OPERATOR'S MANUAL

GENERATOR

G20, G20QS, G20S, G27, G27QS, G27S, G33, G33QS, G33S, G34QS, G40, G40QS, G40S, G41QS, G45, G45QS, G45S

EN - 9831/0650 ISSUE 3 - 11/2017

THIS MANUAL SHOULD ALWAYS STAY WITH THE MACHINE

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EN - 9831/0650 - ISSUE 3 - 11/2017

This manual contains original instructions, verified by the manufacturer (or their authorized representative).

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Foreword

The Operator's Manual

⚠

You and others can be killed or seriously injured if you operate or maintain the machine without first studying the Operator's Manual. You must understand and follow the instructions in the Operator's Manual. If you do not understand anything, ask your employer or JCB dealer to explain it.

Do not operate the machine without an Operator's Manual, or if there is anything on the machine you do not understand.

Treat the Operator's Manual as part of the machine. Keep it clean and in good condition. Replace the Operator's Manual immediately if it is lost, damaged or becomes unreadable.

Machine Delivery and Installation

Even if you have operated this type of equipment before, it is very important that your new machines operations and functions are explained to you by a JCB Dealer Representative following delivery of your new machine.

Following the installation you will know how to gain maximum productivity and performance from your new product.

Please contact your local JCB dealer if the Installation Form (included in this manual) has not yet been completed with you.

Your local JCB Dealer is

Notes:

Contents **Page No.**

Acronyms Glossary

CAN	Controller Area Network
CCV	Crankcase Ventilation
ECM	Engine Control Module
ECU	Electronic Control Unit
FEAD	Front End Accessory Drive
HPV	High Pressure Valve
LCD	Liquid Crystal Display
LED	Light Emitting Diode
PIN	Product Identification Number
RPM	Revolutions Per Minute
SAE	Society of Automotive Engineers
USB	Universal Serial Bus

Notes:

Introduction
About this Manual

Model and Serial Number

This manual provides information for the following model(s) in the JCB machine range:

Model	From:	To:
G20	2288985	2298985
G20QS	2288985	2298985
G20S	2288985	2298985
G27	2288985	2298985
G27QS	2288985	2298985
G27S	2288985	2298985
G33	2288985	2298985
G33QS	2288985	2298985
G33S	2288985	2298985
G34QS	2288985	2298985
G40	2288985	2298985
G40QS	2288985	2298985
G40S	2288985	2298985
G41QS	2288985	2298985
G45	2288985	2298985
G45QS	2288985	2298985
G45S	2288985	2298985

Using the Manual

This operator's manual is arranged to give you a good understanding of the machine and its safe operation. It also contains maintenance and technical data.

Read this manual from the front to the back before you use the machine for the first time, even if you have used machines of a similar/same type before as the technical specification, systems and controls of the machine may have changed. Particular attention must be given to all the safety aspects of operating and maintaining the machine.

If there is anything you are not sure about, ask your JCB dealer or employer. Do not guess, you or others could be killed or seriously injured.

The general and specific warnings in this section are repeated throughout the manual. Read all the safety statements regularly, so you do not forget them. Remember that the best operators are the safest operators.

The illustrations in this manual are for guidance only. Where the machines are different, the text and or the illustration will specify.

The manufacturer's policy is one of continuous improvement. The right to change the specification of the machine without notice is reserved. No responsibility will be accepted for discrepancies which may occur between specifications of the machine and the descriptions contained in this manual.

All of the optional equipment included in this manual may not be available in all territories

Left-Hand Side, Right-Hand Side

References to the left side and right side of the engine are when view from the flywheel end of the engine.

Cross References

In this manual, cross references are made by presenting the subject title in blue (electronic copy only). The number of the page upon which the subject begins is indicated within the brackets. For example: Refer to: Cross References (Page 2).

Safety

Safety - Yours and Others

All machinery can be hazardous. When a machine is correctly operated and maintained, it is a safe machine to work with. When it is carelessly operated or poorly maintained it can become a danger to you (the operator) and others.

In this manual and on the machine you will find warning messages, you must read and understand them. They inform you of potential hazards and how to avoid them. If you do not fully understand the warning messages, ask your employer or JCB dealer to explain them.

Safety is not just a matter of responding to the warnings. All the time you are working on or with the machine you must be thinking of what hazards there might be and how to avoid them.

Do not work with the machine until you are sure that you can control it.

Do not start any work until you are sure that you and those around you will be safe.

If you are not sure of anything, about the machine or the work, ask someone who knows. Do not assume anything.

Remember:

- Be careful
- Be alert
- Be safe.

Safety Warnings

In this manual there are safety notices. Each notice starts with a signal word. The signal word meanings are given below.

The signal word 'DANGER' indicates a hazardous situation which, if not avoided, will result in death or serious injury.

The signal word 'WARNING' indicates a hazardous situation which, if not avoided, could result in death or serious injury.

The signal word 'CAUTION' indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

The signal word 'Notice' indicates a hazardous situation which, if not avoided, could result in machine damage.

The safety alert system symbol (shown) also helps to identify important safety messages in this manual. When you see this symbol your safety is involved, carefully read the message that follows.

Figure 1. The safety alert system symbol

General Safety

The following safety checklist is intended to help remind you of safety procedures and practices.

Safety is Your Responsibility

You must also refer to local regulations in the country your equipment is being used in. Some of the information may be repeated in the following warnings and cautions pages and in the main text.

- Do not change the application or specification of the engine. Install the engine in accordance with recommendations made in the Engine Installation Manual. – Do not lift heavy objects on your own, use lifting equipment or obtain the help of an assistant.
- Do not smoke when adding fuel to the tank or working in the engine bay area.
- Always clean up spilt fluids, dispose of fluids, contaminated material etc. in accordance with local regulations. Do not pollute drains or the ground. – Use the right tools for the job. – Always make the equipment safe before completing any maintenance tasks, for instance disconnect the battery so that the engine can not be started.
- Allow engine components to cool before attempting any maintenance tasks, components such as the exhaust can become extremely hot.
- Do not adjust the engine, or add fuel, oil whilst it is running unless procedures in this manual instruct you to do so.
- Do not siphon fluids by mouth.
- Operate the engine in well ventilated areas, if using indoors then a purpose designed exhaust fume extraction unit may be needed. – Keep other people at a safe distance when operating the engine or equipment.
- Do not operate an engine if the safety guard (when applicable) has been removed.
- Vapours from solvents, thinners and adhesives can be high flammable. In addition to fire risk, they can be toxic and in certain conditions cause unconsciousness, or death if inhaled. Use these items in well ventilated areas.
- Seek medical advice immediately if your skin contacts high pressure fuel.
- Make sure the engine is operated by one person correctly positioned at the controls.
- Do not operate the engine at high speeds with no load applied.
- Make sure you have adequate fire fighting equipment in your workshop, repair area. Contact your local fire prevention officer for advice.
- Turbocharger impeller blades operate at extremely high revolutions and the turbocharger unit becomes very hot. Allow the unit to cool before completing any maintenance. Keep tools and objects away from the impeller when the unit is operating.
- Use only JCB recommended parts. These parts have been designed to give the engine its optimum performance. Using spurious parts may affect the integrity of the engine.

About the Product
Introduction

Name and Address of the Manufacturer

JCB Power Products Limited, 23/7, Mathura Road, Ballabgarh-121004, Haryana.

Product Compliance

Your JCB product was designed to comply with the laws and regulations applicable at the time of its manufacture for the market in which it was first sold. In many markets, laws and regulations exist that require the owner to maintain the product at a level of compliance relevant to the product when first produced. Even in the absence of defined requirements for the product owner, JCB recommend that the product compliance be maintained to ensure safety of the operator and exposed persons and to ensure the correct environmental performance. Your product must not be altered in any way which could affect or invalidate any of these requirements. For advice consult your JCB dealer.

For its compliance as a new product, your JCB and some of its components may bear approval numbers and marking's, and may have been supplied with a Declaration/Certificate of Conformity. These marking's and documents are relevant only for the country/region in which the product was first sold to the extent that the laws and regulations required them.

Re-sales and import/export of products across territories with different laws and regulations can cause new requirements to become relevant for which the product was not originally designed or specified. In some cases, pre owned products irrespective of their age are considered new for the purposes of compliance and may be required to meet the latest requirements which could present an insurmountable barrier to their sale/use.

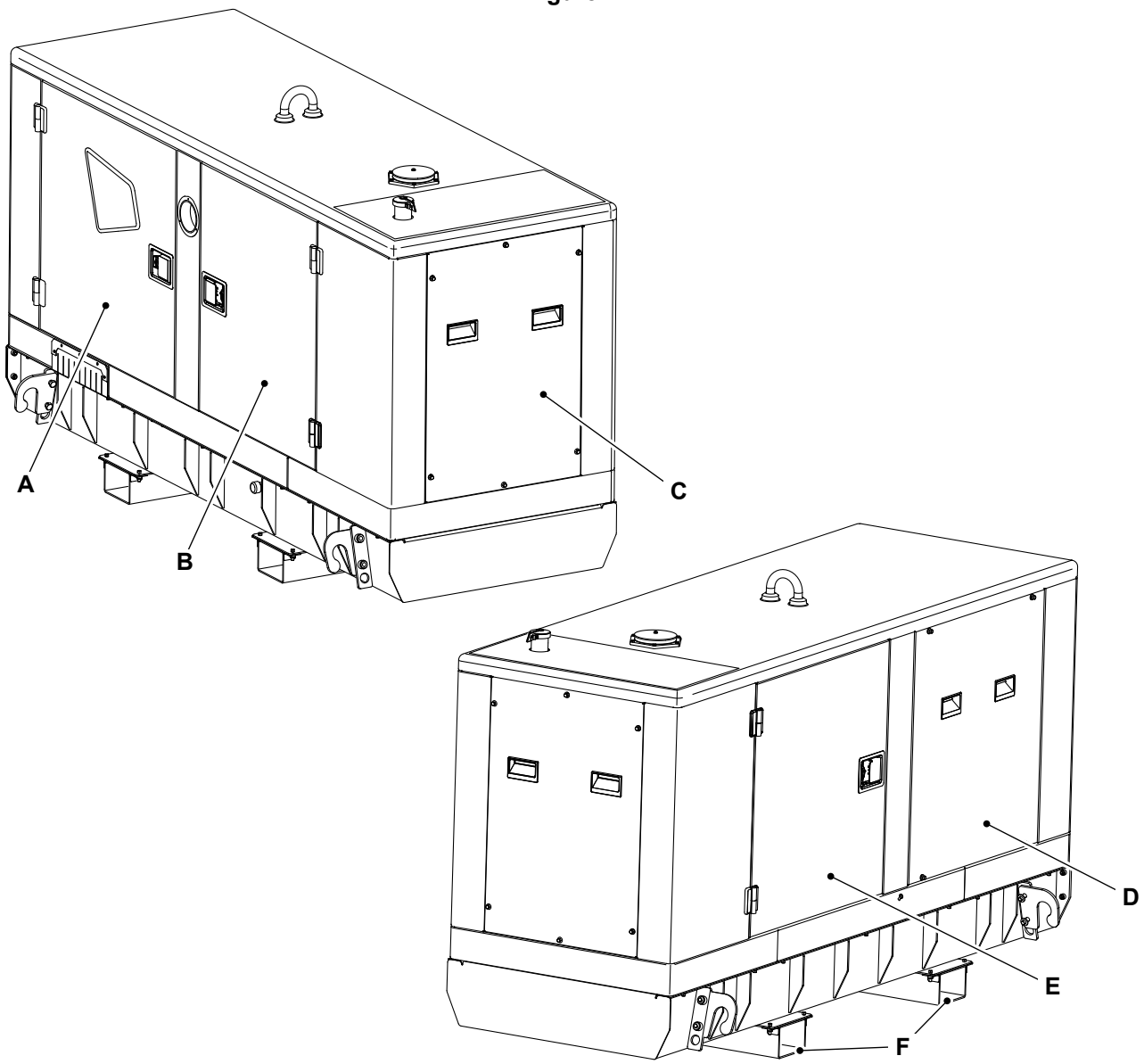
Despite the presence of any compliance related marking's on the product and components, you should not assume that compliance in a new market will be possible. In many cases it is the person responsible for import of a pre owned product into a market that becomes responsible for compliance and who is also considered the manufacturer.

JCB may be unable to support any product compliance related enquiry for a product which has been moved out of the legislative country/region where it was first sold, and in particular where a product specification change or additional certification would have been required in order for the product to be in compliance.

Description

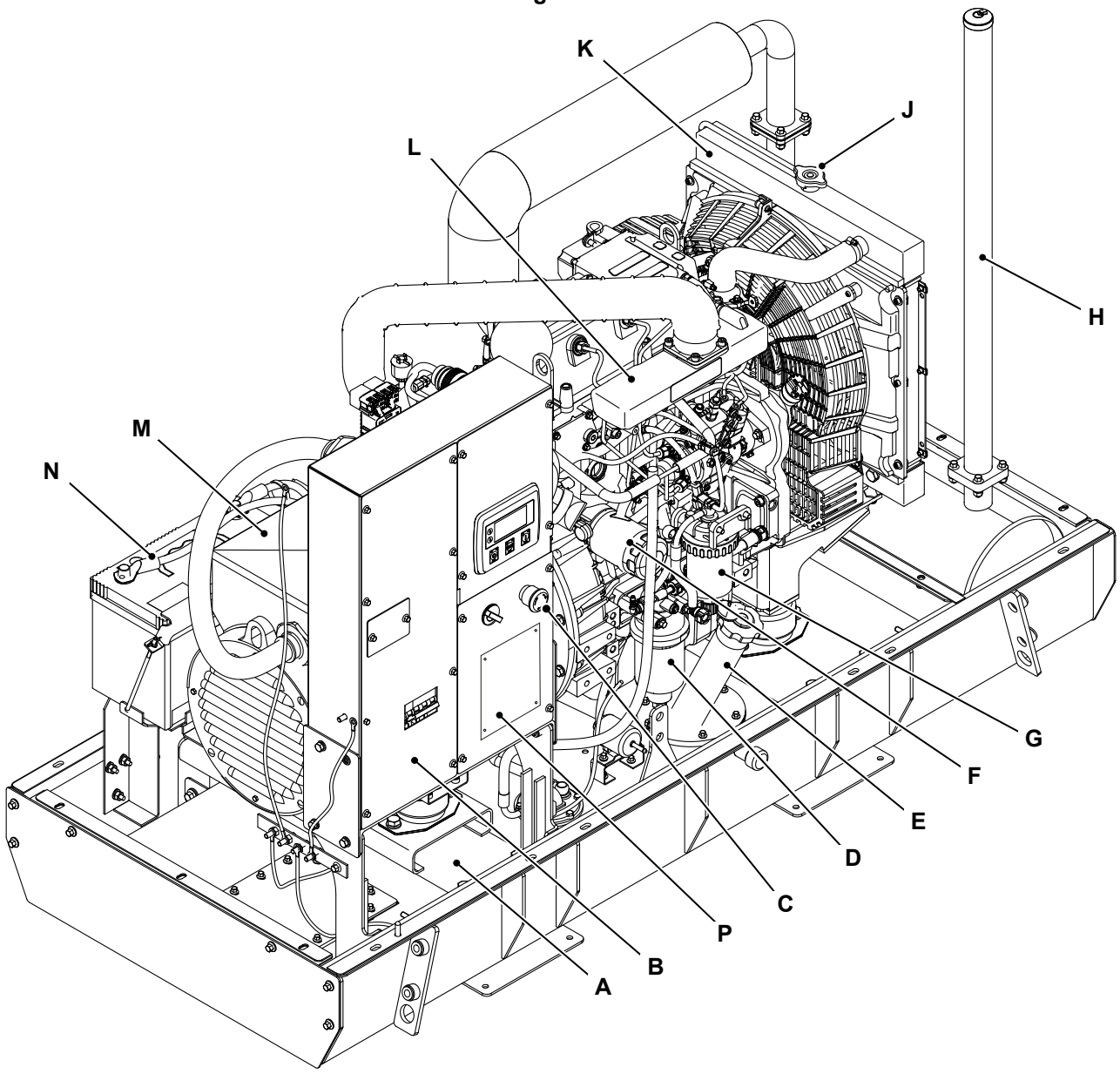
Main Component Locations

Figure 2.



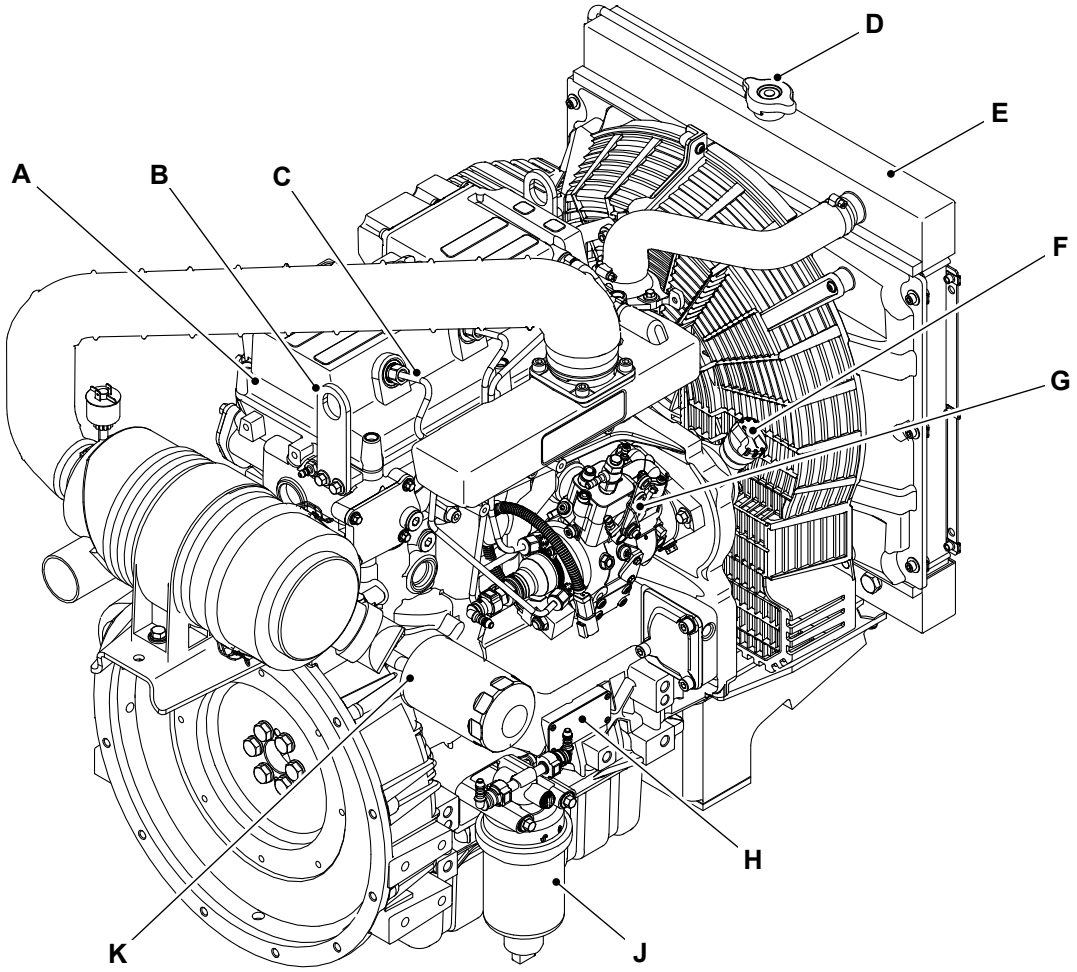
A Access door for the control panel
B Access door for engine and radiator
C Access panel for exhaust muffler
D Access door for alternator
E Access door for battery
F Forklift pockets

Figure 3.



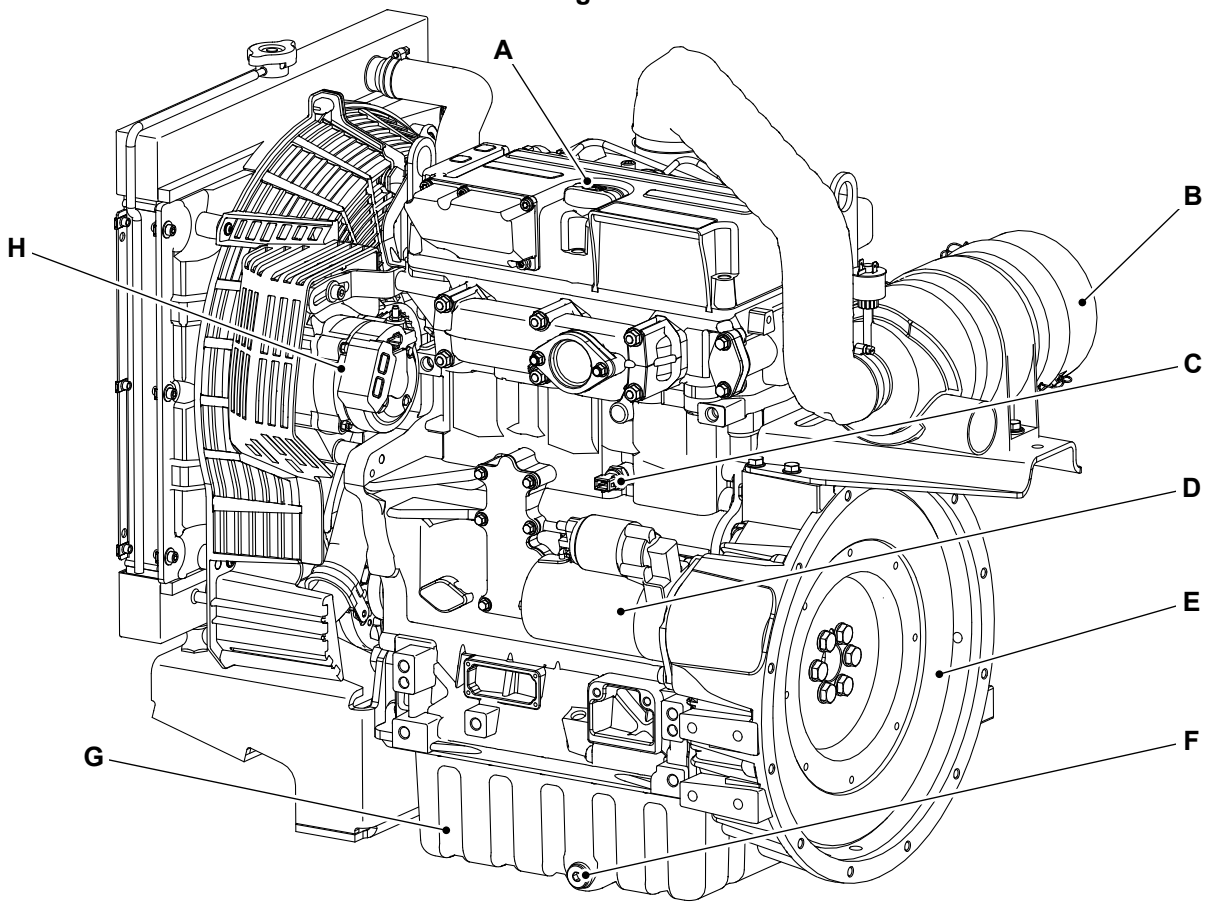
A Fuel tank
B Control panel
C Emergency stop
D Fuel filter/water separator
E Fuel tank filler neck
F Engine oil filter
G Water separator
H Exhaust silencer
J Radiator cap
K Radiator
L Inlet manifold
M Automatic voltage regulator
N Battery
P Data plate

Figure 4.



A Rocker cover
B Lifting eye
C Fuel injectors
D Radiator cap
E Radiator
F Oil filler cap
G High pressure pump
H ECU (Electronic Control Unit)
J Fuel filter/water separator
K Oil filter

Figure 5.



A Oil filter cap
B Air filter
C Oil pressure sensor
D Starter motor assembly
E Fly wheel housing
F Oil drain plug (sump)
G Oil sump
H Alternator

Product and Component Identification

General

The data plate details the model designation, rating, fuel type, weight, year of manufacture, output rating and other generating set specific information. The data plate is normally located on the right hand side of the alternator terminal box (looking at the alternator end of the generator). The generator model designation can be used to determine the version of generating set.

Figure 6. Example Identification Plate

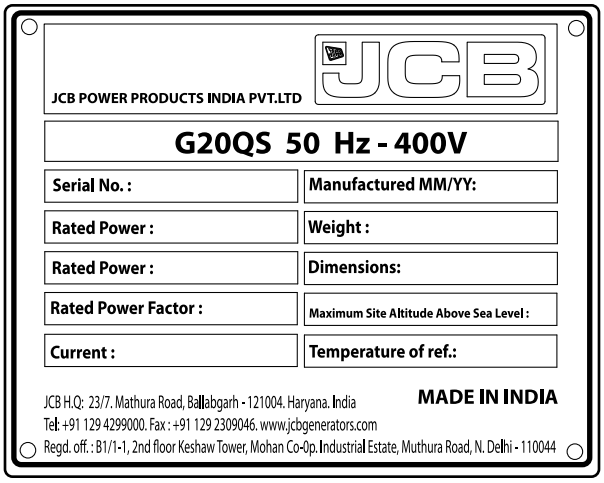
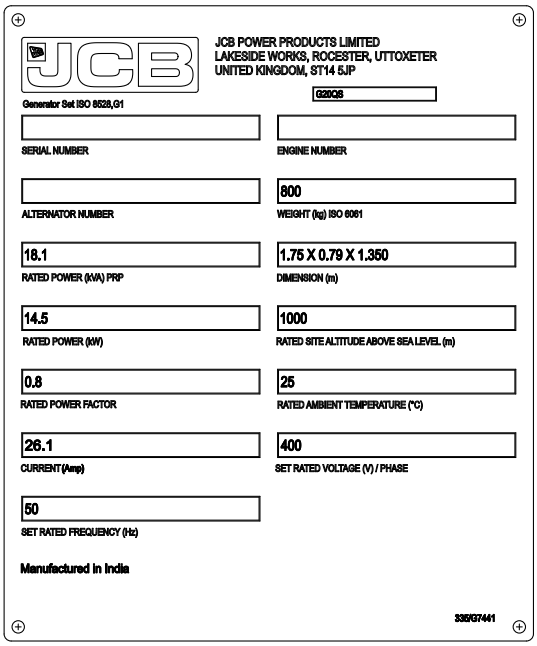


Figure 7. Example Identification Plate

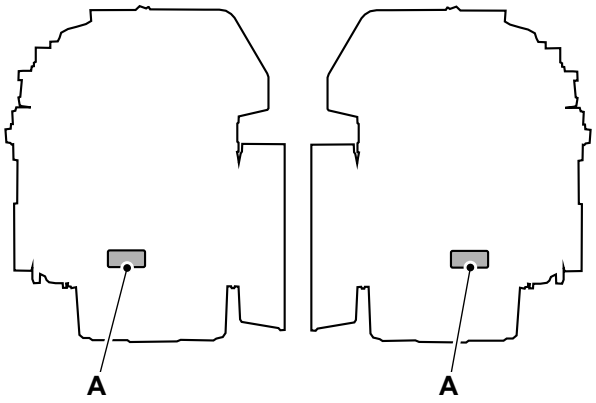


Engine

The engine data labels are attached to the cylinder block as shown. Refer to Figure 8.

The data label includes the engine identification number.

Figure 8.



A Engine data label

Safety Labels

General

⚠ **WARNING** Safety labels on the machine warn you of particular hazards. You can be injured if you do not obey the safety instructions shown.

The safety labels are strategically placed around the machine to remind you of possible hazards.

If you need eye-glasses for reading, make sure you wear them when reading the safety labels. Do not over-stretch or put yourself in dangerous positions to read the safety labels. If you do not understand the hazard shown on the safety label, then refer to Safety Label Identification.

Keep all of the safety labels clean and readable. Replace a lost or damaged safety label. Make sure the replacement parts include the safety labels where necessary. Each safety label has a part number printed on it, use this number to order a new safety label from your JCB dealer.

Safety Label Identification

Figure 9.

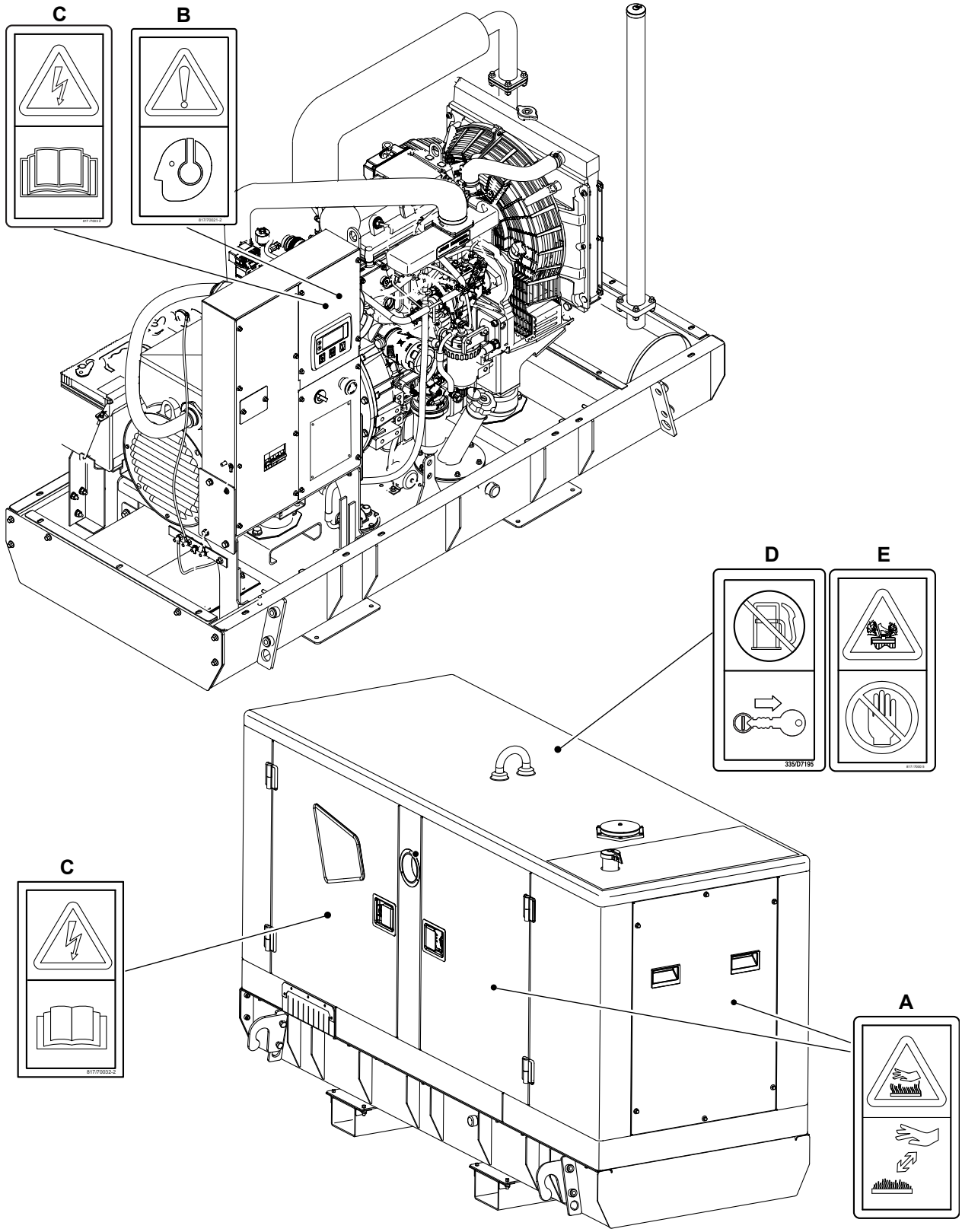


Table 1. Safety Labels

Item	Part No.	Description	Qty.
A	335/D7133	Hot surfaces. Remove the ignition key and refer to the operator's manual and service manual.	2
B	817/70021	Noise warning. Wear ear protection.	2
C	335/D7145	Risk of electrocution. Read the operator's manual before you operate the machine.	3
D	334/D7195	Do not refuel while the machine is running.	2
D	335/D7146	Do not refuel while the machine is running.	2
E	335/D8867	Pressure hazard.	1

Installation and Removal

Installation

Site Installation

The generating set should be located on suitable foundations. A level concrete surface designed to carry the weight of the generating set is ideal (if unsure contact a structural engineer). All electrical and fuel ducting to and from the machine should be professionally installed. All wiring to the terminal box, and through other panels should be installed using the appropriate cable glands.

The generating set should be located to provide suitable access for regular maintenance, servicing and repair work.

The generating set should only be lifted using the designed single point lift bracket if installed, or the lifting points in the base utilising certified lifting equipment with spreaders. Do not lift the unit by the alternator or engine lifting eyes. These are designed only to carry the weight of the specific unit (engine or alternator) and not for the weight of the fully assembled generating set.

Remote Fuel Tank Installation

If a remote fuel tank is used to supply fuel to the generator this must be located in close proximity to the generator. If the tank is installed significantly below the level of the generator, or if long and/or narrow bore hoses are used for the fuel feed hose then fuel starvation may result. This is identified by decreased power and excessive smoke.

If the remote tank is installed above the level of the generator this will restrict the fuel return system and overload the fuel injection equipment, this may cause significant damage to the engine fuel system.

Care must be taken when connecting a remote tank. All connections must be securely attached and fully sealed. Air ingress caused by poor connections can cause significant damage to the fuel injection pump on the engine and normally results in engine hunting and smoking.

The back pressure in any installed system must be checked to be within limits for the generator otherwise it could result in damage to the unit.

Electrical installation should be carried out in accordance with JCB schematics supplied with the specific generating system and by suitably qualified personnel only. If in doubt about any aspect of installation contact your JCB dealer.

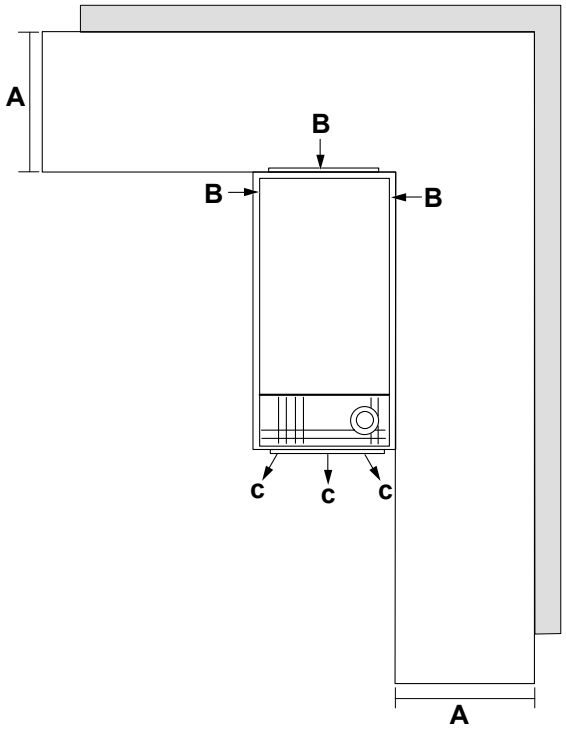
Outdoor Installations

Generator sets which are installed outdoors (excluding soundproof sets, that are intended for such applications), must be located in a place which is protected against weather conditions, dust, etc. as much as possible.

For temporary installations, the generator set can rest on a well-levelled surface. For long-term installations, it is advisable to build a concrete base.

Adequate airflow is critical to the correct operation of the generating set. Outdoor installation should allow for suitable clearance between air inlets and outlets to maintain the correct ventilation. As a guideline when installing a containerised set outdoors maintain a clearance of at least 1.5m around the unit. This is for guidance only. For more detailed information contact your JCB dealer. It is also important to note that placing the unit close to solid surfaces e.g. concrete walls may cause an increase in noise and cooling problems.

Figure 10.



A Distance from wall = 1,500mm
B Air inlet
C Air outlet

Indoor installations

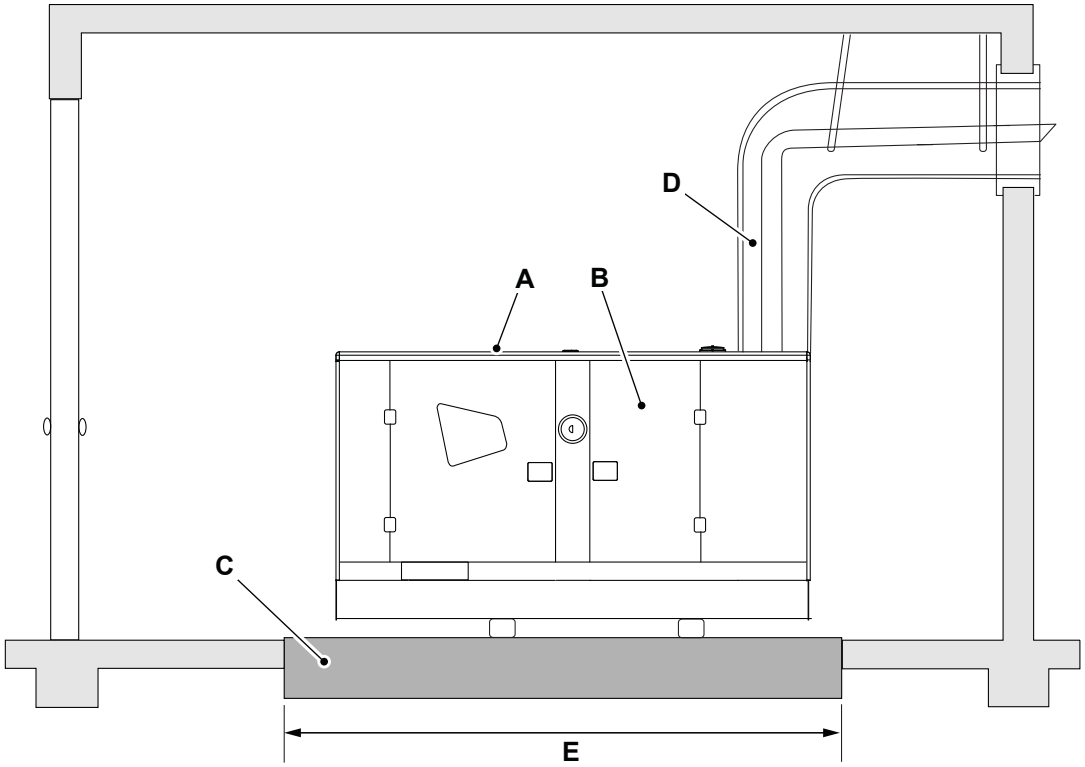
Generator Set Room

For the correct installation of a generator set in closed premises, the size of the room must allow:

- The regular operation of the generator set.
- Easy access to its components for maintenance and possible repairs.
- The possibility of installing the generator set using the available means of transport. The door through which the generator set is brought in must be central, so that the set remains centred once it is inside, and there is no need to move it to facilitate access.
- The existence of apertures that allow oil replacement.
- The installation of the exhaust pipe with the minimum possible number of pipe elbows.
- The layout of the control panel (if an automatic set) to be in a position that allows the operator to have complete visibility over the instruments when operating it.
- Air vents to allow cool air inside and ducting to direct hot air out of the room.

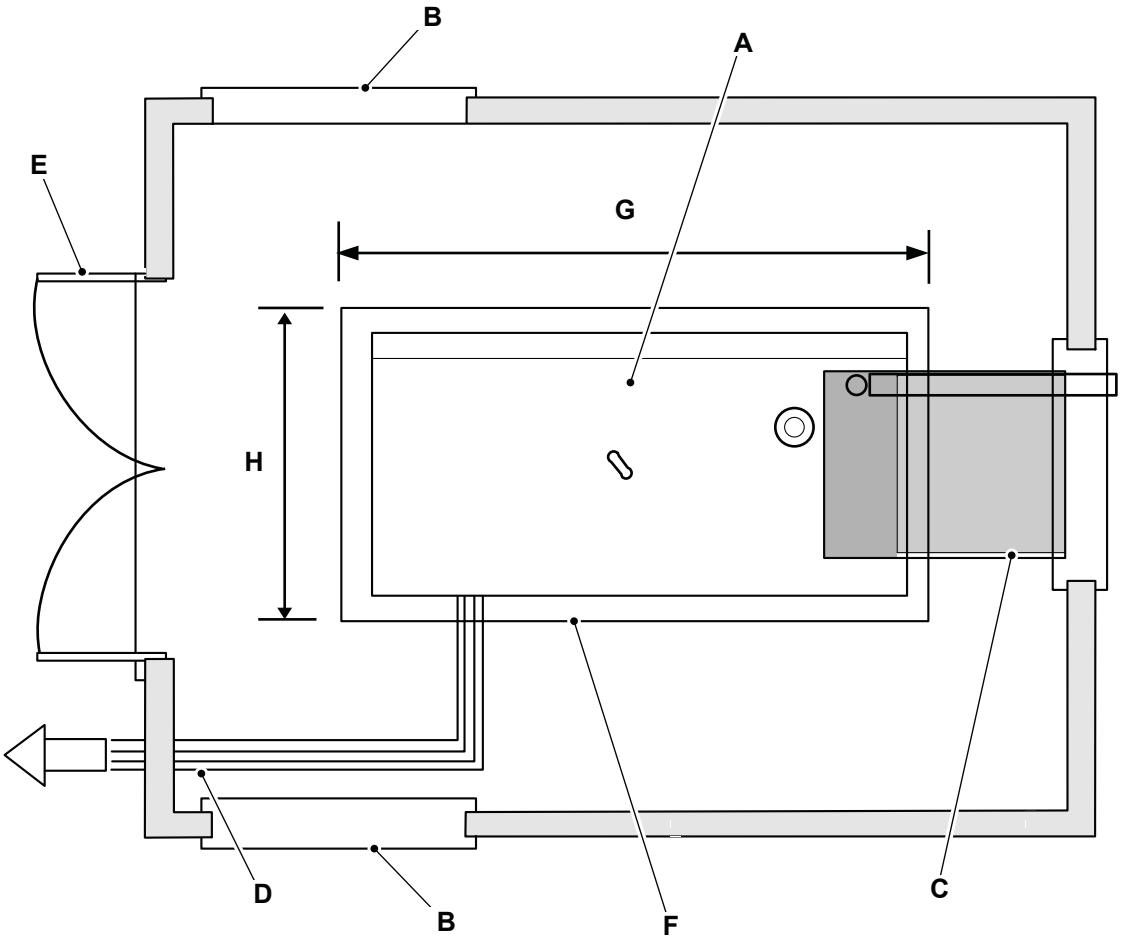
Recommended Room Dimensions

Figure 11. Static Soundproof Generator Set - Side View



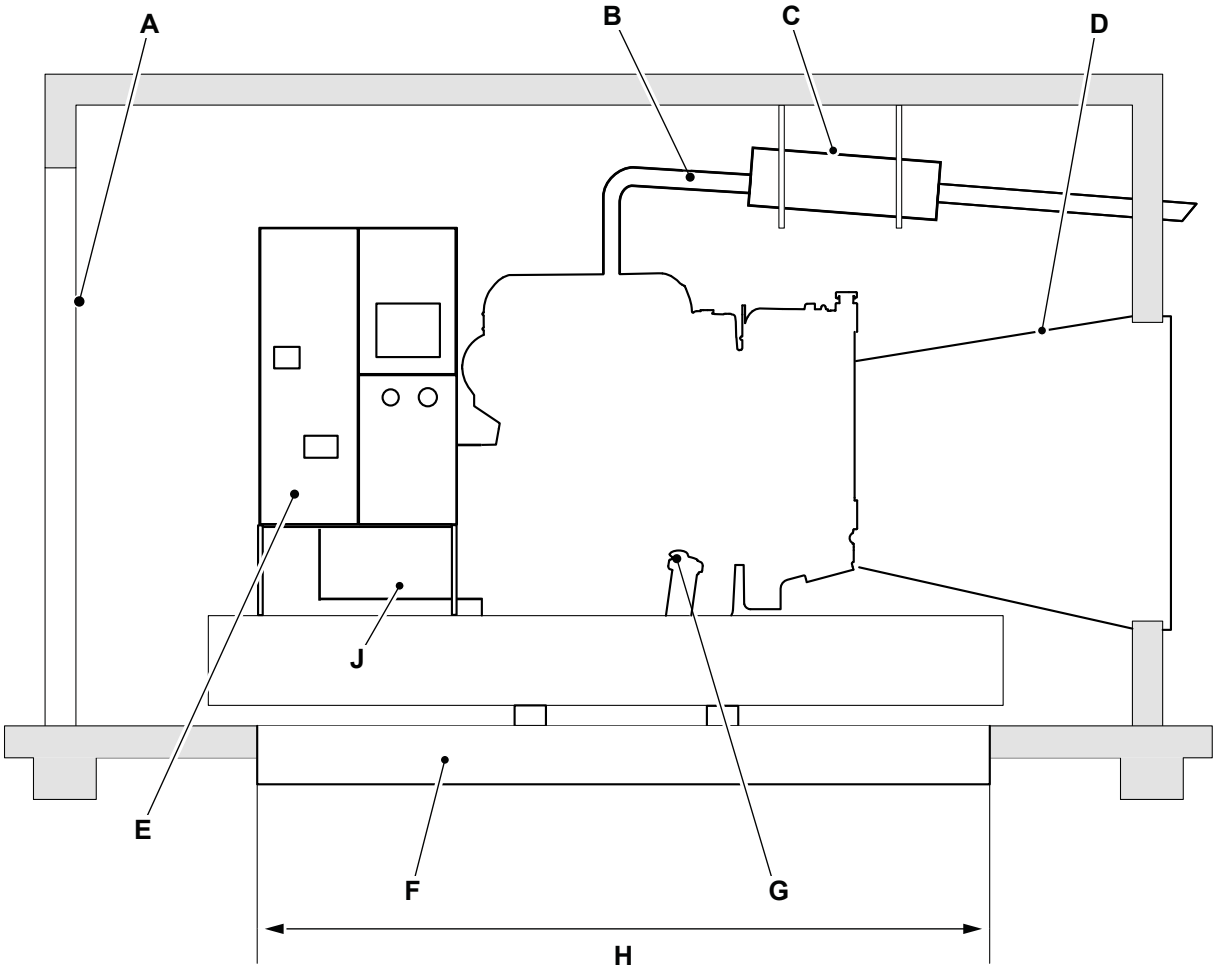
A Generator set
B Access door
C Concrete base
D Exhaust and hot air outlet duct
E Generator length + 200mm

Figure 12. Static Soundproof Generator Set - Plan View



A Generator set
B Air inlet grill
C Exhaust and hot air outlet duct
D Cable Conduit
E Access door
F Concrete base
G Generator length + 200mm
H Generator width + 200mm

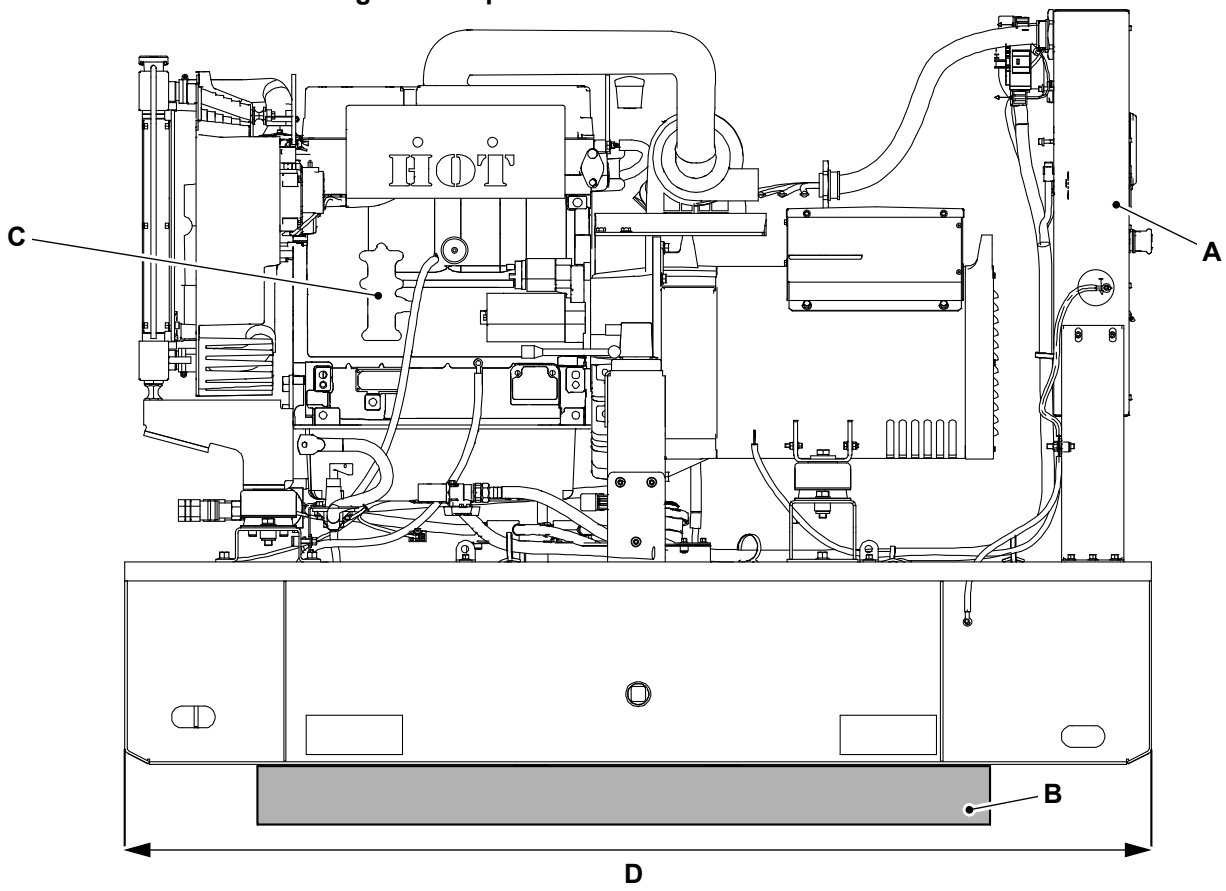
Figure 13. Canopy Delete Set - Side View



A Access door
B Exhaust pipe
C Exhaust silencer
D Hot air outlet ducts
E Control panel
F Concrete base
G Generator set
H Generator length + 200mm
J Alternator

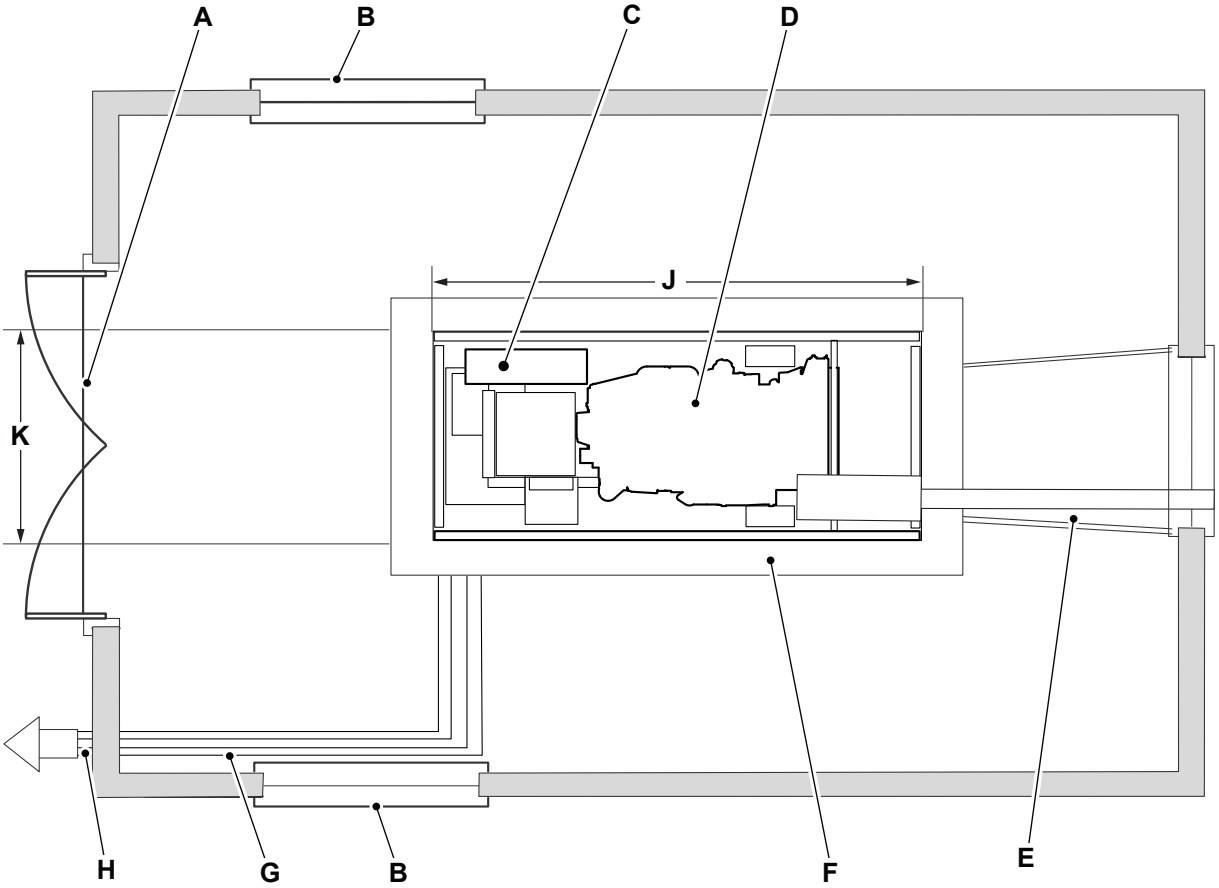
The above figure shows a typical exhaust mounting arrangement. Operator can modified the exhaust mounting arrangement as per their requirement.

