So that you can identify your machine quickly and accurately, we suggest you fill in its specifications on the nameplate below.

1.4 - Storage

Prior to commissioning, machines should be stored :
- Away from humidity : in conditions of relative humidity of more than 90%, the machine insulation can drop very rapidly, to just above zero at around 100%; monitor the state of the anti-rust protection on unpainted parts.
For storage over an extended period, the machine can be placed in a sealed enclosure (heatshrunk plastic for example) with dehydrating sachets inside, away from significant and frequent variations in temperature to avoid the risk of condensation during storage.
- If the area is affected by vibration, try to reduce the effect of these vibrations by placing the generator on a damper support (rubber disc or similar) and turn the rotor a fraction of a turn once a fortnight to avoid marking the bearing rings.

LEROY SOMER® **ALTERNATEURS** PARTNER® **ALTERNATORS**

LSA ____ Date ____
N° ____ ____ Hz
Min-1/R.P.M. ____ Protection ____
Cos φ /P.F. ____ Cl. ther. / Th. class ____
Régulateur/A.V.R. ____
Altit. ≤ ____ m Masse / Weight ____
Rlt AV/D.E bearing ____
Rlt AR/N.D.E bearing ____
Graisse / Grease ____
Valeurs excit / Excit. values ____
en charge / full load ____
à vide / at no load ____

PUISSANCE / RATING

Tension Voltage				V
				Ph.
Connex.				
Continue				kVA
Continuous				kW
40°C				A
Secours				kVA
Std by				kW
27°C				A

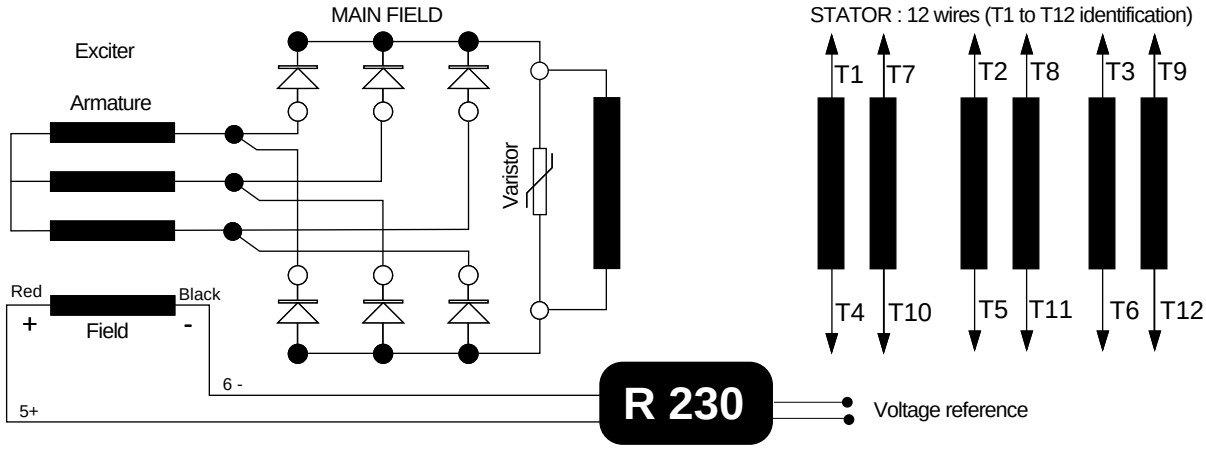
Made by Leroy Somer - 1 024 930/b

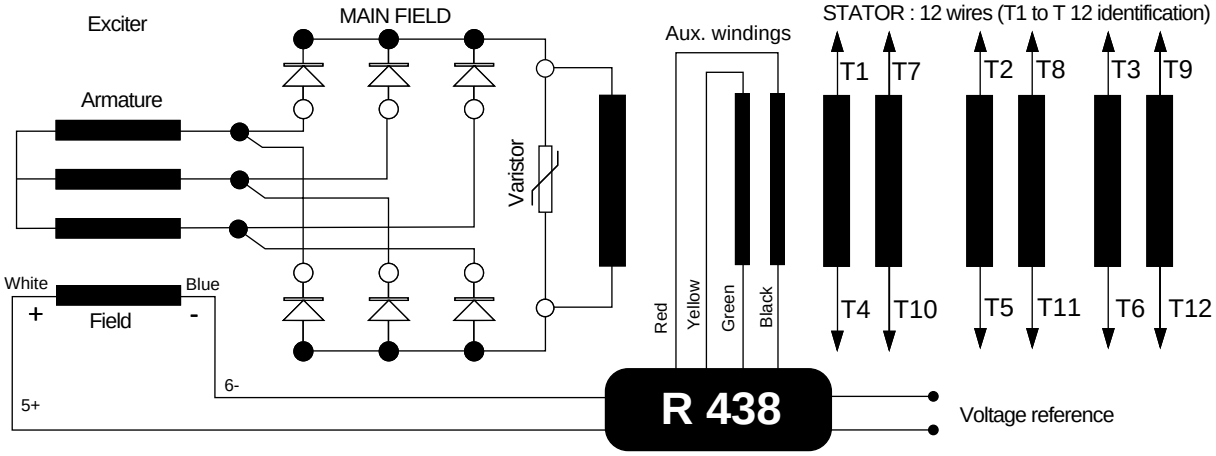
LR 0021 CE **Conforme à C.E.I 34-1 (1994). According to I.E.C 34-1 (1994).**

2 - TECHNICAL CHARACTERISTICS

2.1 - Electrical characteristics

The PARTNER LSA 42.2 alternator is a machine without sliprings and revolving field brushes, wound as "2/3 pitch", 12-wire, with class H insulation and a field excitation system available in either "SHUNT" or "AREP" version (see sections 2.3, 2.4). Interference suppression conforms with standard EN 55011, group 1, class B.





2.1.1 - Options

- Stator temperature detection probes.
- Space heaters.

2.2 - Mechanical characteristics

- Steel frame
- End shields in cast iron
- Greasable ball bearings
- Mounting arrangement

MD 35 :
single bearing with standard feet and SAE flanges/coupling discs.
B 34 :
two-bearing with SAE flange and standard cylindrical shaft extension.

- Drip-proof machine, self-cooled
- Degree of protection : IP 23

2.2.1 - Options

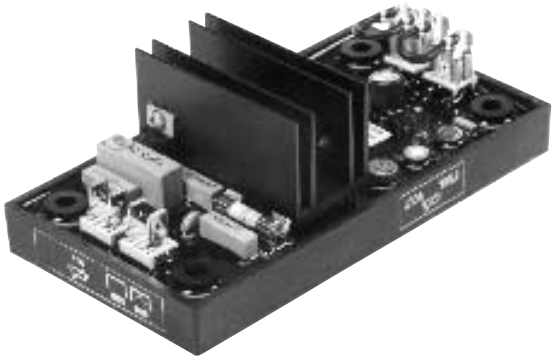
- Protection against harsh environments
- Air inlet filter, air outlet labyrinth seals.

Alternators fitted with air inlet filters should be derated by 5% (power).
To prevent excessive temperature rise caused by clogged filters, it is advisable to fit the stator winding with thermal sensors (PTC or PT100).

LSA 42.2 - 2 & 4 POLE
ALTERNATORS
TECHNICAL CHARACTERISTICS

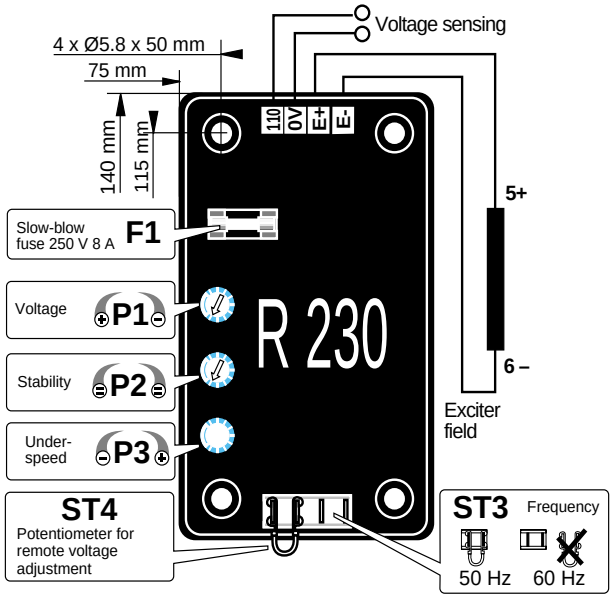
2.3 - SHUNT field excitation system

The alternator with Shunt field excitation is self-excited with a voltage regulator **R 230**. The regulator monitors the exciter excitation current as a function of the alternator output voltage. Very simple in design, the alternator with Shunt excitation has no sustaining short-circuit capability.



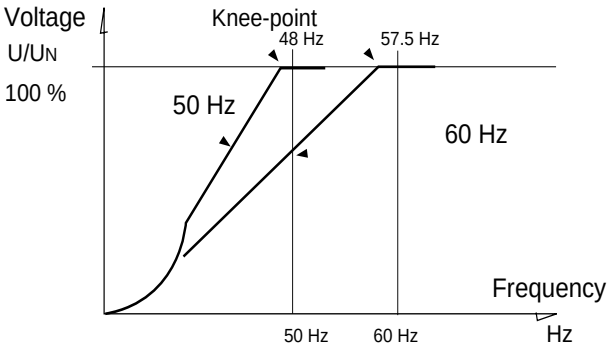
2.3.1 - R 230 AVR

- Voltage regulation: around ± 0,5 %.
- Voltage detection range 85 to 139 V (50/60Hz).
- Rapid response time (500 ms) for a transient voltage variation amplitude of ± 20 %.
- Voltage setting **P1**.
- Stability setting **P2**.
- Power supply protected by 8 A fuse, slow-acting (tolerates 10 A for 10s).
- Frequency: 50 Hz with strap **ST3** - 60 Hz without strap **ST3**
- Factory set underspeed protection **P3** plombé usine.



