

SERVICE MANUAL

GENERATOR
G625RS T4F

EN - 9823/4750 - ISSUE 1 - 06/2021

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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.

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Acronyms Glossary

DEF	Diesel Exhaust Fluid
EMS	Electronic Monitoring System
PIL	Parts Identification List
SCR	Selective Catalytic Reduction



03 - Safety

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03 - Safety - Yours and Others

Introduction

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.

Persons not familiar with the controls of the machine should not attempt to operate 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.

06 - Safety Warnings

Introduction

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



09 - General Safety

Introduction

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 generator. Install the generator in accordance with recommendations made in the Operator 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 generator can not be started.
 - Allow generator components to cool before attempting any maintenance tasks, components such as the exhaust can become extremely hot.
 - Do not adjust the generator, or add fuel, oil or coolant whilst it is running unless procedures in this manual instruct you to do so.
 - Do not siphon fluids by mouth.
 - Operate the generator in well ventilated areas, if using indoors then a purpose designed exhaust fume extraction unit is needed. – Keep other people at a safe distance when operating the generator or equipment.
 - Do not operate a generator if any mechanical or electrical guards have been removed or overridden.
 - 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 generator is operated by one person correctly positioned at the controls.
 - 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 generator its optimum performance. Using spurious parts may affect the integrity of the generator.

12 - Maintenance Safety

Introduction

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.

You must stop the machine operation, isolate the controls and turn off the engine when persons are required to interact with the machine.

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 Trichloroethane 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®, Fluorel™ 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 fluoroelastomeric 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.



Metal Splinters

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or copper drift to remove and install metal pins. Always wear personal protective equipment.

18 - Operating Safety

Introduction

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. Where applicable you may be required to show competency to a national certification scheme. Ensure you comply with local legislation and jobsite rules. 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.

You must stop the machine operation, isolate the controls and turn off the machine when persons are required to interact with it.

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

Breathing the machine exhaust gases can harm and possibly kill you. At time of machine installation in a confined space a system ventilation risk assessment must be carried out by suitably qualified personnel. If deemed necessary a suitable local exhaust ventilation system must be installed and operated when the machine is being used.

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 outdoor 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.

27 - Maintenance Positions

Introduction

It is necessary to lockout the energy sources that can cause injury to personnel. If you do not obey these instructions, there is a risk of injury.

All equipment must be locked out to prevent accidental or inadvertent operation because such operations can cause injury to personnel. Do not operate any locked switch, valve or other energy isolating device.

If more than one person is necessary to lock out equipment, each must place his/her own personal lock on the energy isolating device(s). One designated individual of a work crew or a supervisor, with the knowledge of the crew, may lock out equipment for the whole crew. In such cases, it may be the responsibility of the individual to carry out all steps of the lockout procedure and inform the crew when it is safe to work on the equipment. Additionally, the designated individual must not remove a crew lock until it has been verified that all individuals are clear.

Lockout/Tagout Procedure

1. Identify which switch, valve or other energy isolating devices to be locked out. There may be more than one energy source to be locked out.
2. Do a job authorization before lockout procedure.
3. Inform the responsible person that which device needs to be locked out and why.
4. If the equipment is in operation, use normal procedure and shut down the equipment.
5. Operate the switch, valve or other energy isolating devices to disconnect or isolate the energy sources from the equipment.
6. Lockout energy isolating devices with an assigned individual lock.

Figure 2.



7. Dissipate the stored energy from the capacitors, springs, elevated machine members, rotating flywheels, and air, gas, steam or water pressure with the methods such as grounding, repositioning, blocking, bleeding down.
8. Make sure that there is no one near the equipment. Operate the push button or the normal operating controls and check that the energy sources are disconnected and the equipment will not operate.
9. Make sure to return the operating controls to the neutral position after the test.
10. The equipment is now locked out.

Restore Equipment into Service

1. Make sure that there is no one in the equipment area.
2. When you have completed your work, sign off your job authorization to the responsible person.
3. Remove the lock which you have installed.
 - 3.1. Do not attempt to remove any other Lockout/tagout device installed by other persons.
4. If necessary, operate the energy isolating devices to restore energy to equipment.



06 - About this Manual

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06 - Using the Manual

Introduction

Information in this manual conforms to a standard JCB service manual format. The format uses section headings taken from a PIL (Parts Identification

List). These headings are assigned numerical identification references.

Table 1.

Example	Section	Main Assembly / Heading	Component / Sub-heading
PIL reference	33	03	03
Heading	Electrical System	Battery	Isolator Switch

Information within each PIL reference is included under a set of standard headings such as Introduction, Health and Safety, Technical Data and Operation for example. Where additional relevant

information is contained within another PIL reference a cross reference is provided.

The main systems information is contained in the manual as follows.

Table 2.

System	PIL Reference	Heading
Electrical System	PIL 33-03-03	Battery - Isolator Switch
	PIL 33-09-00	Power Distribution (including fuses and relays)
	PIL 33-00-50	Schematic Circuit
Electronic Diagnostic	PIL 33-57-00	Electronic Diagnostic (including Servicemaster)

Machine Variants

Where information is different depending on machine variant, the applicable information sets are included within the same PIL reference. Headings are included to identify which information is for which variant. Make sure you use the correct information.

Diagnostics

Information in this manual can help you diagnose machine faults.

Before attempting to diagnose possible faults check the following.

- Make sure that the operator understands the machine controls, functions and use. Refer to the applicable Operator Manual.
- Check that the maintenance record complies with the applicable schedule for the operating environment.
- Check that the fluids in use comply with the standards specified.
- Make sure that the machine electronic set-up is applicable.
- Use the applicable diagnostics tools.
- Use applicable generator controller interface (Deif or DSE) diagnostics.

Torque Tightening

When you replace components, always tighten the applicable fixings to the correct torque value. Use the torque tightening values contained in the individual procedures (Remove and Install, Disassemble and Assemble etc.). If no torque values are specified, use the standard torque tightening values. For the torque setting to be effective, do the following before you install the fixings. Refer to PIL 72-00-00.

- Make sure that all the applicable component assemblies are correct.
- Make sure that the applicable fixings are to the correct specification. If necessary discard the original fixings and replace them with new ones. The relevant procedures indicate when this is necessary.
- Make sure that the applicable fixings and threaded holes are free from contamination. This includes dirt, debris, old sealants and compounds, fluids and lubricants.



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00 - General

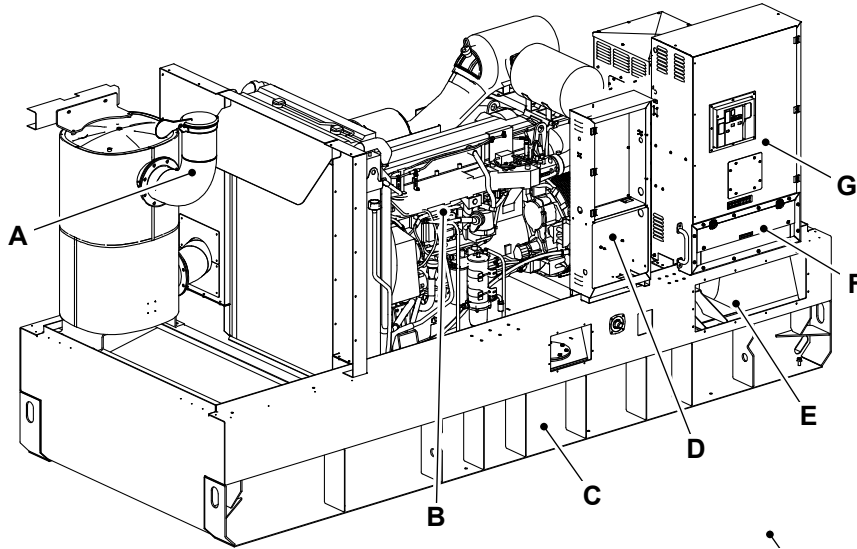
Technical Data

It is the responsibility of the installer to use correct size and type of cable to suit the application and conform to local regulations.

12 - Main Component Locations

Introduction

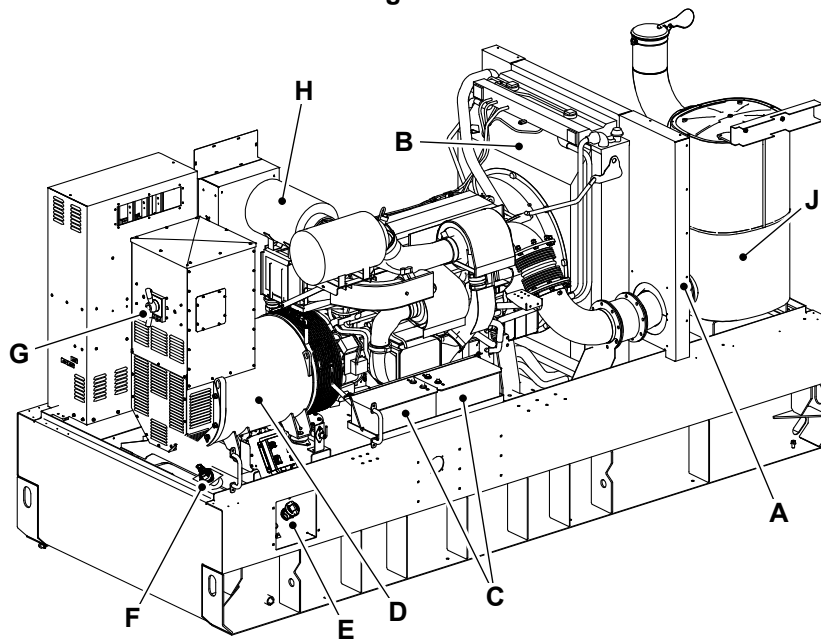
Figure 3.



- A Exhaust system
- C Skid
- E Camlock connections
- G Breaker box

- B Engine
- D Control panel
- F Power cables exit

Figure 4.



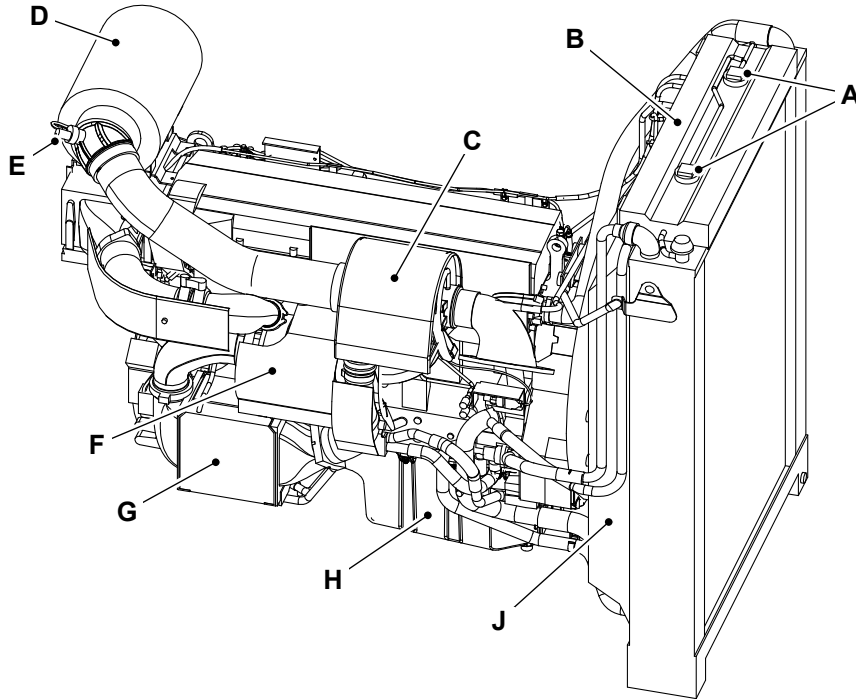
- A Bulkhead
- C Battery
- E Fuel tank filler

- B Radiator
- D Alternator
- F DEF (Diesel Exhaust Fluid) tank filler

- G Voltage control rotary switch
- J SCR (Selective Catalytic Reduction)

H Air filter

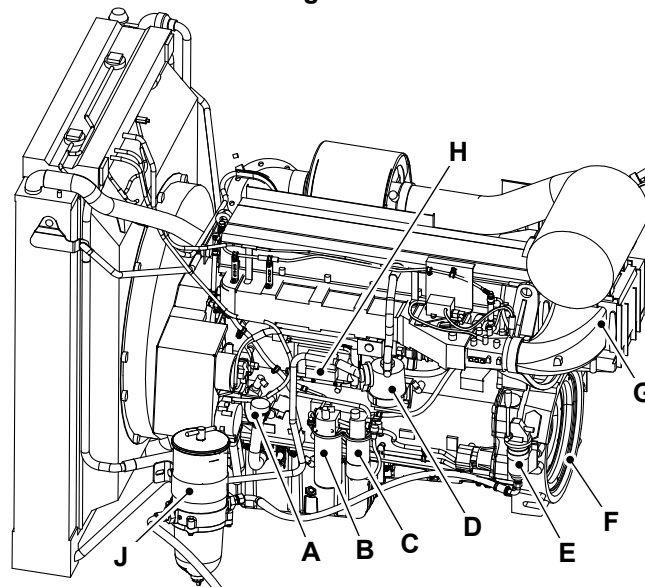
Figure 5.



- A Coolant filler
- C High-pressure turbo charger
- E Air filter indicator
- G Charge air cooler (low pressure turbo)
- J Radiator

- B Expansion tank
- D Air filter
- F Low-pressure turbo charger
- H Oil sump

Figure 6.



- A Engine oil filler
- C Fuel filter

- B Fuel pre-filter
- D Crankcase ventilation



E Oil drain pump
G Charge air cooler (high pressure turbo)
J Main fuel filter

F Flywheel housing
H EMS (Electronic Monitoring System)



33 - Cleaning

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Introduction

▲ WARNING When using cleaning agents, solvents or other chemicals, you must adhere to the manufacturer's instructions and safety precautions.

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.

Notice: Cleaning metal parts with incorrect solvents can cause corrosion. Use only recommended cleaning agents and solvents.

Clean the product with water and/or steam. Do not let mud, debris etc. to collect on the product.

Before you do any service procedures that require components to be removed:

- The cleaning must be done 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 the surrounding product must be cleaned.
- When cleaning is complete, move the product away from the wash area or alternatively, remove the material washed from the product.

When you remove components, be aware of exposure to dirt and debris. Cover any open ports and remove the deposits before proceeding.

Detergents

Do not use a full strength detergent. Always dilute the detergents as per the manufacturer's recommendations, or damage to the paint finish can occur.

Always obey the local regulations regarding the disposal of debris created from cleaning the product.

Use detergent to clean only non electrical components.

Exterior Cleaning

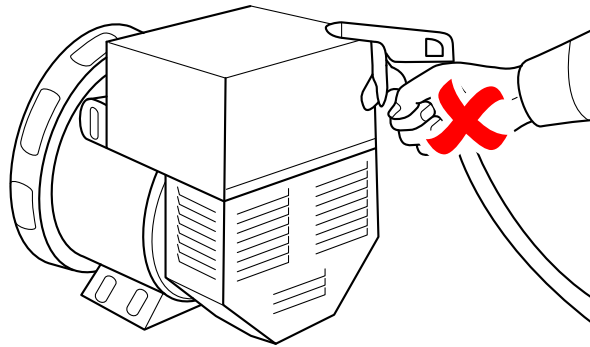
1. Stop the machine and allow it to cool for at least one hour. Do not attempt to clean any part of the machine while it is running.
2. Ensure all electrical loads are disconnected and the generator is made safe by disconnecting at the breaker, turning off the machine and activating the emergency stop switch.
3. Make sure that all electrical connectors are correctly coupled. If connectors are open install the correct caps or seal with waterproof 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 a clean cloth.

Interior Cleaning

1. Make sure that the engine is switched off and the machine is fully isolated and locked off.
2. 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 7.



Never use liquids or water. Do not clean the electrical components inside with compressed air, because this could cause short circuits or other faults occurring.

Preparation

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, install the correct caps or seal with waterproof 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 a clean cloth.
7. Make sure that the machine is fully dry before operating. If necessary, use an external blower or heater.



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06 - Body and Framework

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00 - Body and Framework

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Notes:

00 - General

Check (Condition)

▲ WARNING Breathing the machine exhaust gases can harm and possibly kill you. At time of machine installation in a confined space a system ventilation risk assessment must be carried out by suitably qualified personnel. If deemed necessary a suitable local exhaust ventilation system must be installed and operated when the machine is being used.

CAUTION The exhaust pipe becomes extremely hot when the engine is running and will remain so for some time after the engine is stopped. If you touch the hot pipe you could be severely burned.

1. Obey all electrical system health and safety information.
[Refer to: PIL 33-00-00.](#)
2. Visually inspect the exterior of the machine for dirt, damage and cracks.
3. Clean the machine.
[Refer to: PIL 01-33-00.](#)
4. Check the condition of all access doors, hinges and locks.
5. Check the condition of the engine, cooling pack and alternator mounting bolts. If necessary, tighten all the fasteners to the correct torque value as required.
 - 5.1. Make a note that loose mounting bolts can cause severe vibrations and may damage the machine internal parts.
6. If installed, visually inspect the external socket pack for indications of damage.
7. During operation, be alert for mechanical problems that can create unsafe or hazardous conditions.
8. Examine the external surfaces for damage at specified intervals.
[Refer to: PIL 78-24-00.](#)
9. Clean the external surfaces to remove any dirt.
10. Check the condition of the door seals for damage. If necessary, replace the seals.
11. Check the door handles and locks for correct operation.
12. Make sure that there is no debris in the air inlet and outlets. Make sure that no objects are placed against them.
13. Check the condition of the full exhaust system with the exhaust manifold, muffler, and exhaust pipe with the generator set in operating condition.
 - 13.1. Check the condition of the exhaust system at specified intervals for leaks and damage.
[Refer to: PIL 78-24-06.](#)
 - 13.2. Check the condition of all the connections, welds, gaskets and joints for leaks.
 - 13.3. If there are any leaks, shutdown the generator and correct any leaks immediately.
 - 13.4. Check that the exhaust pipe exit is free from blockage and clear of debris.
 - 13.5. Make sure that no material or debris has come in contact with the exhaust system.
14. Check the operation of the control panel.
15. Check the condition of the power cables.
 - 15.1. Make sure that no power cable terminals are loose. Tighten the terminal bolts to the correct torque value. Refer to Table 3.
16. Check and record the controller event logs.
17. Check the condition of the bus bar terminals for tightness.
18. Check the condition of the generator set earth connections for tightness.
19. Check the condition of the battery connections for tightness.
20. Check the condition of the battery.
[Refer to: PIL 33-03-00.](#)
21. Check the condition of the engine, alternator and the control panel mountings for tightness.
22. Check the condition of the engine and controller harness for tightness.
23. Check all equipotential bonds for condition and tightness.
[Refer to: PIL 72.](#)

Table 3. Torque Values

Item	Description	Nm
A	M10 at control panel	44
A	M12 at alternator terminal block	42



06 - Moveable Panel and Cover

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00 - General

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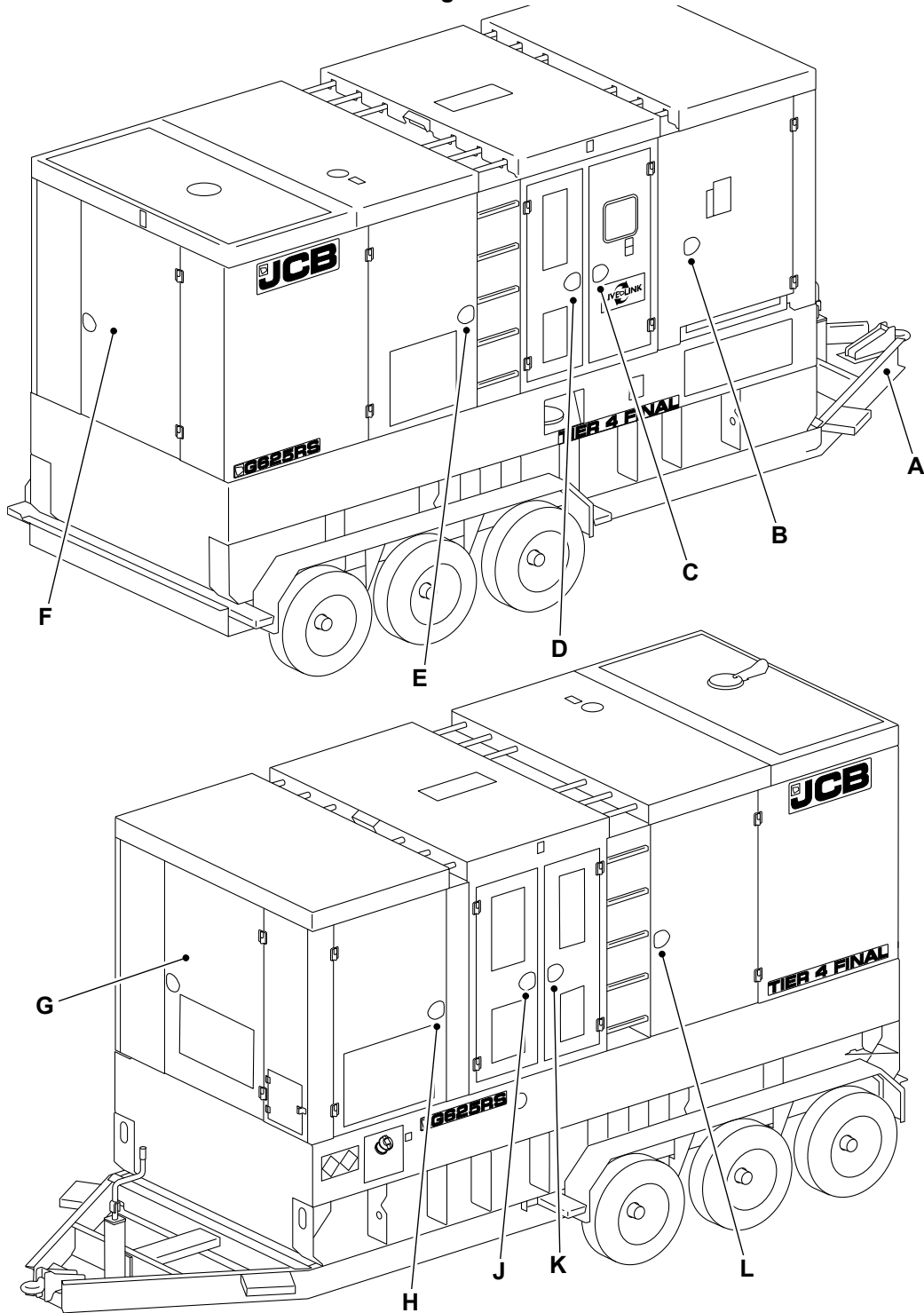
Introduction

Access panels provide easy access to the machine major components test and service points and other parts which require routine testing, servicing, adjusting, replacement or repair.

Before you operate the machine, make sure that all of the access panels are in their operation position and secure.

Component Identification

Figure 8.



- A Trailer
- C Right centre front door
- E Rear right door
- G Front door

- B Right front door
- D Right centre rear door
- F Rear door
- H Left front door



J Left centre front door
L Left rear door

K Left centre rear door

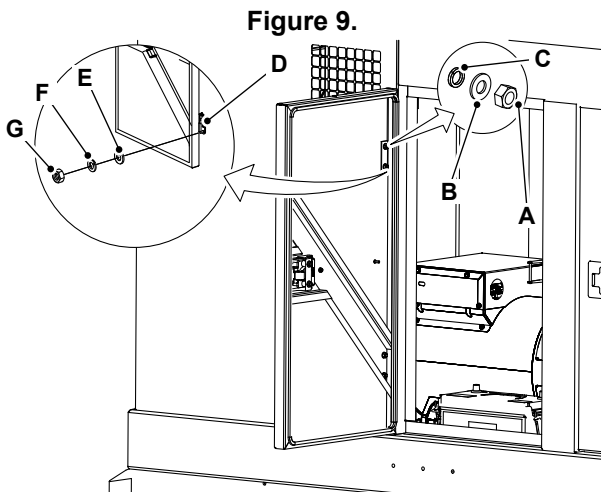
Remove and Install

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

The following procedure is for the front left door. The procedure for the remaining doors is similar.

Remove

1. Make the machine safe.
Refer to: [PIL 01-03](#).
2. Disconnect the earth cable from the door.
3. Open the door.
4. Support the door with suitable lifting equipment.
5. Remove the spring washer 1 (x4), plain washer 1 (x4) and nut 1 (x4) from the hinge (x2) that attaches the door to the canopy.
6. Move the door away from the machine.
7. Remove the spring washer 2 (x4), plain washer 2 (x4) and nut 2 (x4) that attaches the hinge (x2) to the door.
8. Remove the hinge (x2) from the door.



- A Nut 1 (x6)
- B Plain washer 1 (x6)
- C Spring washer 1 (x6)
- D Hinge (x3)
- E Plain washer 2 (x6)
- F Spring washer 2 (x6)
- G Nut 2 (x6)

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that the generator is positioned on a flat level surface.
3. Make sure that the doors are straight and not damaged.
4. Check the hinges for tightness.
5. Make sure that the doors are closed and adjustments are made to the hinges to have an equal/parallel gap around the door.
6. Use the Go/No-go gauge and check the gap tolerance of all four service access doors. Make sure that the tolerance is within specified value.
Distance: $8 \pm 2\text{mm}$
7. Secure the door lock.
8. Use a hose with a complete spray head and spray water towards the top edge of the doors

Figure 10.



Figure 11.



from the specified angle. Make sure that you do not spray water directly at the door gaps and locks.

Angle: 30°

Figure 12.



18 - Door Lock

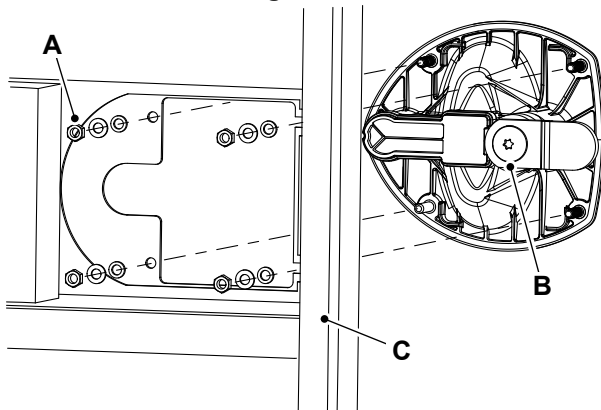
Remove and Install

The following procedure is for the rear left door lock.
The procedure for the remaining door locks is similar.

Remove

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Open the door.
3. Hold the door lock and remove the nuts (x4) and washers that attach the door lock.
4. Remove the door lock from the door.

Figure 13.



- A** Nuts (x4)
B Door lock
C Door

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Tighten the fasteners to the correct torque value.



63 - Identification Label

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Notes:



00 - General

Introduction

The machine has identification plates that contain important information relating to the specific machine details, for example VIN or PIN number and engine serial number. These serial numbers can help you identify exactly what equipment has been installed on the machine.

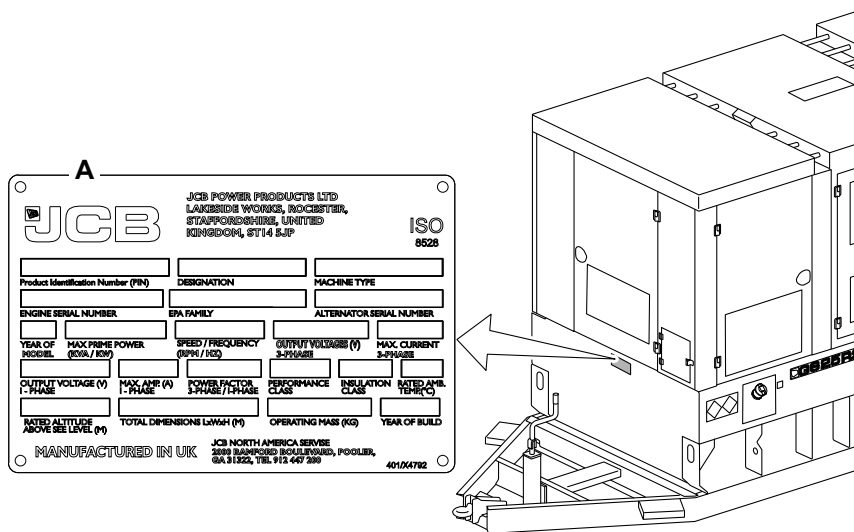
03 - Machine

Introduction

The data plate details the model designation, rating, weight, year of manufacture, output rating and other generating set specific information. The data plate and service plate are located in the control panel compartment. Refer to Figure 14.

The identification plate may vary by region due to the legislative requirements.

Figure 14. Identification Plate



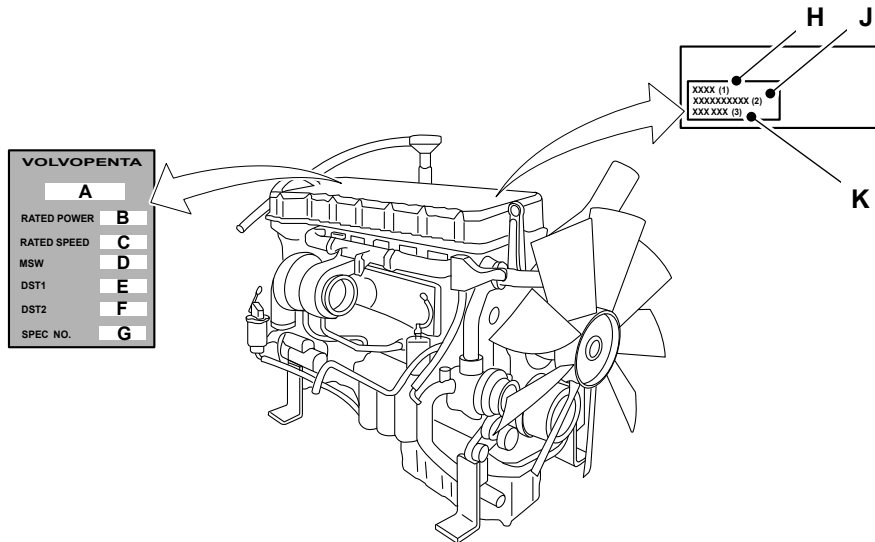
A Data plate

06 - Engine

Introduction

The engine data labels are placed on the valve cover.
Refer to Figure 15.

Figure 15.



A Engine designation
C Maximum engine speed
E Data set 1
G Product number

B Engine power, net, (without fan)
D Main software
F Data set 2
H Engine designation
K Specification number

Table 4. Explanation of Engine Designation

Example: TAD1641GE/TAD941VE	
T	Turbo
A	Air to air intercooler
D	Diesel engine
16	Cylinder volume, litre
4	Generation
1	Version
G	Generator unit engine
V	Stationary and mobile operation
E	Emission certified



Notes:



15 - Engine

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Acronyms Glossary

CAC	Charge Air Cooler
CAN	Controller Area Network
DC	Direct Current
DEF	Diesel Exhaust Fluid
ECU	Electronic Control Unit
FEAD	Front End Accessory Drive
HP	High Pressure
LP	Low Pressure
SCR	Selective Catalytic Reduction



00 - Engine

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00 - General

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Introduction

This section does not contain all information about the engine assembly. Refer to below listed Volvo Manuals further details on Volvo Engine maintenance and service.

Refer to: [Service and Maintenance - Engine \(TAD13 Series\)](#).

Refer to: [Service and Maintenance - Engine \(TAD8 Series\)](#).

Refer to: [Workshop Manual - Engine \(TAD8 Series\)](#).

Refer to: [Workshop Manual 1 - Engine After-Treatment System \(TAD series\)](#).

Refer to: [Workshop Manual 2 - Engine After-Treatment System \(TAD Series\)](#).

Refer to: [Workshop Manual - Engine Electrical System \(TAD8, TAD13 Series\)](#).

Refer to: [Workshop Manual - Engine \(TAD13 Series\)](#).

Refer to: [Service and Maintenance - Engine \(TWD16 Series\)](#).

Refer to: [Workshop Manual - Engine \(TWD16 Series\)](#).

Make sure that the correct engine service tools, consumables and torque figures are used when you perform service procedures. Renewal of oil seals, gaskets, etc., and any component showing obvious signs of wear or damage is expected as a matter of course. It is expected that components will be cleaned and lubricated where appropriate, and that any opened hose or pipe connections will be blanked to prevent excessive loss of fluid, engine oil and ingress of dirt.

These engines are equipped with electronically controlled fuel management (engine management system). Engine management system is an electronic system with CAN (Controller Area Network) for diesel engine control. The system includes fuel regulation and diagnostic functions. The system consists of a control unit, injectors, a number of sensors that supply the control unit with information, and connectors for diagnostics and functional checks. Volvo diagnostic tools are required to monitor and configure the Engine ECU (Electronic Control Unit).

Health and Safety

accordance with local regulations. Use authorised waste disposal sites.

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.

Turning the Engine

Do not try to turn the engine by pulling the fan or fan belt. This could cause injury or premature component failure.

Notice: *The engine and other components could be damaged by high pressure washing systems. Special precautions must be taken if the machine is to be washed using a high pressure system. Make sure that the alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system. Do not aim the water jet directly at bearings, oil seals or the engine air induction system.*

WARNING! *To bleed the injectors you must turn the engine. When the engine is turning, there are parts rotating in the engine compartment. Before starting this job make sure that you have no loose clothing (cuffs, ties etc) which could get caught in rotating parts. When the engine is turning, keep clear of rotating parts.*

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: *Do not exceed the maximum level of engine oil in the sump. If the maximum is exceeded, 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! *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! *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.*

Notice: *A drive belt that is loose can cause damage to itself and/or other engine parts.*

WARNING! *Do not open the high pressure fuel system with the engine running. Engine operation causes high fuel pressure. High pressure fuel spray can cause serious injury or death.*

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*

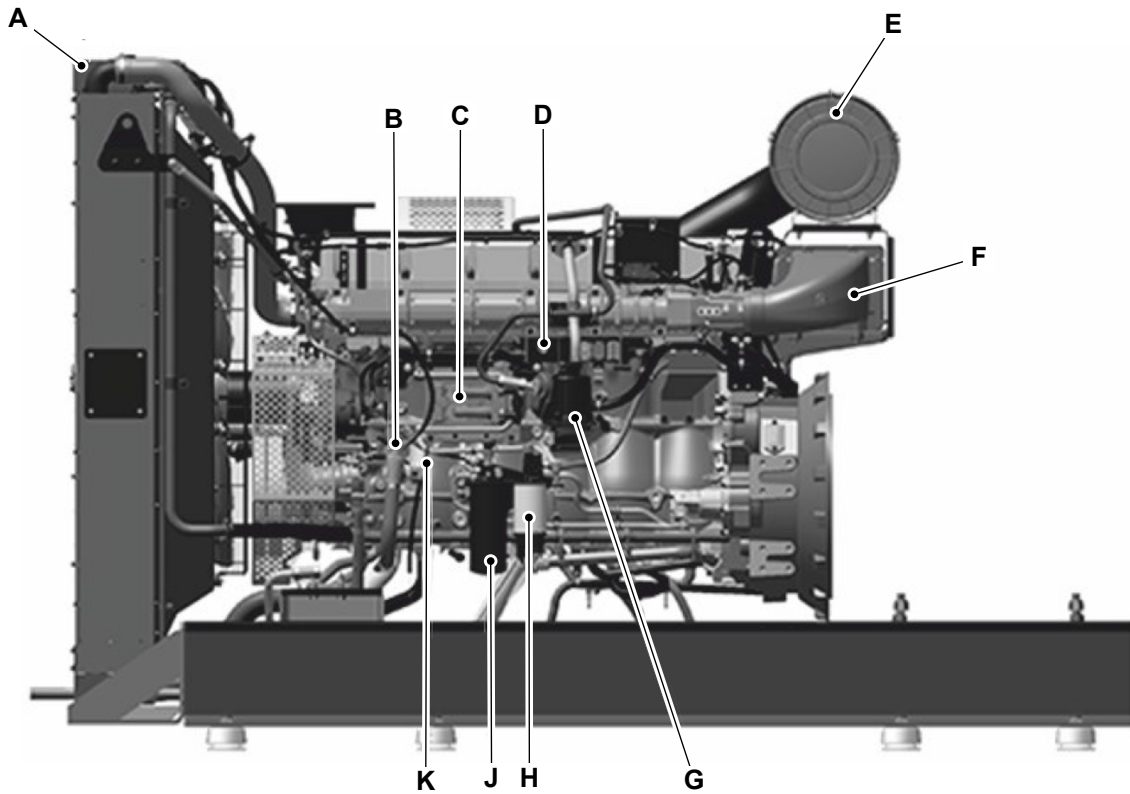
Technical Data

Table 5.

Manufacturer and Model	Volvo TWD1672GE
Fuel	Diesel
Injection	Direct
Aspiration	Turbocharged
Cylinders	6
Cooling	Water
Governor	Electronic
After treatment	SCR (Selective Catalytic Reduction)
Fuel consumption @ 75% PRP	25.8 g/h
Fuel autonomy	22h
DEF (Diesel Exhaust Fluid) consumption @75% PRP	1.83 g/h
DEF autonomy	23h

Component Identification

Figure 16.



A Expansion tank

C Control unit

E Air filter

G Crankcase ventilation

J Fuel pre-filter

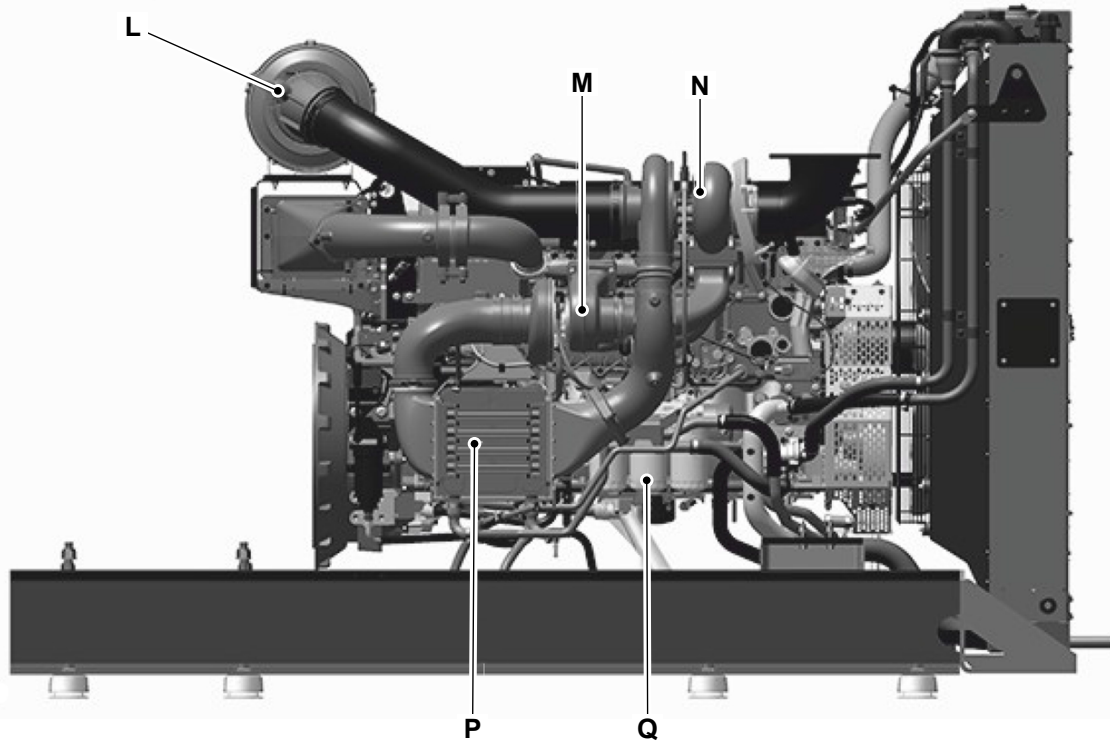
B Oil filler cap

D Auxiliary stop

F CAC (Charge Air Cooler)(LP (Low Pressure)turbo)

H Fuel filter

K Oil dipstick

Figure 17.

L Air filter indicator
N HP (High Pressure) Turbo
Q Oil filter

M LP Turbo
P CAC(LPturbo)

Fault-Finding

Fault

Engine cannot be stopped	Table 6.	Page 15-8
Starter motor does not rotate	Table 7.	Page 15-8
Starter motor rotates slowly	Table 8.	Page 15-8
Starter motor rotates normally but the engine does not start	Table 9.	Page 15-8
Engine starts but stops again	Table 10.	Page 15-9
Engine does not reach correct operating speed at full throttle	Table 11.	Page 15-9
Engine runs roughly	Table 12.	Page 15-9
High fuel consumption	Table 13.	Page 15-9
Black exhaust smoke	Table 14.	Page 15-9
Too low lubrication oil pressure	Table 15.	Page 15-9
Excessive coolant temperature	Table 16.	Page 15-9
Too low coolant temperature	Table 17.	Page 15-10
Too high exhaust temperature	Table 18.	Page 15-10

Table 6. Engine cannot be stopped

Cause	Remedy
Poor contact/open circuit in electrical wiring	Check electrical wiring.
Faulty ignition lock	Check or replace the ignition lock.

Table 7. Starter motor does not rotate

Cause	Remedy
Discharged batteries	Charge the batteries.
Poor contact/open circuit in electrical wiring	Check electrical wiring.
Main switch turned off	Turn on the main switch.
Main fuse faulty	Replace the main fuse.
Faulty ignition lock	Replace the ignition lock.
Faulty main relay	Replace the main relay.
Faulty starter motor/solenoid	Repair or replace the starter motor.

Table 8. Starter motor rotates slowly

Cause	Remedy
Discharged batteries	Charge the batteries.
Poor contact/open circuit in electrical wiring	Check the electrical wiring.

Table 9. Starter motor rotates normally but the engine does not start

Cause	Remedy
No fuel in supply tank	Check the level in the fuel tank, use sight gauge or dipstick. Fill the fuel tank with correct fuel.
Blocked fuel fine-filter/pre-filter	Drain fuel/water separator or replace fuel filter.
Fuel is aerated	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Water/contamination in fuel	Drain fuel/water separator.

Table 10. Engine starts but stops again

Cause	Remedy
No fuel in supply tank	Check the level in the fuel tank, use sight gauge or dipstick. Fill the fuel tank with correct fuel.
Blocked fuel fine-filter/pre-filter	Drain fuel/water separator or replace fuel filter.
Fuel is aerated	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Water/contamination in fuel	Drain fuel/water separator.
Insufficient air supply to the engine	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.

Table 11. Engine does not reach correct operating speed at full throttle

Cause	Remedy
Blocked fuel fine-filter/pre-filter	Clean the fuel filter.
Air in the fuel system	Bleed the fuel system.
Water/contamination in fuel	Drain the fuel filter.
Insufficient air supply to the engine	Clean the air filter.
Blocked charge air cooler	Repair/replace as required.
Faulty fuel injectors	Replace the fuel injectors.
High back pressure in the exhaust system	Contact the JCB dealers.

Table 12. Engine runs roughly

Cause	Remedy
Air in the fuel system	Bleed the fuel system.
Water/contamination in fuel	Drain the fuel filter.

Table 13. High fuel consumption

Cause	Remedy
Insufficient air supply to the engine	Check the air filter condition.
Coolant temperature too low	Increase the coolant temperature.
High back pressure in the exhaust system	Contact your JCB dealer.

Table 14. Black exhaust smoke

Cause	Remedy
Insufficient air supply to the engine	Make the sufficient air supply to the engine.
Faulty fuel injectors	Replace the fuel injectors.

Table 15. Too low lubrication oil pressure

Cause	Remedy
Oil level too low	Check the oil level. Top up oil level as required.

Table 16. Excessive coolant temperature

Cause	Remedy
Coolant level too low	Check the coolant level. Top up the coolant.
Air in coolant system	Bleed the coolant.
Faulty circulating pump	Repair/replace the circulating pump.
Defective thermostat	Replace the thermostat.
Blocked radiator	Check and clean the radiator.

Table 17. Too low coolant temperature

Cause	Remedy
Defective thermostat	Replace the thermostat.

Table 18. Too high exhaust temperature

Cause	Remedy
Insufficient air supply	Make the sufficient air supply to the engine.
Coolant level too low	Check the coolant level. Top up the coolant.
Air in the coolant system	Bleed the coolant.
Faulty circulation pump	Replace the circulation pump.
Blocked charge air cooler	Check and clean the charged air cooler.
High back pressure in the exhaust system	Contact your JCB dealer.
Blocked radiator	Clean the radiator.
No pressure in cooling system	Check the coolant pump.

Drain and Fill

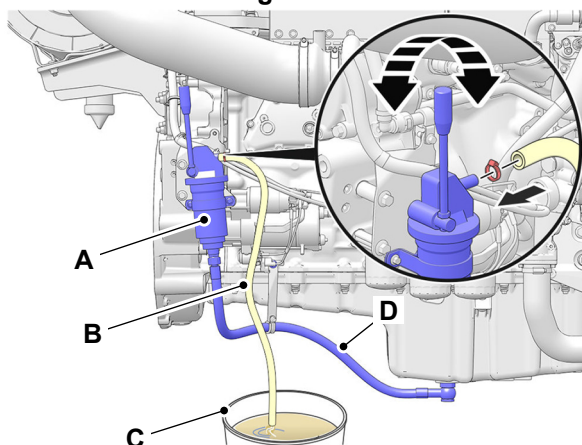
Engine oil replacement must be completed in accordance with the service schedules. Failure to replace the oil at the recommended interval could cause serious engine failure.

Drain the oil when the engine is warm as contaminants held in suspension will then be drained with the oil.

Drain

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Connect the engine oil hose to the ball valve at the engine.
3. Connect the drain hose to the oil output port of the engine oil drain pump assembly.
4. Put a clean container underneath the hose to collect the drained oil.
5. Open the ball valve.
6. Move the handle and drain the oil.
7. Close the ball valve.
8. Disconnect the engine oil hose from the ball valve.

Figure 18.



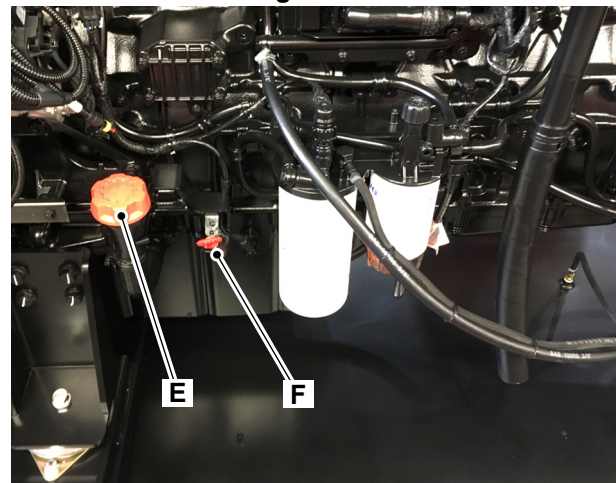
- A** Engine oil pump assembly
- B** Oil drain hose
- C** Container
- D** Engine oil hose

Fill

1. Remove the oil filler cap.
2. Fill the engine with the recommended oil to the MAX mark on the dipstick.

3. Wipe off any spilt oil, install the oil filler cap and make sure it is secure.
4. Operate the engine at idle, make sure that the oil pressure low warning light is extinguished immediately after the engine starts. If it does not extinguish, stop the engine and investigate the cause.
5. Check for oil leakage.
6. When the oil has cooled, check the oil level again, and if necessary top up with clean engine oil.