Figure 14. Open Generator Set- Side View



A Control panel
B Concrete base
C Generator set
D Generator over all length

Figure 15. Open Generator Set - Plan View



A Access door
B Air inlet grille
C Control panel
D Generator set
E Hot air outlet duct
F Concrete base
G Cable conduit
H Cable exit
J Generator length + 200mm
K Generator width + 200mm

Basic Elements to be Considered

- Foundations
- Exhaust installations
- Ventilation
- Fuel installation
- Electrical connections
- Grounding
- Heating

Foundations

Foundations must prevent the transmission of vibrations and noise to other parts of the building.

The surface on which the set will be placed must be levelled in order to allow its correct operation.

Exhaust Installation

The pipes must evacuate the gases to those areas where they cause no danger or damage, and must end with a protection cap to protect them from water entry.

The connection between the engine's manifold (or the turbocharger) and the pipe must be made a section of flexible tube, to absorb thermal expansion and vibration.

Ventilation

Adequate ventilation is essential for correct operation and durability of the generator set.

The generator set room must:

- Allow the heat produced by operation of the generator to be dissipated by radiation and convection.
- Provide sufficient air flow for engine combustion and cooling.
- Provide adequate air for the health and safety of the operator.

Heating

To ensure quick starting of automatic starting generator sets, the engine room temperature must be maintained above 10–15°C (50.0–59.0°F).

Electric heaters with thermostatic controls ranging from 500W to 1,500W are available for cold climates.

Where necessary, battery chargers and heaters should be connected to a voltage supply.

Fuel Supply System

The generator set is supplied with an integral fuel supply system with a fuel tank located on the bed plate.

The fuel tank is connected to the engine by flexible pipework suitable for normal operating conditions.

In especially arduous conditions a separate fuel tank may be required. This must be connected to the engine using suitable pipework to ensure that the fuel injection pump can draw fuel correctly.

Electrical Connections

The generator set cables must be correctly connected as shown on the electrical schematics.

Grounding

Metal parts that may be exposed to human contact must be connected to ground.

Suitable protective conductor connections should be made in accordance with local regulations.

Operating Generators in Extreme Cold Climates

When the JCB Generator is operated in extreme cold climates, care must be taken to prevent the operating temperature of the engine decreasing below a level that will result in the incorrect operation of the engine components. Additional care must be taken to prevent the engine components from freezing or failing to operate.

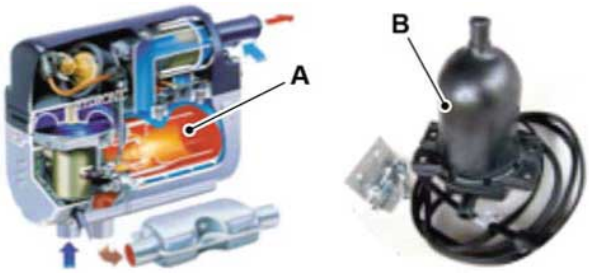
Table 2.

Operating ambient temperature	Manifold air grid heater	Cold start advance	Engine oil	Fuel	Battery
0°C (32.0°F) to -15°C (59.0°F)	No	120s	10W-40 or API CH-4	Winter	100Ah 800CCA SAE (Society of Automotive Engineers)
-16°C (60.8°F) to -25°C (77.0°F)	550W	120s	5W-40 or API CH-4	Arctic	110Ah 950CCA SAE
Below -25°C (77.0°F)	550W	120s	0W-30 or API CH-4	Arctic	120Ah 1000CCA SAE

Cold Start

For a temperature range between 0°C (32.0°F) to -15°C (59.0°F), the standard QS canopy generator will enable the engine to crank at sufficient speed for cold starting with the standard 10w-40 engine oil. At this temperature, the grid heater is not required on the engine. but starting can be aided with the use of the coolant heater installed on the generator.

Figure 16.



A Coolant heater - Diesel fuelled **B** Coolant heater - Electrically operated (Optional)

If the generator is to be cold started in temperature between -15°C (59.0°F) to -25°C (77.0°F), the engine will require a block heater and an oil of at least 5w40. The alternators and control panels should be installed with anti-condensation heaters. The canopy heaters should also be used based on the generator application. Alternative engine block heaters may be required if an auxiliary power supply is not available.

Temperatures below -25°C (77.0°F) are considered as Extreme operating conditions. At this temperatures, the standard QS generator will need special measures and additional modifications to protect the engine and engine components from freezing or failing to operate. The additional modifications are completed by specialist companies, usually located locally in the region, who have local experience and knowledge of these cold climate issues.

Cold Running

The engine is designed to operate at temperatures between 0°C (32.0°F) to -15°C (59.0°F) when the engine is filled with standard 10w40 oil.

For generators and engines operating in temperatures between -15°C (59.0°F) to -25°C (77.0°F) an appropriate oil grade such as 5x40 and a coolant mixture of minimum 40% anti-freeze must be used.

For generators and engines operating in temperatures below -25°C (77.0°F), the engine would need a block heater to start. At these operating temperatures the machine would need special modifications to operate correctly. The additional modifications are completed by specialist companies, usually located locally in the region, who have local experience and knowledge of these cold climate issues.

To give optimum running performance special attention should be given to correct oils and coolants. Use of correct fuel specification and heaters on fuel tank, fuel line, CCV (Crankcase Ventilation) and air intake hose will improve the performance.

Generator loads must also be considered when operating at extreme cold temperatures. Light loads will increase the risk of engines producing more water vapour. If the engine is not sufficiently hot to burn off the vapour in extreme cold climates this will lead to freezing within the CCV breather systems.

Important Notes

If the generator is operated in the cold weather climates without special protective measures it may lead to the following consequential issues:

1. If the generators are operated in extremely cold climates without the above measures being implemented, the machine could suffer from reduced service life or even catastrophic mechanical and electrical component failures.

2. Use of incorrect specification of engine oil, will result in vital bearing faces of the engine not being lubricated and would cause overheating, scoring and even seizure.

3. Use of incorrect fuel will cause the fuel to wax/thicken. This will block filter elements and increase wear in the fuel injection pump and injection systems. At extremely low temperatures trace heating may also be required to prevent the fuel from thickening and waxing.
4. If the engine block heater is not used then the engine may have problems in cold starting. Combined with incorrect coolant mixture will lead to cracks and damage to the engine crankcase or cylinder head due to freezing of the water mixture.
5. Freezing of the condensate within the CCV filter and breather pipe may also occur if the combined extremely low ambient temperature and subsequent air flow wind speed reduce the temperature around the components to a level that the condensate freezes. Moderating the airflow using actuated louvers on the air intake and raising the under canopy temperature helps prevent freezing.
6. For the main alternator, if Anti Condensation Heaters (ACH) are not installed, then in cold climates condensation can form on the windings and electronic AVR boards.
7. This condensation can cause tracking and short circuits of components and subsequent failure. The same can happen inside the control panel and related circuits.
8. To prevent condensation on the alternator and control panel, an Anti Condensation Heater (ACH)/auxiliary canopy heater may be required.
9. Failure to protect the batteries from the cold climate can also cause premature discharge of the battery voltage and give problems with the engine cranking speed.

Operating Safety

General

Care and Alertness

All the time you are working with or on the machine, take care and stay alert. Always be careful. Always be alert for hazards.

Clothing

You can be injured if you do not wear the correct clothing. Loose clothing can get caught in the machinery. Keep cuffs fastened. Do not wear a necktie or scarf. Keep long hair restrained. Remove rings, watches and personal jewellery.

Lifting Equipment

You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job. Make sure that lifting equipment is in good condition and complies with all local regulations.

Training

Make sure that you have had adequate training and that you are confident in your ability to operate the machine safely before you use it. Practice using the machine and its attachments until you are completely familiar with the controls and what they do. With a careful, well trained and experienced operator, your machine is a safe and efficient machine. With an inexperienced or careless operator, it can be dangerous. Do not put your life, or the lives of others, at risk by using the machine irresponsibly. Before you start to work, tell your colleagues what you will be doing and where you will be working. On a busy site, use a signalman.

Before doing any job not covered in this manual, find out the correct procedure. Your local JCB distributor will be glad to advise you.

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

Communications

Bad communications can cause accidents. Keep people around you informed of what you will be doing. If you will be working with other people, make sure any hand signals that may be used are understood by everybody. Worksites can be noisy, do not rely on spoken commands.

Machine Condition

A defective machine can injure you or others. Do not operate a machine which is defective or has missing parts. Make sure the maintenance procedures in this manual are completed before using the machine.

Machine Limits

Operating the machine beyond its design limits can damage the machine, it can also be dangerous. Do not operate the machine outside its limits. Do not try to upgrade the machine performance with unapproved modifications or additional equipment.

Exhaust Gases

Machine exhaust gases can harm and possibly kill you or bystanders if they are inhaled. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, install an exhaust extractor. If you begin to feel drowsy, stop the machine at once and get into fresh air.

Sparks

Explosions and fire can be caused by sparks from the exhaust or the electrical system. Do not use the machine in closed areas where there is flammable material, vapour or dust.

Hazardous Atmospheres

This machine is designed for use in normal out door atmospheric conditions. It must not be used in an enclosed area without adequate ventilation. Do not use the machine in a potentially explosive atmosphere, i.e. combustible vapours, gas or dust, without first consulting your JCB dealer.

Regulations

Obey all laws, worksite and local regulations which affect you and your machine.

Hot Components

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

Alcohol and Drugs

It is extremely dangerous to operate machinery when under the influence of alcohol or drugs. Do not consume alcoholic drinks or take drugs before or while operating the machine or attachments. Be aware of medicines which can cause drowsiness.

Battery Isolator

General

The battery isolator switch is used to disconnect the battery from the machine electrics. The switch must be turned to the off position if any maintenance work is to be performed on the machine.

Some machine systems perform shut down cycles after the engine stops. Wait until shut down cycles are complete before setting the battery isolator switch to the off position.

At the end of a working cycle or if the machine is being left unattended and the lights are not required, the battery must be isolated.

Disconnect

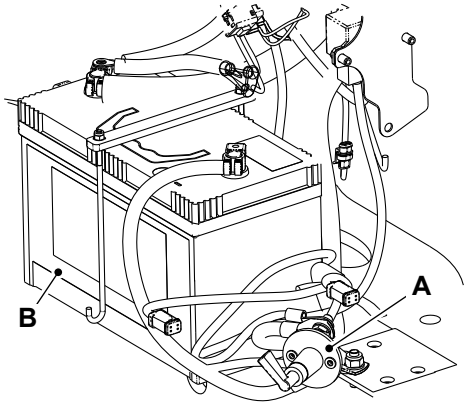
If the machine has an electronically controlled engine, you must wait a period of time before you isolate the battery. This is to allow the ECM (Engine Control Module) to shutdown correctly. The time period starts when you turn the ignition off. Check the isolator switch label and the operators manual for the correct time period.

In the event of an emergency, remove the isolator key without waiting.

If a radio is installed, you may lose any settings.

1. Wait for the specified duration after the engine is turned off before you isolate the battery.
   Duration: 30s
2. Make the machine safe.
3. Turn the ignition key to the off position.
4. Wait for the engine ECM to shutdown correctly (if installed).
5. Get access to the isolator key.
6. Turn the battery isolator key in the indicated direction and remove.

Figure 17.



A Battery isolator key **B** Battery

Connect

Before you start the engine or use the machine electrics, the battery isolator key must be installed and switched on.

1. Make sure the ignition is set to off.
2. Insert the battery isolator key and turn in the indicated direction.

Before Starting the Engine

General

After correct installation of the unit and the wiring, the generating set must be fully checked over before first starting can be attempted. Points to check include:

- Check all belts, guards and panel covers are firmly secured.
- Check the installed wiring to ensure all connections are firmly installed in the correct position, and that wires are in good condition.
- Ensure that the machine exhaust/silencer has been correctly fitted and all connections are secure.
- Connect battery cables. Ensure battery connections are secure and polarity of connections are correct.
- Ensure that there is fuel in the fuel tank.
- If the machine has not been run previously, if it has run out of fuel or if the fuel supply has been reconnected then the fuel system must be primed prior to starting. Check for fuel leaks during this process.
- Check level of coolant in machine radiator, and top-up if low.
- Check hoses for damage or loose clamps.
- Check level of engine oil using dipstick.
- Check fuel filter/water separator for presence of water or contaminants.
- Visually inspect the engine and alternator for any signs of damage, water, oil or fuel leaks.
- Ensure that machine intake and outlet air vents and grills are not obstructed or blocked in any way to allow good airflow through the machine.
- Check that the engine intake air filter is correctly fitted, and that there are no obstructions to the incoming air.
- Ensure that all supplied documentation packs have been removed from the machine.
- Ensure that the alternator windings and assembly are not damp, or dirty. Failure to do so could result in damage to the alternator windings. If windings are observed to be damp/dirty contact your JCB Dealer.
- With the exception of emergency power generators, the engine should be warmed up with a reduced load before applying the full load.

Checks After Running

Ensure that the electrical load is switched OFF before stopping the engine.

- Check that the power is cut from the battery master switch and that the control switch is in the "0" position.
- Fill the fuel tank. Make sure that the filler cap and the area round the filler opening are clean to avoid contamination of the fuel.
- If there is a risk of freezing, the cooling system must contain the correct antifreeze.
- At temperatures below 0°C: Prepare for the next start by connecting the engine heater.

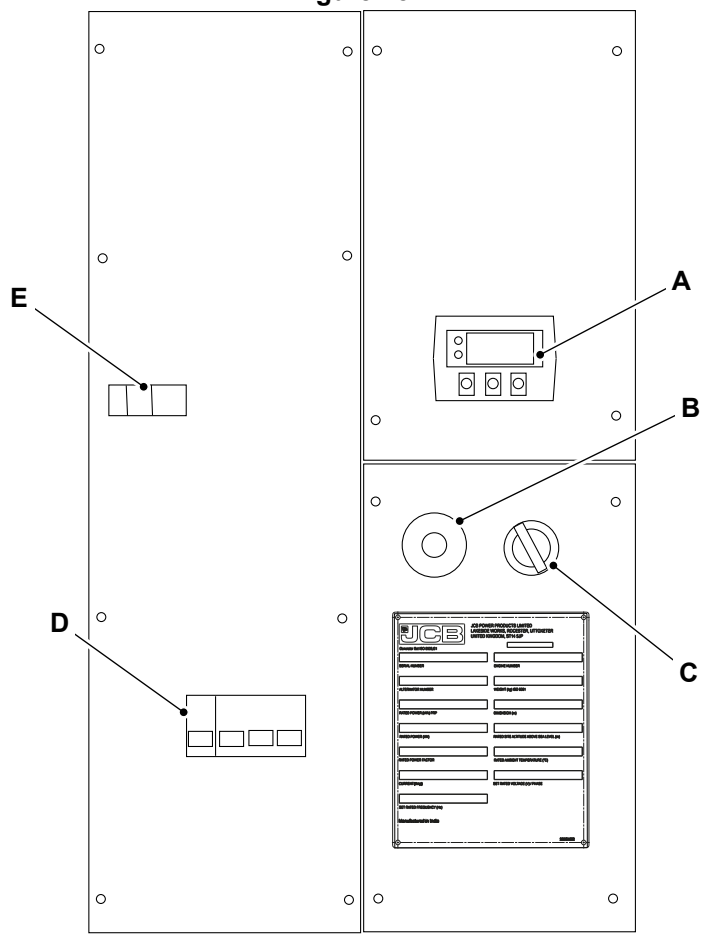
Coolant should be topped up when the engine is stopped after the first start.

Instruments

Instrument Panel

Introduction

Figure 18.



A Digital controller
B Emergency stop button
C Digital controller on/off switch
D Main power supply MCCB
E Earth leakage relay

Operation

1. Turn on the digital controller switch.
2. Wait for few seconds, to allow the controller to power up and display to stabilise.
3. Make sure that the power on LED (Light Emitting Diode) is illuminated on earth leakage trip and there is no trip active.
4. Make sure that the main power supply MCCB is switched off.
5. Check that the emergency stop button is fully out, if necessary twist to reset the button.
6. Complete all pre-start, system and engine checks.
7. Press the start button and the machine will start in manual.
8. The engine will run up to speed and stabilise.
9. Check that the machine operation is correct using the screen information.
10. Make sure the power on LED is illuminated on earth leakage trip and there is no trip active.

11. Turn on the main power supply MCCB.
12. The generator can now be loaded.
13. If the earth leakage relay trips at this point consult the site electrical installation engineer.
14. To stop the generator, remove any electrical loads.
15. Turn the main power supply MCCB to off position.
16. Press the stop button the generator will now stop. Refer to Figure 18.

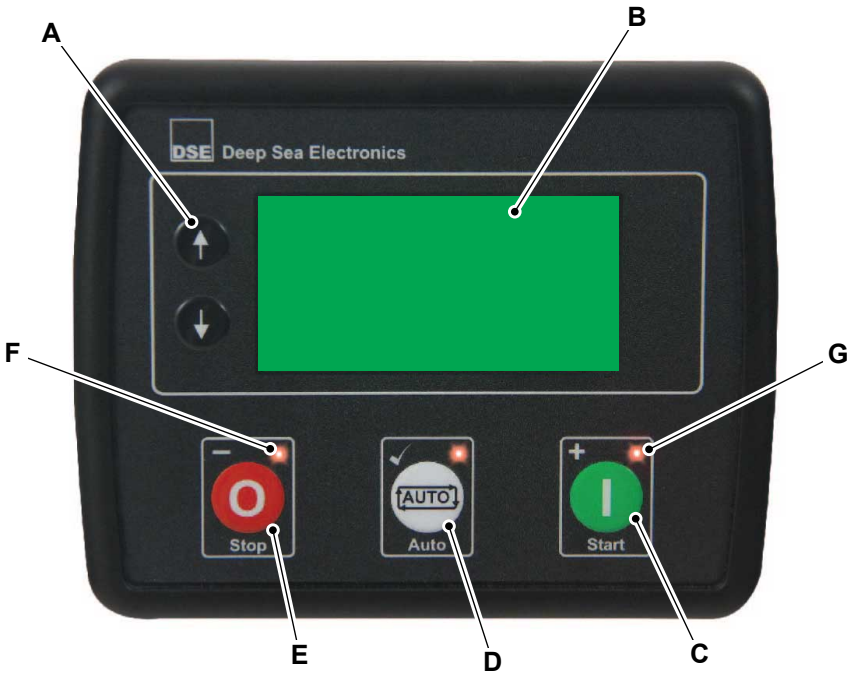
Digital Controller

The following description details the sequences followed by a module containing the standard `factory configuration'. Always refer to your configuration source for the exact sequences and timers observed by any particular module in the field.

Control of the module is via push buttons mounted on the front of the module with STOP/RESET mode, AUTO mode and MANUAL/START mode functions. For normal operation, these are the only controls which need to be operated.

The module may instruct an engine start event due to external influences. Therefore, it is possible for the engine to start at any time without warning. Prior to performing any maintenance on the system, it is recommended that steps are taken to remove the battery and isolate supplies.

Figure 19.



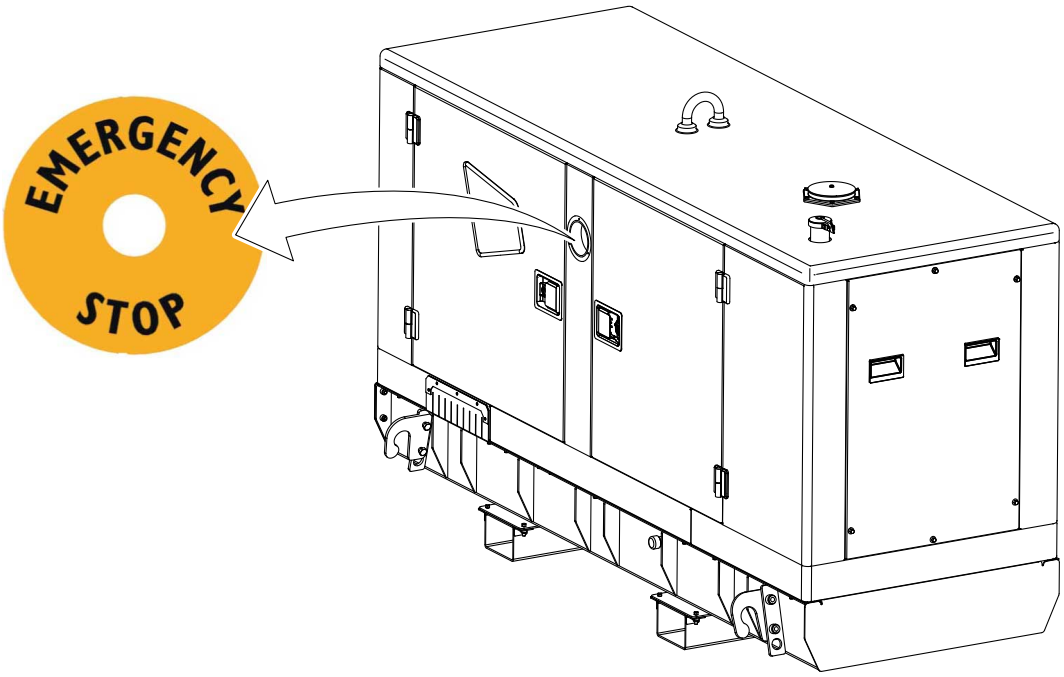
A Menu navigation (up/down)
B Module display
C Manual/start mode
D Auto mode
E Stop/reset mode
F Stop/reset mode LED
G Stop/reset mode LED

Emergency Stop Button

A machine isolation button/emergency Stop button is mounted both externally on the canopy and internally near the control panel. If either is pressed, all machine systems will stop completely.

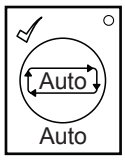
Use the emergency stop button in the case of an emergency or if the machine becomes unsafe and does not shutdown automatically.

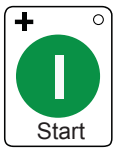
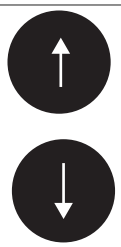
Figure 20.



Control Push-Buttons

Table 3.

	This button places the module into its STOP/RESET mode. This will clear any alarm conditions for which the triggering criteria have been removed. If the engine is running and the module is put into STOP mode, the module will automatically instruct the generator to unload (`Close Generator' and `Delayed Load Output 1, 2, 3 & 4' become inactive (if used)). The fuel supply de-energises and the engine comes to a standstill. Should any form of remote start signal be present while operating in this mode, a start will not occur.
	This button places the module into its AUTO MODE. This mode allows the module to control the function of the generator automatically. The module will monitor the remote start input and battery charge status and once a start request is made, the set will be automatically started and placed on load (`Close Generator' and `Delayed Load Output 1, 2, 3 & 4' become active in order from lowest to highest (if used)). Upon removal of the starting signal, the module will remove the load from the generator and shut the set down observing the stop delay timer and cooling timer as necessary (`Close Generator' and `Delayed Load Output 1, 2, 3 & 4' become inactive at once (if used)). The module will then await the next start event.

	This button will start the engine and run off load. To place the generator on load, digital inputs are required to be assigned to perform this function. If the engine is running off-load in MANUAL/START mode button and a REMOTE START SIGNAL becomes present, the module will automatically instruct the changeover device to place the generator on load (`Close Generator' and `Delayed Load Output 1, 2, 3 & 4' becomes active (if used)). Upon removal of the Remote Start Signal, the generator remains on load until either selection of the STOP/RESET Mode or AUTO Mode.
	Used for navigating the instrumentation, event log and configuration screens.

Module Display

Depending upon the module's configuration, some display screens may be disabled.

Instrumentation Icons

When viewing instrumentation pages, an icon is displayed in the instrumentation icon section to indicate what section is currently being displayed.

Table 4.

Icons	Description
	The default HOME PAGE which displays generator voltage and mains voltage
	Generator voltage and frequency instrumentation screen
	Mains voltage and frequency instrumentation screen
	Generator current instrumentation screen
	Mains current instrumentation screen
	Load power instrumentation screen
	Engine speed instrumentation screen
	Hours run instrumentation screen
	Battery voltage instrumentation screen
	Oil pressure instrumentation screen
	Coolant temperature instrumentation screen

Icons	Description
	Flexible sender instrumentation screen
	Appears when the event log is being displayed
	Current time held in the unit
	The current value of the scheduler run time and duration
	ECU (Electronic Control Unit) diagnostic trouble codes
	Oil filter maintenance timers
	Air filter maintenance timers
	Fuel filter maintenance timers

Active Configuration

An icon is displayed in the Active Config section to indicate the active configuration within the currently selected within the controller.

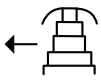
Table 5.

Icons	Description
	Appears when the main configuration is selected.
	Appears when the alternative configuration is selected.

Front Panel Editor (FPE)/Auto Run Icon

When running in AUTO mode and on the Home page, an icon is displayed in the FPE/Auto Run section to indicate the source of the auto start signal.

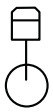
Table 6.

Icons	Description
	Appears when a remote start input is active
	Appears when a low battery run is active
	Mains failure
	Appears when a scheduled run is active

Mode Icon

An icon is displayed in the Mode Icon section to indicate the mode the controller is currently in.

Table 7.

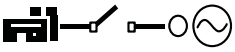
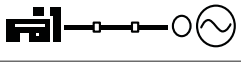
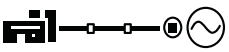
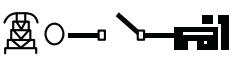
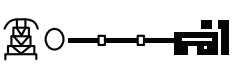
Icons	Description
	Appears when the engine is at rest and the unit is in stop mode.
	Appears when the engine is at rest and the unit is in auto mode.
	Appears when the engine is at rest and the unit is waiting for a manual start.
	Appears when a timer is active, for example cranking time, crank rest etc.
	Appears when the engine is running, and all timers have expired, either on or off load. The animation speed is reduced when running in idle mode.
	Appears when the unit is in the front panel editor.
	Appears when a USB (Universal Serial Bus) connection is made to the controller.
	Appears if either the configuration file or engine file becomes corrupted.

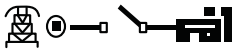
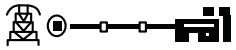
Load Switching Icon

Additional features for optional DSE4520 mains failure controller.

Icons are displayed in the Load Switching Icon section to indicate the current operation status of the controller.

Table 8.

Icons	Description
	Appears when the generator is at rest or not available and when the generator breaker is open.
	Appears when the generator is at rest or not available and the generator breaker has failed to open.
	Appears when the generator is available and the generator breaker is open.
	Appears when the generator is available and the generator breaker is closed.
	Appears when the mains supply is not available and the mains breaker is open.
	Appears when the mains supply is not available and the mains breaker is closed.

Icons	Description
	Appears when the mains supply is available and the mains breaker is open.
	Appears when the mains supply is available and the mains breaker is closed.

Backlight

The LED backlight is on if the unit has sufficient voltage while the unit is turned on, unless the unit is cranking for which the backlight is turned off.

Alarm Icons (Protections)

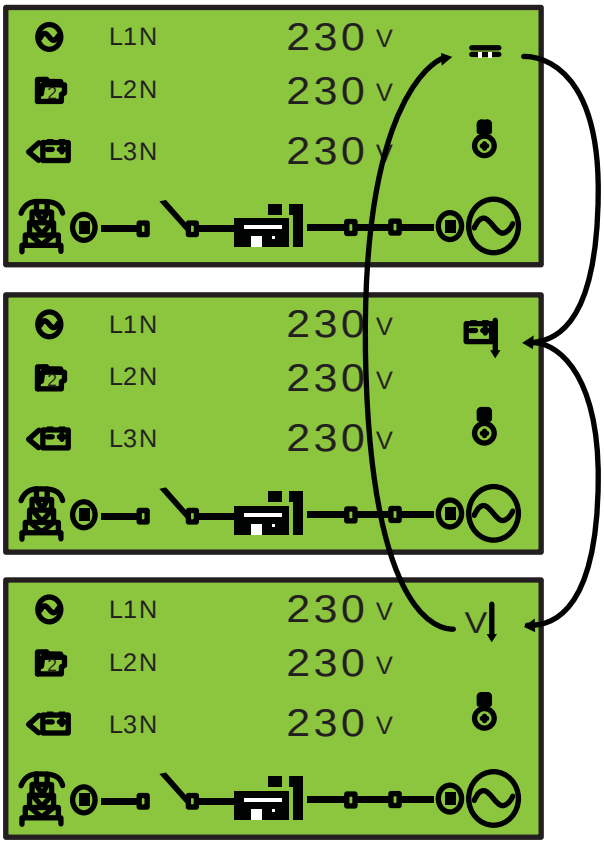
An icon is displayed in the Alarm Icon section to indicate the alarm that is current active on the controller.

In the event of a warning alarm, the LCD (Liquid Crystal Display) only displays the alarm icon. In the event of an electrical trip or shutdown alarm, the module displays the alarm icon and the stop/ reset mode button LED begins to flash.

If multiple alarms are active at the same time, the alarm Icon automatically cycles through all the appropriate icons to indicate each alarm which is active.

If the DSE controller was sensing a charge alternator failure alarm, delay over current alarm and a AC under voltage alarm at the same time, it would cycle through all of the icons to show the procedure.

Figure 21.



Warning Alarm Icons

Warnings are non-critical alarm conditions and do not affect the operation of the generator system, they serve to draw the operators attention to an undesirable condition. By default, warning alarms are self-resetting when the fault condition is removed. However enabling `all warnings are latched' will cause warning alarms to latch until reset manually. This is enabled using the DSE configuration suite in conjunction with a compatible PC.

Table 9.

Icon	Fault	Description
	Auxiliary Inputs	The module detects that an auxiliary input which has been user configured to create a fault condition has become active.
	Analogue Input Configured As Digital	The analogue inputs can be configured to digital inputs. The module detects that an input configured to create a fault condition has become active.
	Fail To Stop	The module has detected a condition that indicates that the engine is running when it has been instructed to stop. `Fail to Stop' could indicate a faulty oil pressure sensor. If engine is at rest check oil sensor wiring and configuration.
	Charge Failure	The auxiliary charge alternator voltage is low as measured from the W/L terminal.
	Low Fuel Level	The level detected by the fuel level sensor is below the low fuel level pre-set pre-alarm setting.
	High Fuel Level	The level detected by the fuel level sensor is above the high fuel level pre-set pre-alarm setting.
	Battery Under Voltage	The DC supply has fallen below or risen above the low volts preset pre-alarm setting.
	Battery Over Voltage	The DC supply has risen above the high volts pre-set pre-alarm setting.
	Generator Under Voltage	The generator output voltage has fallen below the pre-set prealarm setting after the Safety On timer has expired.
	Generator Over Voltage	The generator output voltage has risen above the pre-set prealarm setting.
	Generator Under Frequency	The generator output frequency has fallen below the pre-set prealarm setting after the Safety On timer has expired.

Icon	Fault	Description
	Generator Over Frequency	The generator output frequency has risen above the pre-set pre-alarm setting.
	CAN ECU Fault	The engine ECU has detected an alarm.
	CAN (Controller Area Network) Data Fail	The module is configured for CAN operation and does not detect data on the engine CAN data link.
	Immediate Over Current	The measured current has risen above the configured trip level.
	Delayed Over Current	The measured current has risen above the configured trip level for a configured duration.
	Oil Filter Maintenance Alarm	Maintenance due for oil filter.
	Air Filter Maintenance Alarm	Maintenance due for air filter.
	Fuel Filter Maintenance Alarm	Maintenance due for fuel filter.

Electrical Trip Alarm Icons

Electrical trips are latching and stop the Generator but in a controlled manner. On initiation of the electrical trip condition the module de-energises all the `Delayed Load Output' and the `Close Gen Output' outputs to remove the load from the generator. Once this has occurred the module starts the Cooling timer and allows the engine to cool off-load before shutting down the engine. The alarm must be accepted and cleared, and the fault removed to reset the module.

Electrical trips are latching alarms and to remove the fault, press the STOP/RESET mode button on the module.

The alarm condition must be rectified before a reset will take place. If the alarm condition remains, it is not possible to reset the unit (The exception to this is the Low Oil Pressure alarm and similar `active from safety on' alarms, as the oil pressure is low with the engine at rest).

Table 10.

Icon	Fault	Description
	Auxiliary Inputs	The module detects that an auxiliary input which has been user configured to create a fault condition has become active.
	Analogue Input Configured as Digital	The analogue inputs can be configured to digital inputs. The module detects that an input configured to create a fault condition has become active.

Icon	Fault	Description
	Low Fuel Level	The level detected by the fuel level sensor is below the low fuel level pre-set alarm setting.
	High Fuel Level	The level detected by the fuel level sensor is above the high fuel level pre-set alarm setting.
	Delayed Over Current	The measured current has risen above the configured trip level for a configured duration.
	kW Overload	The measured kW has risen above the configured trip level for a configured duration.

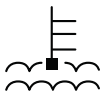
Shutdown Alarm Icons

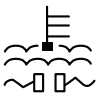
Shutdown alarms are latching and immediately stop the Generator. On initiation of the shutdown condition the module de-energises all the `Delayed Load Output' and the `Close Gen Output' outputs to remove the load from the generator. Once this has occurred, the module shuts the generator set down immediately to prevent further damage. The alarm must be accepted and cleared, and the fault removed to reset the module.

Shutdowns are latching alarms and to remove the fault, press the STOP/RESET Mode button on the module.

The alarm condition must be rectified before a reset will take place. If the alarm condition remains, it is not be possible to reset the unit (The exception to this is the Low Oil Pressure alarm and similar `active from safety on' alarms, as the oil pressure is low with the engine at rest).

Table 11.

Icon	Fault	Description
	Auxiliary Inputs	The module detects that an auxiliary input which has been user configured to create a fault condition has become active.
	Analogue Input Configured As Digital	The analogue inputs can be configured to digital inputs. The module detects that an input configured to create a fault condition has become active.
	Fail To Start	The engine has failed to start after the configured number of start attempts.
	Low Oil Pressure	The module detects that the engine oil pressure has fallen below the low oil pressure pre-alarm setting level after the Safety On timer has expired.
	Engine High Temperature	The module detects that the engine coolant temperature has exceeded the high engine temperature pre-alarm setting level after the `Safety On' timer has expired.
	Under Speed	The engine speed has fallen below the under speed pre alarm setting.

Icon	Fault	Description
	Over Speed	The engine speed has risen above the over speed pre alarm setting.
	Charge Failure	The auxiliary charge alternator voltage is low as measured from the W/L terminal.
	Low Fuel Level	The level detected by the fuel level sensor is below the low fuel level pre-set alarm setting.
	High Fuel Level	The level detected by the fuel level sensor is above the high fuel level pre-set alarm setting.
	Generator Under Voltage	The generator output voltage has fallen below the pre-set alarm setting. after the Safety On timer has expired.
	Generator Over Voltage	The generator output voltage has risen above the pre-set alarm setting.
	Generator Under Frequency	The generator output frequency has fallen below the pre-set alarm setting after the `Safety On' timer has expired.
	Generator Over Frequency	The generator output frequency has risen above the pre-set alarm setting.
	Delayed Over Current	The measured current has risen above the configured trip level for a configured duration.
	kW Overload	The measured kW has risen above the configured trip level for a configured duration.
	CAN ECU Fault	The engine ECU has detected an alarm - check engine light Contact Engine Manufacturer for support.
	CAN Data Fail	The module is configured for CAN operation and does not detect data on the engine CAN data link.
	Emergency Stop	The emergency stop button has been depressed. This failsafe (normally closed to emergency stop) input and immediately stops the set should the signal be removed.
	Oil Sender Open Circuit	The oil pressure sensor has been detected as being open circuit.
	Coolant Temperature Sender Open Circuit	The coolant temperature sensor has been detected as being open circuit.

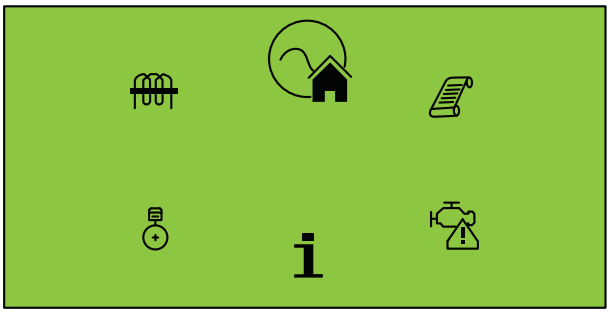
Icon	Fault	Description
	Oil Filter Maintenance Alarm	Maintenance due for oil filter.
	Air Filter Maintenance Alarm	Maintenance due for air filter.
	Fuel Filter Maintenance Alarm	Maintenance due for fuel filter.

Viewing The Instrument Pages

Navigation Menu

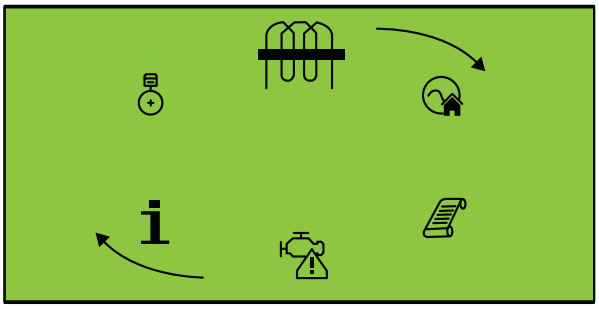
To enter the navigation menu, press both the UP and DOWN buttons simultaneously.

Figure 22.



To select the required icon, press the UP button to cycle right or the DOWN button to cycle left until the desired instrumentation section is reached.

Figure 23.

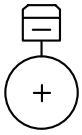


Once the desired icon is at the top, press the AUTO Mode button to enter that instrumentation section.

If the AUTO mode button is not pressed, the display automatically returns to the HOME PAGE after the configured setting of the LCD Scroll Timer.

Navigation Menu Icons

Table 12.

Icon	Description
	Generator and mains voltage instrumentation
	Generator instrumentation
	Mains instrumentation
	Current and load instrumentation
	Engine instrumentation
	Module information
	Engine DTCs (Diagnostic Trouble Codes) if active
	Event Log

General Navigation

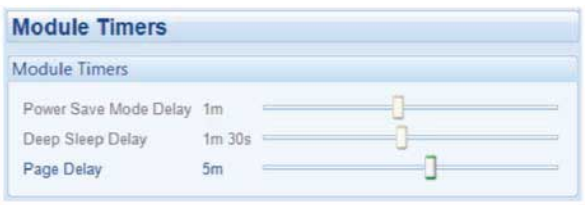
It is possible to scroll through the display to view different pages of information by repeatedly operating the up or down navigation buttons, and so on until the last page is reached.

A further press of the navigation down button returns the display to the homepage.

Once selected, the page will remain on the LCD display until the user selects a different page or, after an extended period of inactivity (Page Delay Timer), the module reverts back to the homepage.

The `Page Delay Timer' is configurable using the `DSE Configuration Suite Software' or by using the `Front Panel Editor'.

Figure 24.

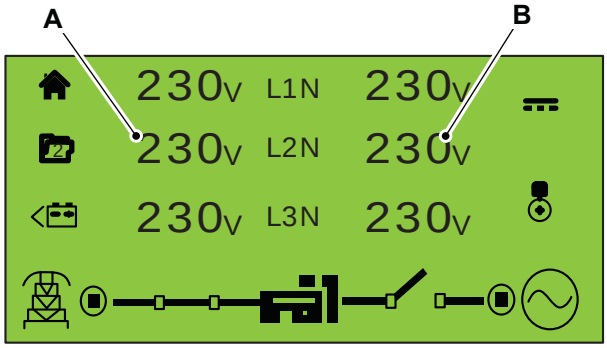


Home

This is the page that is displayed when no other page has been selected and is automatically displayed after a period of inactivity (Page Delay Timer) of the module facia buttons. It also contains the voltage reading of the generator and mains that is measured from the module's voltage inputs.

- Generator Voltage (ph-N/ph-ph)Mains Voltage (ph-N/ ph-ph)

Figure 25.



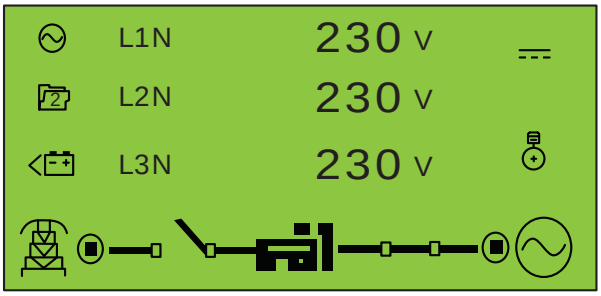
A Mains voltage **B** Generator voltage

Generator

These pages contain electrical values of the generator, measured or derived from the module's voltage inputs.

- Generator Voltage (ph-N)Generator Voltage (phph) Generator Frequency

Figure 26.

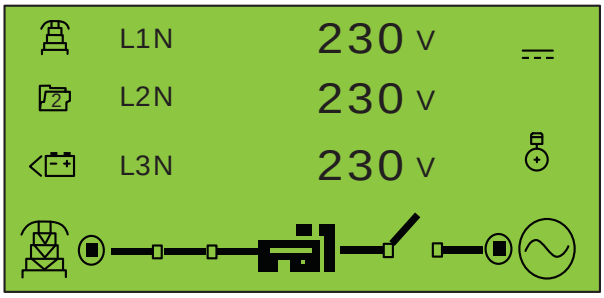


Mains

These pages contain electrical values of the mains, measured or derived from the module's voltage inputs.

- Mains Voltage (ph-N)Mains Voltage (ph-ph)Mains Frequency

Figure 27.

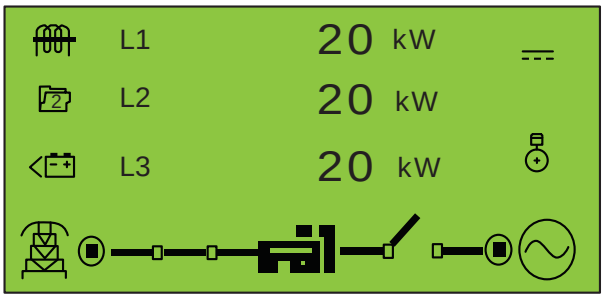


Load

These pages contain electrical values of the load, measured or derived from the module's voltage and current inputs. The power values displayed depend on which supply is on load.

- Generator Current (A)Mains Current (A)Load ph-N (kW)Total Load (kW)Load ph-N (kVA)Total Load (kVA)Load ph-N (kVAr)Total Load (kVAr)Power Factor ph-NPower Factor AverageAccumulated Load (kWh, kVAh, kVArh)

Figure 28.

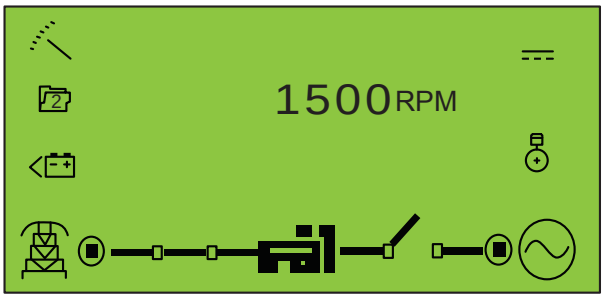


Engine

These pages contain instrumentation gathered about the engine measured or derived from the module's inputs, some of which may be obtained from the engine ECU.

- Engine Speed
- Engine Run TimeEngine Battery VoltsEngine Coolant TemperatureEngine Oil PressureEngine Fuel Level/ Flexible SensorEngine Maintenance Due - OilEngine Maintenance Due - AirEngine Maintenance Due - Fuel

Figure 29.

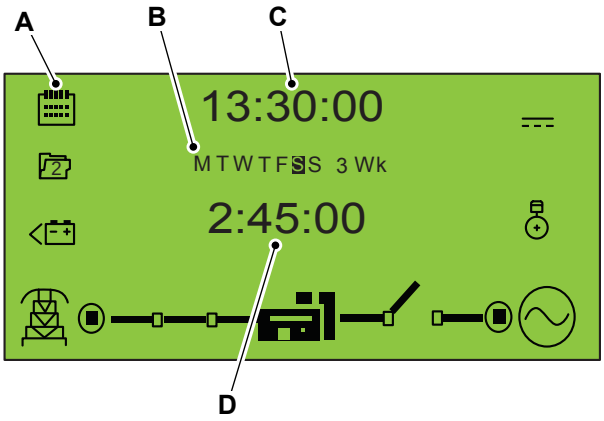


Info

These pages contain information about the controller.

- Module's date and timeScheduler settingsProduct description and USB identification numberApplication and Engine Version

Figure 30.



A Icon to indicate that the scheduler is currently displayed
B Day and week of scheduled run
C Start time of scheduled run
D Duration of scheduled run

Engine DTC (ECU Alarms)

If the DSE module is connected to an ECU, this page contains active Diagnostic Trouble Codes (DTC) only if the engine ECU generating a fault code. These alarm conditions are detected by the engine ECU and displayed by the DSE controller.

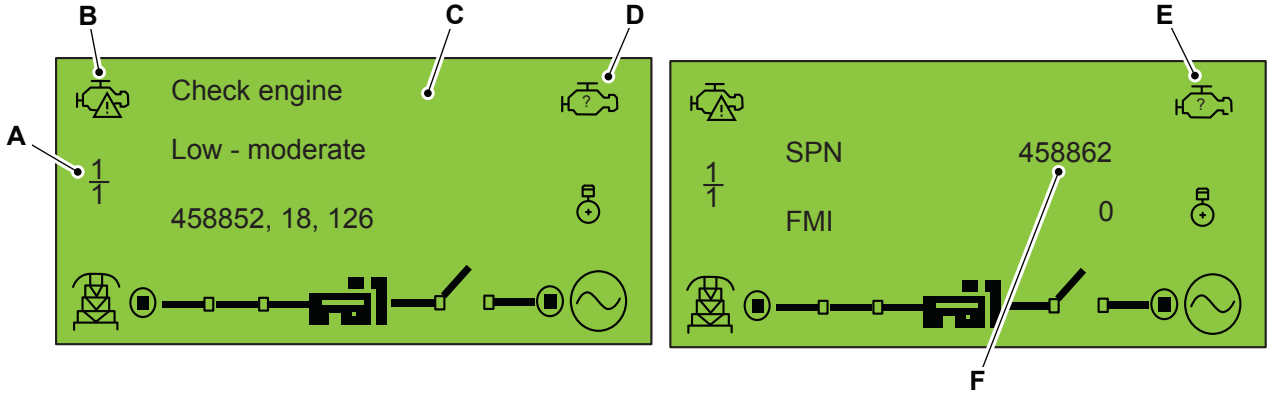
Viewing Active Engine DTC

To view the engine DTC, press both UP and DOWN buttons simultaneously, the navigation menu is then displayed. Once entered, cycle to the DTC section and enter.