2.3.2 - R230 regulator options

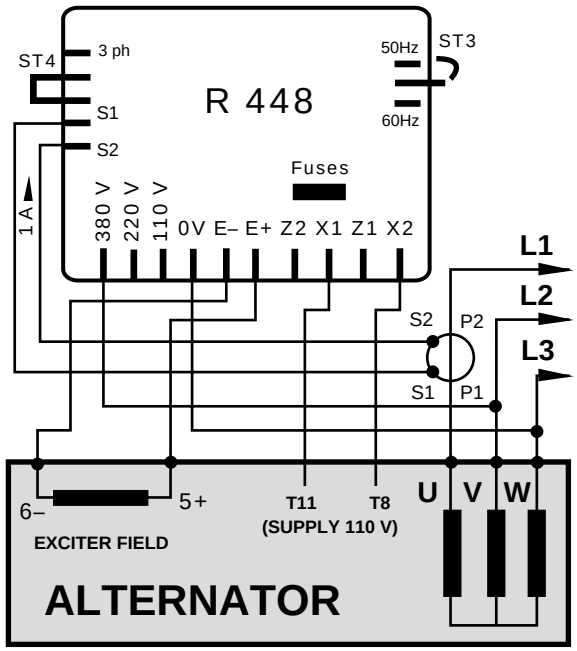
Potentiometer for remote voltage adjustment, 1000 Ω / 0.5 W min : adjustment range ± 5%.
- Remove strap **ST4** .



2.3.3 - Working with A.V.R. R448

As an option the 448 A.V.R. can be adapted on shunt alternator in order to get the following functions
In this case the R 230 A.V.R. is disconnected :
- Parallel operation between alternators with current transformer
- Parallel operation with the mains with current transformer and R 726 module
- 3 phase detection R 731
- LAM function (integrated in the R448).

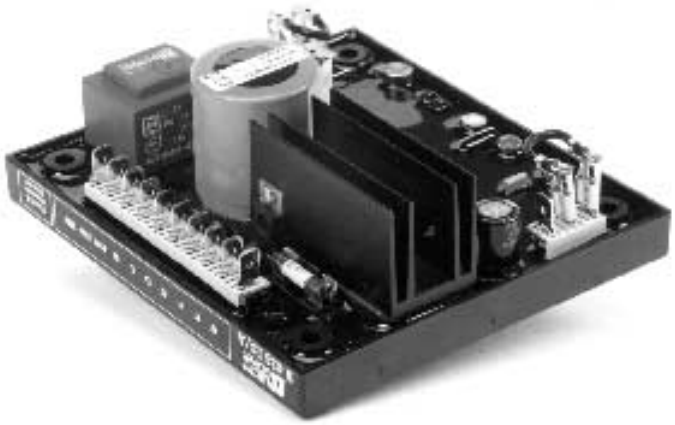
This A.V.R. and your modules must be installed outside the terminal box.
In this case, the R 230 is replaced by R 448.
For adjusting and fault detection refer to the section 4.5 of this notice (the function of R 438 and R 448 are the same, & 2.4).

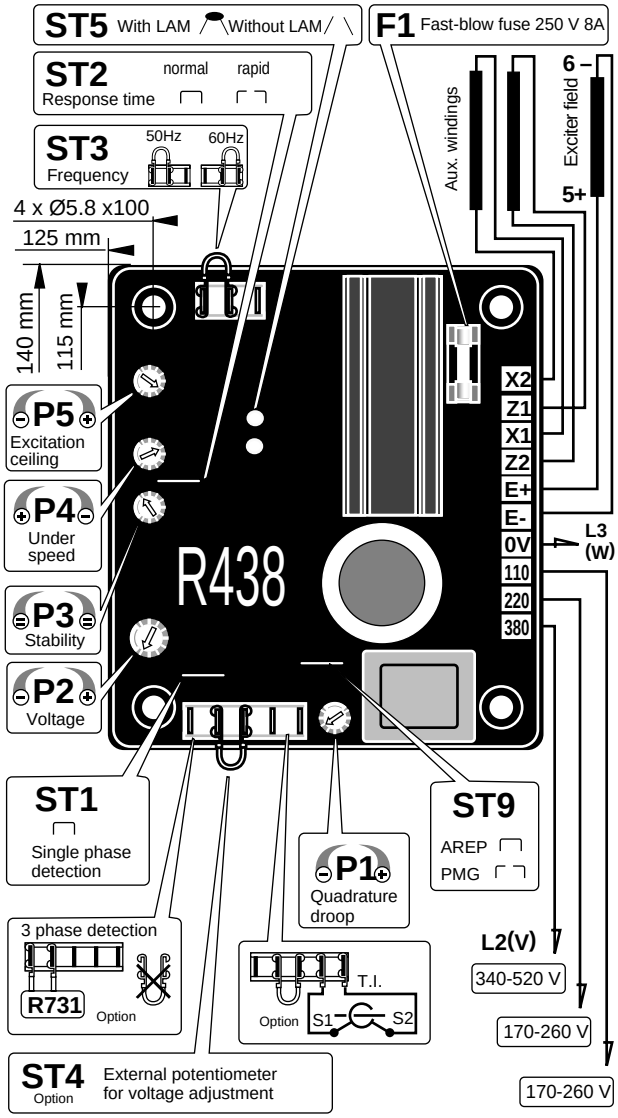


LSA 42.2 - 2 & 4 POLE
ALTERNATORS
TECHNICAL CHARACTERISTICS

2.4 - AREP field excitation system

With AREP excitation, the electronic A.V.R. **R 438** is powered by two auxiliary windings which are independent of the voltage detection circuit. The first winding has a voltage in proportion with the output voltage of the alternateur (Shunt characteristic), the second has a voltage in proportion with the stator current (compound characteristic: Booster effect). The power supply voltage is rectified and filtered before being used by the regulator monitoring transistor. This principle ensures that regulation is not affected by distortions generated by the load.





2.4.1 - R 438 regulator

- short-circuit current = 3 x IN for 10 seconds
- standard power supply; 2 auxiliary windings
- shunt power supply; max 48V - 50/60 Hz
- rated overload current: 8A - 10s
- electronic protection (overload, short-circuit opening on voltage detection): excitation ceiling current for 10 seconds then return to approx. 1A.

WARNING

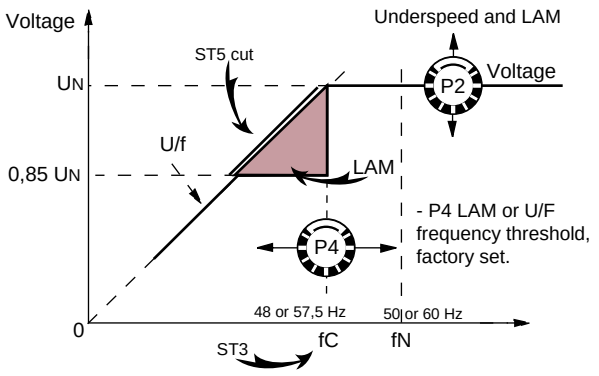
The alternator must be stopped (or the power switched off) in order to reset the protection.

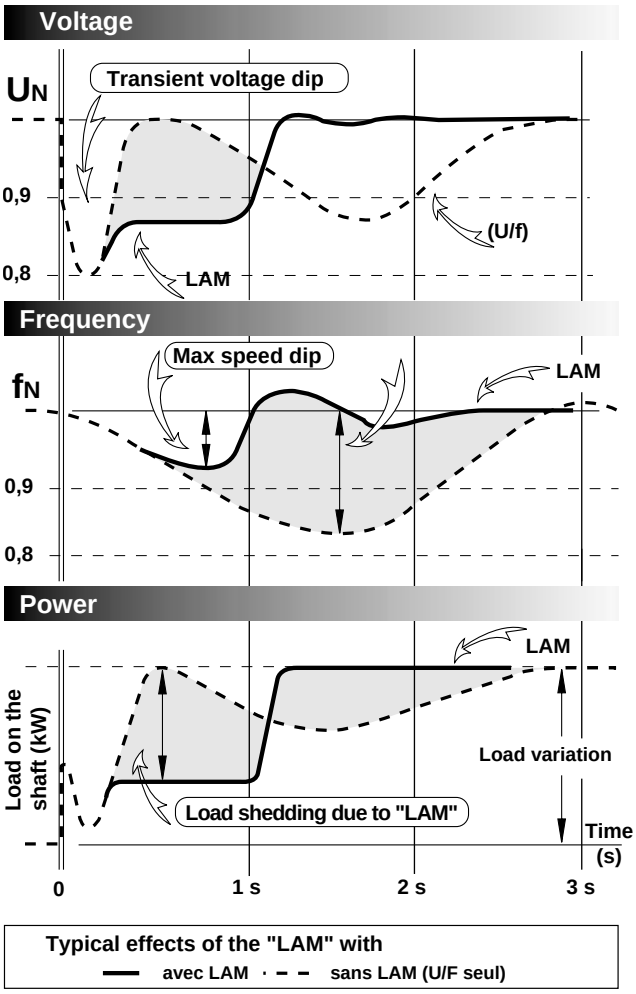
- Fusibles :
  - Fuse F1 on input side (X1, X2).
- Voltage detection: 5 VA isolated via transformer
  0-110 V terminals = 95 to 140 V
  0-220 V terminals = 170 to 260 V
  0-380 V terminals = 340 to 520 V
- Voltage regulation ± 0,5 %.
- Rapid or normal response time via strap **ST2**.
- voltage adjustment via potentiometer **P2**
  other voltages via step down transformer
- Current detection: (parallel operation): C.T. 2.5 VA cl1, secondary 1A (Option)
- Quadrature droop adjustment via potentiometer **P1**
- Underspeed protection (U/f) and LAM: frequency threshold adjustable via potentiometer **P4**
- Max. excitation current adjustment via **P5**: 4.5 to 10A
- 50/60 Hz selection via strap **ST3**.