Figure 19.

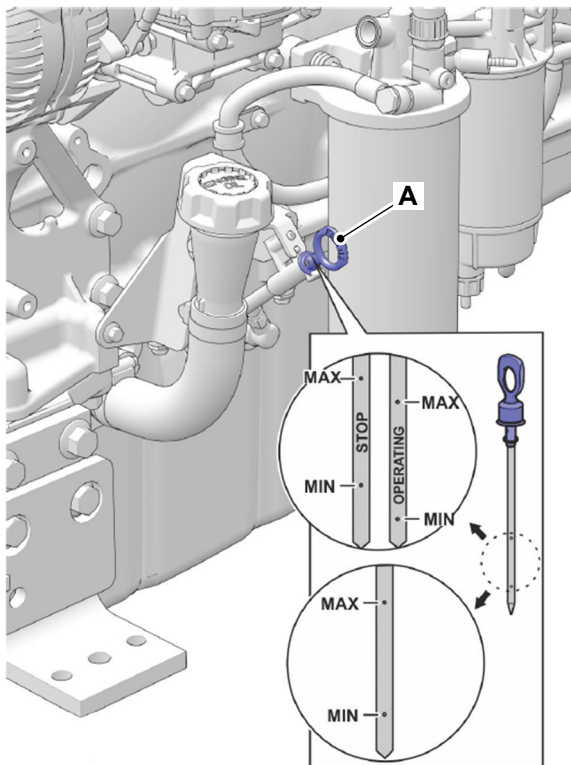


- E** Oil filler cap
- F** Dipstick

Check (Level)

1. Make the machine safe.
Refer to: [PIL 01-03-27](#).
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. 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.
4. Remove and clean the dipstick.
5. Dipstick is marked with STOP/OPERATING conditions. Read both when the engine is stopped and when it is running. Use the STOP side of the dipstick when the engine is stopped and the OPERATING side when in operation.
6. Check the oil level. The oil should be between the two marks on the dipstick.

Figure 20.



A Oil dipstick



18 - Engine Belt

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Introduction

A crankshaft pulley is used to drive a FEAD (Front End Accessory Drive) belt. The belt drives the coolant pump. Depending on the machine application, the belt is configured to drive engine mounted accessories, such as the alternator and cooling fan.

Some applications have a second pulley on the crankshaft which drives a dedicated fan belt. The belt drives an engine mounted cooling fan.

Health and Safety

Turning the Engine

Do not try to turn the engine by pulling the fan or fan belt. This could cause injury or premature component failure.

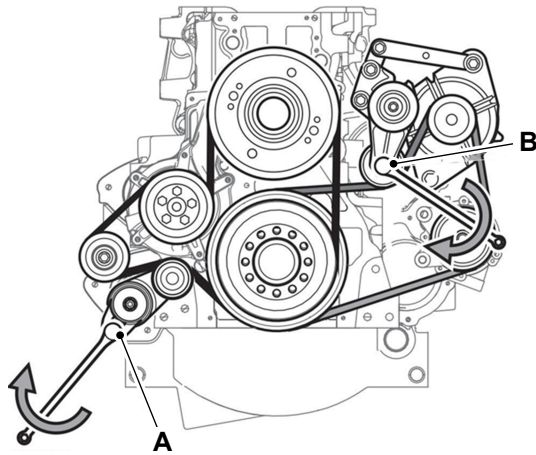
WARNING! *The engine has exposed rotating parts. Switch off the engine before working in the engine compartment. Do not use the machine with the engine cover open.*

Notice: *A drive belt that is loose can cause damage to itself and/or other engine parts.*

Adjust

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Stop the engine.
3. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
4. Always change the belt if it is oily, worn or damaged.
5. Remove the fan guard and fan ring round the cooling fan.
6. Remove the belt guard.
7. Place a suitable square wrench in the belt tensioner 1. Lift the wrench up and lift the water pump drive belt off.
8. Place a suitable square wrench in the belt tensioner 2. Press the wrench down and remove the alternator belt.
9. Check that the pulleys are clean and undamaged.
10. Press the wrench in the belt tensioner 2 down and install the new alternator belt.
11. Lift the wrench in the belt tensioner 1 and install the water pump drive belt.
12. Adjust the alternator belt tension.
13. Install the belt guards.
14. Install the fan guard and fan ring around the cooling fan.
15. Start the engine and perform a function check.

Figure 21.



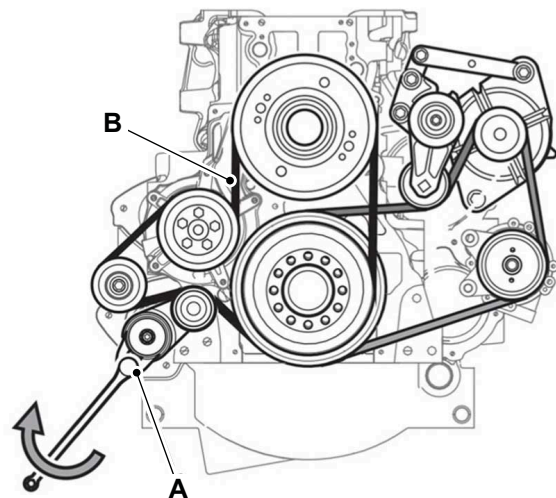
- A** Belt tensioner 1
- B** Belt tensioner 2

Remove and Install

Remove

1. Make the machine safe.
 Refer to: [PIL 01-03-27](#).
2. Stop the engine and let it cool down.
3. Remove the fan guard and fan ring around the cooling fan.
4. Remove the belt guard.
5. Place a suitable square wrench in the belt tensioner.
 - 5.1. Lift the wrench and remove the drive belt. Do not use excessive force or the tensioner will be damaged.
6. Thread the drive belt around the fan and remove it.
7. Check that the pulleys are clean and undamaged.

Figure 22.



- A** Belt tensioner
- B** Drive belt

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Before you install the new belt, check that the tensioner roller and the fan pulley rotate smoothly and that there is no play in the bearings.
3. Thread the new drive belt over the fan.



4. Lift the wrench and install the new drive belt.
5. Install the belt guards.
6. Install the fan guard and fan ring around the cooling fan.
7. Start the engine and perform a function check.



03 - Front End Accessory Drive (FEAD) Belt

Health and Safety

- ▲ **Notice:** A drive belt that is loose can cause damage to itself and/or other engine parts.



21 - Oil Filter

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Health and Safety

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.

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! *Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the plug.*

CAUTION! *The oil filter canister will contain some oil which could spill out when you remove the canister.*

Remove and Install

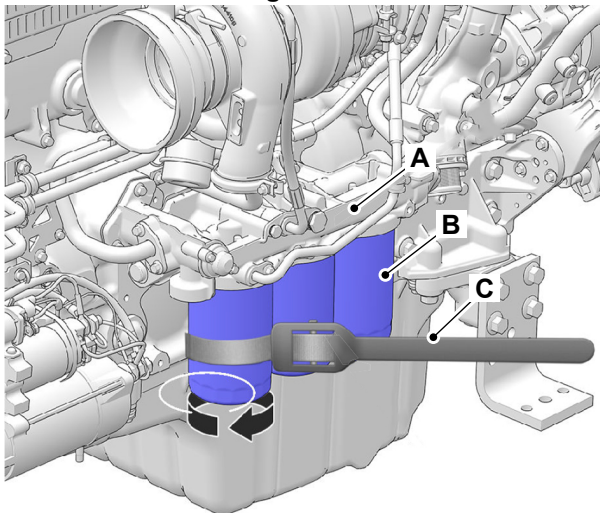
Drain the oil when the engine is warm as contaminants held in suspension will then be drained with the oil.

CAUTION! Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the plug.

Remove

1. Make the machine safe.
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Place a container of suitable size beneath the drain plug.
4. Remove the oil sump drain plug and O-ring.
 - 4.1. Let the oil drain out, clean and install the drain plug with a new O-ring.
 - 4.2. Tighten the plug to the correct torque value.
5. Clean the oil filter bracket.
6. Remove all oil filters with a suitable oil filter extractor.

Figure 23.



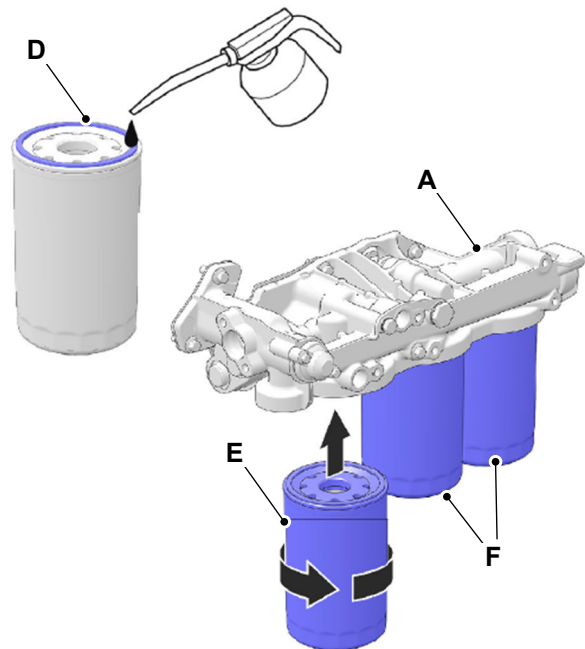
- A** Oil filter bracket
- B** Oil filter
- C** Oil filter extractor

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

2. Apply a thin layer of engine oil on the seal rings of the new oil filters.
3. Install the new oil filters.

Figure 24.



- A** Oil filter bracket
- D** Seal ring
- E** Bypass filter
- F** Full-flow filters

- 3.1. Tighten the two full-flow filters 1/2 - 3/4 of a turn after they bottom.
- 3.2. Tighten the bypass filter 3/4 - 1 turn after it bottoms.
4. Check the engine oil level and top up to the correct level.
5. Start the engine and let it run for 20-30 seconds.

Refer to: [PIL 15-00-00](#).



24 - Air Filter

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Introduction

Engine performance and durability will be severely affected if the quality of the air intake is poor.

A dirty and blocked air cleaner element will reduce the amount of air entering the combustion chamber which can cause engine mis-firing, black smoke and low output power.

A dirty and blocked air filter can also lead to abrasion of the cylinder bores and valves (referred to as dusting). This will cause excessive oil consumption, black smoke, low output power and a reduced engine life.

In hostile environments, change the air filter elements more frequently.

In some applications, an air filter pre-cleaner can be installed.

Health and Safety

▲ **Notice:** Do not run the engine when the element has been removed.

Notice: The outer element must be renewed immediately if the warning light on the instrument panel illuminates.

Check (Condition)

The air filter element (s) should be changed at the recommended service interval, refer to the Maintenance Schedules. [Refer to: PIL 78-24.](#)

Check all the hose connections for loose installations and damaged hose clamps, look specifically for splits or cracks in the hoses. Pay particular attention to the connections on the air intake to turbo compressor and on the crossover tube.

Renew any damaged components.

The air filter elbow is installed with a vacuum switch. The switch will detect if there is a restriction on the air intake and this will activate a warning within the engine ECU (Electronic Control Unit), which will be viewed as a fault code on the controller.

09 - 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.



63 - Mount

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Introduction

Engine mounts support the engine, they dampen noise and vibration. The mounts isolate the engine from the chassis or framework so that vibrations and noise are not transmitted to the rest of the machine.

Most engine mounts consist of metal attachment plates and large rubber insulator blocks. The rubber portions of the mount are flexible and provide the cushioning that dampens the engine vibrations. The metal bracket part of the mount provides the mechanical support and attachment points for the engine mounts.

Check (Condition)

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Check the condition of the engine mounts for wear and damage.
4. Check the condition of the engine mounts for correct tightness.
5. If necessary, tighten the engine mounts to the correct torque value.

Table 19. Torque Values

Item	Description	Nm
A	Engine Mounting bolts	83

Remove and Install

Do the below procedure for each AVM that requires replacement.

Remove

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Remove the engine compartment cover.
4. Remove the fan cowl.
5. Remove the mounting bolts on the engine feet and alternator.
6. Make sure that you work on one mount at a time.
7. Use suitable lifting equipment to lift the engine up until the AVM can slid out and choke the engine.
8. Remove the AVM.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Replace the AVM with new.
3. Make sure that the AVM is installed in correct installation position.
4. Remove the choke and lower the engine.
5. Install the mounting bolts to the engine feet and alternator.
6. Tighten the mounting bolts to the correct torque value.
[Refer to: PIL 72-00-00.](#)
7. Install the fan cowl.



72 - Alternator

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Introduction

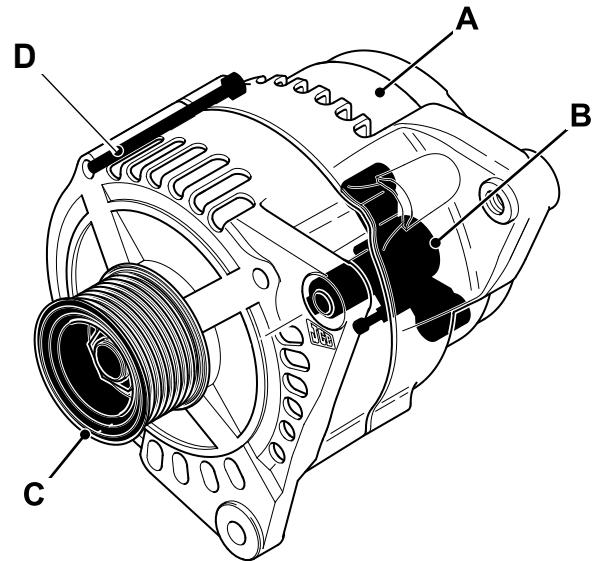
When the generator is running, the current from the battery flows by way of the No Charge warning light to the field winding. This creates a magnetic field which supplements the residual magnetism in the rotor poles. As the engine is started, the FEAD (Front End Accessory Drive) belt drives the rotor and the alternating current is generated in the power windings as they are cut by the rotating magnetic field. Output is controlled by a solid state regulator which varies the field current in accordance with electrical demand.

Health and Safety

- Ensure that the battery negative terminal is connected to the earthing cable.
- Never make or break connections to the battery or alternator, or any part of the charging circuit whilst the engine is running. Disregarding this instruction will result in damage to the regulator or rectifying diodes.
- Main output cables are 'live' even when the engine is not running. Take care not to earth connectors in the moulded plug if it is removed from the alternator.
- During arc welding on the machine, protect the alternator by removing the moulded plug (or if separate output cables installed, remove the cables).
- If slave starting is necessary, connect the second battery in parallel without disconnecting the vehicle battery from the charging circuit. The slave battery may then be safely removed after a start has been obtained. Take care to connect batteries positive to positive, negative to negative.

Component Identification

Figure 25.



- A Alternator
- B Regulator and brush assembly
- C Drive pulley
- D Tie bolts



75 - Starter Motor

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Introduction

The starter motor is a DC (Direct Current) motor with combined starter solenoid. When the current from the battery is applied to the solenoid, the solenoid engages a lever that pushes out the drive pinion on the starter driveshaft and meshes the pinion with the starter ring gear on the flywheel of the engine.

The solenoid also closes high current contacts for the starter motor, which begins to turn. Once the engine starts and is above cranking speed the controller will remove the crank signal and a spring in the solenoid assembly pulls the pinion gear away from the ring gear, and the starter motor stops. The starter motor pinion is clutched to the drive shaft through an overrunning clutch which permits the pinion to transmit drive in only one direction. Drive is then transmitted through the pinion to the flywheel ring gear, but if the pinion remains engaged (as for example because the controller fails to remove the crank signal as the engine starts, or if there is a short and the solenoid remains engaged), the pinion will spin independently of the drive shaft, this prevents the engine driving the starter.

The starter motor is only designed for intermittent use, the electrical components are designed only to operate for a time period of 20s before overheating.

Health and Safety

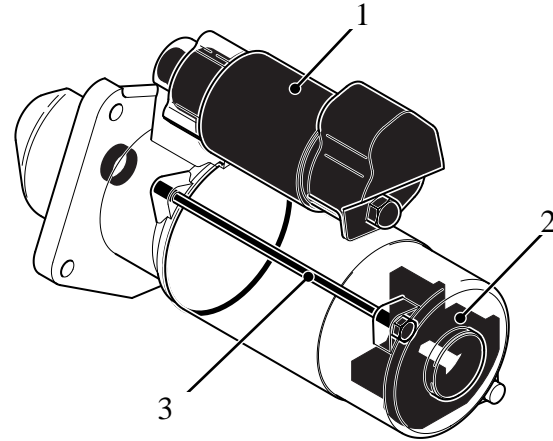
▲ **Notice:** Before carrying out arc welding on the machine, disconnect the battery and alternator to protect the circuits and components. The battery must still be disconnected even if a battery isolator is installed.

WARNING Do not attempt to disconnect the batteries while the generator is running.

WARNING Ensure that the generator is isolated and made safe, by switching off the battery charger and disconnecting the starter batteries.

Component Identification

Figure 26.



- 1 Solenoid
- 2 Brush gear
- 3 Tie bolts

Check (Condition)

Before carrying out the multimeter tests, check the battery condition and make sure that all the applicable electrical connections are clean and tight. Make sure that the starter motor fixing bolts are tightened to the correct torque.

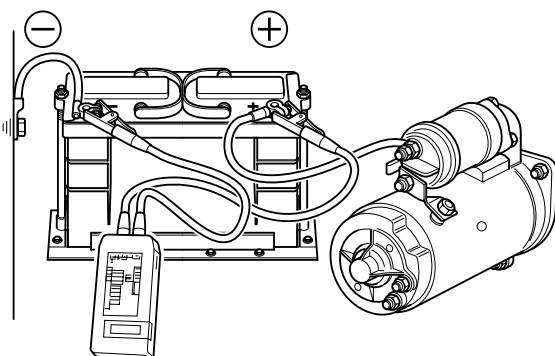
To prevent the engine starting during the tests make sure that the applicable engine stop fuse is removed.

Check the readings in the following sequence using a multimeter. Unless otherwise stated, the readings must be taken with the ignition switch held in the start position (HS) and the controls set to enable the starter motor. The readings are shown for both 12V and 24V systems. The highest values are for machines with 24V systems. Identify the applicable system before carrying out the tests.

Do not operate the starter motor for more than 20s at one time. Let the starter motor cool for at least 2min between starts.

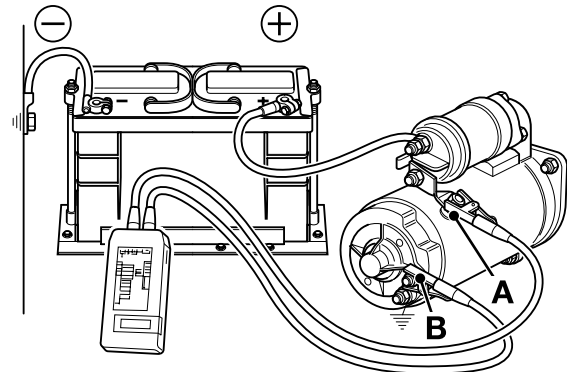
1. Connect the multimeter across the battery terminals.

Figure 27.



- 1.1. Reading in start position approximately
 Voltage: 10V
 Voltage: 20V
- 1.2. Minimum permissible reading in start position
 Voltage: 9.5V
 Voltage: 18V
- 1.3. A low reading probably indicates a fault in the starter motor.
2. Connect the multimeter between the starter main terminal and the commutator end bracket. In the start position, the reading should not be below the reading obtained in 1 by any more than
 Voltage: 0.5V
 Voltage: 1V

Figure 28.

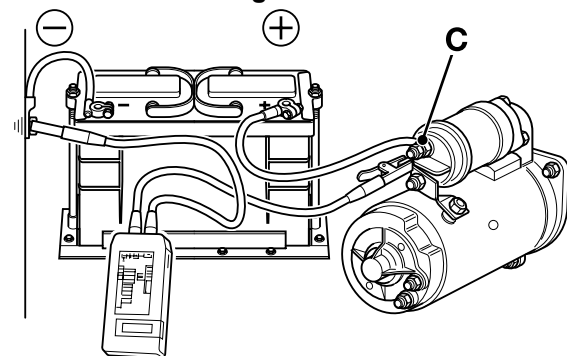


- A** Starter main terminal
- B** Commutator end bracket (Starter earth connection)

- 2.1. Minimum permissible reading in start position
 Voltage: 9V
 Voltage: 17V
- 2.2. If the reading is within this limit, continue to 3. If the reading is outside the limit, proceed to 4.

3. Connect the multimeter between the solenoid terminal and a good earth. Minimum permissible reading in start position
 Voltage: 8V
 Voltage: 16V

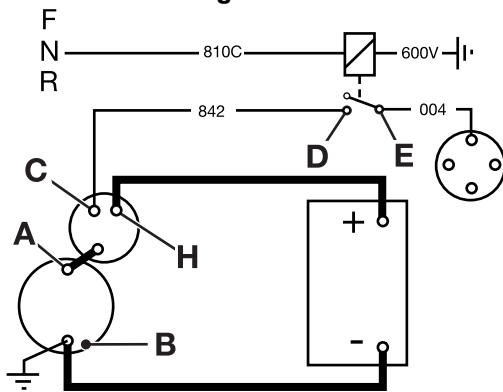
Figure 29.



- C** Solenoid terminal

4. If the reading is less than specified, connect the multimeter between the start relay switched output and earth. A fault is indicated with the wiring from the start relay to the solenoid if the reading increases to
 Voltage: 8V
 Voltage: 16V

Figure 30.



- A Starter main terminal
- B Starter earth connection
- C Solenoid terminal
- D Start relay feed
- E Start relay switched output
- H Battery positive and solenoid connection

4.1. If the reading is less than specified, connect the multimeter between the start relay feed and earth.

4.2. A faulty start relay or a fault in the feed to the relay solenoid is indicated if the voltage increases to

Voltage: 8V
 Voltage: 16V

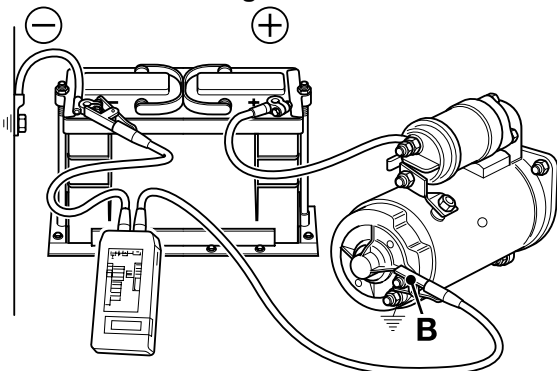
4.3. Check also the solenoid earth connection. The fault must be in either the starter switch or in the wiring between the solenoid, starter switch, and the start relay, if the reading between terminal and earth is less than

Voltage: 8V
 Voltage: 16V

5. Connect the multimeter between battery negative and starter earth connection. The reading in the start position should be practically zero, maximum permissible reading

Voltage: 0.25V

Figure 31.



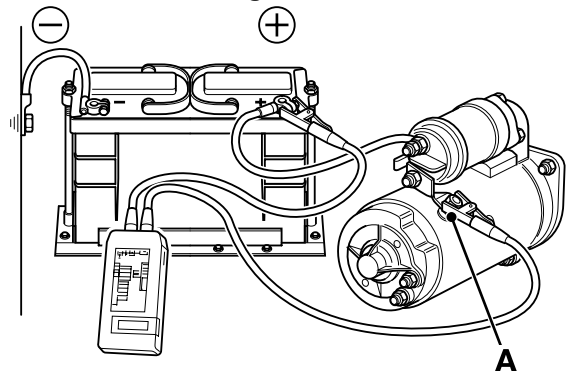
- B Starter earth connection

5.1. If the reading is above the maximum permissible voltage, a high resistance in the earth lead or connections is indicated.

6. Connect the voltmeter between battery positive and the starter main terminal. With the starter switch off, the voltmeter should indicate battery voltage, but it should fall to practically zero when the switch is turned to the on position, maximum permissible reading

Voltage: 0.25V

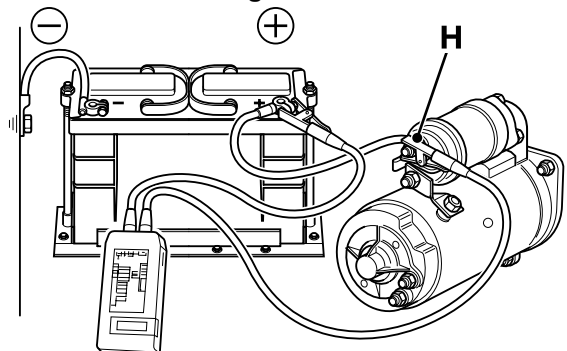
Figure 32.



- A Starter main terminal

7. If the reading is above the maximum permissible voltage, a high resistance is present in the insulated lead or in the solenoid. Connect the multimeter between the battery positive and solenoid connection. If the multimeter now reads zero with the switch closed, the fault is in the solenoid.

Figure 33.



- H Battery positive and solenoid connection

8. Finally install the engine stop fuse.



18 - Fuel and Exhaust System

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Acronyms Glossary

DEF	Diesel Exhaust Fluid
DTI	Dial Test Indicator
ECU	Electronic Control Unit



00 - Fuel and Exhaust System

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00 - General

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Drain and Fill	18-4
Bleed	18-5

Health and Safety**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.

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear personal protective equipment. Hold a piece of cardboard close to suspected leaks and then examine the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

WARNING! Do not open the high pressure fuel system with the engine running. Engine operation causes high fuel pressure. High pressure fuel spray can cause serious injury or death.

Notice: Do not allow dirt to enter the fuel system. Before disconnecting any part of the fuel system, thoroughly clean around the connection. When a component has been disconnected, for example a fuel pipe, always install protective caps and plugs to prevent dirt ingress. Failure to follow these instructions will lead to dirt entering the fuel system. Dirt in the fuel system will seriously damage the fuel injection equipment and could be expensive to repair.

Notice: The high pressure fuel system is extremely susceptible to damage if it is contaminated. Always clean the engine using the correct procedures before carrying out maintenance. Contamination of the fuel system can cause catastrophic failure of the engine.

Notice: Running the engine with air in the system could damage the fuel injection pump. After maintenance, the system must be bled to remove any air.

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.

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.

Discharge and Pressurise

▲ Notice: Running the engine with air in the system could damage the fuel injection pump. After maintenance, the system must be bled to remove any air.

Obey all fuel system health and safety information.
Refer to: [PIL 18-00-00](#).

The entry of air into the fuel system can cause problems such as difficult engine starting and unstable engine running. Air can enter the system if the following occurs:

- A fuel system component has been disconnected. For example, a fuel filter renewal.
- A leak in the low pressure side of the fuel system during engine operation, or the low pressure pipes have been disconnected. Refer to Fuel System - General (PIL 18-00) for a more detailed description of the fuel circuit.
- The fuel tank is allowed to drain fully during normal operation.

The engine installation features an electrically operated fuel lift pump. The system is designed to bleed automatically when the lift pump is operated. Make sure that as much air is removed from the fuel as possible before you start the engine. Bleed the system as follows:

Important: DO NOT attempt to bleed the high pressure fuel system by loosening the high pressure pipe connections even when the engine is not running. To bleed the fuel system follow the correct procedure.

1. Turn on the ECU (Electronic Control Unit) override to start the fuel lift pump. DO NOT start the engine. Allow the pump to run for specified duration.

Duration: 30s

2. Turn off the ECU override to stop the fuel lift pump.

- 2.1. Wait for specified duration and turn the ECU override to start the pump. DO NOT start the engine.

Duration: 10s

- 2.2. Allow the pump to run for specified duration.

Duration: 30s

3. Repeat step 2 two times more before you start the engine.

4. Start the engine and make sure it runs smoothly.

Drain and Fill

1. Obey all fuel system health and safety information.

Refer to: [PIL 18-00-00](#).

2. Make the machine safe.

Refer to: [PIL 01-03](#).

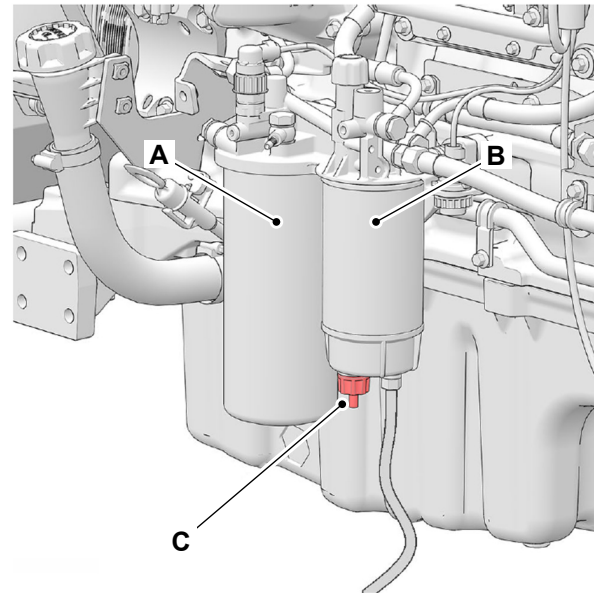
3. Put a collection vessel under the fuel pre-filter to collect the condensate and fuel.

4. Open the drain nipple in the base of the fuel pre-filter.

5. Tighten the drain tap when fuel without water starts to run out.

6. Do not reuse the drained fuel.

Figure 34. Typical Engine



- A** Fuel filter
- B** Fuel pre-filter
- C** Drain nipple

Bleed

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Get access to the engine.
3. Clean the area around the fuel injection pump.
4. Disconnect the fuel pipe at the injection pump.
5. Check that there is sufficient fuel in the tank.

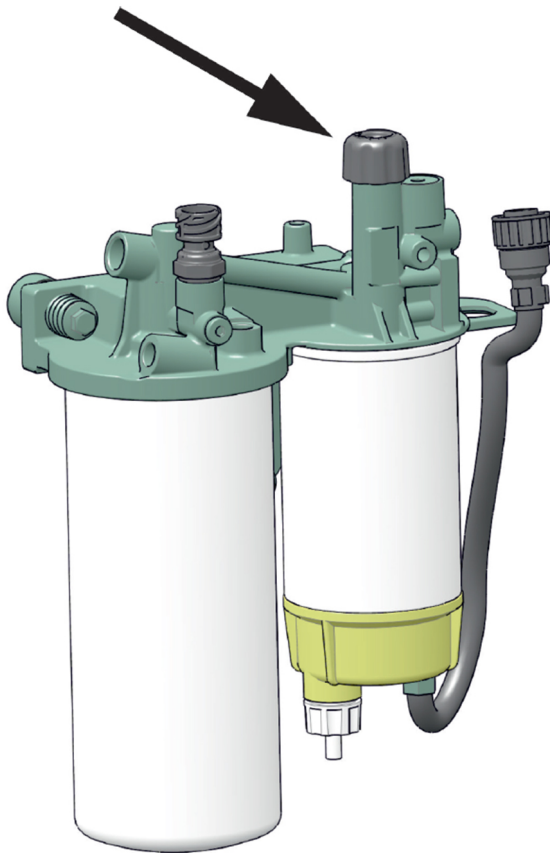
9. Start the engine and allow it to idle fast for about 10 minutes.

10. Perform a leak test and function check.

Important: The engine should never be run at full speed or full load until the fuel system has been properly bled of air.

If the engine continues to run roughly, check again for air in the fuel system. Check all seals and connections, especially in the low pressure side of the system.

Figure 35.



- 5.1. Check if any fuel taps are open.
6. Release the hand pump on the fuel bracket by pushing down and twisting the plastic handle.
 - 6.1. Vent the fuel system by pumping with the hand pump.
 - 6.2. Air vents to the tank via the fuel return pipe. No breathing nipples need be opened.
7. The engine is now ready to start. If the engine runs smoothly for a short time and then begins to run roughly, leave at idle until it runs smoothly.
8. Lock the hand pump, push down and twist the handle.



09 - Filter

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00 - General

Introduction

The fuel filter consists of filtration media folded in such a way as to give a very large surface area. This is known as the filter element. It is most important that the fuel filter is changed regularly in accordance with the machine maintenance schedule. Use only the correct specification filters.

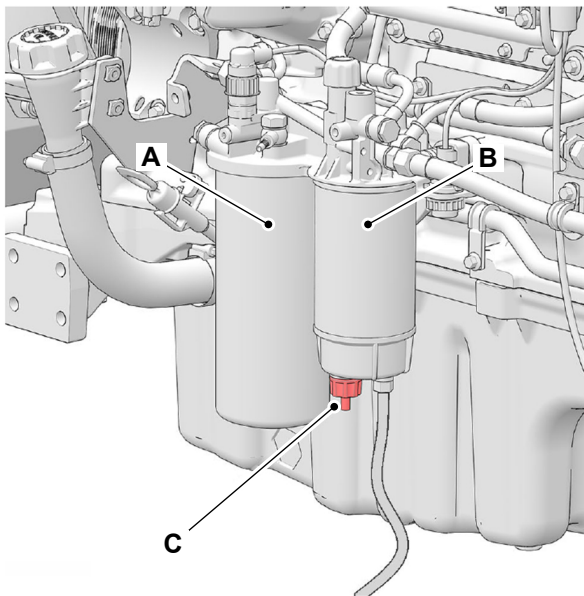
03 - Filter Element

Remove and Install

Before Removal

1. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
2. Get access to the filter.
3. Thoroughly clean the outside of the filter housing and around the filter head.
4. Loosen the drain nipple and allow the water / fuel to drain into a suitable container.

Figure 36.

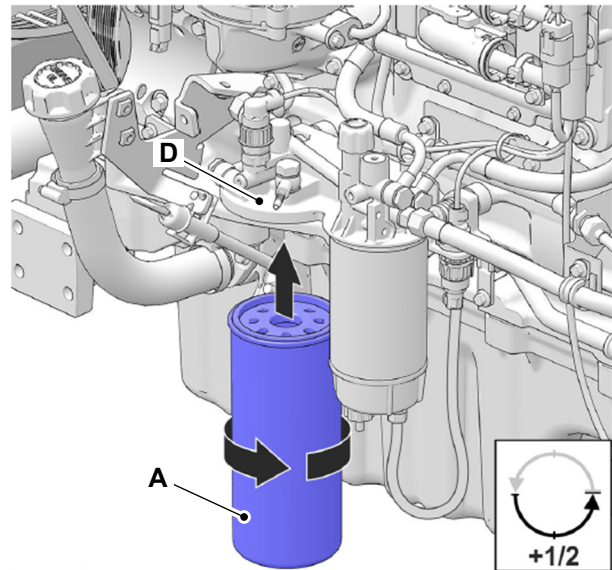


- A Fuel filter
- B Fuel pre-filter / water trap filter
- C Drain nipple

Remove

1. Remove the low pressure fuel lines.
 - 1.1. Put a label on the hoses to help installation.
 - 1.2. Plug all the open ports and hoses to prevent contamination.
2. Remove the filter with a suitable filter strap. Collect any spilled fuel in a collection vessel.

Figure 37.



- D Filter bracket
- A Fuel filter

Install

1. Make sure that the filter is in the correct position to enable connection of the fuel lines.
2. Clean the filter mating surface on the filter bracket.
3. Lubricate the seal with diesel fuel and install the new fuel filter.
 - 3.1. Tighten the fuel filter in accordance with the instructions on the fuel filter.
4. If a water trap is installed, change the filter in it at the same time as the fuel filter.
 - 4.1. Clean the water trap in the plastic bowl under the filter with a soft rag.
5. Install the filter strap.
 - 5.1. Tighten the filter strap to the correct torque value.
6. Install the low pressure fuel lines.
 - 6.1. Make sure they are installed at the correct ports.
7. Bleed the fuel system.

Refer to: [PIL 18-00-00](#).



09 - Pre-Filter Element

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Introduction

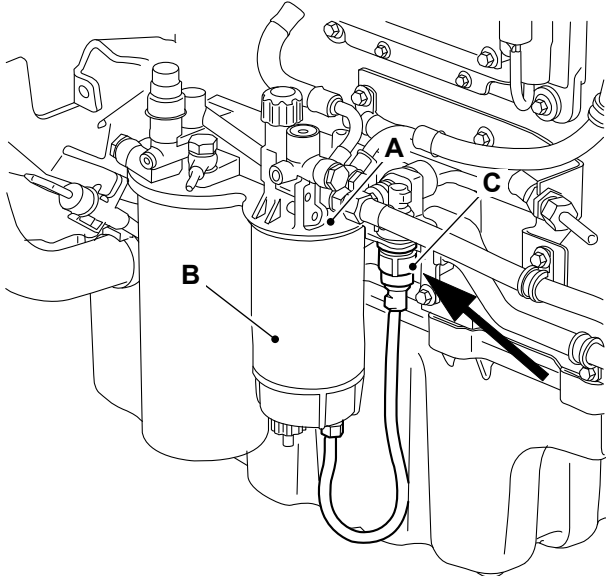
The fuel pre-filter with water separator is installed on to the fuel lift pump. The fuel lift pump is a sealed integral electrical unit.

Remove and Install

Remove

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Get access to the fuel pre-filter.
3. Remove the cable from the water trap sensor.

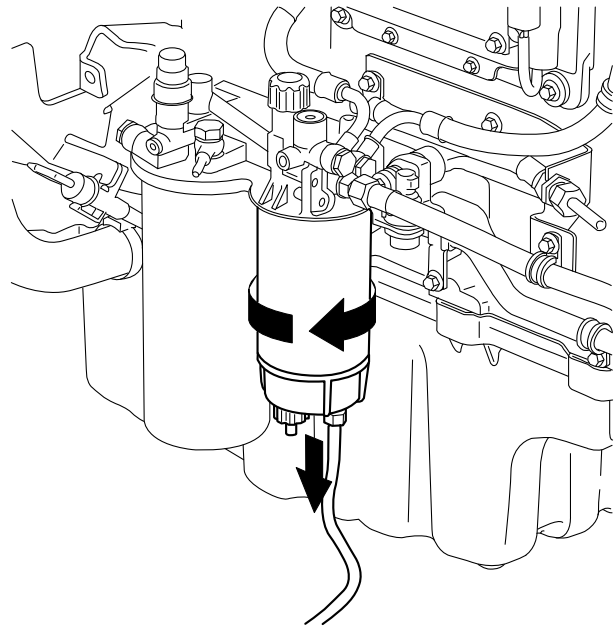
Figure 38.



- A** Filter bracket
- B** Pre-filter / water trap filter
- C** Water trap sensor

4. Remove the water trap filter from the filter bracket. Collect any spilled fuel in a collection vessel.

Figure 39.



5. Remove the lower part of the water trap from the filter.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Clean the lower part of the water trap with a soft rag.

Figure 40.



- 2.1. Check that the drain hole in the lower part is not blocked.



3. Lubricate the seal with diesel fuel.
 - 3.1. Install the filter onto the filter bracket by hand until the rubber seal just touches the mating surface.
 - 3.2. Make sure that you tighten a further half turn, no more.
4. Connect the cable to the water trap sensor.
5. If necessary, bleed the fuel system.
[Refer to: PIL 18-00-00.](#)



12 - Water Separator

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00 - General

Remove and Install

Refer to Fuel and Exhaust system - Filter - Pre-Filter
Element. [Refer to: PIL 18-09.](#)



04 - Water in Fuel Sensor

Introduction

The water in fuel sensor is installed in the fuel filter water bowl. A warning light will illuminate in the instrument panel to indicate that water has accumulated in the fuel filter water bowl and must be drained.



24 - Exhaust

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00 - General

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Health and Safety

Exhaust Gases

Breathing the machine exhaust gases can harm and possibly kill you. At time of machine installation in a confined space a system ventilation risk assessment must be carried out by suitably qualified personnel. If deemed necessary a suitable local exhaust ventilation system must be installed and operated when the machine is being used.

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 outdoor 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.

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.

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.*

Check (Condition)

Excessive smoke from the exhaust stack combined with a complaint of low power could be as a result of:

- Dirt or dust (unfiltered air) ingested directly into the engine, resulting in damage to the cylinder bores and/or turbocharger (if installed). There will also be a possible increase in oil consumption.
- Air leaks from the air hose connections.
- Exhaust manifold leaks.

03 - Inlet Manifold

Check (Condition)

1. Check the manifold mating faces for signs of damage and distortion.
2. Check the manifold casting for signs of cracks.
3. Renew the manifold if there are any signs of defect.

04 - Outlet Manifold

Check (Condition)

1. Check the manifold mating faces for signs of damage and distortion.
2. Check the manifold casting for signs of cracks.
3. Renew the manifold if there are any signs of defect.
4. Visually inspect for leaks at the exhaust manifold. Make sure all gaskets are in good condition, replace as required.

06 - Silencer

Introduction

The silencer is a device used to reduce noise level of the engine exhaust system to accepted level.

The silencer on this machine is mounted in a separate compartment on the generator chassis and the exhaust exits the top of the canopy to be topped off by a hinged rain cap.

27 - Spark Arrestor

Remove and Install

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.

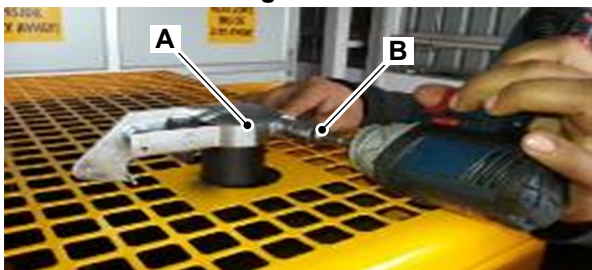
CAUTION! The exhaust pipe becomes extremely hot when the engine is running and will remain so for some time after the engine is stopped. If you touch the hot pipe you could be severely burned.

The spark arrestor is optional to the secondary silencer.

Remove

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
 - 1.1. Obey all exhaust system health and safety information.
[Refer to: PIL 18-00-00.](#)
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Remove the rear access cover.
[Refer to: PIL 06-06-14.](#)
4. Isolate the battery.
[Refer to: PIL 33-03-00.](#)
5. Remove the exhaust system.
6. If necessary, remove the exhaust rain cap.

Figure 41.

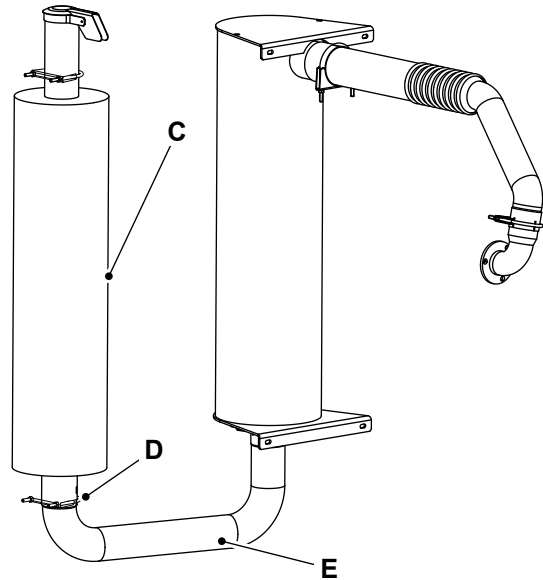


- A Exhaust rain cap
- B Bolt

- 6.1. Remove the bolt.
- 6.2. Remove the exhaust rain cap from the spark arrestor.
7. Support the exhaust assembly.

8. Remove the nut from the U clamp (x2). Remove the U clamp (x2) and remove the spark arrestor from the silencer pipe.

Figure 42.



- C Spark arrestor
- D U clamp (x2)
- E Silencer pipe

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Tighten the fasteners to the correct torque value.



30 - Aftertreatment System

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Notes:

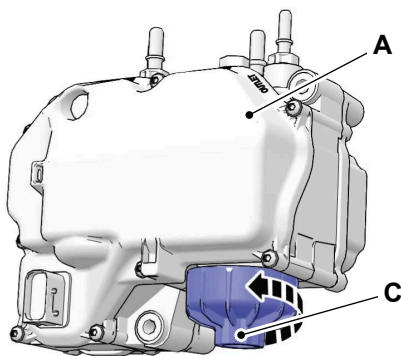
06 - Filter

Remove and Install

Remove

1. Make the machine safe.
Refer to: [PIL 01-03-27](#).
2. Make sure that the engine is safe to work on. If the engine has been running, make sure the engine has cooled sufficiently before you start the removal.
3. Remove the filter cap from the DEF (Diesel Exhaust Fluid) module.
 - 3.1. If necessary, use the specified wrench to remove the filter cap.

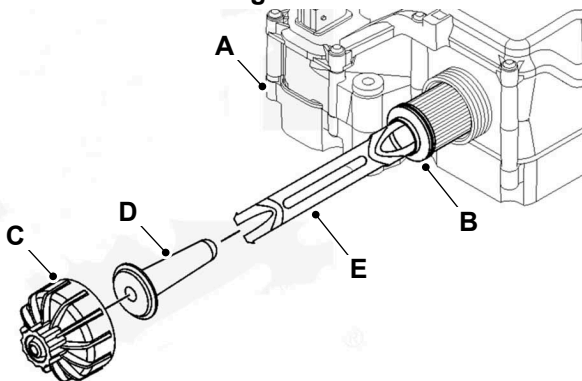
Figure 43.



- A DEF
- C Filter cap

4. Remove and discard the filter equalizing element.

Figure 44.



- A DEF module
- B Filter element
- C Filter cap
- D Filter equalizing element
- E Service tool

5. Remove and discard the filter element.
 - 5.1. Use the appropriate end of the service tool, depending on the colour of the plastic on the filter.
 - 5.2. A disposable service tool is supplied with the filter to aid in filter removal.
 - 5.3. When you insert the tool, a 'click' sound is heard which indicates proper engagement with the filter.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Tighten the filter cap to the correct torque value.