To view the active DTC alarms, repeatedly press the UP or DOWN buttons until the LCD screen displays the alarm. Continuing to press the UP or DOWN buttons will cycle through the alarms.

To exit the active DTC alarm section, press the UP and DOWN buttons simultaneously to enter the navigation menu. Once entered, cycle to the desired instrumentation section.

Figure 31.



A Number of DTC displayed out of number of active DTCs
B Icon to indicate that the event log is currently display
C Description and fault code of active DTC alarm
D Icon to indicate the type of DTC fault that is active
E Current operating status of the module
F SPN and FMI fault code of active DTC alarm.

Table 13.

icon	Fault	DTC Description
	Check Engine Fault	The engine ECU has detected a fault not recognised by the DSE module, contact engine manufacturer for support.
	Low Oil Pressure	The engine ECU has detected that the engine oil pressure has fallen below its configured low oil pressure alarm level.
	Under Speed	The engine ECU has detected that the engine speed has fallen below its configured under speed alarm level.
	Over Speed	The engine ECU has detected that the engine speed has risen above its configured over speed alarm level.
	Charge Failure	The engine ECU has detected that the engine's charge alternator output has fallen below its configured alarm level.
	Low Fuel Level	The engine ECU has detected that the engine's fuel level has fallen below its configured low fuel level alarm.
	Battery Under/Over Voltage	The engine ECU has detected that the engine's DC supply has fallen below or risen above its configured alarm level.

Event Log

This module's event log contains a list of the last 15 record electrical trip or shutdown events and the engine hours at which they occurred. Once the log is full, any subsequent electrical trip or shutdown alarms overwrites the oldest entry in the log. Hence, the log always contains the most recent shutdown alarms. The module logs the alarm, along with the engine running hours.

Viewing The Event Log

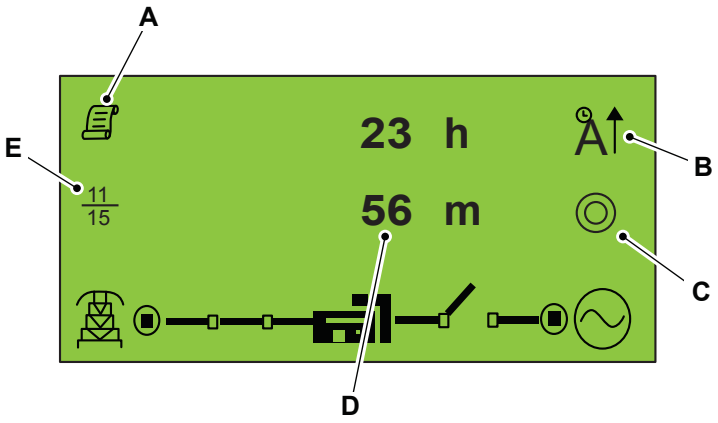
To view the event log, press both UP and DOWN buttons simultaneously, the navigation menu is then displayed. Once entered, cycle to the event log section and enter.

To view the event log, repeatedly press the UP or DOWN buttons until the LCD screen displays the desired event.

Continuing to press down the UP or DOWN buttons will cycle through the past alarms after which the display shows the most recent alarm and the cycle begins again.

To exit the event log, press the UP and DOWN buttons simultaneously to enter the navigation menu. Once entered, cycle to the desired instrumentation section.

Figure 32.



A Icon to indicate that the event log is currently display

B The engine hours at which the event occurred

C Current operating state of the module

D Icon to indicate the electrical trip or shutdown alarm that has been recorded

E Number of event displayed out

Operation

The following descriptions detail the sequences followed by a module containing the standard `factory configuration'. Always refer to your configuration source for the exact sequences and timers observed by any particular module in the field.

Quickstart Guide

This section provides a quick start guide to the module's operation.

Starting The Engine

Press the MANUAL/START button to crank the engine.

Figure 33.

A Manual/start button

Stopping The Engine

Select STOP/RESET mode. The generator is stopped.

Figure 34.

B Stop/reset mode button

Stop/Reset Mode

If a digital input configured to panel lock is active, changing module modes will not be possible. Viewing the instruments and event logs are not affected by panel lock.

STOP/RESET mode is activated by pressing the STOP/ RESET mode button. The STOP/RESET icon is displayed to indicate STOP/RESET mode operations.

In STOP/RESET mode, the module removes the generator from load (if necessary) before stopping the engine if it is already running.

If the engine does not stop when requested, the FAIL TO STOP alarm is activated (subject to the setting of the Fail to Stop timer). To detect the engine at rest the following must occur:

Engine speed is zero as detected by the CANbus ECU. Generator AC Voltage and frequency must be zero. Engine charge alternator voltage must be zero.Oil pressure sensor must indicate low oil pressure.

When the engine has stopped, it is possible to send configuration files to the module from DSE configuration suite PC software and to enter the front panel editor to change parameters.

Any latched alarms that have been cleared are reset when STOP/RESET Mode is entered.

The engine is not started, when in STOP/RESET mode. If remote start signals are given, the input is ignored until AUTO mode is entered.

When left in STOP/RESET mode with no presses of the fascia buttons and configured for `Power Save Mode`, the module enters Power Save Mode. To `wake' the module, press any fascia control buttons or activate Digital Input. The same is true for Deep Sleep Mode.

Automatic Mode

If a digital input configured to external panel lock is active, changing module modes is not possible. Viewing the instruments and event logs are not affected by panel lock.

AUTO mode is activated by pressing the AUTO mode button. The AUTO mode icon is displayed to indicate AUTO mode operations if no alarms are present. AUTO mode allows the generator to operate fully automatically, starting and stopping as required with no user intervention.

Waiting In Auto Mode

If a starting request is made, the starting sequence begins. Starting requests can be from the following sources:

- Activation of an auxiliary input that has been configured to remote startActivation of the inbuilt exercise scheduler.

Starting Sequence

To allow for `false' start requests, the start delay timer begins.

Should all start requests be removed during the start delay timer, the unit returns to a stand-by state.

If a start request is still present at the end of the start delay timer, the fuel relay is energised and the engine is cranked.

If the unit has been configured for CAN, compatible ECU's receive the start command via CAN and transmit the engine speed to the DSE controller.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the crank rest duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence is terminated and the display shows Fail to Start.

Engine Running

Once the engine is running and all starting timers have expired, the animated `Engine Running' icon is displayed. The generator is placed on load if configured to do so.

The load transfer signal remains inactive until the oil pressure has risen. This prevents excessive wear on the engine.

If all start requests are removed, the stopping sequence will begin.

Stopping Sequence

The return delay timer operates to ensure that the starting request has been permanently removed and isn't just a short term removal. Should another start request be made during the cooling down period, the set returns on load.

If there are no starting requests at the end of the return delay timer, the load is removed from the generator to the mains supply and the cooling timer is initiated.

The cooling timer allows the set to run off load and cool sufficiently before being stopped. This is particularly important where turbo chargers are fitted to the engine.

After the cooling timer has expired, the set is stopped.

Manual/Start Mode

If a digital input configured to panel lock is active, changing module modes is not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Waiting In Manual Mode

To begin the starting sequence, press the Manual/Start Mode button. If `protected start' is disabled, the start sequence begins immediately.

If `Protected Start' is enabled, the waiting in MANUAL mode icon is displayed and the LED above the MANUAL/START mode button flashes to indicate `Waiting in MANUAL mode'.The MANUAL/START mode button must be pressed once more to begin the start sequence.

Starting Sequence

There is no start delay in this mode of operation.

The fuel relay is energised and the engine is cranked.

If the unit has been configured for CAN, compatible ECU's receives the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the crank rest duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence is terminated and the display shows Fail to Start.

When the engine fires the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency.

Additionally, rising oil pressure can be used to disconnect the starter motor (but cannot detect under speed or over speed).

After the starter motor has disengaged, the safety on timer activates, allowing oil pressure, high engine temperature, under-speed, charge fail and any delayed auxiliary fault inputs to stabilise without triggering the fault.

Engine Running

Once the engine is running and all starting timers have expired, the animated `Engine Running' icon is displayed.

In manual mode, the load is not transferred to the generator unless a `loading request' is made. A loading request can come from a number of sources.

- Activation of an auxiliary input that has been configured to Remote Start On Load or Auxiliary Mains Fail.Activation of the inbuilt exercise scheduler if configured for `on load' runs.

The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive wear on the engine.

Once the generator has been placed on load, it is not automatically removed. To manually remove the load either:

- Press the AUTO mode button to return to automatic mode. The set observes all auto mode start requests and stopping timers before beginning the `Auto Mode Stopping Sequence'.
- Press the STOP/RESET mode button to remove load and stop the generator.
- Activation of an auxiliary input that has been configured to generator load inhibit.

Stopping Sequence

In manual/start mode the set will continue to run until either:

1. The STOP/RESET mode button is pressed - The delayed load outputs are de-activated immediately and the set immediately stops.
2. The AUTO mode button is pressed. The set observes all auto mode start requests and stopping timers before beginning the 'Auto Mode Stopping Sequence'.

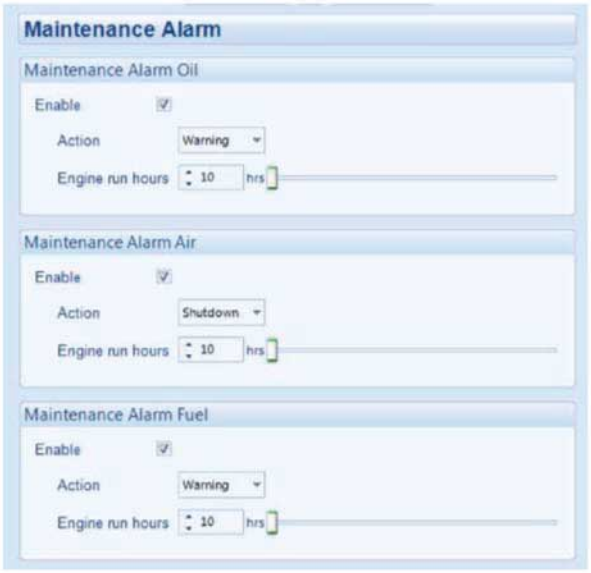
Maintenance Alarm

Depending upon module configuration one or more levels of engine maintenance alarm may occur based upon a configurable schedule.

Example 1

DSE Configuration Suite Software showing the configuration of the maintenance alarm for oil, air and fuel.

Figure 35.



When activated, the maintenance alarm can be either a warning (set continues to run) or shutdown (running the set is not possible).

Resetting the maintenance alarm is normally actioned by the site service engineer after performing the required maintenance.

The method of reset is either by:

- Activating an input that has been configured to maintenance reset alarm X, where X is the type of maintenance alarm (air, fuel or oil).
- Pressing the maintenance reset button in the DSE Configuration Suite, Maintenance section.
- Pressing and holding the STOP/RESET mode button for ten seconds on the desired `Maintenance Alarm' status page. This can be protected by a PIN (Product Identification Number) number.

Example 2

DSE Configuration Suite Software showing the configuration of a digital input for `Maintenance Reset Alarm Air'. Refer to Figure 36.

Figure 36.

Example 3

DSE Configuration Suite Software showing the Maintenance Alarm Reset `button' in the DSE Configuration Suite SCADA/MAINTENANCE section. Refer to Figure 37.

Figure 37.

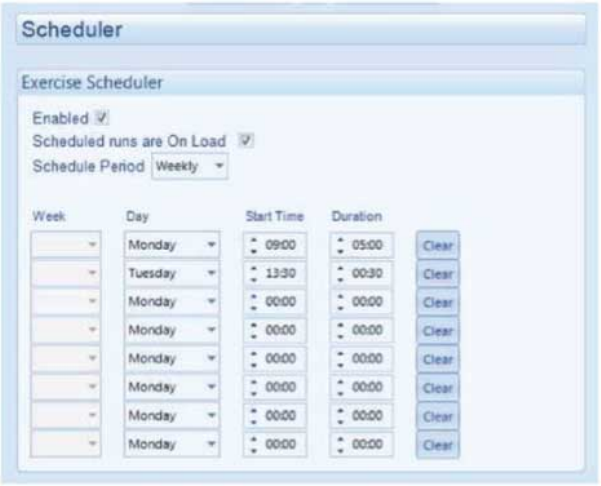
Scheduler

The controller contains an inbuilt exercise run scheduler, capable of automatically starting and stopping the set. Up to 8 scheduled start/stop sequences can be configured to repeat on a 7-day or 28-day cycle.

Scheduled runs may be on load or off load depending upon module configuration.

Example

Figure 38.



DSE Configuration Suite Software showing the configuration of the Exercise Scheduler.

In this example, the set will start at 09:00 on Monday and run for 5 hours, then start at 13:30 on Tuesday and run for 30 minutes.

Stop Mode

Scheduled runs do not occur when the module is in STOP/ RESET mode.

Manual/Start Mode

Scheduled runs do not occur when the module is in MANUAL/START mode waiting for a manual start.

Activation of a scheduled run `On Load' when the module is operating OFF LOAD in MANUAL/START mode will force the set to run ON LOAD.

Auto Mode

Scheduled runs operate only if the module is in AUTO mode with no `Shutdown or Electrical Trip' alarm present.

If the module is in STOP/RESET mode or MANUAL/ START mode when a scheduled run begins, the engine is not started. However, if the module is moved into AUTO mode during a scheduled run, the engine will be called to start.

Depending upon configuration by the system designer, an external input can be used to inhibit a scheduled run.

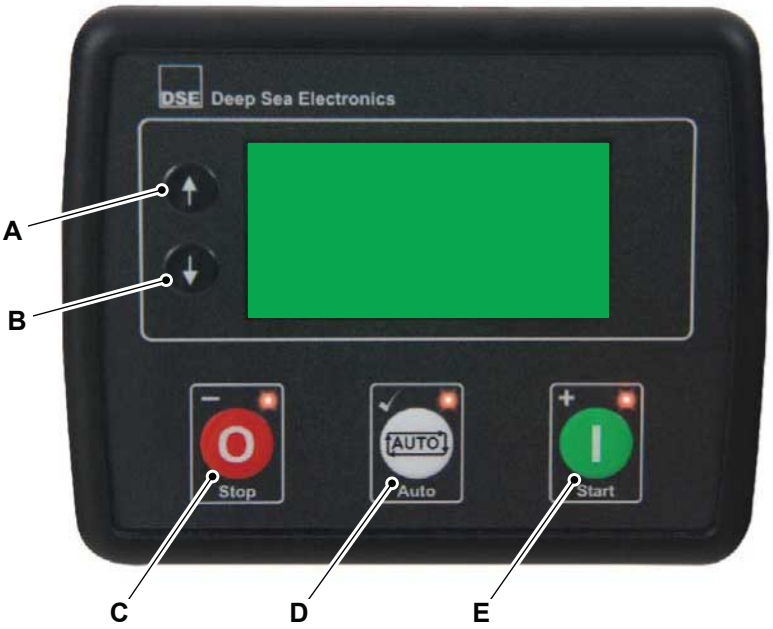
If the engine is running OFF LOAD in AUTO mode and a scheduled run configured to `On Load' begins, the set is placed ON LOAD for the duration of the schedule.

Front Panel Configuration

This configuration mode allows the operator to fully configure the module through its display without the use of the DSE Configuration Suite PC Software.

Use the module's facia buttons to traverse the menu and make value changes to the parameters.

Figure 39.



A Next Section (101-201-301)
B Previous Section (301-201-101)
C Previous Parameter (103-102-101)
D Edit or Save Parameter
E Next Parameter (101-102-103)

Accessing the Front Panel Configuration Editor

1. Press the STOP/RESET and AUTO buttons together to enter the editor mode.
2. Press the UP or DOWN navigation buttons to cycle through the front panel editor to select the required page in the configuration tables.
3. Press the MANUAL/START to select the next parameter or STOP/RESET to select the previous parameter within the current page.
4. When viewing the parameter to be edited, press the AUTO button, the value begins to flash.
5. Press the MANUAL/START or STOP/RESET buttons to adjust the value to the required setting.
6. Press the AUTO button the save the current value, the value ceases flashing.
7. Press and hold the AUTO button to save and exit the editor, the configuration icon is removed from the display.

Pressing and holding the MANUAL/START or STOP/RESET buttons will give auto-repeat functionality. Values can be changed quickly by holding the buttons for a prolonged period of time.

The editor automatically exits after 5 minutes of inactivity to ensure security.

The PIN number is automatically reset when the editor is exited (manually or automatically) to ensure security.

Commissioning

Before the system is started, it is recommended that the following checks are made:

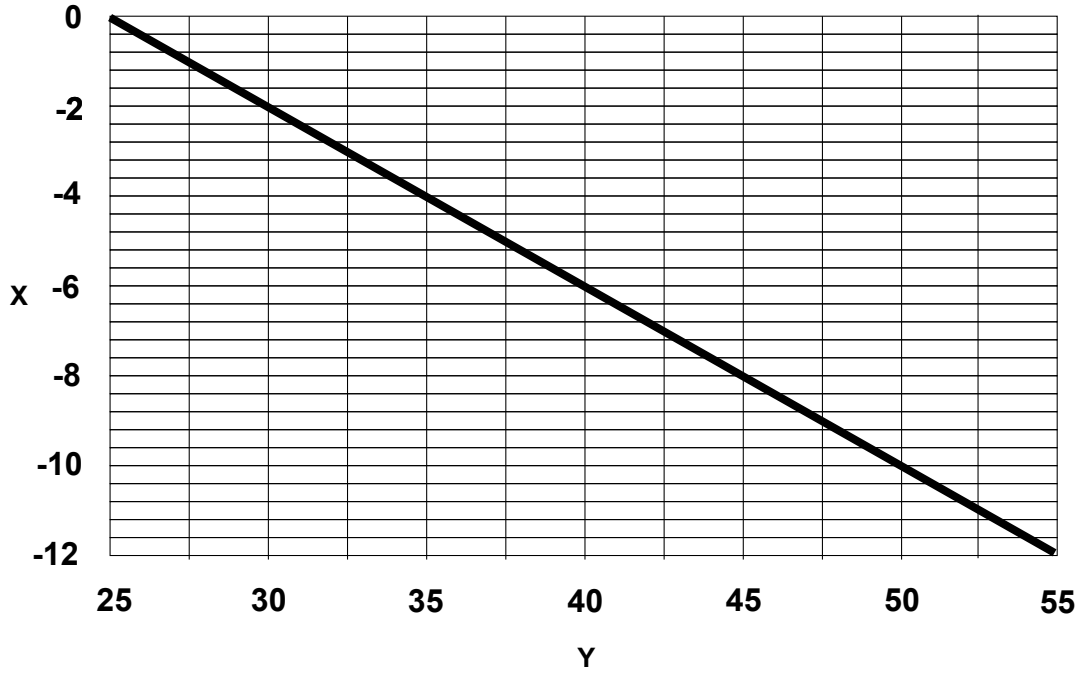
1. The unit is adequately cooled and all the wiring to the module is of a standard and rating compatible with the system.
2. Check all mechanical parts are fitted correctly and that all electrical connections (including earths) are sound.
3. The unit DC supply is fused and connected to the battery and that it is of the correct polarity.
4. The `Emergency Stop' input is wired to an external normally closed switch connected to DC negative.
5. To check the start cycle operation, take appropriate measures to prevent the engine from starting (disable the operation of the fuel solenoid). After a visual inspection to ensure it is safe to proceed, connect the battery supply. Press the MANUAL/START mode button the unit start sequence will commence.
6. The starter will engage and operate for the pre-set crank period. After the starter motor has attempted to start the engine for the pre-set number of attempts, the LCD will display `Failed to start.
7. Press the STOP/RESET mode button to reset the unit.
8. Restore the engine to operational status (reconnect the fuel solenoid).
9. Press the MANUAL/START mode button.
    9.1. This time the engine should start and the starter motor should disengage automatically. If not then check that the engine is fully operational (fuel available, etc.) and that the fuel solenoid is operating.
    9.2. The engine should now run up to operating speed. If not, and an alarm is present, check the alarm condition for validity, then check input wiring.
    9.3. The engine should continue to run for an indefinite period. It will be possible at this time to view the engine and alternator parameters.
10. Press the AUTO mode button, the engine will run for the pre-set cooling down period, then stop.
    10.1. The generator should stay in the standby mode. If not check that there is no signal present on the remote start input.
11. Initiate an automatic start by supplying the remote start signal (if configured).
    11.1. The start sequence will commence and the engine will run up to operational speed.
    11.2. Once the generator is available the delayed load outputs will activate, the generator will accept the load.
    11.3. If not, check the wiring to the delayed load output contactors. Check the warming timer has timed out.
12. Remove the remote start signal. The return sequence will begin. After the pre-set time, the generator is unloaded.
    12.1. The generator will then run for the pre-set cooling down period, then shutdown into its standby mode.
13. Set the modules internal clock/calendar to ensure correct operation of the scheduler and event logging functions.

Operating Environment

General

Power De-rating

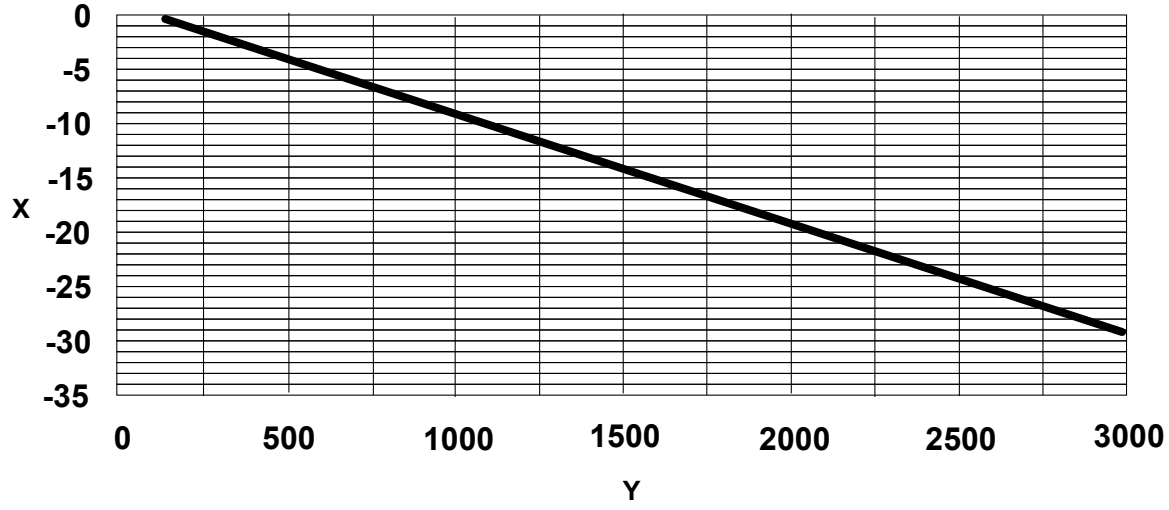
Figure 40. Power de-rating depending on operating air temperature above 25 degrees Celsius



X Power de-rating (%)

Y Air temperature (Celsius)

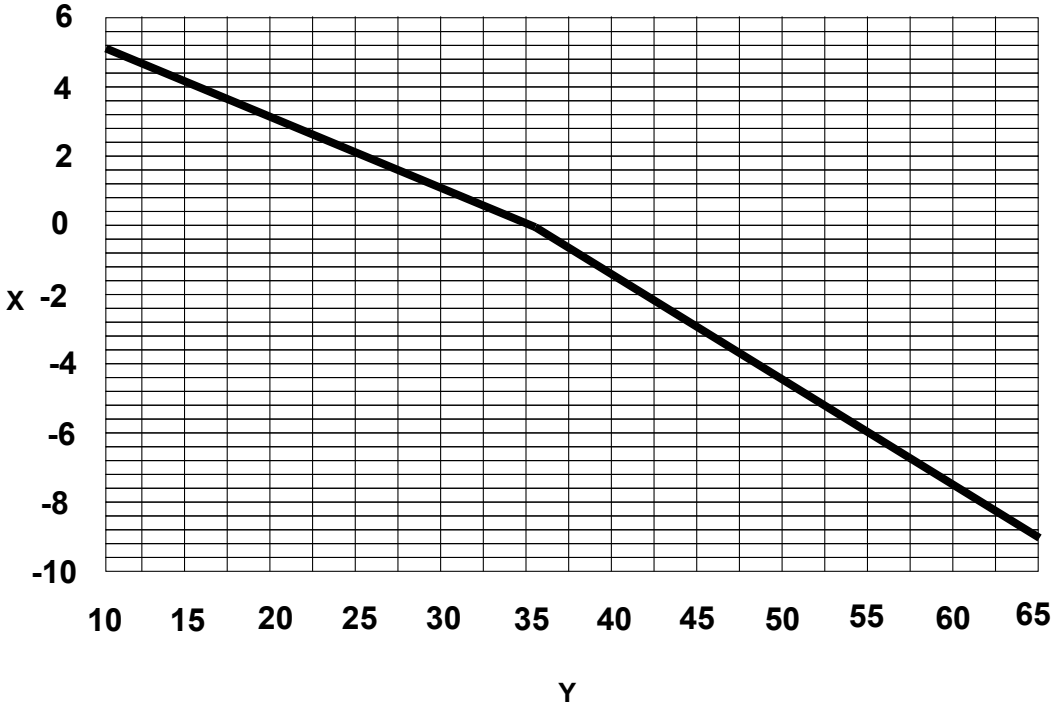
Figure 41. Power de-rating depending on operating altitude higher than 100m above sea level.



X Power de-rating (%)

Y Altitude above sea level (m)

Figure 42. Power de-rating depending on operating fuel temperature at injection pump inlet



X Power de-rating (%)

Y Fuel temperature (Celsius)

Derate Table

The generator output is affected by temperature and altitude. The following derate should be applied to take this into account.

Table 14.

Altitude	**Ambient Temperature**					
	-30°C (86.0°F)	-25°C (77.0°F)	-20°C (68.0°F)	-15°C (59.0°F)	-10°C (50.0°F)	-5°C (41.0°F)
Sea Level						
500 M						
1,000						
1,500						
2,000						
2,500						
3,000						
3,500	2%	2%	2%	2%	2%	2%
4,000	6%	6%	6%	6%	6%	6%
4,500	10%	10%	10%	10%	10%	10%
5,000	13%	13%	13%	13%	13%	13%

Table 15.

Altitude	**Ambient Temperature**						
	0°C (32.0°F)	5°C (41.0°F)	10°C (50.0°F)	15°C (59.0°F)	20°C (68.0°F)	25°C (77.0°F)	30°C (86.0°F)
Sea Level							
500 M							
1,000							
1,500							

Altitude	**Ambient Temperature**						
2,000						4%	5%
2,500					1%	7%	8%
3,000		1%	1%	3%	4%	10%	11%
3,500	2%	5%	5%	7%	8%	13%	15%
4,000	6%	8%	9%	11%	11%	16%	18%
4,500	10%	12%	13%	14%	15%	20%	21%
5,000	13%	16%	16%	18%	18%	23%	24%

Table 16.

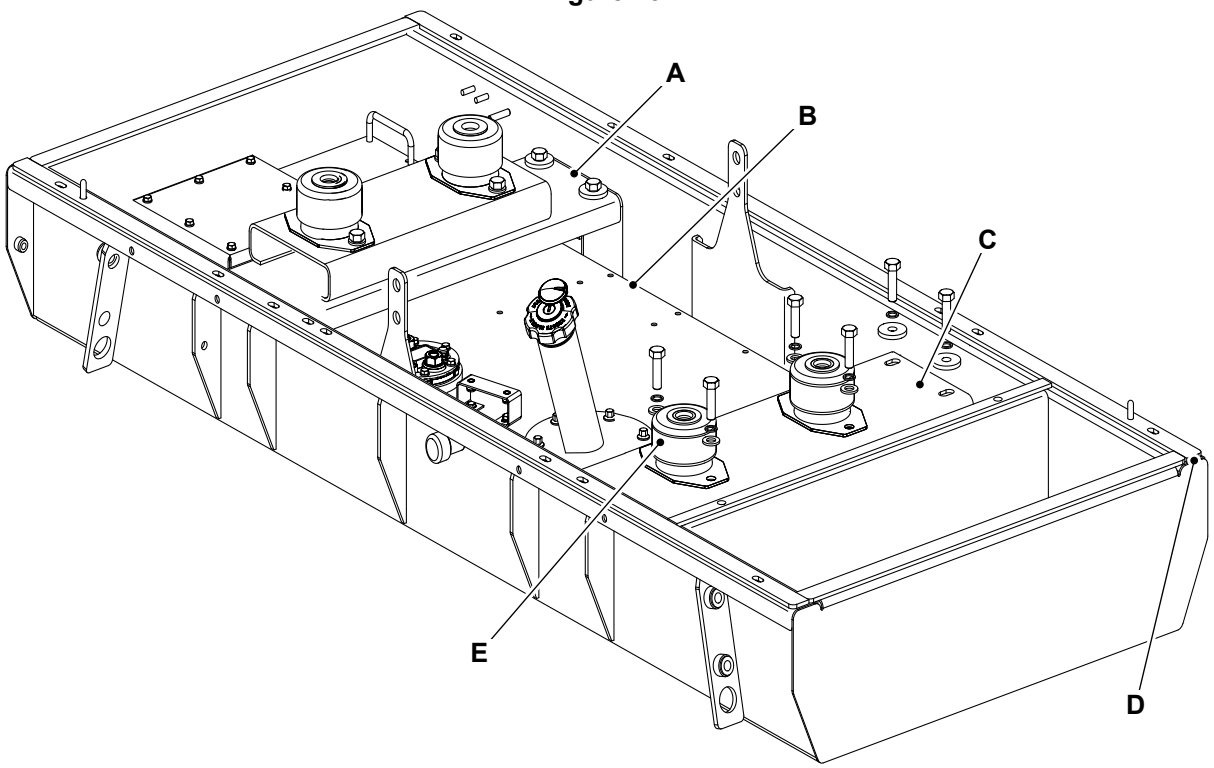
Altitude	**Ambient Temperature**					
	35°C (95.0°F)	40°C (103.9°F)	45°C (112.9°F)	50°C (121.9°F)	55°C (130.9°F)	60°C (139.9°F)
Sea Level			4%	7%	9%	11%
500 M			4%	7%	9%	11%
1,000			4%	7%	9%	11%
1,500		4%	8%	11%	13%	16%
2,000	7%	9%	13%	16%	17%	21%
2,500	10%	12%	16%	19%	21%	24%
3,000	13%	15%	19%	22%	24%	27%
3,500	17%	18%	22%	24%	26%	27%
4,000	20%	22%	25%	27%	29%	30%
4,500	23%	25%	28%	30%	32%	33%
5,000	27%	28%	31%	33%	34%	36%

Attachments
Working with Attachments

Attachments for your Machine

Bunding Tank

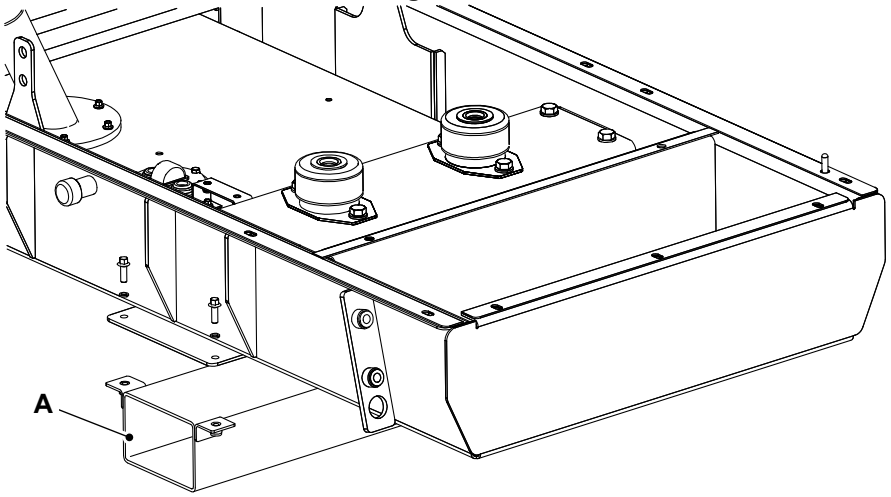
Figure 43.



A Alternator mounting plate
B Fuel bunding tank
C Engine mounting plate
D Bunding tank base frame
E Generator AVM

Fork Pockets

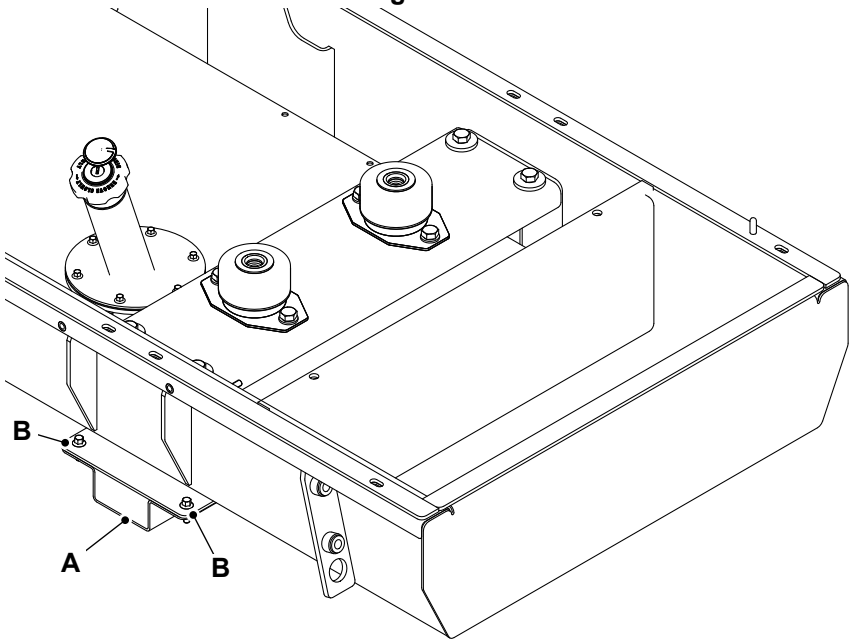
Figure 44.



A Fork pocket

Transportation Bracket

Figure 45.

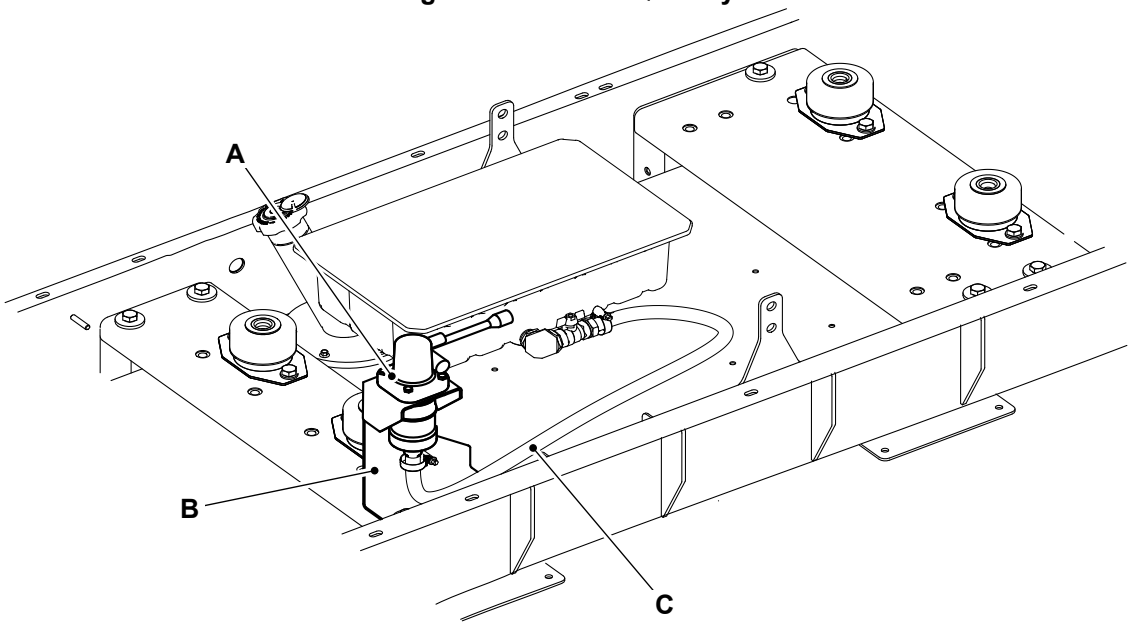


A Transportation bracket **B** Bolts

Transportation brackets is a temporary installation and must be removed after transportation. Loosen the bolts to remove all the four transportation bracket from the generator base. Refer to Figure 45.

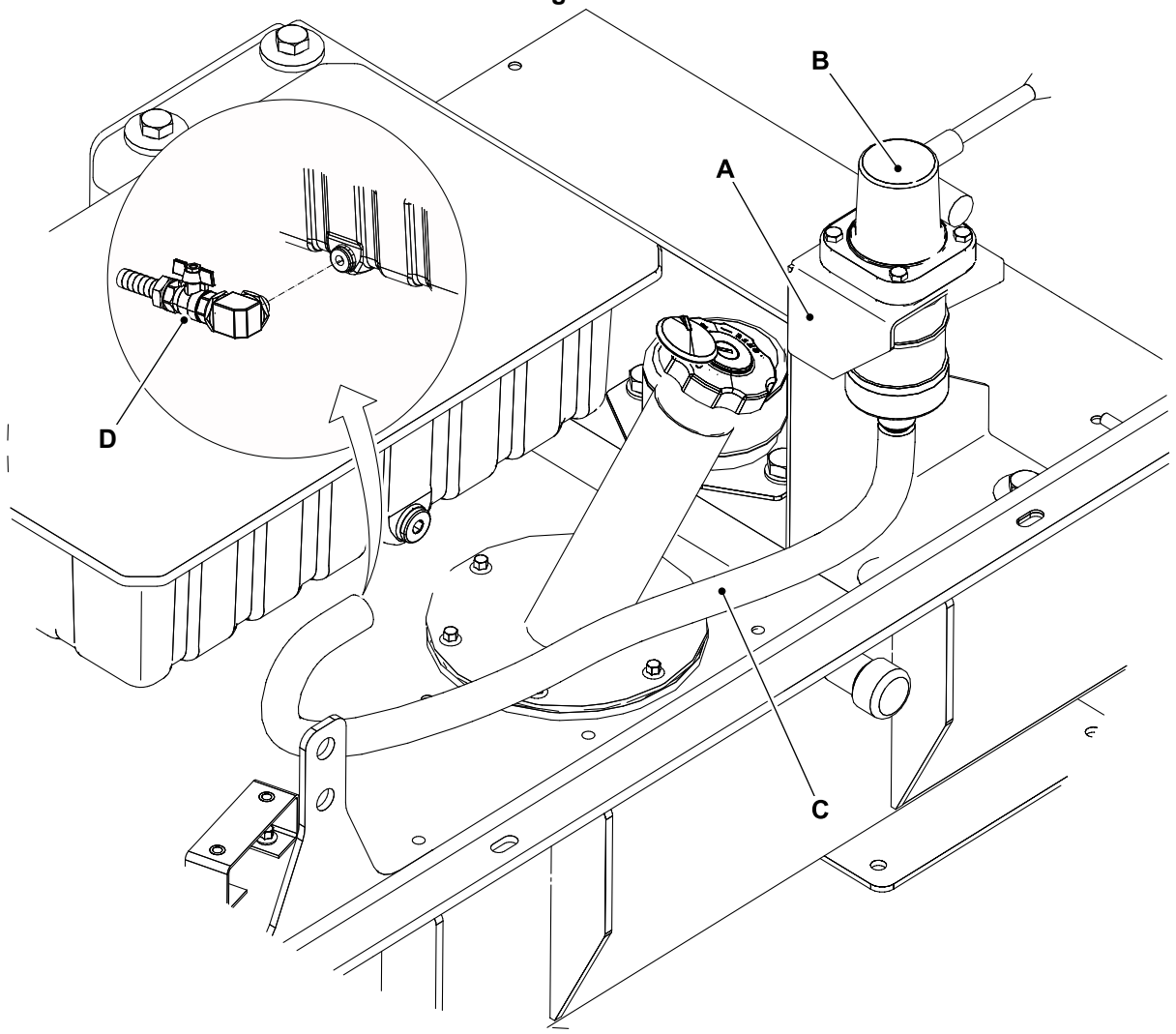
Oil Drain Valve/Pump Assembly

Figure 46. For G20QS Only



A Drain pump **B** Drain pump mounting bracket
C Hose

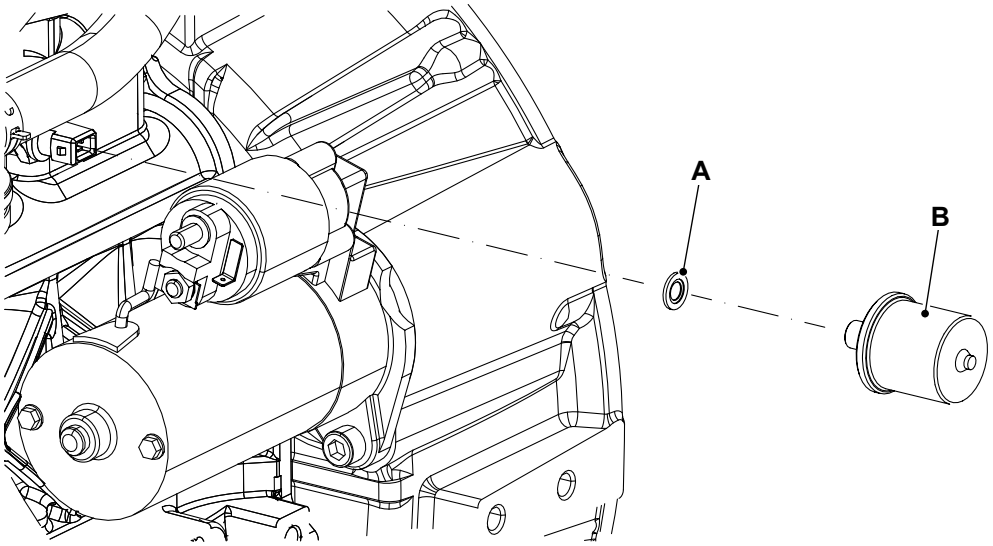
Figure 47.



A Drain pump mounting bracket
B Drain pump
C Hose
D Drain valve

Oil Pressure Sensor

Figure 48.

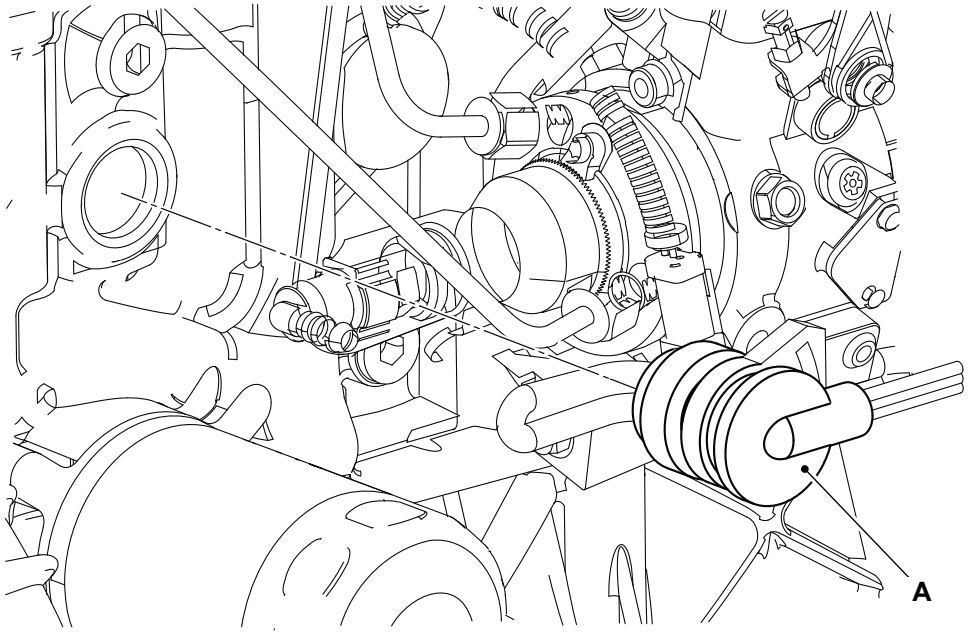


A Bonded seal

B Pressure transducer

Water Jacket Heater

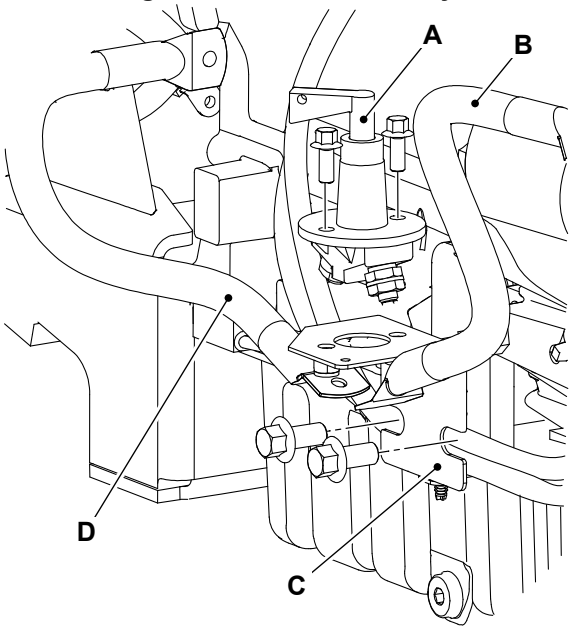
Figure 49.



A Block heater thermostat

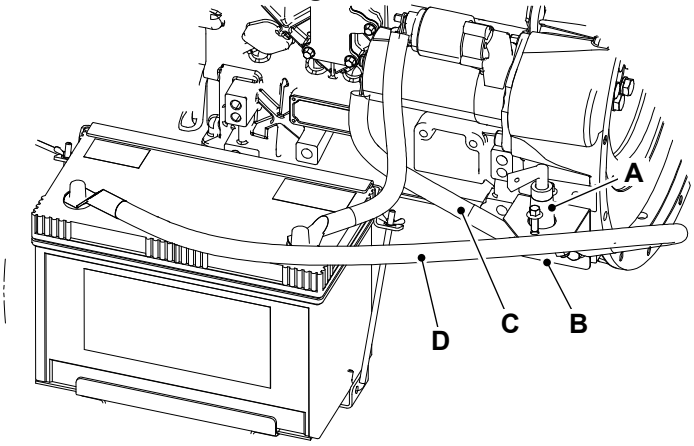
Battery Isolator

Figure 50. For G20QS Only



A Isolator switch
B Cable (Battery negative to isolator)
C Battery isolator mounting bracket
D Cable (Isolator to starter motor)

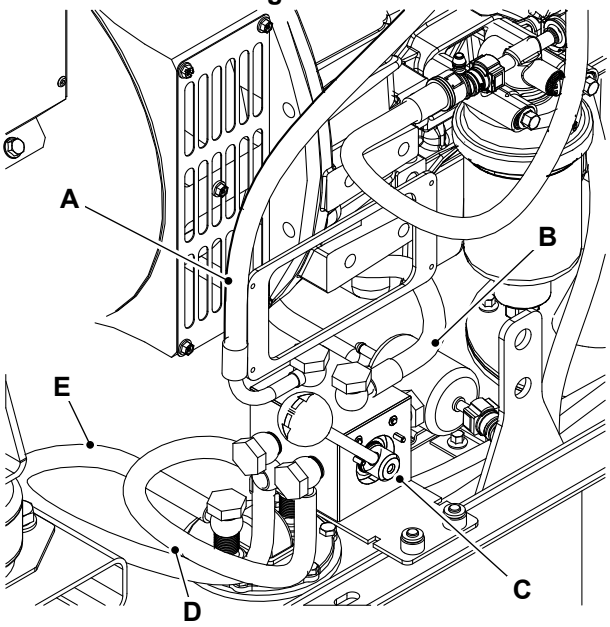
Figure 51.



A Isolator switch
B Battery isolator mounting bracket
C Cable (Isolator to starter motor)
D Cable (Battery negative to isolator)

3 Way Fuel Valve (WFV)

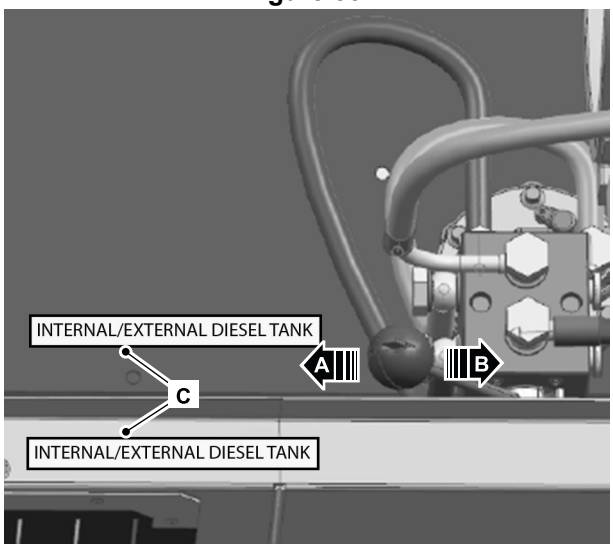
Figure 52.



A Return line (Engine return to 3WFV)
B Forward line (3WFV to lift pump inlet)
C 3 way fuel valve
D Return line (3WFV outlet to fuel tank)
E Forward line (Fuel tank suction to 3WFV)

Always refer to the direction label for the selection of internal /external tank. Refer to Figure 53.