LSA 42.2 - 2 & 4 POLE
ALTERNATORS
TECHNICAL CHARACTERISTICS

2.4.2 - LAM characteristics

The LAM system is integrated as standard in the R 438 LS regulator.
- Role of the "LAM" (Load Adjustment Module):
On load impact, the rotation speed of the generator set decreases. When it passes below the preset frequency threshold, the "LAM" causes the voltage to drop by approximately 15% and consequently the amount of active load applied is reduced by approximately 25%, until the speed reaches its rated value again.
Hence the "LAM" can be used either to reduce the speed variation (frequency) and its duration for a given applied load, or to increase the applied load possible for one speed variation (turbo-charged engine).
To avoid voltage oscillations, the trip threshold for the "LAM" function should be set approximately 2 Hz below the lowest frequency in steady state.
- LAM: action eliminated by cutting strap ST5





2.4.3 - R 438 A.V.R. options

- **Current transformer** for parallel operation
- Remote voltage **adjustment potentiometer**: 470 Ω, 0.5 W min: adjustment range ± 5% (range limited via internal voltage potentiometer **P2**). Remove ST4 to connect the potentiometer. (A 1 k Ω potentiometer can also be used to extend the adjustment range.)
- **R 731 external module**: detection of 3-phase voltage 200 to 500 V, compatible with parallel operation. Cut ST1 to connect the module; set the voltage via the module potentiometer. (The previous version module is not compatible with parallel operation).
- **R 726 module**: 3 functions (external mounting).
• P.F. φ regulation (2F) and voltage matching prior to paralleling with the mains (3 F).
• C.T. of ...../1A . 5 VA CL 1 (see schematic included with this manual).

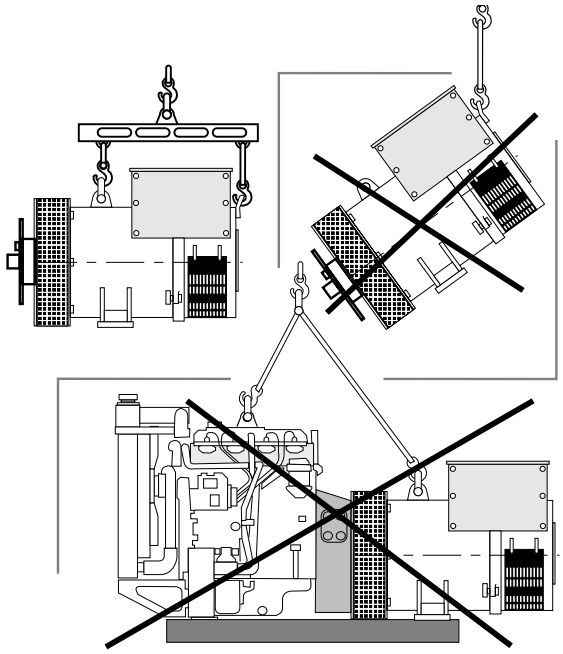
3 - INSTALLATION

3.1 - Assembly

All mechanical handling operations must be undertaken using approved equipment.
While being handled, the machine should remain horizontal.

3.1.1 - Handling

The generously-sized lifting rings are for handling the alternator alone. They must not be used to lift the genset. Choose a lifting system which respects the positionning of the rings.



3.1.2 - Coupling

3.1.2.1 - single bearing alternator
Before coupling to the prime mover, check that both are compatible by:
- Undertaking a torsional analysis of the transmission.
-Checking the dimensions of the flywheel and its housing, the flange, coupling discs and offset.

WARNING

When coupling the alternator to the prime mover, the holes of the coupling discs should be aligned with the flywheel holes by cranking the engine.
Do not use the alternator fan to turn the rotor.
Tighten the coupling discs screws to the recommended torque (see section 4.6.2.) and check that there is lateral play on the crankshaft.

3.1.2.2 - two-bearing alternator
- Semi-flexible coupling
Careful alignement of the machines by measuring the concentricity and parallelism of the two parts of the coupling is recommended, the difference between the teadings should not exceed the specified values (say 0,1 mm).

WARNING

This alternator has been balanced with a 1/2 key.

3.1.3 - Location

Ensure that the ambient temperature in the room where the alternator is placed cannot exceed 40°C for standard power ratings (for temperatures above 40°C, apply a derating coefficient). Fresh air, free from damp and dust, must be able to circulate freely around the air input louvres on the opposite side from the coupling. It is essential to prevent not only the recycling of hot air from the machine or engine, but also exhaust fumes.

3.2 - Inspection prior to first use

3.2.1 - Electrical checks

Under no circumstances should an alternator, new or otherwise, be operated if the isolation is less than 1 megohm for the stator and 100,000 ohms for the other windings.
There are two possible methods for restoring the above minimum values.
a) Dry out the machine for 24 hours in a drying oven at a temperature of approximately 110 °C.
b) Blow hot air into the air input, having made sure that the machine is rotating with the exciter field disconnected.
c) Run in short-circuit mode (disconnect the AVR)
- Short-circuit the output phases using connections capable of supporting the rated current (try not to exceed 6 A/mm2).
- Insert a clamp ammeter to monitor the current passing through the short-circuit connections.
- Connect a 48 Volt battery in series with a rheostat of approximately 10 ohms (50 Watts), to the exciter field terminals, respecting the polarity.
- Open fully all the alternator orifices.
- Run the alternator at rated speed . Adjust the exciter field current using the rheostat to obtain the rated output current in the short-circuit connections.
Note: Prolonged standstill: In order to avoid these problems, we recommend the use of space heaters, as well as turning over the machine from time to time. Space heaters are only really effective if they are working continuously while the machine is stopped.

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3.2.2 - Physical and visual checks

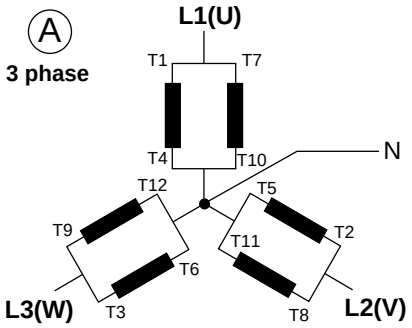
Before starting the machine for the first time, check that:
- the fixing bolts on the feet are tight
- the cooling air is drawn in freely
- the protective louvres and housing are correctly in place
- the standard direction of rotation is clockwise as seen from the shaft end (phase rotation in order 1 - 2 - 3). For anti-clockwise rotation, swap 2 and 3.
- the winding connection corresponds to the site operating voltage (see section § 3.3)

3.3 - Terminal connection diagrams

To modify the connection, change the position of the terminal cables. The winding code is specified on the nameplate.

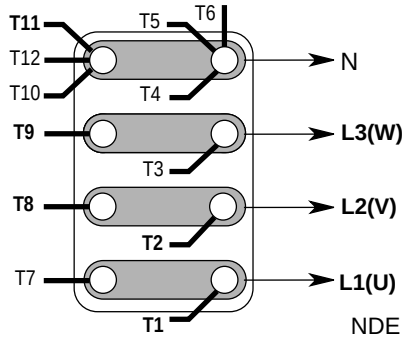
Any intervention on the alternator terminals during reconnection or checks should be performed with the machine stopped.

Connection code A — 3 phase

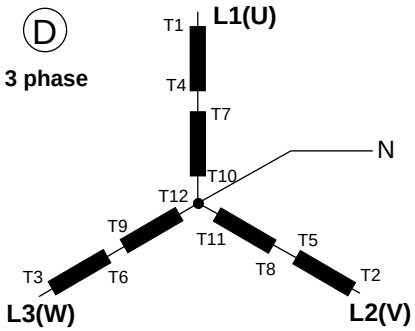


Winding	50 Hz	60 Hz
6	190 - 208	190 - 240
7	220 - 230	-
8	-	190 - 208

R 230 voltage detection :
0 => (T8) / 110 V => (T11)
R 438 LS voltage detection :
0 => (T3) / 220 V => (T2)

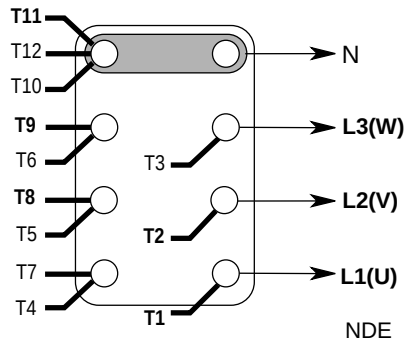


Connection code D — 3 phase

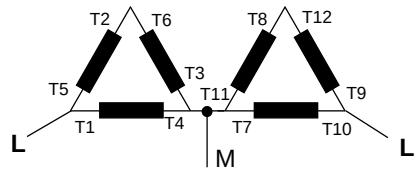


Winding	50 Hz	60 Hz
6	380 - 415	380 - 480
7	440 - 460	-
8	-	380 - 416

R 230 voltage detection :
0 => (T8) / 110 V => (T11)
R 438 LS voltage detection :
0 => (T3) / 380 V => (T2)



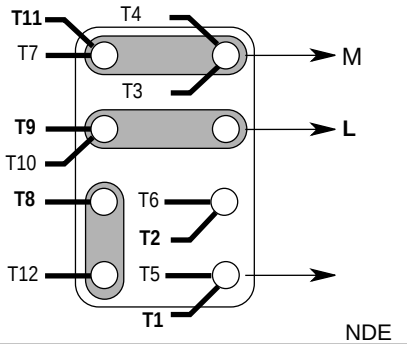
Connection code FF — 1 phase



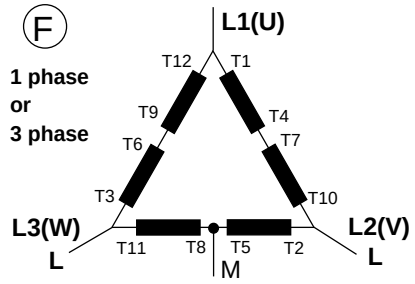
Voltage LM = 1/2 voltage LL

Winding	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

R 230 voltage detection :
0 => (T1) / 110 V => (T4)
R 438 LS voltage detection :
0 => (T10) / 220 V => (T1)