Table 20. Torque Values

Item	Nm
C	20 +/-5



35 - Turbocharger

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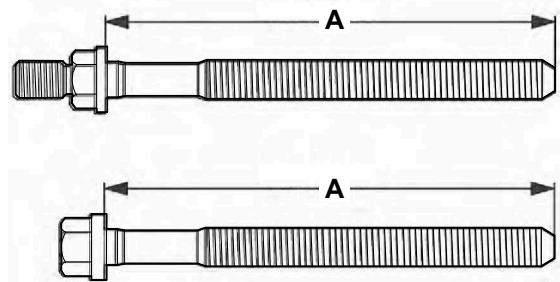
00 - General

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Check (Condition)

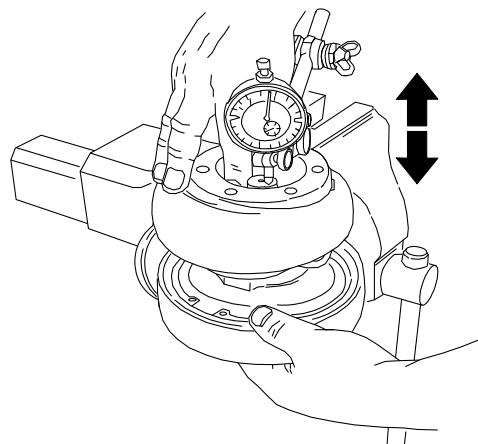
1. Visually inspect for leaks at the turbocharger. Make sure that all gaskets are in good condition, replace as required.
2. Check the turbine and compressor blades inside the turbocharger rotate freely and smoothly by hand. If the blades are stiff to turn, or damaged the turbocharger must be replaced.
3. Make sure that the oil feed pipe and oil drain pipe are clear and free from debris and sludge.
4. Check the turbine shaft running clearance.
 - 4.1. Place the stylus of a DTI (Dial Test Indicator) against the shaft.
 - 4.2. Move the shaft sideways.

Figure 45.



- 4.3. Make sure that the turbine shaft running clearance is within the specified limits.
5. Check the shaft end float.
 - 5.1. Place the stylus of the DTI against the end of the shaft.

Figure 46.



- 5.2. Move the shaft axially.

- 5.3. Make sure that the shaft end float is within the specified limits.

Check (Operation)

To maximise the duration of the turbocharger follow the rules described below.

Start-up

Start the engine and keep it at idle speed for about a minute. The oil operating pressure is reached within a few seconds, but it is useful to allow the moving parts to warm up in good lubrication conditions. Immediately increasing the engine speed after start up will result in the turbocharger running at high rpm with less than optimal lubrication. This may lead to premature failure of the turbocharger.

After maintenance

When carrying out maintenance on the engine or turbocharger, pre-lubricate the oil inlet of the turbocharger by adding clean lubricant until it is completely full. After pre-lubrication, let the engine run via the starter motor without firing (engine / fuel pump stop out) to allow the oil to circulate through the complete system under pressure. Upon engine start-up, make it run at idle speed for a few minutes, allowing the oil and bearings system to work satisfactorily.

Low temperature air or engine inactivity

If the engine has been inactive for a certain period of time or the air temperature is very low, start the engine and then let it run at idle speed. This enables the oil to go into the lubrication system before applying high loads and speeds to the engine and turbocharger.

Engine shutdown

Before switching the engine off after intense activity, you must allow the turbocharger to cool down, let the engine run for 10 minutes to allow the turbocharger to cool.

Engine at idle speed

Avoid running the engine at idle speed for long periods (above 20-30 minutes). Idle operation leads to low pressure values in the turbocharger, which may cause oil leaks from the seals at the ends of the turbo bearing shaft. Even if this does not cause damage, it can cause blue smoke from the exhaust when the engine speed and load are increased.



21 - Cooling System

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Acronyms Glossary

CAC Charge Air Cooler



00 - Cooling System

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Introduction

During the working cycle of the engine a great deal of heat is generated. It is important that the engine is kept at its normal operating temperature to achieve maximum efficiency. It is the function of the cooling system to allow the engine to reach this temperature quickly and then maintain it.

Health and Safety

▲ **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.

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

Technical Data

Table 21. Cooling System

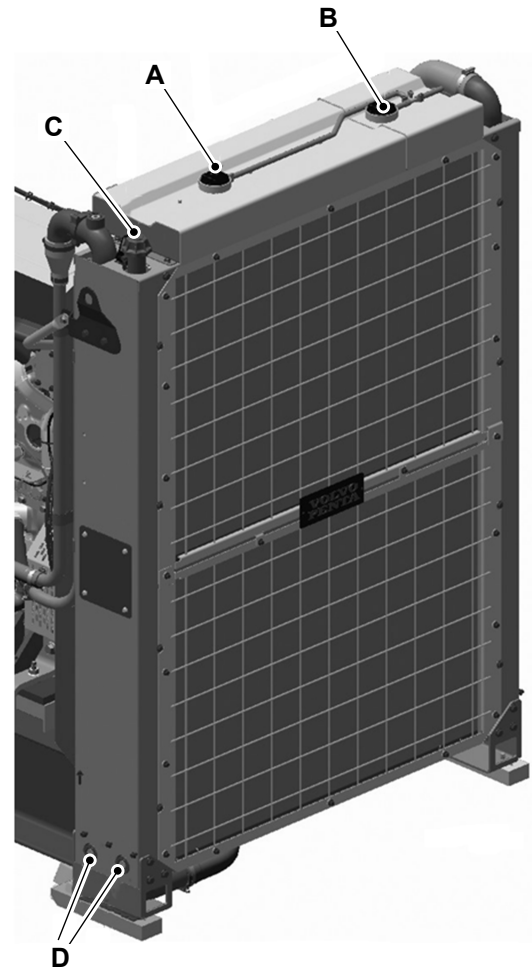
Description	Data
Cooling system design	Pressurised, sealed
Pressure cap, max opening pressure	0.75bar (10.9psi)
Volume (Volvo Penta cooling system)	
Engine circuit (Engine with radiator, hoses and expansion tank)	86L
CAC (Charge Air Cooler) circuit (CAC, hoses and expansion tank)	64L
Thermostat	
Quantity	1
Opening temperature	82°C (179.5°F)

Drain and Fill

Drain

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Stop the engine and let it cool down.
3. Get access to the engine.
4. Remove the filler cap of expansion tank 1, expansion tank 2 and radiator.
5. Place a suitable container and allow the coolant to drain into a suitable container.
6. Flush the system by pouring clean water into the filler port.
7. Open all drain points.
8. Connect the bottom radiator hose.
 - 8.1. Drain the coolant from the radiator and engine block, using the drain hose.
9. Check that all coolant drains out. Deposits may be found inside the drain plug/tap, and need to be cleared away.

Figure 47.



- A** Expansion tank 1
- B** Expansion tank 2
- C** Radiator
- D** Radiator nipples

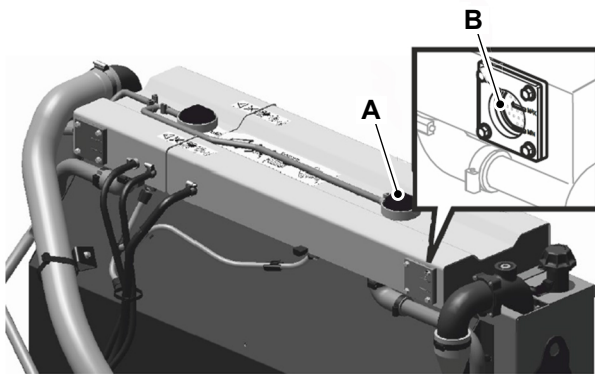
Fill

1. Open the caps to both the expansion tank and radiator.
2. Fill coolant into the expansion tank until it is completely full, to the MAX mark on the sight glass.
3. Fill the radiator through the nipples at the bottom of the radiator.
4. Top up until the system is completely full.
5. Vent the system through openings on the expansion tank and radiator.
6. Shut any taps and check that the spring-loaded covers on the nipples close completely. Install the rubber plugs.

Check (Level)

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Get access to the coolant expansion tank.
3. Check the level of coolant in the coolant expansion tank. Make sure that the coolant level is above the MIN mark on the sight glass.
4. If necessary, fill the expansion tank to the MAX mark on the sight glass. Refer to Figure 48.
5. Install the filler cap and make sure it is tight.
6. Run the engine for a while to raise the coolant to working temperature and pressure.
7. Stop the engine and check for leaks.

Figure 48.



A Expansion tank

B Sight glass



03 - Cooling Pack

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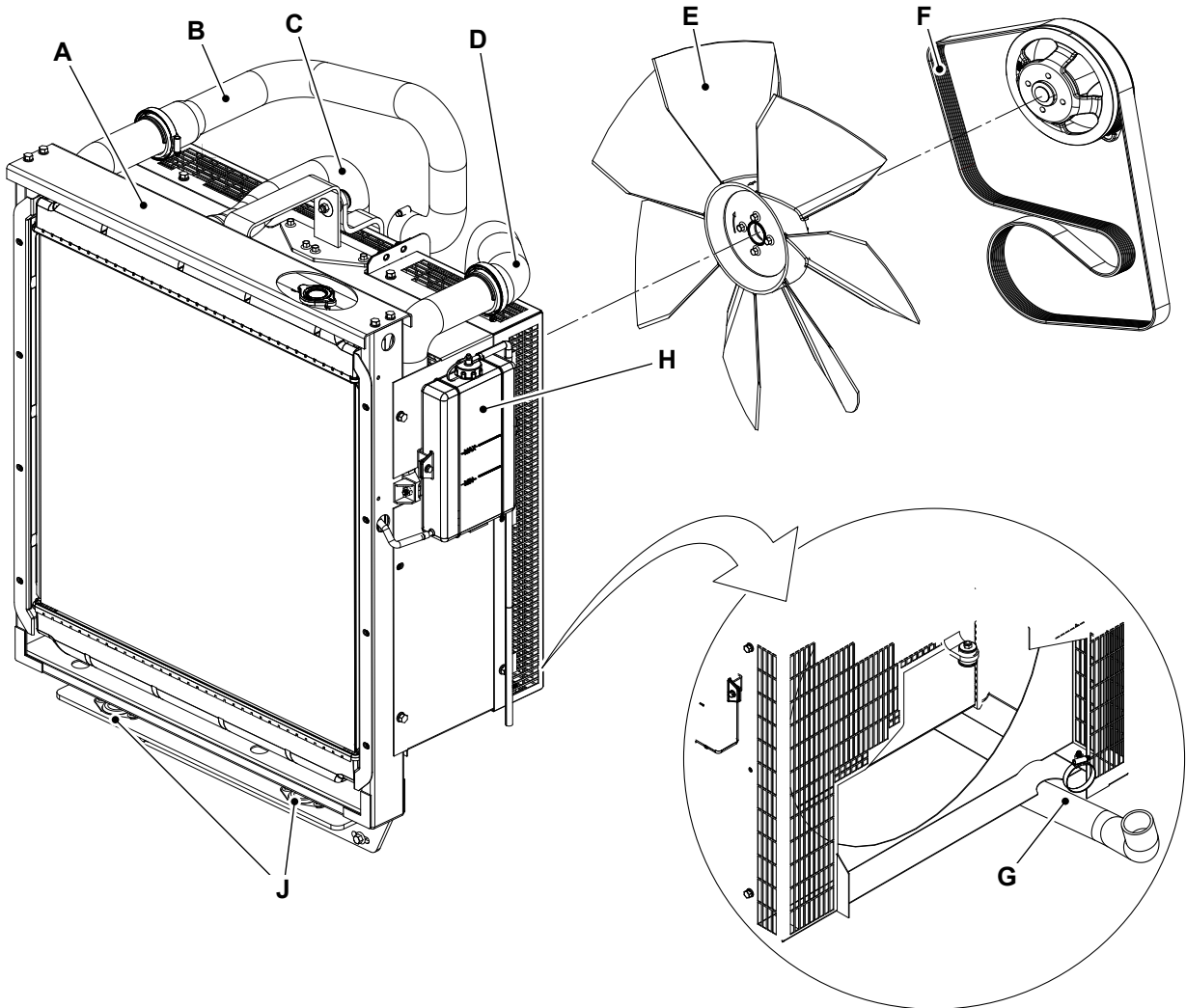
Introduction

The cooling pack of these machines has following two major components.

- Radiator. Refer to: PIL 21-03-03.
- Fan. Refer to: PIL 21-03-15.

Component Identification

Figure 49. Cooling pack



- A** Radiator
- C** Top radiator hose
- E** Fan assembly
- G** Bottom radiator hose
- J** Mounting (x2)

- B** Inlet Hose
- D** Outlet hose
- F** Drive belt
- H** Expansion tank

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.



03 - Radiator

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Introduction

The radiator is a device in the cooling system that removes heat from the coolant passing through it, allowing the coolant to remove heat from the engine.

Check (Condition)

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.

WARNING! *Never remove the radiator cap when the cooling system is hot - severe risk of scalding.*

1. Check the condition of the radiator.
2. Clean the radiator fins and make sure that the fins are not damaged.
3. Remove any blockage from the air flow path of the radiator.

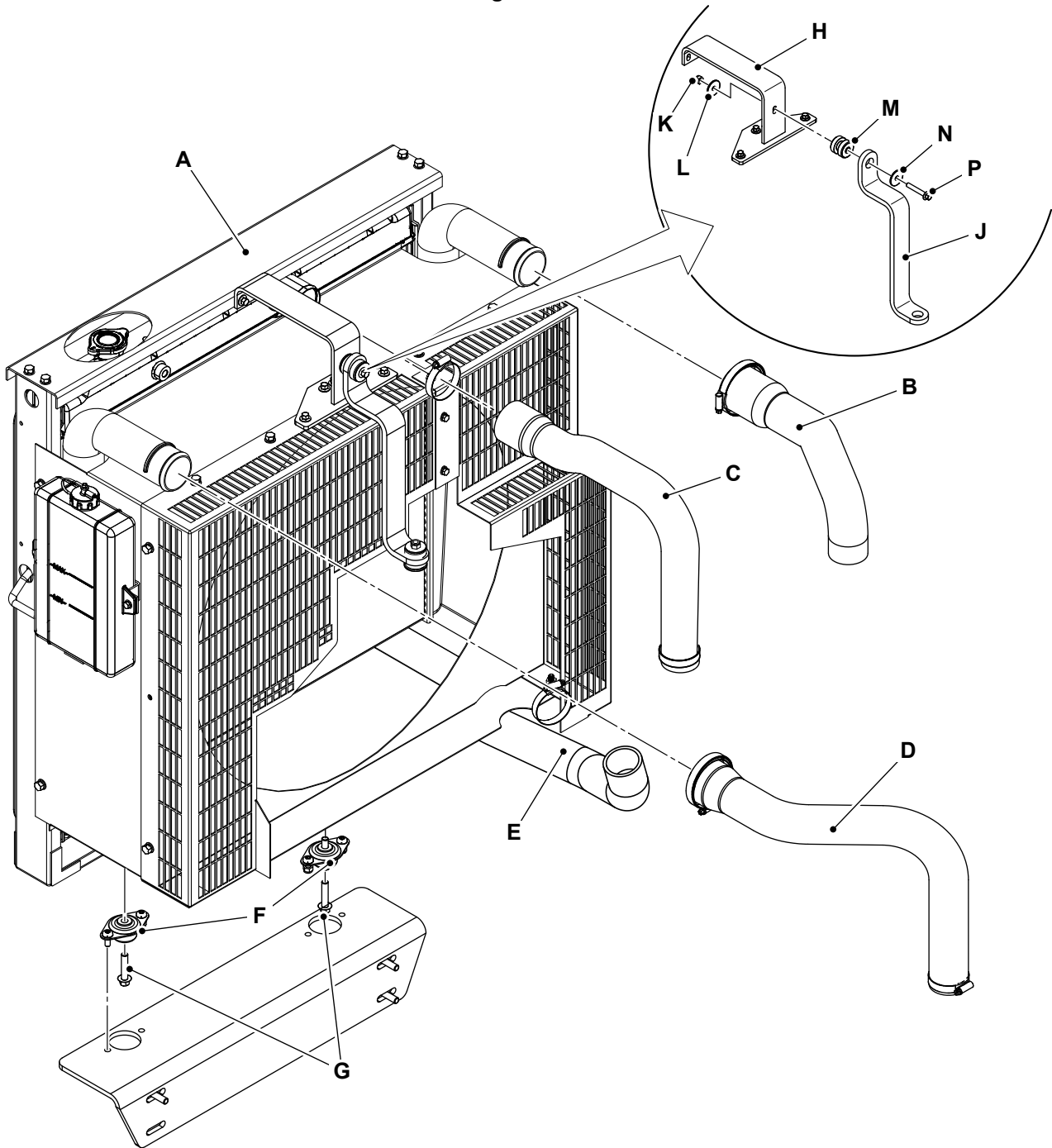
Remove and Install

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

Remove

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Isolate the battery.
[Refer to: PIL 33-03-00.](#)
3. Remove the rear cover.
[Refer to: PIL 06-06-14.](#)
4. Drain the cooling system.
[Refer to: PIL 21-00-00.](#)
5. Remove the expansion tank.
[Refer to: PIL 21-06-00.](#)
6. If installed, loosen the worm drive clip and disconnect the inlet hose from the radiator.
7. If installed, loosen the worm drive clip and disconnect the outlet hose from the radiator.
8. Disconnect the top radiator hose and the bottom radiator hose from the radiator.
9. Put a label on the hoses to help installation.
10. Plug all the open ports and hoses to prevent contamination.
11. Remove the cooling pack stay from the cooling pack support bracket.
 - 11.1. Remove the locknut, washer 1, upper mounting rubber (x2), washer 2 and bolt 2.
12. Support the radiator with suitable lifting equipment.
13. Remove the radiator from the mountings.
 - 13.1. Remove the bolt 1 (x2) that attach the radiator to the mountings (x2).
14. Remove the radiator from the machine.

Figure 50.



- A Radiator
- C Top hose radiator
- E Bottom radiator hose
- G Bolt 1 (x2)
- J Cooling pack stay
- L Washer 1
- N Washer 2

- B Inlet hose (For aftercooled engine only)
- D Outlet hose (For aftercooled engine only)
- F Mounting (x2)
- H Cooling pack support bracket
- K Locknut
- M Upper mounting rubber (x2)
- P Bolt 2

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Tighten the fasteners to the correct torque value.



15 - Fan

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Introduction

The engine cooling fan is a key component of the engine's cooling system. The cooling fan circulates air through the radiator to dissipate excess engine heat.



Health and Safety

Turning the Engine

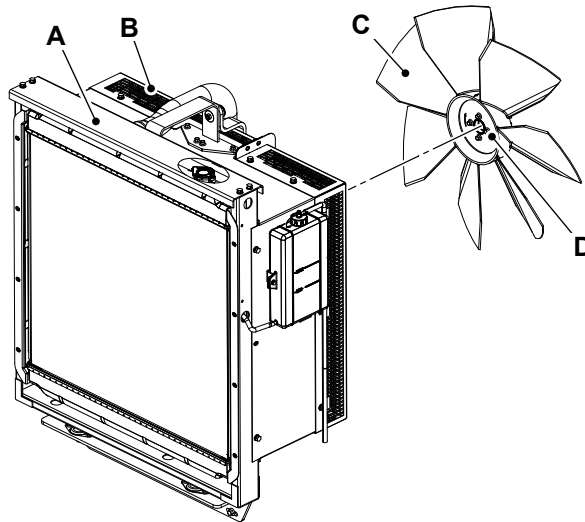
Do not try to turn the engine by pulling the fan or fan belt. This could cause injury or premature component failure.

Remove and Install

Remove

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Open the access cover.
[Refer to: PIL 06-06-00.](#)
4. Remove the fan guard from the radiator.
5. Remove the fan drive belt.
6. Support the fan assembly.
7. Loosen the bolt (x4) that attaches the fan assembly to the fan drive.
8. Remove the fan assembly from the machine.

Figure 51.



A Radiator
C Fan assembly

B Fan guard
D Bolt (x4)

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that you install the spacer between engine pulley and metal disc of the fan.
3. Tighten the bolt (x4) to the correct torque value.

Table 22. Torque Values

Item	Nm
D	43

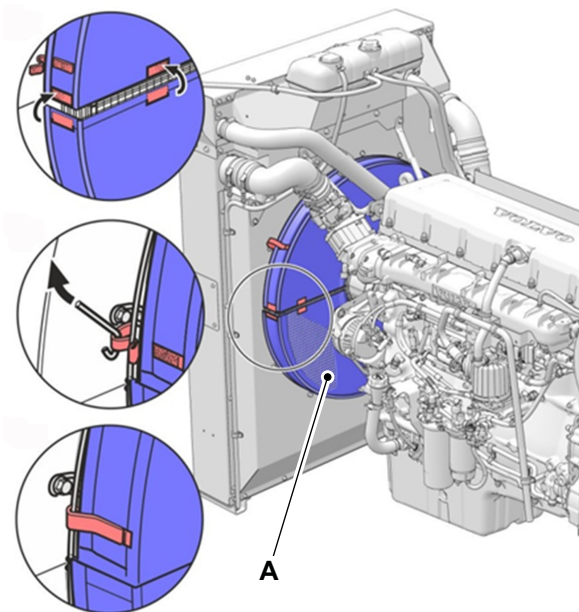
21 - Guard

Remove and Install

Remove

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Stop the engine.
3. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
4. Remove the fan cover over the cooling filter.
5. Remove the cooling filter.
6. Brush away any heavy dirt with a soft brush.
7. Rinse the filter with water.
 - 7.1. Make sure that cleaning agent is an eco-friendly degreaser.
 - 7.2. Spray on the degreaser or apply it using a sponge. Allow it to act for a few minutes and then rinse with tap water.

Figure 52.

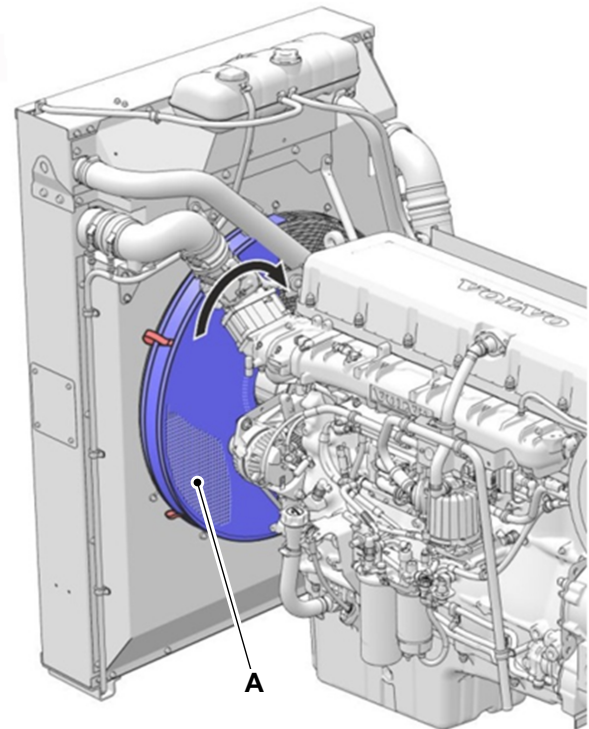


A Cooling filter cover

Install

1. Install the cooling filter. Refer to Figure 52.
2. Slide one half of the filter cover over the fan cover.

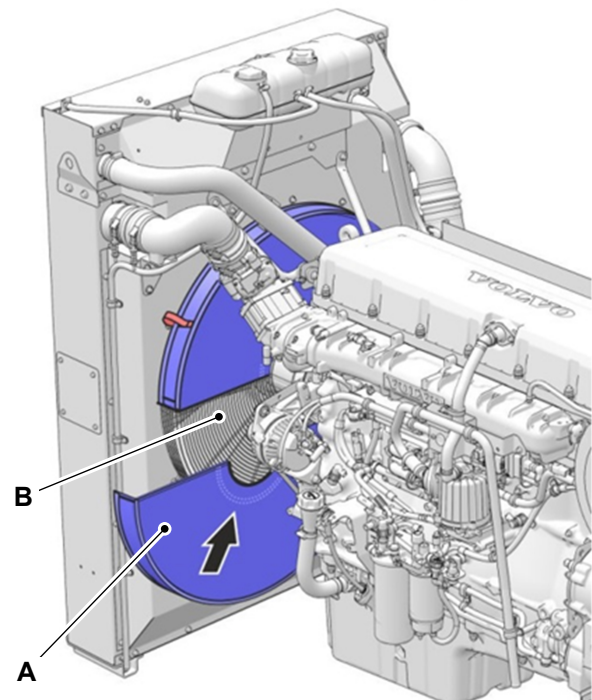
Figure 53.



A Cooling filter cover

3. Turn the half filter until it is able to hang loosely on the fan cover.

Figure 54.



A Cooling filter cover

B Fan cover guard



4. Slide on the other filter half and secure the two halves together with self-affixing Velcro tape. Refer to Figure 52.
5. Fasten the outer Velcro tape around the fan cover guard. Refer to Figure 52.



06 - Expansion Tank

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Introduction

The expansion tank retains coolant that has been forced out of the machines radiator under pressure.

As the machine runs, the temperature of the coolant circulating around the system increases, this causes an increase of pressure in the cooling system. When the pressure builds to a high enough point, the radiator cap allows that pressure to escape into the coolant tank through a rubber overflow tube that is connected from the neck of the radiator to the expansion tank.

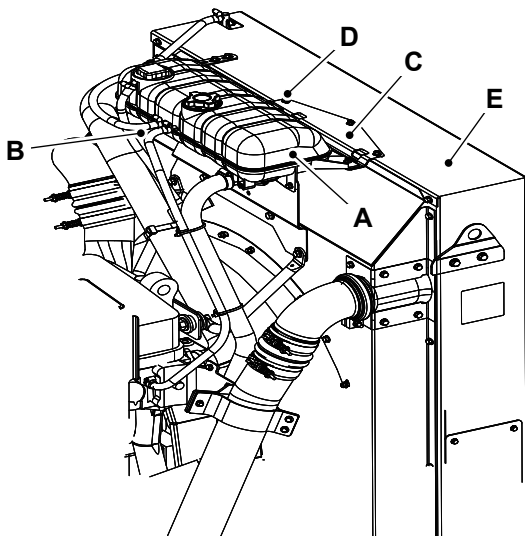
Most of the coolant that is forced into the expansion tank returns to the radiator naturally when the engine is cold.

Remove and Install

Remove

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Put a clean container underneath the expansion tank.
3. Disconnect the hoses from the expansion tank.
4. Put a label on the hoses to help installation.
5. Plug all the open ports and hoses to prevent contamination.
6. Remove the bolts that attach the expansion tank to the radiator.
7. Remove the expansion tank from mounting bracket.

Figure 55.



- A** Expansion tank
- B** Hose
- C** Mounting bracket
- D** Bolt
- E** Radiator

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Tighten the bolts to the correct torque value.



09 - Pump

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Introduction

The coolant pump is a centrifugal type located in the front of the crankcase, driven by the engine drive belt.

The impeller rotates to circulate the coolant through the cooling system. The pump shaft bearing and seal are not renewable.

Operation

The coolant pump is driven via a pulley and front end accessory drive belt, the pump draws coolant from the pump cavity. The coolant is pumped through the outlet gallery to the oil cooler cavity in the left side of the crankcase. As the coolant flows past the oil cooler matrix, heat is exchanged from the oil to the coolant. This enables the oil to function as a coolant as well as a lubricant.



10 - Filter

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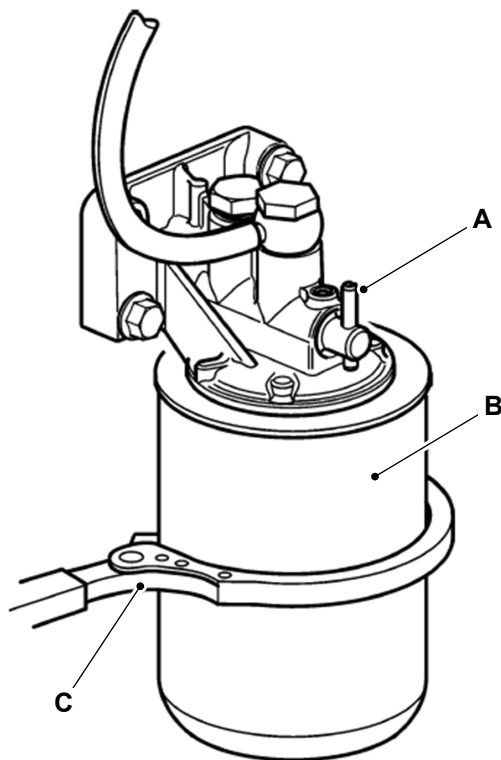
Remove and Install

Remove

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Stop the engine and allow it to cool.
3. Turn the tap to the specified angle to stop the engine coolant flow through the coolant filter.
 Angle: 90°
4. Remove the coolant filter with a suitable extractor.
 - 4.1. Make sure that no residue from the old seal remains in the housing.

2. Put a thin layer of engine coolant on the new coolant filter seal.
 - 2.1. Screw the coolant filter on by hand until the seal comes into contact with the mating surface of the filter bracket.
 - 2.2. Make sure that you tighten the coolant filter half turn only.
3. Turn the tap to the specified angle to release the engine coolant flow through the coolant filter.
 Angle: 90°
4. Check for leaks.
5. Run the engine for a while to increase the coolant temperature to the working temperature and pressure.
6. Stop the engine and check for leaks.

Figure 56.



- A** Tap
B Coolant filter
C Extractor

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.



12 - Thermostat

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Introduction

The thermostat is located between the engine and the radiator. The function of the thermostat is to block the flow of coolant to the radiator until the engine has warmed up to a sufficient temperature.

When the engine is cold, no coolant flows through the engine. Once the engine reaches its operating temperature, generally about 95°C (203°F), the thermostat opens. By letting the engine warm up as quickly as possible, the thermostat reduces engine wear, deposits and emissions.

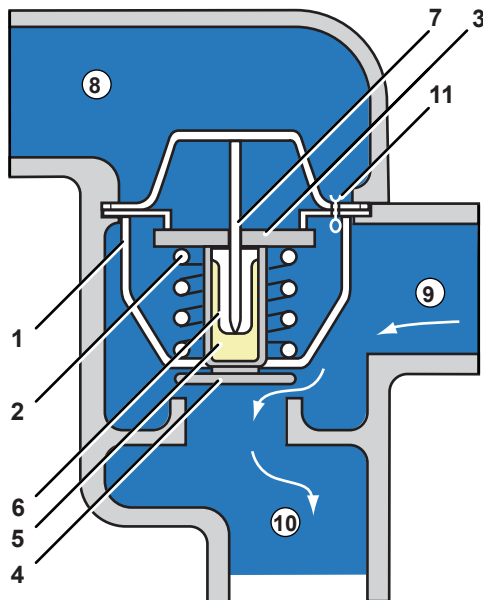
Operation

The thermostat is a wax element type and is configured for by-pass blanking. The thermostat functions as follows:

State A - Closed (Engine Cold)

When the engine is cold the wax pellet has contracted into its housing. This allows the spring to act against the thermostat body and move the valve plate up against its seat, closing the outlet port to the radiator. Since the bottom valve plate is connected to the top valve plate it also moves up, opening the bypass port. The coolant flows from the thermostat housing inlet port into the bypass gallery.

Figure 57.



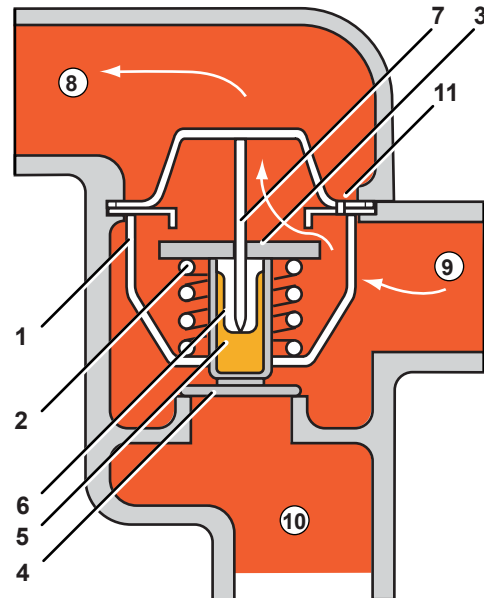
- 1 Thermostat
- 2 Spring
- 3 Top valve plate
- 4 Bottom valve plate
- 5 Wax pellet
- 6 Diaphragm
- 7 Actuating rod
- 8 Outlet port to the radiator top hose
- 9 Inlet port thermostat housing
- 10 Outlet port bypass gallery
- 11 1mm diameter orifice

State B - Open (Engine Hot)

When the engine is hot, the wax pellet melts, as it does so it expands and pushes against the diaphragm. The diaphragm reacts against the actuating rod and both the top and bottom valve plates move down into the thermostat body, compressing spring. The outlet port to the radiator is now open and the bypass port is closed. A 1mm

diameter orifice allows trapped air to be expelled from the system.

Figure 58.



- 1 Thermostat
- 2 Spring
- 3 Top valve plate
- 4 Bottom valve plate
- 5 Wax pellet
- 6 Diaphragm
- 7 Actuating rod
- 8 Outlet port to the radiator top hose
- 9 Inlet port thermostat housing
- 10 Outlet port bypass gallery
- 11 1mm diameter orifice

Check (Condition)

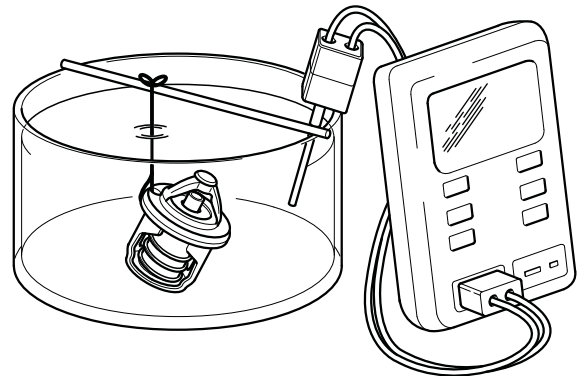
1. If the thermostat is suspected of being faulty, perform a thermostat test, refer to Thermostat - Check Operation to confirm its serviceability. Note that the thermostat is a non-serviceable item. If the thermostat is faulty or damaged it must be renewed.
2. Inspect the seal for damage or splits. If necessary renew the seal. Make sure that the seal is correctly located.

Check (Operation)

A period of 3–5min before the thermostat valve starts to operate is normal because of the time required to heat soak the thermostat.

1. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
2. Remove the thermostat housing and the thermostat. Refer to (PIL 21-12).
3. Suspend the thermostat in a suitable container of coolant. Use an external heat source to gradually increase the temperature of the coolant. Note: When working with boiling water, all the necessary safety precautions must be taken. Refer to Figure 59.

Figure 59.



4. Use a thermometer to measure the temperature of the coolant.
5. When the coolant reaches the operating range of the thermostat the valve should start to open, the movement of the valve plate should be evident.
6. Record the start to open temperature, the fully open temperature and the amount of valve lift travel when fully open. Compare this with the data in Technical Data (PIL 21-00).



93 - Hose

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Introduction

The engine cooling hoses are essential parts of the cooling system. They carry the liquid coolant between the engine and the radiator/cooling pack.

Health and Safety

▲ **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.

Check (Condition)

1. Visually inspect the engine and related cooling components for:
 - 1.1. Leaks.
 - 1.2. Cracked, burnt or perished hoses.
 - 1.3. Hose clips are in good condition and tightened to the correct torque value.



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Acronyms Glossary

AVR	Alternator Voltage Regulator
CAN	Controller Area Network
DC	Direct Current
DEF	Diesel Exhaust Fluid
DLA	Data Link Adaptor
DPF	Diesel Particulate Filter
EAT	Exhaust After Treatment
ECU	Electronic Control Unit
ESP	Emergency Standby Power
GPS	Global Positioning System
LED	Light Emitting Diode
MCCB	Moulded Case Circuit Breaker
RPM	Revolutions Per Minute
SPP	Service Parts Pro
USB	Universal Serial Bus
VIN	Vehicle Identification Number



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Introduction

It is important that the electrical system on the machine is in a sound state of repair.

Make sure that all the health and safety warnings in this section are followed. Before working on any part of the electrical system ensure all correct isolation procedures have been implemented to allow safe working.

Health and Safety

Arc Welding

To prevent the possibility of damage to electronic components, disconnect the battery and the alternator before arc-welding on the machine or attached implements.

If the machine is equipped with sensitive electrical equipment, i.e. amplifier drivers, electronic control units (ECUs), monitor displays, etc., then disconnect them before welding. Failure to disconnect the sensitive electrical equipment could result in irreparable damage to these components.

Parts of the machine are made from cast iron, welds on cast iron can weaken the structure and break. Do not weld cast iron. Do not connect the welder cable or apply any weld to any part of the engine.

Always connect the welder earth (ground) cable to the same component that is being welded to avoid damage to pivot pins, bearings and bushes. Attach the welder earth (ground) cable a distance from the part being welded no more than 0.6 m.

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

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

Technical Data

Table 23.

Multi Switch Position	3	2	1
Frequency	60Hz	60Hz	60Hz
Phases	1	3	3
Output Voltage	240V/120V	208V/120V	480V/277V
Prime	300kW kW 300kVA	500kW 625kVA	500kW 625kVA
Amps	1,250A	1,290A A	753A
Power factor	1	0.8	0.8
Rated Speed	1800 RPM (Revolutions Per Minute)	1800 RPM	1800 RPM
Alternator	ECO40-1.5L/4B	ECO40-1.5L/4B	ECO40-1.5L/4B
Alternator Maximum In- stantaneous Fault Current	16,523A	16,523A	16,523A
Breaker	1,600A/2,000A	1,600A/2,000A	1,600A/2,000A
Sensor Plug	1,600A/2,000A	1,600A/2,000A	1,600A/2,000A
Overcurrent protection (Ir)	1,250A	1,735A	752A
Short circuit protection (I _{sd})	3,750A	5,210A	2,260A
Instantaneous current setting (I _i)	4,800A/4,000A	6,400A/6,000A	3,200A/4,000A
Overcurrent protection time setting (tr)	1s	1s	1s
Short circuit time delay (tsd)	0s	0s	0s

Prime: This rating is for the supply of continuous electrical power, at variable load (70% average), in lieu of commercially purchase power. There is no limitation on the annual hours of operation and 10% over load power can be supplied for 1h in 12h.

Standby: Standby Power (ESP (Emergency Standby Power)) is the maximum output available, for up to 200h per year, where the average load (variable) does not exceed 70% of the standby power rating. No overload is available.

Check (Condition)

1. Switch OFF the generator.
2. Check all the electrical cables for damage.
3. Make sure that no cable terminals are loose. Tighten the terminal nuts to the correct torque value.
4. Check the condition of the cable terminals for corrosion and carbon build-up.
5. Make sure that all electrical cables are free from dirt, dust, oil and grease.
6. Check the condition of the power alternator.
[Refer to: PIL 33-08-00.](#)
7. Check the condition of the starter motor. Refer engine service manual.
8. Check the battery charging voltage.
9. Check readings of the engine sensors.
10. Check the controller for any faults.
11. Check the alternator voltage from phase to phase.
12. Check the alternator voltage from phase to neutral.
13. Check the neutral connection for any leakage in current.
14. Check the operation of the MCCB (Moulded Case Circuit Breaker).
15. If necessary, do the load test of the generator.
16. Check the earth connections for security and correct installation.



50 - Schematic Circuit

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Diagram 33-10

Introduction

A schematic wiring diagram is a simplified pictorial representation of the machine's electrical circuit. It shows the components of the circuit as simplified electrical symbols, and the power and signal connections between the devices. The wiring diagram is used to troubleshoot problems and to make sure that all the connections have been made and that everything is present.

Use the schematics together with the correct electrical harness drawings to reference the connector pin details.

This section may contain more than one set of electrical schematics for different machine variants.

Understanding Electrical Schematics

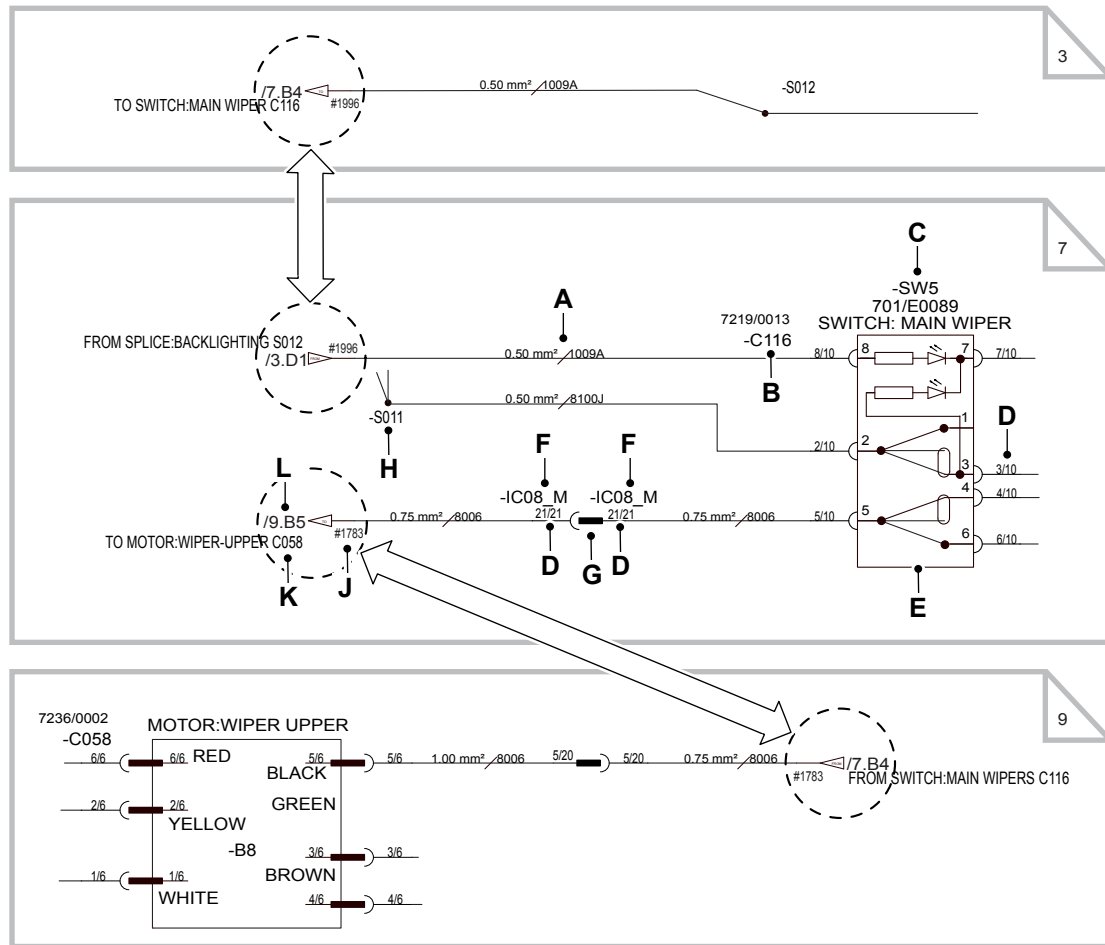
Use the applicable schematic set to trace wires and connections between electrical devices. In most cases it will be necessary to trace wires across more than one schematic sheet.

The example identifies the information contained on the diagrams. It also shows how to follow wires from one diagram sheet to another.

The harness inter-connector codes and device harness connector codes are the same as used on the applicable harness drawings.

Splices are not normally accessible. Splices are inside the harness sheath and not visible on the outside. Wires are welded together at a splice, there are no individual connector components.

Figure 60.



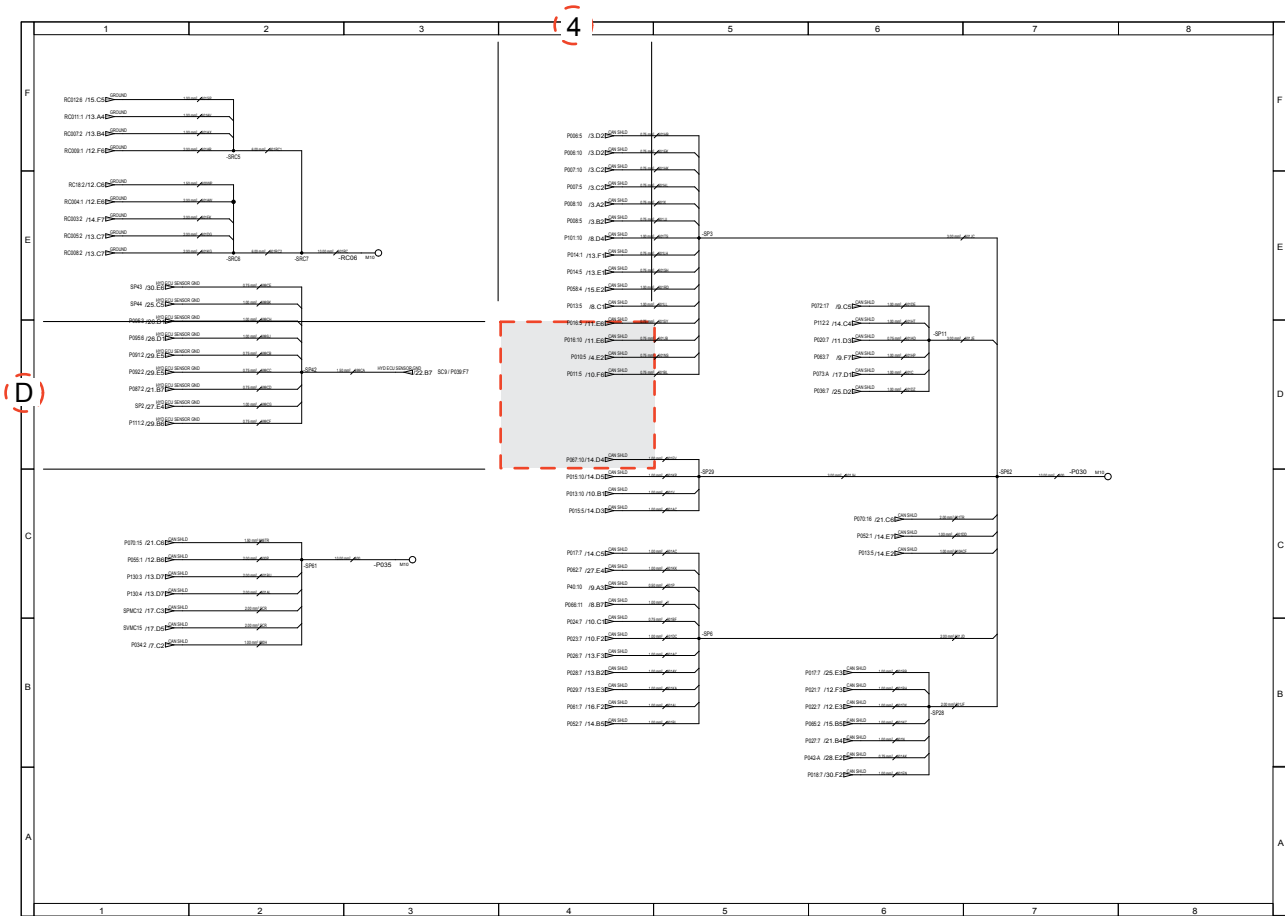
- A** Wire size (area) and number
- C** Device description
- E** Device internal schematic
- G** Harness inter-connector symbol
- J** Destination reference number
- L** Destination (diagram sheet and grid)

- B** Device harness connector code
- D** Connector pin number (wire location / total)
- F** Harness inter-connector codes
- H** Splice code and symbol
- K** Destination (harness connector code)

To help locate a wire destination from other diagram sheets use the grid reference. This identifies the applicable location zone on the sheet in a similar way to a map reference.