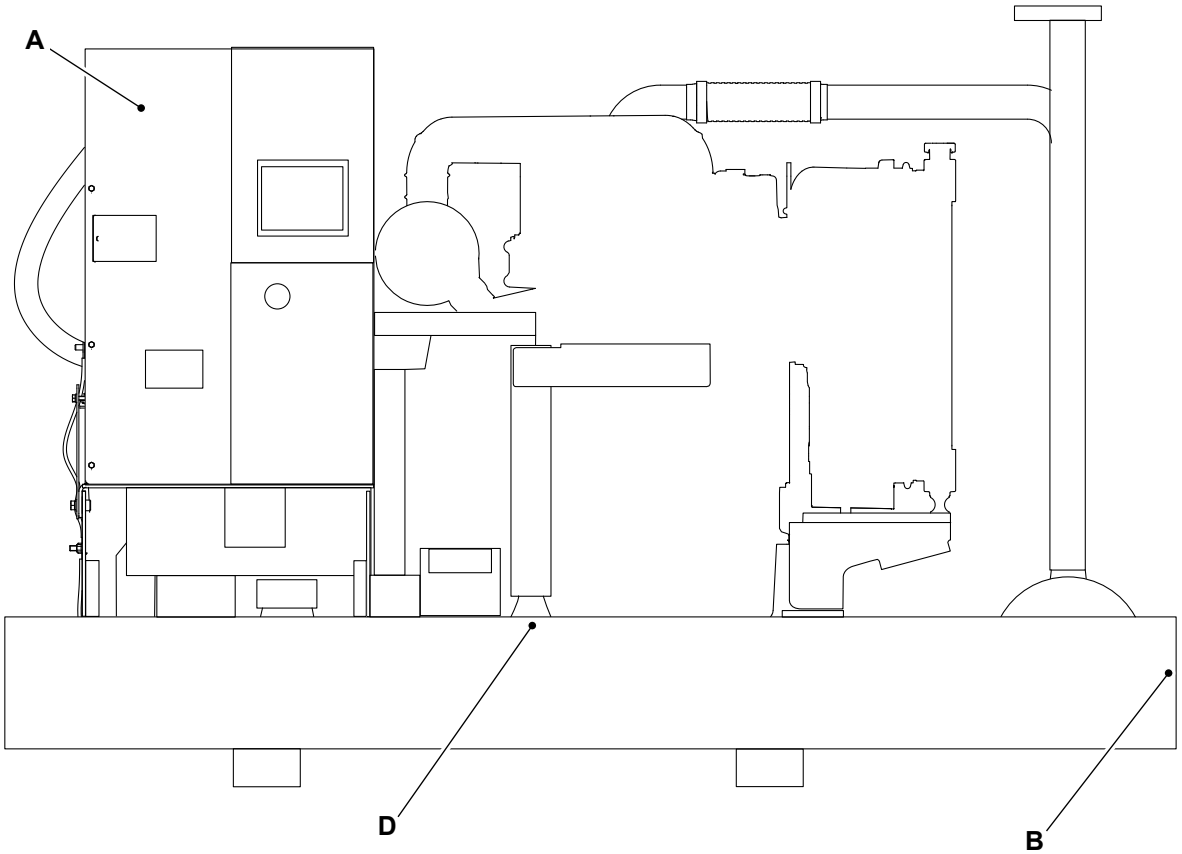
Figure 53.



A Internal tank
B External tank
C Direction label

Canopy Delete Z0

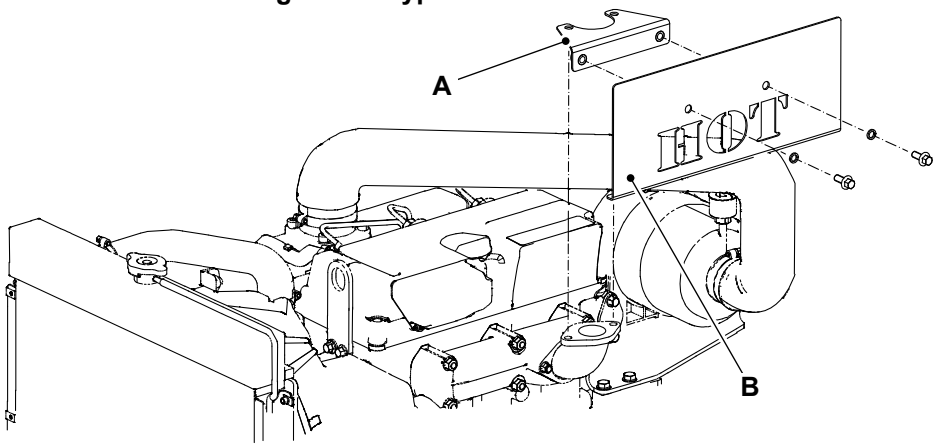
Figure 54. Typical Generator



A Electrical installation
B Skid installation
D Fuel system installation

CE Hot Guards

Figure 55. Typical Hot Guard Plate



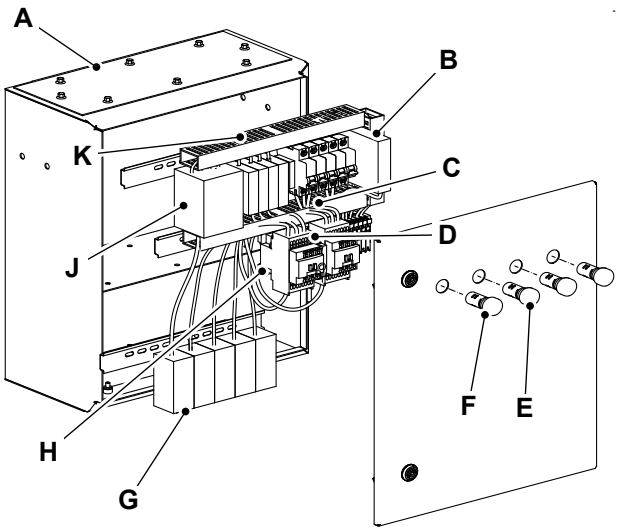
A Mounting bracket

B CE hot guard

ATP Panel

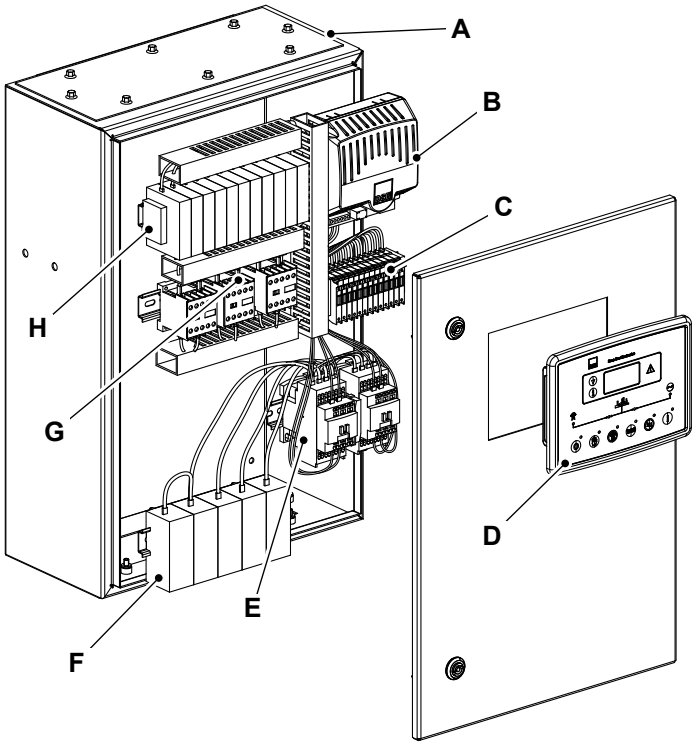
ATP panel installation differ according to ampere requirements.

Figure 56.



A Control panel box
B Monitoring relay
C MCB stopper
D Mechanical Interlock
E Indicator LED (yellow)
F Indicator LED (red)
G Power busbar terminal
H AC contactor
J Voltage surge suppressor
K PVC duct

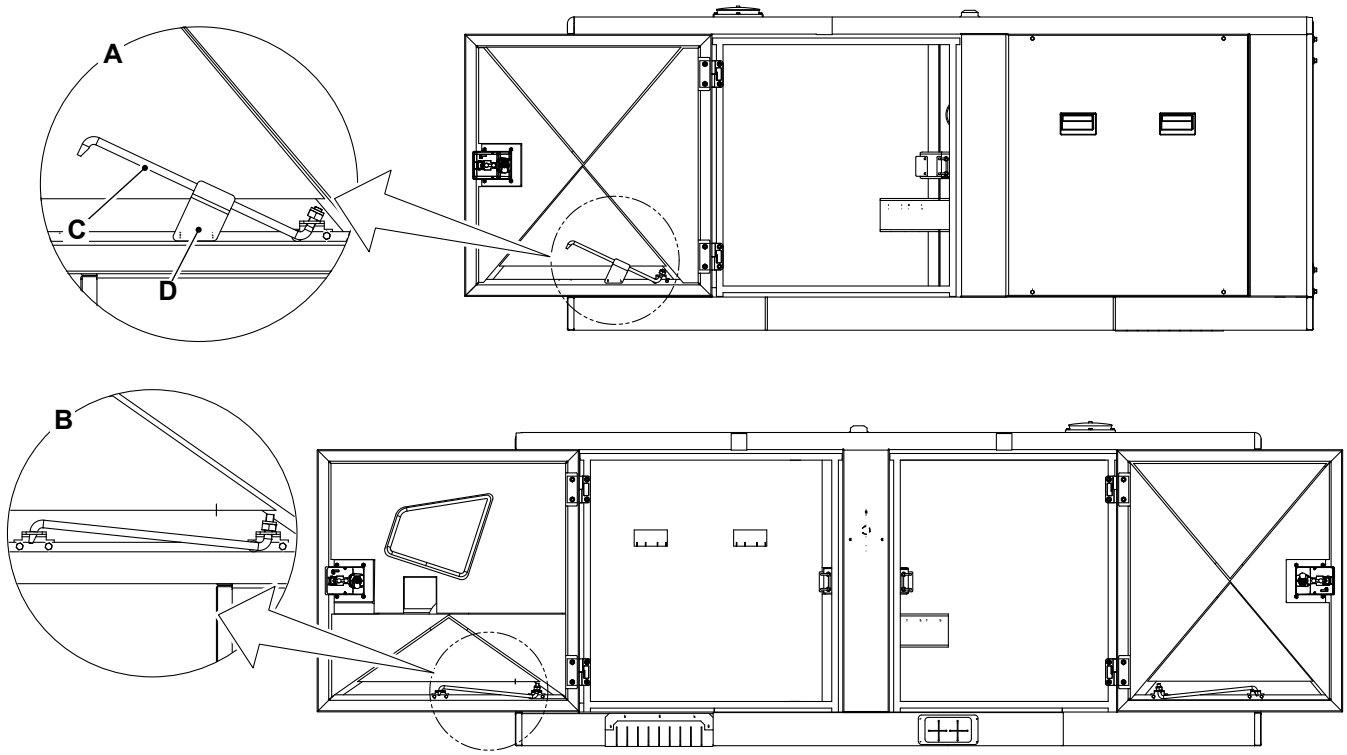
Figure 57.



A Control panel box
B Self seeking power supply
C Terminal block
D Controller
E AC contactor
F Power busbar terminal
G Control relay
H MCB stopper

Door Stop Arrangement

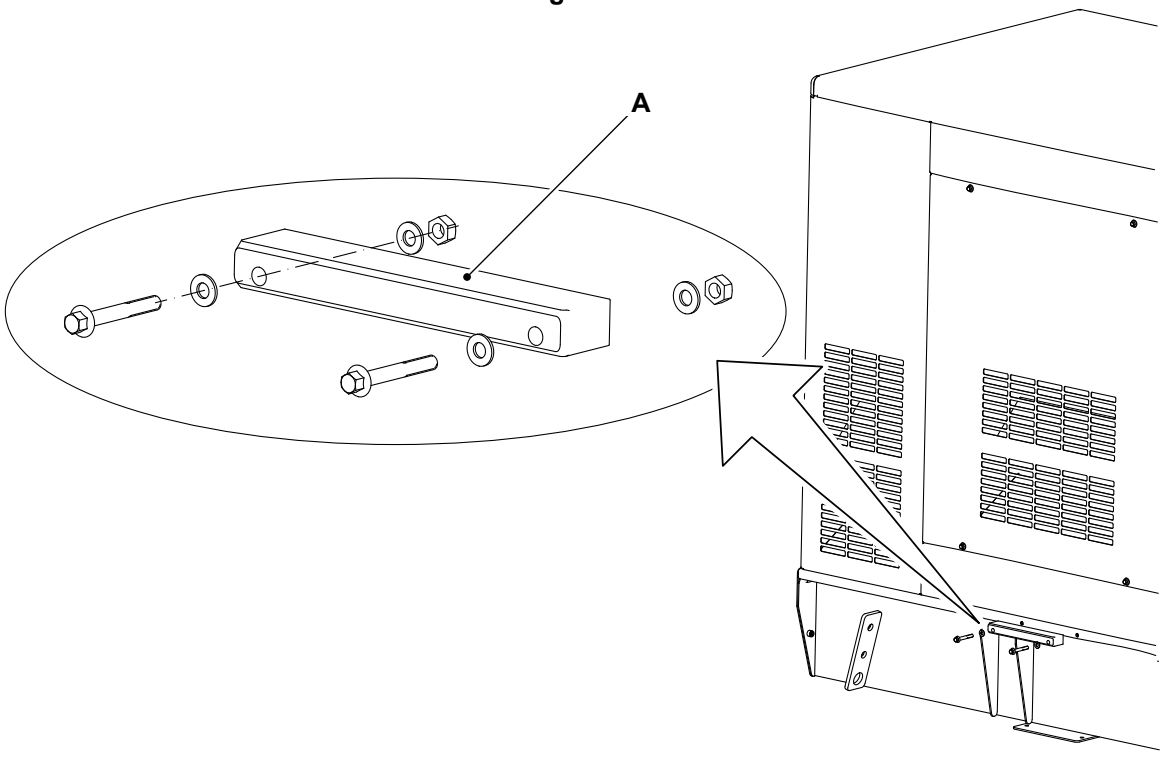
Figure 58.



A Position 1
B Position 2
C Door retainer bracket
D Door retainer link

Canopy Protection Kit

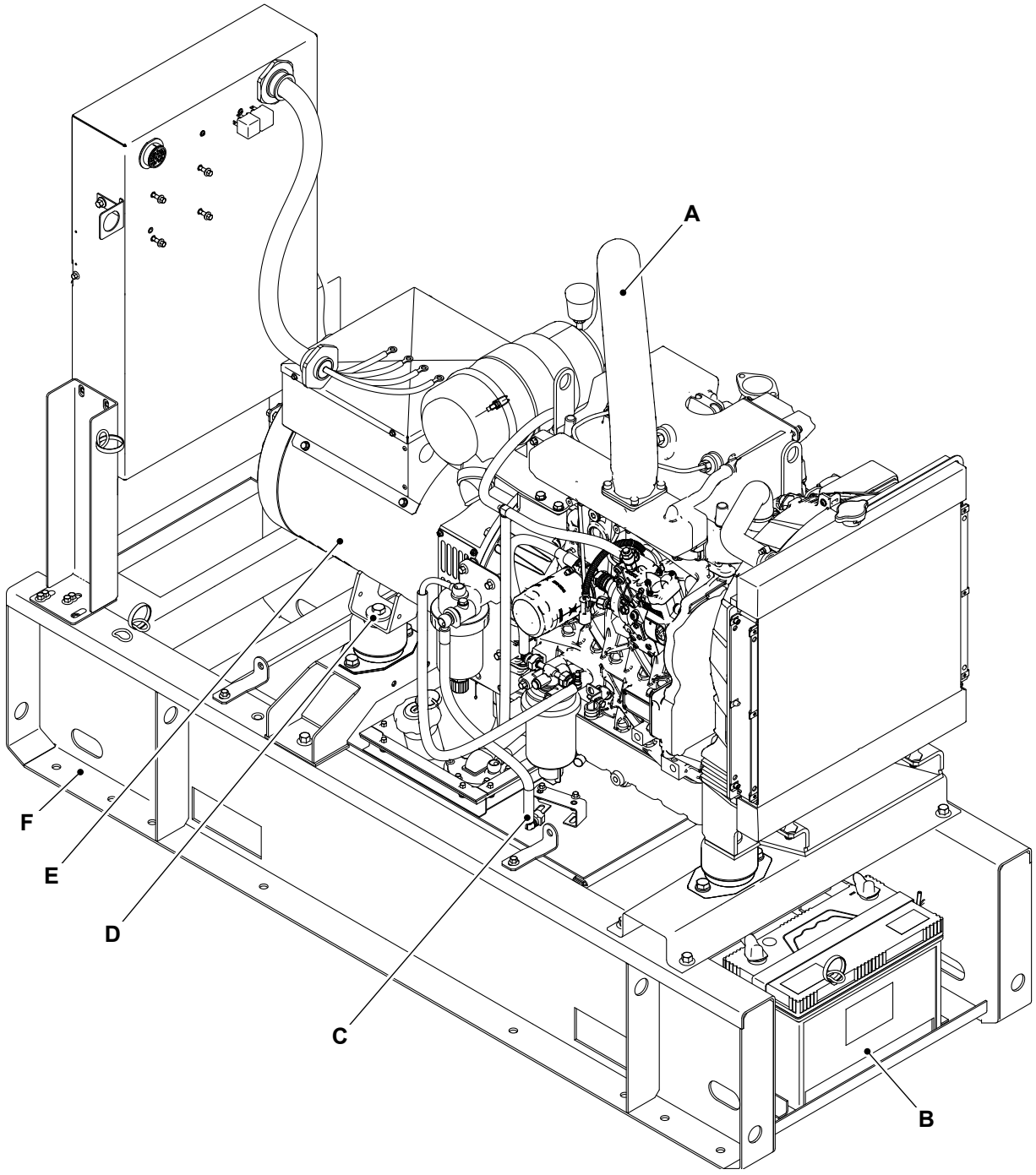
Figure 59.



A Canopy protection block

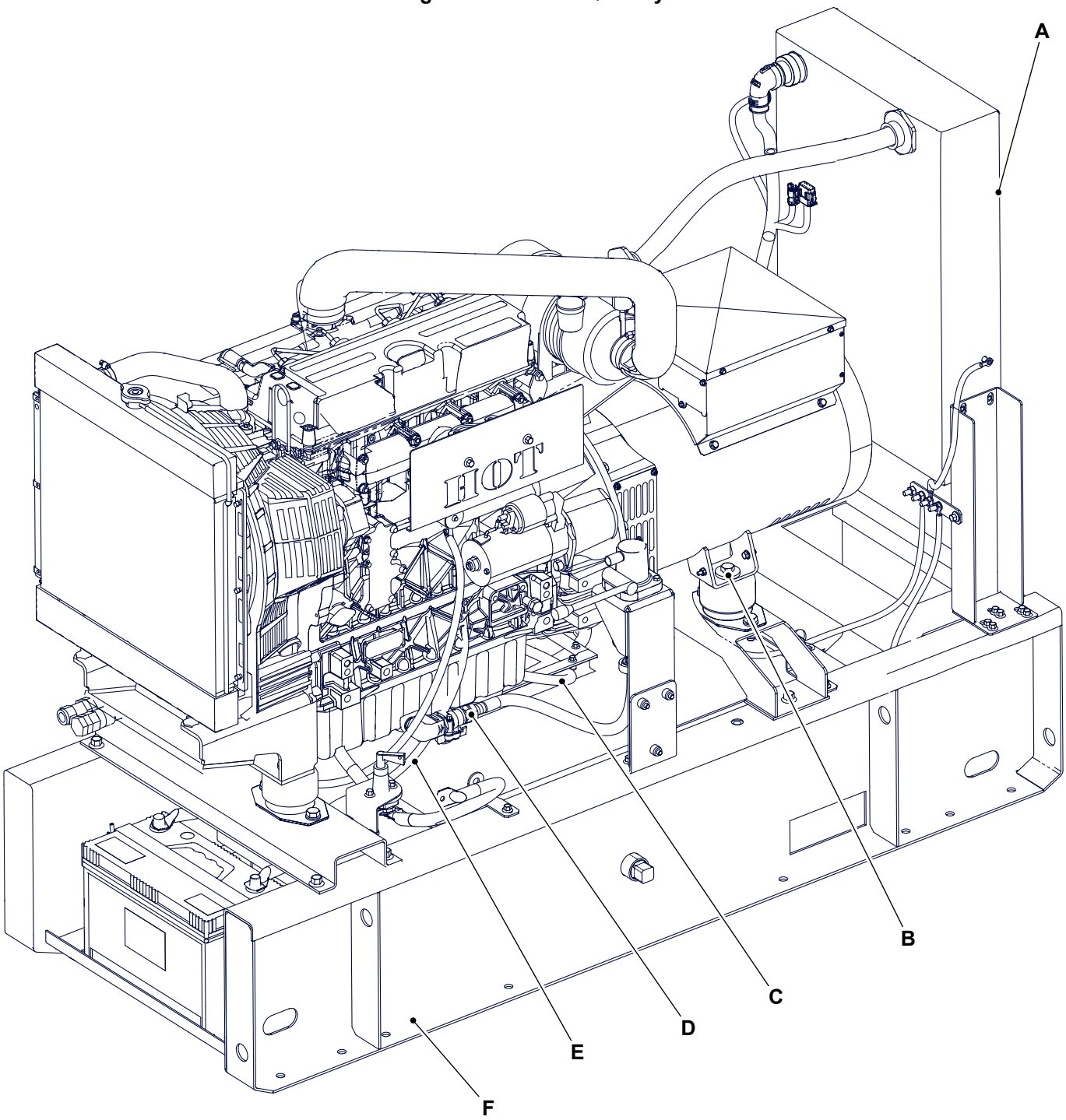
Open Set Dedicated Design

Figure 60. For G20QS Only



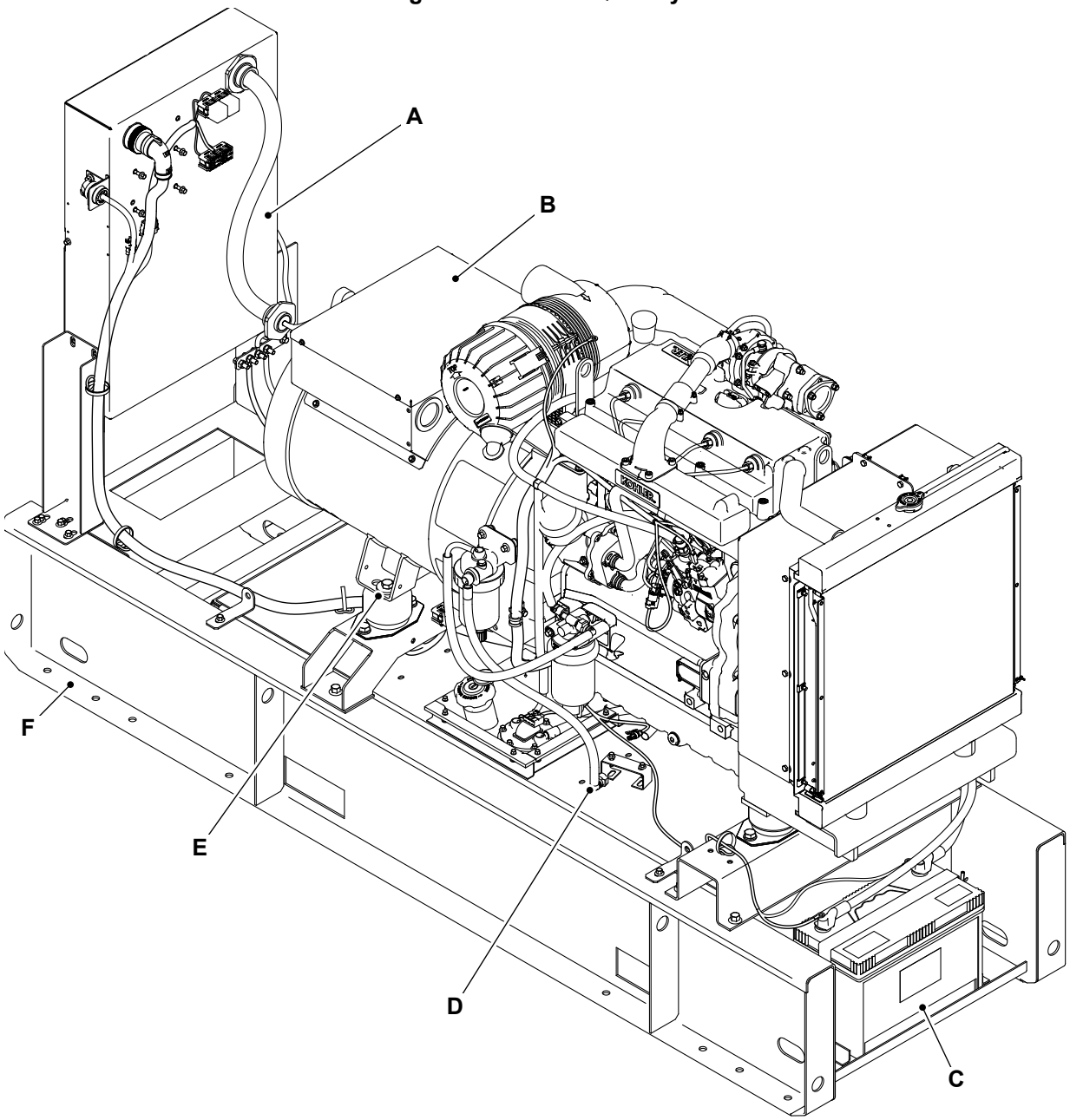
A KDI
B Battery installation
C Fuel system installation
D Generator installation
E Generator
F Base frame

Figure 61. For G27QS Only



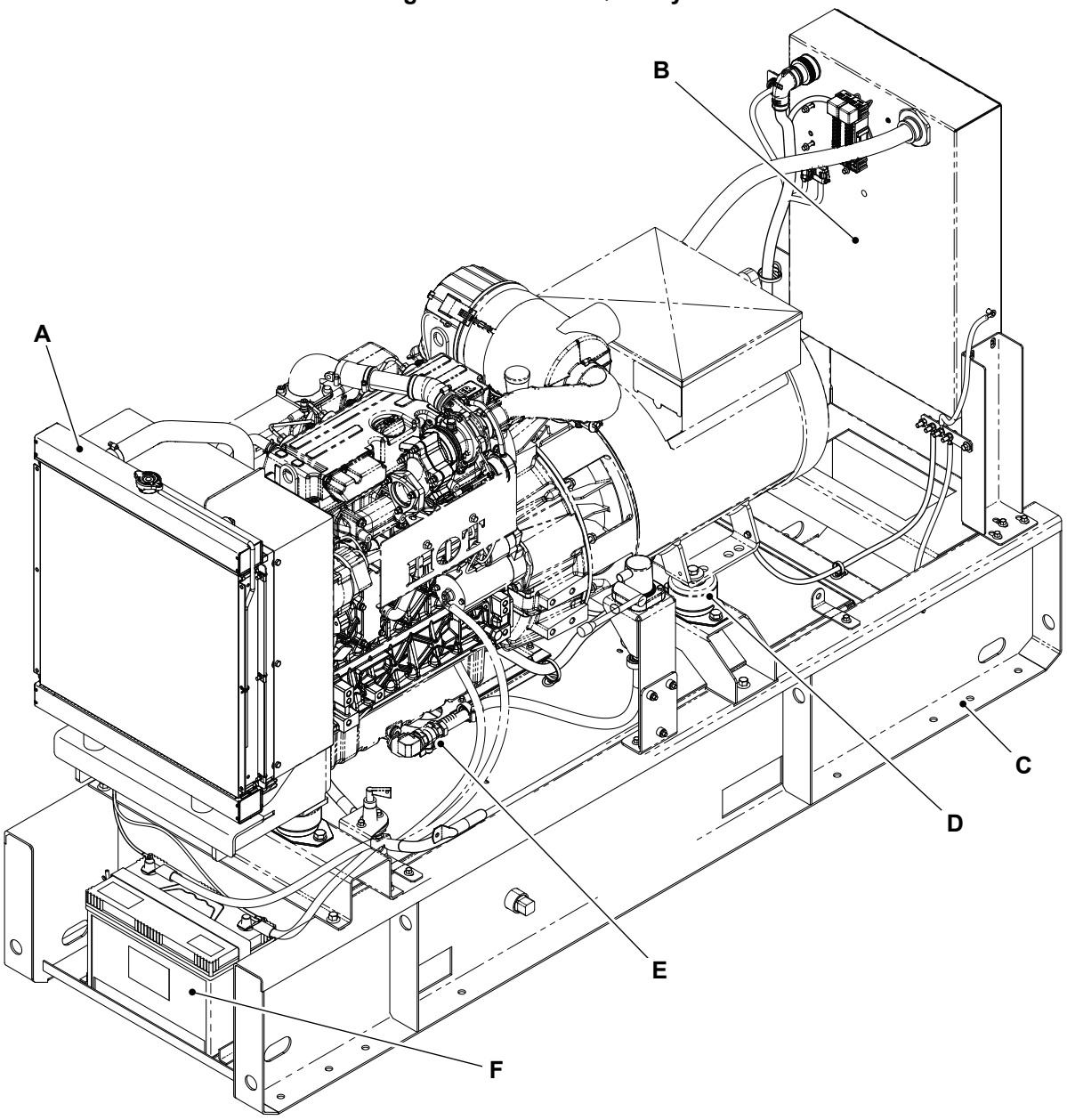
A Electrical installation
B Generator installation
C Fuel system installation
D G drive installation
E Battery installation
F Base frame

Figure 62. For G40QS Only



A Electrical installation
B Alternator
C Battery installation
D Fuel system installation
E Generator installation
F Base frame

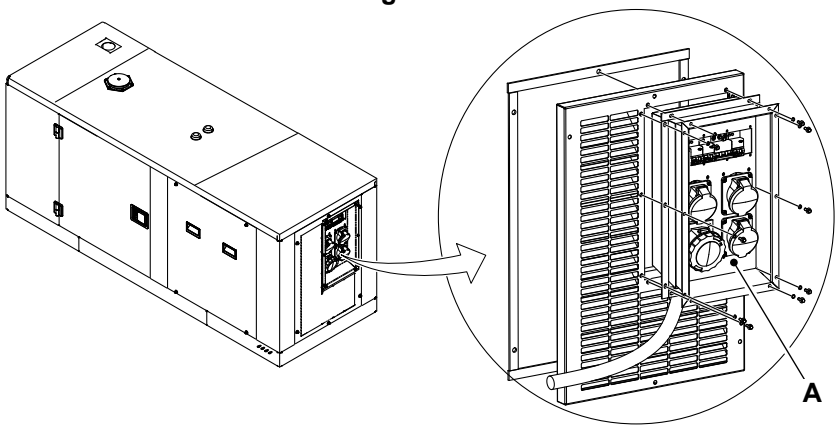
Figure 63. For G45QS Only



A KDI
B Electrical installation
C Base frame
D Generator installation
E G drive installation
F Battery installation

Socket Box

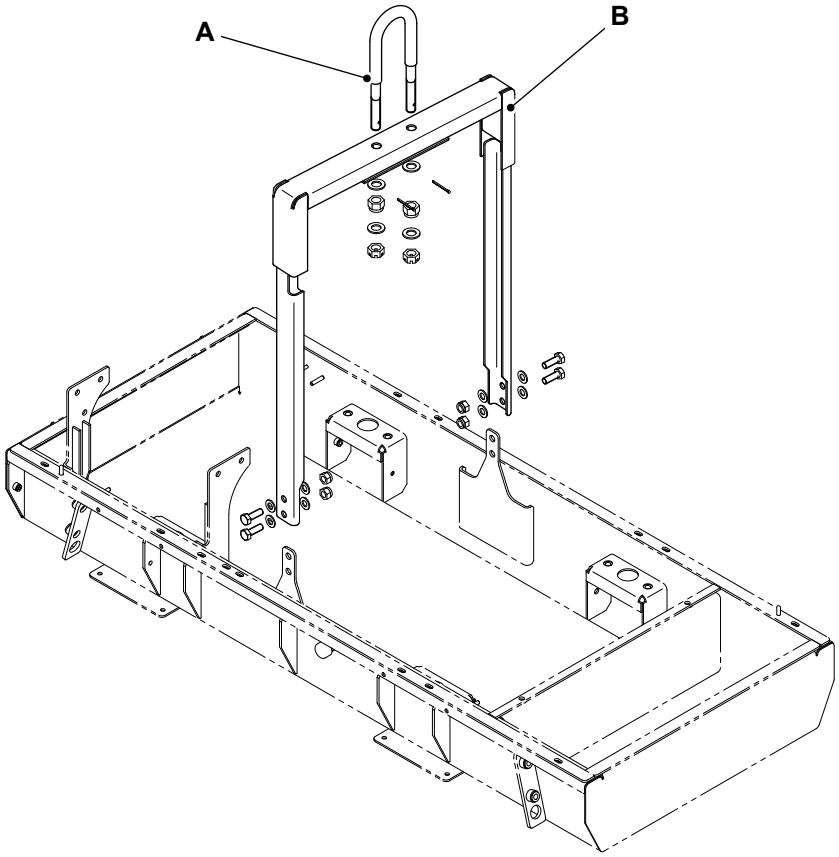
Figure 64.



A Socket box

Lifting Frame Single Point

Figure 65.

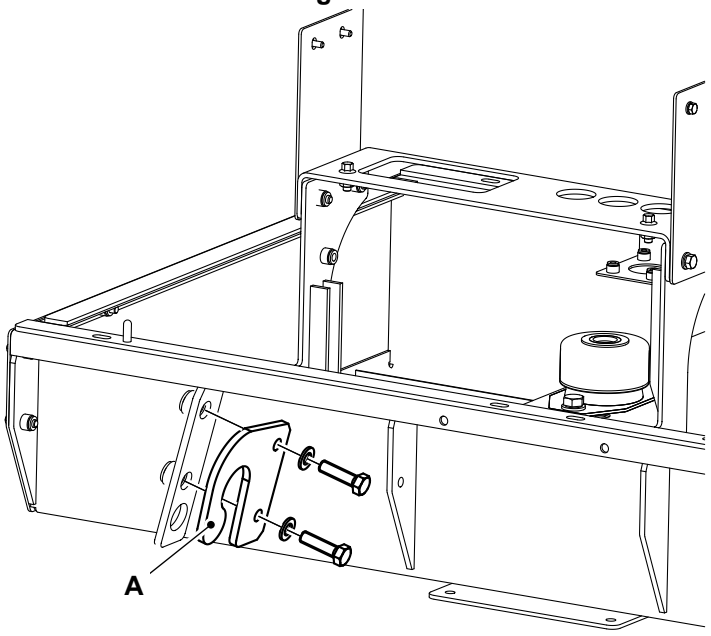


A Lifting hook

B Lifting frame

Four Point Lifting Kit

Figure 66.

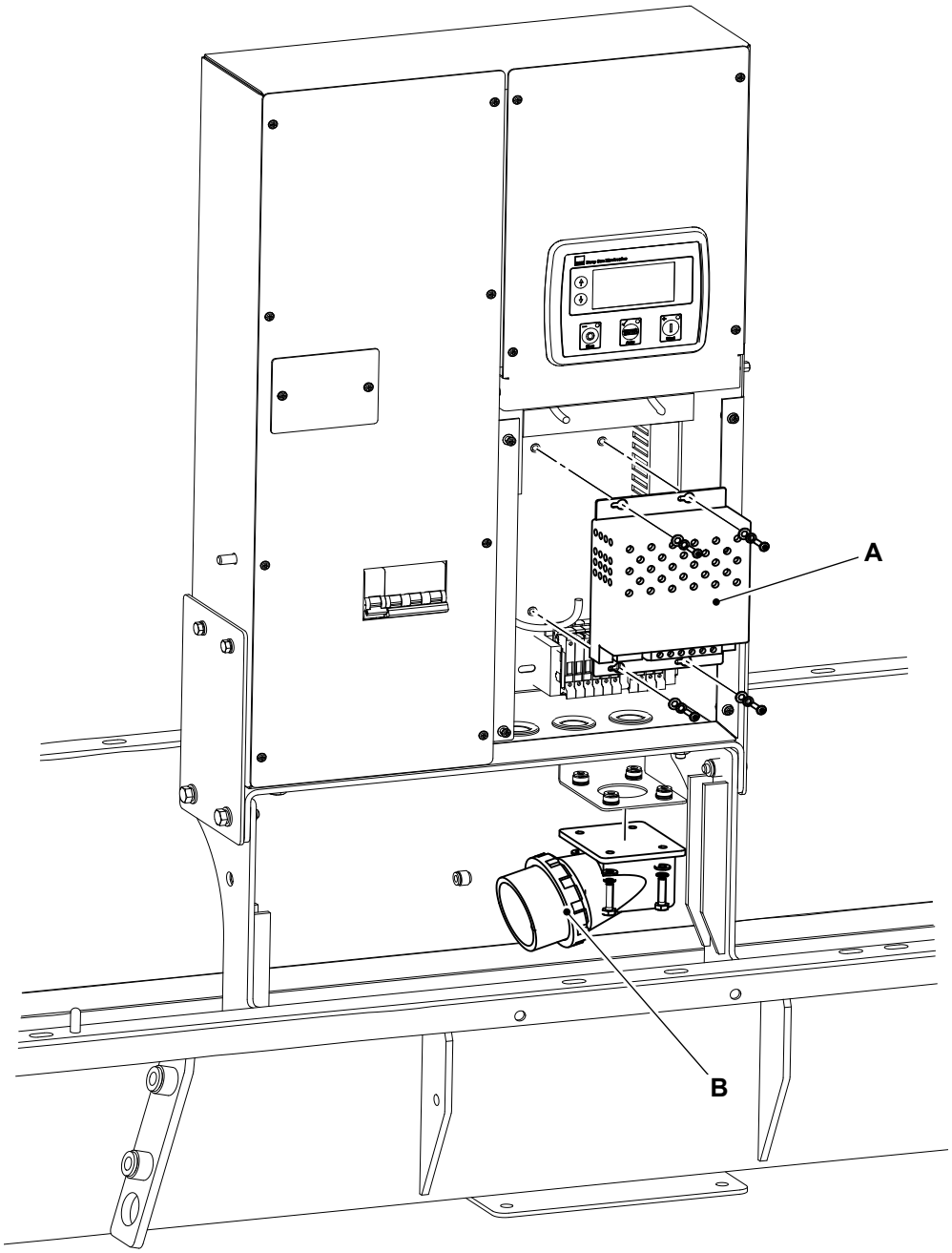


A Lifting hook

Battery Charger

27- 45kVA

Figure 67.

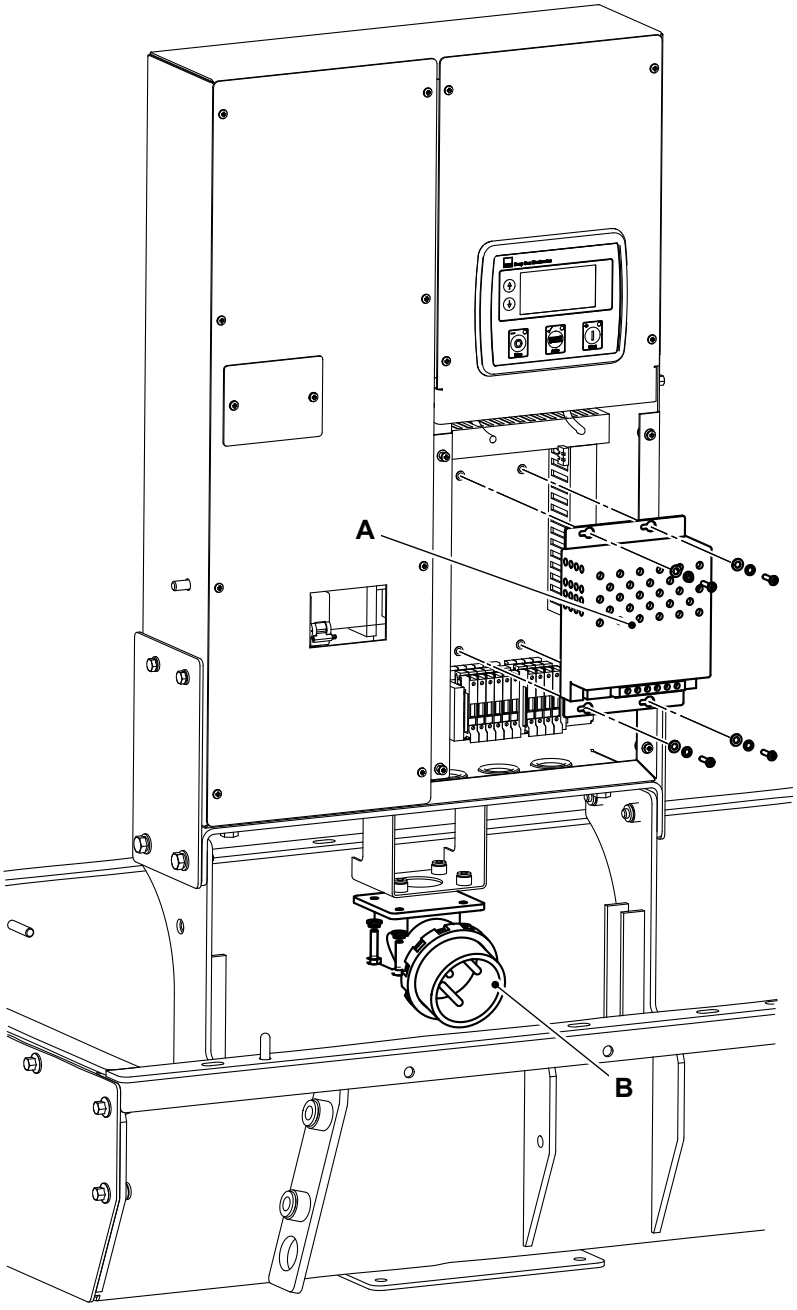


A Lead acid battery charger

B 230V AC, 16A 1P44 plug

20kVA

Figure 68.

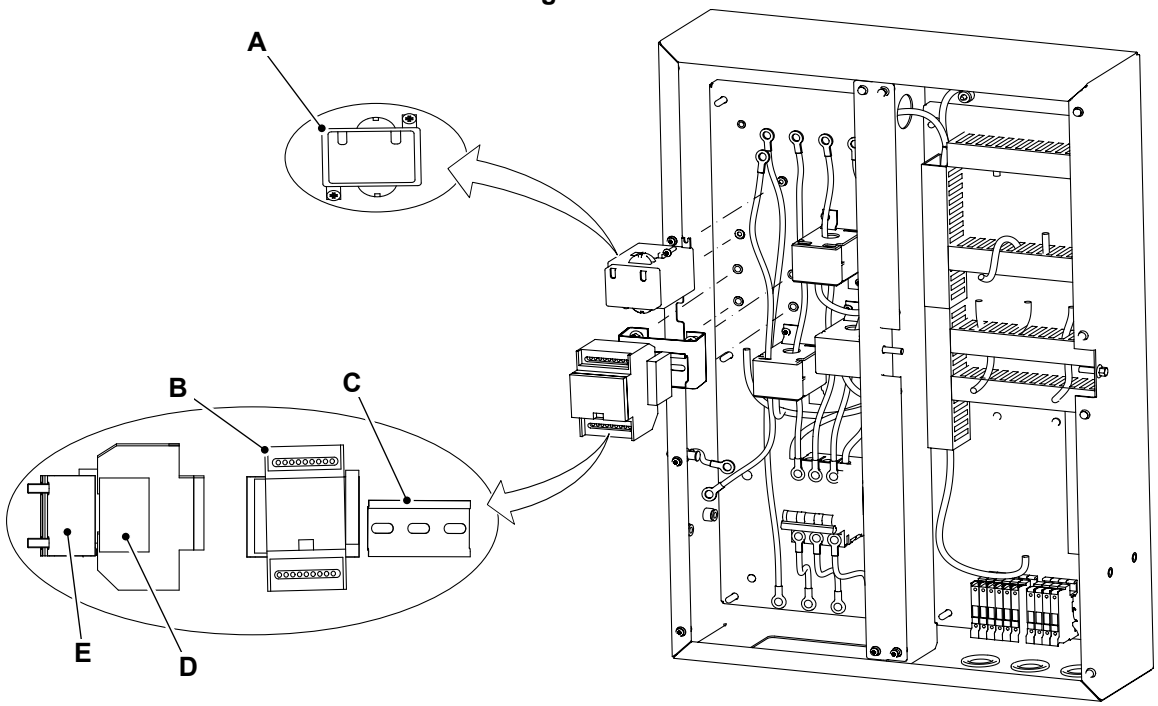


A Lead acid battery charger

B 230V AC, 16A 1P44 plug

EFR

Figure 69.



A Current transducer
B Earth leakage relay
C Din rail
D MCB Stopper
E Earth leakage bracket

Notes:

Preservation and Storage
Cleaning

General

1. Stop the machine and allow it to cool for at least one hour. Do not attempt to clean any part of the machine while it is running.
2. Ensure all electrical loads are disconnected and the generator is made safe by disconnecting at the breaker, turning off the machine and activating the emergency stop switch.
3. Make sure that all electrical connectors are correctly coupled. If connectors are open fit the correct caps or seal with water proof tape.
4. Make sure that the oil filler caps and dipstick are correctly installed.
5. Apply an approved cleaning and degreasing agent with a brush. Obey the manufacturers instructions.
6. Wipe the outer body with cloth.

Maintenance
Introduction

General

⚠ **WARNING** The engine has exposed rotating parts. Switch off the engine before working in the engine compartment. Do not use the machine with the engine cover open.

WARNING The machine can auto-start You must isolate the engine start circuit before you start service or maintenance procedures.

CAUTION Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

CAUTION To avoid burning, wear personal protective equipment when handling hot components. To protect your eyes, wear goggles when using a brush to clean components.

It is recommended that set maintenance is carried out on a regular basis. Machine maintenance requirements should be followed to maintain warranty validity. Refer to: Maintenance Schedules (Page 88). A regular preventative maintenance schedule is highly recommended in order to preserve the life of the generating set. A generating set in stand-by application and in a healthy environment will require visual inspection approximately once a month, while the same generating set in dusty, damp or humid climates will require inspection and maintenance more often than this. Generating set preventative maintenance depends on generating set environment, application and workload all these factors should be taken into consideration when planning a maintenance schedule for the machine.

Daily checks should include a minimum of visual inspections for fluid leaks, loose connections, contamination, debris etc. in addition to the recommended maintenance tasks.

If the generator is not being sufficiently loaded on a regular basis it may cause coking of the engine and exhaust system which may cause excessive smoke and contamination of the lubrication oil. To avoid this problem ensure the load on the generator is suitable (typically 60% or more of the generator maximum load). If this problem does occur, then additional load will need to be applied to rectify the problem.

Connecting a load bank (additional electrical load) should be a routine action at normal service intervals if the machine regularly operates at part load (less than 60%). In addition the lubrication oil should also be assessed and a reduced service interval (possibly 50% of the recommended interval) should be adopted.

Equipment utilizing the engine must be correctly switched off and prepared, for example safety circuit brakers tripped, prior to completing maintenance tasks on the engine. Maintenance must be completed by suitably qualified personnel. You or others could be killed or seriously injured if the machine is not correctly prepared and maintained. To obtain the best performance from your engine, make sure that the service tasks are completed at the recommended period. If the machine/engine is working in adverse conditions, then the service intervals should be reduced, examples of adverse conditions are:

- operating in a very dusty environment
- operating at light load for long periods
- operating in an environment with lots of chaff
- operating in an extremely hot or cold environment
- operating continuously at high altitude
- operating in an environment with high humidity
- operating with a low quality fuel. All maintenance procedures

Maintenance Safety

General

Exhaust Gases

Machine exhaust gases can harm and possibly kill you or bystanders if they are inhaled. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, install an exhaust extractor. If you begin to feel drowsy, stop the machine at once and get into fresh air.

Communications

Bad communications can cause accidents. If two or more people are working on the machine, make sure each is aware of what the others are doing. Before starting the engine make sure the others are clear of the danger areas. Examples of danger areas are: the rotating blades and belt on the engine, the attachments and linkages, and anywhere beneath or behind the machine. People can be killed or injured if these precautions are not taken.

Machine Modifications

This machine is manufactured in compliance with prevailing legislative requirements. It must not be altered in any way which could affect or invalidate its compliance. For advice consult your JCB dealer.

Repairs

If your machine does not function correctly in any way, get it repaired straight away. Neglect of necessary repairs could result in an accident or affect your health. Do not try to do repairs or any other type of maintenance work you do not understand. To avoid injury and/or damage get the work done by a specialist engineer.

'O' rings, Seals and Gaskets

Badly installed, damaged or rotted 'O' rings, seals and gaskets can cause leakages and possible accidents. Renew whenever disturbed unless otherwise instructed. Do not use Triochloroethane or paint thinners near 'O' rings and seals.

Hot Components

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

Chemicals

Certain seals and gaskets (e.g. crankshaft oil seal) on JCB machines contain fluoroelastomeric materials such as Viton®, FluorelTM and Technoflon®. Fluoroelastomeric materials subjected to high temperatures can produce highly corrosive hydrofluoric acid. This acid can severely burn. New fluoroelastomeric components at ambient temperature require no special safety precautions. Used fluoroelastomeric components whose temperatures have not exceeded 300°C (571.6°F) require no special safety precautions. If evidence of decomposition (e.g. charring) is found, refer to the next paragraph for safety instructions. Do not touch component or surrounding area. Used fluoroelastomeric components subjected to temperatures greater than 300°C (571.6°F) (e.g. engine fire) must be treated using the following safety procedure. Make sure that heavy duty gloves and special safety glasses are worn: Thoroughly wash contaminated area with 10% calcium hydroxide or other suitable alkali solution, if necessary use wire wool to remove burnt remains. Thoroughly wash contaminated area with detergent and water. Contain all removed material, gloves etc. used in this operation in sealed plastic bags and dispose of in accordance with Local Authority Regulations. Do not burn fluoroelastiometric materials.

Oil

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

Fires

If your machine is equipped with a fire extinguisher, make sure it is checked regularly. Keep it in the correct machine location until you need to use it.

Do not use water to put out a machine fire, you could spread an oil fire or get a shock from an electrical fire. Use carbon dioxide, dry chemical or foam extinguishers. Contact your nearest fire department as quickly as possible.

Fluids and Lubricants

Oil

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

Antifreeze

Never perform checks or maintenance on the cooling system when it is hot. Never remove radiator cap when engine is hot - severe risk of scalding. Never remove radiator cap when the engine is running. Antifreeze is toxic. If accidentally swallowed, medical advice must be sought Immediately. Antifreeze is corrosive to the skin. If accidentally spilled on to skin, it must be washed off immediately. Protective clothing and eye protection must be worn when handling antifreeze.