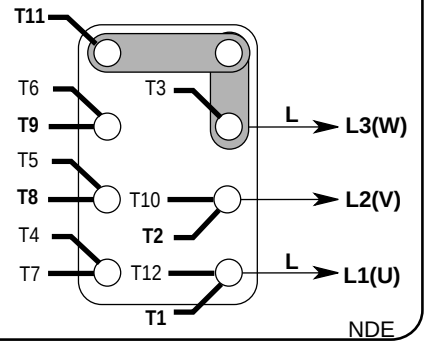
Connection code F — 1 phase or 3 phase



Voltage LM = 1/2 voltage LL

Winding	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

R 230 voltage detection :
0 => (T8) / 110 V => (T11)
R 438 LS voltage detection :
0 => (T3) / 220 V => (T2)



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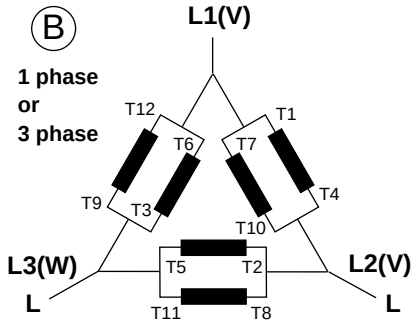
Connection codes

B

1 phase or 3 phase

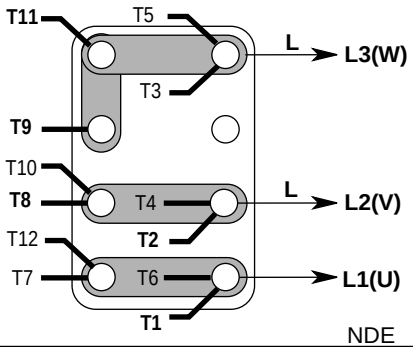


L.L voltage

Winding	50 Hz	60 Hz
6	110 - 120	120
7	120 - 130	-
8	-	110 - 120

R 230 voltage detection :
0 => (T8) / 110 V => (T11)
R 438 LS voltage detection :
0 => (T3) / 110 V => (T2)

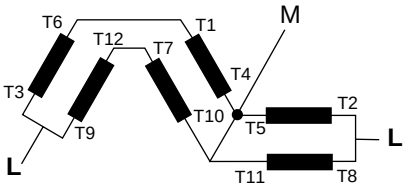
Factory connection



G

Connection not recommended

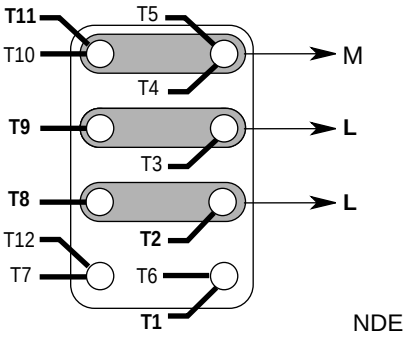
1 PH



LM voltage = 1/2 LL voltage

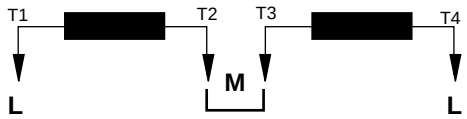
Winding	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

R 230 voltage detection :
0 => (T8) / 110 V => (T11)
R 438 LS voltage detection :
0 => (T3) / 220 V => (T2)



SINGLE PHASE 4 LEADS - WINDING DEDICATED type M or M1

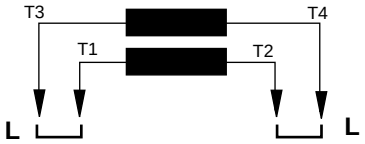
SERIES CONNECTION



Voltage 50/60 Hz			Output		
L - L	L - M	Connect	L	L	M
220 230 240	110 115 120	T2 - T3	T1	T4	T2 - T3

R 230 voltage detection : 0 => (T1) / 110 V => (T2)

PARALLEL CONNECTION

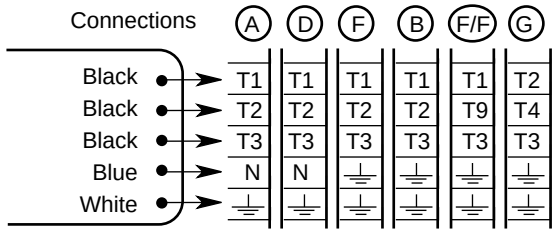


Voltage 50/60 Hz			Output		
L - L	L - M	Connect	L	L	M
110 115 120	- - -	T1 - T3 T2 - T4	T1-T3	T2 - T4	-

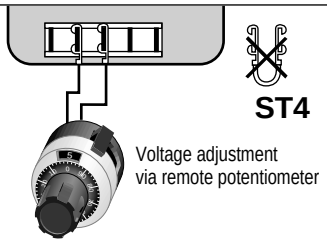
R 230 voltage detection : 0 => (T1) / 110 V => (T2)

3.3.1 - Connection diagram for options

R 791 T interference suppression kit (standard for CE marking)



Voltage potentiometer



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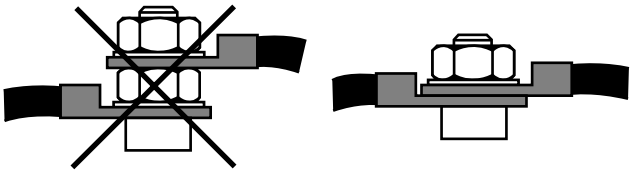
3.3.2 - Connection checks

Electrical installations must comply with the current legislation in force in the country of use.

Check that:
- the differential circuit-breaker conforms to legislation on protection of personnel, in force in the country of use, and has been correctly installed on the alternator power output as close as possible to the alternator. (Disconnect the blue wire of the R 791 interference suppression module linking the neutral).
- any protective devices in place have not tripped,
- if there is an external regulator, the connections between the alternator and the cubicle are made in accordance with the connection diagram,
- there is no short-circuit between phase or phase-neutral between the alternator output terminals and the generator set control cabinet (part of the circuit not protected by circuit-breakers or cubicle relays)
- the machine should be connected with the terminal lugs on top of one another as shown in the terminal connection diagrams.



3.3.3 - Electrical checks on the A.V.R.

- Check that all connections have been made properly as shown in the attached connection diagram.
- Check that the frequency selection strap "ST3" is on the correct frequency setting.
- Check whether strap ST4 or the remote adjustment potentiometer have been connected.
- Optional operating modes (R 438 LS)
• Strap ST1: cut to connect the R 731 3-phase detection module.
• Strap ST2: cut for rapid response time.
• Strap ST5: cut to suppress the LAM function.

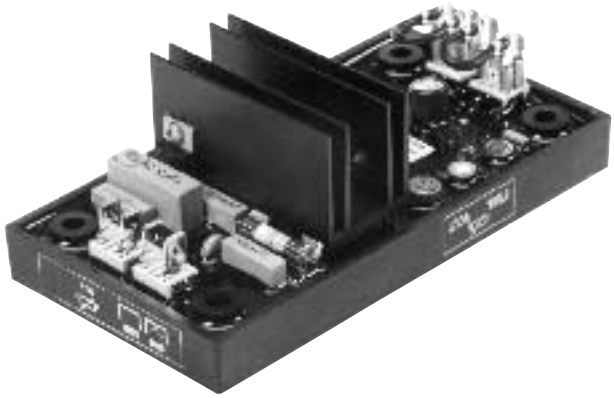
3.4 - Commissioning

The machine can only be started up and used if the installation is in accordance with the instructions and advice defined in this manual.
The machine is tested and set at the factory. When first used with no load, make sure that the drive speed is correct and stable (see the nameplate). On application of the load, the machine should maintain its rated speed and voltage; however, in the event of abnormal operation, the machine setting can be altered (follow the adjustment procedure in section 3.5). If the machine still operates incorrectly, the cause of the malfunction must be located (see section 4.4).

3.5 - Setting up

The various adjustments during tests must be made by a qualified engineer. Take care that the drive speed specified on the nameplate is reached before commencing adjustment. After operational testing, replace all access panels or covers.
The A.V.R. is used to make any adjustments to the machine.

3.5.1 - R 230 adjustments (Shunt system)



Initial potentiometer settings
- Potentiometer **P1** (AVR voltage adjustment): fully anticlockwise.
- Remote voltage adjustment potentiometer: middle
Run the alternator at its rated speed: if the voltage does not increase, the magnetic circuit should be remagnetized (see section 4.5).
- Turn the AVR voltage adjustment potentiometer **P1** slowly until the output voltage rated value is obtained.
- Adjust the stability using **P2**.
- Sealed potentiometer **P3** is factory set at 48 Hz for 50 Hz and 57.5 Hz for 60 Hz.

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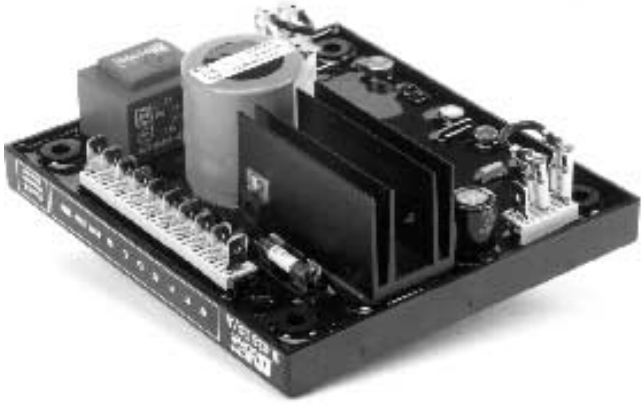
3.5.2 - R 438 LS adjustments

WARNING

Avant toute intervention sur le régulateur, s'assurer que le strap ST9 est fermé en excitation AREP et coupé en excitation PMG.



a) Initial potentiometer settings (see table)
- remote voltage adjustment potentiometer : centre (ST4 strap removed).