Due to space limitations, the grid is sometimes omitted.

Figure 61. Grid reference example (D4)





Diagram

Figure 62. 401/G9343 - Issue 4 (Sheet 1 of 1).....Page 33-11

Figure 62. (Part 1 of 2)

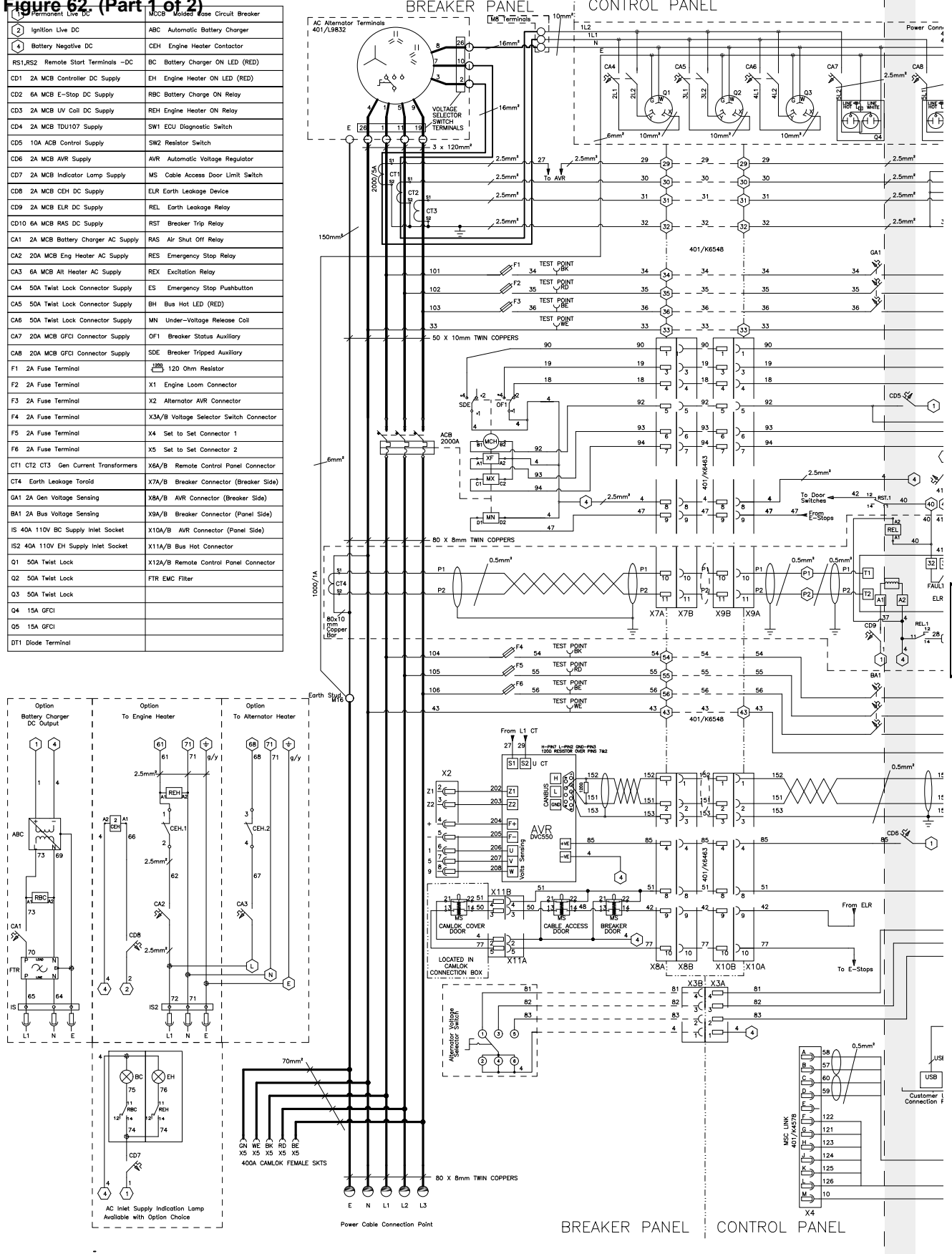
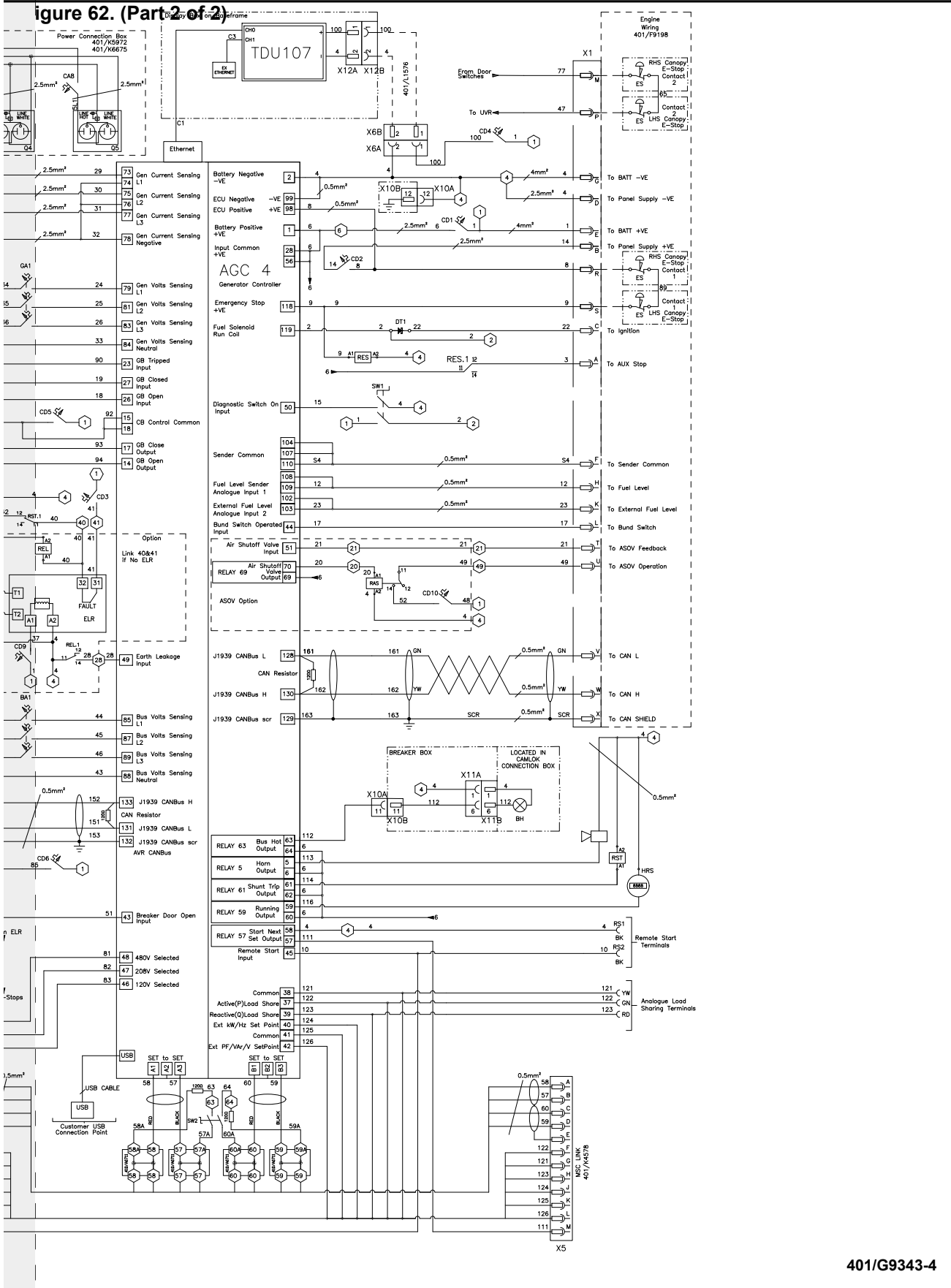


Figure 62. (Part 2 of 2)



401/G9343-4



90 - Earth Point

Introduction

The connection of the equipment to earth shall be the responsibility of the installer and configured to meet the requirements of the specific application and local regulations.



03 - Battery

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00 - General

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Introduction

Batteries used in normal temperate climate applications should not need topping up. However, 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.

Figure 63.



A Maintenance free battery

Maintenance

To make sure that the battery provides optimum performance the following steps should be observed:

- Make sure that the electrical connections are clean and tight. Smear 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.

Health and Safety

▲ 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 5 min before connecting it up.

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

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.

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.

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

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.

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.

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.

Fault-Finding

The most obvious sign of a battery problem is a machine not being able to start. However, because the battery is part of a larger electrical system connected to other parts of the machine, a flat battery may indicate another problem.

If something else is going wrong in the electrical system, for example, a weak alternator, corrosion or loose connections, cold weather starting, electrical equipment being left on without the engine running, interrogate the cause of the problem.

The best way to test the condition of the battery is with an electronic battery tester. Refer to Battery-Check Condition.

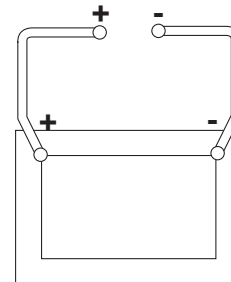
When the machine is not in use, make sure that the electrical system is not causing a drain on the battery. On machines with electronically controlled engines check the operation of the power hold relay. Refer to PIL 33-09-06.

Disconnect and Connect

The battery leads will require connecting on initial installation.

When connecting the battery to the machine, always connect the positive terminal first followed by the negative terminal. When disconnecting, remove the negative first then the positive. These steps will ensure accidental shorting of the battery terminals cannot take place.

Figure 64. 12V System



Check (Condition)

Special Tools

Description	Part No.	Qty.
Battery Tester	400/G9956	1

Introduction

As of July 2019, this procedure must be used for all battery warranty claims. This procedure provides details on the new battery warranty claim criteria and details of how to test the batteries with the new battery tester kit.

To allow for the effective processing of battery warranty claims you must complete the battery test procedure specified in this document before you submit a warranty claim and in the event of claim submission, all the supporting criteria detailed in this procedure for approval should be made available.

Figure 65.



A Battery Tester Kit

Important Information.

- Any claims submitted without all the required criteria to support may be declined.
- All monthly test receipts and machine delivery test receipt should be kept with the machine or vehicle records and should be able to be evidenced in the event of a battery claim submission.

Battery Warranty Claim Adjudication.

Batteries are only warranted against the defects due to faulty workmanship or materials. Battery failures due to poor maintenance or a consequence of other

electrical issues on the machine are not separately claimable.

Note that damaged and leaking batteries are not considered as warrantable defects as such defects do not arise from faulty materials or workmanship. Claims must not be submitted if those are the identified defects. Such claims will get declined.

Batteries must only be returned to JCB Service when requested by the warranty adjudicator.

Important: Any claims submitted without all the below criteria may get declined.

Battery Claim Criteria.

- Images of the machine and battery
- Images of the battery test receipt deeming a 'failed' battery
- Images of the battery test receipt at delivery
- Images of monthly stock check health receipts.

All the criteria should be compiled using the attachment to bulletin (W228) and the pdf attached to the claim.

Battery Maintenance.

Batteries in stock require periodic checking and maintenance, whether on the shelf or in stock.

Dealer Lay-up.

- Upon arrival at your dealership, all machines must have their battery condition checked. The battery must be tested as per this battery test procedure. On the printed test receipt, write the machine serial number, date and sign.
- Important: As best practice for all machines, as of July 2019, the battery test receipt at point of delivery should be retained, even after machine retail.
- Machines in stock must have their batteries tested on a monthly basis. The battery must be tested as per this procedure. On the printed test receipt, write the machine serial number, date and sign.
- If the result deems recharge is required, the battery should be recharged and retested to show successful recharge. Again, on the printed test receipt, write the machine serial number, date and sign.

Important: All monthly battery test receipts should be kept with the machine or vehicle records and should be able to be evidenced in the event of a battery claim submission.

- If a battery is on a machine which is not going to be used for more than one month, it should be disconnected from the machine (Isolated or physically disconnected). Machines have electrical accessories which can slowly discharge the battery even when the ignition key has been removed.

Battery Stock Lay-up.

- Battery stock should be rotated (First in first out - FIFO) to make sure that the customer receives a good quality battery.
- The open circuit voltage of stock batteries should be checked every month (with the use of a digital voltmeter) and the voltage recorded on a ticket (date and voltage and signed) attached to the battery. The results of the test should be retained (by the dealer) upon battery retail for the duration of the battery warranty.
- If a stock battery has a voltage below 12.5V, a fresh recharge must be conducted.
- The battery condition must be checked before hand-over to the customer to make sure that its voltage is 12.5V or more.

Battery Test Procedure.

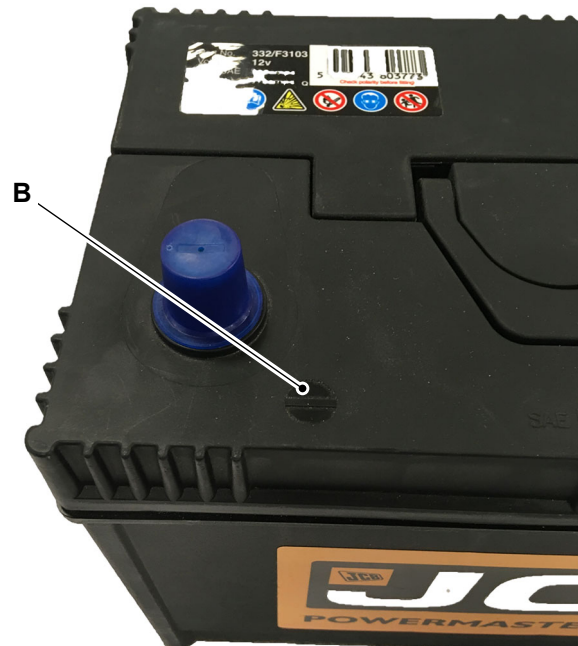
Note: All images are shown as examples. Some machines may require panels to be removed to get access to the battery. Refer to the respective service manual for information on the machine specific battery location to access.

All details on the battery test procedure can also be found in the battery test kit owner's manual. The engineer who completed this test must be familiar with the kit functionality and features.

The engineer who will carry out the procedure must have completed the JCB basic electrics training course to complete this procedure. They must be fully conversant in battery testing, a function of operation and battery lifting/handling.

1. Locate the negative terminal on the battery and identify the terminal by its symbol ('-'). Refer to Figure 66.

Figure 66.



B Negative battery-terminal identification

2. Connect the black clamp from the testing kit to the negative terminal. Make sure that the clamp is fully secured. Refer to Figure 68.
3. Locate the positive terminal on the battery and identify the terminal by its symbol ('+'). Refer to Figure 67.

Figure 67.



C Positive battery-terminal identification

4. Connect the red clamp from the testing kit to the positive terminal. Make sure that the clamp is fully secured. Refer to Figure 68.

Special Tool: Battery Tester (Qty.: 1)

Figure 68.



- D Black clamp
- E Red clamp

5. The display of the battery tester will light up when both cables are connected to the battery.
 - 5.1. If the cables have not been connected to the battery correctly, the test kit will recognise this and ask you to reconnect. Refer to Figure 69. Refer to Figure 70.

Figure 69.



Figure 70.



6. Press the 'Forward' or 'Back' button to select 'BATTERY TEST'. Refer to Figure 71.

Figure 71.



7. Press the 'Enter' button to proceed. Refer to Figure 72.

Figure 72.



8. Select the machine battery type. The JCB batteries are 'Flooded'. Move through the different types using the forward or back arrow buttons. Once selected press 'Enter'. Note: This procedure does not apply to 48V electric machines.
9. Select 'SAE' for the rating option and press 'Enter'.

Figure 73.



10. Set the battery capacity. Refer to Figure 76. This can be found on the battery labelled as 'CCA SAE'. Refer to Figure 74. Refer to Figure 75.

10.1. Press and hold the 'Forward' button until the desired value is selected and press 'Enter'.

Figure 74.

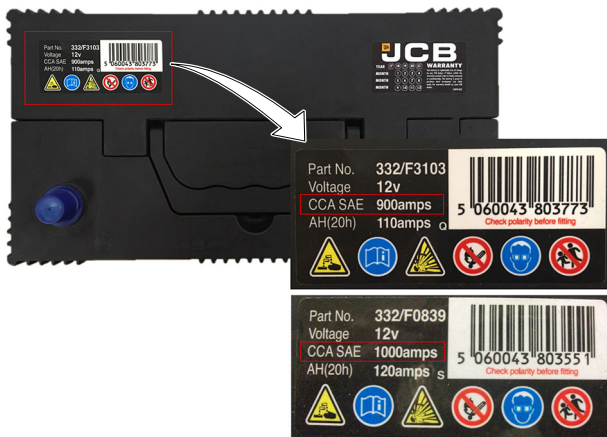


Figure 75.



Figure 76.



11. The battery tester will now perform the test. Once completed, the result will display on the screen. Refer to Table 24.

12. To print the test result, press the 'Enter' button. It will first display the battery resistance. Refer to Figure 77.

Figure 77.



13. Press 'Enter' again, and it will ask 'PRINT RESULT?'. Press the 'forward' button to display 'YES' and press 'Enter'. Refer to Figure 78.

Figure 78.



14. The battery tester should now print the test result. Refer to Figure 79.

Figure 79.

Table 24.

Results	Description
GOOD and PASS	The battery is good and capable of holding charge.
GOOD and RECHARGE	The battery is good but needs to be recharged.
RECHARGE and RETEST	The battery is discharged. The battery condition cannot be determined until it is fully charged. Recharge and retest the battery.
BAD and REPLACE	The battery will not hold a charge. It should be replaced immediately.
BAD CELLS and REPLACE	The battery will not hold a charge. It should be replaced immediately.

Charge

Precautions Before Charging

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

1. Make the machine safe.
Refer to: [PIL 01-03](#).
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 an 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, do the following steps.
 - 6.1. Connect a secondary battery in parallel without disconnecting the vehicle battery from the charging circuit.
 - 6.2. Connect the batteries using suitable jump leads. Connect the positive lead to the positive terminals of both batteries. Connect the negative lead to the negative terminals of both batteries.
 - 6.3. After the jump start, safely disconnect the jump leads and remove the secondary battery.

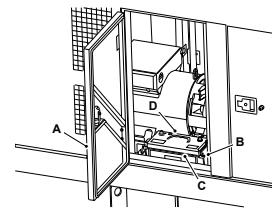
Remove and Install

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

Remove

1. Obey all electrical system health and safety information.
Refer to: [PIL 33-00-00](#).
2. Open the rear right side access panel.
Refer to: [PIL 06-06-00](#).
3. Disconnect the battery cables.
4. Loosen the wing nut (x2).
5. Move the battery strap away from the battery.
6. Remove the battery from the machine.

Figure 80.



- A** Rear right side access cover
- B** Wing nut (x2)
- C** Battery strap
- D** Battery

Install

1. The installation procedure is the opposite of the removal procedure.



03 - Isolator Switch

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Introduction

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.

This machine does have a DEF (Diesel Exhaust Fluid) cycle, which runs after the engine stops and only be interrupted in case of emergency. In normal circumstance wait for 5min after the generator has stopped before you switch OFF the battery isolator.

Disconnect and Connect

▲ 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.

Notice: Do not isolate the machine electrics when the engine is running, this may cause damage to the machine electrics.

The control system is designed such that if the battery isolator is switched off then there is a 2min time delay to de-energise the ECU (Electronic Control Unit) to allow the DEF (Diesel Exhaust Fluid) purge to complete its shutdown cycle.

Disconnect the Machine Electrics:

1. Get access to the battery isolator.
2. Turn the battery isolator key in a counter-clockwise direction and remove.

Connect the Machine Electrics:

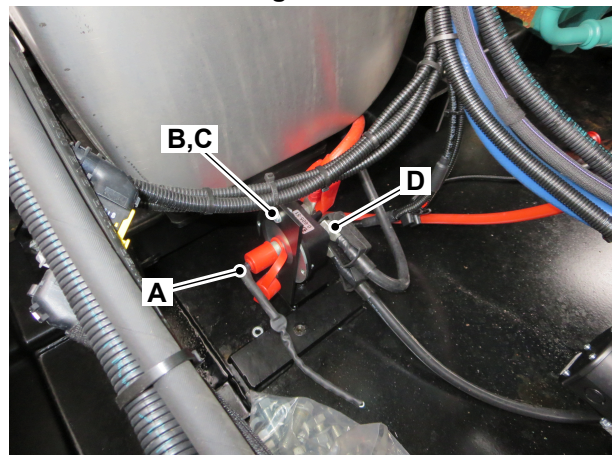
1. Insert the battery isolator key and turn in a clockwise direction.

Remove and Install

Removal

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Open the canopy door.
[Refer to: PIL 06-06.](#)
3. Disconnect the battery leads.
[Refer to: PIL 33-03-00.](#)
4. Remove the nut (x2) and the washer (x2) from the battery isolator switch.
5. Carefully pull out the battery isolator switch from its position.
6. Disconnect the harness (x2) from the battery isolator switch.
7. Remove the battery isolator switch.

Figure 81.



- A** Battery isolator switch
- B** Nut (x2)
- C** Washer (x2)
- D** Harness (x2)

Install

1. The installation procedure is the opposite of the removal procedure.

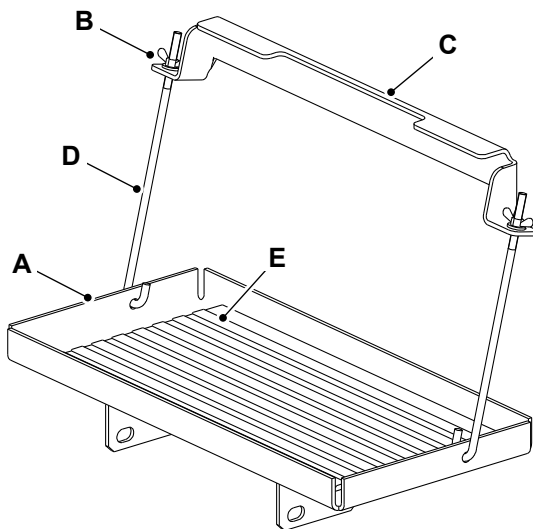
24 - Tray

Remove and Install

Remove

1. Obey all electrical system health and safety information.
[Refer to: PIL 33-00-00.](#)
2. Open the rear right side access panel.
[Refer to: PIL 06-06-00.](#)
3. Remove the battery.
[Refer to: PIL 33-03-00.](#)
4. Remove the wing nut (x2).
5. Remove the battery strap and the J bolt.
6. Remove the nut and bolts from the battery tray.
7. Remove the matt.
8. Remove the battery tray from the machine.

Figure 82.



- A** Battery tray
- B** Wing nut (x2)
- C** Battery strap
- D** J bolt (x2)
- E** Matt

Install

1. The installation procedure is the opposite of the removal procedure.



08 - Power Alternator

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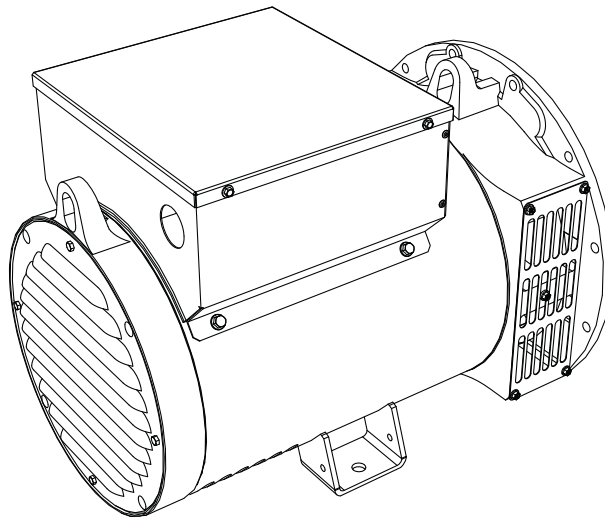
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Introduction

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 83.

Health and Safety

▲ **WARNING** Suitable grounding of the product provides extra safety. The international electric code requires that the product is properly connected to an appropriate earth to help prevent electric shock. A suitable terminal is located on the generator for this purpose. For remote grounding connect a length of heavy gauge copper wire from the product terminal to a copper rod driven into the ground. (cable and rod not supplied). Never operate electrical equipment with damaged or defective cables.

WARNING Working with equipment that runs on Alternating Current (AC) could be dangerous. Any maintenance work on such equipment should be done by an authorised electrical engineer or a suitably trained person. All maintenance work must comply with ISO 60204-1 in Europe.

CAUTION You or others could be seriously injured by rotating parts if the alternator drive belt cover plate is not installed. Always install the cover plate before starting the engine.

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.

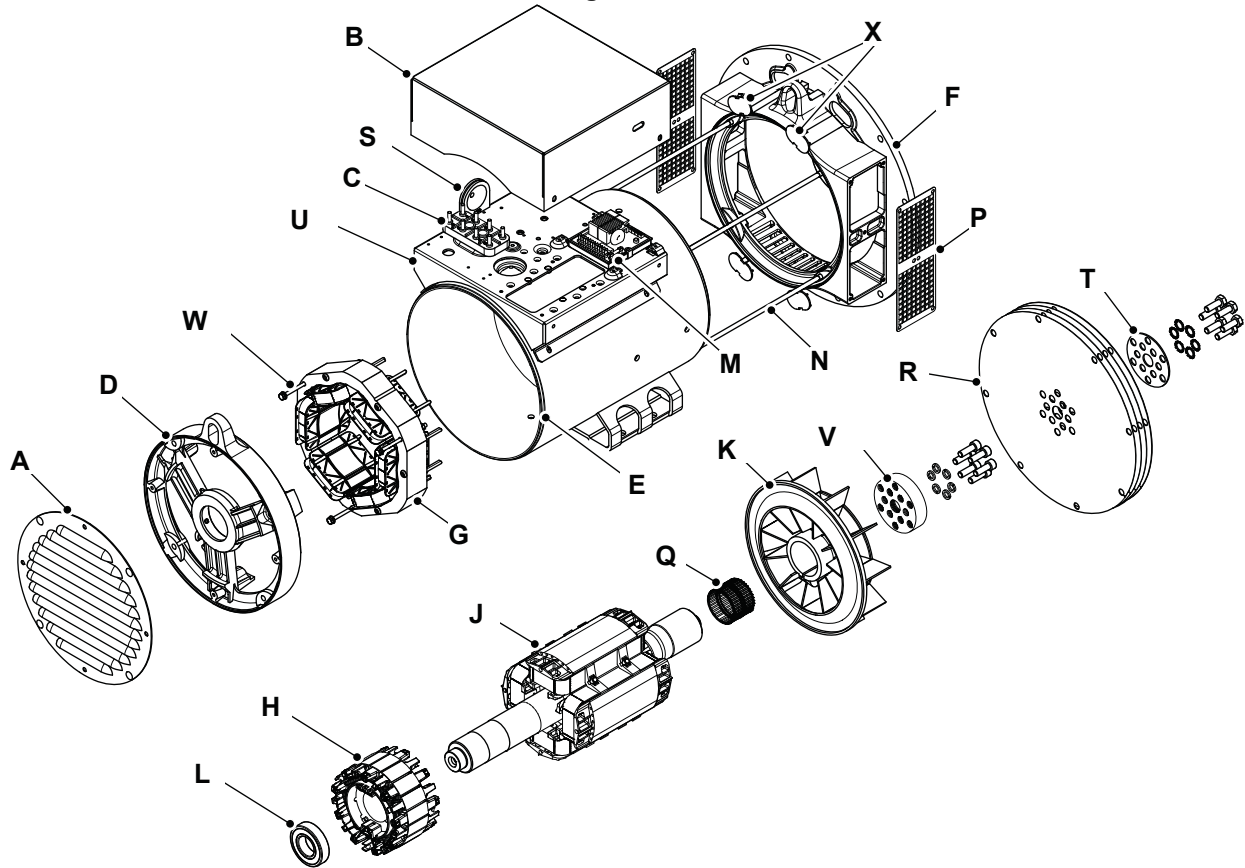
Notice: The engine or certain components could be damaged by high pressure washing systems; special precautions must be taken if the engine is to be washed using a high pressure system. Ensure that the engine air intake, alternator, starter motor and any other electrical components are shielded and not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

Notice: The engine and other components could be damaged by high pressure washing systems. Special precautions must be taken if the machine is to be washed using a high pressure system.

Make sure that the alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system. Do not aim the water jet directly at bearings, oil seals or the engine air induction system.

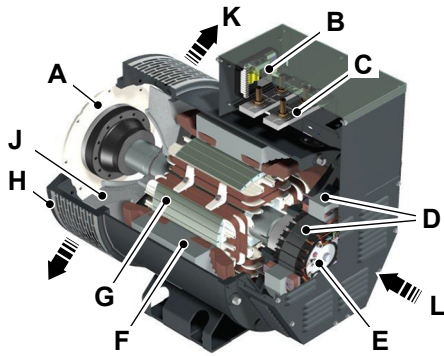
Technical Data

Refer to: [PIL 33-00-00](#).

Component Identification
Figure 84.


- A** Rear seal
- C** Terminal board 6 pin
- E** Frame and stator
- G** Exciter stator
- J** Rotor assembly
- L** Rear bearing
- N** Cover stay bolt
- Q** Fixing ring
- S** Cable grommet
- U** Component carrying panel
- W** Exciter stay bolt

- B** Terminal box cover
- D** Non drive end bracket
- F** Drive end bracket
- H** Exciter armature
- K** Fan
- M** Electronic regulator
- P** Protection screen
- R** Coupling disc plates
- T** Disc blocking ring spacer
- V** Ring Spacer
- X** Bracket cap

Figure 85. Alternator Assembly


- A Engine flywheel coupling
- B DSR
- C Terminal block connections
- D Exciter rotor and stator
- E Rectifier diodes
- F Main stator
- G Main rotor
- H Fan guard
- J Fan
- K Airflow outlet vent
- L Airflow inlet vent

Fault-Finding

Fault

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Table 25. No voltage builds up while starting

Cause	Remedy
Lack of residual magnetism	Connect a new battery of the specified voltage to terminals E+ and E-, respecting the polarity, for the specified time. Voltage: 4–12V
Faulty diodes	
Revolving field coil open circuit	
Faulty AVR	
Field winding open circuit	
Revolving field coil open circuit	

Table 26. Voltage too low

Cause	Remedy
Faulty DSR	Check the drive speed.
Field winding short circuited	
Rotating diode burn out	
Incorrect winding resistance	
Incorrect drive speed	

Table 27. Voltage too high

Cause	Remedy
Faulty DSR	Adjust the DSR voltage potentiometer.

Table 28. Unstable voltage

Cause	Remedy
Incorrect speed and irregular cycle	Adjust the DSR stability potentiometer.
Loose connections	
Faulty AVR	
Speed too low when on load	

Table 29. Voltage correct at no load and too low when on load

Cause	Remedy
Incorrect speed	Run at no load and check the voltage between E+ and E- on the DSR.
Faulty rotating diodes	
Short-circuit in the revolving field coil	
Faulty exciter armature	

Table 30. Voltage disappears during operation

Cause	Remedy
Exciter winding open circuit	Check the AVR, the surge suppressor and the rotating diodes. If necessary, replace them.
Faulty exciter armature	
Faulty AVR	
Revolving field coil open circuit or short-circuited	

Table 31. Faulty bearing

Cause	Remedy
Excessive temperature rise in one or both bearings (bearing temperature more than 80°C) with or without abnormal bearing noise	If the bearing has turned blue or if the grease has turned black, change the bearing.
	Make sure that the bearing is not fully locked (abnormal play in the bearing cage).
	Check the end shield alignment (flange is not properly installed).

Table 32. Abnormal temperature

Cause	Remedy
Excessive temperature rise in alternator case (more than 40°C above ambient temperature)	Air flow (intake-outlet) partially clogged or hot air is recycled from the alternator or the engine.
	Alternator operates at a high voltage (greater than the specified value of unload) Percentage: 105%
	Make sure that the alternator is not overloaded.

Table 33. Vibration

Cause	Remedy
Excessive vibration	Check for the coupling misalignment.
	Check for the defective mounting or play in the coupling.
	Check for the rotor balancing fault (Engine-Alternator).
Excessive vibration and humming noise coming from the machine	Check for the phase imbalance.
	Check for the stator short-circuit.

Table 34. Abnormal noise

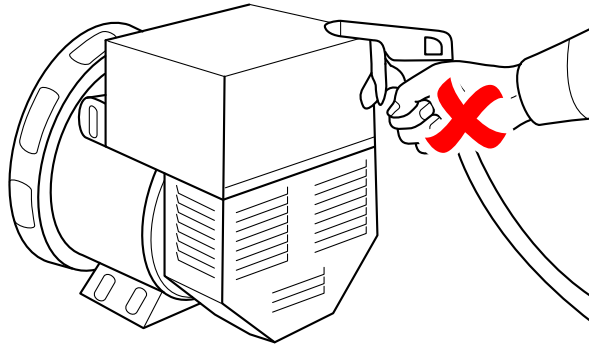
Cause	Remedy
Alternator damaged by a significant impact, followed by humming and vibration	Check for the system short-circuit.
	Check for the misalignment.
	Check for the broken or damaged coupling.
	Check for the broken or bent shaft extension.
	Check for the shifting and short-circuit of the revolving field winding.
	Check condition of the fan.
	Check condition of the rotating diodes or AVR.

Clean

Before you approach or touch the alternator, make sure that it is not live and it is at room temperature;

at this stage it is possible to clean the outside using compressed air.

Figure 86.

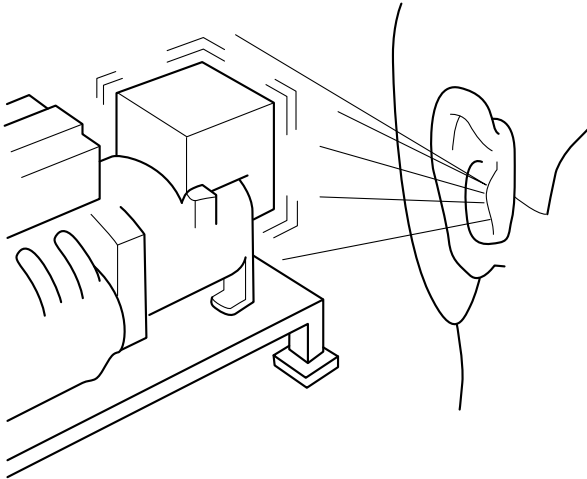


Never use liquids or water. Do not clean inside electrical components with compressed air, this may cause short circuits or cause damage.

Check (Condition)

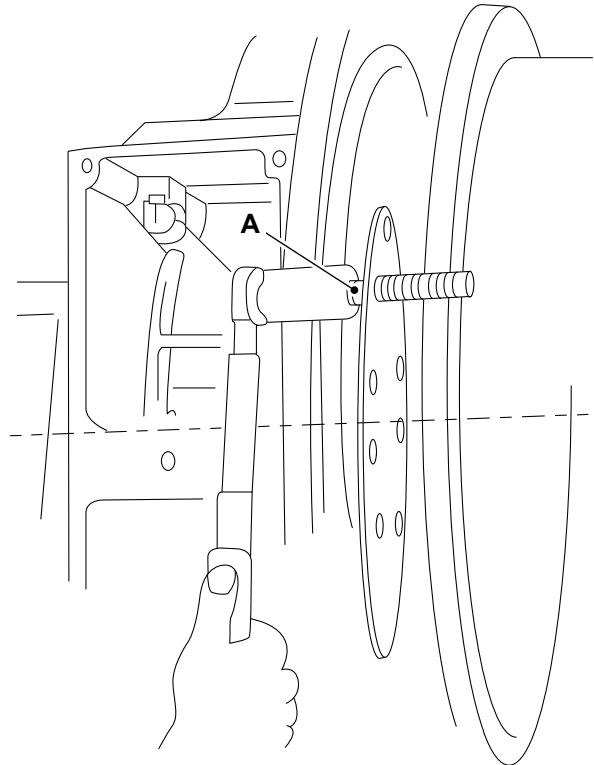
1. Check the machine for unusual noises and vibrations.
 - 1.1. If there are noises and vibrations then it indicates that the bearings are damaged.
 - 1.2. Make sure that the coupling is aligned correctly and it is not damaged.
 - 1.3. Make sure that there is no stress on the combustion engine.
 - 1.4. Make sure that the vibration mounts are not damaged.
 - 1.5. Check the performance data and make sure that it is similar to the data on the generator's plate.

Figure 87.



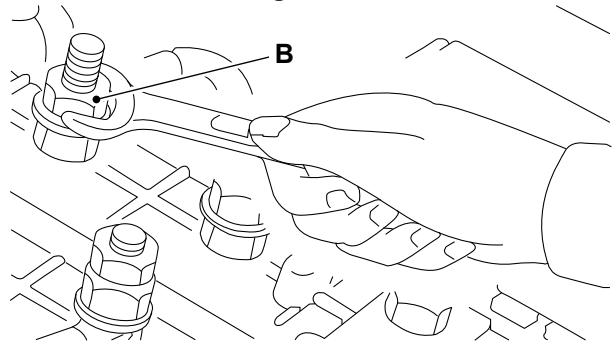
2. Check the electrical connections.

Figure 88.



A Bolt - Alternator to engine flywheel

Figure 89.



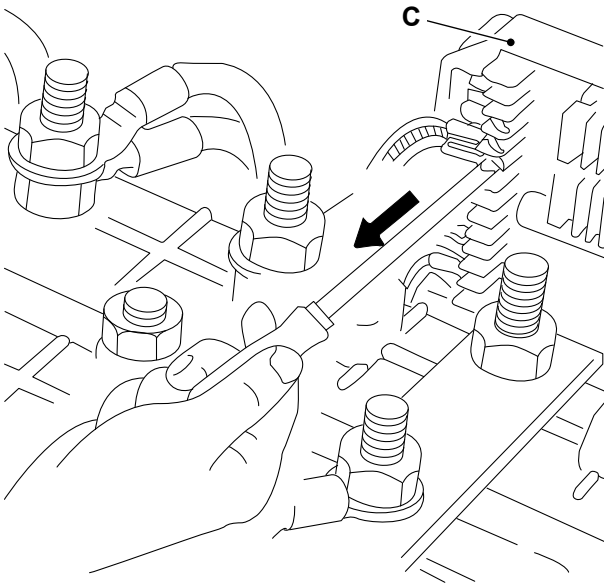
B Terminal nut

- 2.1. Make sure that there is no voltage when you check the electrical connections.

Check windings condition after long period of storage or inactivity.

1. Measure the insulating earth resistance with the megger device or a similar device to estimate the condition of the windings.
2. Disconnect the voltage regulator. Refer to Figure 90.

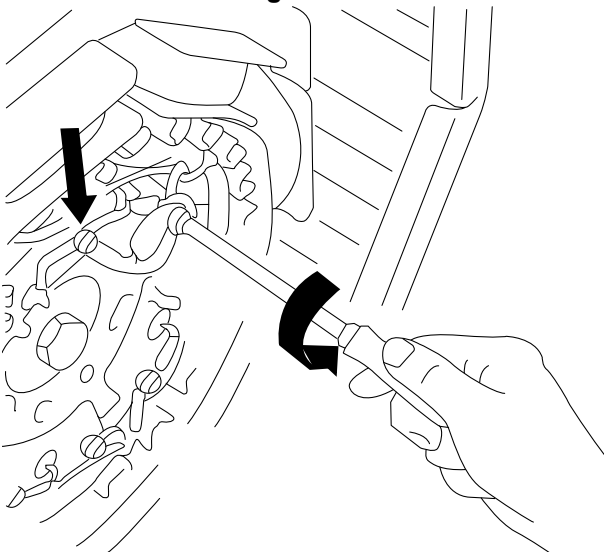
Figure 90.



C Voltage regulator

3. Disconnect the rotating diode bridge. Refer to Figure 91.

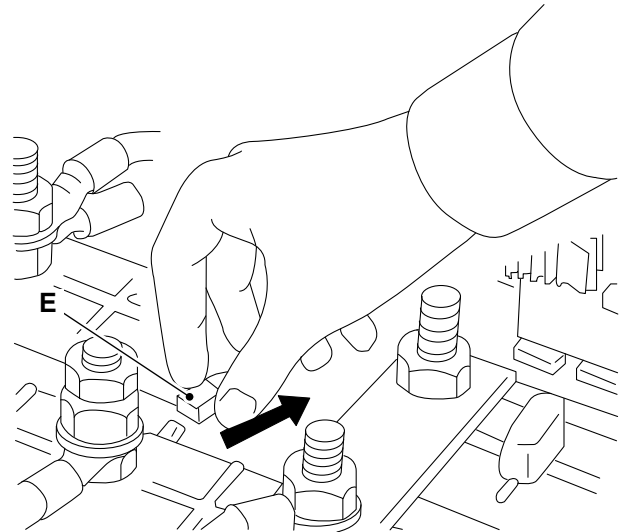
Figure 91.



D Rotating diode bridge

4. Disconnect the radio interference filter. Refer to Figure 92.

Figure 92.



E Radio-interference filter

5. Check if there is any other device connected to the windings before you get the measurements.
6. Make sure that the measured earth resistance of the windings is more than the specified value. If the resistance is less than the specified value then the windings must be sufficiently dried up.

Resistance: 10,000,000Ω

Check (Operation)

The following section involves testing of LIVE equipment and should only be carried out if the machine cannot be tested in a safer manner. Any testing should be in accordance with local site rules for testing LIVE systems.

1. Obey all electrical system health and safety information.

Refer to: PIL 33-00-00.

2. Test the main stator as follows:

- 2.1. Use a multimeter to check all the 3 phases.
- 2.2. Make sure that the voltage must be balanced phase to phase within the specified value.

Percentage: 1%

Figure 93.

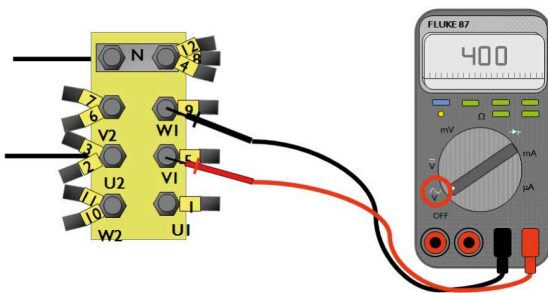


Figure 94.

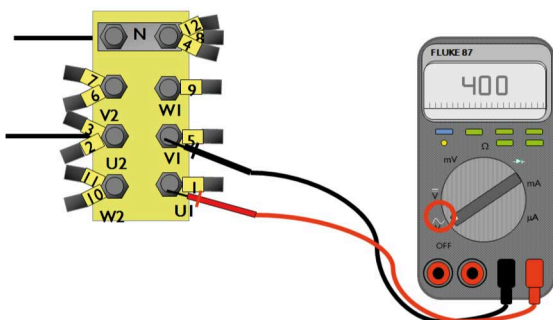
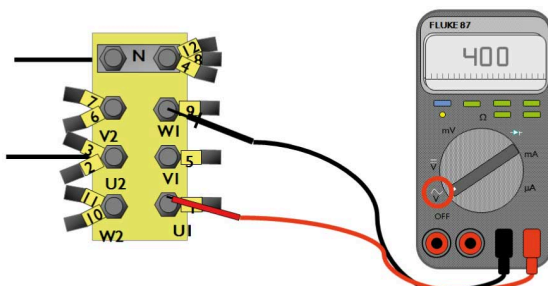


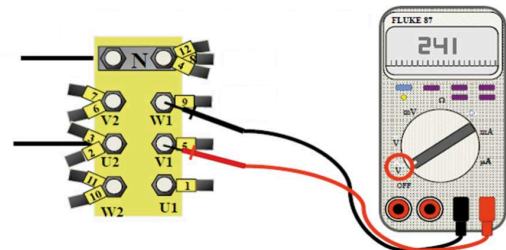
Figure 95.



- 2.3. If the voltage is unbalanced phase to phase at the specified value, it indicates a fault in the main stator windings.

Percentage: 10%

Figure 96.



- 2.4. Disconnect all the external leads from the generator and repeat the tests.

Figure 97.

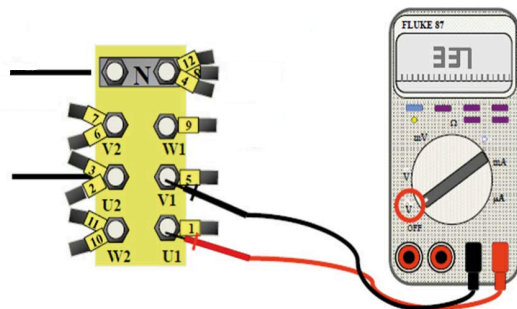
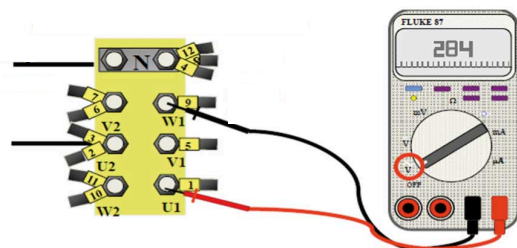


Figure 98.



- 2.5. Make a note that if the voltages are still unbalanced, it indicates that the main stator is faulty.

3. Make a note of the symptoms of the main stator failure as follows:

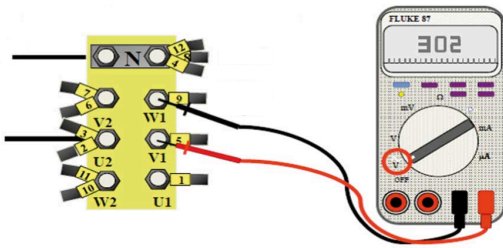
- 3.1. The output voltage will be unbalanced, phase to phase or neutral.
- 3.2. If separately excited with a battery, the engine will appear to be 'loaded'. This results from the short circuit current in the winding fault.
- 3.3. If the generator runs for a short period, the fault area in the windings area will become very hot. This can be detected by hand, or from the insulation burning (smell).

4. Test the windings and the main rectifier as follows:

- 4.1. If the voltages PH and -PH are balanced, it indicates that the main stator is ok.
- 4.2. If the voltages are lower than the specified value below the nominal, it indicates that there is a fault on the diodes or excitor rotor windings.