Hygiene

JCB lubricants are not a health risk when used correctly for their intended purposes.

However, excessive or prolonged skin contact can remove the natural fats from your skin, causing dryness and irritation.

Low viscosity oils are more likely to do this, so take special care when handling used oils, which might be diluted with fuel contamination.

Whenever you are handling oil products you must maintain good standards of care and personal and plant hygiene. For details of these precautions we advise you to read the relevant publications issued by your local health authority, plus the following.

Storage

Always keep lubricants out of the reach of children.

Never store lubricants in open or unlabelled containers.

Waste Disposal

⚠ **CAUTION** It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants.

Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.

CAUTION Damaged or spent batteries and any residue from fires or spillage must be put in a suitable closed receptacle and must be disposed of in accordance with local environmental waste regulations.

All waste products must be disposed of in accordance with all the relevant regulations.

The collection and disposal of used oil must be in accordance with any local regulations. Never pour used engine oil into sewers, drains or on the ground.

Handling

⚠ **CAUTION** The temperature of the hydraulic oil will be high soon after stopping the machine. Wait until it cools before beginning maintenance.

New Oil

There are no special precautions needed for the handling or use of new oil, beside the normal care and hygiene practices.

Used Oil

Used engine crankcase lubricants contain harmful contaminants.

Here are precautions to protect your health when handling used engine oil:

- Avoid prolonged, excessive or repeated skin contact with used oil
- Apply a barrier cream to the skin before handling used oil. Note the following when removing engine oil from skin:
  - Wash your skin thoroughly with soap and water
  - Using a nail brush will help
  - Use special hand cleansers to help clean dirty hands
  - Never use petrol, diesel fuel, or paraffin for washing
- Avoid skin contact with oil soaked clothing
- Don't keep oily rags in pockets
- Wash dirty clothing before re-use
- Throw away oil-soaked shoes

First Aid - Oil

Eyes

In the case of eye contact, flush with water for 15min. If irritation persists, get medical attention.

Swallowing

If oil is swallowed do not induce vomiting. Get medical advice.

Skin

In the case of excessive skin contact, wash with soap and water.

Spillage

Absorb with sand or a locally approved brand of absorbent granules. Scrape up and remove to a chemical disposal area.

Fires

⚠ **WARNING** Do not use water to put out an oil fire. This will only spread it because oil floats on water.

Extinguish oil and lubricant fires with carbon dioxide, dry chemical or foam.

Battery

⚠ **DANGER** Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage. Keep metallic items (watches, rings, zips etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches to off before disconnecting and connecting the battery. When disconnecting the battery, take off the earth (-) lead first.

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait 5min before connecting it up.

When reconnecting, attach the positive (+) lead first.

WARNING Battery electrolyte is toxic and corrosive. Do not breathe the gases given off by the battery. Keep the electrolyte away from your clothes, skin, mouth and eyes. Wear safety glasses.

CAUTION Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

Notice: Do not disconnect the battery while the engine is running, otherwise the electrical circuits may be damaged.

CAUTION The machine is negatively earthed. Always connect the negative pole of the battery to earth.

When connecting the battery, connect the earth (-) lead last.

When disconnecting the battery, disconnect the earth (-) lead first.

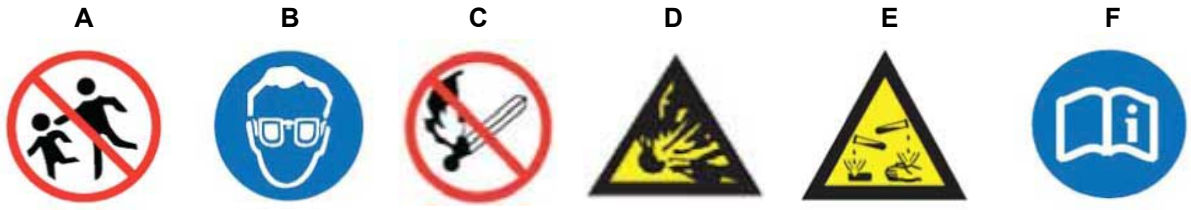
DANGER If you try to charge a frozen battery, or jump start and run the engine, the battery could explode. Do not use a battery if its electrolyte is frozen. To prevent the battery electrolyte from freezing, keep the battery at full charge.

Notice: Before carrying out arc welding on the machine, disconnect the battery and alternator to protect the circuits and components. The battery must still be disconnected even if a battery isolator is installed.

Warning Symbols

The following warning symbols may be found on the battery.

Figure 70.



A Keep away from children
B Shield eyes
C No smoking, no naked flames, no sparks
D Explosive gas
E Battery acid
F Note operating instructions

Disposal

When the battery reaches the end of its usual life it must be removed from the machine and recycled in an approved way in accordance with local environmental regulations. This service is usually operated by battery vendors. Machine users that cannot find a suitable battery recycling facility should contact their JCB dealer for assistance.

First Aid - Electrolyte

Eyes

In the case of eye contact, flush with water for 15min. always get medical attention.

Swallowing

Do not induce vomiting. Drink large quantities of water or milk. Then drink milk of magnesia, beaten egg or vegetable oil. Get medical help.

Skin

Flush with water, remove affected clothing. Cover burns with a sterile dressing then get medical help.

Maintenance Schedules

General

A poorly maintained machine is a hazard. Doing the regular maintenance and lubrication jobs listed in these schedules will help keep the machine in safe running order.

Apart from the daily jobs, the schedules are based on machine running hours. Keep a regular check on the hour meter reading. Do not use a machine which is due for a regular service. Rectify any defects found during regular maintenance before clearing the machine for use.

Generators may be used in either 'Prime' or 'Stand-by' applications. Minimum annual servicing is included to cover 'Stand-by' units where minimal hours will be accumulated.

Apart from the daily jobs, the schedules are based on machine running hours. Keep a regular check on the hourmeter readings to correctly gauge service intervals. Do not use a machine which is due for a service. Make sure any defects found during the regular maintenance checks are rectified immediately.

How to Use the Maintenance Schedules

The schedules show the service tasks which must be done and their intervals.

The services must be done at either the hourly interval or the calendar equivalent, whichever occurs first.

The intervals given in the schedules must not be exceeded. If the machine is operated under severe conditions (high temperature, dust, water, etc.) shorten the intervals.

Table 17.

○	Service task can be completed by a competent operator. Details of how to complete the service task are given in the Operator's Manual.
□	We recommend that a Service Engineer completes the service task. Details of how to complete the service task are given in the Service Manual.

Maintenance Intervals

Table 18.

Interval (h)	**Calendar Equivalent**
10	Daily
50	Weekly
250	Three months
500	Six months
1000	Yearly
2000	Two years
6000	Six years
8000	Eight years

Pre-start Cold Checks, Service Points and Fluid Levels

Table 19.

Component	**Task**	**10**	**50**	**250**	**500**	**1000**	**2000**	**5000**	**6000**
Overall Machine									
Visual inspection	Overall visual check	○	○	□	□	□	□	□	□
Control Panel	Check operation	○	○	□	□	□	□	□	□
Safety decals	Check condition			□	□	□	□	□	□

Component	Task	10	50	250	500	1000	2000	5000	6000
Emergency stop switches	Check operation			☐	☐	☐	☐	☐	☐
Earth Leakage RCD and MCB[1]	Check operation			☐	☐	☐	☐	☐	☐
External Power Socket Box[2]	Check condition				☐	☐	☐	☐	☐
Battery Terminals and voltage	Check				☐	☐	☐	☐	☐
Control panel events history	Check				☐	☐	☐	☐	☐
Bus bar cover safety switch	Check operation				☐	☐	☐	☐	☐
Alternator and engine mounting bolts	Check tightness				☐	☐	☐	☐	☐
Bus bar terminals	Check tightness				☐	☐	☐	☐	☐
Machine earth connections	Check condition				☐	☐	☐	☐	☐
Engine and controller harness	Check condition and connections				☐	☐	☐	☐	☐
Load Test	Load Test @ 75% of maximum load								
Engine									
Oil Level	Check	○	○	☐	☐	☐	☐	☐	☐
Engine oil [3]	Change				☐	☐	☐	☐	☐
Coolant level/radiator heat exchanger surface	Check	○	○	☐	☐	☐	☐	☐	☐
Coolant [5]	Change					☐	☐	☐	☐
External catridge dry type air filter [4]	Check			☐	☐	☐	☐	☐	☐
Radiator heat-exchange surface	Check			☐	☐	☐	☐	☐	☐
Alternator belt tension [6]	Check			☐	☐	☐	☐	☐	☐
Alternator belt [6, 7, 8]	Change				☐	☐	☐	☐	☐
Rubber hose (intake air/ coolant)	Check				☐	☐	☐	☐	☐
Fuel hose	Check				☐	☐	☐	☐	☐
Fuel hose	Change							☐	☐
Oil filter catridge [3, 8]	Change				☐	☐	☐	☐	☐
Fuel filter catridge[3, 8]	Change				☐	☐	☐	☐	☐
Intake manifold hose (air filter - intake manifold)[6]	Change					☐	☐	☐	☐
Coolant hoses [6]	Change					☐	☐	☐	☐
Main Alternator									

Component	Task	10	50	250	500	1000	2000	5000	6000
Generator Alternator cables	Check condition				☐	☐	☐	☐	☐
Generator Alternator Terminals	Check tightness				☐	☐	☐	☐	☐

(1) If installed
(2) Check seals and O-rings are in place, check covers close securely Replace if there is any sign of wear
(3) In case of low use: 12 months
(4) The period of time that must elapse before checking the filter element depends on the environment in which the engine operates. The air filter must be cleaned and replaced more frequently under very dusty conditions
(5) In case of low use: 24 months
(6) The replacement must be carried out by authorized Kohler workshops.
(7) In case of low use: 36 months
(8) If operating under arduous conditions, do these jobs more frequently.

Engine

General

Clean

⚠ **Notice:** Clean the engine before you start engine maintenance. Obey the correct procedures. Contamination of the fuel system will cause damage and possible failure of the engine.

Notice: The engine or certain components could be damaged by high pressure washing systems; special precautions must be taken if the engine is to be washed using a high pressure system. Ensure that the engine air intake, alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system.

Before carrying out any service procedures that require components to be removed, the engine must be properly cleaned.

Cleaning must be carried out either in the area of components to be removed or, in the case of major work, or work on the fuel system, the whole engine and surrounding machine must be cleaned.

Stop the engine and allow it to cool for at least one hour. Do not attempt to clean any part of the engine while it is running.

1. Make sure that the electrical system is isolated.
2. Make sure that all electrical connectors are correctly coupled. If connectors are open fit the correct caps or seal with water proof tape.
3. Cover the alternator with a plastic bag to prevent water ingress.
4. Seal the engine air intake, exhaust and breather system.
5. Make sure that the oil filler caps and dipstick are correctly installed.
6. Use a low pressure water jet and brush to soak off caked mud or dirt.
7. Apply an approved cleaning and degreasing agent with a brush. Obey the manufacturers instructions.
8. Use a pressure washer to remove the soft dirt and oil. Important: Do not aim the water jet directly at oil seals or electrical and electronic components such as the ECU (Electronic Control Unit), alternator or fuel injectors. Do not place the jet nozzle closer than specified to any part of the engine.

   Length/Dimension/Distance: 600mm
9. When the pressure washing is complete move the machine away from the wash area, or alternatively, clean away the material washed from the machine.
10. Before working on specific areas of the engine use a compressed air jet to dry off any moisture. When the area is dry use a soft clean brush to remove any sand or grit particles that remain.
11. When removing components be aware of any dirt or debris that may be exposed. Cover any open ports and clean away the deposits before proceeding.

Oil

Check (Level)

⚠ **WARNING** Never check the oil level or add oil with the engine running. Be careful of hot lubricating oil. Danger of scalding.

Notice: Do not exceed the correct level of engine oil in the sump. If there is too much engine oil, the excess must be drained to the correct level. An excess of engine oil could cause the engine speed to increase rapidly without control.

1. Make the machine safe.

2. Wait for the oil to drain back into the engine sump before you take a reading. If not, a false low reading may be recorded which can cause the engine to be overfilled.
3. Get access to the engine.
4. Remove and clean the dipstick.
5. Replace the dipstick.
6. Remove the dipstick.
7. Check the oil level. The oil should be between the two marks on the dipstick.
8. If necessary, add more oil:
   8.1. Remove the filler cap.
   8.2. Add the recommended oil slowly through the filler point
   8.3. Replace the dipstick.
   8.4. Remove the dipstick.
   8.5. Check the oil level, if necessary add more oil.
   8.6. Replace the dipstick
   8.7. Replace the filler cap.

Replace

⚠ **Notice:** Do not exceed the correct level of engine oil in the sump. If there is too much engine oil, the excess must be drained to the correct level. An excess of engine oil could cause the engine speed to increase rapidly without control.

WARNING Hot oil and engine components can burn you. Make sure the engine is cool before doing this job.

Used engine crankcase lubricants contain harmful contaminants. In laboratory tests it was shown that used engine oils can cause skin cancer.

CAUTION It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants.

Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.

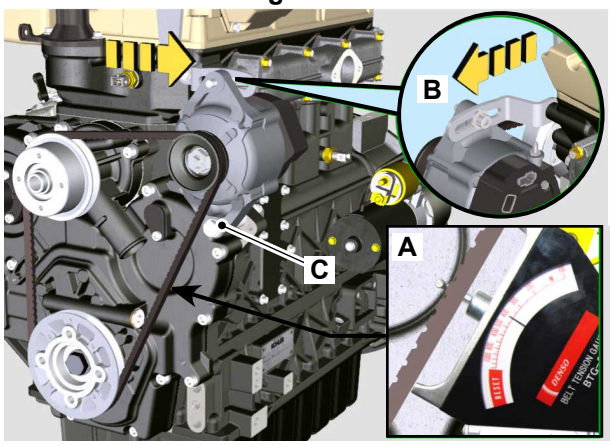
1. Make the machine safe.
2. Get access to the engine.
3. Remove the oil filler cap.
4. Remove the engine oil drain plug. Drain the oil in to a suitable container.
5. Clean the drain plug. Install the drain plug. Tighten the drain plug to the correct torque value.
6. Remove the cap from the oil filter housing.
7. Remove and discard the oil filter cartridge.
8. Fit a new filter with new gaskets.
9. Fit and tighten the cover on the oil filter housing. Tighten the cover to the correct torque value.
10. Add the correct specification and quantity of oil.
11. Check the oil level.
12. Install the oil filler cap.

Drive Belt

Check (Condition)

1. Make the machine safe.
2. Let the engine cool.
3. Remove the FEAD (Front End Accessory Drive) belt cover.
4. Check the belt condition, if worn out or deteriorated contact your JCB dealer for any service requirements.
5. Check the belt tension.

Figure 71.



A Position of instrument
B Bolt 25N·m
C Bolt 69N·m

5.1. Check the tension of the belt with the instrument (DENSO BTG-2). The tension must be between the values specified.

Weight/Force: 200–230N

5.2. If necessary adjust the tension.

Adjustment

1. Loosen the alternator mount bolts. Do not remove them.
2. Pull the alternator outwards as shown to tension the belt.
3. Hold the alternator in position and tighten the mount bolts.
4. Tighten the alternator mount bolts to correct torque value.
5. Check the belt tension, if necessary repeat the steps from 1 to 4.
6. Install the belt cover.

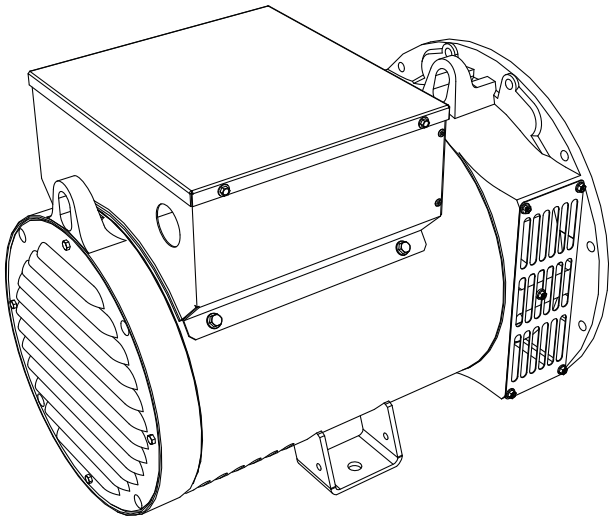
Alternator

General

ECO-ECP 4 pole alternators are brushless, self-regulating and incorporate a rotating inductor with damper cage winding and a fixed stator with skewed slots.

The alternators are made in compliance with the 2006/42, 2006/95, 2004/108 CEE directives and their amendments, and the CEI 2-3, EN 60034-1, IEC 34-1, VDE 0530, BS4999-5000, CAN/CSA-C22.2 N°14 -N °100 regulations.

Figure 72.



Safety Requirement

Before any cleaning, lubrication or maintenance operation, ensure that the generator is stationary and disconnected from the power supply.

When stopping the generator, ensure the compliance with the procedures for stopping the prime mover.

Electrical Connections

Windings Connection

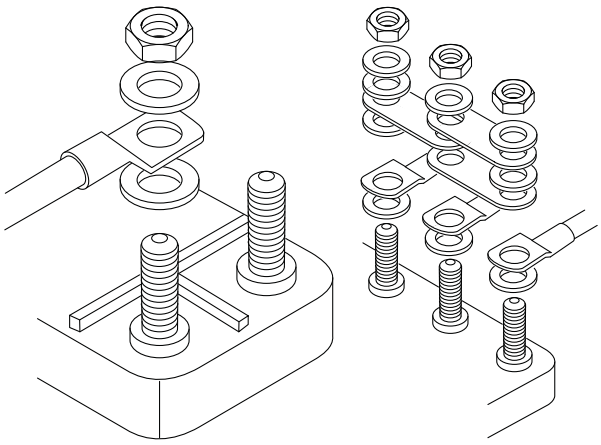
All alternators feature both star with neutral and delta connections.

To reconnect from a star to delta connection (for e.g. from 400V to 230V), modify the linking arrangements on the output terminal board.

It is not necessary to adjust the voltage regulator.

These alterations must be carried out by a suitably qualified and competent person. Consult you JCB dealer.

Figure 73. Connecting Lugs



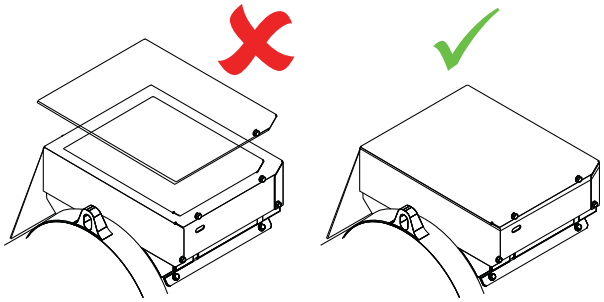
Standard alternators are equipped with 12 cables to offer different voltages (e.g. 230/400/460/800V).

The alternator must always be earthed by sufficiently rated cable, using one of the inside or outside terminals. For the electrical connections, use wires suitable for the power of the generator and connect them to the terminal board.

After completing output connections, ensure that the terminal box cover is securely in place.

Make sure the terminal box cover is fitted at all times.

Figure 74.



DSR Digital Regulator

This manual contains information on the operation and use of the DSR digital regulator.

In order to avoid damage to persons and/or property, only qualified personnel, having full knowledge and understanding of the information contained in this manual, should perform the procedures described herein; when power to the unit is on, the voltage present may be lethal for the operator.

All connections must be made with the power off. The plastic protections on connectors must not be removed for any reason whatsoever.

Introduction

Since the regulator is designed to control many different types of generators, it must be appropriately configured to obtain the best performance.

Most of the settings are stored in a non-volatile integrated memory (EEPROM).

The first time the regulator is turned on, a default configuration will be present, which satisfies the most widely requested characteristics and is suitable to facilitate installation.

The trimmers are active and the inputs for the external potentiometer and the 60Hz jumper are enabled, therefore the basic calibrations can be performed without the use of additional equipment.

Technical Characteristics

- Full digital controlled regulator, based on DSP
- On-board machine installation
- Suitable for all self-regulated alternators
- Voltage supply: 40V AC to 270V AC (from auxiliary winding, output voltage or PMG)
- Frequency range: 12–72Hz
- Sensing of voltage with true rms or average measurement (70–240V AC)
- Maximum continuous output current: 4A DC
- Precision of voltage regulation: 1% from no-load to nominal load in static condition, with any power factor and for frequency variations ranging from -5% to +20% of the nominal value
- Transient power drops and overvoltage within 15%
- Voltage recovery time within 3% of the value set, in less than 300 ms
- Transient overvoltage during start up: less than 5% of nominal voltage
- Single phase sensing

- Parameters: Volt, Stab, Amp and Hz can be set with trimmers (default) 50/60Hz through a jumper (default). All parameters can be programmed via software
- Analogical remote control of output voltage is possible through external voltage (0 to 2, 5V DC) or with a 10 kohm linear potentiometer
- Environmental temperature: - -25°C (-13.0°F) to 70°C (157.9°F)
- Underspeed protection with adjustable threshold and slope
- Overvoltage and undervoltage alarms
- Excitation overcurrent protection with delayed intervention
- Management of temporary short circuits (start up of asynchronous motors)
- Open collector output (not insulated) signalling intervention of protective devices (insulation on optional DI1 module) with programmable activation with respect to the individual alarms and the possibility to delay intervention
- Abnormal operation conditions storage (type of alarm, number of events, duration of the last event, total time)
- Memorization of the regulator operation time (starting from revision 11 of the Firmware)
- RS232 and RS485 serial communications interface (with optional DI1 module).

Operation of the DSR is not specified below 12Hz.

Installation

Upon receipt of the digital regulator, perform a visual inspection to ensure that no damage has been sustained during transportation and movement of the equipment.

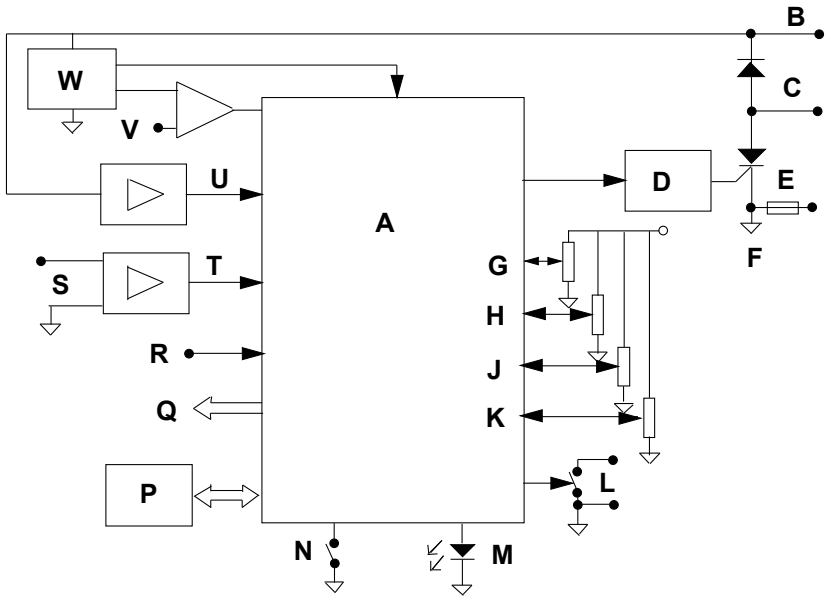
In the event of damage, advise the shipper, the insurance company, the seller or Mecc Alte immediately. If the regulator is not installed immediately, store it in its original packaging in a dust and humidity-free environment.

The regulator is normally installed in the generator terminal box. It is fixed with two M4x20 or M4x25 screws and must be installed in a location where the temperature does not exceed the environmental conditions foreseen.

Connection

The digital regulator connections depend on the application and excitation system for the functional aspect of the connection points to the regulator. Refer to Figure 75.

Figure 75. Block Diagram



A DSP
B Aux. Exc+
C Exc-
D Driver
E Auxiliary
F Ground
G Volt
H Stab
J Ampere
K Frequency

L A.P.O
M Alaram LED
N 50/60
P Memory
Q Serial communication interface
R Vext
S Sensing
T Voltage output
V Vmin
W Power supply

An error in connection may have serious consequences for the unit. Carefully check to make sure that all connections are precise and in accordance with the attached drawings, before turning on the power.

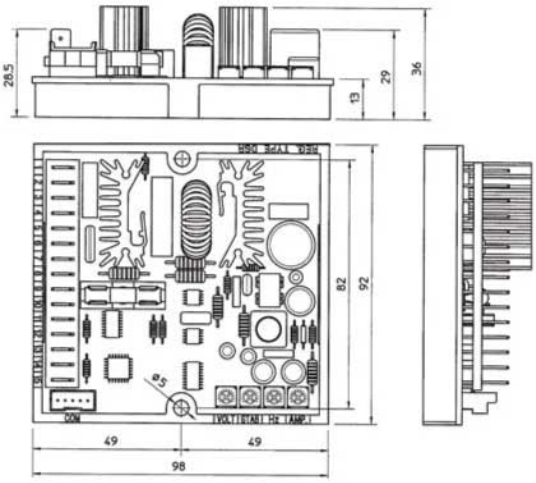
Terminals

The connections must be made using cables having a minimum diameter:

- For power cables on terminals 1, 2, 3 and 9 (Exc-, Aux/ exc+, Aux): 1.5 mm
- For signal cables: 0.5mm

For the connection terminals. Refer to Figure 76.

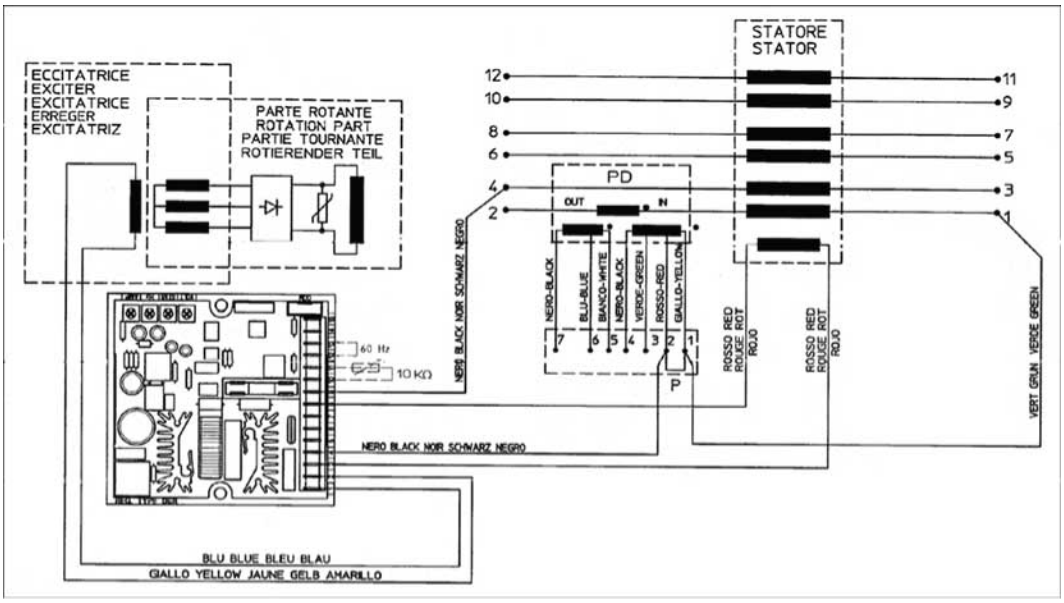
Figure 76.



DSR Connections for Typical Applications

Drawing SCC0063/02 shows the connection to alternators with 12 terminals, in series star connection or series delta connection, with reference to the entire phase from 140V to 280V (for example series ECO28-38, ECO40-1S, ECO40-2S ECO40-1L, ECO40-2L and ECO40VL)s

Figure 77.



Regulator Setup

Selection of the sensing scale takes place directly according to the connection on the power terminal board; additional settings can be made with 4 trimmers (VOLT, STAB, AMP and Hz) and 3 jumpers (50/60Hz, JP1 and JP2).

Terminals 4, 5, 6, 7 and 8 of connector CN1 are used for voltage sensing.

Trimmers

The trimmers are enabled by the software from the Configuration Menu. If they are not enabled, they do not perform any function.

The Volt trimmer allows adjustment from about 70V to about 140V or from about 140V to about 280V.

The Stab trimmer adjusts the dynamic response (statism) of the alternator under transient conditions.

The Hz trimmer allows a variation up to - 20% with respect to the nominal speed value set by jumper 50/60 (if it is active) or from box 50/60 of the Configuration Menu (at 50Hz the threshold can be calibrated from 40Hz to 50Hz, at 60 Hz the threshold can be calibrated from 48Hz to 60Hz). The Amp trimmer adjusts the excitation overcurrent protection intervention threshold.

Excitation Overcurrent

The DSR regulator is equipped with an excitation (main rotor) winding temperature estimator.

An estimate of the temperature is memorised in real time (and can be read) at location 45. The progress of the temperature is of the exponential type.

Through parameter 22 or the AMP trimmer, it is possible to define a limit (which involves intervention of alarm 5) to the excitation voltage and therefore to the temperature.

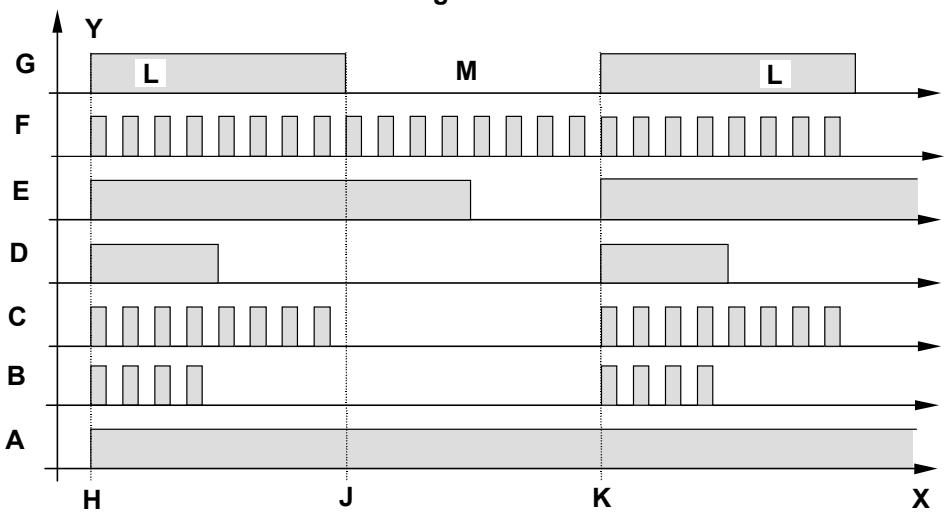
The function of this alarm is not only to signal an excessive temperature, but it also has an active function in reducing the cause. In fact, an adjustment ring takes control of the voltage generated when the threshold set is exceeded.

This reduces the voltage to the point of reducing the excitation current by a value compatible with the ability of thermal dissipation of the machine.

Alarms

During normal operation and a duty cycle of 50%, an indicator light mounted on the board flashes every two seconds. It flashes differently in the event of intervention or alarm.

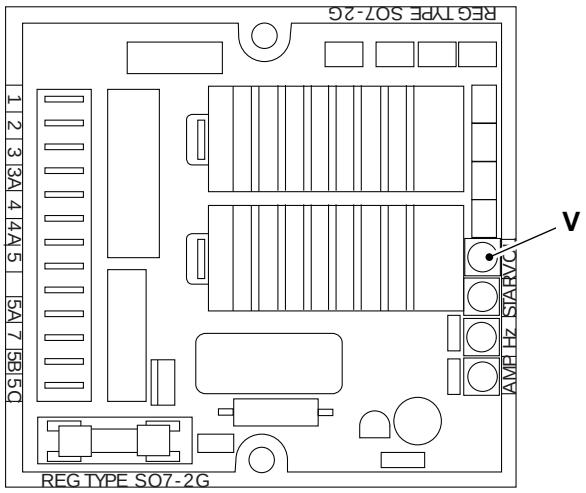
Figure 78.



A Stop
B Amp and (Hz or O.S.)
C Hz or O.S.
D Amp
E Short circuit
F Check sum
G Ok
H Allarm intervention
J 1
K 2
L Lead on
M Lead off
X t (sec)
Y Led

Regulators

Figure 79.



V Voltage

The generator output must be checked under no load conditions, with the correct setting of frequency.

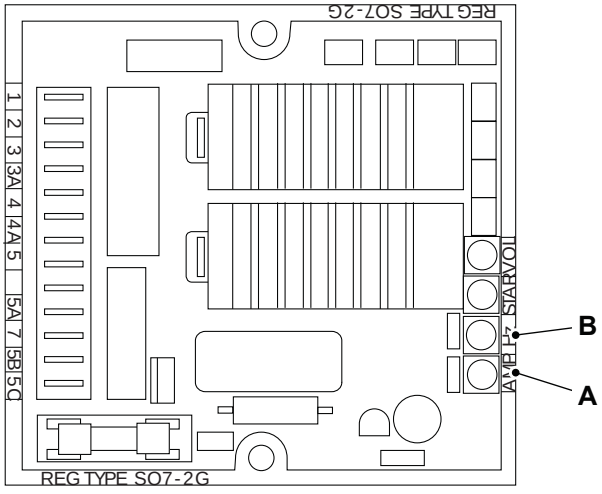
The voltage may be adjusted by +/- 5% of the nominal, by acting upon the voltage potentiometer on the electronic regulators.

It is possible to get a remote voltage regulation of +/- 5% inserting in the proper terminals a 100k potentiometer (for the six units) or a 100k potentiometer with a 100k resistance in series (for the 12 lead units).

Protections

The DSR is provided with an underspeed protection with an intervention threshold which can be adjusted by the potentiometer marked `Hz'. This protection intervenes instantaneously by reducing the alternator voltage to a safe value when frequency falls below 10% of the nominal value. This regulator also has inherent overload protection which senses the exciter field voltage value. Should this field voltage value exceed the nominal value for a period of more than 20 seconds, then again the alternator voltage is automatically reduced to a safe operating level. This overload function has a built-in delay to allow for the overload when starting motors (normally 5-10 seconds). The operating threshold of this protection device is adjustable by the potentiometer marked `AMP'.

Figure 80.



A Amper **B** Hertz

When using the machine in single phase, or for voltages different from the one pre-set at the factory, recalibration of the AMP and STAB potentiometers could be necessary.

Intervention of Protection Devices Causes

Underspeed Protection Instantaneous Intervention

- Speed reduced by 10% of nominal RPM (Revolutions Per Minute).

Delayed intervention of Overload Protection

- Overload by 20% of nominal rating.
- Power factor (cos f)lower than the nominal one.
- Ambient temperature above 50°C (121.9°F).

Intervention of Both Protections:

- Combination of factor 1 with factors 2, 3, 4.

In case of intervention the output voltage will drop down to a value which will depend on the fault.

The voltage will return automatically to its nominal value as soon as the fault is removed.

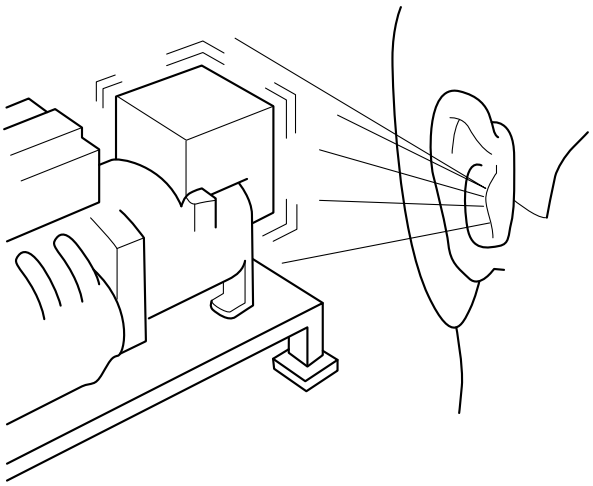
For further details on regulators, please see the specific manual.

Starting and Stopping The Operations

All the instrumentation for starting, running and stopping the system shall be provided by the installer.

The starting, running and stopping operations must be carried out by skilled personnel who have read and understood the safety instructions at the beginning of this manual.

Figure 81.



When the system is set to work for the first time, which has to be done at a reduced speed, the operator shall check that no anomalous noises can be detected. If an anomalous noise is detected, stop the system immediately and improve the mechanical coupling.

Maintenance

The alternators series ECO-ECP are designed to give a long maintenance free working life.

Before performing this operation, read the safety requirements at the beginning of this manual carefully.

Maintenance operations can be divided into routine and extraordinary maintenance operations. In both cases, all operations must be authorised by the safety representative and they must be carried out when the machine is turned off and insulated from the electric installation or from the power mains.

High qualified mechanical or electrical technicians must carry out maintenance operations and any fault search since all operations described hereunder could put personnel in serious danger. It is also highly recommended to take all the necessary precautions so as to prevent an inadvertent starting of the machine during maintenance and fault search operations.

Routine maintenance operations can be done as follows:

- Assessment of findings conditions after long periods of storage or inactivity.
- Assessment, on a regular basis, of correct functioning (absence of anomalous noises or vibrations).
- Mechanical inspections on all fastening bolts and, in particular, on electric connections.
- External cleaning of generator.

Internal and External Cleaning of the Generator

For the external cleaning of the generator, you can use compressed air. The use of dry-cleaners and detergent fluids is strictly forbidden. In the stationary condition the standard protection degree of the generator is IP21, therefore, use of fluids could cause anomalies or even short circuits.

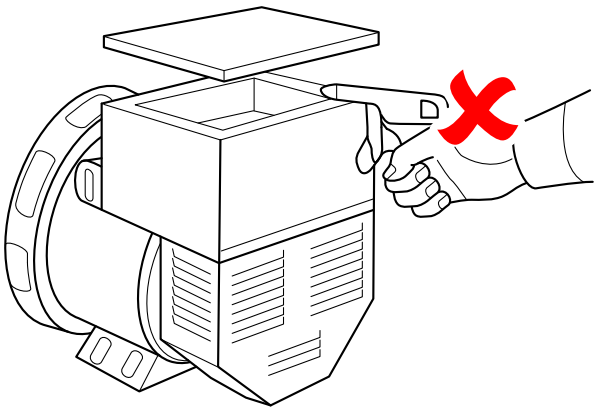
Extraordinary maintenance operations can be summed up as follows:

1. Maintenance and replacement (if necessary) of bearings.
2. Cleaning of air filters (if available).
3. Cleaning of windings.
4. Replacement of diode bridge.
5. Replacement of exciter.
6. Replacement of voltage regulator.
7. Check of residual voltage.

Clean

Prior to approaching or touching the alternator, ensure that it is not live and it is at room temperature; at this stage it is possible to clean it on the outside using compressed air.

Figure 82.



Never use liquids or water. Do not clean the inside electric components with compressed air, because this may cause short circuits or other anomalies.

Air Filter

General

Check (Condition)

1. Make the machine safe.
2. Get access to the air filter.
3. Check the system hoses for:
   3.1. Condition.
   3.2. Damage.
   3.3. Security.
4. Replace the system hoses if necessary.

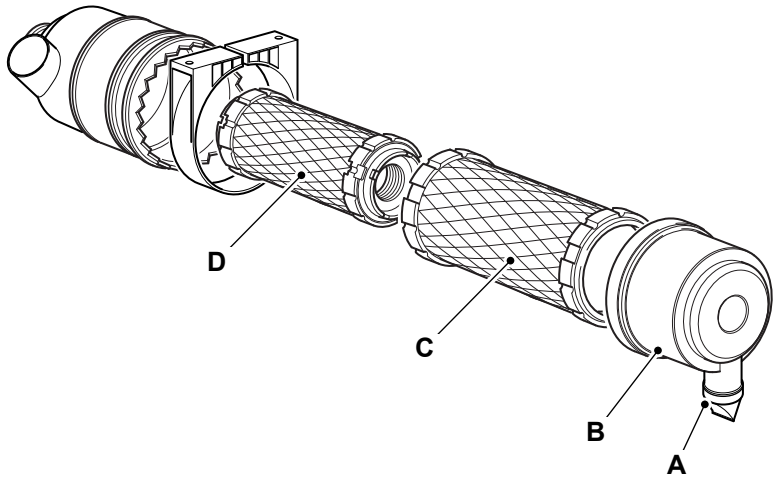
Replace

Do not attempt to wash or clean the elements, they must only be renewed.

Remove

1. Make the machine safe.
2. Depress the clips on the cover and lift off the cover.
3. Remove the outer element. Take care not to tap or knock the element.
4. If the inner element is to be changed, lift up, pull and remove the inner element.

Figure 83.



A Dust valve
B Cover
C Outer element
D Inner element

Install

1. Replacement is a reversal of the removal procedure.
2. Clean inside the housing, and cover, make sure the air holes are clear.
3. Check the condition of the dust valve.
4. Install the cover and fasten the clips. Make sure that the dust valve is at the bottom.

Dust Valve

Check (Condition)

- Check the dust valve for rips/tears.
- Check there are no obstructions.
- Check that the dust valve is free of dirt and dust.
- Check that the dust valve securely attached to the air filter housing.

Fuel System

General

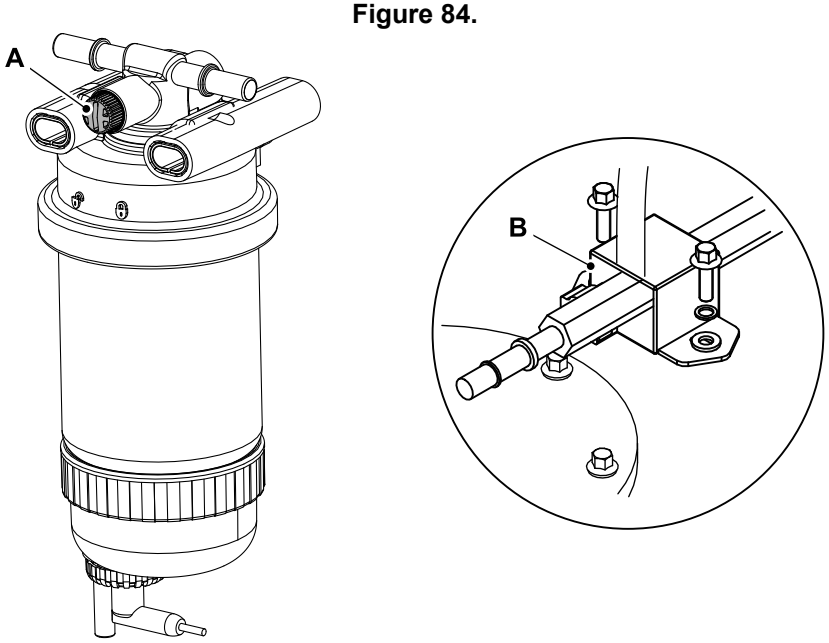
Bleed

⚠ **Notice:** Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always install protective caps and plugs to prevent dirt ingress.

Failure to follow these instructions will lead to dirt entering the system. Dirt in the system will seriously damage the systems components and could be expensive to repair.

1. Make the machine safe.
2. Get access to the fuel filter.
3. Make sure there is sufficient fuel in the tank.
4. Loosen the bleed screw on the fuel filter.
5. Turn on the ignition until fuel with no air flows freely from the valve, then close the bleed screw.
6. Check the engine for smooth running.
7. If the engine continues to run roughly, check again the bleeding procedure.

Figure 84.



A Bleed screw

B Fuel lift pump

Check (Leaks)

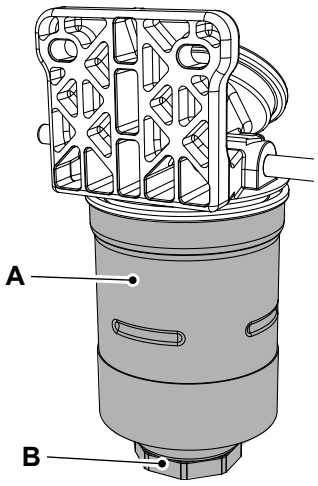
1. Make the machine safe.
2. Get access to the engine compartment (if applicable).
3. Check the engine compartment (if applicable), fuel lines and the area below for leaks.
4. If necessary, contact your JCB dealer.

Engine Fuel Filter

Replace

1. Make the machine safe.
2. Get access to the engine compartment
3. Remove the sensor housing.
4. Unscrew and remove the filter element.
5. Fit a new element. Lubricate the gasket of the new cartridge. Do not fill the new cartridge with fuel.
6. Refit the sensor housing.
7. Bleed the fuel system.
8. Close the engine cover.

Figure 85.



A Filter element

B Sensor housing

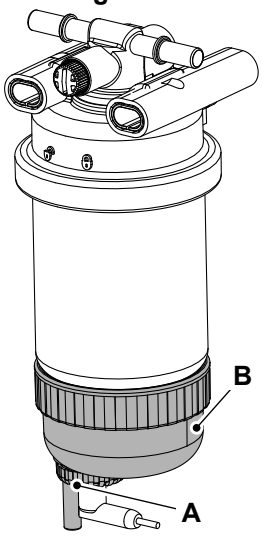
Water Separator

Clean

Draining the Water Separator

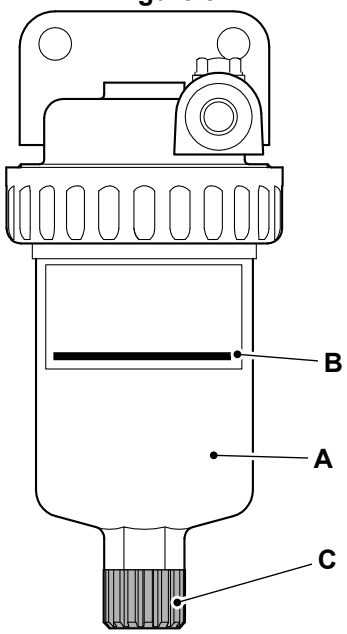
1. Make the machine safe.
2. If there is water but no sediment, open the tap to drain the water. If there is any sediment in the bowl replace the fuel filter element.

Figure 86.



A Tap
B Bowl

Figure 87.



A Water separator
B Maximum level (red line)
C Drain plug

Cooling System

Coolant

Check (Level)

⚠ **CAUTION** The cooling system is pressurised when the coolant is hot. When you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

1. Carefully loosen the radiator cap. Let any pressure escape before removing the cap.
2. Remove the radiator cap.
3. Check that the coolant level is flush with the top of the filler neck.
4. Fill with 50% antifreeze and 50% decalcified water until it reaches the correct level and replace the cap.
5. Top liquid up until the pipes inside the radiator are covered approximatively by the amount specified. Do not overfill the radiator, but leave room for the coolant to expand.

   Length/Dimension/Distance: 5mm
6. Run the engine to raise the coolant to working temperature and pressure. Stop the engine, checks for leaks and re-check the fluid level.

Replace

⚠ **CAUTION** The cooling system is pressurised when the coolant is hot. When you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

1. Stop the engine and let it cool down. Make the machine safe.
2. Carefully loosen the radiator cap. Let any pressure escape before removing the cap.
3. Disconnect the bottom radiator hose and allow the coolant to drain.
4. Flush the system by pouring clean water into filler port.
5. Reconnect the radiator hose.
6. Fill the radiator to the level indicated using the correct anti-freeze solution.
7. Check for leaks.
8. Run the engine to raise the coolant to working temperature and pressure.
9. Stop the engine and check for leaks. Check the level in the radiator and top up if necessary.

Cooling Pack

Clean

1. Make the machine safe.
2. Let the engine cool.
3. Get access to the cooling pack.
4. If necessary, use a soft bristle brush or compressed air to remove all debris from the cooling pack.

Check (Condition)

1. Make the machine safe.
2. Let the engine cool.

3. Get access to the radiator.
4. Check the condition of the coolant hoses.
5. Check the radiator and intercooler surfaces for signs of damage.
6. If necessary, contact your JCB dealer for any service requirements.

Electrical System

General

Check (Condition)

Batteries

Batteries used in normal temperate climate applications should not need topping up. In certain conditions (such as prolonged operation in high ambient temperatures or if the alternator overcharges) the electrolyte level should be checked frequently and topped up as necessary.

The electrolyte level should be checked in accordance with the routine maintenance schedule. Shorter maintenance intervals are required if the machine is operating at high ambient temperatures or continuously for long periods.

Later machines may have the new type batteries installed which include a sight glass to check the condition of the battery. New batteries should be used as replacements if replacing the battery on earlier machines.

Maintenance

For the optimum performance of the battery, follow the steps:

- Make sure that the electrical connections are clean and tight. Apply petroleum jelly on connectors to prevent corrosion.
- When applicable - never allow the electrolyte level to fall below the recommended level of 6mm above the plates. Use only distilled water for topping up.
- Keep the battery at least three quarters charged, otherwise the plates may become sulphated (hardened) - this condition makes recharging the battery very difficult.

Extra precautions must be taken when bench charging maintenance free batteries, they are more prone to damage by overcharging than the standard type of battery:

- Never boost charge a maintenance free battery (if installed).
- Never charge a battery at a voltage in excess of 15.8V.
- Never continue to charge a battery after it begins to gas.

Quiescent Current Drain

If the machine has no permanently live circuits there should be zero quiescent current drain, when the key-switch is off and all the lights are switched off.

It should be noted that some permanently live circuits will place a quiescent drain on the battery. Typically the quiescent drain will be in the range of 10–20 mA. If the quiescent drain measures 40 mA or more, there is a problem with the wiring insulation or the accessories, if the fault is not rectified it will continue to drain the battery.

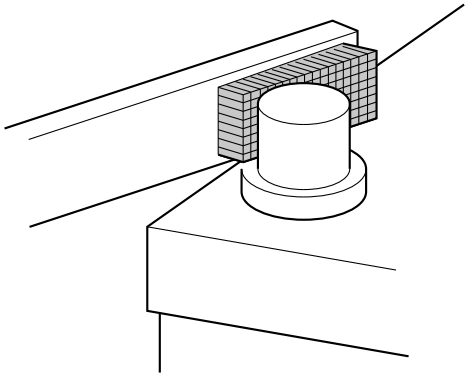
Battery

Clean

⚠ **WARNING** Keep metal watch straps and any metal fasteners on your clothes, clear of the positive (+) battery terminal. Such items can short between the terminal and nearby metal work. If it happens you can get burned.