Action	Factory adjust.	Pot.
Voltage minimum fully anti-clockwise	400V - 50 Hz (Input 0 - 380 V)	
Stability	Not adjusted (middle)	
Threshold/LAM or U/F Underspeed protection and "LAM" trip threshold Maximum frequency fully anti-clockwise	If ST3 = 50 Hz (factory) = 48 Hz If ST3 = 60 Hz (factory) = 58 Hz	
Voltage quadrature droop (// operation with C.T.) - 0 quadrature droop fully anti-clockwise.	Not set (fully anti-clockwise)	
Excitation ceiling Limit of excitation ceiling and short-circuit current, minimum fully anti-clockwise	10 A maximum	

b) Install a D.C. analogue voltmeter (needle dial) cal. 50V on terminals E+, E- and an A.C. voltmeter cal. 300 - 500 or 1000V on the alternator output terminals.

c) Make sure that the **ST3** strap is positioned on the desired frequency (50 or 60 Hz).

d) Voltage potentiometer **P2** at minimum, fully to anti-clockwise.

e) Turn the V/Hz potentiometer **P4**, fully to clockwise.

f) Stability potentiometer **P3** approximately 1/3 of travel anti-clockwise.

g) Start the engine and set its speed to a frequency of 48 Hz for 50 Hz, or 58 for 60 Hz.

h) Adjust the output voltage to the desired value using **P2**.
- rated voltage UN for solo operation (eg. 400 V)
- or UN + 2 to 4% for parallel operation with C.T. (eg. 410V -)
If the voltage oscillates, use **P3** to make adjustments (try both directions) observing the voltage between E+ and E- (approx. 10V D.C.). The best response times are obtained at the limit of the instability. If no stable position can be obtained, try cutting or replacing the ST2 strap (normal /rapid).

i) Check LAM operation : **ST5** closed.

j) Turn potentiometer **P4** slowly anti-clockwise until there is a significant voltage drop (approx. 15 %).

k) Vary the frequency (speed) of both parts between 48 or 58 Hz according to the operating frequency, and check the change in voltage previously observed (~ 15%).

l) Readjust the speed of the unit to its rated no-load value.

Adjustments in parallel operation

Before any intervention on the alternator, make sure that the speed quadrature droop is identical for all engine.

m) Preset for parallel operation (with C.T. connected to S1, S2 of connector J2)
- potentiometer P1 (quadrature droop) in centre position
Apply the rated load (cos φ = 0.8 inductive).
The voltage should drop by 2 to 3 %. If it increases, swap the 2 incoming wires of the C.T. secondary.

n) The no-load voltages should be identical for all the alternators intended to run in parallel.
- Couple the machines in parallel.
- By adjusting the **speed**, try to obtain 0 Kw power exchange.
- By altering the voltage setting P2 or Rhe on one of the machines, try to cancel (or minimise) the **current** circulating between the machines.
- From now on, do not touch the voltage settings.

o) Apply the available load (the setting is only correct if a **reactive** load is available)
- By altering the **speed**, equalize the KW (or divide the rated power of the units proportionally)
- By altering the quadrature droop potentiometer **P1**, equalize or divide the **currents**.

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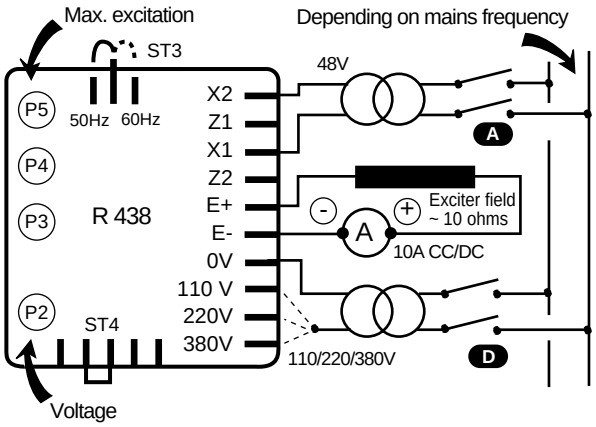
3.5.3 - Max. excitation adjustment (excitation ceiling)

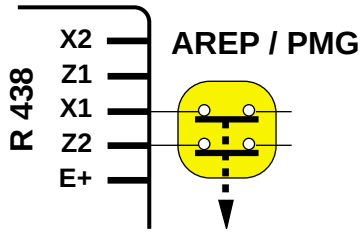


Quadrature droop adjustment of the current limit, potentiometer P5 (fuse rating : 8 A - 10 seconds).
The factory setting corresponds to that of the excitation current required to obtain a 3-phase short-circuit current of approximately 3 x IN at 50 Hz for industrial power, unless otherwise specified (*).
It is possible to reduce the maximum excitation level by a static method which is safer for the alternator and the network. Disconnect power supply wires X1,X2 and Z1,Z2, and the sensing leads (0-110V-220V-380V) on the alternator. Connect the mains power supply (200-240V) as indicated (X1, X2 : 120 V). Install a 10A D.C. ammeter in series with the exciter field. Turn P5 fully C.C.W. , activate the power supply. If there is no output current from the A.V.R., turn potentiometer P2 (voltage) C.W. until the ammeter indicates a stable current. Switch the power supply off, then on again, turn P5 C.W until the required max. current is obtained (no more than 10 A).

Checking the internal protection :
Open switch (D): the excitation current should increase to its preset ceiling, remain at that level for about 10 seconds and then drop to below 1A.
To reset, switch off the power supply by opening switch (A).
Note: After setting the excitation ceiling as described, adjust the voltage again (see section 3.5.2.)
(*) : A short-circuit current of 3 x IN is a legal requirement in most countries so as to offer selective protection.

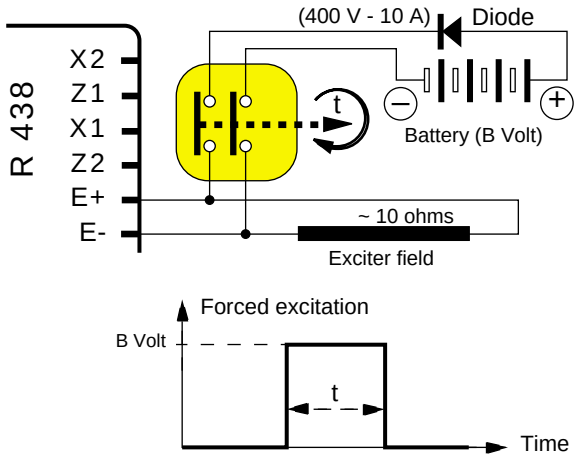
3.5.4 - Special type of use

- **Field de-energizing**



The exciter is switched off by disconnecting the AVR power supply (1 wire on each auxiliary winding) contact rating 10A - 250V A.C.
Connection is identical for resetting the AVR internal protection.

- **Field forcing**



Applications	B volts	Time t
Guaranteed voltage build up	12 (1A)	1 - 2 s
Parallel operation, de-energized	12 (1A)	1 - 2 s
Parallel operation, at standstill	24 (2A)	5 - 10 s
Battery starting	48 (4A)	5 - 10 s
Sustained voltage on over load	48 (4A)	5 - 10 s

4 - SERVICING - MAINTENANCE

4.1 - Safety measures

Servicing or troubleshooting must be carried out strictly in accordance with instructions so as to avoid the risk of accidents and to maintain the machine in its original state.

All such operations performed on the alternator should be undertaken by personnel trained in the commissioning, servicing and maintenance of electrical and mechanical components.
Before any intervention on the machine, ensure that it cannot be started by a manual or automatic system and that you have understood the operating principles of the system.

4.2 - Regular maintenance

4.2.1 - Checks after start-up

After approximately 20 hours of operation, check that all fixing screws on the machine are still tight, plus the general state of the machine and the various electrical connections in the installation.

4.2.2 - Cooling circuit

It is advisable to check that circulation of air is not reduced by partial blocking of the air intake and outlet grilles : mud, fibre, grease, etc.

4.2.3 - Bearings

The bearings are greased for life: approximate life of the grease (depending on use) = 20,000 hours or 3 years. Monitor the temperature rise in the bearings, which should not exceed 90°C above the ambient temperature. Should this value be exceeded, the machine must be stopped and checks carried out.

4.2.4 - Electrical servicing

Cleaning product for the windings

WARNING

Do not use : trichlorethylene, perchlorethylene, trichloroethane or any alkaline products.

Certain strictly defined pure volatile degreasing products can be used, such as :
- Normal petrol (without additives) ; inflammable
- Toluene (slightly toxic); inflammable
- Benzene (or benzine, toxic); inflammable
- Ciclohexare (non toxic); inflammable

Cleaning of the stator, rotor, exciter and diode bridge

The insulating components and the impregnation system are not at risk of damage from solvents (see the list of authorised products).
Avoid letting the cleaning product run into the slots. Apply the product with a brush, sponging frequently to avoid accumulation in the housing. Dry the winding with a dry cloth. Let any traces evaporate before reassembling the machine.

4.2.5 - Mechanical servicing

WARNING

Cleaning the machine using water or a high-pressure washer is strictly prohibited.
Any problems arising from such treatment are not covered by our warranty.
The machine should be cleaned with a degreasing agent, applied using a brush. Check that the degreasing agent will not affect the paint.
Compressed air should used to remove any dust.
If filters have been added to the machine after manufacture and do not have thermal protection, the service personnel should clean the air filters periodically and systematically, as often as necessary (every day in very dusty atmospheres).
Cleaning can be performed using water for dry dust or in a bath containing soap or detergent in the case of greasy dust. Petrol or chloroethylene can also be used.
After cleaning the alternator, it is essential to check the winding insulation (see sections 3.2 and 4.8).

4.3 - Fault detection

If, when commissioned, the alternator does not work normally, the source of the malfunction must be identified.
To do this, check that :
- the protective devices are fitted correctly
- the connections comply with diagrams in the manuals supplied with the machine
- the speed of the unit is correct (see section 1.3).
Repeat the operations defined in section 3.