Percentage: 10%

Figure 99.



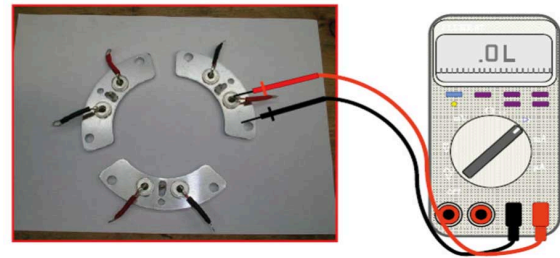
5. Make a note of the symptoms of the diode failure as follows:

- 5.1. The voltage will be low while separately exciting with a specified value battery.
Voltage: 12V
- 5.2. A self excited DSR system may not build up voltage or run up.
- 5.3. Auxiliary winding powered DSR system voltage starts to reduce gradually with continuous indication of overload indicator when the load is applied (depending on how many diodes have failed).
- 5.4. When faulty, diodes become short-circuit.
- 5.5. If two or more diodes short-circuit, it overheats the excitor rotor.
- 5.6. A short circuit diode melt its solder terminal.

6. Test the main rectifier diodes as follows:

- 6.1. Switch the multimeter to "diode" test position.
- 6.2. Make a note that with the positive test lead on the cathode side of the diode, the meter must give a reading that indicates the electron flow.

Figure 100.



7. Make a note of the symptoms of Varistor failure as follows:

- 7.1. If the Varistor fails, the device short-circuit.
- 7.2. The Varistor will fail catastrophically (explode).
- 7.3. On a self excited DSR system, a short circuit Varistor will prevent the voltage build up on the initial start-up.
- 7.4. On a auxiliary winding powered DSR system, the auxiliary winding can open circuit the varistor after failure.
- 7.5. The generator will function normally without the varistor.

8. Test the windings and the main rectifier as follows:

- 8.1. Make sure that you identify and correct any faults found with the main stator, diodes or the Varistor.
- 8.2. Make sure that the output voltage from the main stator must be balanced across the phases and within the specified value of the nominal voltage.

Percentage: 10%

- 8.3. If the step 8.2 is correct, it indicates that the windings and diodes are ok.
- 8.4. If the output voltage is low, more than the specified value below the nominal, it indicates a fault in one of the excitation windings.
- 8.5. Check condition of the exciter stator, rotor and the main rotor windings.
- 8.6. Make sure that you check the winding resistance values against the correct values given in the generator operator's manual.

9. Make a note of the symptoms of the excitor stator failure as follows:

- 9.1. If separately exciting with a specified value battery, the generator will produce residual

voltage only. This is due to an open circuit in the windings.

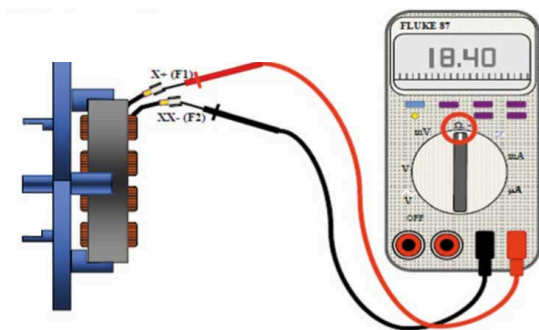
Voltage: 12V

- 9.2. The earth faults in the exciter stator can cause DSR instability, that results in the overheating of the auxiliary winding.
- 9.3. A severe earth fault cause the DSR power diodes to fail, due to excessive leakage current. This also burn out the auxiliary windings.

10. Test the excitor stator as follows:

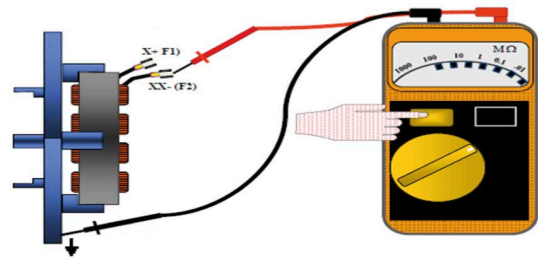
- 10.1. Check the exciter stator resistance across X+ and XX- with a multimeter set on the Ω range.
- 10.2. Make sure that you check for the correct resistance figures given in the operator's and maintenance manual supplied with the generator.

Figure 101.



- 10.3. Check the exciter stator insulation with the specified voltage insulation tester.
Resistance: 500 Ω
- 10.4. Make sure that the minimum insulation value must be of the specified value to earth (ground).
Resistance: 1,000,000 Ω
- 10.5. If the insulation value is less than the specified value, the windings must be cleaned, dried and re-coated with anti-track varnish. If necessary, replace the windings.
Resistance: 1,000,000 Ω

Figure 102.



11. Make a note of the symptoms of the excitor rotor failure as follows:

- 11.1. If separately excited with a specified voltage battery, the voltage is indicated as low.

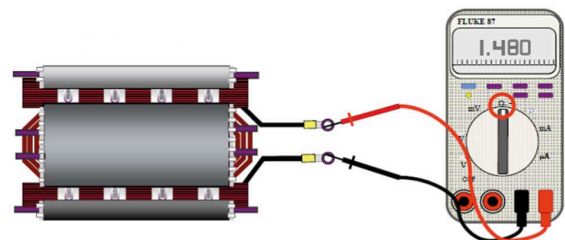
Voltage: 12V

- 11.2. If with a self excited DSR system, the generator may not be able to build up voltage on startup.
- 11.3. If with a auxiliary powered DSR, a short in the exciter rotor may cause repetitive alarming of the DSR overload protection circuit on load.
- 11.4. Make a note that the voltage gradually starts to reduce to protect the winding components.
- 11.5. Make a note that the short circuited diode can damage the exciter rotor windings on the main rectifier.

12. Test the main rotor as follows:

- 12.1. Make sure that you check the main rotor resistance with a multimeter set on the Ω range.
- 12.2. If the resistance readings are low, use a more accurate low resistance bridge meter to further test and confirm the results.
- 12.3. Make a note that the lower resistance will be proportional to the lower voltage.

Figure 103.



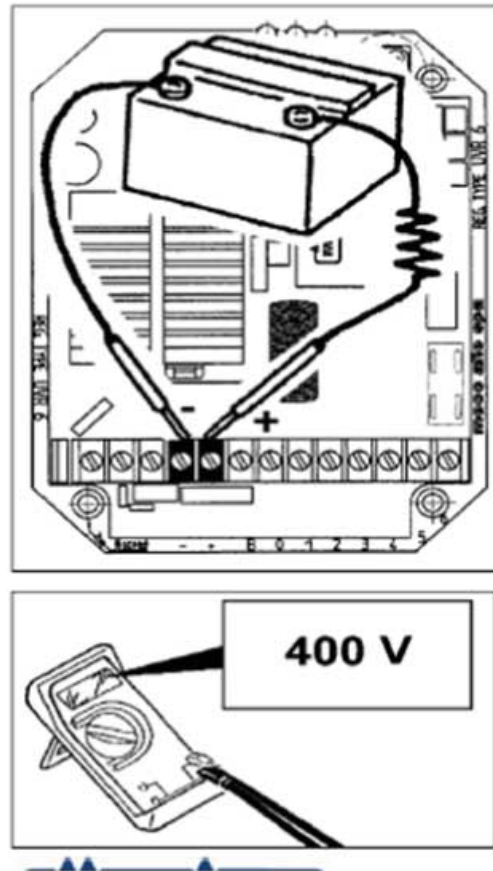
13. Make a note of the symptoms on the loss of residual magnetism as follows:

- 13.1. If separately excited with a specified voltage battery, the generator will appear to give normal voltage (balanced and within 10% of the nominal).
- 13.2. Make a note that the loss of residual magnetism affects self excited DSR control systems only.
- 13.3. Auxiliary winding powered DSR system supports voltage built up during initial start up more effectively than self excited system.
- 13.4. Residual magnetism is stored in the exciter stator core only.
- 13.5. Decay of the residual magnetism can be caused by long storage periods.
- 13.6. Residual magnetism can be destroyed by polarity reversal of the exciter stator (when separately excited with a battery).

14. Check the residual voltage as follows:

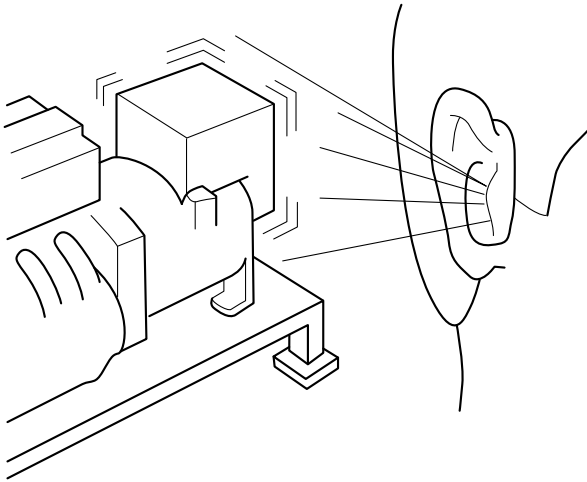
- 14.1. If the generator is switched off, remove the lid from the terminals case regulator.
- 14.2. Connect the two wires to a specified voltage battery with a specified value in series resistance.
Voltage: 12V
Resistance: 30Ω
- 14.3. Follow the electrical diagrams supplied by Mecc Alte, to locate the positive and negative terminals of the electronic regulator.
- 14.4. Start the generator.
- 14.5. Connect, only for a moment, the two wires to the previously located terminals.
- 14.6. Make sure to match the polarities (positive terminal of regulator with positive terminal of battery, negative terminal of regulator with negative terminal of battery).
- 14.7. Use a voltmeter or the right instrument panel, to check whether the generator produces the nominal voltage indicated on the plate.

Figure 104.



15. Check the abnormal noise and vibration as follows:

- 15.1. Make sure that you regularly check the correct function of the generator.
- 15.2. Make sure that there are no anomalous noises or vibrations as their presence indicates damage of the bearings.
- 15.3. Make a note that the alternator itself has no particular vibration since the rotating parts are perfectly balanced.
- 15.4. Make a note that if the rotor balancing has not been altered and the rotor's bearings have not been damaged, vibrations in the generator set may occur due to alignment of the couplings, stress upon the combustion engine or due to the vibration mounts.
- 15.5. Make sure that you check the performance data which must comply with the data on the generator plate.

Figure 105.


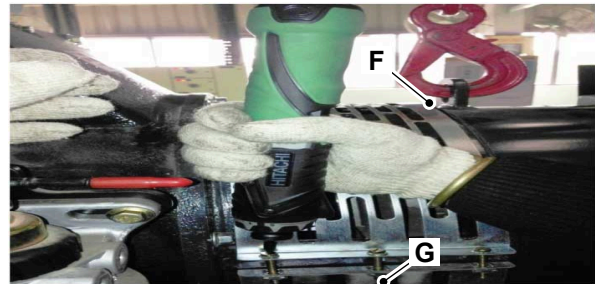
Remove and Install

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.

Remove

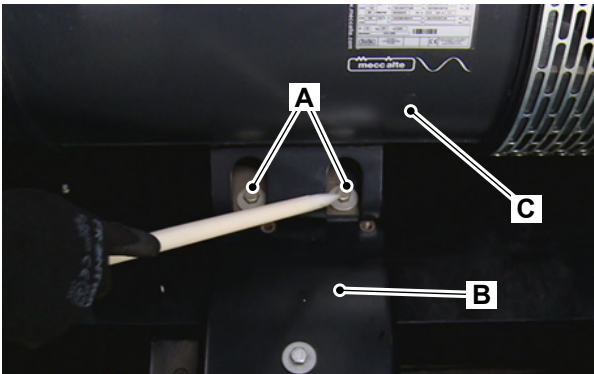
1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Remove the canopy.
3. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
4. Remove the voltage regulator.
[Refer to: PIL 33-08-06.](#)
5. Support the power alternator with suitable lifting equipment.
6. Remove the screw (x3) from the fan guard. Refer to Figure 106.
7. Remove the fan guard from the power alternator.

Figure 106.


- F** Fan guard
- G** Screw (x3)

8. Remove the alternator mounting bolt 1 (x4) that attaches the power alternator to the alternator mounting plate.

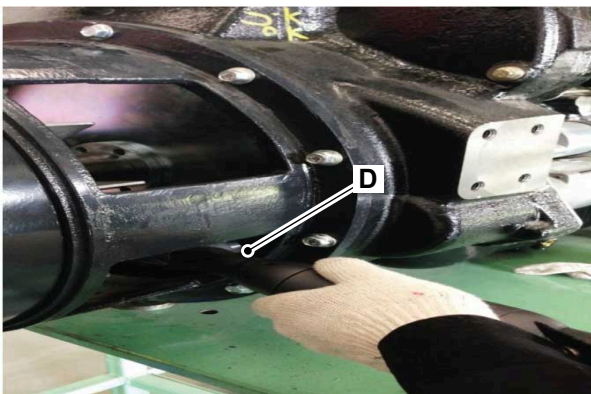
Figure 107.



- A** Alternator mounting bolt 1
- B** Alternator mounting plate
- C** Power alternator

9. Remove the bolt 2 (x8) that attaches the power alternator disc to the flywheel.

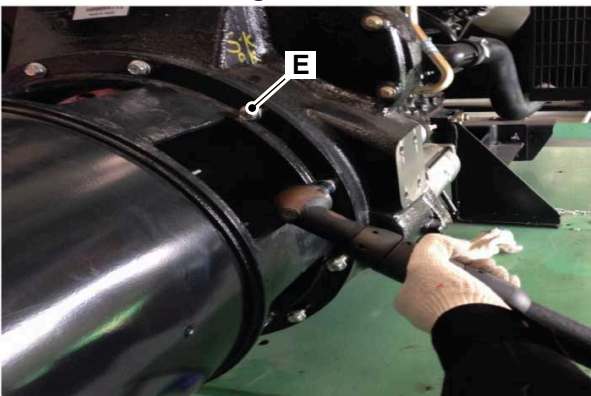
Figure 108.



- D** Bolt 2 (x8)

10. Remove the bolt 3 (x12) that attaches the power alternator to the flywheel housing.

Figure 109.



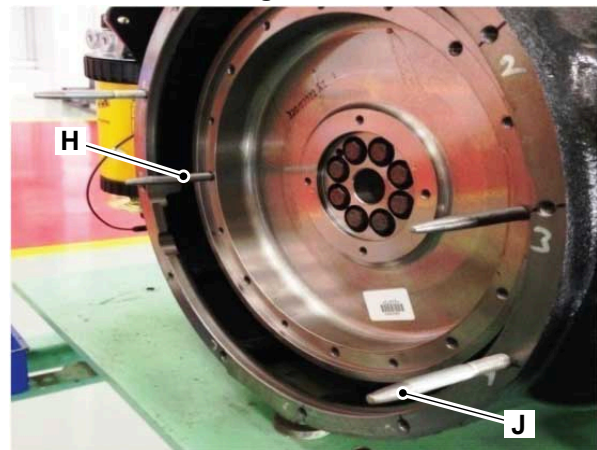
- E** Bolt 3 (x12)

11. Remove the power alternator from the machine.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that the lifting equipment is properly engaged.
3. Position the power alternator at the correct location.
4. Align the power alternator with the flywheel housing through the housing guide pin (x2).
5. Align the power alternator disc with the flywheel through the disc guide pin (x2).

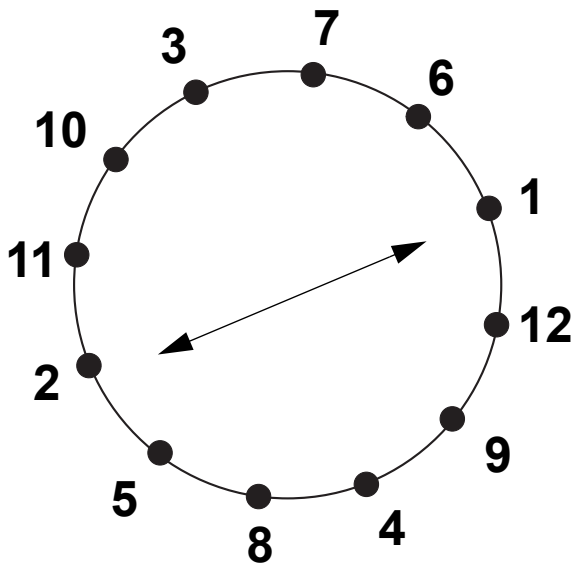
Figure 110.



- H** Disc guide pin (x2)
- J** Housing guide pin (x2)

6. Use a ratchet to diagonally engage and tighten the bolt 3 (x2) that attaches the power alternator to the flywheel housing. Refer to Figure 109.
7. Use the fan rotating tool and engage the bolt 2 (x8) that attaches the power alternator disc to the flywheel. Refer to Figure 108.
8. Remove all the guide pins.
9. Install the remaining bolt 3 (x10).
10. Tighten the bolt 3 (x12) to the correct torque value in the specified sequence. Refer to Figure 111.

Figure 111. Bolt tightening sequence (Power alternator to flywheel housing)



15. Tighten the screw (x3) to the correct torque value.

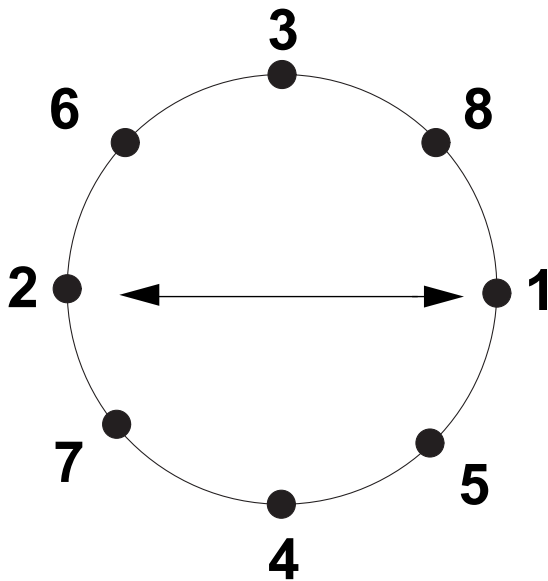
16. Check and mark the alternator mounting bolt 1 (x4).

Table 35. Torque Values

Item	Nm
A	83
D	40
E	47

11. Tighten the bolt 2 (x8) to the correct torque value in the specified sequence. Refer to Figure 112.

Figure 112. Bolt tightening sequence (Power alternator disc to the flywheel)



12. Install the alternator mounting bolt 1 (x4) that attaches the power alternator to the alternator mounting plate.

13. Tighten the alternator mounting bolt 1 (x4) to the correct torque value.

14. Install the fan guard to the power alternator and loosely engage the screw (x3).



06 - Voltage Regulator

Check (Condition)	33-47
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Remove and Install	33-48

Check (Condition)

1. Make the machine safe.
[Refer to: PIL 01-03-27.](#)
2. Obey all electrical system health and safety information.
[Refer to: PIL 33-00-00.](#)
3. Visually inspect the voltage regulator for signs of contamination, dirt and dust.
4. Check condition of the electrical terminals for signs of contamination.
5. Tighten the electrical terminals as required.
6. Make sure that the mounting bolts are correctly tightened.

Check (Operation)

Residual Voltage Check

This check is to make sure that the generator is not over-excited (In such conditions the generator rotates at nominal velocity, the voltage will not be present in the generator's main terminal board).

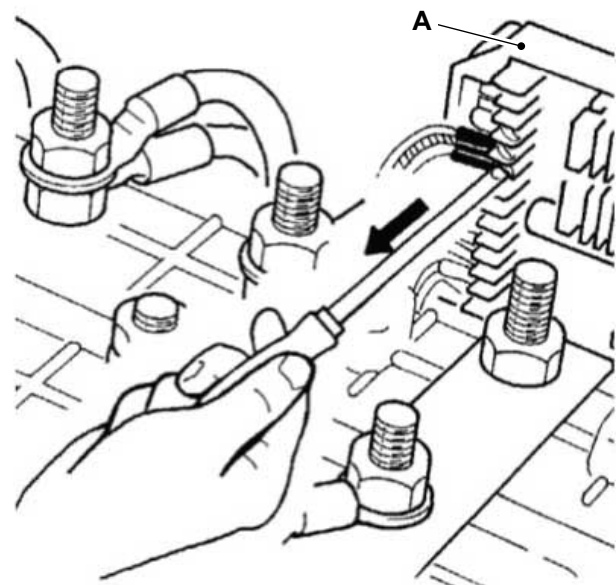
1. Make sure that the generator is switched off.
2. Remove the lid from the terminal case.
3. Connect the connecting wire (x2) to a battery of the specified DC (Direct Current) voltage with a specified in-series resistance.
Voltage: 12V
Resistance: 30Ω
4. Start the generator.
5. Connect the voltage regulator positive terminal with the positive terminal of the battery and the voltage regulator negative terminal with the negative terminal of the battery.
 - 5.1. Make sure you identify the positive and negative terminals of the voltage regulator correctly.
6. Use a voltmeter or the correct instrument panel and check if the voltage indicated on the plate is a nominal voltage.

Remove and Install

Remove

1. Make the machine safe. Refer to (PIL 01-03).
2. Obey all electrical system health and safety information.
3. Open the front right access panel.
4. Disconnect all the terminal board wires. Refer to Figure 113.

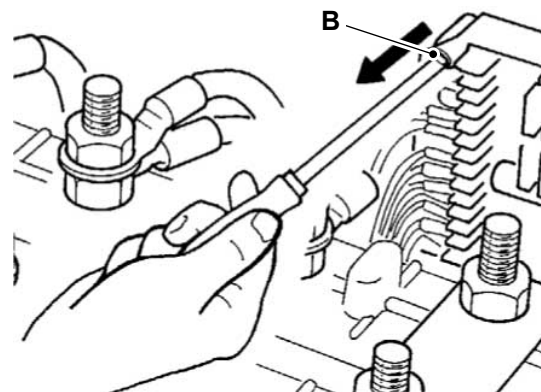
Figure 113.



A Voltage regulator

5. Put a label on the terminal board wires to help installation.
6. Remove the screws from the voltage regulator. Refer to Figure 114.
7. Remove the voltage regulator.

Figure 114.



B Screws



Install

1. The installation procedure is the opposite of the removal procedure.



15 - Diode Bridge

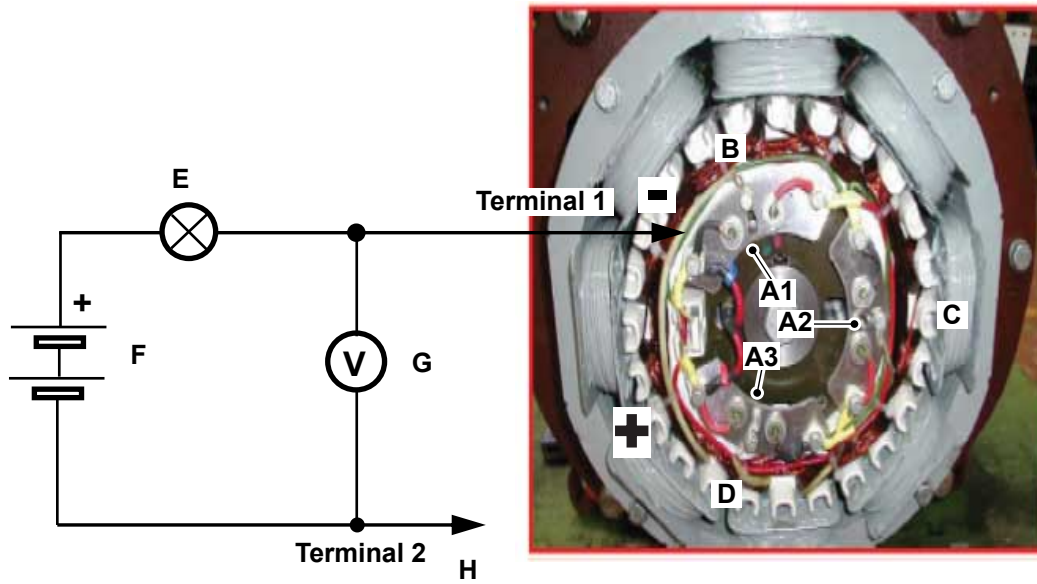
Check (Operation) 33-50
Remove and Install 33-53

Check (Operation)

Test of the diodes on the Negative Terminal

1. Disconnect the cables (x2) that connect the main rotor to the diode bridge.
2. Connect the battery, lamp and the voltmeter as shown in the figure. Refer to Figure 115.
 - 2.1. Use the specified voltage battery.
Voltage: 12V
 - 2.2. Use the lamp of specified value.
Voltage: 12V
Power: 21W
3. Connect the terminal 1 of the lamp to the negative terminal of the diode 1.
4. Connect the terminal 2 of the lamp to the point A1 of the diode 1.
5. Check the readings on the voltmeter.
6. If the voltage is within the specified value then the diode is in good condition.
Voltage: 0.8–1.2V
7. If the voltage is less than the specified value then the diode is in short circuit.
Voltage: 0.6V
8. If the voltage is more than the specified value then the diode is in open circuit.
Voltage: 1.3V
9. Do the step 3 to step 8 for the diode 2 and the diode 3.

Figure 115.



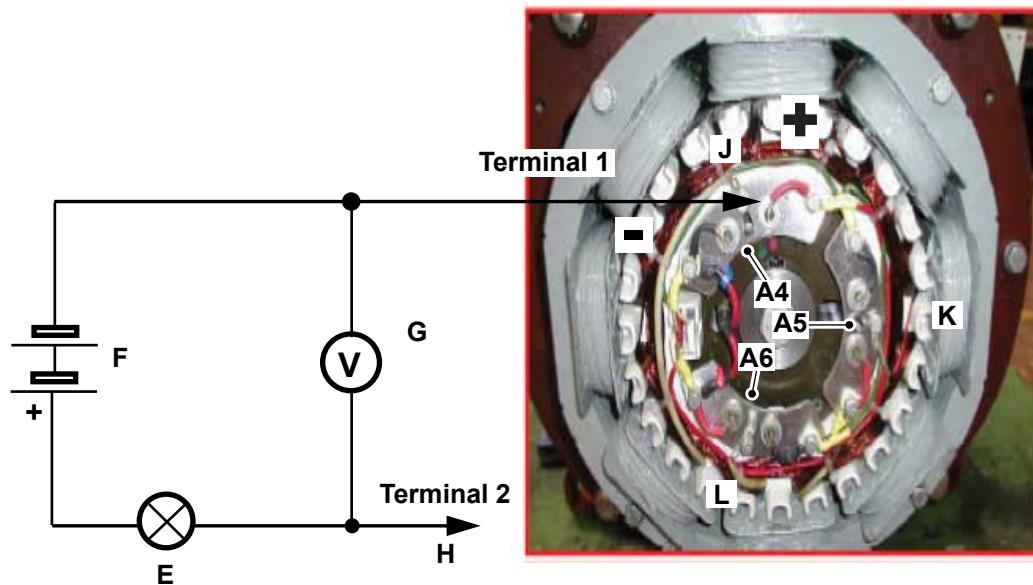
- B Diode 1
- D Diode 3
- F Battery
- H Probe

- C Diode 2
- E Lamp
- G Voltmeter

Test of the diodes on the Positive Terminal

1. Disconnect the cables (x2) that connect the main rotor to the diode bridge.
2. Connect the battery, lamp and the voltmeter as shown in the figure. Refer to Figure 116.
 - 2.1. Use the specified voltage battery.
Voltage: 12V
 - 2.2. Use a lamp of specified value.
Voltage: 12V
Power: 21W
3. Connect the terminal 1 of the battery to the positive terminal of the diode 1.
4. Connect the terminal 2 of the battery to the point A4 of the diode 1.
5. Check the readings on the voltmeter.
6. If the voltage is within the specified value then the diode is in good condition.
Voltage: 0.8–1.2V
7. If the voltage is less than the specified value then the diode is in short circuit.
Voltage: 0.6V
8. If the voltage is more than the specified value then the diode is in open circuit.
Voltage: 1.3V
9. Do the step 3 to step 8 for the diode 2 and the diode 3.

Figure 116.



E Lamp
G Voltmeter
J Diode 1
L Diode 3

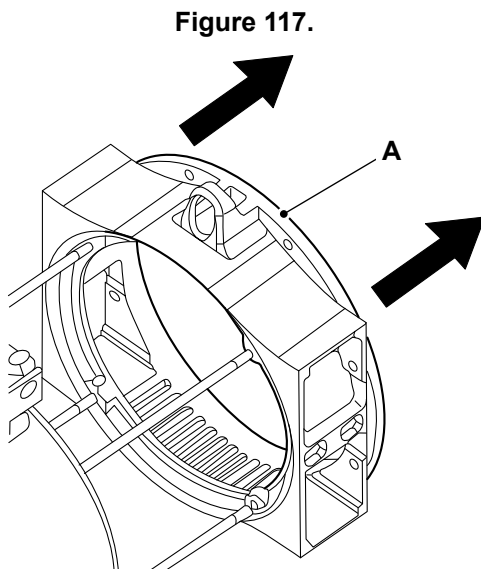
F Battery
H Probe
K Diode 2

Remove and Install

It is necessary to install a new diode if the measured values indicate that the diode is damaged. While you install a new diode do not pull the rheophores out from their locations, cut the rheophores near to the body of the component. Install a new component of the correct polarity and soft solder it accurately with the remaining pieces of the rheophores.

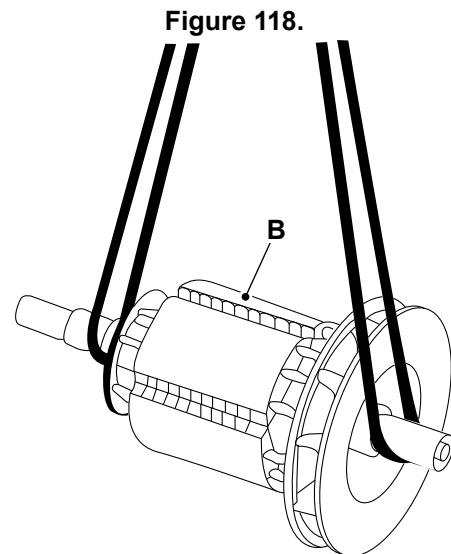
Remove

1. Make the machine safe.
[Refer to: PIL 01-03.](#)
2. Obey all the electrical health and safety information.
3. Remove the power alternator.
[Refer to: PIL 33-08-00.](#)
4. Remove the drive end bracket. Refer to Figure 117.



A Drive end bracket

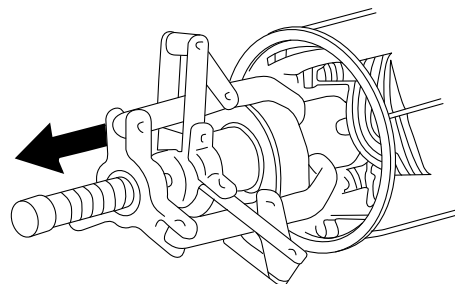
5. Support the rotor assembly with suitable lifting equipment. Refer to Figure 118.



B Rotor assembly

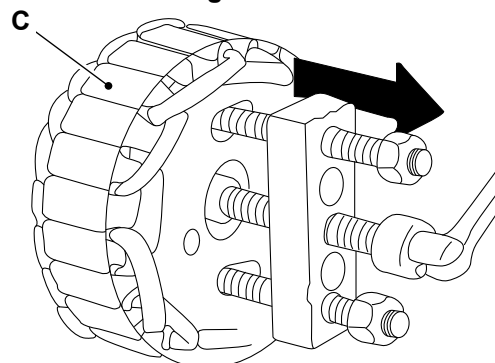
6. Use a suitable puller to remove the bearing. Refer to Figure 119.

Figure 119.



7. Use a suitable puller to remove the exciter armature. Refer to Figure 120.

Figure 120.



C Exciter armature

Install

1. The installation procedure is the opposite of the removal procedure.



09 - Power Distribution

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00 - General

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Health and Safety 33-56

Introduction

The electrical circuits are protected by fuses. If a fuse blows, find out why and rectify the fault before installing a new one.

A full up to date list of fuses and relays and their locations can be found in the relevant operator manual, maintenance section.

Health and Safety

▲ **Notice:** Always replace fuses with ones of correct ampere rating to avoid electrical system damage.

Notice: When installing auxiliary electrical components always ensure that the additional load rating is suitable for that particular circuit. It is unacceptable to simply increase the fuse rating as this can cause overloading and consequential failure of wiring, along with failure of integral circuit components, which the fuse is protecting.



12 - Harness

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Notes:



00 - General

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Diagram 33-63
Repair 33-63
Check (Condition) 33-64

Introduction

Harness Drawings

Drawings are reproduced from production electrical harness drawings. Each harness drawing includes tables showing wire connections and destinations for all the connectors on the harness. To identify the correct harness drawing for a particular machine refer to the relevant Harness Interconnection page for the machine serial number range.

Health and Safety

▲ **Notice:** When installing auxiliary electrical components always ensure that the additional load rating is suitable for that particular circuit. It is unacceptable to simply increase the fuse rating as this can cause overloading and consequential failure of wiring, along with failure of integral circuit components, which the fuse is protecting.

Harness Repair (Butane Heater)

▲ **WARNING** In addition to the warnings incorporated into this procedure, extreme care should be taken when handling the gas heating tool to ensure that the flame does not damage or set fire to any items in the vicinity of the repair, i.e. other wires, floor panels, floor mats, sound proofing, paintwork, etc. This tool should not be used in any restricted location prohibiting the use of "Naked Flames" or where risk of explosive gas or similar safety parameters apply. No other heat source should be used to attempt a sealed joint.

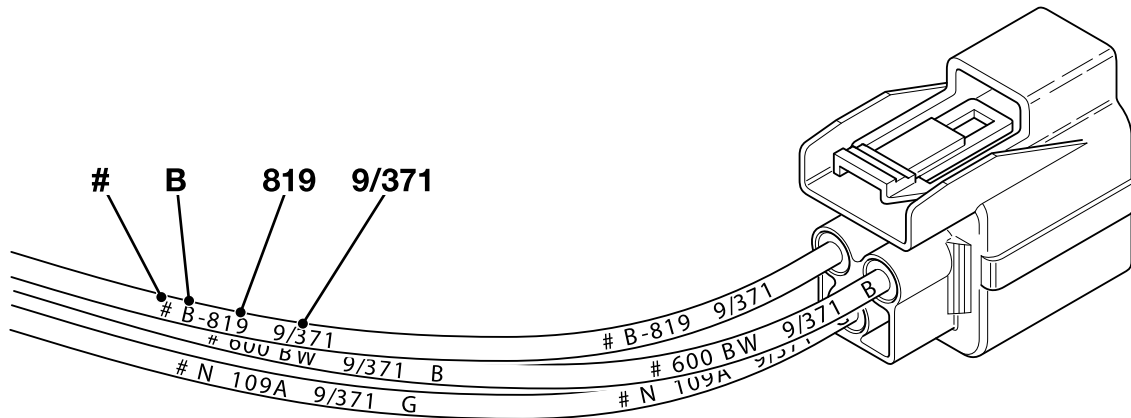
CAUTION When the heater is in use, the reflector and the air coming out are extremely hot. Keep away to avoid accidental burns. Do not touch the reflector until it has had time to cool down after switching off. If flame reappears at the reflector when the heater is in use, the catalytic element is damaged or used up. Stop work immediately and replace the heater.

Component Identification

Wire and Harness Number Identification

This section details the allocation of wire numbers and the identification of wires in the wiring harness.

Figure 121.



The illustration shows a typical connector and wires. Each wire has an individual identification number permanently marked on it, at regular intervals along its length. The number stamped on the wire identifies the following:

Table 36. Wire and Harness Number Identification

Identification Number	Description
#	The # indicates the start of the identification number. It is always printed to the left of the identification number.
B	If applicable - The colour of the flying lead that the harness wire should mate with. For instance, if wire 819 from harness 719/37100 mated with a flying lead coloured black (colour code B) then the number printed on the wire would be B-819 9/371.

Identification Number	Description
819	The wire's unique identification number. The wire functions and numbers allocated to them are consistent throughout the JCB range of products. Refer to Wire Numbers and Functions.
9/371	If applicable - The part number of the harness that the wire originates from. If the harness part number is 719/37100, the number printed on the harness wires will be 9/371 (71 and 00 are common numbers and therefore deleted).

Wire Numbers and Functions

Table 37. Wires 000-199, 1000-1999 (These numbers are reserved for ignition feeds, heater start circuits and start circuits)

Wire Number	Description
Wires 000 - 099	Unfused ignition feeds
Wires 100 - 199 and 1000 - 1999	Fused ignition feeds (feeds via ignition relays are also classed as ignition feeds). Power supplies output by a control module.

Table 38. Wires 200-399, 2000-3999 (These numbers are reserved for battery feeds)

Wire Number	Description
Wires 200-299 and 2000-2999	Unfused battery feeds. Power supplies output by a control module.
Wires 300-399 and 3000-3999	Fused battery feeds. Power supplies output by a control module.

Table 39. Wires 400-599, 4000-5999

Wire Number	Description
Wires 400-599 and 1000-5999	These numbers are reserved for instruments, sensors and variable input/output signal wires used in electronic systems. CAN wires also use numbers in this series.

Table 40. Wires 600-799, 6000-7999

Wire Number	Description
Wires 600-799 and 6000-7999	These numbers are used for earth wires. When the number is printed on to a wire it is prefixed by the Earth symbol. This symbol is printed onto the wire, it may however be omitted from harness drawings. Where a load is switched negative, the wire number from the load to the switch shall be different to that of the wire from the switch to the earth.

Figure 122.

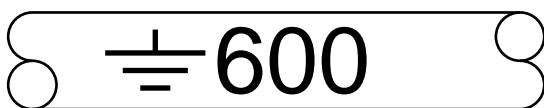


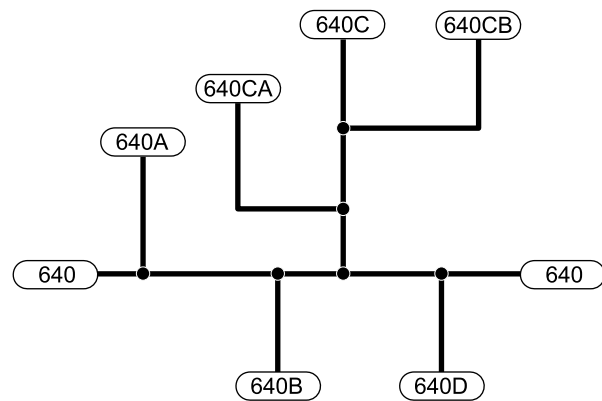
Table 41. Wires 800-999, 8000-9999

Wire Number	Description
Wires 800-999 and 8000-9999	These numbers are reserved for switched supplies to electrical loads, i.e. to lights, etc. Power supplies output by a control module.

Table 42. Wires In Splices

Wire Number	Description
Various	The main input wire is allocated with a wire number and a suitable description, i.e. Wire 640 earth splice to earth. The additional wires in the splice are allocated the same wire number and a postfix, i.e. 640A, 640B, etc.

Figure 123.



General Points

1. Wires continue to have the same number even after passing through a connector block to another harness.
2. The descriptions are applicable to JCB specification wiring harnesses. The machine may be installed with some wiring that does not conform to the JCB specifications, typically when it is part of equipment supplied by other manufacturers.

Diagram

A full set of harness drawings are available. Refer to: servicepro.jcb.com.

Repair

Special Tools

Description	Part No.	Qty.
Wiring Crimp Tool	892/00349	1

Consumables

Description	Part No.	Size
Wiring Splice (0.5-1.5mm Red, contains 50 off)	892/00351	-
Wiring Splice (1.5-2.5mm Blue, contains 50 off)	892/00352	-
Wiring Splice (3-6mm Yellow, contains 50 off)	892/00353	-

Instances occur where it is necessary to incorporate auxiliary electrical components into existing electrical circuits and although unlikely with present wiring harnesses, repair or replace specific individual wires within a harness. This will also apply to other machines in addition to those of manufacture.

To make sure that either the inclusion of an auxiliary electrical component or a repair within a harness is completed to an acceptable standard it is strongly recommended that the following tools, equipment and procedures are always used. Note that JCB harnesses have an Ingress Protection rating of 67 (I.P.67).

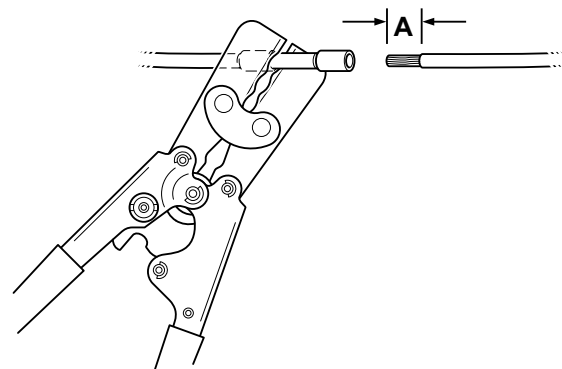
The sheath covering of the recommended splice is heat shrunk onto the original wire insulation. This results in a seal and corresponding joint to IP 67 specifications.

Procedure

1. Cut the wire and remove the protective insulation for a suitable distance dependent upon the size of wire and splice to be used.

Special Tool: Wiring Crimp Tool (Qty.: 1)

Figure 124.



A Distance for splice (check size)

- Using the correct sized splice, attach the new section of wire required or auxiliary flying lead to the existing harness and secure using the crimp tool. Note that each of the splices detailed is colour-coded to make size and range readily visible. They are secured using the corresponding size and matching colour-coded jaws of the crimp tool to ensure joint security. This tool also incorporates a ratchet closing mechanism which will not release until the splice is fully closed to the correct compression size.

Consumable: Wiring Splice (0.5-1.5mm Red, contains 50 off)

Consumable: Wiring Splice (1.5-2.5mm Blue, contains 50 off)

Consumable: Wiring Splice (3-6mm Yellow, contains 50 off)

- Seal the connection with insulation tape.

Check (Condition)

This section describes how to use electrical measuring devices that are used in electrical fault finding.

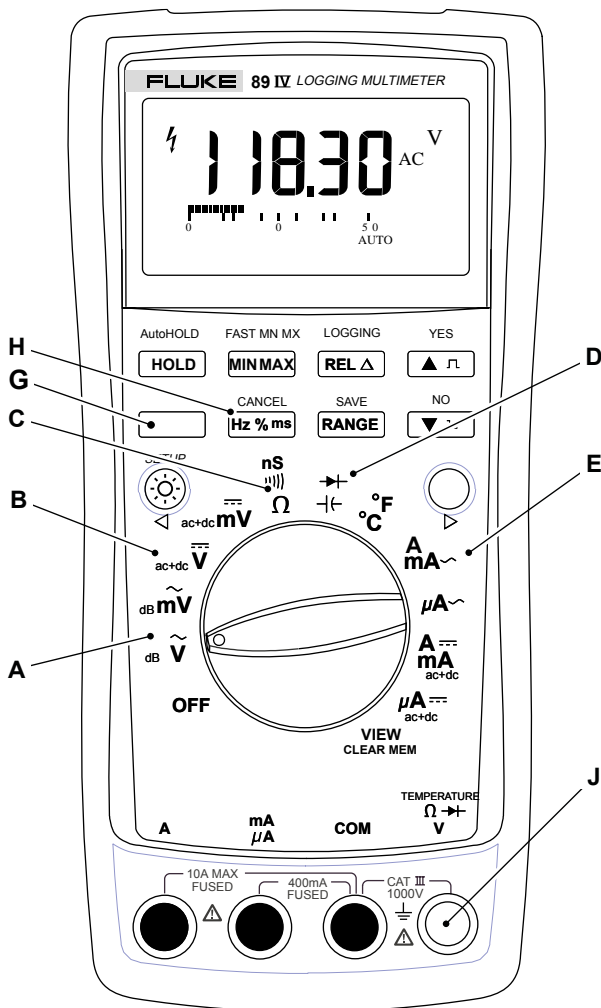
Use of Multimeters

In order to obtain the maximum benefit from the fault finding information contained in the Electrical Section, it is important that the technician fully understands the approach to fault finding and the use of the recommended test equipment, in this case a digital multimeter, or a moving pointer analogue multimeter. The approach is based on a fault finding check list. In tracing the fault from the symptoms displayed you will be directed to make measurements using a multimeter. These instructions are intended to cover the use of the recommended meters.

- Make sure that the test leads are plugged into the correct sockets. The black test lead should be plugged into the black socket (sometimes, this socket is also marked by a -, or E or marked as COMMON or COM). The red test lead should be plugged into the red socket marked with +, V or Ω .
- When you make a measurement, make sure that the test probes have a good clean contact with bare metal, free from grease, dirt, and corrosion as these can cause a false reading.
- When you measure a voltage, make sure that the correct range is selected, that it is set to the selector value equal to or greater than that you are about to measure. e.g. If asked to measure 12 Volts, set the selector to the 12V range. If there is no 12V range, set the selector to the next range higher, 20V for instance. If the meter is set to a range that is too low, it may be damaged. e.g. setting to the 2V range to measure 12V.

Measuring DC Voltage

- Select the correct range on the multimeter.
 - On the digital multimeter, turn the switch to position B.

Figure 125. Typical Digital Multimeter


2. Connect the black probe to the nearest available suitable earth point, usually this will be the starter motor earth, the battery negative, or the chassis. Connect the red probe to the wire or contact from which you are measuring the voltage.

Measuring Resistance

1. Make sure that there is no power to the part of the circuit you are about to measure.
2. Connect one probe at one end of the component or wire to be checked and the other probe at the other end. It does not matter which way round the two probes are placed.
3. Select the correct range on the multimeter.
 - 3.1. Turn the switch to position C and check that the W sign at the right hand side of the display window is on. If the F sign is on instead, press the blue button G to change the reading to Ω. Touch the meter lead probes together and press the REL3 key on

the meter to eliminate the lead resistance from the meter reading.

Measuring Continuity

1. Make sure that there is no power to the part of the circuit you are checking for continuity.
2. Connect one probe to one end of the component or wire to be checked and the other probe to the other end. It does not matter which way round the two probes are placed.
3. Select the correct range on the multimeter.
 - 3.1. On the digital multimeter, turn the switch to position C and check that the beeper symbol appears at the left hand side of the display window. If the F sign is on instead, press the button labelled F. If there is continuity in the circuit, the beeper will sound. If there is no continuity (open circuit), the beeper will not sound.

Measuring Frequency

1. Insert the black plug into the COM socket on the meter and attach the probe to the nearest suitable earth point on the chassis, for example, the battery negative terminal.
2. Insert the red probe into socket J.
3. Turn the selector switch to position A and depress G repeatedly until F is highlighted on the top row of the display.
4. Press button H once.
5. Touch or connect the red probe to the frequency source to be measured. Press and hold the button if an average reading is required.