1. Make the machine safe.
2. Get access to the battery.
3. If the terminal posts are corroded and covered with white powder wash them with hot water. If there is considerable corrosion, clean the terminal posts with a wire brush or abrasive paper. Refer to Figure 88.

Figure 88.



4. Apply a thin layer of petroleum jelly to the terminal posts.

Connect

The batteries leads will require connecting on initial installation.

When connecting the single battery to the machine, always connect the positive terminal first followed by the negative terminal. When connecting the twin batteries to the machine, first connect the link lead or leads, then the positive terminal, and finally the negative terminal.

If the machine has a battery isolator, move the switch to the on position.

When disconnecting, remove the negative first then the positive. These steps will ensure accidental shorting of the battery terminals cannot take place.

Depending on the size of the generating set, the electrical system will either be 12V or 24V.

Figure 89. 12V System

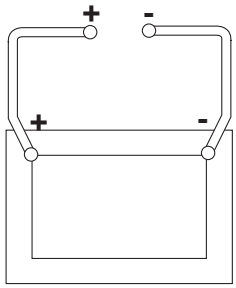
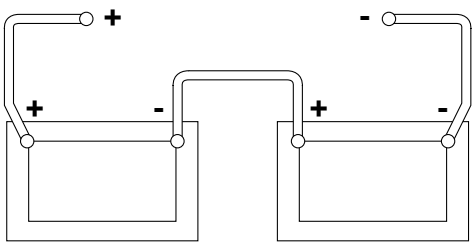
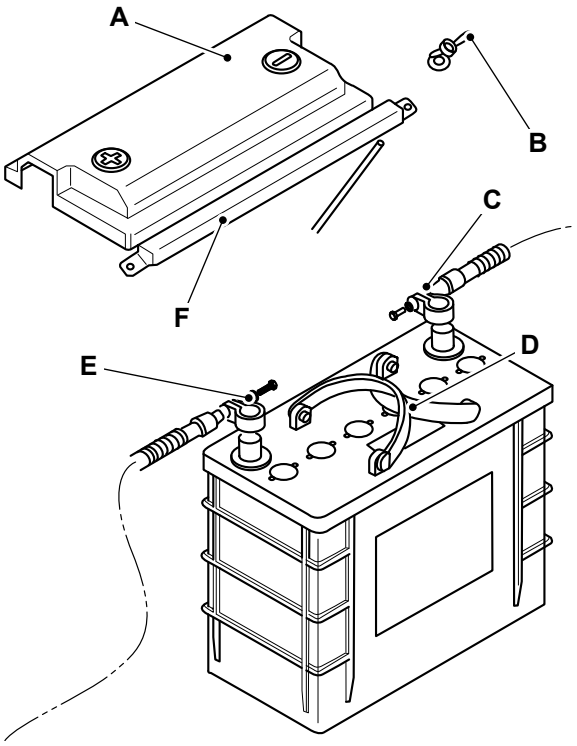


Figure 90. 24V System



Follow the procedure to connect the battery.

Figure 91.

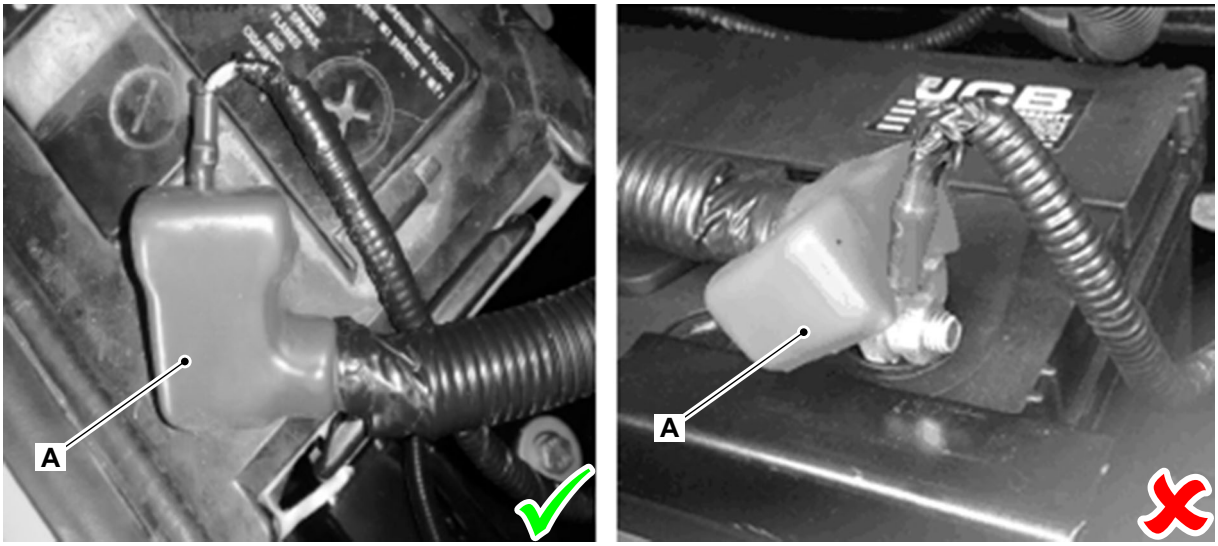


A Cover
B Nut
C Cable 1
D Handle
E Cable 2
F Clamp

1. Make the machine safe.
2. Use the handles to put the battery into its compartment.
3. Connect the cable 1 and the cable 2.
4. Install the cover (if removed).
5. Install the clamp.
6. Install the two nut and the two washers.
7. Check the battery terminals.
   Refer to: Clean (Page 110).

Battery Cable Installation

Figure 92.



A Rubber boot

1. Make sure to cover the battery connection with the rubber boot.
2. Lug should not bend, crack or stress during installation.
3. Make sure that lug should not touch to any conducting part.

Disconnect

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Notice: Before you install a pair of batteries to a machine, make sure you know the machines voltage. Some machines require two batteries but have a 12 V electrical system. This means the batteries need to be connected in parallel.

For 24 V machines, the batteries must be connected in series. Incorrect voltage may result in serious damage to the electrical system.

The illustrations show typical battery connections. The actual battery connections installed on your machine may look different.

Figure 93. Parallel and Series Connection (Example)

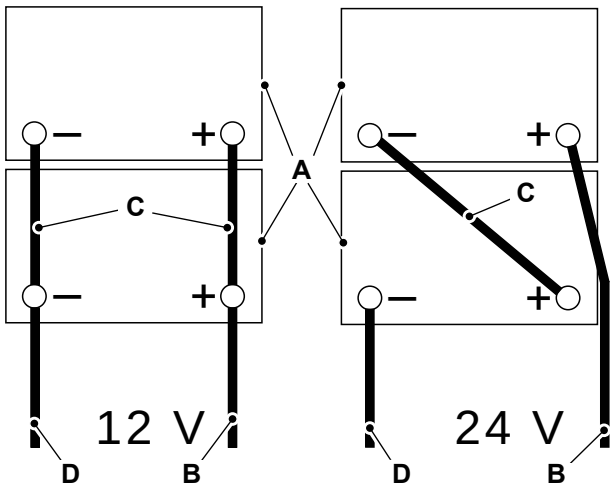
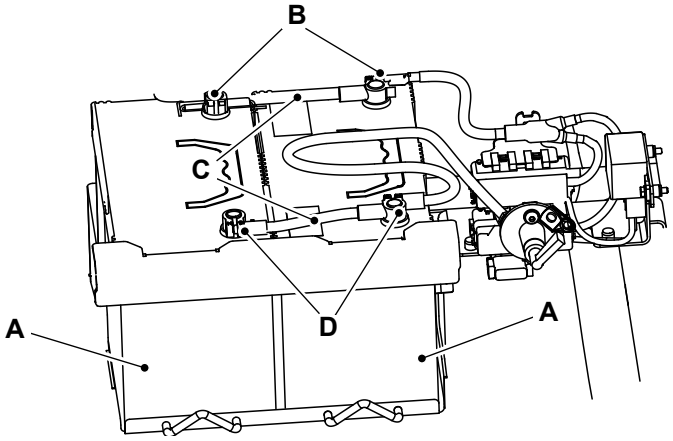
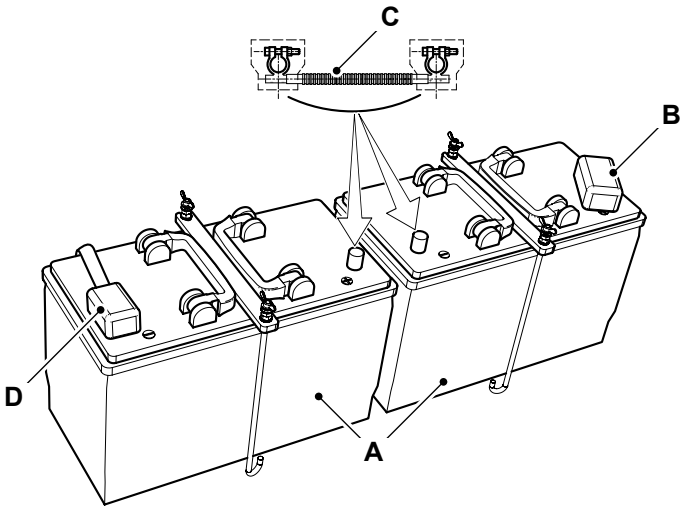


Figure 94. Twin Battery 12V Machines - Parallel Connection (Example)



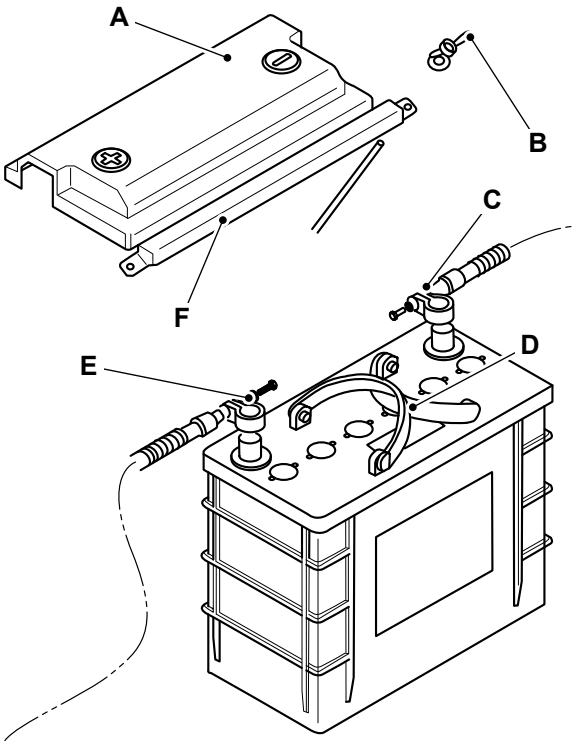
A Battery
B Positive lead
C Battery link lead
D Negative lead

Figure 95. 24 Volt Machines - Series Connection (Example)



A Battery
B Positive lead
C Battery link lead
D Negative lead

Figure 96.



A Cover
B Nut
C Cable 1
D Handle
E Cable 2
F Clamp

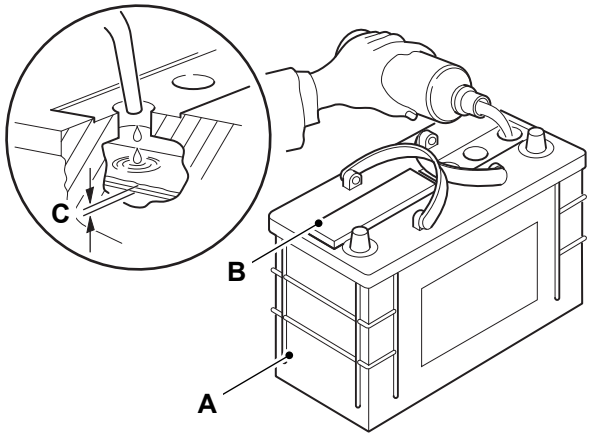
1. Make the machine safe.
2. Get access to the battery or batteries (depending on the specification of your machine).
3. If installed, move the battery isolator switch to the off position and then remove the key.
4. Disconnect the negative battery lead first. Refer to Figure 94. and Refer to Figure 95.
5. Disconnect the positive battery lead and put it away from the batteries. Refer to Figure 94. and Refer to Figure 95.
6. Disconnect and remove the battery link lead or leads. Refer to Figure 94. and Refer to Figure 95.
7. Remove the two nut and the two washers. Refer to Figure 96.
8. Loosen the battery clamp. Refer to Figure 96.
9. Move the clamp.
10. Remove the cover (if installed).
11. Disconnect the cable 1 and the cable 2.
12. Make sure that battery connection wires are clear of the battery top cover.
13. Use the handles to remove the battery from its compartment.

Check (Electrolyte Level)

⚠ **WARNING** Do not top the battery up with acid. The electrolyte could boil out and burn you.

Maintenance free batteries used in normal temperate climate applications should not need topping up. However, in certain conditions (such as prolonged operation at tropical temperatures or if the alternator overcharges) the electrolyte level should be checked as described below.

Figure 97.



A Battery
B Cover
C Electrolyte level (6mm above the cell)

1. Open the battery access panel and get access to the battery.
2. Disconnect the battery.
3. Remove the battery from the machine.
4. Remove the covers.
5. Look at the level in each cell.
   5.1. Make sure that the electrolyte is above the plates by specified value.
   Length/Dimension/Distance: 6mm
   5.2. If necessary, top up the battery with distilled water or de-ionized water.
6. Install the battery.
7. Close the battery access panel.

Charging the Battery

If the battery voltage is below 24.8V and 12.4Vfor 12V system, the engine cranking speed is so low that the engine does not start, charging is required.

If the generating set has an on board battery charger this will take care of charging when connected to the auxiliary mains supply. If a charger is not fitted, the recommended charging within 1/10 of the normal capacity for 5–6h must be carried out by connecting an external charger.

If using the onboard battery charger the charge current will be controlled by the unit, and reduced accordingly when the battery is fully charged. At this point the battery charger will switch to trickle charge, maintaining the battery in a fully charged condition.

Battery Life

The control panel, remote communication (if installed) and other stand-by functions, provide some drain on the battery. JCB recommend that wherever possible an onboard battery charger is fitted. This charger will provide a maintenance charge to the system batteries allowing for optimum system performance whenever start-up signal is received. The onboard battery charger requires an external supply, therefore installation of this unit is not possible in all applications.

Where it is not possible to have an onboard battery charger installed, JCB recommend a running cycle of 1–2h twice weekly. This exercising of the Generator Set recuperates the battery utilizing the charging alternator, and allows the machine to maintain a healthy stand-by state.

If operating where the ambient temperature could drop below -15°C (5.0°F) remove the battery at the end of the day and store in a warm place until required again. This will help to start the engine easily or install heating pads and/or a battery charger if possible.

Do not jump start the battery on the generator, replace or recharge the battery as an alternative. Jump start can create a surge of high voltage. This will cause catastrophic failure of the electronics component fitted in the control system and engine. This failure is deemed as non-warrantable, as a result of bad practice.

Check (Charge Level)

Precautions before Charging

Follow all the precautions described below, to prevent damage to the alternator and battery.

1. Make the machine safe.
2. Make sure that the battery negative terminal is connected to the earth cable.
3. Do not connect or disconnect the battery or alternator connections, or any part of the charging circuit while the engine is in operation. If you disregard this instruction, the regulator or rectifying diodes will be damaged.
4. Main output cables are always in active state of current flow even when the engine is not in operation. If the alternator connector is removed, do not earth the moulded plug.
5. When you do arc welding on the machine, remove the moulded plug (or if the separate output cables are installed, remove the cables) to protect the alternator.
6. If it is necessary to jump start the battery then do the steps below.
   6.1. Connect the secondary battery in parallel without disconnecting the vehicle battery from the charging circuit.
   6.2. After the jump start, safely disconnect and remove the secondary battery.
   6.3. Make sure you connect the positive terminal to the positive terminal and the negative terminal to the negative terminal of both the batteries.

Battery Test

This test is to determine the electrical condition of the battery and to give an indication of the remaining useful life.

Before you test the battery, make sure that the battery is at least 75% charged (Specific gravity of 1.23 to 1.25 for ambient temperature up to 27°C).

Make sure that the battery is completely disconnected from the vehicle.

Connect up the battery tester as follows:

1. Set the check load switch to off position.
2. Set the battery voltage switch to 12V.
3. Connect the red flying lead to the battery positive (+) terminal and the black flying lead to the battery negative (-) terminal.
4. Set the check/load switch to 'check' to read the battery no-load voltage which should be at least 12.4 volts.
5. Set the check/load switch to 'load' and hold down for 5-10 seconds until the meter reading stabilises. The reading should be at least 9 volts.

6. If the tests are unsatisfactory, refer to the fault diagnosis table.

Table 20. Fault Diagnosis

Battery Tester Readings		Remedy
Check	**Load**	
0–12.6V	Less than 6V	Renew battery
6–12.4V	less than 9V and decreases steadily but remains in yellow zone	Recharge and re-test. If tests are still unsatisfactory renew battery
Less than 10V	Less than 3V	Indicates battery has been over-discharged and unlikely to recover. Renew battery
more than 11V	6–10V steady	Charge battery which will probably recover

Specific Gravity Test

The specific gravity of the electrolyte gives an idea of the state of charge of the battery. Readings should be taken using a hydrometer, when the electrolyte temperature is 15°C (60°F). If the battery has recently been on charge, wait approximately one hour (or slightly discharge the battery) to dissipate the surface charge before testing.

Readings should be as tabulated and should not vary between cells by more than 0.04. A greater variation indicates an internal fault on that particular cell.

If the electrolyte temperature is other than 15°C (60°F) a 'correction factor' must be applied to the reading obtained. Add 0.07 per 10°C (18°F) if the temperature is higher than 15°C (60°F) and subtract the same if the temperature is lower.

Table 21. Specific Gravity at 15°C (60°F))

Ambient Temperature degrees C (degrees F)	Fully Charged	Half Discharged	Fully Discharged
Below 27 (80)	1.270 - 1.290	1.190 - 1.210	1.110 - 1.130
Above 27 (80)	1.240 - 1.260	1.170 - 1.190	1.090 - 1.110

Fault-Finding

General

The fault finding procedures are given in the form of flow charts. There are a number of charts, each one dedicated to a particular fault category.

The charts are designed to identify possible causes by performing checks and where applicable, specific tests on the engine. Having identified a cause the suggested remedy is given. The charts are designed to identify causes through a process of elimination, starting with the simplest, most easily rectified faults.

Due to the time and effort involved in removing, dismantling, assembling and replacing an engine, it is recommended that fault finding procedures are carried out until a fault can be identified with a good degree of certainty.

There are many reasons why an engine may malfunction, time and effort will be saved by following basic troubleshooting steps:

- Do not make assumptions.
- If possible, talk to the operator for a description of the fault. Also, check if any recent maintenance or repair has been completed on the engine.
- Start simple - for instance many starting and running faults can be attributed to low fuel level.
- Systematically work through each of the possible causes.
- Confirm your diagnosis before dismantling and assembling.
- Follow the recommended repair procedures in this manual.

Engine

Table 22. Engine - Will Not Start or Difficult to Start (No Exhaust Smoke)

Cause	Remedy
No fuel in supply tank.	Check the level in the fuel tank, use sight gauge or dipstick. Replenish as required.
Starter switch or starter electrical system failure.	Check the operation of the starter switch. Check the correct electrical wires for open or short circuits.
Improper starting procedure.	Verify proper starting procedure.
Fuel filter blocked with water or other contamination.	Drain fuel/water separator or replace fuel filter.
Defective fuel lift pump (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Check fuel inlet restriction.	Maximum inlet restriction to fuel lift pump must not exceed 100 mm Hg (4 in. Hg).
Air intake or exhaust system blocked.	Visually check the air intake and exhaust system for blockage or obstruction - remove as required. Check the air filter elements for signs of blocking - replace as required.
Fuel drain return line blocked, not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.
	Do all the necessary fault finding checks before removal of the high pressure fuel pump.
Injectors contaminated.	Check the injectors. Use the Servicemaster test procedure in Servicemaster tools actuator Test. Test and replace as required.

Table 23. Engine - Will Not Start or Difficult to Start (Exhaust Smoke)

Cause	Remedy
Starting procedure incorrect.	Verify proper starting procedure.

Air intake system blocked or restricted.	Visually check the air intake for blockage or obstruction - remove as required. Check the air filter elements for signs of blocking - replace as required.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the fuel injection pump. Check the correct electrical wires for open or short circuits.
Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Monitor the engine performance.
	WARNING: Dirty fuel will cause damage to the fuel injection pump and injectors.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel drain return line blocked, not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.
Check fuel inlet restriction.	Maximum inlet restriction to fuel transfer pump must not exceed 100 mm Hg (4 in. Hg).
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Engine compression low in one or more cylinders.	Check the engine compression.
Cranking speed too slow.	Refer to Table 24.
Electrical sensor fault.	Check the electrical connections at the sensors.

Table 24. Engine - Will Not Crank or Cranks Slowly

Cause	Remedy
Starting electrical circuit connections loose or corroded.	Clean and tighten connections.
Battery charge low.	Check battery voltage, charge the battery or replace as required. Make sure that the alternator is functioning correctly and charging the battery.
No electrical connection to starter solenoid.	Check voltage to solenoid.
Crankshaft rotation restricted.	Use special tool 892/01147 (crankshaft turning tool) to manual turn the engine and check for any severe rotational resistance.
Solenoid or starter motor fault.	Replace starter motor.
Starter motor operating but not cranking.	Remove the starter motor and check for broken teeth on the ring gear or broken starter motor spring.

Table 25. Engine - Starts then Stops

Cause	Remedy
No fuel in supply tank.	Check the level in the fuel tank, use sight gauge or dipstick. Replenish as required.
Engine starting under load.	Check for added loading from malfunctioning accessories or driven units (alternator)
Air intake or exhaust system blocked.	Visually check the air intake and exhaust system for blockage or obstruction - remove as required. Check the air filter elements for signs of blocking - replace as required.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.

Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump is operating and delivering fuel to the injection pump.
Fuel is waxing due to extremely cold weather.	Verify by inspecting the fuel filter. Clean the system and use acclimatised fuel.
Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel.
	WARNING: Dirty fuel will cause damage to the fuel injection pump and injectors.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s).
Fuel drain return line blocked, not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.

Table 26. Engine - Poor Running

Cause	Remedy
Condition only occurs at idle.	Refer to Table 27.
Engine is cold, coolant temperature sensor fault.	Check the electrical connection at the coolant sensor. Check the correct electrical wires for open or short circuits. If engine will not reach operating temperature, Table 24. Coolant - Under Temperature.
Fuel injection lines leaking.	Replace defective high pressure fuel lines.
	WARNING: DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones.
	WARNING: Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the fuel injection pump. Check the correct electrical wires for open or short circuits.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Monitor the engine performance.
	WARNING: Dirty fuel will cause damage to the fuel injection pump and injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Engien compression low in one or more cylinders.	Check the engine compression.
ECU or electrical sensor fault.	Check the electrical connections at the sensors.
Worn or malfunctioning high pressure fuel pump	Do all the necessary fault finding checks before removal of the high pressure fuel pump.
Camshaft or tappets damaged.	Inspect camshaft and tappets.

Table 27. Engine - Poor Running at Idle

Cause	Remedy
Coolant temperature sensor fault	Check the electrical connection at the coolant sensor. Check the correct electrical wires for open or short circuits. test the coolant sensor. If engine will not reach operating temperature refer to the following table. Refer to Table 45..
Engine mounts over-tightened, damaged or loose.	Verify condition of mounts. Refer to the machine's service manual for correct adjustment procedure.
Fuel injection lines leaking.	Replace defective high pressure fuel lines.
	WARNING: DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones.
	WARNING: Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.
Fuel is aerated.	Check the low pressure fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the fuel injection pump. Check the correct electrical wires for open or short circuits.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel.
	WARNING: Dirty fuel will cause damage to the fuel injection pump and injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Engine compression low in one or more cylinders.	Check the engine compression.
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Electrical sensor fault.	Check the electrical connections at the sensors.
Worn or malfunctioning high pressure fuel pump.	Do all the necessary fault finding checks before removal of the high pressure fuel pump.

Table 28. Engine - Noise Excessive

Cause	Remedy
Drive belt squeal, insufficient tension or abnormally high loading.	Check the tensioner and inspect the drive belt for loading. deterioration, Make sure water pump, tensioner pulley, fan alternator turn freely.
	Check for paint/oil or other material on pulleys.
	Check the tension of accessory drive belts.
Coolant temperature sensor fault	Check the electrical connection at the coolant sensor. Check the correct electrical wires for open or short circuits. test the coolant sensor. If engine will not reach operating temperature refer to the following table. Refer to Table 45..
Intake air or exhaust leaks.	Table 13. Engine - Exhaust Smoke Excessive (Black Smoke) and Table 14. Engine - Exhaust Smoke Excessive (White/Blue Smoke).

Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel.
	Note: Dirty fuel will cause damage to the fuel injection pump and injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances. Make sure the push rods are not bent or the rocker levers are not severely worn.
Turbocharger noise.	Check turbocharger impeller and turbine wheel for housing contact.
Inlet and exhaust valve springs broken.	Check and fit new valve springs.
Worn crank/connecting rod bearings (knocking under load).	Check/replace rod and main bearings.
Excessive camshaft bearing wear.	Check bearings (engine overhaul required).
Worn or damaged pistons and/or piston rings.	Check piston assemblies (engine overhaul required)
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Gear train noise.	Visually inspect and measure gear backlash. Replace gears as required.
Loss of Pilot injection on one or more cylinders.	Use service master to disable pilot injections to identify audibly if they are still present.

Table 29. Engine - Compression Knocks

Cause	Remedy
Fuel is aerated.	Check the low pressure fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel is contaminated or incorrect grade diesel fuel used.	STOP THE ENGINE.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel.
	WARNING: Dirty fuel will cause damage to the fuel injection pump and injectors.
Electrical sensor fault.	Check the electrical connections at the sensors.
Inlet and exhaust valve springs broken.	Check and fit new valve springs.
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Coolant operating temperature incorrect.	Refer to Table 44. and Refer to Table 45.

Table 30. Engine - Reduced Power Output

Cause	Remedy
No fuel in supply tank.	Check the level in the fuel tank, use sight gauge or dipstick. Replenish as required.
Oil level incorrect.	Check oil level.
Engine overload.	Check for added loading from malfunctioning accessories or driven units (alternator).
Throttle position sensor (TPS) system defective.	Check the throttle assembly
Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Monitor the engine performance.
	WARNING: Dirty fuel will cause damage to the fuel injection pump and injectors.
Turbocharger boost control pipe leaking or damaged, or wastegate diaphragm ruptured	Check boost control pressure. Inspect and tighten fittings, repair pipes, replace wastegate assembly.

Fuel injection lines leaking.	Inspect and correct as required leaks in the high pressure lines, fittings injector sealing washers, or delivery valves.
	WARNING: Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the fuel injection pump. Check the correct electrical wires for open or short circuits.
Air intake or exhaust system blocked.	Visually check the air intake and exhaust system for blockage or obstruction - remove as required. Check the air filter elements for signs of blocking - replace as required.
One or more fuel injector worn or malfunctioning	Check the electrical connections at the injectors.
Exhaust leak at the manifold or turbocharger (if applicable).	Check/correct leaks in the manifold or turbocharger gaskets. Look for a cracked manifold.
Extra injector sealing washer installed under injector.	Remove extra injector sealing washer.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Worn or malfunctioning fuel injection pump.	Do all the necessary fault finding checks before removal of the fuel injection pump.
Engine compression low in one or more cylinders.	Check the engine compression.
Engine in reduced torque or limp home mode.	Investigate the fault using ServiceMaster.
Electrical engine fault.	Investigate the fault using ServiceMaster.

Table 31. Engine - Will Not Reach Maximum RPM

Cause	Remedy
Tachometer faulty.	Verify engine speed with hand tachometer. Correct as required.
Engine overloaded.	Verify high idle speed without load. Investigate operation to be sure correct gear is being used.
Throttle position sensor (TPS) system defective.	Check the throttle assembly.
Fuel is aerated.	Check the low pressure fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits.
Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel.
	Monitor the engine performance.
	WARNING: Dirty fuel will cause damage to the high pressure fuel pump and injectors.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s).
	Check fuel lines for restriction.
Turbocharger wastegate actuator diaphragm ruptured. (turbocharged machines only)	Repair of replace turbocharger.

One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Worn or malfunctioning high pressure fuel pump.	Do all the necessary fault finding checks before removal of the high pressure fuel pump.

Table 32. Engine - RPM Surges

Cause	Remedy
Fuel injection lines leaking.	Replace defective high pressure fuel lines.
	WARNING: DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones.
	WARNING: Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.
Fuel tank cap vent/breather blocked.	Inspect and rectify as required - replace cap if necessary.
Fuel is aerated.	Check the low pressure fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Electrical sensor fault.	Check the electrical connections at the sensors.
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Worn or malfunctioning high pressure fuel pump.	Do all the necessary fault finding checks before removal of the high pressure fuel pump.

Table 33. Engine - Vibration Excessive

Cause	Remedy
Engine not running smoothly/misfiring.	Refer to Table 27.
Oil level over-full.	Check oil level.
Fan damaged or accessories faulty.	Check/replace the vibrating component.
Fan hub faulty.	Inspect/replace the fan hub. Refer to workshop manual.
Engine mounts loose or broken.	Check/replace engine mounts. Refer to the machine's service manual for correct installation and torque figures.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Engine compression low in one or more cylinders.	Check the engine compression.
Alternator bearing worn or damaged.	Check/replace the alternator.
Flywheel housing misaligned.	Check/correct flywheel alignment.
Electrical sensor fault.	Check the electrical connections at the ECU (Electronic Control Unit) and sensors.
Drive line components worn or unbalanced.	Check and inspect drive line components such as propshafts. Refer to workshop manual.

Table 34. Engine - Exhaust Smoke Excessive (Black Smoke)

Cause	Remedy
Engine being lugged down.	Use appropriate gear for task.
Air intake or exhaust system blocked.	Visually check the air intake and exhaust system for blockage or obstruction - remove as required. Check the air filter elements for signs of blocking - replace as required.
Air leak between the turbocharger and the intake manifold (Turbocharged machines only).	Check/correct leaks in the air crossover tube, hoses, or manifold cover.
Exhaust leak at the Manifold or Turbocharger (Turbocharged machines only).	Check/correct leaks in the manifold or turbocharger gaskets. Look for a cracked manifold.

Turbocharger wastegate faulty. (Turbocharged machines only).	Repair or replace wastegate.
Turbocharger malfunction.	Replace Turbocharger.
Electrical sensor fault.	Check the electrical connections at the sensors.
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Engine compression low in one or more cylinders. Smokes under load at all speeds, but mainly low to mid speed range.	Check the engine compression.

Table 35. Engine - Exhaust Smoke Excessive (White/Blue Smoke)

Cause	Remedy
Improper starting procedure.	Verify proper starting procedure.
Fuel is contaminated or incorrect grade diesel fuel used.	Stop the engine.
	Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Monitor the engine performance.
	WARNING: Dirty fuel will cause damage to the fuel injection pump and injectors.
Oil level incorrect.	Check oil level.
Diesel or hydraulic oil in sump.	Check oil consistency. If oil contamination is suspected check equipment suck as PTO pump for hydraulic oil leaks past the seal into the engine. Drain, flush and fill with clean oil.
Coolant temperature too low (over-cooling) - light blue or white high speed/light load.	Refer to Table 45.
Electrical sensor fault.	Check the electrical connections at the sensors.
One or more engine injector worn or malfunctioning. - white/ blue smoke at operating temperature.	Check the electrical connections at the injectors.
Coolant leaking into combustion chamber.	Refer to Table 43.
Leaking valve stem seals - evident after long idle period and then acceleration.	Replace valve seals.
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Piston rings not sealing - evident with persistent blue smoke at all speeds/load.	Check the engine compression.

Table 36. Engine - Will Not Shut Off

Cause	Remedy
Stop switch or stop switch electrical system failure.	Check the operation of the stop switch. Check the correct electrical wires for open or short circuits.

Fuel

Table 37. Fuel - Consumption Excessive

Cause	Remedy
Additional load on engine.	Check/repair accessories and vehicle components. Refer to the equipment manufacturer's procedures.
Operator technique.	Review operation for correct gear shifts, deceleration and idling.
Fuel leaks.	Check for external leaks at the fuel tank, fuel lines, filters and lift pump.
	WARNING: DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones.

	WARNING: Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.
Intake air or exhaust leaks.	Refer to Table 34. and Refer to Table 35.
Engine compression low in one or more cylinders.	Check the engine compression.
Electrical sensor fault.	Check the electrical connections at the sensors.
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.

Table 38. Fuel/Oil - Leaking from Exhaust Manifold

Cause	Remedy
Operating for extended periods under light or no load conditions.	Review operation for correct gear shifts, deceleration and idling.
Intake air or exhaust leaks.	Refer to Table 34. and Refer to Table 35.
Turbocharger lubricating oil drain line obstructed.	Check/clean line.
Exhaust leak at the Manifold or Turbocharger	Check/correct leaks in the manifold or turbocharger gaskets. Look for a cracked manifold.
Valve guide seals are leaking.	Replace valve guide stem seals as required.
Electrical sensor fault.	Check the electrical connections at the sensors.
One or more fuel injector worn or malfunctioning.	Check the electrical connections at the injectors.

Lubricating Oil

Table 39. Lubricating Oil - Consumption Excessive

Cause	Remedy
Oil leaks.	Inspect the engine for visible signs of leaks. Pay particular attentions to seals, gaskets oil cooler and external connections.
Oil level over-full.	Check oil level.
Incorrect lubricating oil (specification of viscosity).	Make sure the correct lubricating oil is being used. Refer to Fluids, Lubricants and Capacities
	Check for reduced viscosity from dilution with fuel. Fuel dilution in lubricating oil can originate from a defective fuel injection pump driveshaft seal.
	Review/reduce the lubricating oil change intervals.
Crank case ventilation (CCV) system blocked).	Check the breather tube area for signs of lubricating oil loss. Check and if necessary replace the CCV filter.
Lubricating oil cooler leak.	Check for lubricating oil in the coolant.
Turbocharger leaking lubricating oil to the air intake or exhaust (if fitted).	Inspect the air crossover tube for evidence of lubricating oil transfer.
Valve guide seals are leaking.	Replace valve guide stem seals as required.
Piston rings not sealing - lubricating oil being consumed by the engine (blue smoke from exhaust).	Check the engine compression.
Worn cylinder bores - lubricating oil being consumed by the engine (blue smoke from exhaust).	Check the engine compression.
Glazed cylinder bores.	De-glaze bores as required.

Table 40. Lubricating Oil - Contaminated

Cause	Remedy
Coolant in the lubricating oil, internal engine component leaks.	Refer to Table 43.

Lubricating oil sludge excessive.	Change oil and filter.
	Review oil and filter change period. If operating in arduous applications, change more frequently.
	Make sure the correct lubricating oil is being used.
Fuel in the lubricating oil, engine operating too cold.	Review the operation for excessive idling resulting in the engine running below normal temperature.
Electrical sensor fault	Review the operation for excessive idling resulting in the engine running below normal temperature.
One or more engine injector worn or malfunctioning.	Have oil sample analysed. Repair engine as required.

Table 41. Lubricating Oil - Pressure Low

Cause	Remedy
Oil level incorrect.	Check oil level.
Incorrect lubricating oil (specification of viscosity).	Make sure the correct lubricating oil is being used.
	Check for reduced viscosity from dilution with fuel. Fuel dilution in lubricating oil can originate from a defective high pressure fuel pump driveshaft seal.
	Review oil and filter change period. If operating in arduous applications, change more frequently.
Pressure sensor or gauge fault.	Change lubricating oil filter.
Lubricating oil filter blocked.	Change lubricating oil filter.
	Review oil and filter change period. If operating in arduous applications, change more frequently.
Lubricating oil filter drain down valve not fitted.	Change lubricating oil filter.
Suction pump pressure relief valve stuck open.	Check/replace seal.
Oil pump pressure relief valve stuck open.	Replace oil pump assembly.
Lubricating oil pump worn.	Replace oil pump assembly.

Table 42. Lubricating Oil - Pressure High

Cause	Remedy
Incorrect lubricating oil (specification of viscosity).	Make sure the correct lubricating oil is being used.
	Review oil and filter change period. If operating in arduous applications, change more frequently.
Pressure sensor or gauge fault.	Verify the pressure sensor is functioning correctly.
Engine running too cold.	Refer to Table 45.
Oil pump pressure relief valve stuck closed.	Replace oil pump assembly.

Coolant

Table 43. Coolant - Loss

Cause	Remedy
Incorrect coolant level.	Check the level.
Coolant leaking from engine radiator or block heater.	Visually inspect the radiator heater, hoses and connection to locate the leak.
External engine coolant leak.	Visually inspect the engine and components for seal, gasket hose connection leaks. Make sure all hose clips are in good condition and torqued to the recommended figure.
Overheating or compression gases leaking, resulting in loss through the radiator overflow.	Refer to Table 44.
If equipped, transmission cooler leak.	Check for mixing of coolant and transmission fluid.
If the engine is coolant aftercooled, aftercooler leak.	Check/replace the aftercooler. Look for coolant in the intake manifold and in the oil.

Lubricating oil cooler leak.	Check/replace the oil cooler. Look for coolant in the oil.
Cylinder head gasket leak.	Check/replace the head gasket.
Cylinder head cracked or porous.	Check/replace the head.
Cylinder block coolant passages leaking.	Check/replace the cylinder block.

Table 44. Coolant - Over Temperature

Cause	Remedy
Incorrect coolant level (low).	Check the level.
	Ensure low level is not as a result of a coolant leak, Table 22. Coolant - Loss.
External radiator matrix blocked with dirt or chaff.	Clean exterior or radiator matrix.
Air flow to the radiator inadequate or restricted.	Check/repair fan shroud, anti-recirculation sealing.
Coolant pump or fan drive belts loose.	Check/correct belt tension.
Radiator hose collapsed, restricted or leaking.	Check/replace hose.
Oil level over-full.	Check oil level.
Cooling system pressure cap incorrect or faulty.	Replace cap with the correct rating for the system.
Over concentration of anti-freeze.	Remove part of the coolant from cooling system and replace with water.
Temperature sensor faulty.	Verify that the gauge and temperature sensor are accurate.
Thermostat faulty, incorrect or missing.	Check/replace the thermostat.
Air or combustion gases in the cooling system.	Make sure the fill rate is not exceeded and the correct vented thermostat is installed.
	If aeration continued, check for a compression leak through the head gasket.
Coolant pump faulty.	Check/replace the coolant pump.
Vent line from engine and/or radiator blocked or incorrectly routed (sudden overheating).	Check routing and operation or vent line.
Leak between the top tank and the auxiliary tank (sudden overheating).	Check for coolant leakage between radiator auxiliary tank and radiator top tank.
Cooling passages in radiator, cylinder head, head gasket or block blocked.	Flush the system and fill with clean coolant.
Electrical sensor fault.	Check the electrical connections at the sensors.
One or more engine injector worn or malfunctioning.	Check the injectors.

Table 45. Coolant - Under Temperature

Cause	Remedy
Air flow across the radiator excessive.	Check/repair fan shroud, anti-recirculation sealing, shutters, fan sensors, fan speeds as required. Refer to the machine manufacturer's documentation for detailed information.
Temperature sensor faulty.	Verify that the gauge and temperature sensor are accurate.
Thermostat faulty, (open - not sealing).	Check/replace the thermostat.
Coolant not flowing by temperature sensor(1)	Check/clean coolant passages.

(1) A total coolant loss may result in the gauge showing low temperature initially. In which case, check the level.

Table 46. Coolant - Contaminated

Cause	Remedy
Coolant rusty, operation without correct mixture of antifreeze and water.	Drain and flush the cooling system. Fill with correct mixture of antifreeze and water.
	Review the coolant change interval. Refer to the Operation and Maintenance Manual.

Electrical

Table 47. General Fuel System Faults

Step	Trouble	Action/Remedy
1	Fuel supply fault	Check the low pressure circuit connections are secure.
		Check the fuel pressure in low circuit/tank level.
		Check the fuel type (EN590 Specification).
		Check for the external diesel fuel leaks.
		Check the filter is not blocked
		Check the fuel lift pump operation
		Replace/repair as necessary.
		If no faults are found, proceed to Step 2 or 3 depending on symptoms.
2	Engine does not start	Complete the `Static Injector Leak Test'.
		If the injector backleak is above the limit, replace injector(s) as necessary.
		If the injector backleak is OK check the rail pressure is above 300 bar, if not, replace the high pressure pump.
		If the rail pressure is OK and backleak is within limits, raise Techweb Helpdesk Call.

Table 48. General Sensor Fault

Step	Trouble	Action/Remedy
1	Sensor supply voltage fault	Disconnect the sensor, check sensor voltage supply at the harness connector (see relevant sensor help file for pin numbers or refer to engine electrical schematic). If voltage supply is faulty, disconnect all other sensor in turn until voltage supply returns.
		If sensor supply voltage is OK, proceed to Step 2.
2	Sensor connection faulty	Check the condition of sensor to harness connection, make sure the seals are in place, check for signs of corrosion or contamination. Repair/replace as necessary.
		If no fault is found, proceed to Step 3.
3	Sensor failure	Check the sensor resistance (see relevant helpfile page). If sensor is out of specification replace.
		If no faults is found, proceed to Step 4.
4	Wiring fault	Check the harness continuity and machine and engine earth contacts. Repair/replace as necessary.
		If no fault found, raise Techweb Helpdesk call.

Table 49. Water in Fuel Sensor Fault

Step	Trouble	Action/Remedy
1	Sensor supply voltage fault	Check the presence of electrical supply on water sensor.
		If sensor supply voltage is OK, proceed to Step 2.

2	Sensor connection faulty	Check the condition of sensor to harness connection, make sure the seals are in place, check for signs of corrosion or contamination. Repair/replace as necessary.
		If no fault is found, proceed to Step 3.
3	Sensor failure	Check the sensor resistance (see relevant helpfile page). If sensor is out of specification replace.
		If no faults is found, proceed to Step 4.
4	Wiring faults	Check the harness continuity and machine and engine earth contacts. Repair/replace as necessary.
		If no fault found, raise Techweb Helpdesk call.

Table 50. General Relay Fault

Step	Trouble	Action/Remedy
1	Relay supply voltage fault	Perform the relay test routine.
		If relay supply voltage is found fault, proceed to Step 2.
		If relay supply voltage is OK, raise Techweb Helpdesk Call.
2	Relay connection faulty	Check the condition of relay to harness connection, make sure the seals are in place, check for signs of corrosion or contamination. Repair/replace as necessary.
		If no fault is found, proceed to Step 3.

Table 51. Electrical Network - CanBus system

Step	Trouble	Action/Remedy
1	Wiring fault	Check the harness continuity and electrical insolation, repair/replace as necessary.
		If no faults is found, proceed to Step 3.
2	Network and CAN (Controller Area Network) resistors faulty	Check the network and CAN resistors, repair as necessary.
		If no fault is found proceed to raise Techweb Helpdesk call.

Table 52. Injector Calibration

Step	Trouble	Action/Remedy
1	Injector cylinder position and value fault	Check that `individual injector corrections' are correctly entered in ECU. Check the cylinder position and value.
		If no faults is found, proceed to Step 3.
2	Injector program fault	Re-flash the injector calibration codes, respecting power down and up delay and taking care of injector position; erase all the faults.
		If no fault is found proceed to step 4.
3	Electrical connection faulty	Check the knock sensor connection and screw torque, repair as necessary. Check the ground shield connection of knock sensor.
		If no knock sensor is installed, raise Techweb Helpdesk call.

Table 53. High Pressure Fuel Valve

Step	Trouble	Action/Remedy
1	HPV (High Pressure Valve) connection fault	Check the connection of HPV.
		If the HPV connection is faulty, repair or replace as necessary.
		If no fault is found proceed to step 2.
2	Wiring fault	Check the harness continuity and electrical insolation, repair/replace as necessary.
		If no fault is found proceed to step 3.
3	Electrical resistance fault	Measure the HPV electrical resistance, it should be around 2.2Ω at 25°C (77.0°F).

		If the electrical resistance is OK, replace the rail and HPV.
		If no fault is found proceed to step 4.
4	HPV buzzing fault	Perform the HPV buzz test. If the HPV is not buzzing replace the rail and HPV.
		If the HPV buzzes, raise Techweb Helpdesk call.

Table 54. Open Circuit Injector

Step	Trouble	Action/Remedy
1	Fuel injector fault	Perform the injector buzz test, if the injector is faulty it will not produce a buzzing sound. In such instances raise Techweb Helpdesk call.
		If no fault is found proceed to step 2.
2	Injector connection fault	Check the resistance of injector. For solenoid, it should be less than 1Ω.
		If the resistance is incorrect, change the injector and calibrate it.
		If no fault is found proceed to step 3.
3	Wiring fault	Check the harness continuity and electrical installation, repair/replace as necessary. If no fault is found
		If no fault is found raise Techweb Helpdesk call.

Table 55. Injection Bank

Step	Trouble	Action/Remedy
1	Injector connection fault	Check the injector connections corresponding to faulty bank, repair as necessary.
		If no fault is found proceed to step 2.
2	Injector faulty	Check all the injectors individually. Replace the injector and re-calibrate the ECU with the trim file of the new injector.
		If no fault is found proceed to step 3.
3	Wiring fault	Check the harness continuity and electrical installation, repair/replace as necessary.
		If no fault is found raise Techweb Helpdesk call.

Table 56. Short Circuit Injector

Step	Trouble	Action/Remedy
1	Fuel injector fault	Perform the injector buzz test, if the injector is faulty it not will produce a buzzing sound. In such instances raise Techweb Helpdesk call.
		If no fault is found proceed to step 2.
2	Injector connection fault	Disconnect the injector (one by one) to see if the fault disappeared. Repair/ replace as necessary.
		Disconnect the engine harness inter connect plug it to see if the fault disappears. Repair/replace as necessary.
		If no fault is found proceed to step 3.
3	Wiring fault	Check the harness continuity and electrical installation, repair/replace as necessary.
		If no fault is found raise Techweb Helpdesk call.

Table 57. Engine Low on Power

Step	Trouble	Action/Remedy
1	Injector fault - electrical	If an electrical injector fault is present raise Techweb Helpdesk call.
		If no fault is found proceed to step 2.

2	Injector connection fault	Check the Individual Injector Corrections and injector connections. If the problem with C3I or injector connection is evident, replace/repair as necessary.
		If no fault is found proceed to step 3.
4	Engine Cylinder compression fault	Run the compression test (automatic or manual), if any of the engine cylinder pressure is not in the limits, repair/replace as necessary.
		If no fault is found proceed to step 5.
5	Blocked inlet tubes	Check the fuel lines for any blockage and contamination. Clean the fuel lines as necessary.
		If no fault is found proceed to step 6.
6	Injector faulty	Swap the injectors with another. Re-write the trim codes. Replace/repair as necessary and re-flash the injector calibration codes.

Table 58. Knock Sensors

Step	Trouble	Action/Remedy
1	Sensor connection fault	Check the following sensors and make sure they work correctly:
		Knock sensors
		Water temperature sensor
		Air temperature sensor
		Fuel temperature sensor
		Barometric pressure sensor (built inside the ECU)
		Check the knock sensors connection and screw torque (Check particularly the ground shield connection). Repair as necessary and re-enter all injector calibration codes (read then write) in correct position to reset learned parameters.
		If no fault is found proceed to step 2.
2	Knock sensors ground fault	Check the grounding of knock sensors, repair as necessary.
		If no fault is found proceed to step 3.
3	Wiring fault	Check the harness continuity and electrical installation, repair/replace as necessary.

Table 59. Boost Pressure Sensor

Step	Trouble	Action/Remedy
1	Sensor supply voltage or calibration fault	Disconnect the sensor, check sensor voltage supply at the harness connector (see relevant sensor helpfile for pin numbers or refer to engine electrical schematic). If voltage supply is faulty, disconnect all other sensor in turn until voltage supply returns. Replace the faulty sensor.
		If sensor supply voltage is OK, proceed to Step 2.
2	Air inlet circuit fault	Check the consistency of barometric pressure reading. Verify the conformity of air inlet circuit:
		- Leakage before Turbo
		– Air filter
		– Valve position using ServiceMaster
		– Vane state
		Check all the hose connections for air leaks, repair as necessary.
		If no fault is found, raise Techweb Helpdesk call.
3	Sensor connection faulty	Check the condition of sensor to harness connection, make sure the seals are in place, check for signs of corrosion or contamination. Repair/replace as necessary.
		If no fault is found, proceed to Step 4.

3	Sensor failure	Check the sensor resistance (see relevant helpfile page). If sensor is out of specification replace.
		If no faults is found, proceed to Step 4.
4	Wiring fault	Check the harness continuity and machine and engine earth contacts. Repair/ replace as necessary.
		If no fault found, raise Techweb Helpdesk call.

Table 60. Battery Voltage

Step	Trouble	Action/Remedy
1	Battery fault	Switch on the ignition key and check the battery voltage with a multimeter. If the specific gravity of the battery is below 9 volt and above 16 volt, charge/replace the battery.
		If no fault is found proceed to step 2.
2	Battery connection fault	Disconnect the electrical connection from the battery. Check for signs of corrosion or contamination in the battery terminals, clean the terminals. Repair as necessary.
		If no fault is found proceed to step 3.
3	Battery charge circuit fault	Check the battery charge circuit, if the circuit is found faulty repair as necessary.
		If no fault is found raise a Techweb Helpdesk call.

Table 61. Crankshaft Position Sensor

Step	Trouble	Action/Remedy
1	Sensor supply voltage fault	Disconnect the sensor, check sensor voltage supply at the harness connector (see relevant sensor helpfile for pin numbers or refer to engine electrical schematic). If voltage supply is faulty, replace the sensor.
		If sensor supply voltage is OK, proceed to Step 2.
2	Sensor connection faulty	Check the condition of sensor to harness connection, make sure the seals are in place, check for signs of corrosion or contamination. Repair as necessary.
		If no fault is found, proceed to Step 3.
4	Sensor signals faulty	Check the sensor signals. If scope available, display Cam and crank signals on the scope. Change the sensor as necessary.
		If no fault is found, proceed to Step 5.
5	Sensor failure	Check the sensor resistance (see relevant helpfile page). If sensor is out of specification replace.
		If no faults is found, proceed to Step 6.
6	Sensor target wheel fault	Check the crankshaft position sensor target wheel if damaged, replace with a new crankshaft.
		If no faults is found raise Techweb Helpdesk call.