4.4 - Défauts mécaniques

Fault		Cause
Bearing	Excessive overheating of one or both bearings (bearing temperature 80°C above the ambient temperature) (With or without abnormal bearing noise)	- If the bearing has turned blue or if the grease has turned black, change the bearing. - Bearing not fully locked (abnormal play in the bearing cage) - End shields incorrectly aligned
Abnormal temperature	Excessive overheating of alternator frame (more than 40° C above the ambient temperature)	- Air flow (inlet-outlet) partially clogged or hot air is being recycled from the alternator or engine - Alternator operating at too high a voltage (> 105% of Un on load) - Alternator overloaded
Vibrations	Too much vibration	- Misalignment (coupling) - Defective mounting or play in coupling - Rotor balancing fault (Engine - Alternator)
	Excessive vibration and humming noise coming from the machine	- Phase imbalance - Stator short-circuit
Abnormal noise	Alternator damaged by a significant impact, followed by humming and vibration	- System short-circuit - Misparalleling Possible consequences - Broken or damaged coupling - Broken or bent shaft end - Shifting and short-circuit of main field - Fan fractured or coming loose on shaft - Irreparable damage to rotating diodes/AVR

4.5 - Electrical faults

Fault	Action	Effect	Check/Cause
No voltage at no load on start-up	Connect a new battery of 4 to 12 volts to terminals E- and E+, respecting the polarity, for 2 to 3 seconds	The alternator builds up and its voltage is still correct when the battery is removed.	- Lack of residual magnetism
		The alternator builds up but its voltage does not reach the rated value when the battery is removed.	- Check the connection of the voltage reference to the AVR - Faulty diode - Armature short-circuit
		The alternator builds up but its voltage disappears when the battery is removed.	- Faulty AVR - Field windings open circuit (check winding) - Main field winding open circuit (check the resistance)
Voltage too low	Check the drive speed	Correct speed	Check the AVR connections (possible AVR failure) - Field windings short-circuited - Rotating diodes burnt out - Main field winding short-circuited - Check the resistance
		Speed too low	Increase the drive speed (Do not touch the AVR voltage pot. (P2) before running at the correct speed.)
Voltage too high	Adjust AVR voltage potentiometer	Adjustment ineffective	Faulty AVR
Voltage oscillations	Adjust AVR stability potentiometer	If no effect : try normal / fast recovery modes (ST2)	- Check the speed : possibility of cyclic irregularity - Loose connections - Faulty AVR - Speed too low when on load (or LAM set too high)
Voltage correct at no load and too low when on load (*)	Run at no load and check the voltage between E+ et E- on the AVR	Voltage between E+ and E– SHUNT < 6V - AREP < 10V	- Check the speed (or LAM set too high)
		Voltage between E+ and E– SHUNT > 10V - AREP > 15V	- Faulty rotating diodes - Short-circuit in the main field. Check the resistance. - Faulty exciter armature. Check the resistance.
(*) Warning : During single-phase operation, check that the sensing wires from the AVR are connected to the correct output terminals.			
Voltage disappears during operation	Check the AVR, the surge suppressor, the rotating diodes, and replace any defective components	The voltage does not return to the rated value.	- Exciter winding open circuit - Faulty exciter armature - Faulty AVR - Main field open circuit or short-circuited
(**) Warning : The AVR internal protection may cut in (overload lost connection, short circuit).			

4.5.1 - Checking the winding

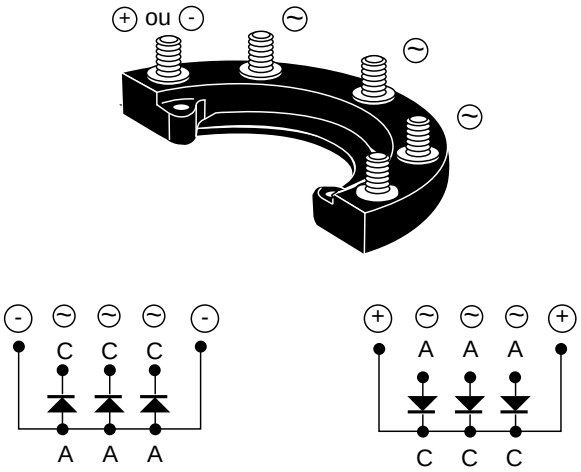
You can check the winding insulation by performing a high voltage test. In this case, you must disconnect all AVR wires.

WARNING

Damage caused to the AVR in such conditions is not covered by our warranty.

4.5.2 - Checking the diode bridge

A diode in good working order must allow the current to flow from the anode to the cathode.



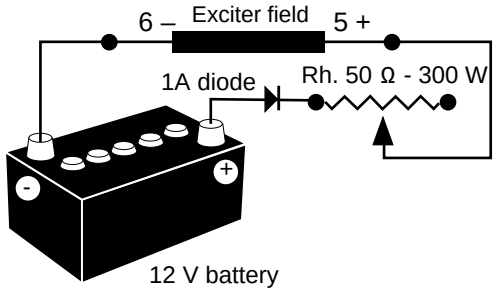
4.5.3 - Checking the windings and rotating diodes using separate excitation

During this procedure, make sure that the alternator is disconnected from any external load and inspect the terminal box to check that the connections are fully tightened.

1) Stop the unit, disconnect and isolate the AVR wires.
2) There are two ways of creating an assembly with separate excitation.

Assembly A : Connect a 12 V battery in series with a rheostat of approximately 50 ohms - 300 W and a diode on both field wires (5+) and (6-).

ASSEMBLY A



Assembly B : Connect a "Variac" variable power supply and a diode bridge on both exciter field wires (5+) and (6-).

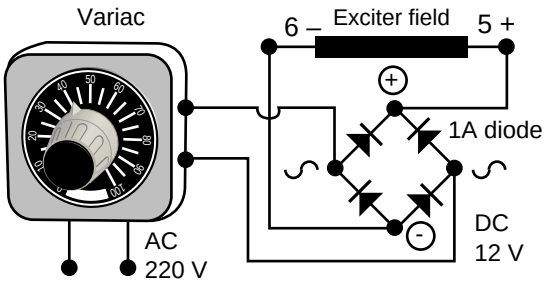
Both these systems should have characteristics which are compatible with the machine field excitation power (see the nameplate).

3) Run the unit at its rated speed.

4) Gradually increase the exciter field current by adjusting the rheostat or the variac and measure the output voltages on L1- L2 - L3, checking the excitation voltage and current at no load and on load (see the machine nameplate or ask for the factory test report).

When the output voltage is at its rated value and balanced within 1 % for the rated excitation level, the machine is in good working order. The fault therefore comes from the AVR or its associated wiring (ie. sensing, auxiliary windings).

ASSEMBLY B



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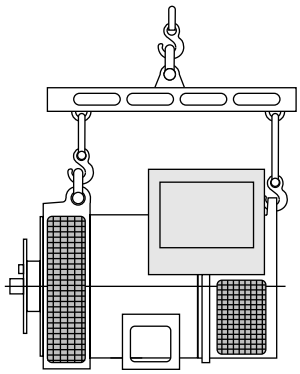
4.6 - Dismantling, reassembly (see sections 5.4.1. & 5.4.2)

During the warranty period, this operation should only be carried out in an approved workshop or in our factory, otherwise the warranty may be invalidated.

WARNING

Whilst being handled, the machine should remain horizontal (rotor not locked when moved).



4.6.1 - Tools required

Pour le démontage total de la machine, il souhaitable de disposer des outils définis ci-dessous :
- 1 ratchet spanner + extension
- 1 torque wrench
- 1 7 mm flat spanner
- 1 8 mm flat spanner
- 1 10 mm flat spanner
- 1 12 mm flat spanner
- 1 8 mm socket
- 1 10 mm socket
- 1 13 mm socket
- 1 5 mm Allen key (eg. Facom: ET5)
- 1 6 mm Allen key (eg. Facom: ET6)
- 1 TORX T20 bit
- 1 TORX T30 bit
- 1 puller (eg. Facom: U35)
- 1 puller (eg. Facom: U32/350).

4.6.2 - Screw tightening torque

IDENTIFICATION	screw Ø	Torque N.m
Field term. block screw	M4	4 N.m
Field screw	M6	10 N.m
Diode bridge screw	M 6	5 N.m
Diode nut	M 5	4 N.m
Assembly rod	M 8	20 N.m
Earth screw	M 6	5 N.m
Balancing bolt	M 5	4 N.m
Discs/shaft screw	M 10	66 N.m
Lifting screw	M 8	4 N.m
Grille screw	M 6	5 N.m
Cover screw	M 6	5 N.m

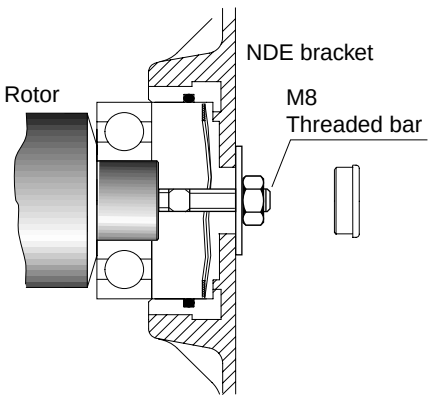
4.6.3 - Access to connections and the regulation system

The terminals are accessed by removing the terminal box lid [48].
To access the adjustment potentiometers on the AVR, the side plate should be removed [367].

4.6.4 - Accessing, checking and replacing diodes

4.6.4.1 - Dismantling
- Remove the terminal box lid [48].
- Remove the air intake louvre [51].
- Unscrew the fixing clamps on the power output cables, disconnect E+, E- on the exciter and R 791 module.
- Remove the 4 nuts on the tie rods.
- Remove the NDE bracket [36] using an extractor: eg. U.32 - 350 (FACOM).
- Remove the surge suppressor [347].
- Remove the 4 fixing screws from the diode bridges on the armature.
- Disconnect the diodes.
- Check the 6 diodes using either an ohmmeter or a battery lamp (see section 4.5.1).

4.6.4.2 - Reassembly
- Replace the diodes, respecting the polarity (see section 4.5.1).
- Replace the surge suppressor [347].
- Insert a new O ring in the bearing housing.
- Refit the NDE bracket and pass the bundle of wires between the top bars of the flange.
- Replace the fixing clamps on the cables and the R 791 module.
- Refit the air intake louvre [51].
- Replace the terminal box lid [48].



4.6.5 - Replacing the NDE bearing on a single-bearing machine

4.6.5.1 - Dismantling

- Dismantle the NDE bracket [36] (see section 4.6.2.1).
- Remove the bearing [70] using a puller.