Testing a Diode or a Diode Wire

A diode wire is a diode with male connector installed on one end and a female connector installed on the other end. The diode is sealed in heatshrink sleeving. To test a Diode or a Diode Wire.

1. On the digital multimeter:
 - 1.1. Turn the switch to position D.
 - 1.2. Press the HOLD button and check that the H sign appears at the top right hand side of the display window.
 - 1.3. Connect the black probe to the end of the diode with a band or to the male connector of the diode wire. Connect the red probe to the other end of the diode or diode wire. If the beeper does not sound the diode or diode wire is faulty.



- 1.4. Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. If the beeper sounds or the meter does not read O.L., the diode or diode wire is faulty.
- 1.5. Press the HOLD button and check that the H sign disappears from the right hand side of the display window.



57 - Electronic Diagnostic

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33-57-12 LiveLink	33-78
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Notes:

03 - Servicemaster

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Preparation	33-71
Disconnect and Connect	33-77

Introduction

Servicemaster software can be used only for Livelink configuration on this product.

For engine module control diagnostics refer to Volvo Service Documentation. Refer to: [Workshop Manual - Vodia 5 User's Guide](#).

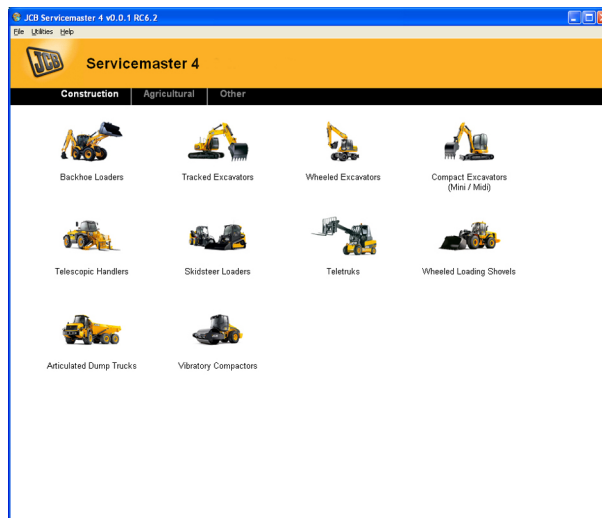
JCB Servicemaster is updated on a monthly basis by incorporating Web Update. This is a program which works alongside Servicemaster to let the user know and allow them to download an update as and when it becomes available.

JCB Servicemaster software is for use with Microsoft Windows and a laptop personal computer. The laptop computer is connected to the machine diagnostic socket using special cables and an adaptor.

Servicemaster Front Screen

The start-up page of Servicemaster is known as the front screen. This interface allows the user to easily and quickly navigate to the machine they are working on to ensure that they have the applicable tools for that machine.

Figure 126. Typical Front Screen



Once the user has clicked on the applicable machine type they will be able to select the tool they require from a list of the tools available for that machine range. Below are screen-shots showing the different machine tool sets.

Operation

Start Servicemaster

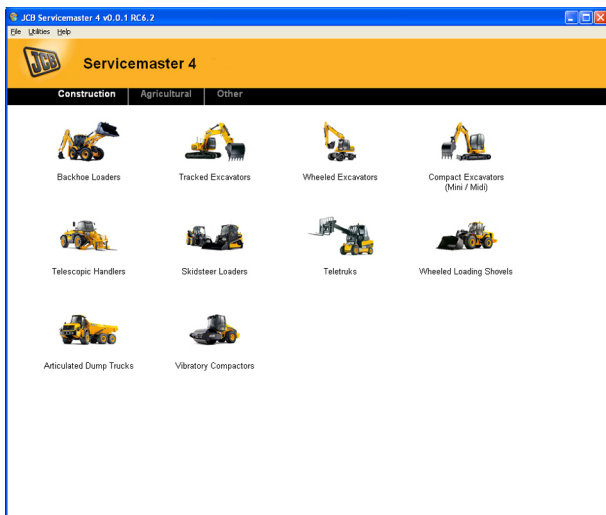
1. Set up Servicemaster, refer to Servicemaster - Refer to (PIL 57-03).
2. Double click on the Servicemaster icon. (The icon is found on the desktop or in the Start menu, Programs, JCB).

Figure 127.



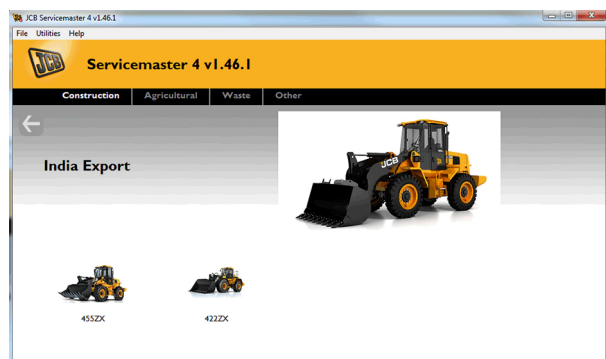
3. The Servicemaster window will open.

Figure 128.



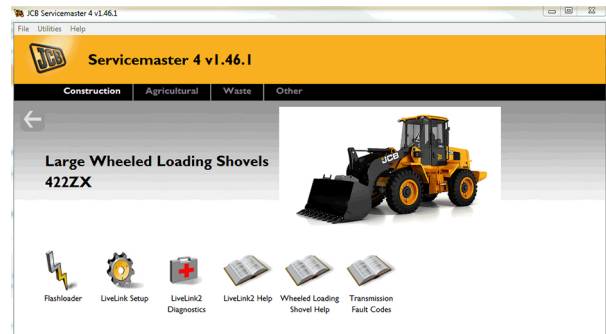
4. Double click the desired machine group.

Figure 129.



5. Select the applicable product.

Figure 130.



6. Access the relevant servicemaster tool to perform the operation. For full details of the Servicemaster tools, refer to Introduction, (PIL 33-57-03).

Preparation

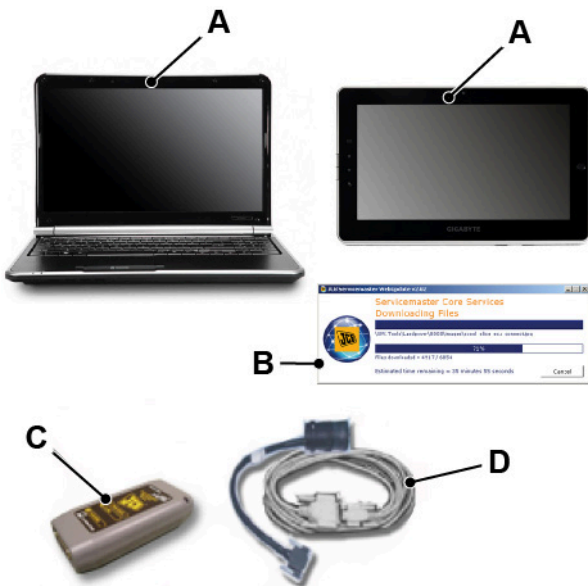
Set-up Servicemaster

The procedures below describe how to set up Servicemaster for USB (Universal Serial Bus) compatible equipment. There are other procedures and options. These are described in detail in the Servicemaster help files.

Before you start Servicemaster set up procedure make sure that you have the following:

- 1 A Microsoft Windows compatible laptop/PC with a USB port. Refer to Figure 131.
 - a Make a note that Servicemaster is compatible with Windows 98, 2000, ME, XP, Vista, and 7 operating systems (32 bit and 64bit).
- 2 The latest Servicemaster software (internet connection for web updates). Refer to Figure 131.
- 3 A JCB compatible DLA (Data Link Adaptor). Refer to Figure 131.
- 4 The correct connection cables. Refer to Figure 131.
 - a Do not connect any cables to the laptop, DLA or machine at this time.

Figure 131.



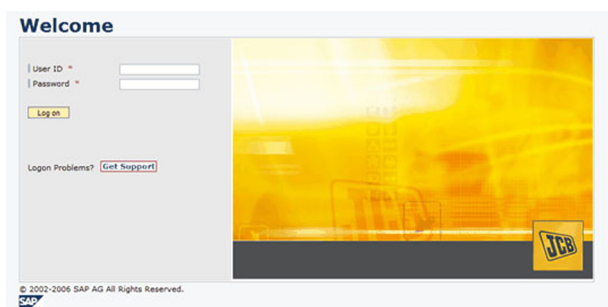
- A Laptop computer
- B Servicemaster software
- C DLA
- D Connection cables

JCB Servicemaster Web Update - New Installation

Once you install JCB Servicemaster on your laptop/PC you will need to keep it updated. JCB Servicemaster is updated through the "JCB Web Update" program. Do the below steps to download and install the JCB web update.

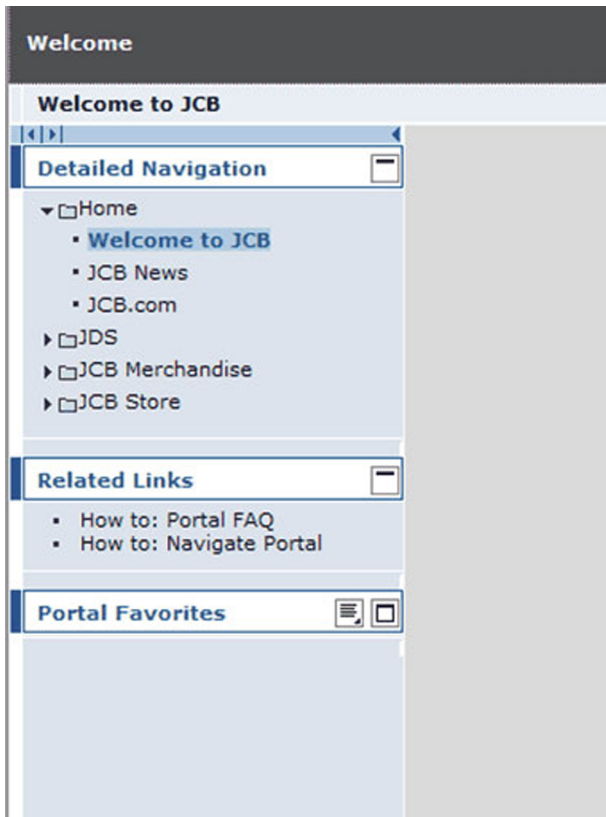
1. Use the web address www.business.jcb.com to install JCB web update.
2. A web page will open on the screen. Refer to Figure 132.

Figure 132.



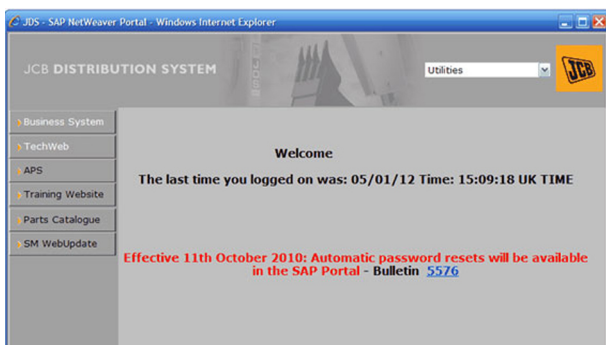
3. If you do not already have a User ID and Password, click the "Get Support" option.
 - 3.1. Apply for an account to get access to JDS (JCB Distribution System) and SPP (Service Parts Pro).
4. Once you are logged in, you will find a link "JDS" on the LH (Left Hand) tool bar. Refer to Figure 133.
 - 4.1. Click the "JDS" link.

Figure 133.



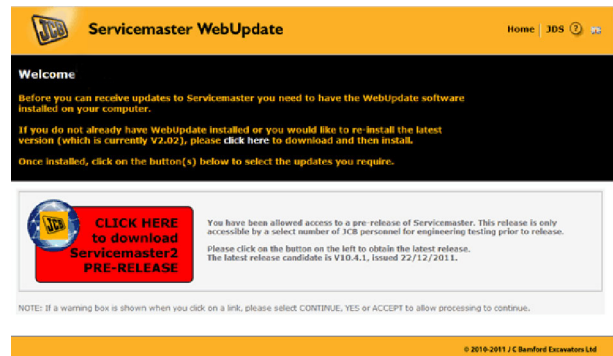
5. A new screen "JCB DISTRIBUTION SYSTEM" will open. Refer to Figure 134.

Figure 134.



- 5.1. Click the "SM Web Update" link option of the LH tool bar.
6. A new "Servicemaster Web Update" screen will open. Refer to Figure 135.

Figure 135.



- 6.1. Click the "click here" link which is the orange colour text sentence to download JCB web update.
7. A new "File Download - Security Warning" window will appear on the screen. Refer to Figure 136.

Figure 136.



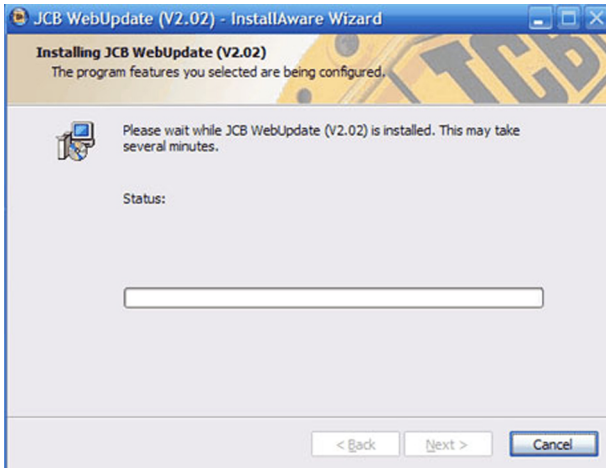
- 7.1. Click the "Run" option to start download.
8. Due to the computer system firewall, you may get a warning window "Internet Explorer - Security Warning". Refer to Figure 137.
- 8.1. Click the "Run" option to proceed.

Figure 137.



9. A new "JCB Web Update (V2.02) Installation Wizard" window will open. Refer to Figure 138.
 - 9.1. Once the download is finished, it will automatically run.

Figure 138.



10. The "JCB Web Update" program shortcut will be created on the computer desktop. Refer to Figure 139.

Figure 139.



11. Refer to the below section "JCB Web Update Downloads - Authorisation" to authorise your downloads.

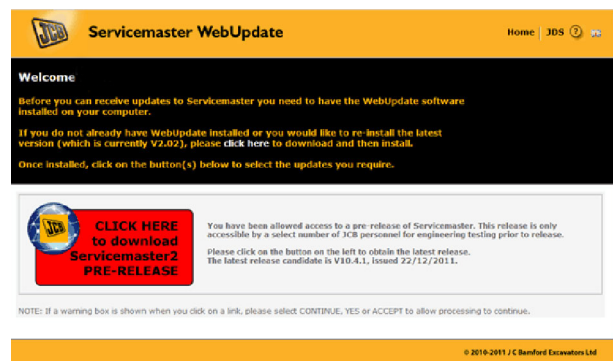
JCB Web Update Downloads - Authorisation

The below authorisation procedure is needed to access the downloads through the "JCB Web Update" on a laptop/PC.

1. It is necessary to authorise the download after the installation, to make sure that you get future updates.

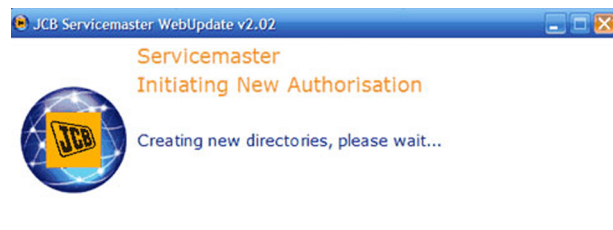
2. After the installation you will need to authorise the download to ensure that you get future updates.
3. Get access to the "Servicemaster Web Update" screen. Refer to Figure 140.
4. The "Servicemaster Web Update" screen will have one of the red or orange dialogue box. Refer to Figure 140.
 - 4.1. The dialogue box depends on the download privileges attached to your name (red for pre-release and orange for full release only).

Figure 140.



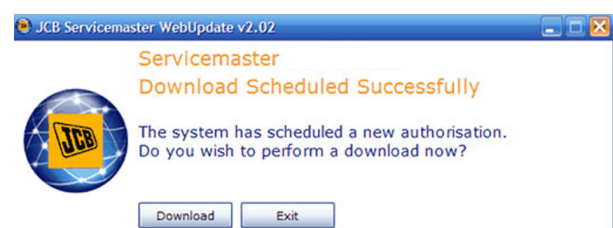
5. Click the dialogue box to start the authorisation process. Refer to Figure 141.
 - 5.1. A new window "Servicemaster Pre-Release Initiating New Authorisation" will open.

Figure 141.



6. After the system download authorisation process, "Download" option will reflect on the window. Refer to Figure 142.
 - 6.1. Click the "Download" option to download the JCB web update.

Figure 142.



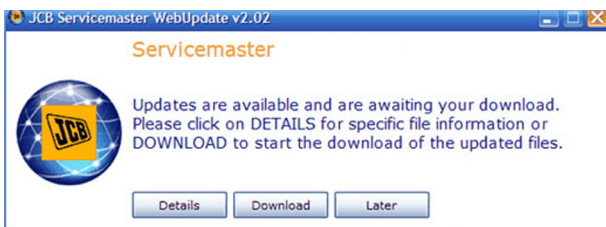
7. The authorisation process of "JCB Web Update" is now complete.

Servicemaster Updates - "JCB Web Update" Program

The updates for Servicemaster is downloaded through the "JCB Web Update" program on a laptop/PC. Refer to the below steps.

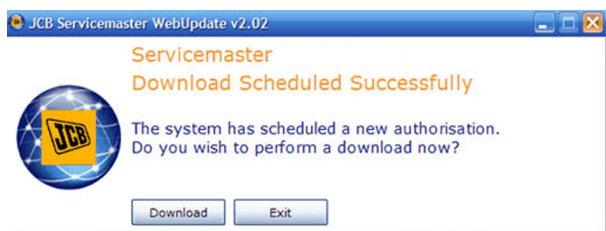
1. Run the "JCB WebUpdate" program either by using desktop shortcut or "Help" menu within Servicemaster, to do a Servicemaster update.
2. The "JCB WebUpdate" program will check for updates and inform you if there is any to download. Refer to Figure 143.

Figure 143.



- 2.1. You may click the "Details" option to check which files have been changed, added or removed.
- 2.2. Click the "Download" option to download the updates.
3. Once the updates downloaded, the "JCB Web Update" will give option to install them. Refer to Figure 144.
 - 3.1. You may select options to install the updates immediately or at a later date.

Figure 144.

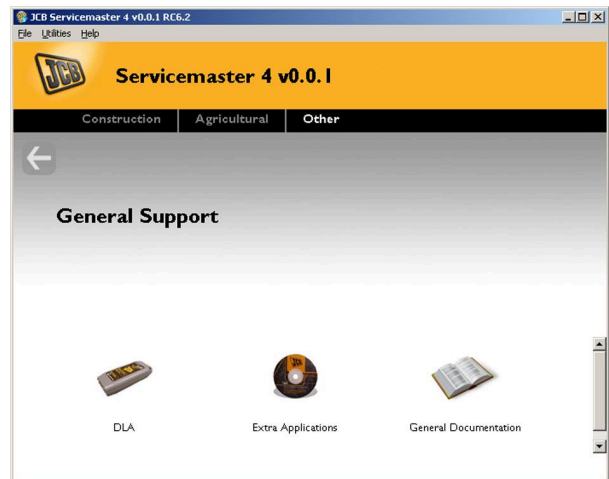


DLA Driver Software - Installation

When you use Servicemaster first time on your laptop/PC (which is newly installed with Servicemaster software), the DLA driver software is necessary to install first. Do the below steps to install the DLA driver software.

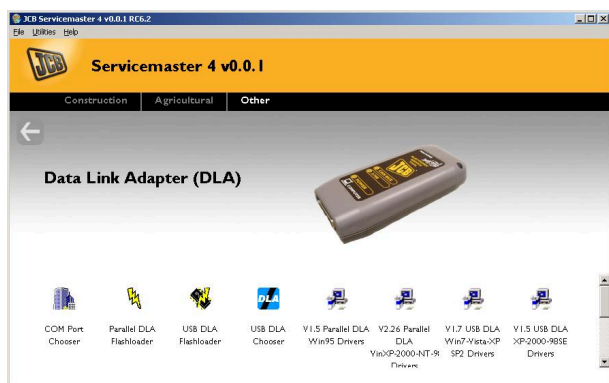
1. Once you complete the DLA driver software installation procedure, it will not require to do again on your laptop/PC.
2. Do not connect the DLA or cables to the machine or laptop/PC before to install the DLA driver software.
3. Open Servicemaster on your laptop computer.
4. Click the "Other" tab to get access to the "General Support" icon.
5. Click the "General Support" icon to get access to the "DLA" icon.
6. Click the "DLA" icon. Refer to Figure 145.

Figure 145.



7. Select and open the USB driver icon. Refer to Figure 146.
 - 7.1. Make a note that the other drivers icon are also available for the computers with serial ports (no USB) and other versions of Microsoft Windows.
 - 7.2. If your laptop does not have a USB port, select and open the correct driver icon.

Figure 146.



8. A new window "Driver Installer" will open. Refer to Figure 147.
 - 8.1. Obey the window instructions to the complete the DLA driver software installation.

Figure 147.



V1.7 USB DLA
 Win 7-Vista-XP
 SP2 Drivers

DLA Type and Communications Port - Configuration

When you use Servicemaster first time on your laptop/PC (which is newly installed with Servicemaster software) make sure that the correct DLA and laptop/PC port is selected to communicate with the DLA. Do the below steps to configuration the DLA with the laptop/PC.

1. Once you complete the DLA configuration, it will not require to do again on your laptop/PC.
2. Open Servicemaster on your laptop computer.
3. Click the "Other" tab to get access to the "General Support" icon.
4. Click the "General Support" icon to get access to the "DLA" icon.
5. Click the "DLA" icon.
6. Select and open the "COM Port Chooser" icon. Refer to Figure 148.

Figure 148.

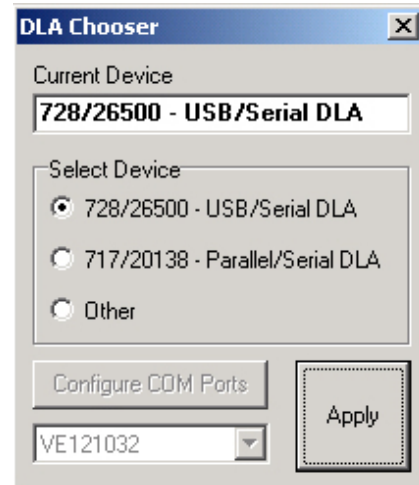


COM Port
 Chooser

7. A new "DLA Chooser" window will open. Refer to Figure 149.
 - 7.1. Select the USB /Serial DLA" device and click the "Apply" option to confirm.

- 7.2. Make a note that the older DLA and laptop computers may not be compatible with the USB ports. Select the "Parallel/Serial DLA" device in the DLA chooser.

Figure 149.



DLA Firmware File - Check

The DLA has software embedded in its own flash memory. This file must be replaced with a new one when new firmware is released. You will only have to Check the DLA firmware file version if you receive a new Servicemaster version or use a different DLA.

1. Make sure that the DLA is connected to the laptop computer.
2. Open Servicemaster on your laptop computer.
3. Click the "Other" tab to get access to the "General Support" icon.
4. Click the "General Support" icon to get access to the "DLA" icon.
5. Click the "DLA" icon.
6. Select and open the "USB DLA Flashloader" icon. Refer to Figure 150.
 - 6.1. Make a note that the older DLA and laptop computers may not be compatible with the USB ports. Select and open the "Flashloader for Serial/Parallel DLA" icon.

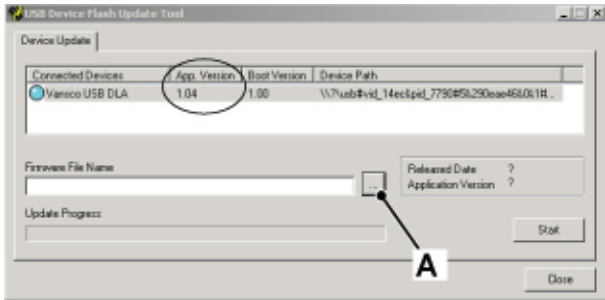
Figure 150.



USB DLA
 Flashloader

7. A window "USB Device Flash Update Tool" will open. Refer to Figure 151.
 - 7.1. The firmware details in the DLA are displayed with the application version (for example - 1.04). Refer to Figure 151.

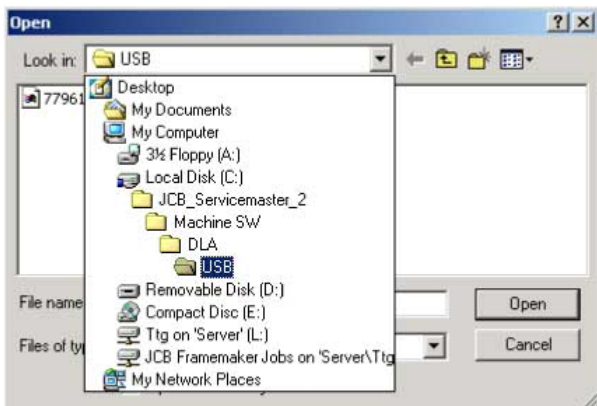
Figure 151.



A Browse option

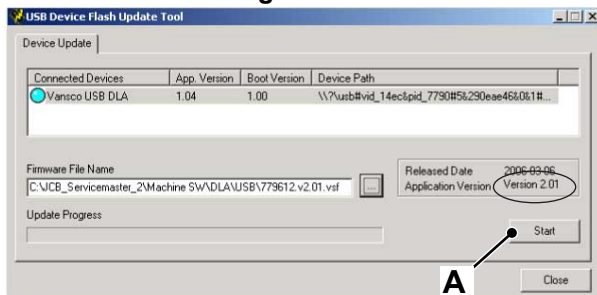
8. Check for a new firmware file.
 - 8.1. Click the "Browse" option and find the file stored within the JCB Servicemaster directory on your laptop hard drive. Refer to Figure 152.
 - 8.2. Select the file and click the "Open" option.

Figure 152.



- 8.3. The selected file appears in the firmware file name field together with its release date and application version (for example - 2.01). Refer to Figure 153.

Figure 153.



A Start option

9. Load a new firmware file.
 - 9.1. If the firmware in the DLA is not up to date, load the new file.
10. Click the "Start" option and obey the on-screen instructions.

Disconnect and Connect

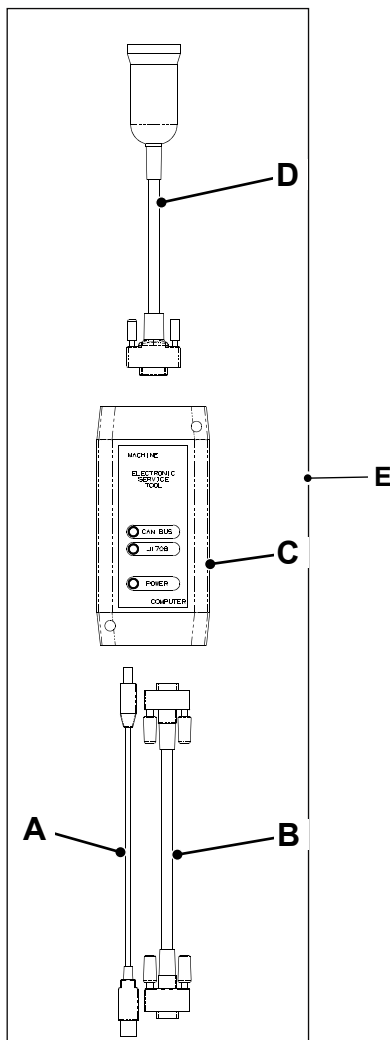
Special Tools

Description	Part No.	Qty.
Data Link Adaptor (DLA) Kit	892/01174	1*
Data Link Adaptor (DLA 2.0) Kit	728/H5409	

*Unless otherwise stated, you can use any of the tools shown.

To use Servicemaster, connect your laptop computer to the machine CAN (Controller Area Network) bus. Connection is made using the DLA (Data Link Adaptor) and the applicable cables.

Figure 154.



- A** USB PC Cable - 718/20235
- B** Serial PC Cable - 718/20236
- C** USB DLA - 728/26500
- D** Machine Cable - 718/20237
- E** Kit - 892/01174 (contains items A, B, C and D)

Note: Connect the USB cable directly to the laptop computer. Do not connect the cable via a USB hub.

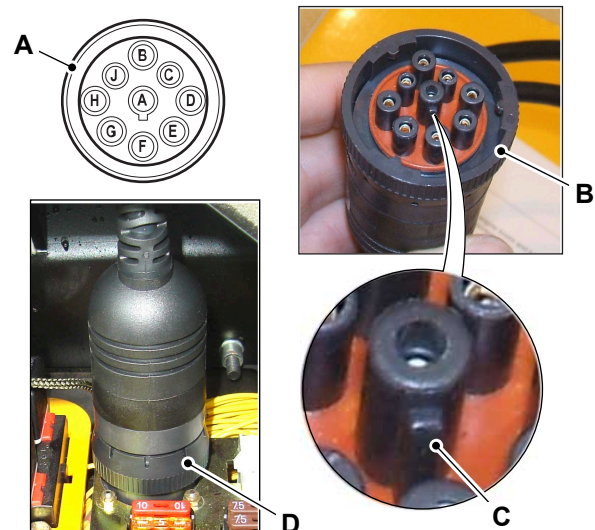
Note: Older DLA and laptop computers may not be compatible with USB ports. Use the serial PC cable to connect the DLA to the laptop serial port.

1. Make sure the machine ignition system is OFF.
2. To use the Servicemaster diagnostic tool, connect the laptop computer to the machine.

Special Tool: Data Link Adaptor (DLA) Kit / Data Link Adaptor (DLA 2.0) Kit (Qty.: 1)

3. Connect the USB PC Cable to the DLA and a free port on the laptop computer.
4. Connect the Machine Cable to the DLA. The Machine Cable has a 15-way D-type connector on one end and a 9-way CAN connector on the other. Plug the 15-way connector into the DLA and tighten the thumb screws.

Figure 155.



- A** USB PC Cable
- B** Serial PC cable
- C** Centre pin location tab
- D** Locking ring

5. Connect the 9-way CAN connector into the machines Diagnostics Connector as follows:
 - 5.1. Position the CAN connector to align the centre pin location tab with the diagnostics connector.
 - 5.2. Couple the connectors. Turn the locking ring clockwise to secure the connectors.



12 - LiveLink

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Introduction

JCB LiveLink is a web based application for storing, sharing, and distributing information. It provides a collaborative work environment that helps the organisation to improve business processes and share information.

Operation

Special Tools

Description	Part No.	Qty.
Data Link Adaptor (DLA) Kit	892/01174	1*
Data Link Adaptor (DLA 2.0) Kit	728/H5409	

*Unless otherwise stated, you can use any of the tools shown.

Start LiveLink Diagnostic

1. Open the ServiceMaster diagnostic tool.
2. Select the 'Generators' option in ServiceMaster. Refer to Figure 156.
 - 2.1. Click on the "TIER4 Final" icon.

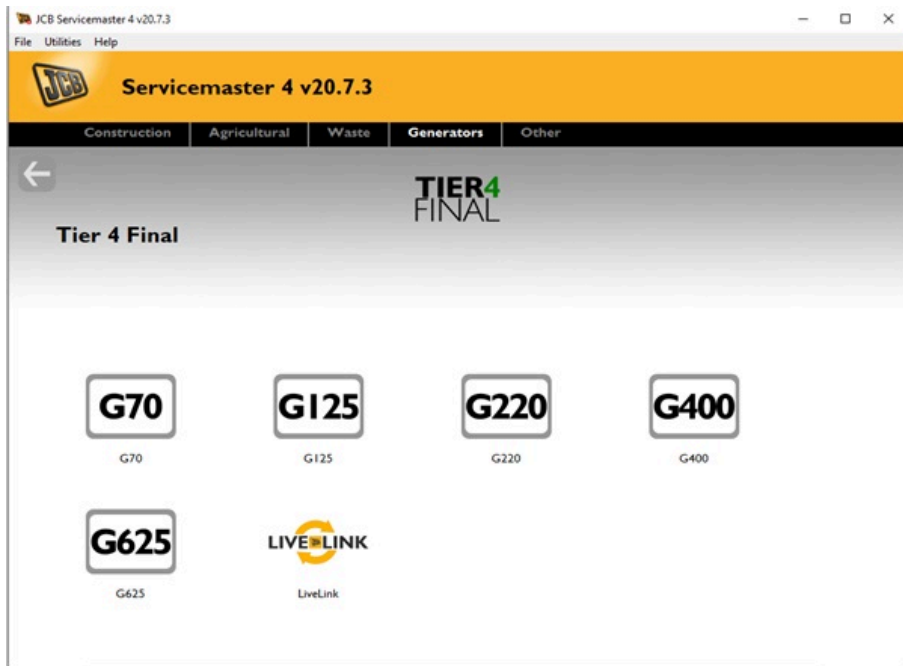
Figure 156.



3. Use the DLA (Data Link Adaptor) to connect ServiceMaster to the machine.

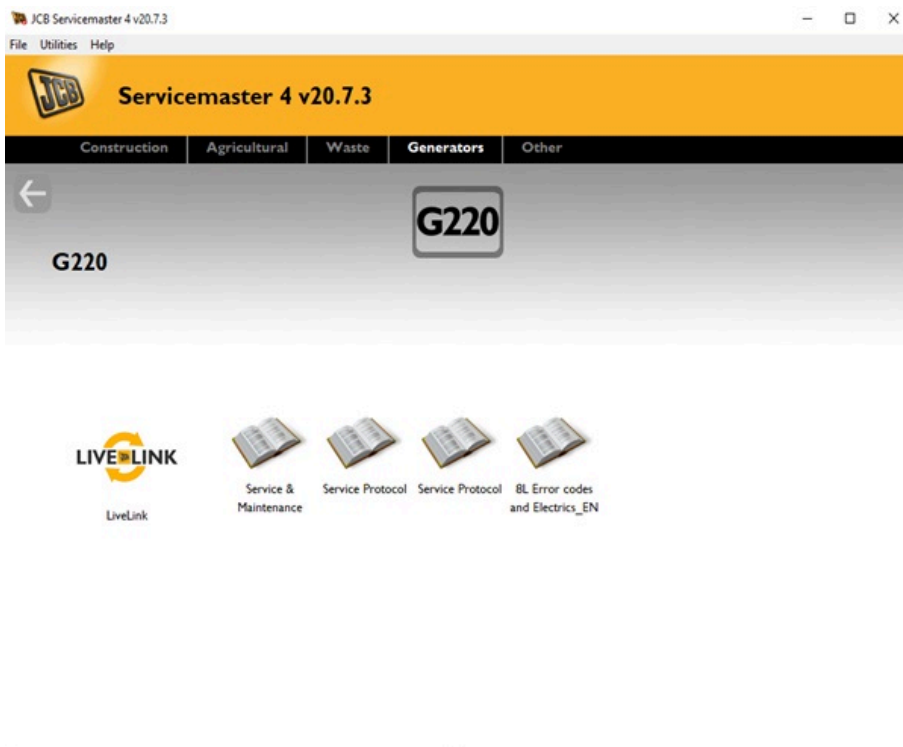
Special Tool: Data Link Adaptor (DLA) Kit / Data Link Adaptor (DLA 2.0) Kit (Qty.: 1)
4. Select your machine model icon. Refer to Figure 157.

Figure 157.



5. Select the 'LiveLink' icon. Refer to Figure 157.

Figure 158.



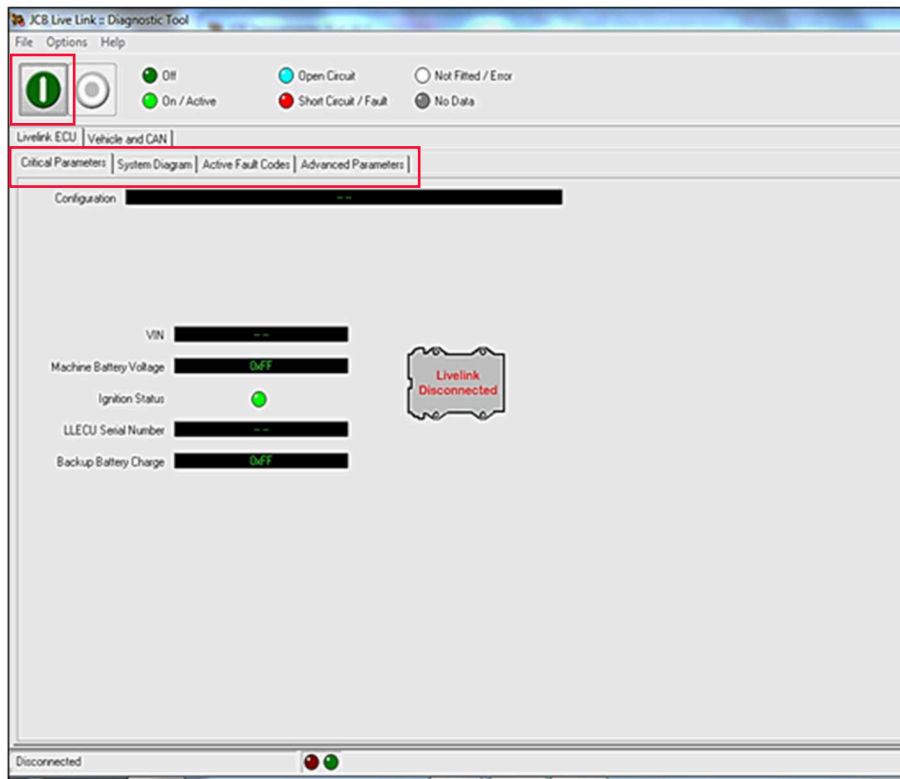
6. Select the 'LiveLink 2 Diagnostics' icon. Refer to Figure 159.

Figure 159.



- 6.1. Use 'Livelink 2 Diagnostics' to check the operation and diagnose the problem of JCB LiveLink ECU (Electronic Control Unit).
- 7. There are four program menus in the 'LiveLink 2 Diagnostics'. Refer to Figure 160.
 - 7.1. Critical parameters.
 - 7.2. System diagram.
 - 7.3. Active fault codes.
 - 7.4. Advanced parameters.

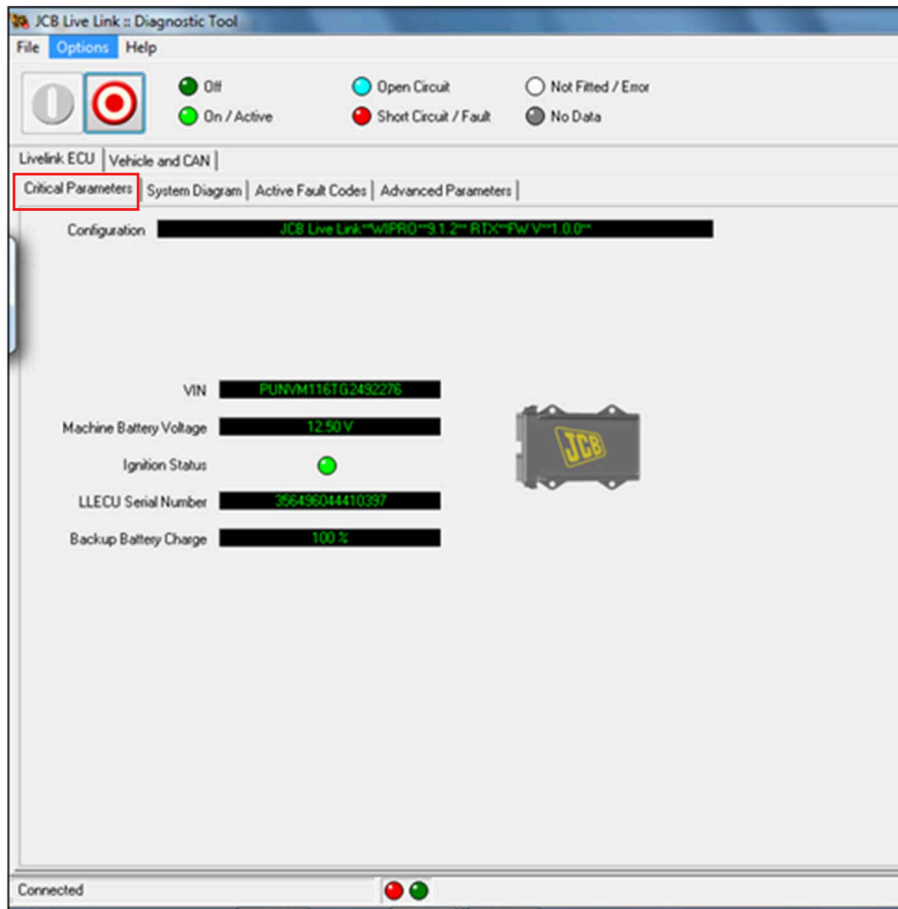
Figure 160.



8. Select the green 'Start' button at the top of the LiveLink 2 Diagnostics' screen. Refer to Figure 160.

The 'Critical Parameters' tab shows the following information: Refer to Figure 161.

Figure 161.

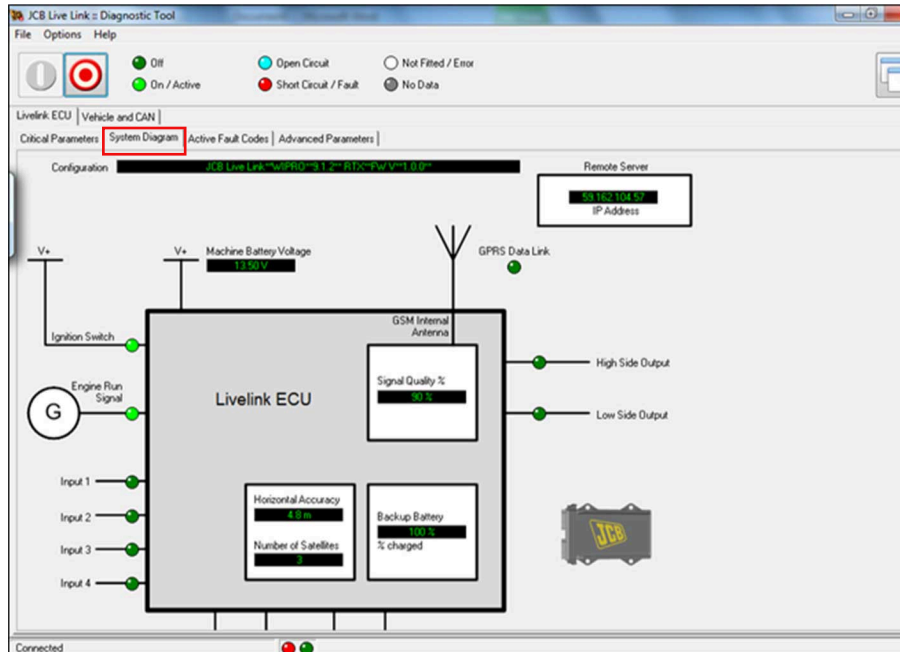


- Configuration: Configuration of software of the LiveLink.
- VIN (Vehicle Identification Number).
- Machine battery voltage.
- Ignition status.

- LLECU Serial number.
- Backup battery charge.

The 'System Diagram' tab shows following information: Refer to Figure 162.

Figure 162.

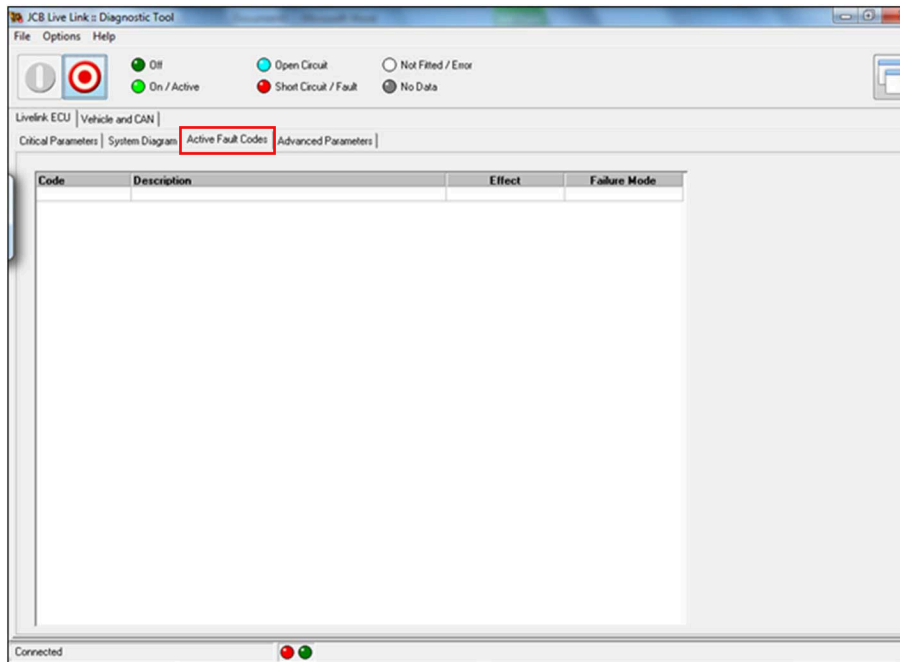


- Configuration.
- Machine battery voltage.
- Engine run signal.
- Input 1, Input 2, Input 3, Input 4: Status of the four hardwired input signals to LiveLink ECU.
- Signal quality of GPS (Global Positioning System).
- Horizontal accuracy of GPS.

- Number of satellites for GPS.
- Backup battery.
- GPRS data link.
- Remote server IP address.
- High side output.
- Low side output.

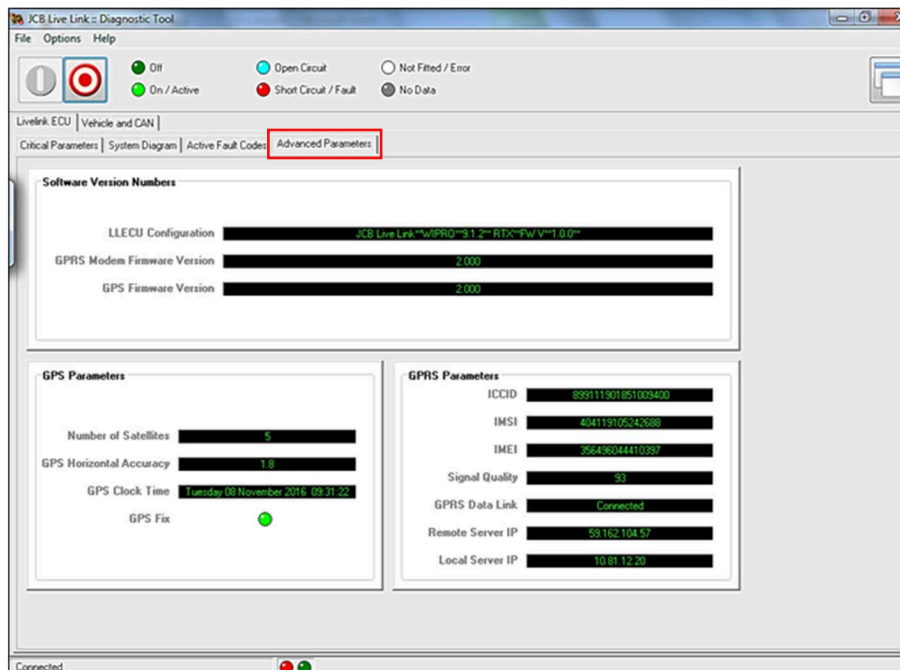
The 'Active Fault Codes' tab shows the present faults related to LiveLink: Refer to Figure 163.