Table 62. Camshaft Position Sensor

Step	Trouble	Action/Remedy
1	Sensor supply voltage fault	Disconnect the sensor, check sensor voltage supply at the harness connector (see relevant sensor helpfile for pin numbers or refer to engine electrical schematic). If voltage supply is faulty, replace the sensor.
		If sensor supply voltage is OK, proceed to Step 2.
2	Sensor connection faulty	Check the condition of sensor to harness connection, make sure the seals are in place, check for signs of corrosion or contamination. Repair as necessary.
		If no fault is found, proceed to Step 3.
3	Sensor failure	Check the sensor resistance (see relevant helpfile page). If sensor is out of specification replace.

		If no faults is found, proceed to Step 4.
4	Sensor signals faulty	Check the sensor signals. If scope available, display Cam and crank signals on the scope. Change the sensor as necessary.
		If no fault is found, proceed to Step 5.
5	Sensor target wheel fault	Check the Cam target wheel if damaged, replace with new camshaft.
		If no faults is found raise Techweb Helpdesk call.

Table 63. TMAF Sensor

Step	Trouble	Action/Remedy
1	Sensor supply voltage or calibration fault	Disconnect the sensor, check sensor voltage supply at the harness connector (see relevant sensor helpfile for pin numbers or refer to engine electrical schematic). If voltage supply is faulty, disconnect all other sensor in turn until voltage supply returns. Replace the faulty sensor.
		If sensor supply voltage is OK, proceed to Step 2.
2	Air inlet fault	Check all the hose connections for air leaks, repair as necessary.
		If no fault is found proceed to step 3.
3	Sensor connection faulty	Check the condition of sensor to harness connection, make sure the seals are in place, check for signs of corrosion or contamination. Repair/replace as necessary.
		If no fault is found, proceed to Step 4.
4	Sensor failure	Check the sensor resistance (see relevant help file page). If sensor is out of specification replace.
		If no faults is found, proceed to Step 5.
6	Wiring fault	Check the harness continuity and machine and engine earth contacts. Repair/ replace as necessary.
		If no fault found, raise Techweb Helpdesk call.

Table 64. High Pressure Diagnostics

Step	Trouble	Action/Remedy
1	Pressure diagnostics fault	Check the fault of type IMV or HPV (if applicable) or pressure sensor, repair the corresponding fault.
		If no fault is found proceed to step 2.
2	High pressure system fault	Read the Diagnostic Trouble Code (DTC)
		Connect the battery booster
		If the DTC links to high pressure control:
		Check the fuel feed circuit is in good condition.
		Check the diesel fuel is present in the system.
		Check there is no air bubbles or emulsion in the pipes.
		Check there is enough fuel pressure in the inlet pump.
		Check there are no high pressure circuit leaks.
		Check the quality and type of the diesel fuel.
		If the low pressure circuit is faulty, repair the low pressure circuit.
		If no faults are found, proceed to Step 3 or 4 depending on symptoms, replace the corresponding injectors.
3	Engine does not start	Perform the `Static Injector Backleak Test'.
		If the static pressure is not reached, replace the high pressure pump.
		If the static pressure is reached, replace the corresponding injectors.

Table 65. Open Circuit Injector

Step	Trouble	Action/Remedy
1	Pressure diagnostics fault	Perform the injector buzz test, if the injector is faulty it will not produce a buzzing sound. In such instances raise Techweb Helpdesk call.
		If no fault is found proceed to step 2.
2	Injector connection fault	Check the resistance of injector.
		– For solenoid, it should be less than 1 Ohm.
		If the resistance is incorrect, change the injector and calibrate it.
		If no fault is found proceed to step 3.
3	Wiring fault	Check the harness continuity and electrical insolation, repair/replace as necessary.
		If no fault is found raise Techweb Helpdesk call..

Alternator

Table 66.

Cause	Remedy
Alternator does not excite	Substitute fuse.
	Increase speed by 15%.
	For an instant apply on "+" and " -" of the electronic regulator a 12 V battery voltage with a 30 resistor in series, respecting the polarities.
After being excited alternator does not excite	Check connection cables as per attached drawings.
Low voltage at no load	Reset voltage potentiometer.
	Check speed.
	Check windings.
High voltage at no load	Reset voltage potentiometer.
	Substitute regulator.
At load conditions, voltage lower than rated voltage	Reset the voltage potentiometer.
	Current too high, power factor lower than 0.8, speed lower than 4% of rated speed.
	Substitute regulator.
	Check diodes, disconnect cables.
At load conditions, voltage higher than rated voltage	Calibrate the voltage.
	Replace the controller.
Unstable voltage	Check uniformity of rotation.
	Regulate stability of regulator by acting on STAB potentiometer.

Control Panel

Starting

Table 67.

Symptom	Possible Remedy
Unit is inoperative. Read/Write configuration does not operate	Check the battery and wiring to the unit
	Check the DC supply
	Check the DC fuse
Unit shuts down	Check DC supply voltage is not above 14.7V or below 9V Volts

	Check the operating temperature is not above 70°C (157.9°F)
	Check the DC fuse
Fail to Start is activated after pre-set number of attempts to start	Check the wiring of fuel solenoid.
	Check the fuel
	Check the battery supply
	Check the battery supply is present on the fuel output of the module
	Check the speed-sensing signal is present on the module's inputs
Continuous starting of generator when in the AUTO Mode	Check that there is no signal present on the "Remote Start" input
	Check configured polarity is correct
	Check the mains supply is available and within configured limits
Generator fails to start on receipt of Remote Start signal.	Check the start delay timer has timed out
	Check the signal is on `Remote Start' input. Confirm correct configuration of input is configured to be used as `Remote Start'
	Check that the oil pressure switch or sensor is indicating low oil pressure to the controller. Depending upon configuration, then set will not start if oil pressure is not low
Pre-heat inoperative	Check the wiring to engine heater plugs
	Check the battery supply
	Check the battery supply is present on the Pre-heat output of module
	Check the pre-heat configuration is correct
Starter motor inoperative	Check the wiring to starter solenoid
	Check the battery supply
	Check the battery supply is present on the Starter output of module
	Ensure oil pressure switch or sensor is indicating the "low oil pressure" state to the controller

Loading

Table 68.

Symptom	Possible Remedy
Engine runs but generator will not take load	Check Warm up timer has timed out
	Ensure generator load inhibit signal is not present on the module inputs
	Check connections to the switching device
	Note that the set will not take load in manual mode unless there is an active load signal
Incorrect reading on Engine gauges	Check engine is operating correctly
	Check that sensor is compatible with the module and that the module configuration is suited to the sensor
Fail to stop alarm when engine is at rest	Check that sensor is compatible with the module and that the module configuration is suited to the sensor

Alarms

Table 69.

Symptom	Possible Remedy
Low oil pressure fault operates after engine has fired	Check the engine oil pressure.
	Check the oil pressure switch/sensor and wiring.
	Check configured polarity (if applicable) is correct (i.e. normally open or normally closed) or that sensor is compatible with the module and is correctly configured.
High engine temperature fault operates after engine has fired.	Check the engine temperature.
	Check the switch/sensor and wiring.
	Check configured polarity (if applicable) is correct (i.e. normally open or normally closed) or that sensor is compatible with the module.
Shutdown fault operates	Check the relevant switch and wiring of fault indicated on LCD (Liquid Crystal Display) display.
	Check the configuration of input.
Electrical Trip fault operates	Check the relevant switch and wiring of fault indicated on LCD display.
	Check the configuration of input.
Warning fault operates	Check the relevant switch and wiring of fault indicated on LCD display.
	Check the configuration of input.
CAN ECU warningCAN ECU shutdown	This indicates a fault condition detected by the engine ECU and transmitted to the DSE controller.
CAN data fail	Indicates failure of the CAN data link to the engine ECU.
	Check all wiring and termination resistors (if required).
Incorrect reading on engine gauges	Check the engine is operating correctly.
	Check sensor and wiring paying particular attention to the wiring to terminal 10 (refer to appendix).
Fail to stop alarm when engine is at rest	Check that sensor is compatible with the module and that the module configuration is suited to the sensor.

Communications

Table 70.

Symptom	Possible Remedy
CAN data fail	Indicates failure of the CAN data link to the engine ECU.
	Check all wiring and termination resistors (if required).

Instruments

Table 71.

Symptom	Possible Remedy
Inaccurate generator measurements on controller display	Check that the CT primary, CT secondary and VT ratio settings are correct for the application.

	Check that the CTs are wired correctly with regards to the direction of current flow (p1,p2 and s1,s2) and additionally ensure that CTs are connected to the correct phase (errors will occur if CT1 is connected to phase 2). Remember to consider the power factor (kW = kVA x powerfactor).
	The controller is true RMS measuring so gives more accurate display when compared with an `averaging' meter such as an analogue panel meter or some lower specified digital multimeters.
	Accuracy of the controller is better than 1% of full scale. Generator voltage full scale is 415V ph-N, accuracy is 4.15V (1% of 415V).

Miscellaneous

Table 72.

Symptom	Possible Remedy
Module appears to `revert' to an earlier configuration	When editing a configuration using the PC software it is vital that the configuration is first `read' from the controller before editing it. This edited configuration must then be "written" back to the controller for the changes to take effect.
	When editing a configuration using the fascia editor, be sure to press the AUTO mode button to save the change before moving to another item or exiting the fascia editor.

Notes:

Technical Data
Introduction

General

Table 73.

Model	Gererator Set rating (Stand by)	Engine Type	Serial Number
G20	20 kVA	KDI 1903M	From 2288985 to 2298985
G20S	20 kVA	KDI 1903M	From 2288985 to 2298985
G20QS	20 kVA	KDI 1903M	From 2288985 to 2298985
G27	27 kVA	KDI 2504M	From 2288985 to 2298985
G27S	27 kVA	KDI 2504M	From 2288985 to 2298985
G27QS	27 kVA	KDI 2504M	From 2288985 to 2298985
G33	33 kVA	KDI 2504TM	From 2288985 to 2298985
G33S	33 kVA	KDI 2504TM	From 2288985 to 2298985
G33QS	33 kVA	KDI 2504TM	From 2288985 to 2298985
G34QS	33 kVA	KDI 2504TM	From 2288985 to 2298985
G40	40 kVA	KDI 2504TM	From 2288985 to 2298985
G40S	40 kVA	KDI 2504TM	From 2288985 to 2298985
G40QS	40 kVA	KDI 2504TM	From 2288985 to 2298985
G41QS	40 kVA	KDI 2504TM	From 2288985 to 2298985
G45	45 kVA	KDI 2504TM (non certified)	From 2288985 to 2298985
G45S	45 kVA	KDI 2504TM (non certified)	From 2288985 to 2298985
G45QS	45 kVA	KDI 2504TM (non certified)	From 2288985 to 2298985

Static Dimensions

Dimensions

Table 74.

Model	Length (mm)	Width (mm)	Height (mm)	Shipping Volume (sea ready) (m3)
G20	1,750mm	750mm	1,350mm	1.78m³
G20S	1,650mm	650mm	1,200mm	1.3m³
G20QS	1,750mm	790mm	1,350mm	1.88m³
G27	2,250mm	800mm	1,350mm	2.43m³
G27S	1,650mm	650mm	1,250mm	1.35m³
G27QS	2,250mm	840mm	1,350mm	2.55m³
G33	2,250mm	800mm	1,350mm	2.43m³
G33S	2,075mm	670mm	1,250mm	1.75m³
G33QS/G34QS	2,250mm	840mm	1,350mm	2.55m³
G40	2,250mm	800mm	1,350mm	2.43m³
G40S	2,075mm	670mm	1,250mm	1.75m³
G40QS/41QS	2,250mm	840mm	1,350mm	2.55m³
G45	2,250mm	800mm	1,350mm	2.43m³
G45S	2,075mm	670mm	1,270mm	1.78m³
G45QS	2,250mm	840mm	1,350mm	2.55m³

Weights

Table 75.

Model	Weight (standard build excluding fuel) (Kg)
G20	638kg
G20S	590kg
G20QS	800kg
G27	810kg
G27S	730kg
G27QS	1,000kg
G33	810kg
G33S	780kg
G33QS/G34QS	1,000kg
G40	810kg
G40S	780kg
G40QS/G41QS	1,000kg
G45	810kg
G45S	780kg
G45QS	1,000kg

Noise Emissions

Noise Data

Table 76.

Description	G20QS	G27QS	G33QS	G34QS	G40QS	G41QS	G45QS
LpA (7m)	60 dB(A)	62 dB(A)	62 dB(A)	62 dB(A)	62 dB(A)	62 dB(A)	62 dB(A)

Fluids, Lubricants and Capacities

General

The generating set engine oil is pre-filled in factory. However it is important to check the level of oil in the engine before any starting can take place, and also as part of a regular maintenance schedule.

New engines do not require a running-in period. The engine/machine should be used in a normal work cycle immediately, glazing of the piston cylinder bores, resulting in excessive oil consumption, could occur if the engine is gently run-in. Under no circumstances should the engine be allowed to idle for extended periods; (e.g. warming up without load).

For vehicle applications a minimum API CF-4 grade oil must be used. Superior grade oils may be more appropriate for heavy duty applications (such as sustained high loads and operation at elevated temperatures).

Important: Operation of the engine with some types of fuel requires use of superior grade oil.

For generator set applications a minimum API CI-4 grade oil must be used. Superior grade oils may be more appropriate for heavy duty applications (such as sustained high loads and operation at elevated temperatures).

The choice of lubricant viscosity should be made based on the lowest ambient temperature at which the machine will be started and the maximum ambient temperature at which it will operate.

The following table provides guidance as to the temperature range that can be accommodated by standard oil viscosities and can be used to select an appropriate grade.

Important: When selecting the oil viscosity grade make sure the oil conforms with or exceeds the recommended specification.

Table 77.

Oil Viscosity	
SAE	10W-40
	5-W40

Recommended Oils

Table 78.

Engine Oil	**Specification**
JCB Extreme Performance	API CI - 4, CH - 4, CG - 4
	ACEA E4[(1)]
	ACEA E5[(2)]
	ACEA E7[(3)]

(1) High performance (Euro 1 - 2 - 3 Engines) heavy duty
(2) High performance (Euro 1 - 2 Engines) heavy duty
(3) High power over long distances (Euro 4 - 5 engines)

Choose the grade of oil to suit the temperature range as detailed.

Engine Oil Capacity

Table 79.

Item	**Capacity Litres (UK Gal)**
Engine	Maximum 11 (2.9)
	Minimum 8.7 (2.3)

(1) High performance (Euro 1 - 2 - 3 Engines) heavy duty
(2) High performance (Euro 1 - 2 Engines) heavy duty
(3) High power over long distances (Euro 4 - 5 engines)

Choose the grade of oil to suit the temperature range as detailed.

Fuel

⚠ **WARNING** Do not use petrol in this machine. Do not mix petrol with the diesel fuel. In storage tanks the petrol will form flammable vapours.

Notice: No warranty liability will be accepted for engine failures where unacceptable fuel grades (or their equivalent) have been used at any stage.

Acceptable and Unacceptable Fuels

Use the same type of diesel fuel as used in cars (EN 590 for E.U. - ASTM D975-09B regulation - S 15 for U.S). Use of other types of fuel could damage the engine. Do not use dirty diesel fuel or mixtures of diesel fuel and water since this will cause serious engine faults.

Clean fuel prevents the fuel injectors from clogging. Immediately clean up any spillage during refuelling.

Never store diesel fuel in galvanized containers (i.e. coated with zinc). Diesel fuel and the galvanized coating react chemically to each other, producing flaking that quickly clogs filters or causes fuel pump and/or injector failure.

Fuels for Low Temperatures

When operating the engine in ambient temperatures lower than 0°C (32.0°F), use suitable low temperature fuel normally available from fuel distributors and corresponding to the specifications in the table.

These fuels reduce the formation of paraffin in diesel at low temperatures.

When paraffin forms in the diesel, the fuel filter becomes blocked interrupting the flow of fuel.

Biodiesel Fuel

Fuels containing 10% methyl ester or B10, are suitable for use in this engine provided that they meet the specifications listed in the table.

Do not use vegetable oil as a biofuel for this engine.

Any failures resulting from the use of fuels other than recommended will not be warranted.

Table 80. Fuel Compatibility

	Compatible		Certification emission		Warranty coverage		Engine waste	
	yes	no	yes	no	yes	no	yes	no
EN 590, DIN 51628 - Military NATO fuel F-54 (S=10 ppm)	O		O		O			O
No 1 Diesel (US) - ASTM D 975-09 B - Grade 1-D S 15 (S=15 ppm)	O		O		O			O
No 1 Diesel (US) - ASTM D 975-09 B - Grade 1-D S 500 (S=500 ppm)	O			O	O(1)			O
No 2 Diesel (US) - ASTM D 975-09 B - Grade 2-D S 15	O		O		O			O
No 2 Diesel (US) - ASTM D 975-09 B - Grade 2-D S 1500	O			O	O(1)			O
ARCTIC (EN 590/ASTM D 975-09 B)	O(2)		O		O			O
High sulfur fuel < 5000 ppm (<0.5%)	O			O	O(1)			O(1)
High sulfur fuel > 5000 ppm (<0.5%)	O			O	O(3)			O(3)
High sulfur fuel > 10000 ppm (>1%)		O		O		O	O	

	Compatible		Certification emission		Warranty coverage		Engine waste	
Civil Jet Fuels Jet A/A1		O		O		O	O	
Civil Jet Fuels Jet B		O		O		O	O	
Bio Fuels (EN14214)	O(4)		O(4)		O(4)			O(4)

(1) Except for catalyst clogged and EGR.
(2) Without adding oil.
(3) Except for catalyst clogged and EGR. Shorter oil change intervals.
(4) Max. 10% in fuel.

Coolant

⚠ **CAUTION** Antifreeze can be harmful. Obey the manufacturer's instructions when handling full strength or diluted antifreeze.

Check the strength of the coolant mixture at least once a year, preferably at the start of the cold period.

Replace the coolant mixture according to the intervals shown in the machine's Service Schedule.

You must dilute full strength antifreeze with clean water before use. Use clean water of no more than a moderate hardness (pH value 8.5). If this cannot be obtained, use de-ionized water. For further information advice on water hardness, contact your local water authority.

The correct concentration of antifreeze protects the engine against frost damage in winter and provides year round protection against corrosion.

The protection provided by JCB High Performance Antifreeze and Inhibitor is shown below.

Table 81.

Concentration	Level of protection
50% (Standard)	Protects against damage down to -40°C (-40°F)
60% (Extreme Conditions Only)	Protects against damage down to -56°C (-69°F)

Do not exceed a 60% concentration, as the freezing protection provided reduces beyond this point.

If you use any other brand of antifreeze:

- Make sure that the antifreeze complies with International Specification ASTM D6210.
- Always read and understand the manufacturer's instructions.
- Make sure that a corrosion inhibitor is included. Serious damage to the cooling system can occur if corrosion inhibitors are not used.
- Make sure that the antifreeze is ethylene glycol based and does not use Organic Acid Technology (OAT).

Electrical System

General

Table 82.

Description	G20/G20S/ G20QS	G27/G27S/ G27QS	G33/G33S/ G33QS	G34QS	G40/G40S/ G40QS	G41QS	G45/G45S/ G45QS
Frequency Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Phases	3	3	3	3	3	3	3
Rated Speed RPM	1500/1800	1500/1800	1500/1800	1500/1800	1500/1800	1500/1800	1500/1800
Power Factor (3 Phase)	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Alternator							
Poles	4	4	4	4	4	4	4
Winding Connections	star	star	star	star	star	star	star
Insulation	Class H	Class H	Class H	Class H	Class H	Class H	Class H
Enclosure	IP 23	IP 23	IP 23	IP 23	IP 23	IP 23	IP 23
Exciter System	Self regulating brushless	Self regulating brushless	Self regulating brushless	Self regulating brushless	Self regulating brushless	Self regulating brushless	Self regulating brushless
Voltage Regulator	DSR	DSR	DSR	DSR	DSR	DSR	DSR
Steady State Voltage Regulation	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Bearing	Single bearing sealed	Single bearing sealed	Single bearing sealed	Single bearing sealed	Single bearing sealed	Single bearing sealed	Single bearing sealed
Coupling	Flexible disc	Flexible disc	Flexible disc	Flexible disc	Flexible disc	Flexible disc	Flexible disc
Cooling	Direct drive centrifugal blower fan	Direct drive centrifugal blower fan	Direct drive centrifugal blower fan	Direct drive centrifugal blower fan	Direct drive centrifugal blower fan	Direct drive centrifugal blower fan	Direct drive centrifugal blower fan
Coating	Winding Protection Grey	Winding Protection Grey	Winding Protection Grey	Winding Protection Grey	Winding Protection Grey	Winding Protection Grey	Winding Protection Grey
Number of Batteries[(1)]	1	1	1	1	1	1	1
Wet Battery	110 AH	110 AH	110 AH	110 AH	110 AH	110 AH	110 AH
Gel Battery	730CCA	730CCA	730CCA	730CCA	730CCA	730CCA	730CCA
Auxiliary Voltage (V)	12V	12V	12V	12V	12V	12V	12V

(1) Battery not supplied with generator set.

Schematic Circuit

Figure 98. 335/F5093-3 (sheet 1 of 6)

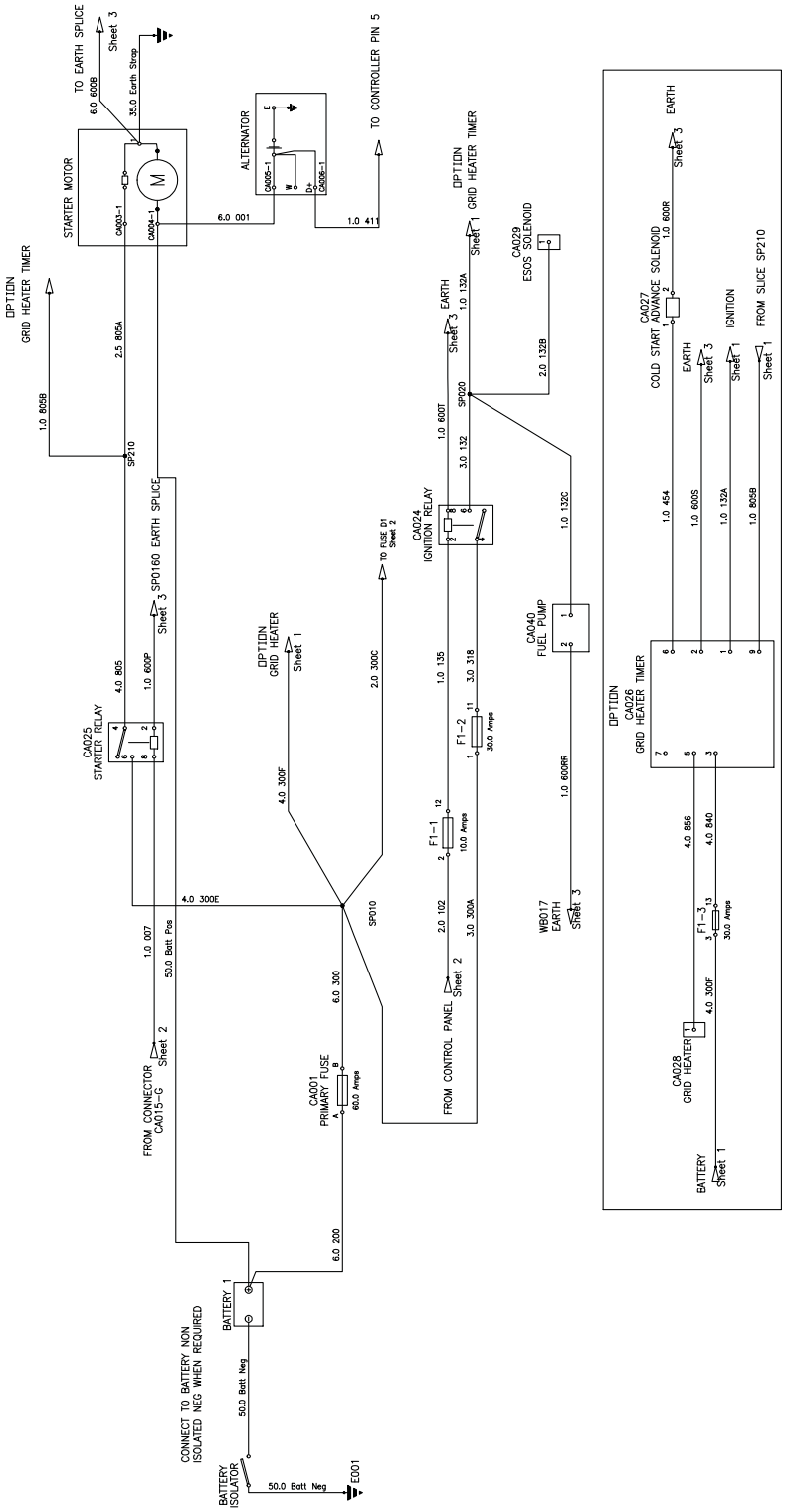


Figure 99. 335/F5093-3 (sheet 2 of 6)

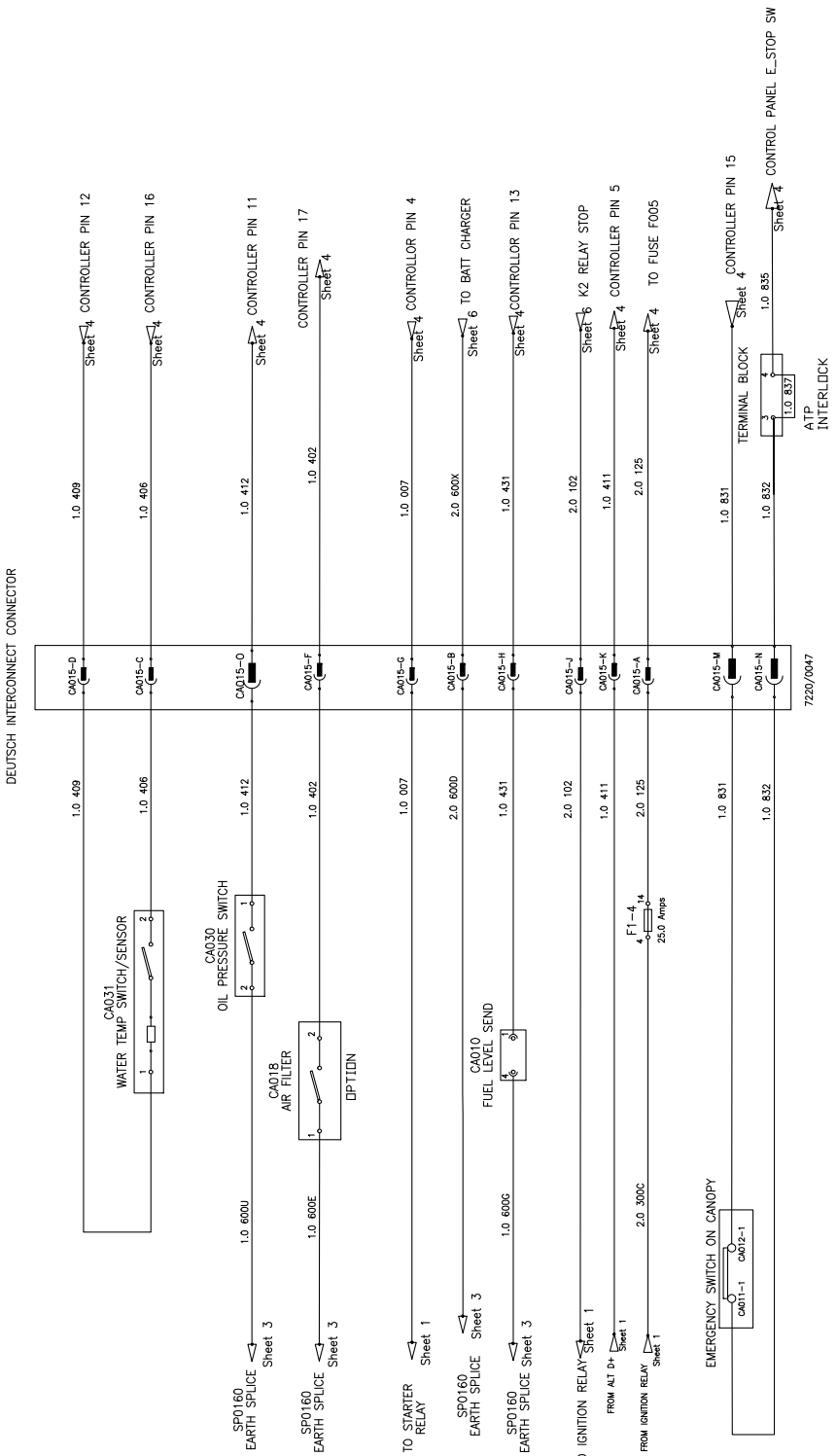


Figure 100. 335/F5093-3 (sheet 3 of 6)

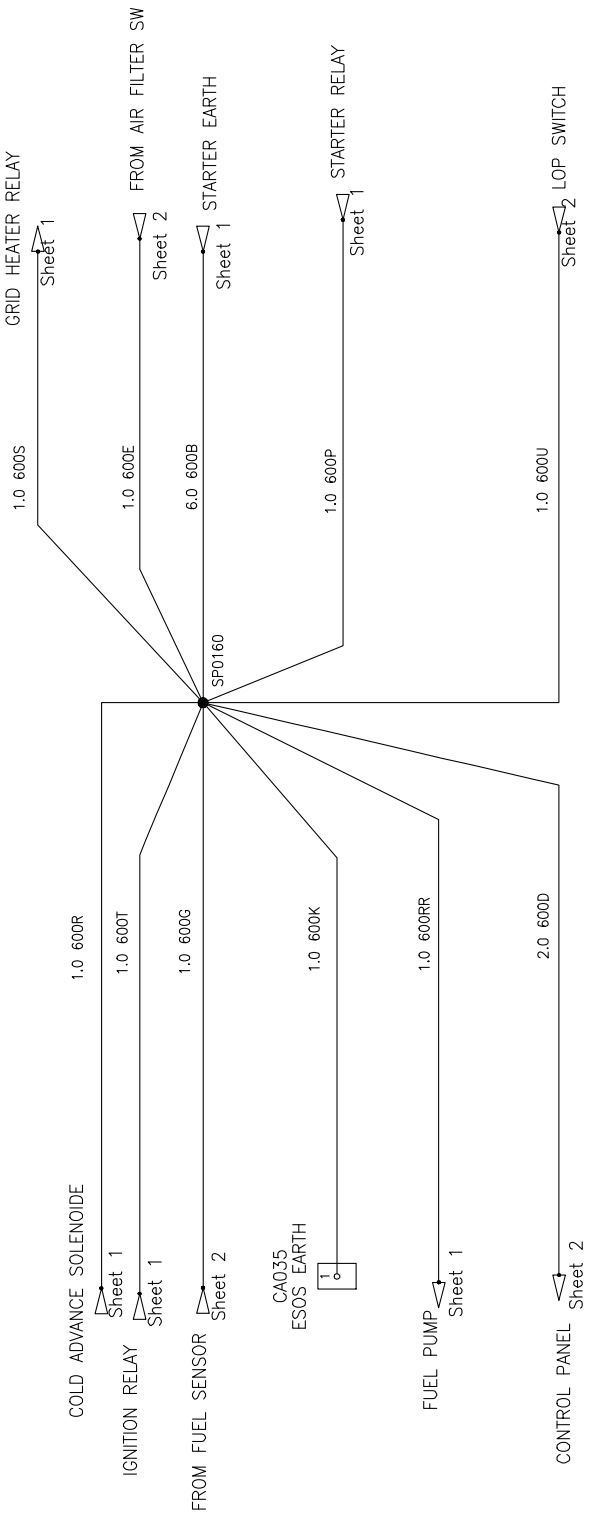


Figure 101. 335/F5093-3 (sheet 4 of 6)

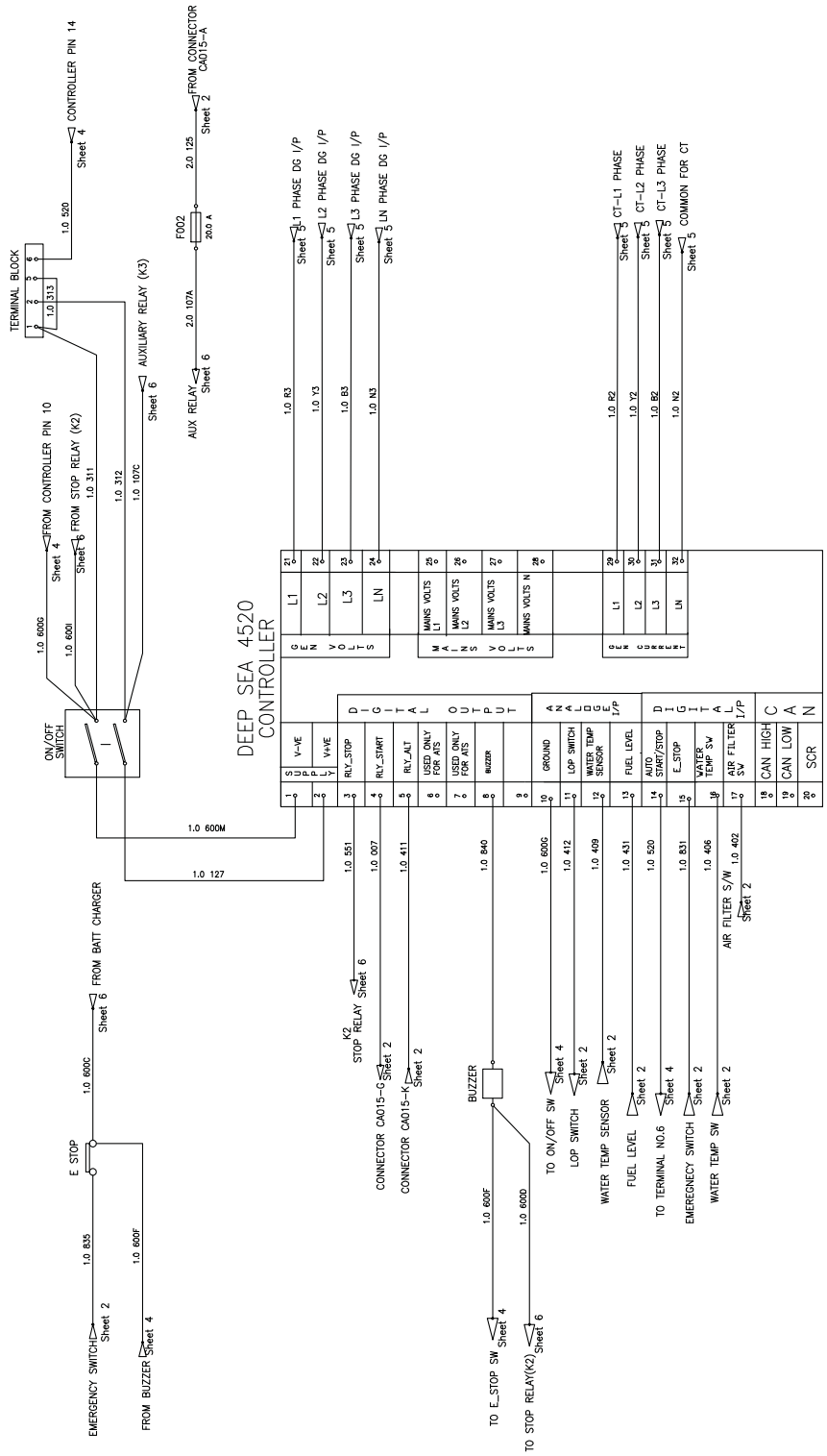


Figure 102. 335/F5093-3 (sheet 5 of 6)

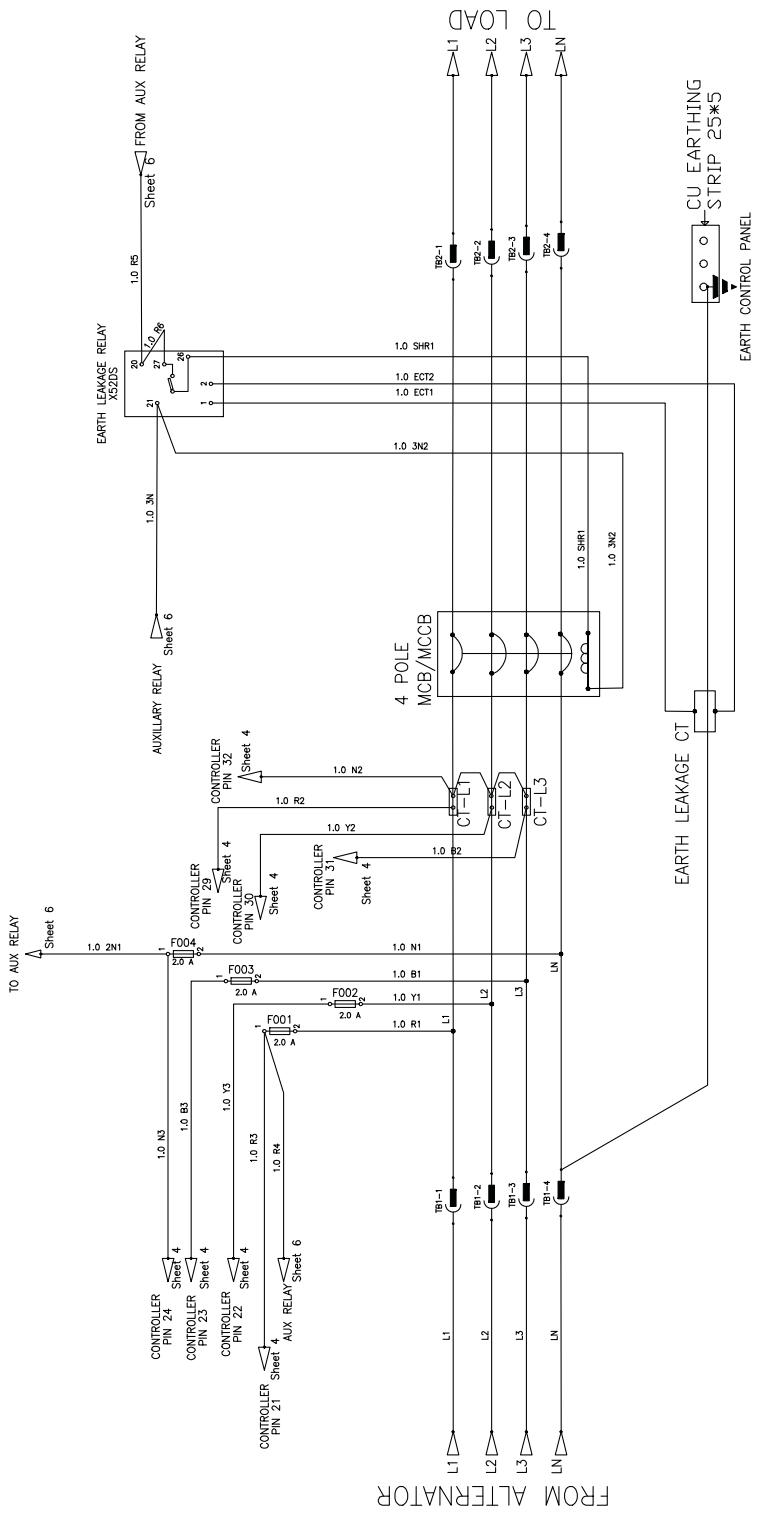


Figure 103. 335/F5093-3 (sheet 6 of 6)

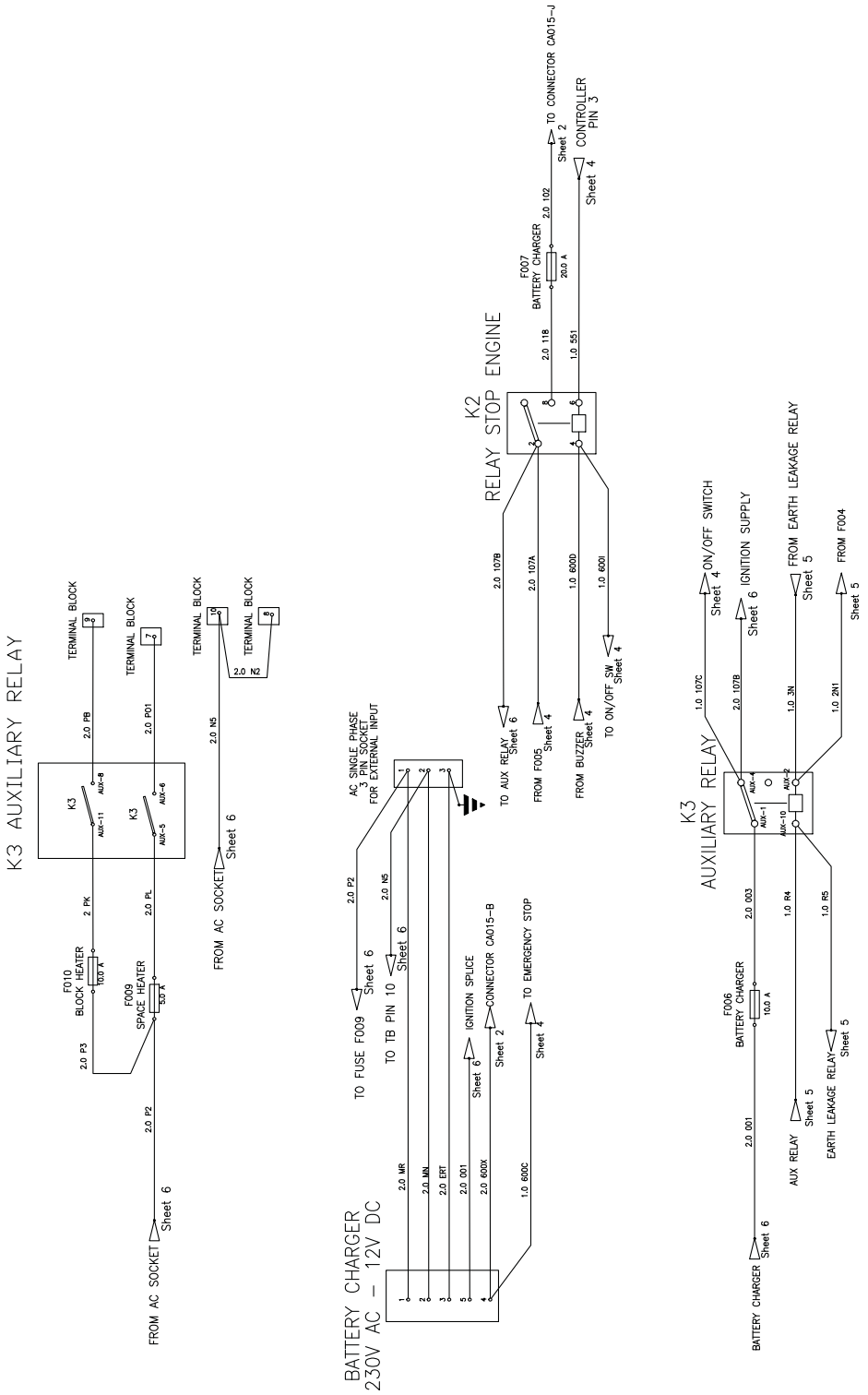


Figure 104. 336/E4738-B (sheet 1 of 7)

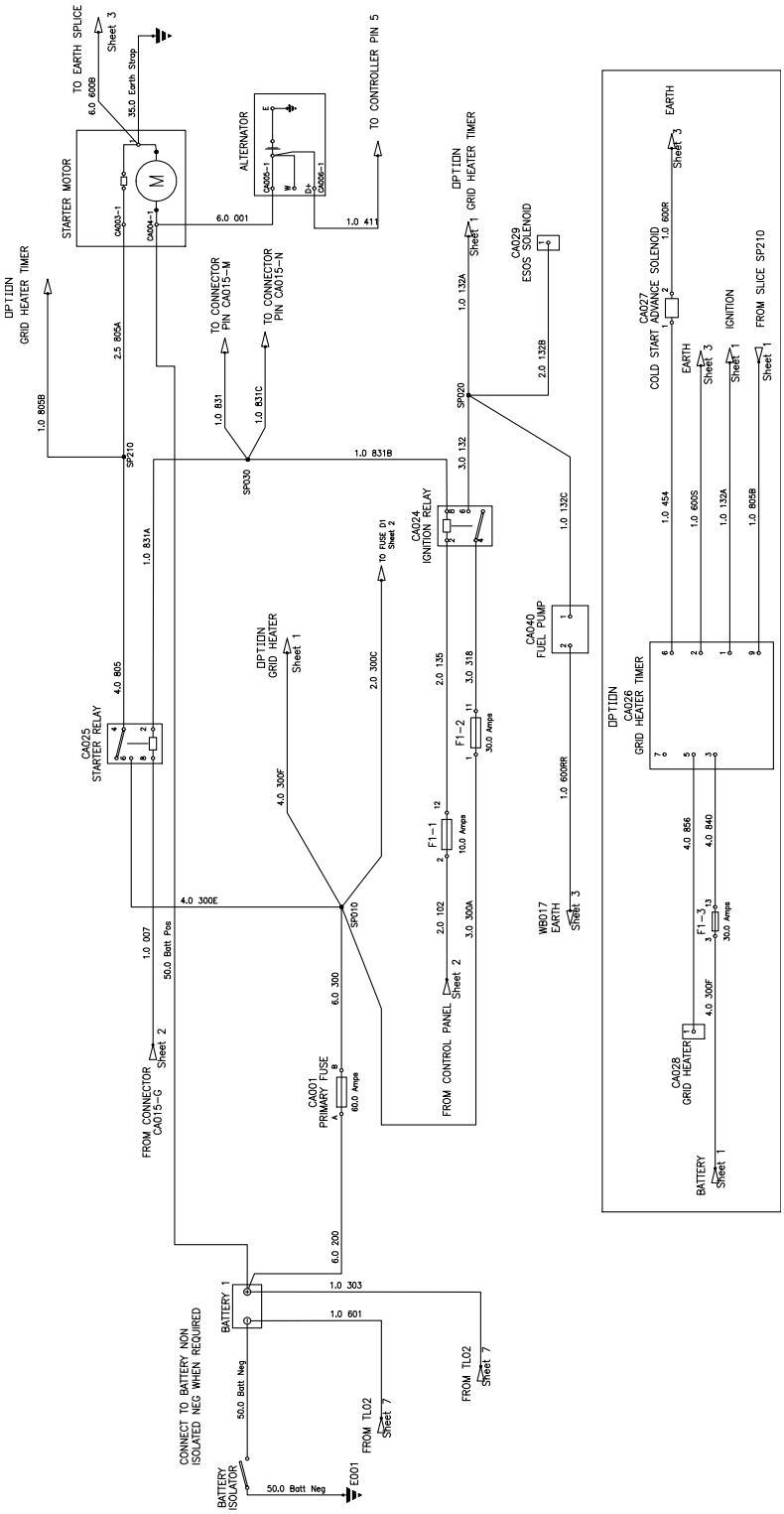


Figure 105. 336/E4738-B (sheet 2 of 7)

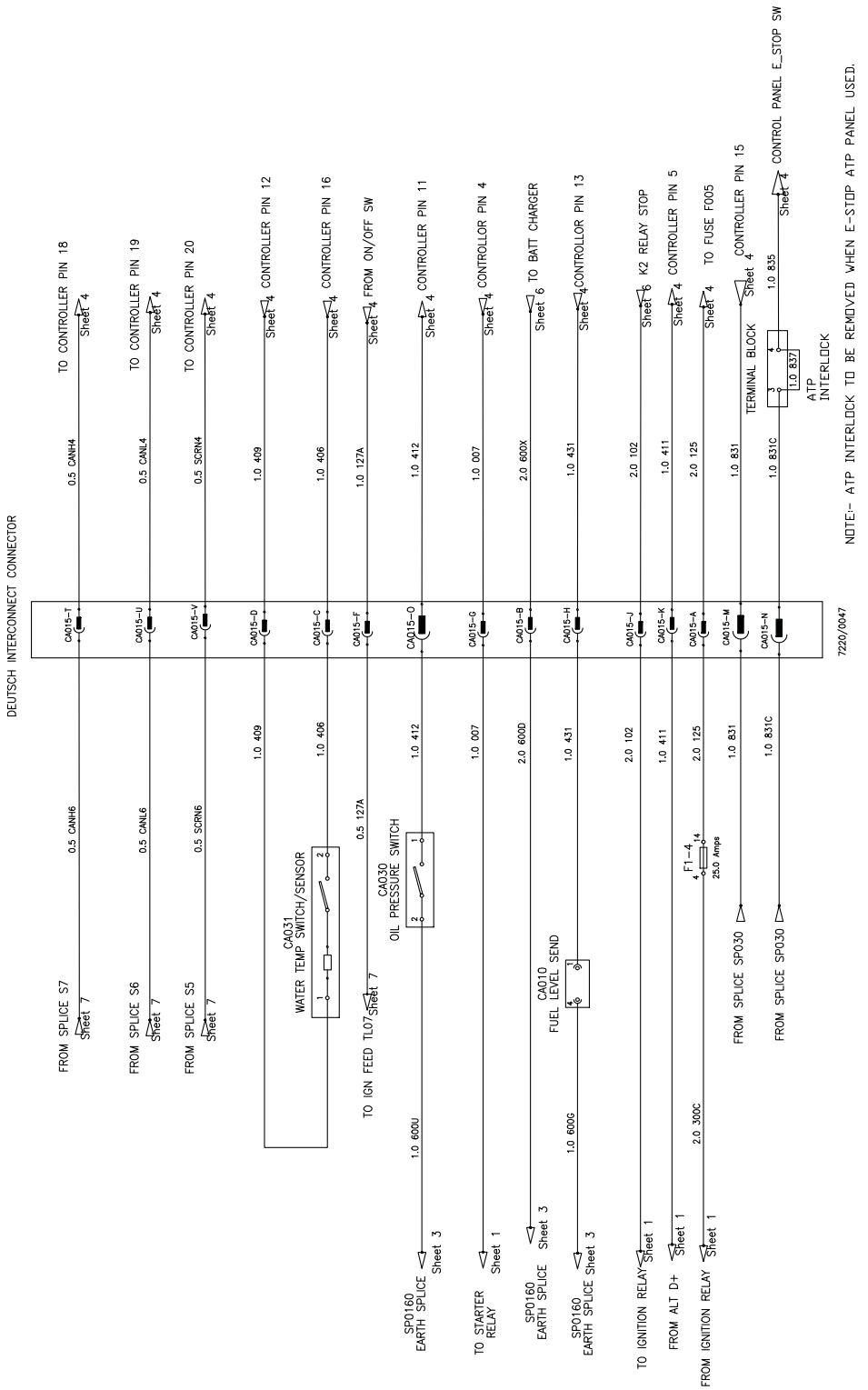


Figure 106. 336/E4738-B (sheet 3 of 7)