4.6.5.2 - Reassembly

- Heat the inner slipring of a new bearing by induction or in a drying oven at 80 °C (do not use an oil bath) and fit it to the machine.
- Place the preloading wavy washer [79] in the flange and fit a new O ring seal [349].
- Replace the NDE bracket [36] (see section 4.6.2.2).

4.6.6 - Replacing the bearings on a two-bearing machine

4.6.6.1 - Démontage

- Uncouple the alternator from the prime mover.
- Remove the 8 assembly screws.
- Remove the DE flange [30].
- Remove the NDE bracket (see section 4.6.2.1).
- Remove both bearings [60] and [70] using a puller.

4.6.6.2 - Reassembly

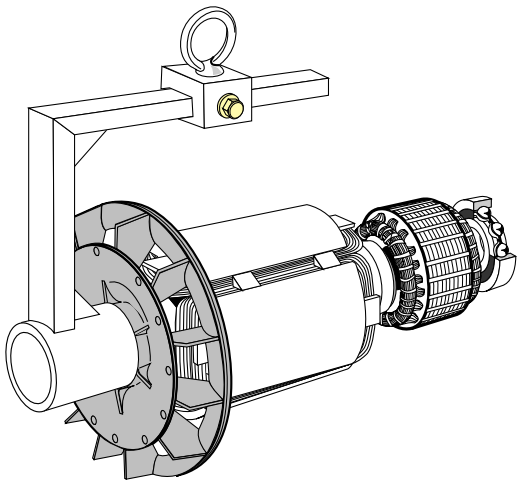
- Fit new bearings after heating them by induction or in a drying oven at 80 °C (do not use an oil bath).
- Check that both the preloading wavy washer [79] and new O ring seal have been fitted [349] on the NDE bracket [36].
- Replace the DE flange [30], and tighten the 8 fixing screws.
- Check that the whole machine is correctly assembled and that all screws are fully tightened.

4.6.7 - Accessing the main field and stator

4.6.7.1 - Dismantling

Follow the procedure for dismantling bearings (see sections 4.6.5.1 and 4.6.5.1.)

- Remove the coupling discs (single-bearing machine) or the DE flange (two-bearing machine) and insert a tube of the corresponding diameter on the shaft end or a support made according the following bellow.



- Rest the rotor on one of its poles, then slide it out. Use the tube as a lever arm to assist dismantling.
- After extraction, be careful with the fan. It is necessary to replace the fan in case of disassembling.

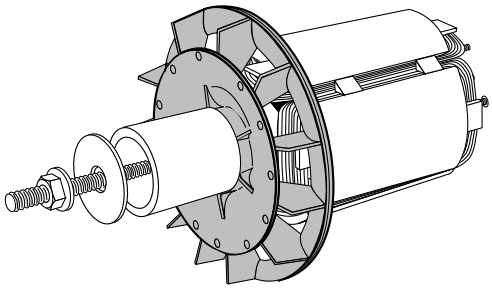
NOTE: If intervention is required on the main field (rewinding, replacement of components), the rotor assembly must be rebalanced.

4.6.7.2 - Reassembly

- Follow the dismantling procedure in reverse order.

Take care not to knock the windings when refitting the rotor in the stator.

If you replace the fan, respect the assembly guide according the following bellow. Use a tube and a screw.



Follow the procedure for reassembling the bearings (see section 4.6.5.2 and 4.6.6.2).

After final adjustments, the access panels or cover should be refitted.

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4.7 - Electrical characteristics table

Alternator - 2 and 4 pole - 50 Hz/60 Hz - Standard winding n°6 and M or M1 in dedicated single phase (400 V for the excitation values).
The voltage and current values are given for no-load operation and operation at rated load with separate field excitation. All values are given at ± 10% and may be changed without prior notification (for exact values, consult the test report). For 60 Hz machines, the "i exc" values are approximately 5 to 10 % lower.

4.7.1 - 3-phase : 2 pole with SHUNT excitation

Resistances at 20 °C (Ω)

LSA 42.2	VS0*	VS2*	S3*	S4*	M5	M6	L7	VL8
L/N stator	1,01	0,76	0,61	0,4	0,22	0,22	0,16	0,1
Rotor	2,93	3,13	3,24	3,53	4,1	4,1	4,7	5,5
Field	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5
Armature	0,79	0,79	0,79	0,79	0,79	0,79	0,79	0,79

Field excitation current i exc (A) - 400 V - 50 Hz
Symbols : "i exc" : excitation current of the exciter field

LSA 42.2	VS0*	VS2*	S3*	S4*	M5	M6	L7	VL8
No-load	0,45	0,4	0,4	0,4	0,45	0,45	0,4	0,4
At rated load	1,6	1,7	1,7	1,7	1,55	1,85	1,7	1,65

* Lister type machine

4.7.2 - Dedicated single phase : 2 pole with SHUNT excitation

Resistances at 20 °C (Ω)

LSA 42.2	VS2	S3	S4	M6	L7
L/N stator	0,36	0,294	0,190	0,108	0,077
Rotor	3,13	3,24	3,53	4,1	4,7
Field	23,5	23,5	23,5	23,5	23,5
Armature	0,79	0,79	0,79	0,79	0,79

Field excitation current i exc (A) - 240 V - 60 Hz
Symbols : "i exc" : excitation current of the exciter field.

LSA 42.2	VS2	S3	S4	M6	L7
No-load	0,26	0,25	0,27	0,28	0,26
At rated load	0,9	0,9	0,91	0,9	0,92

4.7.3 - 3-phase : 4 pole with SHUNT excitation

Resistances at 20 °C (Ω)

LSA 42.2	VS0*	VS2*	S3*	S4*	S5	M6	M7	L9
L/N stator	1,54	0,7	0,53	0,32	0,32	0,2	0,2	0,19
Rotor	1,71	2,1	2,3	2,7	2,7	3,3	3,3	3,7
Field	25,6	25,6	25,6	25,6	25,6	25,6	25,6	25,6
Armature	0,51	0,51	0,51	0,51	0,51	0,51	0,51	0,51

Field excitation current i exc (A) - 400 V - 50 Hz :
Symbols : "i exc" : excitation current of the exciter field

LSA 42.2	VS0*	VS2*	S3*	S4*	S5	M6	M7	L9
No-load	0,5	0,6	0,5	0,6	0,6	0,5	0,5	0,5
At rated load	1,5	1,6	1,65	1,4	1,6	1,3	1,5	1,5

* Lister type machine

4.7.4 - 3-phase : 4 pole with AREP excitation

Resistances at 20°C (Ω) :

LSA 42.2	VS2*	S4	S5	M6	M7	L9
L/N stator	0,76	0,34	0,34	0,22	0,22	0,2
Rotor	2,1	2,7	2,7	3,3	3,3	3,7
Auxil. wind. X1, X2	0,5	0,3	0,3	0,26	0,26	0,23
Auxil. wind. Z1, Z2	0,6	0,5	0,5	0,44	0,44	0,41
Field	6	6	6	6	6	6
Armature	0,5	0,51	0,51	0,51	0,51	0,51

Field excitation current i exc (A) - 400 V - 50 Hz :
Symbols : "i exc" : excitation current of the exciter field

TYPE 42.2	VS2*	S4	S5	M6	M7	L9
No-load	0,9	0,9	0,9	0,8	0,8	0,7
At rated load	2,4	2,1	2,3	2	2,3	2,3

* Lister type machine

4.7.5 - Dedicated single phase : 4 pole with SHUNT excitation

Resistances at 20 °C (Ω)

LSA 42.2	VS2	S3	S5	M7	L9
L/N stator	0,330	0,248	0,147	0,072	0,063
Rotor	2,1	2,3	2,7	3,3	3,7
Field	25,6	25,6	25,6	25,6	25,6
Armature	0,51	0,51	0,51	0,51	0,51

Field excitation current i exc (A) -240 V - 60 Hz
Symbols : "i exc" : excitation current of the exciter field

LSA 42.2	VS2	S3	S5	M7	L9
No-load	0,45	0,43	0,46	0,61	0,62
At rated load	1,21	1,21	1,1	1,05	1,17

5 - SPARE PARTS

5.1 - First maintenance parts

Emergency repair kits are available as an option.
They contain the following items :

No.	Description	Qty	LSA 42.2 - SHUNT 2 & 4 P	Coding
198	Voltage regulator (AVR)	1	R 230	AEM 110 RE 001
343	Diode bridge assembly	1	LSA 411.1.59/60	ESC 025 MD 008
347	Surge suppressor	1	LSA 411.1.17A	CII 411 EQ 017
	AVR fuse	1	250 V - 8 A / slow	

No.	Description	Qty	LSA 42.2 - AREP 4 P	Coding
198	Voltage regulator (AVR)	1	R 438	AEM 110 RE 003
343	Diode bridge assembly	1	LSA 411.1.59/60	ESC 025 MD 008
347	Surge suppressor	1	LSA 411.1.17A	CII 411 EQ 017
	AVR fuse	1	250 V - 8 A / slow	

5.2 - Description of bearings

No.	Description	Qty	LSA 42.2 - 2 & 4 P	Coding
60	D.E. bearing	1	6309 2RS/C3	RLT 045 TN 030
70	N.D.E. bearing	1	6305 2RS/C3	RLT 025 TN 030

5.3 - Technical support service

Our technical support service will be happy to provide any information you require.

When ordering spare parts, you should indicate the complete machine type, its serial number and the information indicated on the nameplate.

Address your enquiry to your usual contact or :

MOTEURS LEROY-SOMER
Usine de Sillac/Alternators
16015 ANGOULEME CEDEX - FRANCE
Tel. : (33) 05.45.64.45.64
Technical support service :
(33) 05.45.64.43.66 - (33) 05.45.64.43.67
(33) 05.45.64.43.68 - (33) 05.45.64.43.69
fax : (33) 05.45.64.43.24
e. mail : sat.sil@leroysomer.com

WARNING

Part numbers should be identified from the exploded views and their description in the parts list.
Our extensive network of "service stations" can dispatch the necessary parts without delay.
To ensure correct operation and the safety of our machines, we recommend the use of original manufacture spare parts.
In the event of failure to comply with this advice, the manufacturer cannot be held responsible for any damage.