Figure 163.



The 'Advanced Parameters' tab shows the following parameters: Refer to Figure 164.

Figure 164.



Software Version Numbers -

- LLECU configuration.
- GPRS Modem firmware version.

- GPS firmware version.

GPS Parameters -

- Number of satellites.
- GPS horizontal accuracy.
- GPS clock time.
- GPS fix.

GPRS Parameters -

- ICCID number.
- IMSI number.
- IMEI number.
- Signal quality.
- GPRS data link.
- Remote server IP address.
- Local server IP address.



90 - Error Codes

Technical Data

Table 43. Engine Fault Codes

SPN	Component
20	Coolant Water Pressure
51	Engine Throttle position (cold)
91	Percent Accelerator Pedal Position
94	Fuel Delivery Pressure
97	Water in fuel indicator
98	Engine Oil Level
99	Engine Oil Filter Differential Pressure
100	Engine Oil Pressure
101	Crankcase pressure
102	Boost pressure
105	Boost temperature
107	Air filter pressure
108	Ambient air pressure
110	Coolant Temperature
111	Coolant Level
131	Exhaust back pressure
158	Battery voltage Battery, Charging
172	Ambient Air Temperature Sensor
173	Exhaust gas temperature
175	Engine Oil Temperature
190	Engine Speed
626	Preheat relay
628	Program Memory
636	CAM Speed sensor
637	Crank Speed sensor
639	J1939 Network #1 Primary Vehicle Network
647	Engine Fan Driver
651	Fuel Injector, Cylinder #1
652	Fuel Injector, Cylinder #2
653	Fuel Injector, Cylinder #3
654	Fuel Injector, Cylinder #4
655	Fuel Injector, Cylinder #5
656	Fuel Injector, Cylinder #6
677	Starter motor relay
729	Starter element
970	Engine stop switch
1188	Wastegate Valve
1485	Main relay output
1639	Fan speed
1668	J1939 Network #4 (engine subnet)
1761	Aftertreatment Reagent Tank Level
2017	Lost Communication (Source Address 17)
2036	Lost Communication (Source Address 36)



33 - Electrical System

57 - Electronic Diagnostic

90 - Error Codes

SPN	Component
3031	Aftertreatment Reagent Tank Temperature
3216	NOx Sensor Inlet
3226	NOx Sensor Outlet
3241	Exhaust gas temperature
3361	Aftertreatment Reagent Dosing Unit
3364	Aftertreatment Tank Reagent Quality
3464	Engine throttle actuator (cold) Engine Throttle Actuator
3509	Sensor Supply Voltage #1 (+5 V DC)
3510	Sensor Supply Voltage #2 (+5V DC)
3511	Sensor Supply Voltage #3 (+5V DC)
5394	Aftertreatment reagent dosing valve
520193	Sea Water Pressure
520335	ECU battery potential
520416	Lost communication with reductant control module on engine subnet
520567	Aftertreatment Exhaust Temperature - Wet
520570	Engine Oil Pressure Before Filter
520688	Aftertreatment Exhaust Temperature - Dry
520691	Torque Speed Control 1 Received With Errors (Counter or Checksum) Torque speed control



78 - Generator Control

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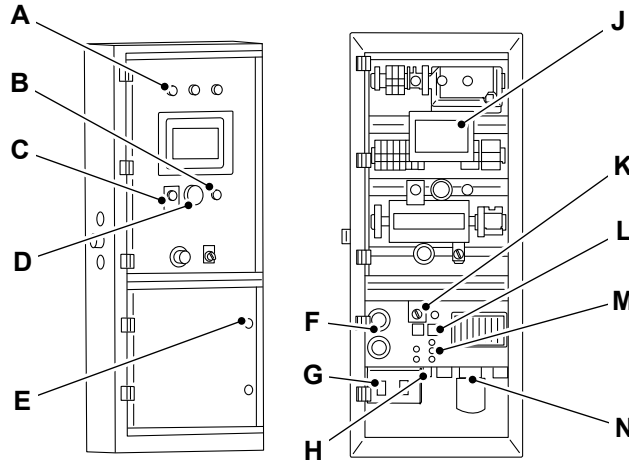
33-78-03 Control Panel	33-91
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03 - Control Panel

Introduction

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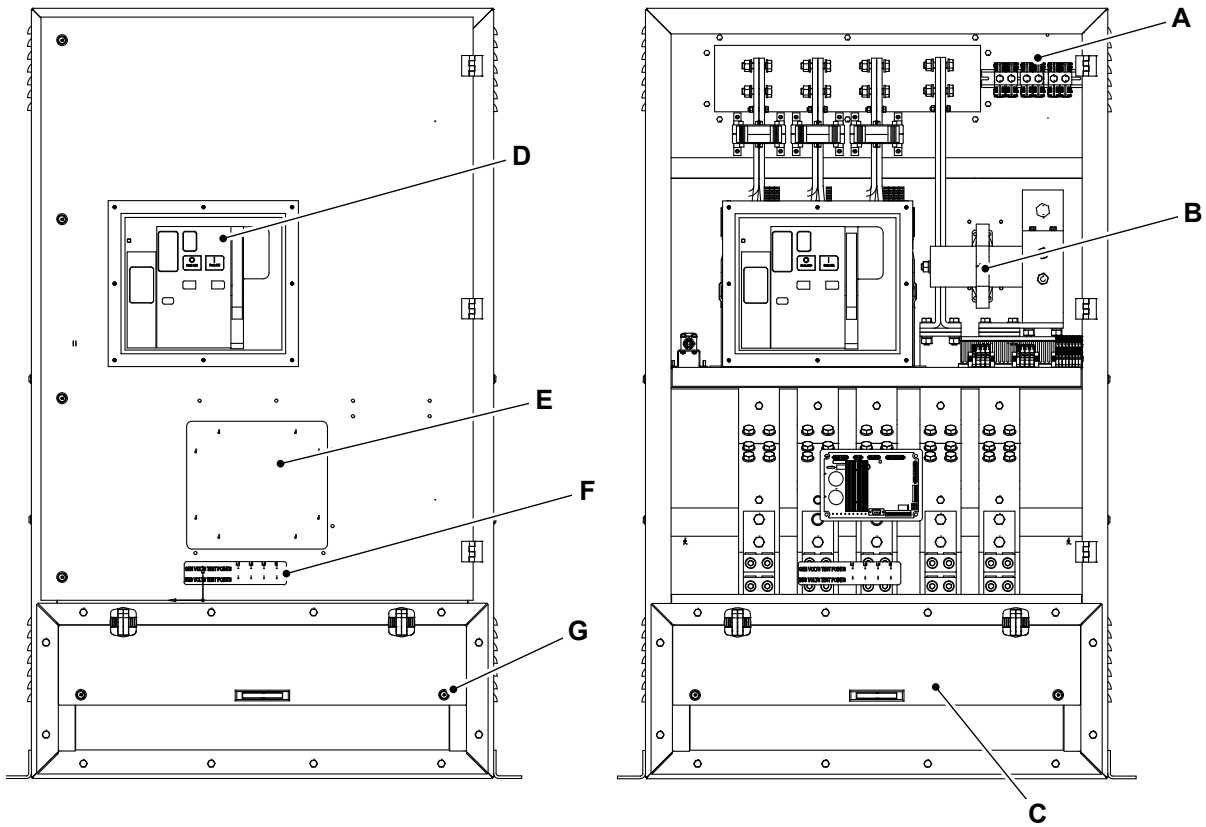
Figure 165.



- A** Auxiliary indicator lamps
- C** BUS live indicator
- E** Lockable door
- G** GFCI 120V Small power
- J** Voltage alarm
- L** Digital synch connections
- N** 3x50A Shore power - 120V/240V

- B** Audible alarm
- D** Audible alarm
- F** Coolant heater and battery charger sockets
- H** USB (Universal Serial Bus)port
- K** End of line synch switches
- M** Analogue loadshare connection point

Figure 166.



- A** DIN rail terminal
- C** Self latching cable cover with padlock
- E** AVR (Alternator Voltage Regulator)
- G** Breaker safety trip switch

- B** Toroid
- D** Automatic circuit breaker
- F** Test point

Operation

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 For: Control Panel DEIF TDU 107
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 For: Control Panel 7310 Page 33-118
 For: Control Panel 8610 Page 33-120

(For: Control Panel DEIF AGC 4)

Display push-buttons and LEDs

Push-button functions

The display unit holds a number of push-button functions which are described below:

Figure 167.

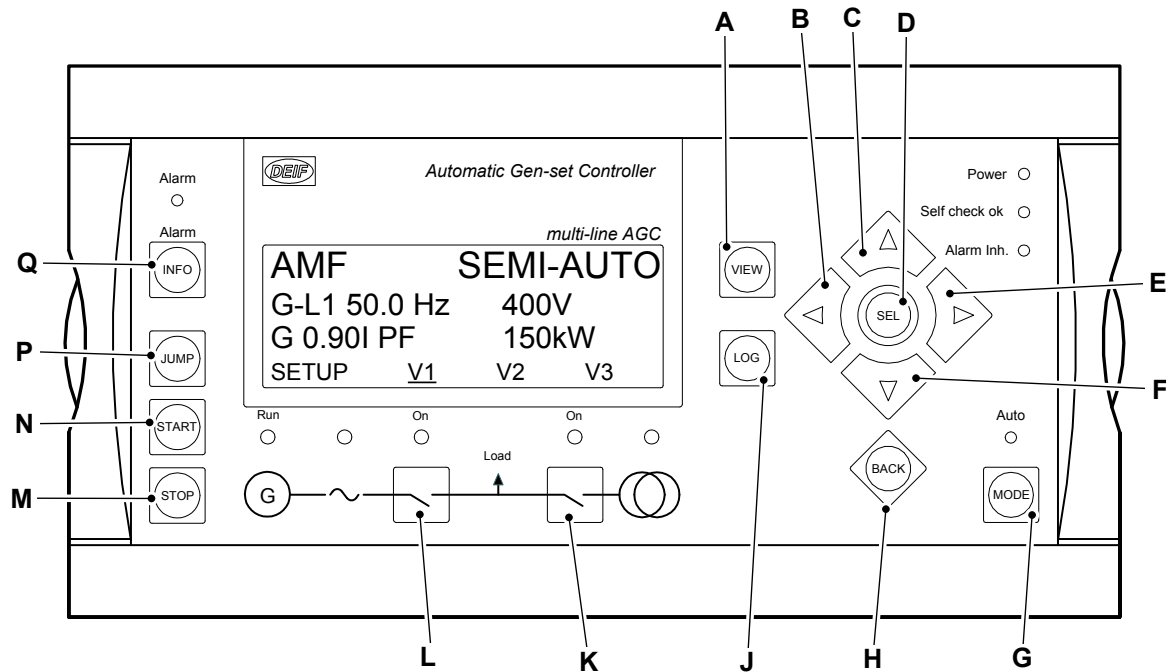


Table 44.

S. No.	Item	Function
A	VIEW	Shifts the first line displaying in the setup menus
B	Left	Scrolling left
C	Up	Scrolling up
D	SEL	Select the underscored entry
E	Right	Scrolling right
F	Down	Scrolling down
G	MODE	Mode selection
H	BACK	Jumps one step backwards in the menu

S. No.	Item	Function
J	LOG	Show the event and alarm list
K		Manual activation of close breaker and open breaker sequence if "SEMI-AUTO" is selected
L		Manual activation of close breaker and open breaker sequence if "SEMI-AUTO" is selected
M	STOP	Stop the genset if "SEMI-AUTO" or "MANUAL" is selected
N	START	Start the genset if "SEMI-AUTO" or "MANUAL" is selected
P	JUMP	Enters a specific menu number selection
Q	INFO	Show the alarm list

LED functions

combination in different situations. The display LEDs are indicating as follows:

The display unit holds 10 LED (Light Emitting Diode) functions. The colour is green or red or a

Figure 168.

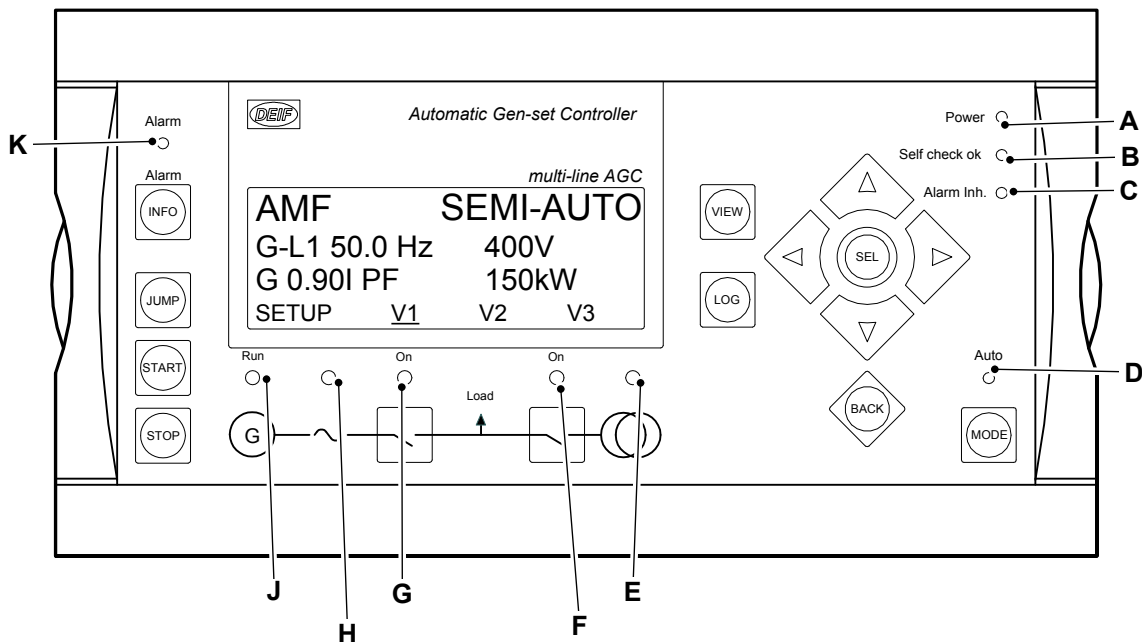


Table 45.

A	Auxiliary supply is switched on
B	Unit is OK
C	Alarm is enabled but inhibited
D	Auto mode is selected
E	Green: mains is present and OK
	Red: mains failure
	Green flashing: mains returns during the "mains OK delay" time
F	Mains breaker is closed
G	Generator breaker is closed
H	Voltage/frequency is present and OK
J	Generator is running

K	LED flashing: unacknowledged alarms are present
	LED fixed: all alarms are acknowledged, but some are still present

Display and menu structure

General

This chapter deals with the display unit including the push-button and LED functions. In addition, the unit menu structure will be presented.

Display layouts for DEIF AGC-4

Figure 169. Engine and generator breaker control (island) (option Y1)

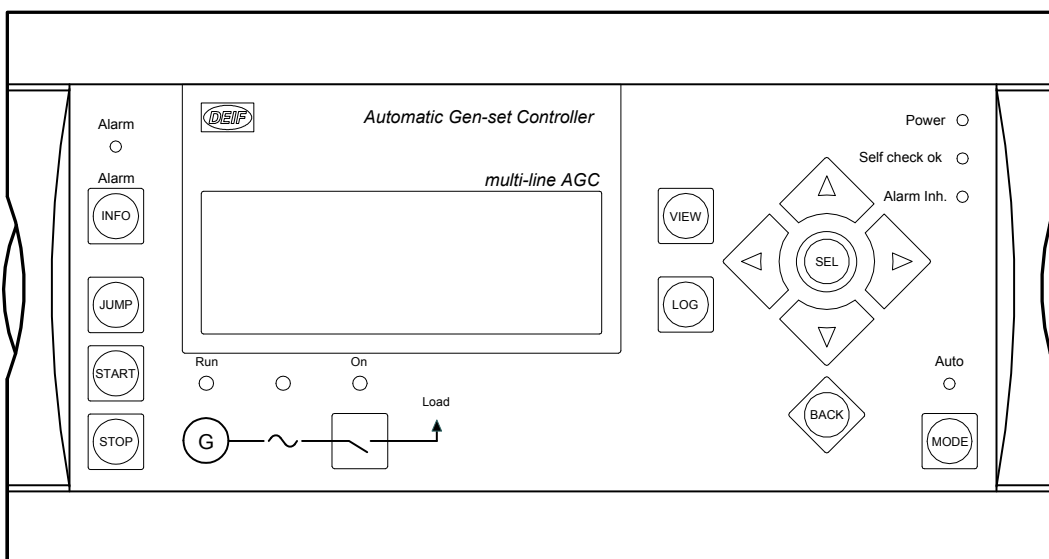


Figure 170. Generator breaker and mains breaker control (option Y3)

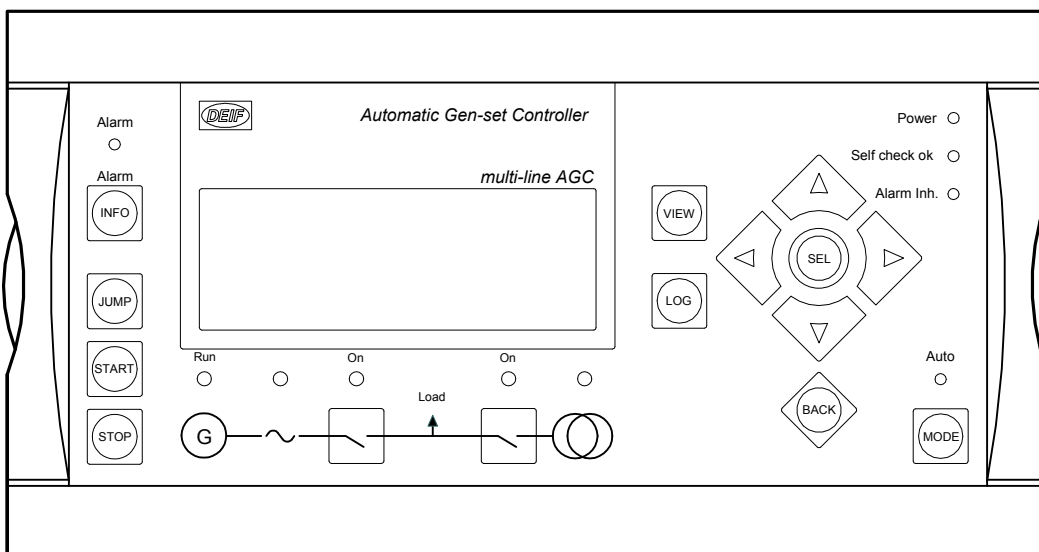


Figure 171. Tie breaker and mains breaker control (option Y4)

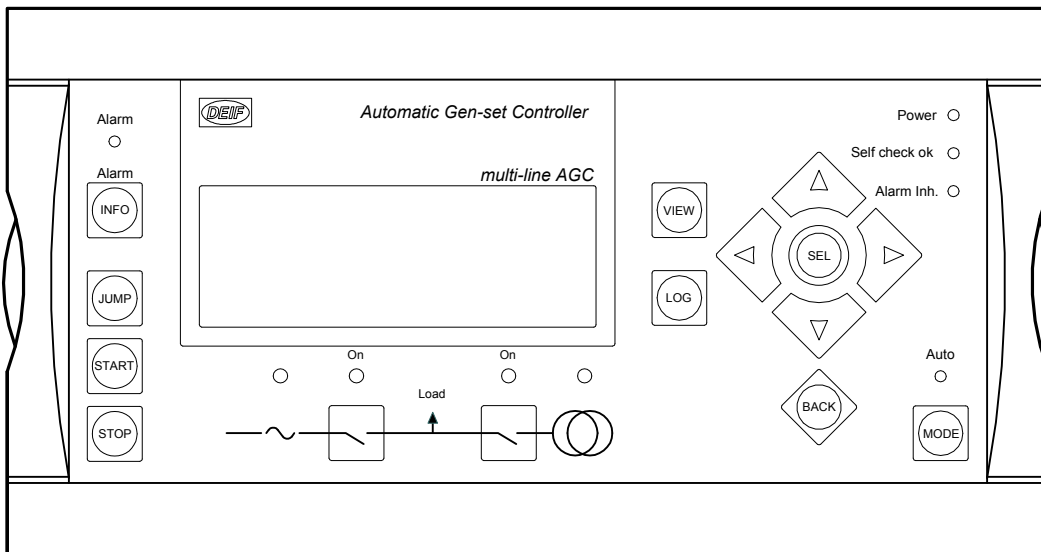
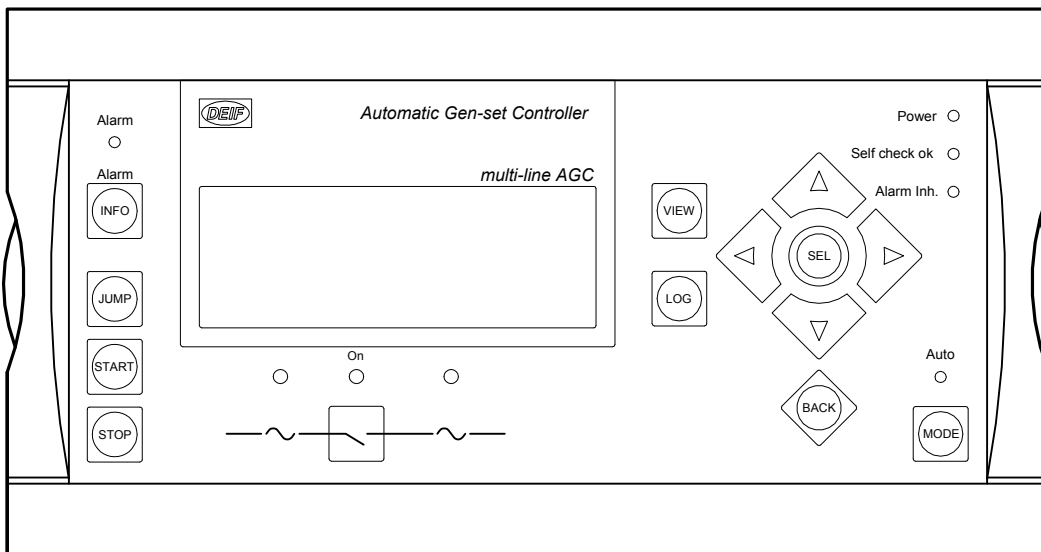


Figure 172. Bus tie breaker control (option Y5)



LCD display

The display is a backlit LED text display containing four lines with 20 characters in each line. There is no control of the display light intensity (no dimmer). Basically, all measured and calculated values can be read in the display. These may be selected via the PC utility software (USW).

Menu structure

The display includes two menu systems which can be used without password entry:

View menu system:

This is the commonly used menu system. 15 windows are configurable and can be entered by using the arrow push-buttons.

Setup menu system (not commonly used by the operator):

This menu system is used for setting up the unit, and if the operator needs detailed information that is not available in the view menu system.

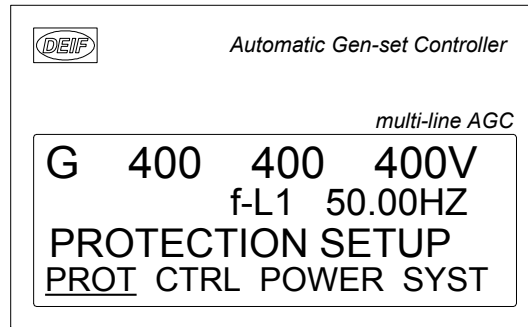
Changing of parameter settings is password-protected.

Entry window

When the unit is powered up, an entry window appears. The entry window is the turning point in

the menu structure and as such the gateway to the other menus. It can always be reached by pushing the BACK push-button three times.

Figure 173.

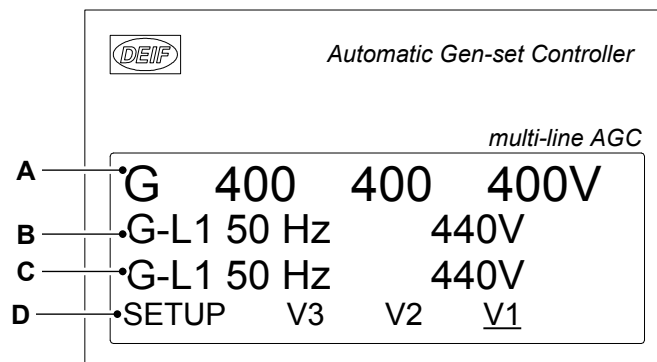


View menu

The view menus (V1, V2 and V3) are the daily use menus for the operator.

In the view menus, various measured values are on display.

Figure 174.



1. First display line: operational status or measurements
2. Second display line: measurements relating to operational status
3. Third display line: measurements relating to operational status
4. Fourth display line: selection of setup and view menus

The cursor is moved using the Left and Right push-buttons on the right side of the display.

View window 1

Display of measured values according to the selections made during configuration.

V1 contains up to 15 different windows which can be selected using the Up and Down push-buttons located on the right hand side of the display.

View menu navigation

The readings etc. are all selected by moving the cursor (fourth display line (note the underscore of V1 in the drawing above - this is the cursor)):

Table 46.

Windows	V1
View 1	Manual selection with Up or Down push-buttons
View 2	
View 3	
View 4	
View 5	
View 6	
View 7	
View 8	
View 9	
View 10	
View 11	
View 12	
View 13	
View 14	
View 15	
View 16	
View 17	
View 18	
View 19	
View 20	

View window 2

Display of measured values according to the selections made during configuration.

Display V2 follows the selection in V1 as follows:

1. View 1: (Start prepare)

2. View 2: (Synchronising)

3. View 3: (Ramp up/down)

4. View 4:

5. View 5: (Default (when none of the above are in operation))

Table 47.

Windows	V2	V3
View 1	Changes automatically between the five first views: ⁽¹⁾ 1. View 1 (Start prepare) ⁽¹⁾ 2. View 2 (Sync.) ⁽¹⁾ 3. View 3 (Ramp up/down) ⁽¹⁾ 4. View 4 ⁽¹⁾ 5. View 5 (Default) ⁽¹⁾	Changes automatically between the five first views: ⁽¹⁾ 1. View 1 (Start prepare) ⁽¹⁾ 2. View 2 (Sync.) ⁽¹⁾ 3. View 3 (Ramp up/down) ⁽¹⁾ 4. View 4 ⁽¹⁾ 5. View 5 (Default) ⁽¹⁾
View 2		
View 3		
View 4	No manual selection.	No manual selection.
View 5	All three lines show measuring values.	Line 1 shows the text 1...5 (above). Line 2 and line 3 show measurements.

(1) The default window is automatically selected after the ramping up when the genset is in normal operation, e.g. fixed power mode.

View window 3

Display of measured values according to the selections made during configuration.

The V3 display changes with running modes:

First display line indicates running status of the unit. The messages shown in the table at the end of this chapter can be displayed.

Second and third display lines display measured values.

Fourth display line displays the selection line.

Display V3 follows the selection in V1 as follows:

1. View 1: (Start prepare)

2. View 2: (Synchronising)

3. View 3: (Ramp up/down)

4. View 4:

5. View 5: (Default (when none of the above are in operation))

Table 48.

Windows	V2	V3
View 1	Changes automatically between the five first views: ⁽¹⁾ 1. View 1 (Start prepare) ⁽¹⁾ 2. View 2 (Sync.) ⁽¹⁾ 3. View 3 (Ramp up/down) ⁽¹⁾ 4. View 4 ⁽¹⁾ 5. View 5 (Default) ⁽¹⁾	Changes automatically between the five first views: ⁽¹⁾ 1. View 1 (Start prepare) ⁽¹⁾ 2. View 2 (Sync.) ⁽¹⁾ 3. View 3 (Ramp up/down) ⁽¹⁾ 4. View 4 ⁽¹⁾ 5. View 5 (Default) ⁽¹⁾
View 2		
View 3		
View 4	No manual selection. All three lines show measuring values.	No manual selection. Line 1 shows the text 1...5 (above). Line 2 and line 3 show measurements.
View 5		

(1) The default window is automatically selected after the ramping up when the genset is in normal operation, e.g. fixed power mode.

Status line text

This table explains the different messages.

Table 49.

Status text	condition	Comment
BLOCK	Block mode is activated	
SIMPLE TEST	Test mode is activated	
LOAD TEST		
FULL TEST		
SIMPLE TEST ###.#min		
LOAD TEST ###.#min	Test mode activated and test timer counting down	
FULL TEST ###.#min		
ISLAND MAN		
ISLAND SEMI	Genset stopped or running and no other action taking place	
READY ISLAND AUTO		
ISLAND ACTIVE	Genset running in Auto	
AMF MAN	Genset stopped or running and no other action taking place	
AMF SEMI		
READY AMF AUTO	Genset stopped in Auto	
AMF ACTIVE	Genset running in Auto	
FIXED POWER MAN	Genset stopped or running and no other action taking place	
FIXED POWER SEMI		
READY FIXED P AUTO	Genset stopped in Auto	
FIXED POWER ACTIVE	Genset running in Auto	
PEAK SHAVING MAN	Genset stopped or running and no other action taking place	
PEAK SHAVING SEMI		
READY PEAK SHAV AUTO	Genset stopped in Auto	



Status text	condition	Comment
PEAK SHAVING ACTIVE	Genset running in Auto	
LOAD TAKEOVER MAN	Genset stopped or running and no other action taking place	
LOAD TAKEOVER SEMI		
READY LTO AUTO	Genset stopped in Auto	
LTO ACTIVE	Genset running in Auto	
MAINS P EXPORT MAN	Genset stopped or running and no other action taking place	
MAINS P EXPORT SEMI		
READY MPE AUTO	Genset stopped in Auto	
MPE ACTIVE	Genset running in mains power export mode	
DG BLOCKED FOR START	Generator stopped and active alarm(s) on the generator	
GB ON BLOCKED	Generator running, GB open and an active "Trip GB" alarm	
SHUTDOWN OVERRIDE	The configurable input is active	
ACCESS LOCK	The configurable input is activated, and the operator tries to activate one of the blocked keys	
GB TRIP EXTERNALLY	Some external equipment has tripped the breaker	An external trip is logged in the event log
MB TRIP EXTERNALLY	Some external equipment has tripped the breaker	An external trip is logged in the event log
IDLE RUN	The "Idle run" function is active. The genset will not stop, until a timer has expired	
IDLE RUN ###.#min	The timer in the "Idle run" function is active	
COMPENSATION FREQ.	Compensation is active	The frequency is not at the nominal setting
Aux. test ##.#V #####s	Battery test activated	
DELOAD	Decreasing the load of the genset in order to open the breaker	
START DG(s) IN ###s	The start genset setpoint is exceeded	
STOP DG(s) IN ###s	The stop genset setpoint is exceeded	
START PREPARE	The start prepare relay is activated	
START RELAY ON	The start relay is activated	
START RELAY OFF	The start relay is deactivated during the start sequence	
MAINS FAILURE	Mains failure and mains failure timer expired	
MAINS FAILURE IN ###s	Frequency or voltage measurement is outside the limits	The timer shown is the mains failure delay. Text in mains units
MAINS U OK DEL #####s	Mains voltage is OK after a mains failure	The timer shown is the mains OK delay
MAINS f OK DEL #####s	Mains frequency is OK after a mains failure	The timer shown is the mains OK delay
Hz/V OK IN ###s	The voltage and frequency on the genset is OK	When the timer runs out it is allowed to operate the generator breaker
COOLING DOWN ###s	Cooling down period is activated	

Status text	condition	Comment
GEN-SET STOPPING	This info is shown when cool down has finished	
EXT. STOP TIME ###s		
PROGRAMMING LANGUAGE	This info is shown if the language file is downloaded from the PC utility software	
TOO SLOW 00<-----	Generator running too slow during synchronising	
-----> 00 TOO FAST	Generator running too fast during synchronising	
EXT. START ORDER	A planned AMF sequence is activated	There is no failure on the mains during this sequence
SELECT GEN-SET MODE	Power management has been deactivated and no other genset mode has been selected	Option G5 must be available
QUICK SETUP ERROR	Quick setup of the application failed	
MOUNT CAN CONNECTOR	Connect the power management CAN line	
ADAPT IN PROGRESS	The AGC is receiving the application that it has just been connected to	
SETUP IN PROGRESS	The new AGC is being added to the existing application	
SETUP COMPLETED	Successful update of the application in all AGC units	
REMOVE CAN CONNECTOR	Remove the power management CAN lines	
RAMP TO #####kW	The power ramp is ramping in steps, and the next step that will be reached after the timer has expired will be displayed	
DERATED TO #####kW	Displays the ramp down setpoint	
PREPARING ETHERNET	Initialising the Modbus TCP/IP	
PREPARING ENGINE IF	Preparing engine IF	
PROGRAMMING MLOGIC		

Texts only related to Power Management (option G5)
Table 50.

Status text	Condition	Comment
DG unit		
BLACKOUT ENABLE	This information is shown if a CAN failure is present in a power management application	
UNIT STANDBY	If redundant mains units are present, this message is shown on the redundant unit	
DELOADING BTB XX	DG units are load sharing asymmetrically to deload BTB XX dividing two sections in an application	
BTB XX DIVIDING SEC.	BTB XX is dividing two sections in an application	
SYNCHRONISING TB XX	TB XX is synchronising	

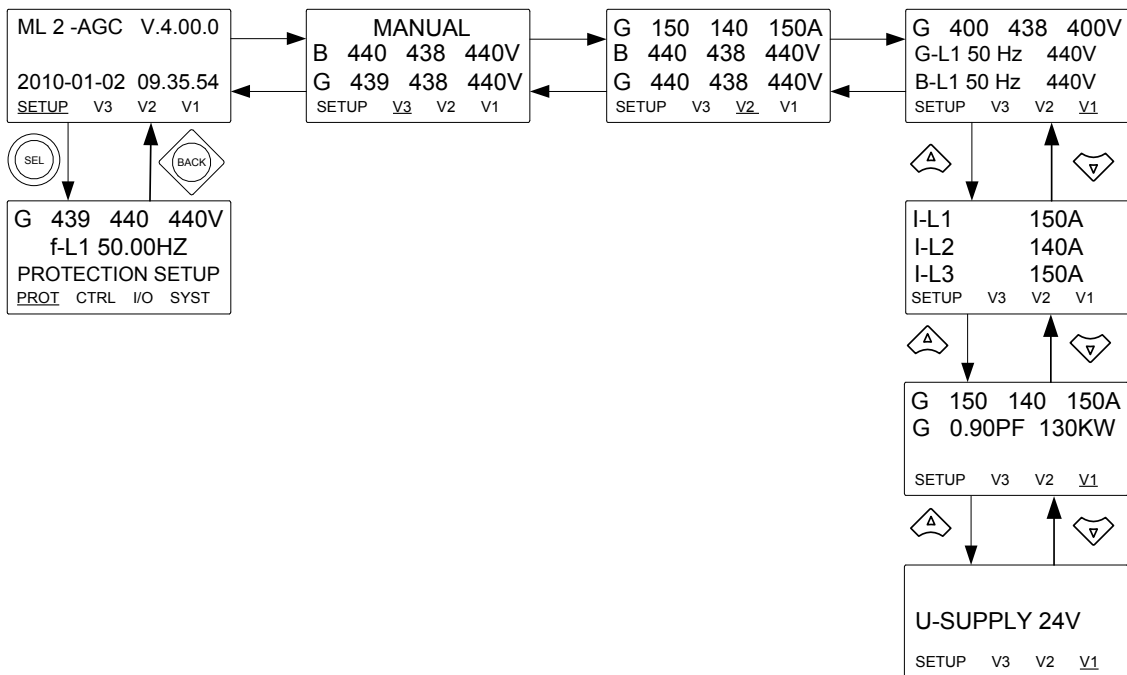


Status text	Condition	Comment
SYNCHRONISING MB XX	MB XX is synchronising	
SYNCHRONISING BTB XX	BTB XX is synchronising	
Mains unit		
UNIT STANDBY	If redundant mains units are present, this message is shown on the redundant unit	
TB TRIP EXTERNALLY	Some external equipment has tripped the breaker	An external trip is logged in the event log
BTB unit		
DIVIDING SECTION	A BTB unit is dividing two sections in an application	
READY AUTO OPERATION	BTB unit in Auto and ready for breaker operation (no active "BTB trip" alarm)	
SEMI OPERATION	BTB unit in Semi	
AUTO OPERATION	BTB unit in Auto, but not ready for breaker operation (active "BTB trip" alarm)	
BLOCKED FOR CLOSING	Last open BTB in a ring bus	
BTB TRIP EXTERNALLY	Some external equipment has tripped the breaker	An external trip is logged in the event log
All units		
BROADCASTING APPL. #	Broadcast of an application through the CAN line	Broadcasts one of the four applications from one unit to the other AGCs in the power management system
RECEIVING APPL. #	AGC receiving an application	
BROADCAST COMPLETED	Successful broadcast of an application	
RECEIVE COMPLETED	Application received successfully	
BROADCAST ABORTED	Broadcast terminated	
RECEIVE ERROR	Application is not received correctly	

View menu example

The following is an example of a configured view menu system. In this example, four of 15 windows have been configured in view 1.

Figure 175.



Mode menu

If the MODE push-button is pushed, a selection of possible running modes appears in the fourth display line.

Using the Left and Right push-buttons moves the cursor, and the appropriate mode can be selected by pressing the SEL button:

Table 51.

Mode	Description
SEMI	The display push-buttons (START, STOP, GB ON, GB OFF) are active and can be used by the operator.
	The regulators are also active, i.e. the speed control will bring the generator to nominal speed upon start.
	When pushing a breaker button for closing, the DEIF AGC will synchronise (if allowed) the breaker. When the breaker closes, the controls stop.
TEST	The unit will start the generator, carry out the test sequence (predefined time period) and stop the generator again. Subsequently, the generator will return to AUTO or SEMI-AUTO mode. The mains breaker will remain closed, and the generator breaker will remain open. NOTE: The test running can be: Simple test: Starting the genset without closing the GB; Load test: Parallel to the mains and take load to a predefined value; Full test: Transfer the load to the genset and open the MB.
AUTO	The unit will automatically carry out the control type selected (AMF, fixed power, etc.).
	The display control push-buttons (START, STOP, GB ON, GB OFF) are disabled.
	If the selected running mode is fixed power, mains power export, load takeover or island, timer start/stop (week watch) or binary input, then start/stop can be used.
MAN	The display push-buttons (START, STOP) are active and can be used by the operator.

Mode	Description
	The regulators are not active, i.e. speed (and voltage) control has to take place using binary inputs for UP and DOWN control.
	The breakers will be able to open or close at any time. A synchronisation check will always be performed to ensure safe closing of the breakers.
BLOCK	The unit will not be able to start. BLOCK mode can be selected during standstill and the password is needed to exit BLOCK mode. If the BLOCK mode is selected while the genset is running, the mode will have no effect until the genset is stopped. To select another mode after the BLOCK mode, the password must be entered.

To return to the other display functions from MODE selection, press the BACK push-button.

Alarm handling and log list

Alarm handling

When an alarm occurs, the unit will automatically go to the alarm list for display of the alarm.

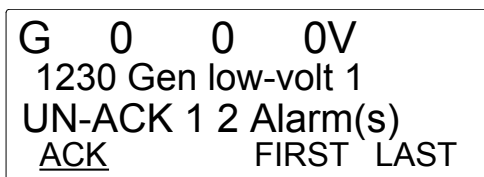
If reading of the alarms is not desired, use the BACK push-button to exit the alarm list.

If you decide to enter the alarm list later, use the INFO push-button to jump directly to the alarm list reading.

The alarm list contains both acknowledged and unacknowledged alarms provided that they are still active (i.e. the alarm condition is still present). Once an alarm is acknowledged and the condition has disappeared, the alarm will no longer be displayed in the alarm list.

This means that if there are no alarms, the alarm list will be empty.

Figure 176.



This display example indicates an unacknowledged alarm. The display can show only one alarm at a time. Therefore, all other alarms are hidden.

To see the other alarms, use the Up and Down push-buttons to scroll in the display.

To acknowledge an alarm, place the cursor (underscore) under "ACK" and then press SEL.

To jump to the first (oldest) or the last (most recent) alarm, place the cursor under the selection (FIRST or LAST) and press SEL.

Log list

The log is divided into three different lists:

1. Events
2. Alarms
3. Battery test

The log list contains up to 150 events, the alarm list contains up to 30 historical alarms and the battery test list contains up to 52 historical battery tests.

An event is e.g. closing of breaker and starting of engine. An alarm is e.g. overcurrent or high cooling water temperature. A battery test is e.g. test OK or test failed.

To enter the log list:

1. Press LOG.
2. Select the list which is needed by using the Left and Right push-buttons and press the SEL push-button.
3. To scroll up and down in the list, use the Up and Down push-buttons.

It is also possible to go to the first (oldest) logging or the last (most recent) logging by placing the cursor (underscore) under the selection (move the cursor using the Left and Right push-buttons) and press the SEL push-button.

(For: Control Panel DEIF TDU 107)

Controller Overview

General Description

The Touch Display Unit, TDU 107, is a touch screen solution for controlling either a DEIF AGC-4 genset or mains controller using the Ethernet port.

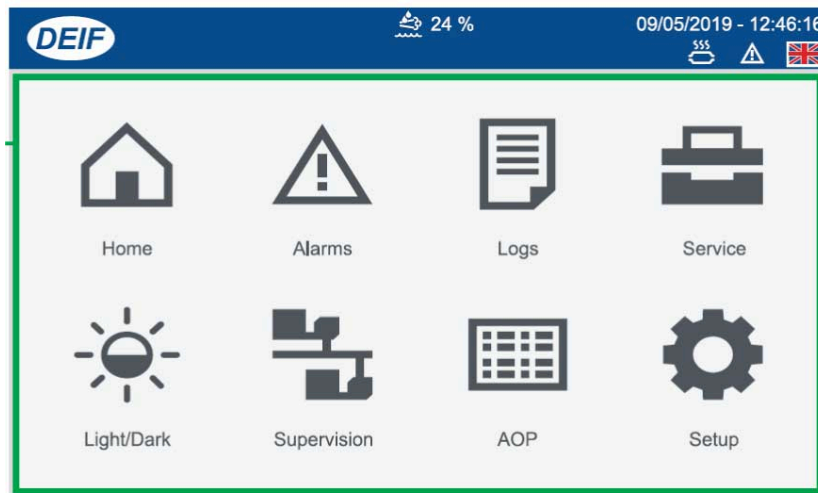
The display gives user-friendly touch screen control, visualisation, and graphic displays from the AGC-4 controller.

Simply operate the controller and access any feature by touching the screen.

Menus

The menu pages give you access to the features and to other menus.

Figure 177.



Return (back) navigation

Some displays allow you to go back to the previous feature or menu.

Use Return to go back to a previous menu or display.

Software Update Using USB

Before You Begin

You can update your TDU 107 with the latest software version by using the USB port.

To update your TDU 107, you need the following:

Required tools:

USB Memory Device (FAT32)

- To import/export the file(s) to your PC.
- Must be formatted for FAT32 file system to be recognised by the TDU 107.

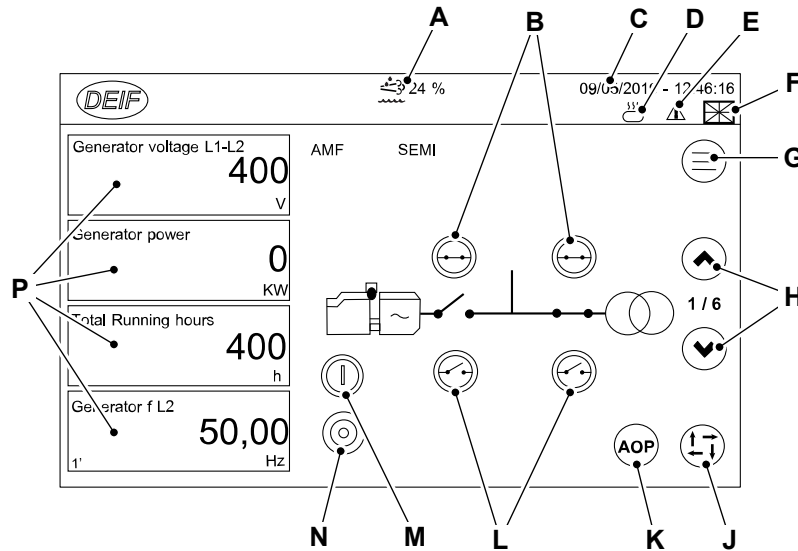
PC

- To download the software package file.
- To copy the software package file to the USB memory device.

Download and Update Software

1. Visit the DEIF homepage <https://www.deif.com/products/tdu-107#software> to download the latest version.
 - 1.1. Software is available for both TDU 107 Core and TDU 107 Extended. Download the software for your version of the TDU 107.
2. Follow the instructions in the DEIF email to complete the software download.
3. Copy the update file across to your USB memory device without renaming the file.
4. Insert the USB memory device in the USB port on the TDU 107.
5. You are then guided through the rest of the installation on the display.

NOTE: The software package is provided as a zipped archive (.zip) file. Do not rename or unzip this file. The file must be copied to your USB memory device with the same file name, and as a ZIP file (.zip) for the update to be recognised by the TDU 107.

Front Overview
Figure 178.

Table 52.