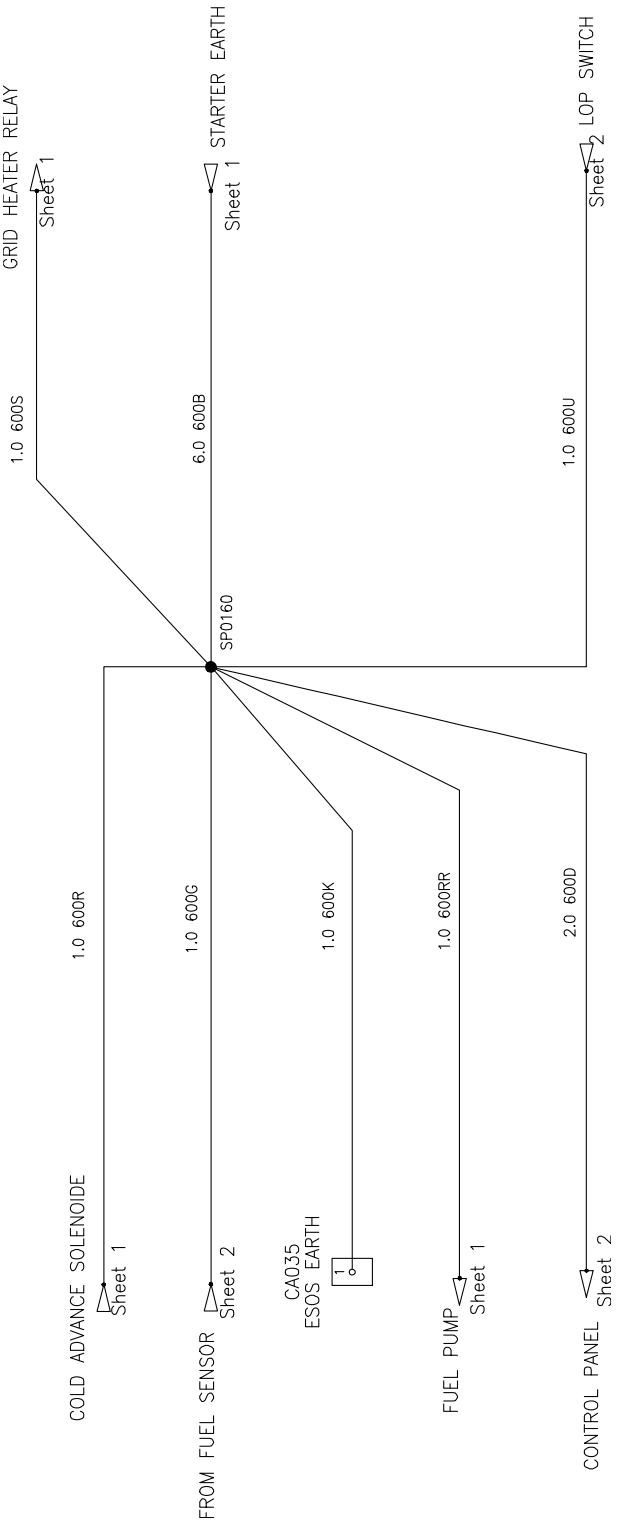


Figure 107. 336/E4738-B (sheet 4 of 7)

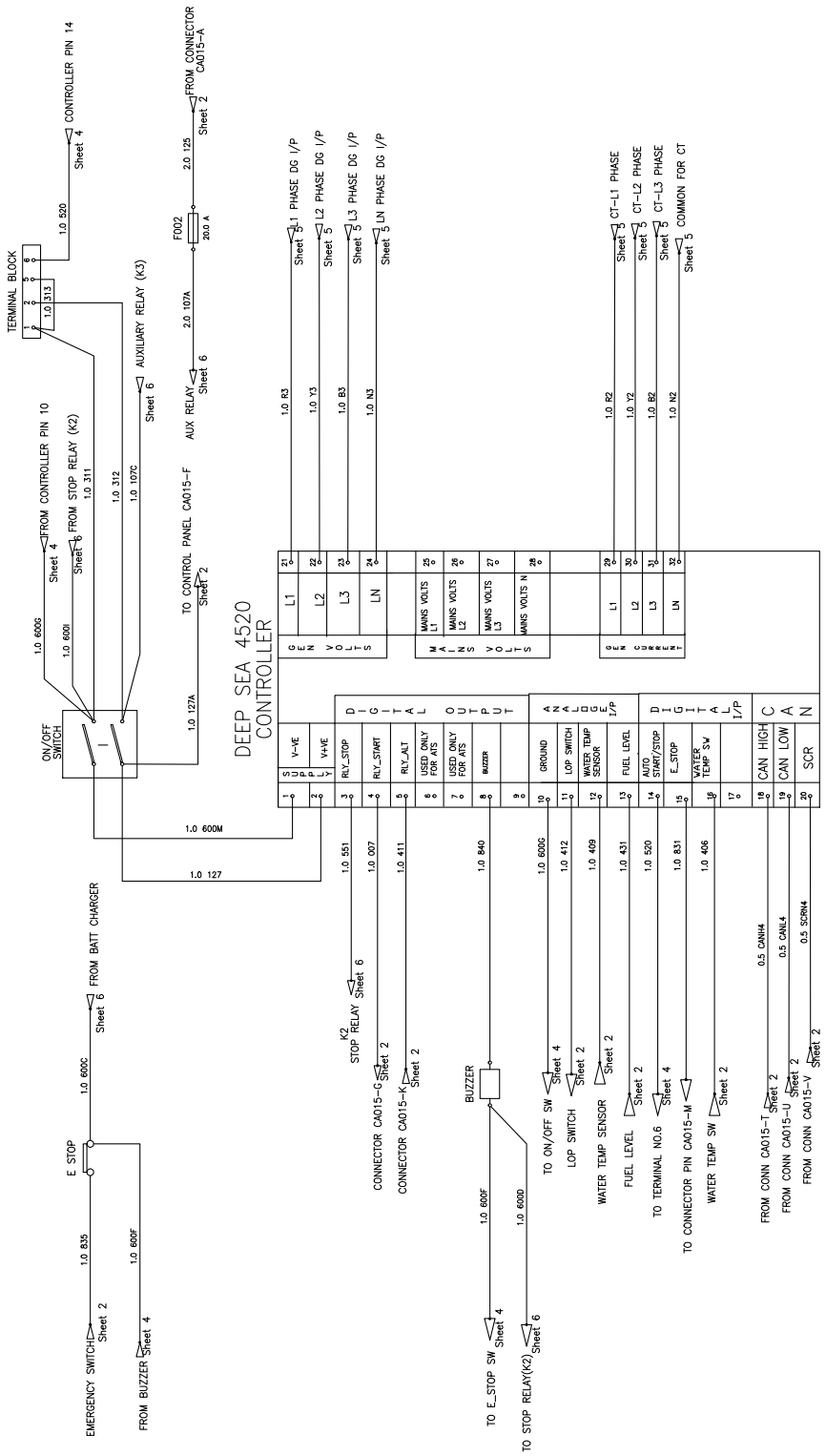


Figure 108. 336/E4738-B (sheet 5 of 7)

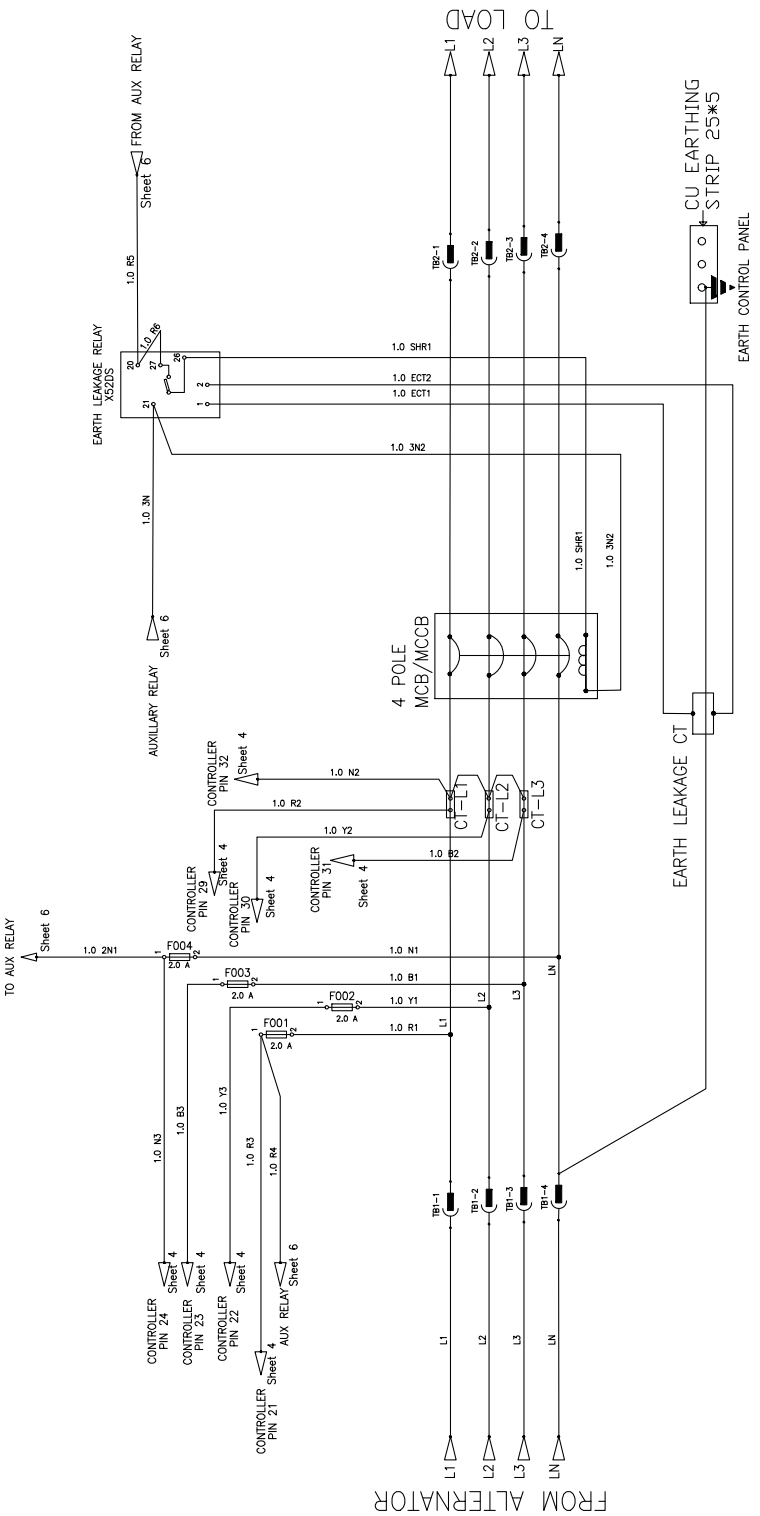


Figure 109. 336/E4738-B (sheet 6 of 7)

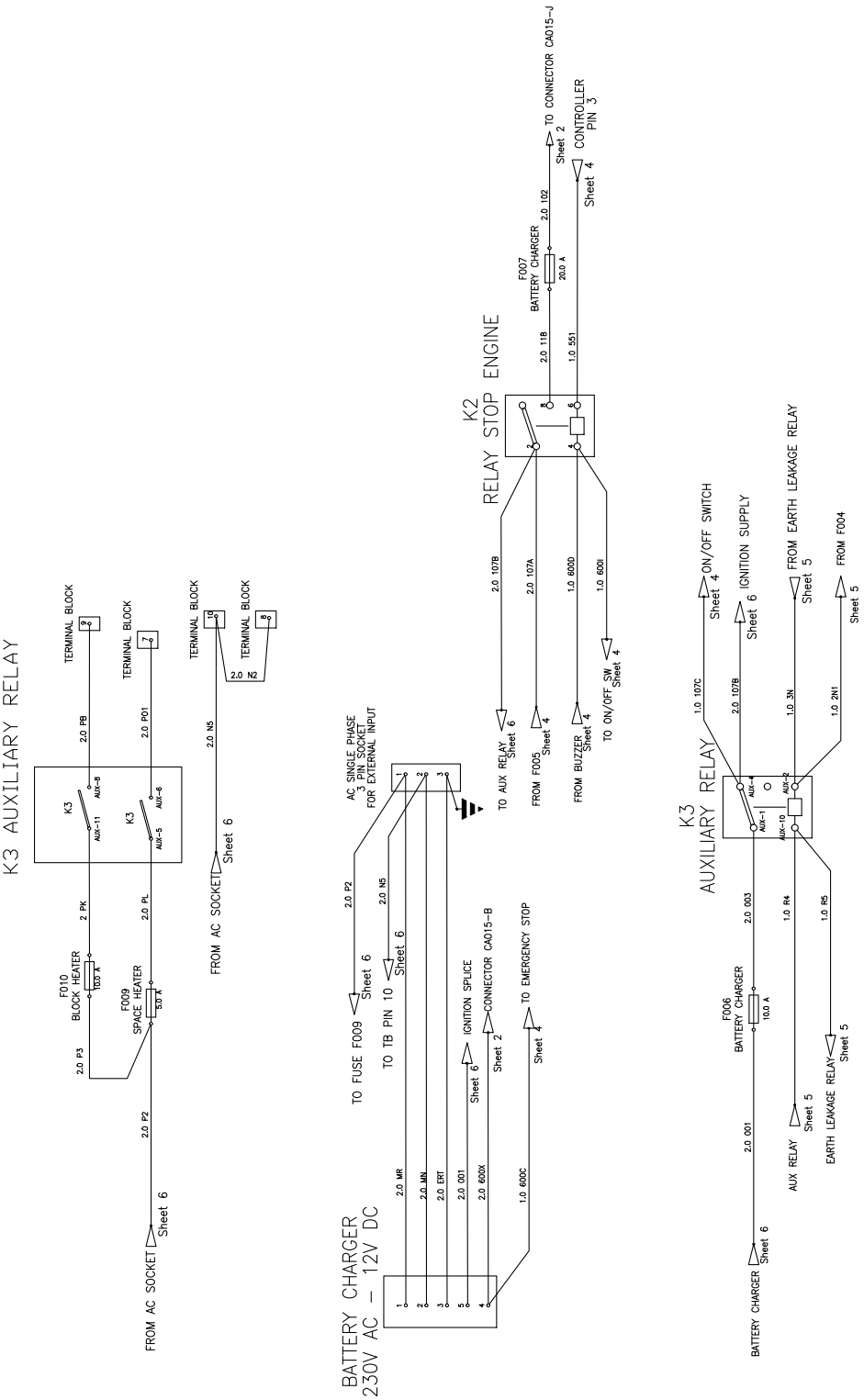


Figure 110. 336/E4738-B (sheet 7 of 7)

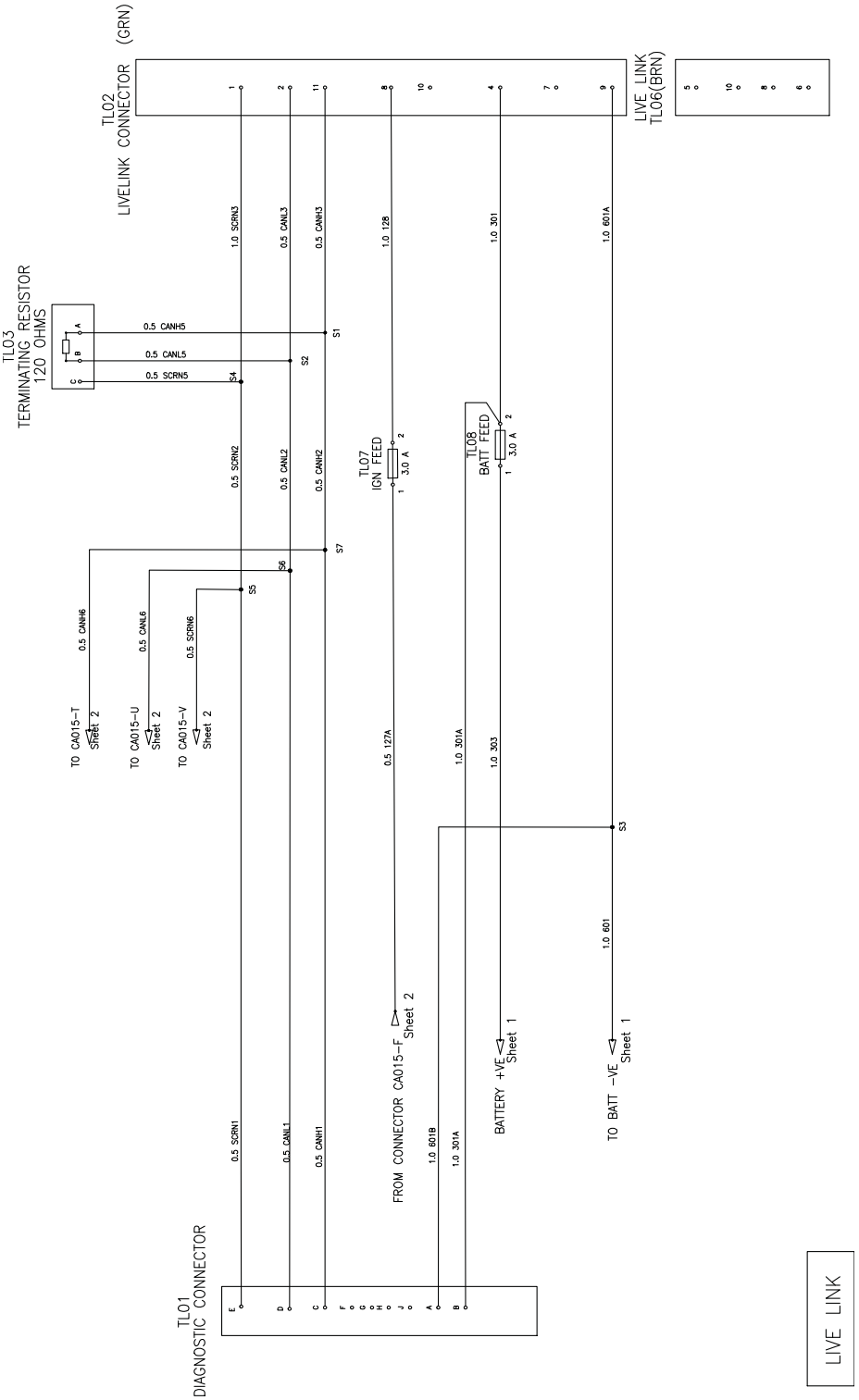


Figure 111. 336/E5832-1 (sheet 1 of 7)

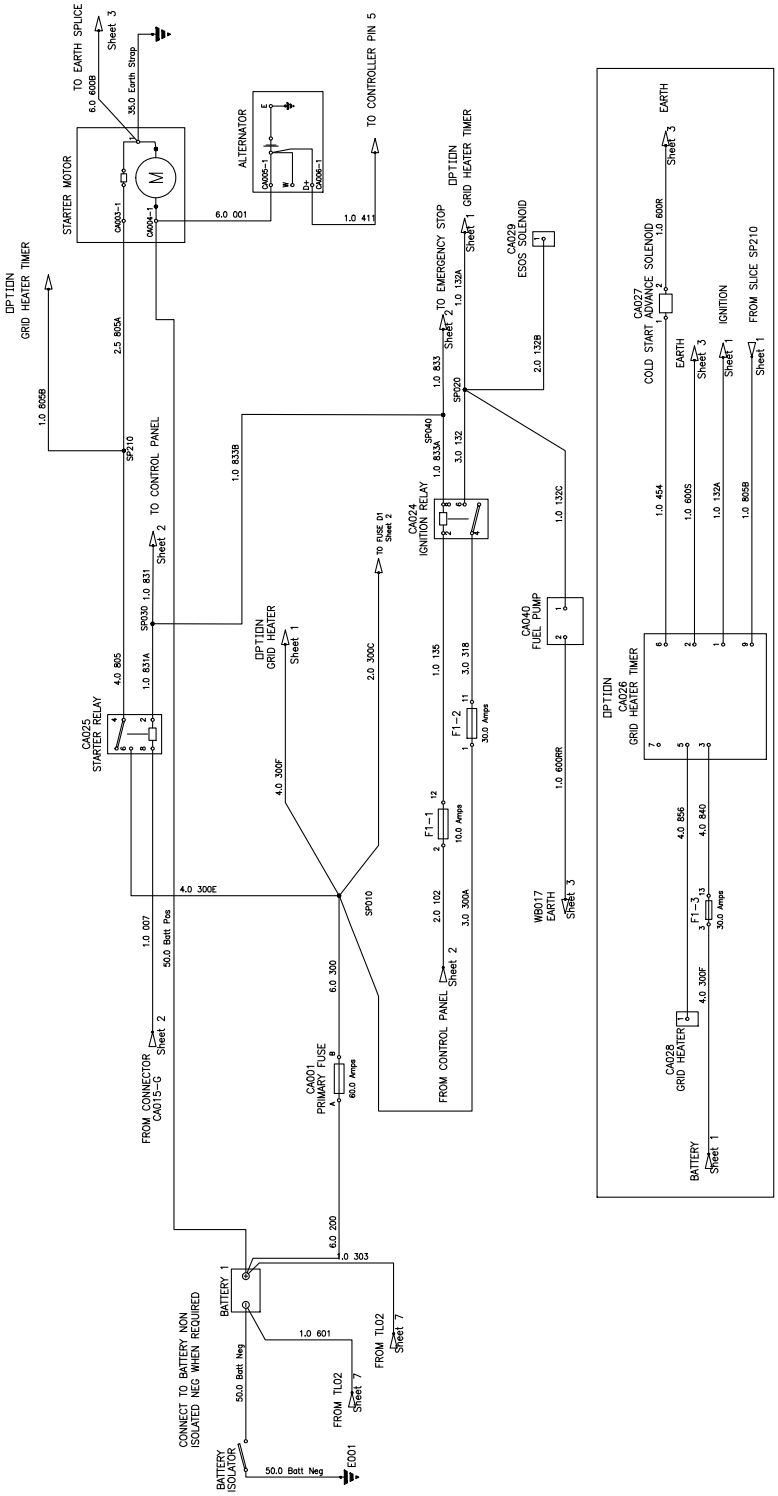


Figure 112. 336/E5832-1 (sheet 2 of 7)

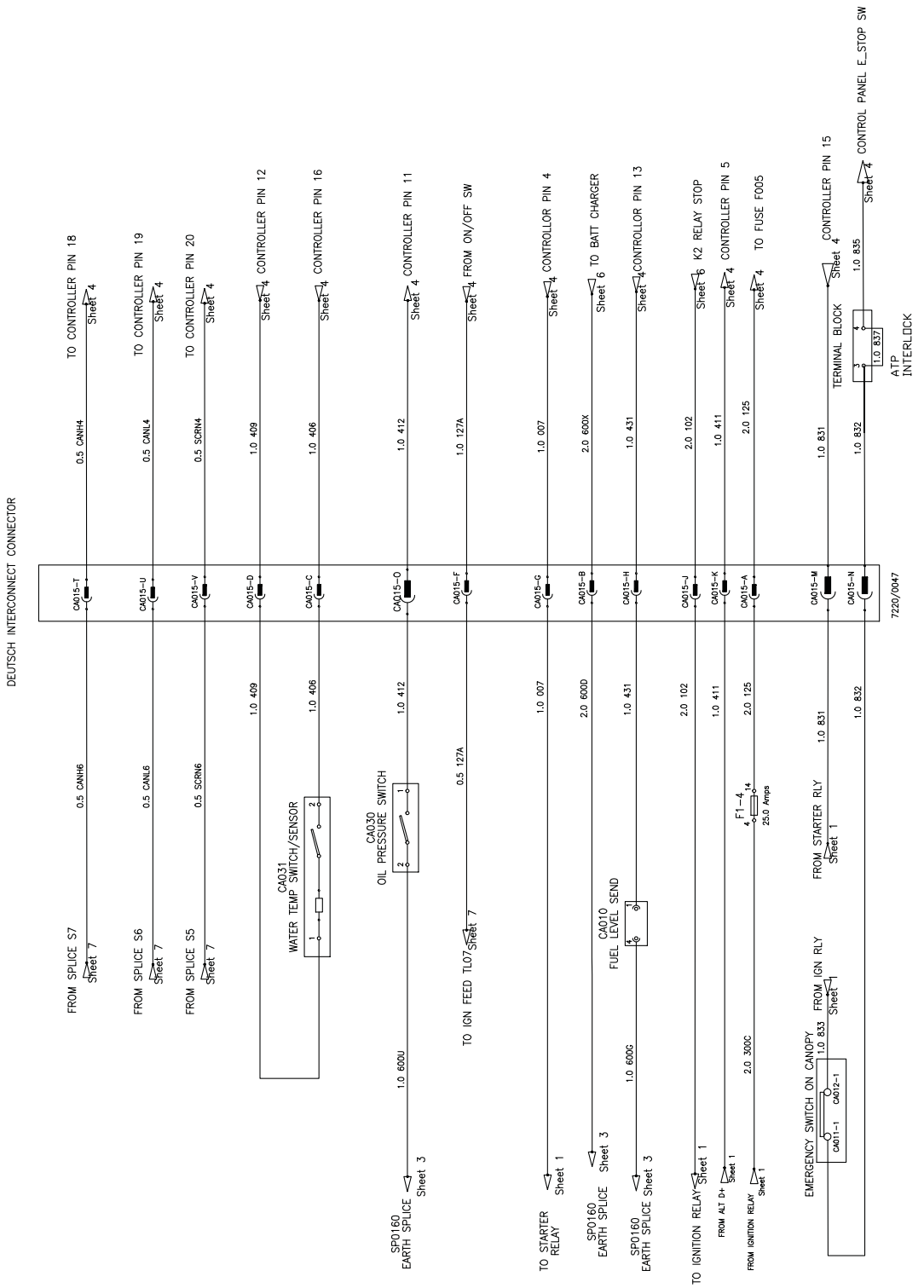


Figure 113. 336/E5832-1 (sheet 3 of 7)

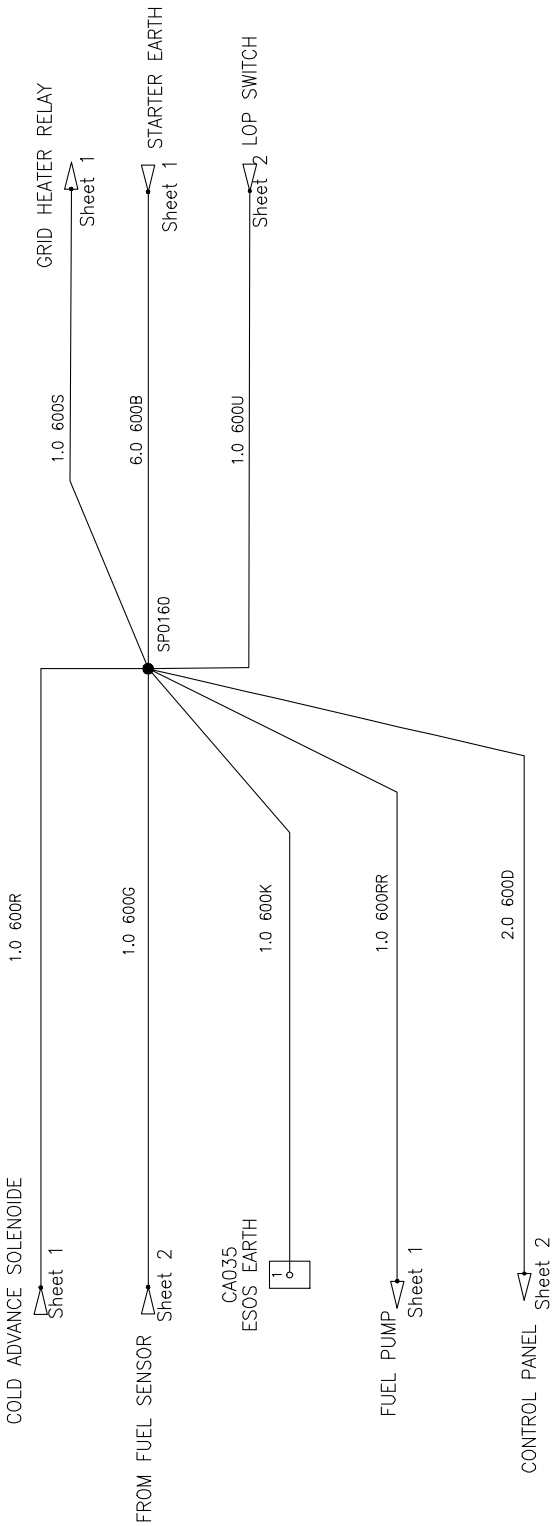


Figure 114. 336/E5832-1 (sheet 4 of 7)

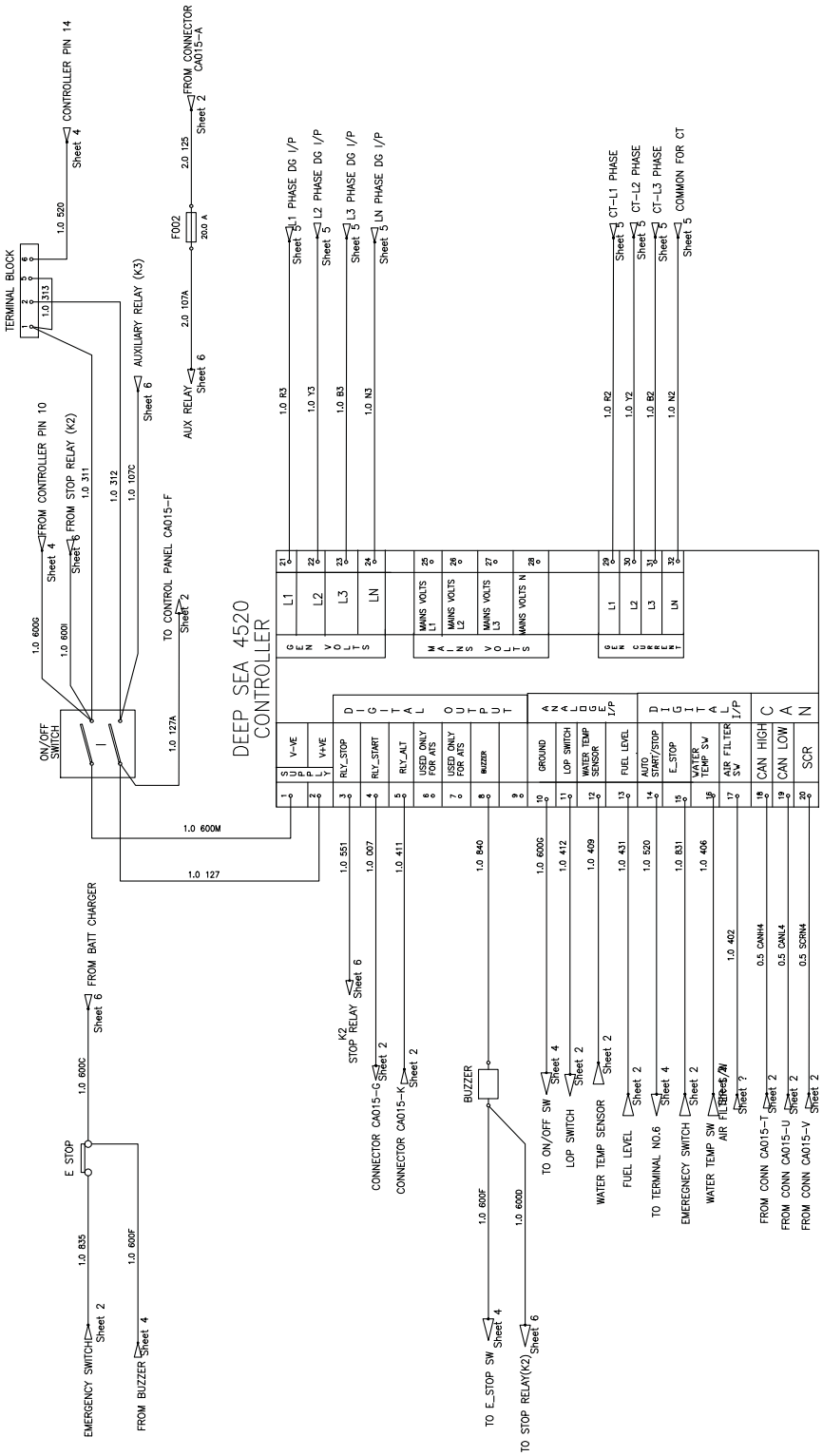


Figure 115. 336/E5832-1 (sheet 5 of 7)

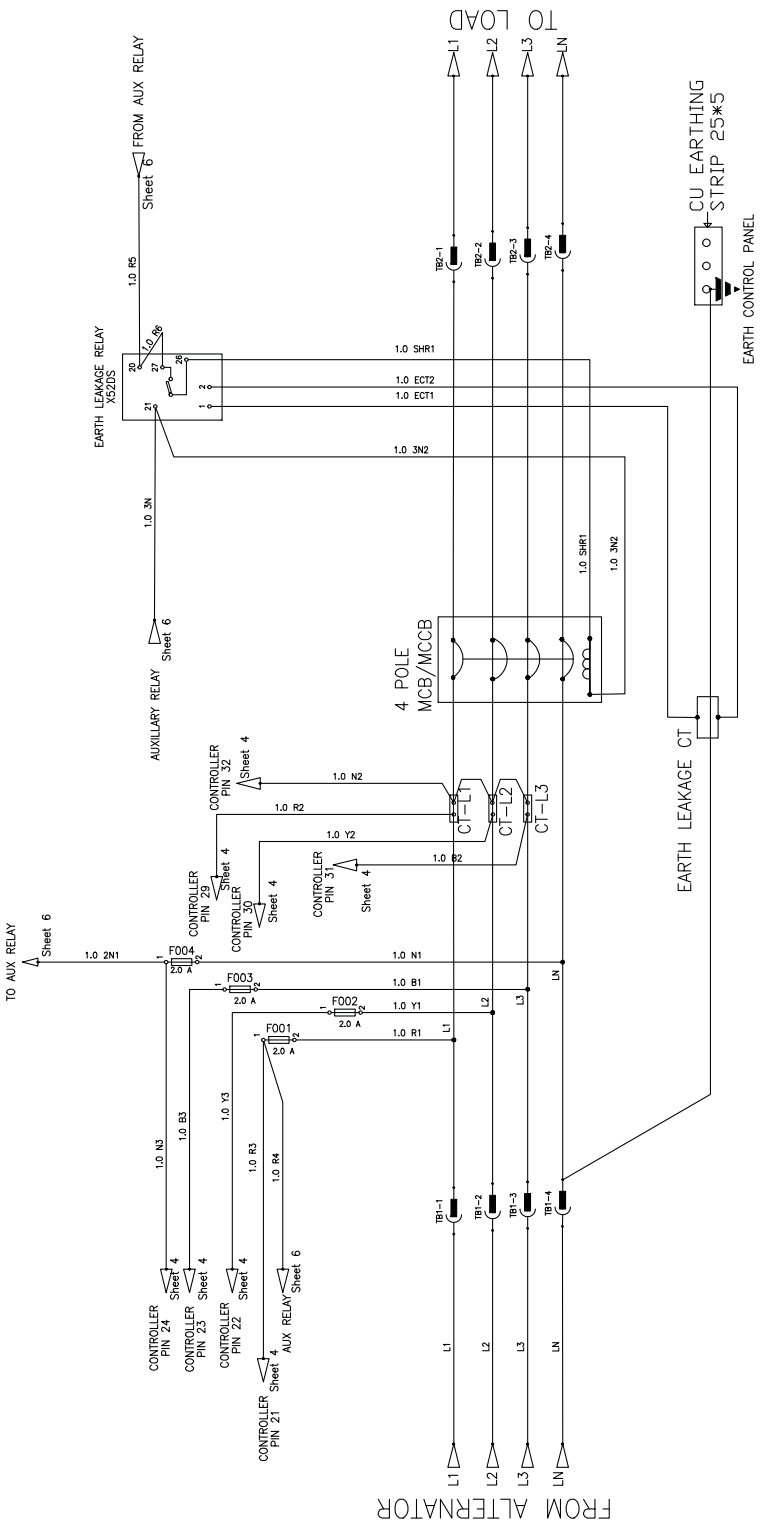


Figure 116. 336/E5832-1 (sheet 6 of 7)

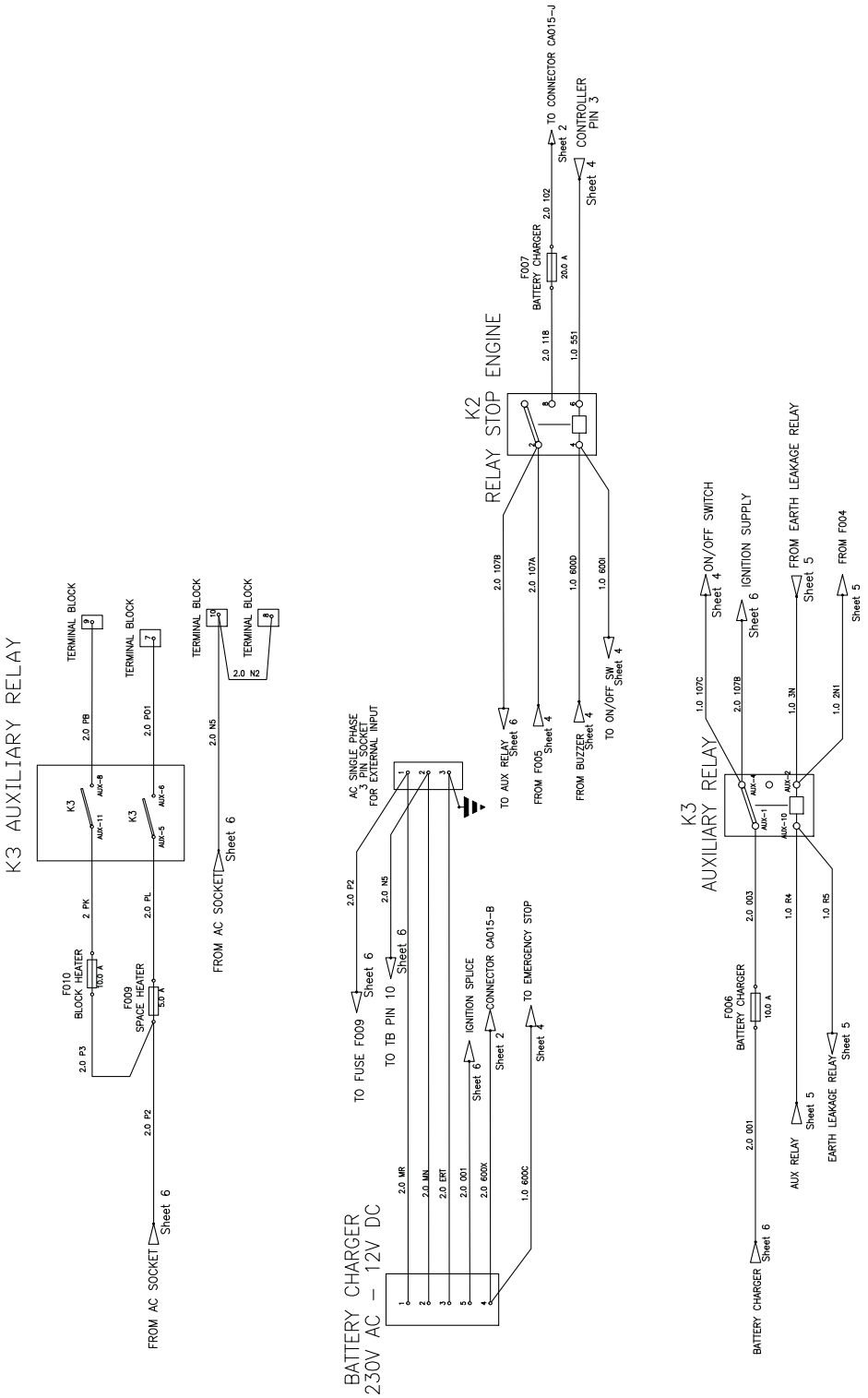
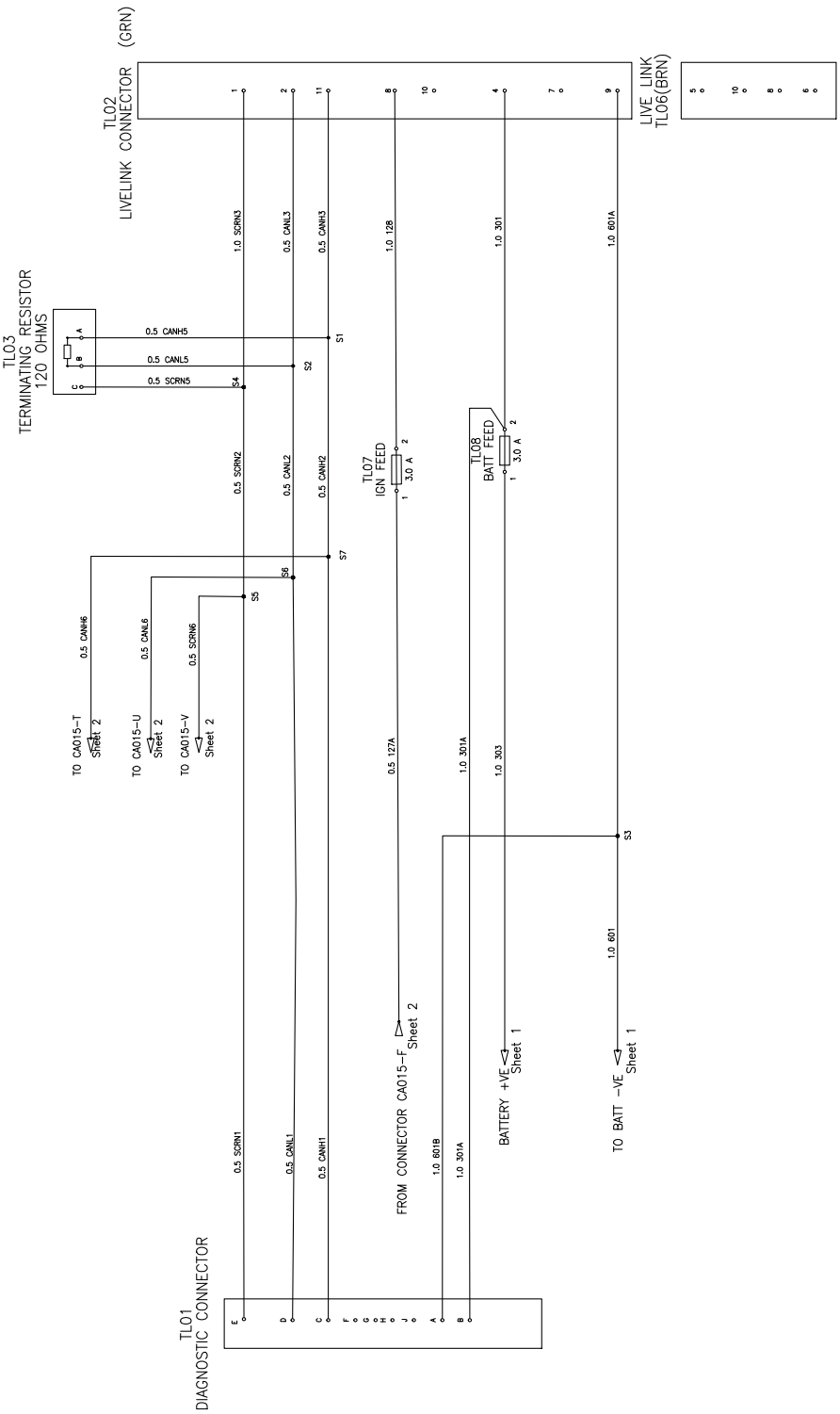


Figure 117. 336/E5832-1 (sheet 7 of 7)



Engine

General

Table 83.

Description	G20/G20S/ G20QS	G27/G27S/ G27QS	G33/G33S/ G33QS	G34QS	G40/G40S/ G40QS	G41QS	G45/G45S/ G45QS
Output Rating (PRP) kW @ 1500 RPM	17.5	23.1	31	31	33.1	33.1	37.3
Output Rating (Standby) kW @ 1500 RPM	19.25	25.41	34	34	36.41	36.41	41.03
Fuel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Injection	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Aspiration	Naturally Aspirated	Naturally Aspirated	Turbo Charged	Turbo Charged	Turbo Charged	Turbo Charged	Turbo Charged
Cylinders	3	4	4	4	4	4	4
Bore and Stroke (mm)	88 x 102mm	88 x 102mm	88 x 102mm	88 x 102mm	88 x 102mm	88 x 102mm	88 x 102mm
Displacement (cm^3)	1861cm^3	2482cm^3	2482cm^3	2482cm^3	2482cm^3	2482cm^3	2482cm^3
Cooling	50% Ethylene Glycol 50% Water	50% Ethylene Glycol 50% Water	50% Ethylene Glycol 50% Water	50% Ethylene Glycol 50% Water	50% Ethylene Glycol 50% Water	50% Ethylene Glycol 50% Water	50% Ethylene Glycol 50% Water
Engine Oil Specification	API CH4-SAE 10W40	API CH4-SAE 10W40	API CH4-SAE 10W40	API CH4-SAE 10W40	API CH4-SAE 10W40	API CH4-SAE 10W40	API CH4-SAE 10W40
Compression Ratio	11.5:1	11.5:1	11.5:1	11.5:1	11.5:1	11.5:1	11.5:1
Engine Oil Capacity (litres)	8.5L	11.3L	11.3L	11.3L	11.3L	11.3L	11.3L
Coolant Capacity (litres)	6.8L	7.6L	7.6L	7.6L	7.6L	7.6L	7.6L
Governor	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Air Filter	Single paper element	Single paper element	Single paper element	Single paper element	Single paper element	Single paper element	Single paper element
Exhaust at 50/60Hz							
Maximum Temperature 100% Standby (ºC)	540°C (1,003.2°F)/ 540°C (1,003.2°F)	540°C (1,003.2°F)/ 540°C (1,003.2°F)	510°C (949.3°F)	510°C (949.3°F)		510°C (949.3°F)/ 460°C (859.4°F)	510°C (949.3°F)
Exhaust Gas Flow 100% Standby (m3/min)	2.01/2.39m^3/min	2.71/3.21m^3/min	2.71m^3/min	2.71m^3/min		2.71/3.21m^3/min	2.71m^3/min
Maximum Allowed Back Pressure (mbar)	50/60mbar	65/85mbar	80mbar	80mbar		80mbar	80mbar
Air System at 50/60 Hz							
Intake Air Flow 100% Standby (m^3/h)	69/82m^3/h	92/109m^3/h	144m^3/h	144m^3/h		144/162m^3/h	146m^3/h
Total Cooling Air Flow 100% Standby (m^3/s)	0.25/0.38m^3/s	0.29/0.39m^3/s	0.49m^3/s	0.49m^3/s		0.67/0.72m^3/s	0.8m^3/s
Alternator Fan Airflow (m^3/s)	0.09/0.10m^3/s	0.09/0.10m^3/s	0.20m^3/s	0.20m^3/s		0.20/0.24m^3/s	0.20m^3/s

Description	G20/G20S/ G20QS	G27/G27S/ G27QS	G33/G33S/ G33QS	G34QS	G40/G40S/ G40QS	G41QS	G45/G45S/ G45QS
Starting System (V)	12V	12V	12V	12V	12V	12V	12V
Starter Motor (kW)	2kW	2kW	2kW	2kW	2kW	2kW	2kW

Warranty Information

General

The machine must be maintained in accordance with the regular maintenance requirements detailed in this handbook. Only suitable trained personal should carry out the regular servicing.

Only Genuine JCB parts, or parts of equivalent quality should be used.

Installation Access

Your JCB Generator will need to be made available for scheduled and unscheduled maintenance work. Units should always be sited to enable reasonable unrestricted access for regular maintenance and repair work. Significant extra costs incurred for gaining access to a generator due to the installation are the responsibility of the customer and will not be covered by warranty.

Downtime Support

If you require a substitute power source during maintenance or repair then alternative power generation must be arranged. JCB do not provide replacement units under warranty, however your JCB dealer may be able to assist in sourcing a substitute generator during any periods of work.

Terms and Conditions

The following warranty terms and conditions are applicable, for further details please contact your JCB dealer:

- – 18 months from date of despatch from JCB or 12 months from first date in service (whichever is earlier).
- – Cross-hire, consequential damage and third party losses are not warrantable.
- – Extended warranty is available for up to 2 years from first date in service, contracts and conditions applicable and administered by JCB Service.

Emergency Standby Power (ESP)

Warranty is 18 months from date of despatch or 12 months from date of commissioning or whichever comes earlier. The unit should not be expected to run more than 200 hours per year.

Prime Power (PRP)

Warranty is 18 months from date of despatch or 12 months from date of commissioning or whichever comes earlier. The unit, operating on variable load, should have an average load not exceeding 75% of PRP rating

Continuous Power (COP) and Limited Time Running Power (LTP)

For machines to be used for such applications the application must first be approved by JCB and then a specific warranty period will be advised.