LSA 42.2 - 2 & 4 POLE
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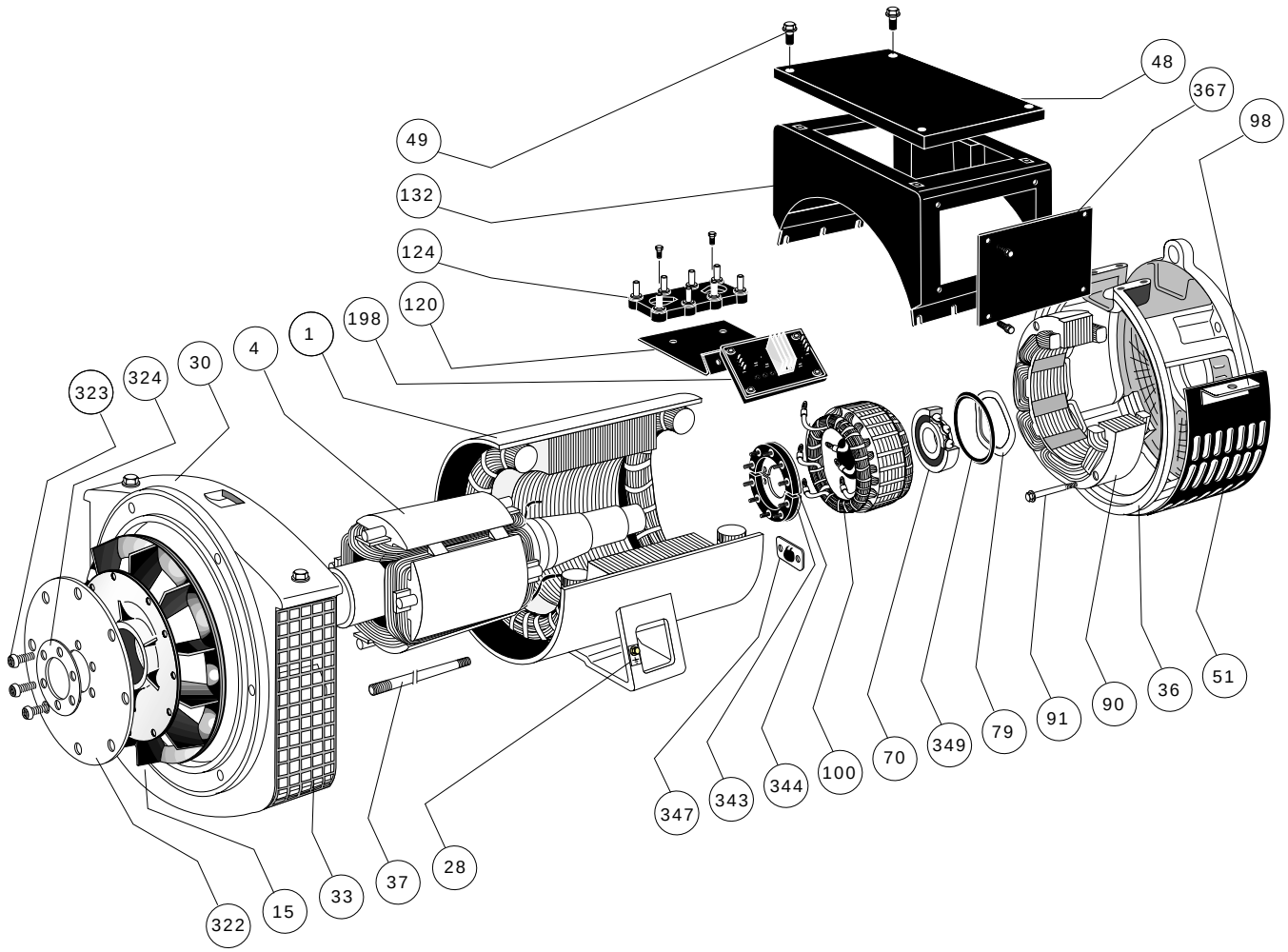
5.4 - Exploded view, parts list

5.4.1 - LSA 42.2 single bearing, AREP or SHUNT



No.	Nbr.	Description	No.	Nbr.	Description
1	1	Stator assembly	98	3	Corner plate
4	1	Rotor assembly	100	1	Exciter armature
15	1	Fan	120	1	Terminal plate support (AREP)
28	1	Earth terminal	124	1	Terminal plate
30	1	DE flange	132	1	Terminal box
33	1	Air outlet grille	198	1	Regulator (AVR)
36	1	N.D.E. bracket	322	1	Coupling disc
37	4	Tie rod	323	6	Fixing screw
48	1	Terminal box lid	324	1	Clamping washer
49	20	Terminal box fixing screw	343	1	Direct diode assembly
51	1	Air intake grille	344	1	Reverse diode assembly
70	1	NDE bearing	347	1	Surge suppressor
79	1	Preloading wavy washer	367	2	Inspection door
90	1	Wound exciter field	349	1	O ring seal
91	4	Field fixing screw			

LSA 42.2 - 2 & 4 POLE
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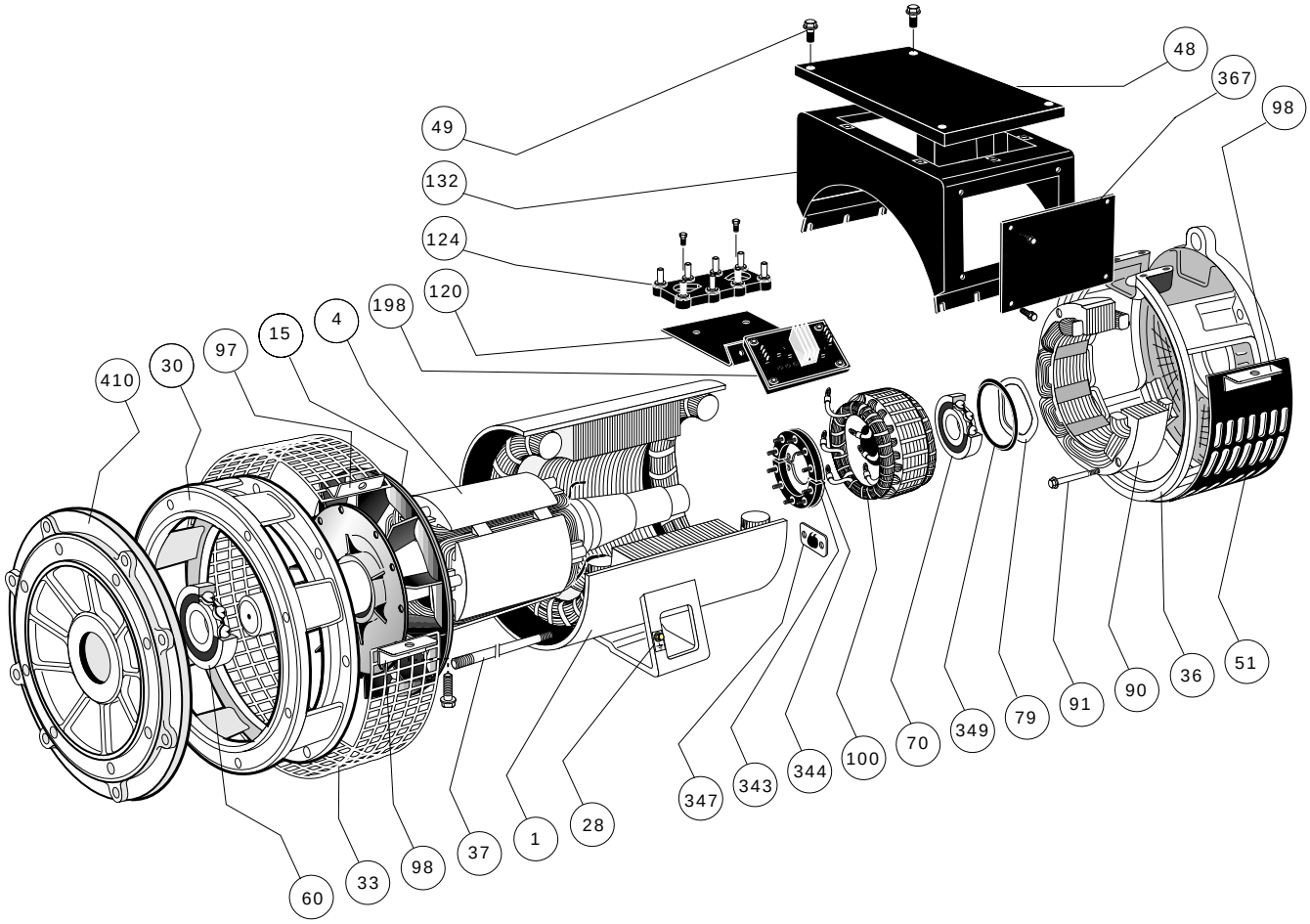
5.4.2 - LSA 42.2 two-bearing, AREP or SHUNT



No.	Nbr.	Description	No.	Nbr.	Description
1	1	Stator assembly	91	4	Field fixing screw
4	1	Rotor assembly	97	1	Corner plate male
15	1	Fan	98	3	Corner plate
28	1	Earth terminal	100	1	Exciter armature
30	1	DE flange	120	1	Terminal plate support (AREP)
33	1	Air outlet grille	124	1	Terminal plate
36	1	N.D.E. bracket	132	1	Terminal box
37	4	Tie rod	198	6	Regulator (AVR)
48	1	Terminal box lid	343	1	Direct diode assembly
49	20	Terminal box fixing screw	344	1	Reverse diode assembly
51	1	Air intake grille	347	1	Surge suppressor
60	1	DE bearing	367	2	Inspection door
70	1	NDE bearing	349	1	O ring seal
79	1	Preloading wavy washer	410	1	DE flange
90	4	Wound exciter field			

MOTEURS LEROY-SOMER 16015 ANGOULÊME CEDEX - FRANCE

RCS ANGOULÊME N° B 671 820 223
S.A. au capital de 131 910 700 F

http://www.leroy-somer.com