Sr. No.	Item	Function
A	DEF (Diesel Exhaust Fluid) percentage	Shows the percentage of DEF
B	Breaker control	Closes the breaker
C	Date and Time	Shows the controller Date and Time
D	EAT (Exhaust After Treatment) dashboard	Opens EAT dashboard (shortcut)
E	Alarm	Opens alarms (shortcut)
F	Language	Opens language (shortcut)
G	Menu	Opens the menu page
H	Scroll page	Scroll Up or Down
J	Mode change	Manual/SEMI/AUTO/TEST modes
K	AOP	Opens Additional Operator Panel (shortcut)
L	Breaker control	Opens breaker
M	Generator control	Starts generator
N	Generator control	Stops generator
P	Instrument values	Shows instrument values

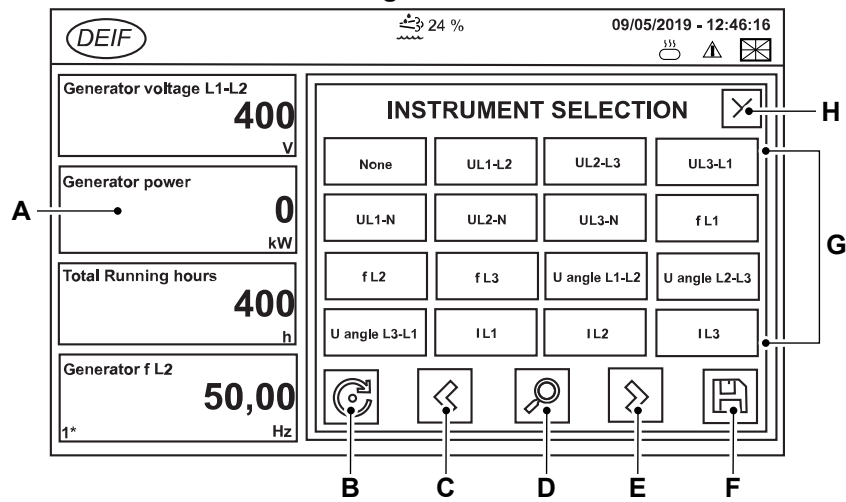
Control Panel

Operates the system, can include mode change, open or close breakers, and start or stop the genset. It also provides instrument values, which can be selected by the operator.

Instrument selection

Changes the displayed instrument value shown on the Control panel page.

Figure 179.



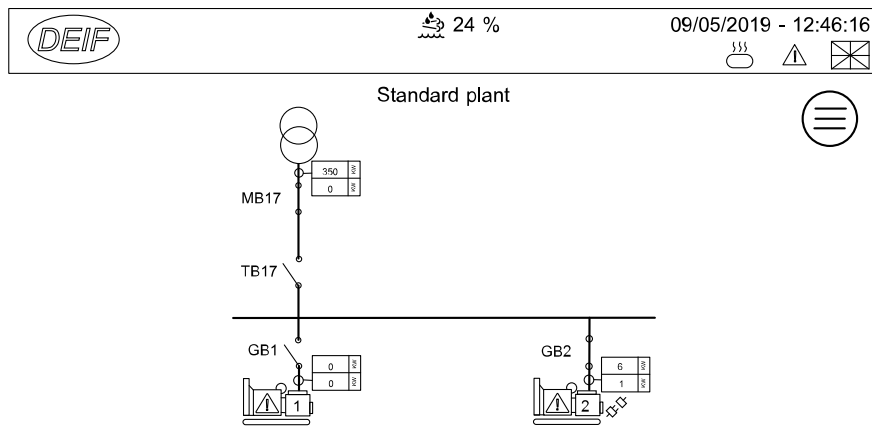
- A Instrument value to be changed
- C Scroll page left
- E Scroll page right
- G Instrument values

- B Refresh
- D Search
- F Save
- H Cancel

Supervision

Views the state of the system in real-time.

Figure 180.



Controller Settings

Views or configures the controller parameter settings.

Figure 181.

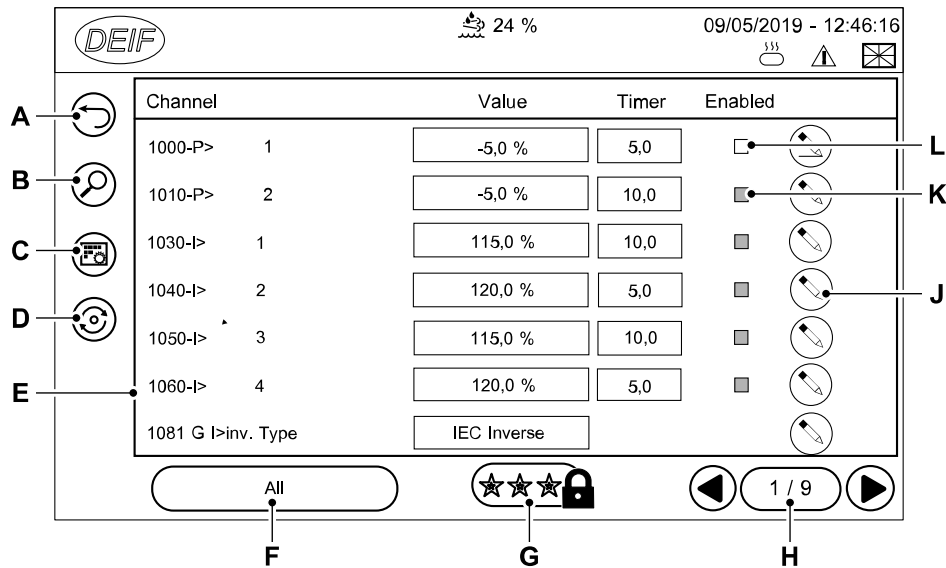
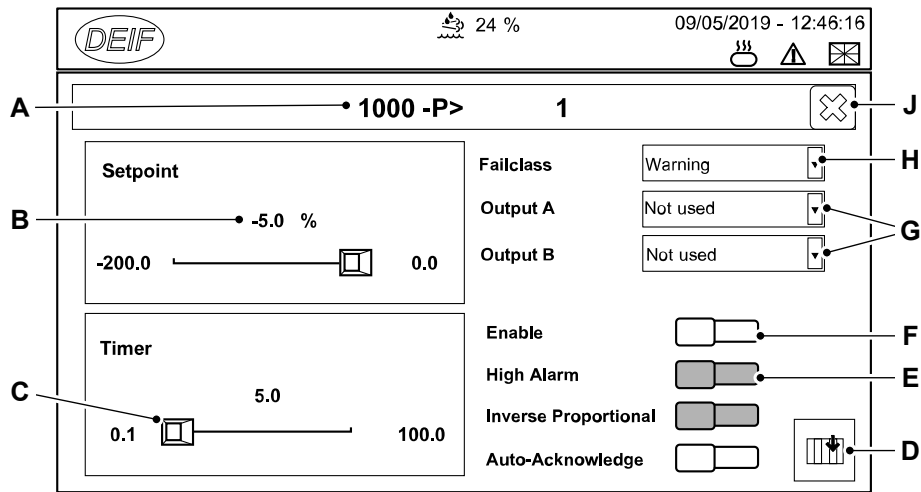


Table 53.

Sr. No.	Item	Function
A	Return	Return to previous display
B	Search	Opens search keyboard
C	Filter groups	Opens groups of parameters
D	Refresh	Reloads the list
E	Controller settings list	Scroll settings up or down on this page
F	Clear filter group	Clears the filter group (if used)
G	Filter by password level	Filters the list by minimum password level
H	Scroll page	Scroll the page left or right
J	Edit	Edits the settings
K	Enabled Status	Not enabled
L	Enabled Status	Enabled

Edit Settings

Edits the controller setting that was selected.

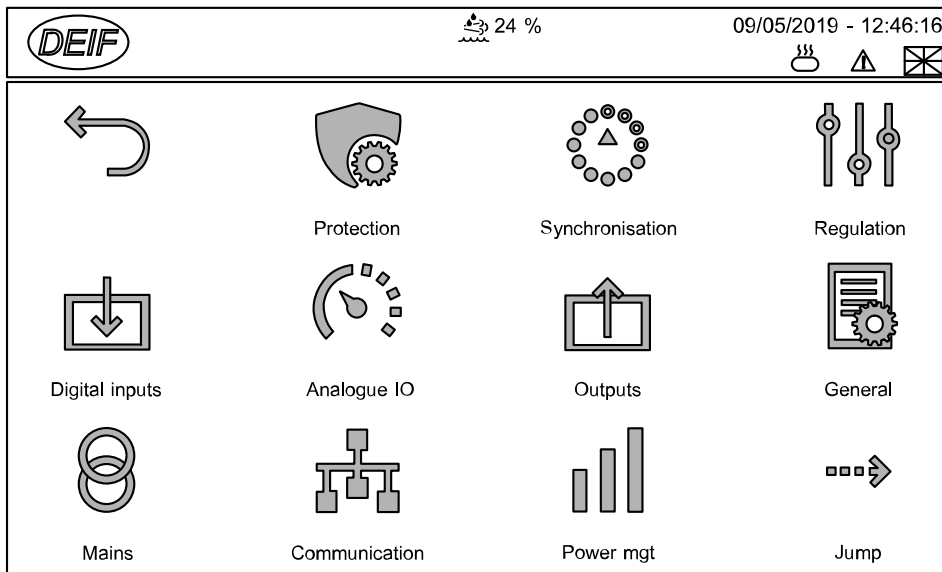
Figure 182.

Table 54.

Sr. No.	Item	Function
A	Setting	Shows the name of the setting
B	Value	Shows or edits the value of the setting
C	Value (scroll)	Scrolls left or right to increase or decrease the value
D	Write	Writes the settings to the controller
E	Settings	Cannot be changed
F	Settings	Settings enabled or disabled
G	Output	Selects an output terminal
H	Failclass	Selects a failclass
J	Cancel	Cancels the changes

Filter Groups

Lists the filter groups you can use to filter the controller settings page.

Figure 183.



Alarms

Views or acknowledges any alarm created in the system.

Figure 184.

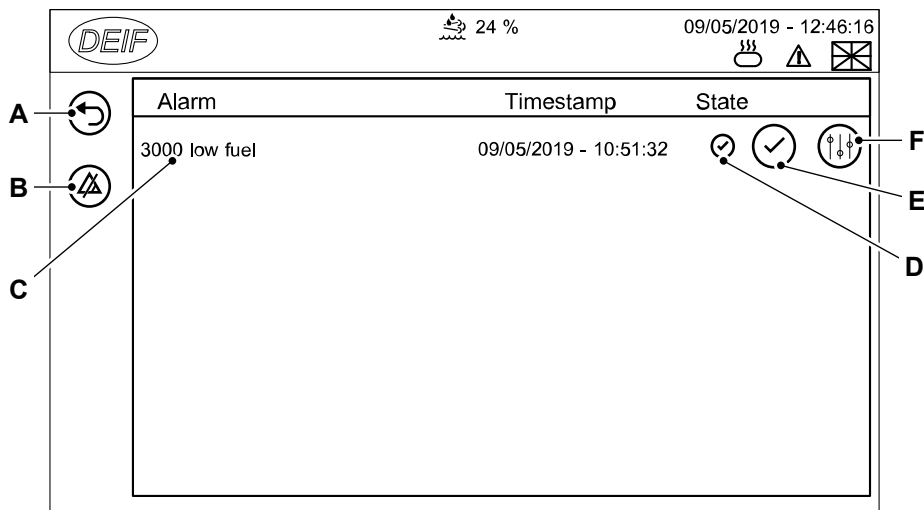


Table 55.

Sr. No.		
A	Back	Returns to previous display.
B	Acknowledge all alarms	Acknowledges all unacknowledged alarms.
C	Alarm list	Scrolls the alarms list up or down.
D	Alarm state	Shows the state of the alarm acknowledged or unacknowledged.

Sr. No.		
E	Acknowledge	Acknowledges alarm.
F	Alarm settings	Opens the alarm configuration.

Alarms Pop-up

New alarms activated in the system are shown on the alarms pop-up at the top of the display.

Figure 185.

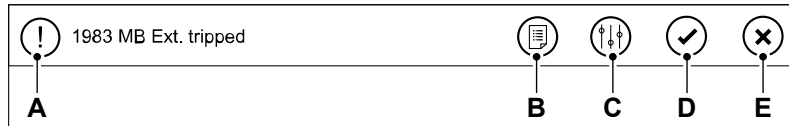


Table 56.

Sr. No.	Item	Function
A	Alarm	Shows the activated alarm.
B	Alarms list	Opens the alarms list (shortcut).
C	Alarm settings	Opens the alarm settings (shortcut).
D	Acknowledge	Acknowledges the alarm (shortcut).
E	Cancel	Cancels the pop up message.

Logs

Shows the list of all recorded events or alarms created in the system. You can also filter, merge, or view further details on the events.

Figure 186.

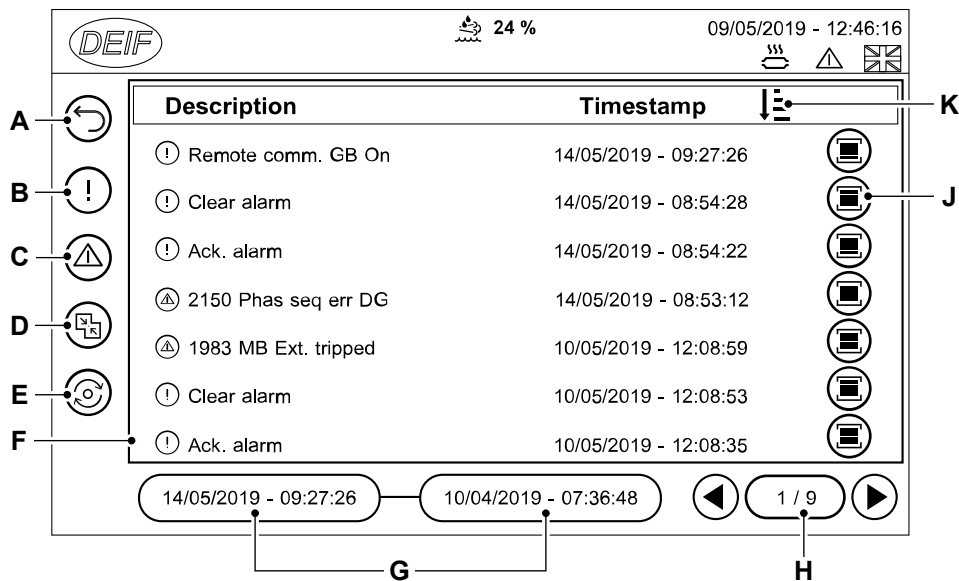
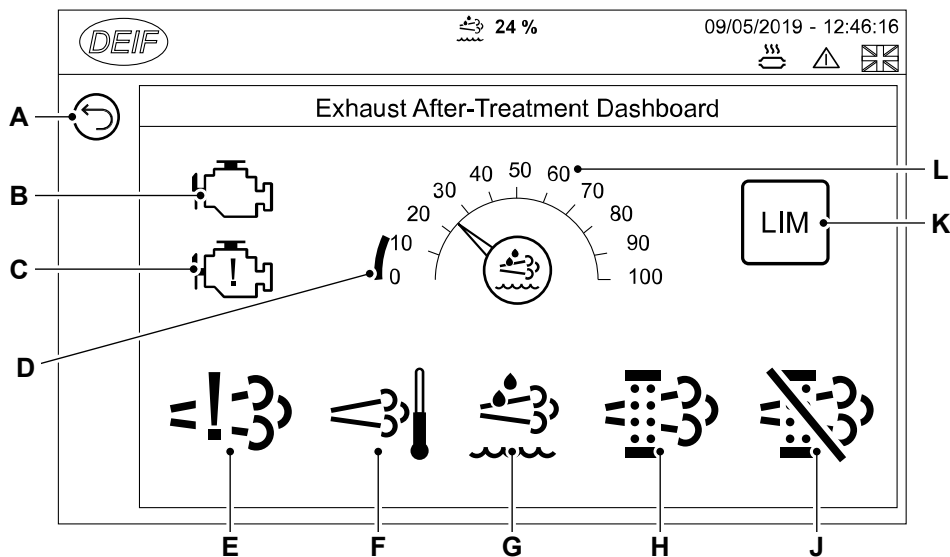


Table 57.

Sr. No.	Item	Function
A	Return	Returns to previous display.
B	Filter	Filters the list by showing alarms only.
C	Filter	Filters the list by showing events only.
D	Merge list	Merges the list to show both alarms and events.
E	Refresh	Refreshes the log list.
F	Log list	Scrolls the log list up or down.
G	Page range	Shows the date range of the list page shown.
H	Scroll page	Scroll the page left or right.
J	Event details	Shows the event details.
K	Sort page	Sorts the page in ascending or descending order.

Exhaust After-Treatment Dashboard (Tier4)

Shows information about the EAT system.

Figure 187.

Table 58.

Sr. No.	Item	Function
A	Return	Returns to previous display.
B	Engine interface status	Shows an engine warning.
C	Engine interface status	Shows an engine shutdown.
D	Minimum DEF % level	Shows th minimum low level for the DEF.
E	Engine emission system failure	Shows an emission failure or malfunction.
F	High temperature - regeneration	Shows a high temperature and regeneration is i n process.
G	DEF	Shows the level is too low.
H	DPF (Diesel Particulate Filter)	Shows that a regeneration is needed.
J	DPF inhibit	Shows that regeneration is inhibited.

Sr. No.	Item	Function
K	LIM	Limit lamp.
L	Minimum DEF % level	Shows the level (%) of the DEF.

Alternator Curve

Views or configures the safe operation limits for the alternator.

Figure 188.

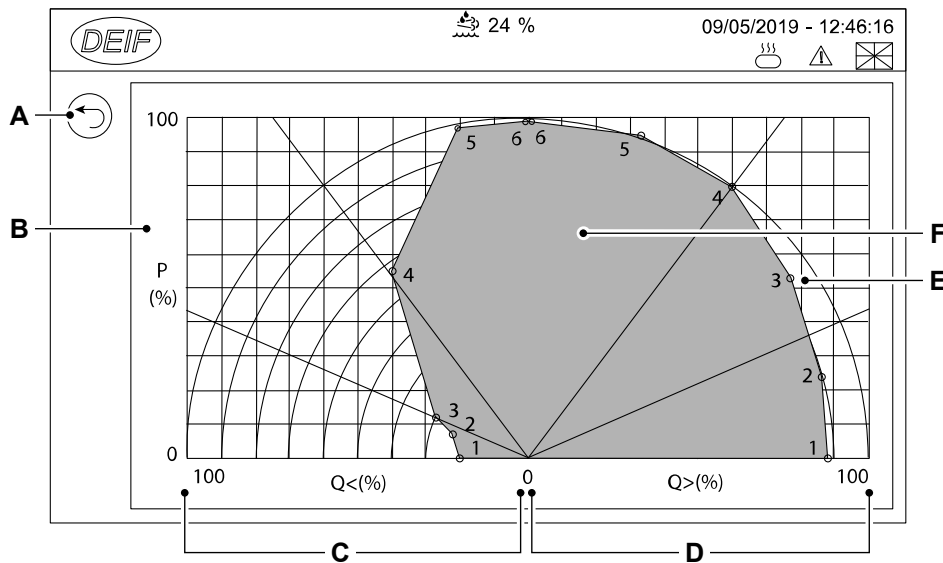


Table 59.

Sr. No.	Item	Function
A	Return	Returns to previous display.
B	Alternator curve	Shows the safe operation limits for the alternator.
C	Import (leading)	Opens the capacitive Q< configuration.
D	Export (lagging)	Opens the inductive Q> configuration.
E	Setting point	Shows the numbered setting points.
F	Actual working points	Shows the gensets actual working point.

Additional Operator Panel

Additional Operator Panels (AOPs) provide you with LED indication and button actions. You can configure

the LED or button labels directly on the display, but the functionality behind them must be configured in your M-logic project on the utility software.

Figure 189.

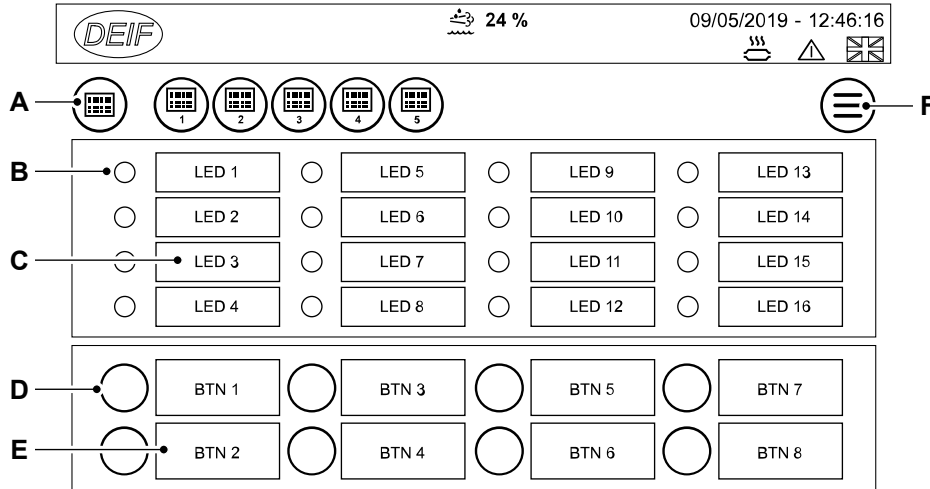


Table 60.

Sr. No.	Item	Function
A	Panel selection	Tap tp select the panel to display.
B	LED status	Shows the LED status from the M-logic project conditions. ⁽²⁾
C	LED name	Edits the LED name. ⁽¹⁾
D	Button	Operated the button if configured.
E	Button name	Edits the button name. ⁽¹⁾
F	Menu	Opens the menu page.

(1) LED name and button name are saved locally on the TDU 107.

(2) The logic conditions must be configured in your M-logic project for the LED status and buttons to work.

Language

Selects an active language for the display.

Figure 190.

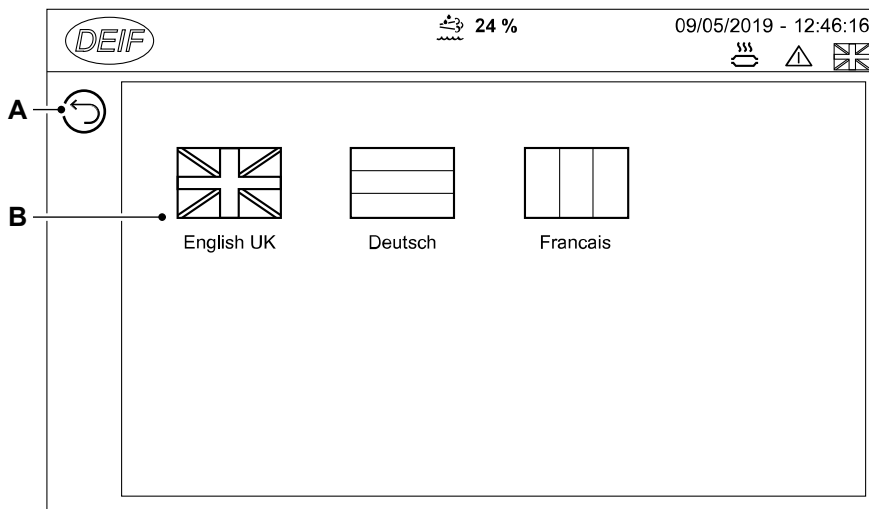


Table 61.

Sr. No.	Item	Function
A	Return	Return to previous display.
B	Languages ⁽¹⁾	Shows the available active languages.

(1) The actual languages shown must be both installed and active to be listed for selection.

User Permissions

Password Levels

Figure 191.

Symbol	Password level	Symbol	Password level
	No login required		Level 1 - Customer
	Level 2 - Service		Level 3 - Master

User Permissions

Features of the display can be restricted to the AGC-4 password levels.

Figure 192.

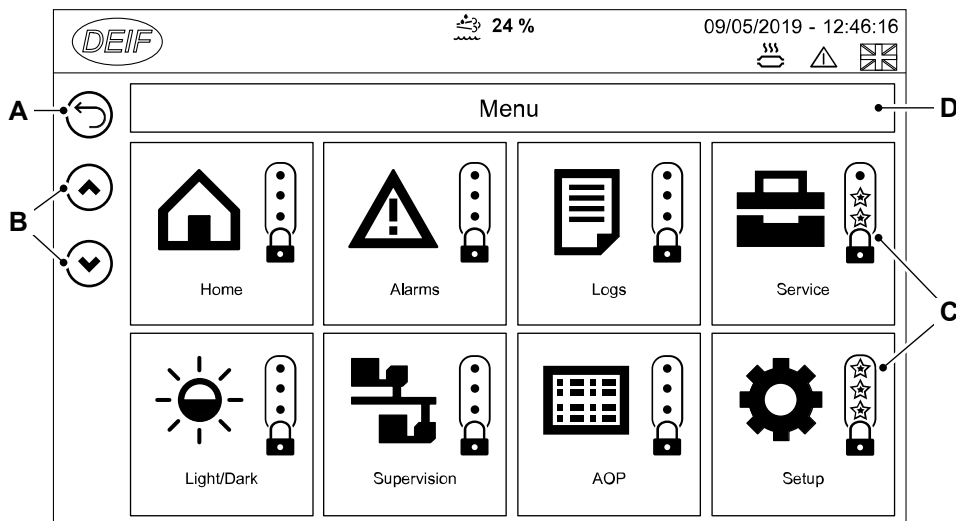
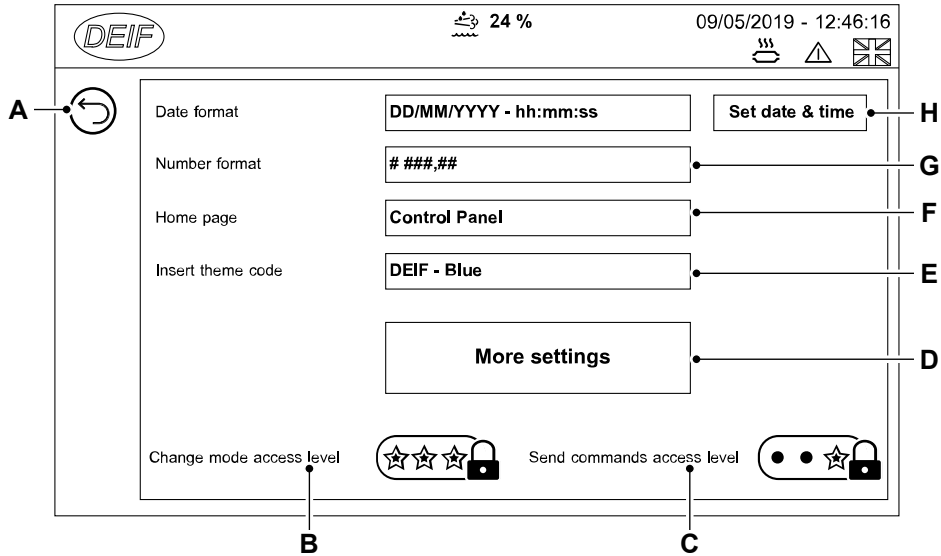


Table 62.

Sr. No.	Item	Description
A	Return	Returns to previous display.
B	Scroll page	Scrolls page up or down.
C	Feature permissions	Toggles through the password levels.
D	Page	Shows the page group name.

Display Configuration

View or configures the display settings.

Figure 193.

Table 63.

Sr. No.	Item	Function
A	Return	Returns to previous display
B	Change mode access level	Shows the minimum access level required to change operation mode.
C	Send commands access level	Shows the minimum access level required to send commands.
D	More settings	Opens the more settings page.
E	Theme code	Edits the name of the theme code.
F	Home page default	Selects the default to show on the home page.
G	Number format	Selects the format for the numbers shown.
H	Date and time	Shows the date and time format.

More Settings

Figure 194.

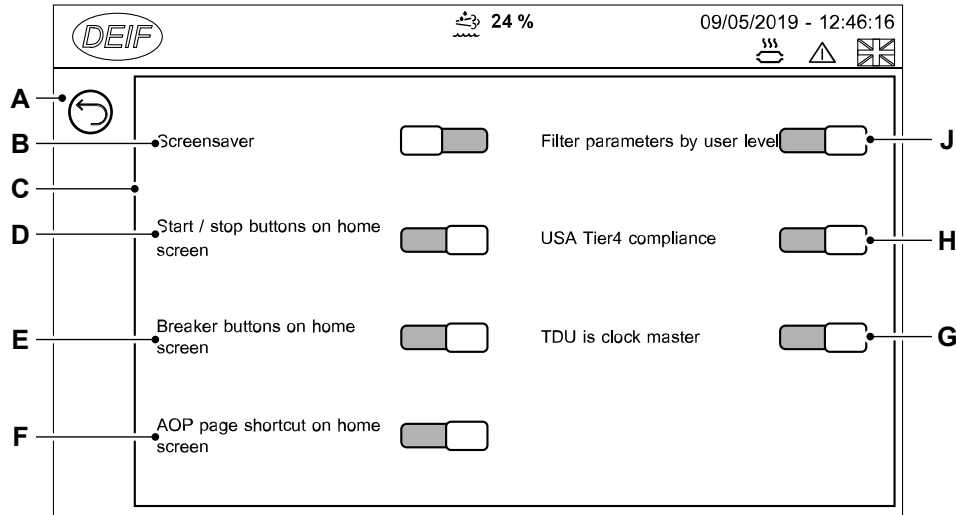


Table 64.

Sr. No.	Item	Description
A	Return	Returns to previous display.
B	Screen saver	Enables or disables the screen saver.
C	Settings	Toggles on or off additional settings.
D	Start or stop buttons	Shows or hides the start or stop buttons on the home page.
E	Breaker buttons	Shows or hides the breaker buttons on the home page.
F	AOP shortcut	Shows or hides the start or stop buttons on the home page.
G	TDU clock master	Enables or disables the TDU as the master clock for the system.
H	Tier 4 compliance	Enable this to automatically display the EAT Dashboard if an alarm becomes active.
J	Filer parameters	Enables or disables the filtering of parameters by minimum password level.

Language Management

Manages the display translations available on the display. Only Active languages can be used on the display.

Figure 195.

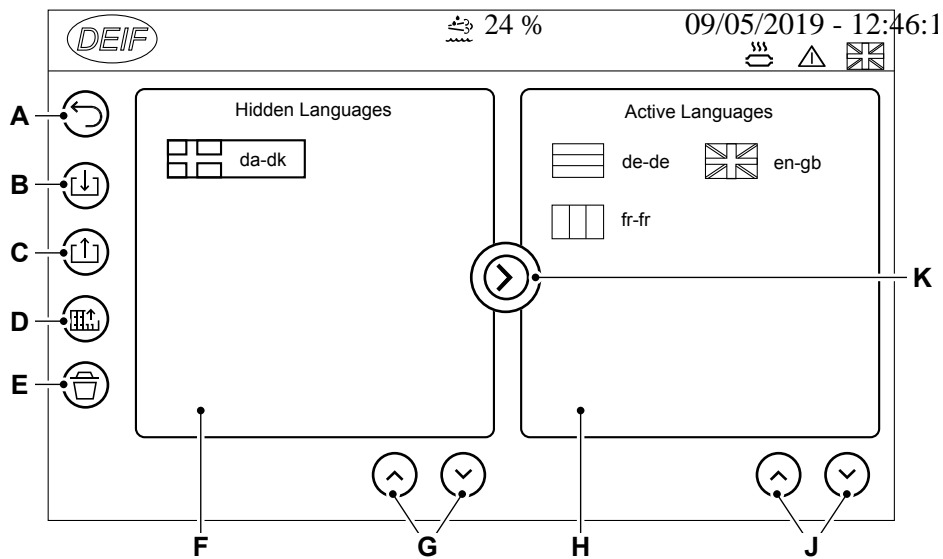


Table 65.

Sr. No.	Item	Description
A	Return	Returns to previous display.
B	Import	Imports all language files present on the USB (Universal Serial Bus) device.
C	Export	Exports the selected language to the USB device.
D	Create language	Create a new language file to the USB device.
E	Delete	Deletes the selected language file.
F	Hidden language list	Shows languages that are hidden from use.
G	Hidden language scroll page	Scrolls page up or down.
H	Active languages list	Shows languages that are active for use.
J	Active languages scroll page	Scrolls page up or down.
K	Move selected language	Move the selected language file.

(For: Control Panel 7310)

⚠ WARNING Electric shock hazard. High voltage can cause serious injury or death. Make sure that all work is performed by qualified personnel. All cabling to the load must comply with the applicable laws and electrical standards.

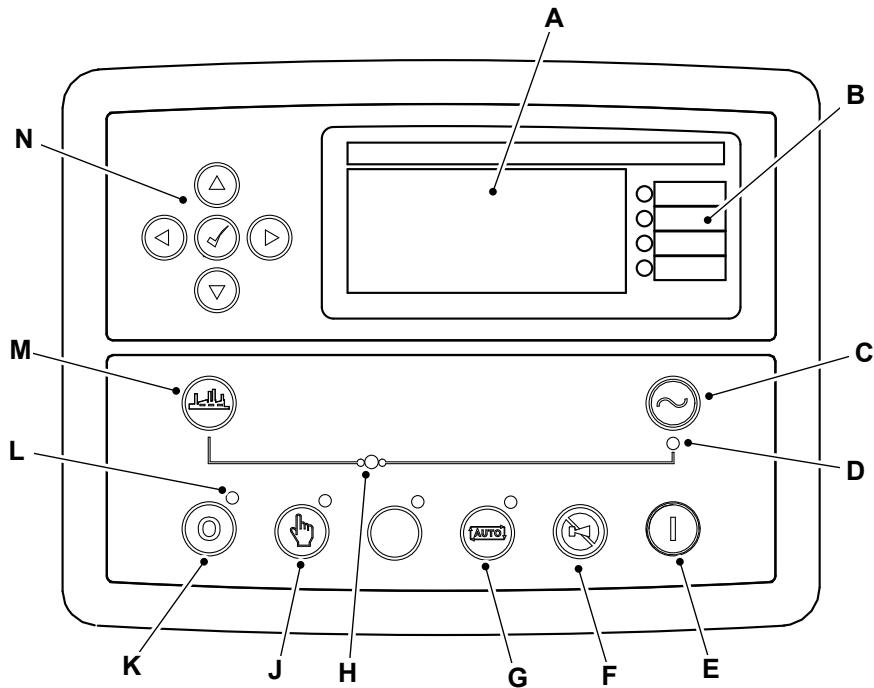
Notice: Possibility of equipment damage. Proper sizing is critical to the operation and performance of the generator. Make sure that the load is sized correctly for the capacity of your generator and cables.

This is the stand alone generator controller. DSE 7310 can not synchronise.

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 which need to be operated for the normal operation. Refer to Table 66.

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 when it is set to Auto Mode. Prior to performing any maintenance on the system, it is recommended that steps are taken to remove the battery and isolate supplies.

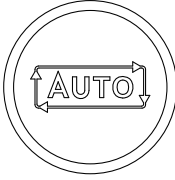
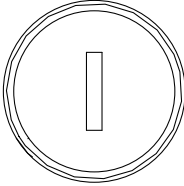
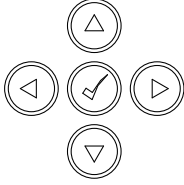
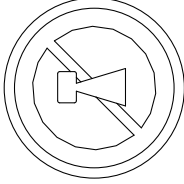
Figure 196.


- | | |
|---|--|
| A Module display | B Four configurable status LED |
| C Close generator | D Generator available LED |
| E Start button | F Alarm mute and lamp test |
| G Auto mode | H Generator breaker LED (not used) |
| J Manual mode | K Stop/reset button |
| L Selected mode indication LED | M Open generator (manual mode only) |
| N Module display Menu navigation buttons | |

Control Push-Buttons

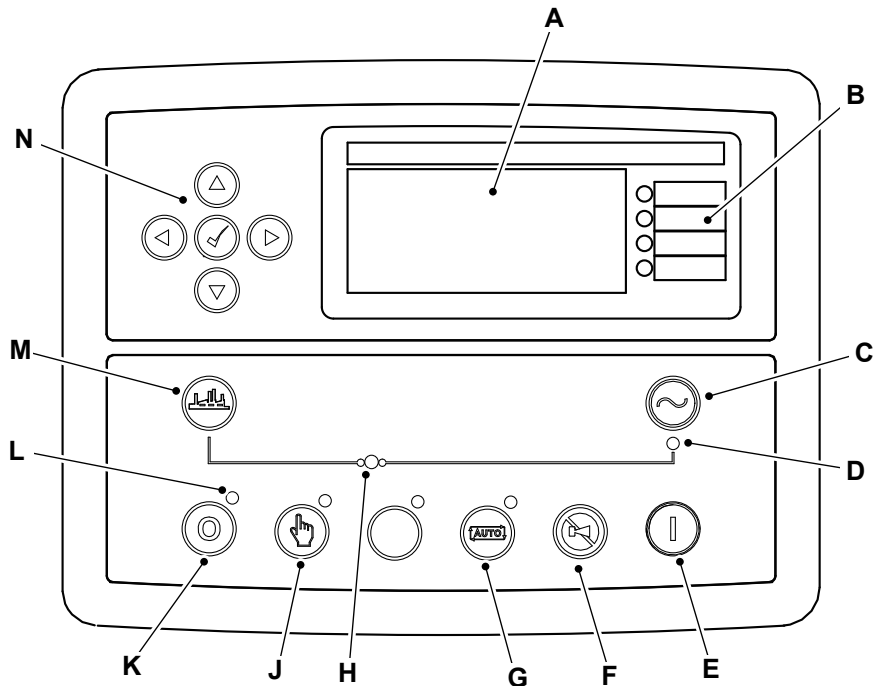
Table 66. Control panel 7310

	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/RESET mode, the module will automatically instruct the generator to unload ('Close Generator output' becomes inactive). In STOP/RESET mode the generator remains at rest.
	This button places the module into its MANUAL mode. Once in MANUAL mode, the module responds to the start button to start the generator and run it off load. The MCCB (Moulded Case Circuit Breaker) need to be closed manually.

	<p>This button places the module into its AUTO MODE. This mode allows the module to control the function of the generator automatically. The module monitors numerous start requests via digital input, PLC and MSC link and when one has been made, the set is automatically started. Once the generator is available, the module automatically instructs the generator to synchronise and once in sync, to be place the generator on load ('Close Generator Output' becomes active). Upon removal of the starting signal, the module starts the Return Delay Timer and once expired, the load is automatically ramped off the generator and then it is taken off load ('Close Generator Output' becomes inactive). The generator then continues to run for the duration of the Cooling Timer until it stops. The module then waits for the next start event.</p>
	<p>This button is only active in the STOP/RESET mode, MANUAL mode. Pressing the Start button in Stop/Reset Mode powers up the engine's ECU (Electronic Control Unit) but does not start the engine. This can be used to check the status of the CAN (Controller Area Network) communication and to prime the fuel system.</p>
	<p>Used for navigating the instrumentation, event log and configuration screens.</p>
	<p>Used to silences the audible alarm in the controller, de-activates the audible alarm output (if configured) and illuminates all of the LED on the module's fascia as a lamp test function.</p>

(For: Control Panel 8610)


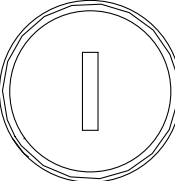
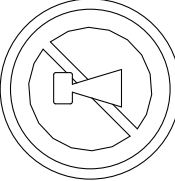
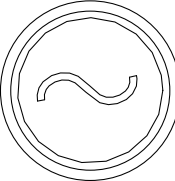
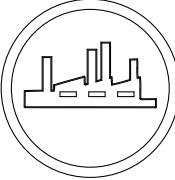
This is the stand alone generator controller. DSE 8610 can synchronise.

Figure 197.


- | | |
|---|--|
| A Module display | B Four configurable status LED |
| C Close generator | D Generator available LED |
| E Start button | F Alarm mute and lamp test |
| G Auto mode | H Generator breaker LED |
| J Manual mode | K Stop/reset button |
| L Selected mode indication LED | M Open generator (manual mode only) |
| N Module display Menu navigation buttons | |

Table 67. Control Panel 8610

	<p>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/RESET mode, the module will automatically instruct the generator to unload ('Close Generator output' becomes inactive). In STOP/RESET mode the generator remains at rest.</p>
	<p>This button places the module into its MANUAL mode. Once in MANUAL mode, the module responds to the start button to start the generator and run it off load. To place the generator on load, use the 'Transfer to Generator' button. The module automatically instructs the generator to synchronise and once in sync, to be place the generator on load ('Close Generator Output' becomes active). To place the generator off load, use the 'Open Generator' button. The module automatically ramps the load off the generator and then takes it off load ('Close Generator Output' becomes inactive). Additional digital inputs are available to perform these functions. If the generator is running off-load in MANUAL mode and on load signal becomes active, the module automatically instructs the generator to synchronise and once in sync, to be place the generator on load ('Close Generator Output' becomes active). Upon removal of the on load signal, the generator remains on load until either selection of the 'STOP/RESET' mode or 'AUTO' mode.</p>

	<p>This button places the module into its AUTO MODE. This mode allows the module to control the function of the generator automatically. The module monitors numerous start requests via digital input, PLC and MSC link and when one has been made, the set is automatically started. Once the generator is available, the module automatically instructs the generator to synchronise and once in sync, to be place the generator on load ('Close Generator Output' becomes active). Upon removal of the starting signal, the module starts the Return Delay Timer and once expired, the load is automatically ramped off the generator and then it is taken off load ('Close Generator Output' becomes inactive). The generator then continues to run for the duration of the Cooling Timer until it stops. The module then waits for the next start event.</p>
	<p>This button is only active in the STOP/RESET mode, MANUAL mode. Pressing the Start button in Stop/Reset Mode powers up the engine's ECU but does not start the engine. This can be used to check the status of the CAN communication and to prime the fuel system.</p>
	<p>Used for navigating the instrumentation, event log and configuration screens.</p>
	<p>Used to silences the audible alarm in the controller, de-activates the audible alarm output (if configured) and illuminates all of the LED on the module's fascia as a lamp test function.</p>
	<p>Close Generator- The Close Generator button controls the operation of the generator load switch and is only active in the Manual Mode once the generator is available. Pressing the Close Generator button when the generator is available and off load automatically instructs the generator to synchronise and once in sync, to be place the generator on load ('Close Generator Output' becomes active). If the generator bus is dead (has not supply on it) the generator is placed on load immediately. Further presses of the Close Generator button have no effect.</p>
	<p>Open Generator- The Open Generator button is only active in the Manual Mode and allows the operator to open the generator load switch. Pressing the Open Generator button when the Generator is on load, automatically ramps the load off the generator and then takes it off load ('Close Generator Output' becomes inactive). Further presses of the Open Generator button have no effect.</p>



72 - Fasteners and Fixings

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00 - Fasteners and Fixings

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00 - General

Introduction

JCB Fasteners (Before September 2017)

Some external fasteners on JCB machines are manufactured using an improved type of corrosion resistant finish. This type of finish is called Dacromet and replaces the original Zinc and Yellow Plating used on earlier machines. The two types of fasteners can be readily identified by colour and part number suffix. Refer to Table 1. Fastener Types.

Table 68.

Fastener Type	Colour	Part Number Suffix
Zinc and Yellow	Golden Finish	Z (e.g. 1315/3712Z)
Dacromet	Mottled Silver Finish	D (e.g. 1315/3712D)

Note: As the Dacromet fasteners have a lower torque setting than the Zinc and Yellow fasteners, the torque figures used must be relevant to the type of fastener.

A Dacromet bolt should not be used in conjunction with a Zinc or Yellow plated nut, as this could change the torque characteristics of the torque setting further. For the same reason, a Dacromet nut should not be used with a Zinc or Yellow plated bolt.

All bolts used on JCB machines are high tensile and must not be replaced by bolts of a lesser tensile specification.

Dacromet bolts, due to their high corrosion resistance are used in areas where rust could occur. Dacromet bolts are only used for external applications. They are not used in applications such as gearbox or engine joint seams or internal applications.

JCB Fasteners (After September 2017)

Table 69.

Fastener Type	Colour	Part Number Suffix
Zinc flake-silver	White aluminium (silver-grey), Dull	D (e.g. 1315/3712D)
Zinc and heavy trivalent passivated with seal	Silver (Bright iridescent)	V (e.g. 1315/3712V)
Zinc Nickel - silver/grey	Dark, dull silver grey	Not assigned

Fastener Type	Colour	Part Number Suffix
Zinc Nickel - black	Black, chalky texture	N (e.g. 1315/3712N)
Zinc flake - black	Black, slight gloss	B (e.g. 1315/3712B)

Torque and Angle Tightening

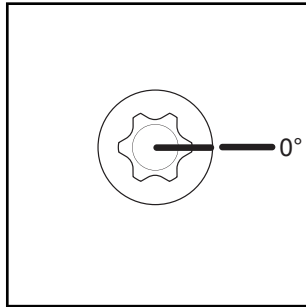
Insufficient pre-load of a bolted joint can cause major problems, such as cylinder head warp, leaking gasket joints etc. There are several methods of achieving an accurate pre-load of a bolted joint, the two main methods used on the JCB engine are:

- Torque Control Tightening - Using a torque meter to control the torque is the most popular means of controlling pre-load, and in the majority of instances this method is adequate. It should be noted that with this process, the majority of the torque is used to overcome friction, therefore slight variations in the frictional conditions can lead to large changes in the bolt pre-load.
- Angle Control Tightening - Where a more precise pre-load is required, the torque and angle tightening method is used. The bolt is tightened to a predetermined torque (this may be done in stages), and then as a final sequence, the bolt is tightened to a predetermined angle - this method of tightening the bolts results in a smaller variation in the final pre-load. It is critical that the predetermined tightening angle is accurately achieved, failure to tighten accurately to the specified angle could result in the bolt pre-load being incorrect - this will lead to eventual failures. It is good practice to replace all bolts that have been tightened using the torque + angle procedure.

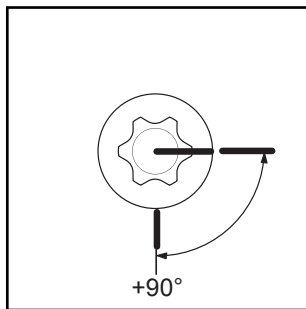
Tightening Method

The following example explains the recommended torque and angle procedure. A torque angle gauge should be used for accuracy, but as a visual check, the bolts can be match marked as described below.

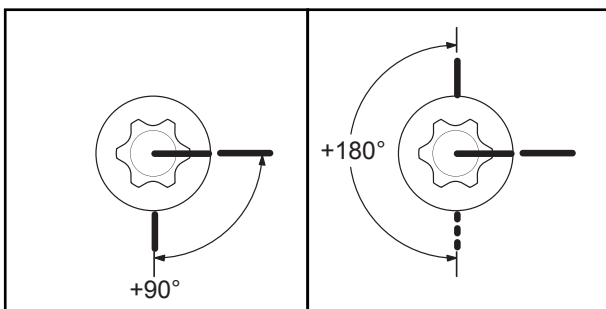
1. Tighten the bolt to the specified torque (specified torque values will be detailed in the relevant PIL sections).
2. Mark a line across the centre of the bolt, and a second line on the part to be clamped - the two lines should be aligned. Refer to Figure 198.

Figure 198.


3. Mark a third line at the specified torque angle - in this instance the additional torque angle is 90° . This line must be marked the specified angle in a clockwise direction (to further tighten the bolt). Refer to Figure 199.

Figure 199.


4. In some instances, angle torque tightening can be specified in two stages, for instance in this example, the first angle quoted is 90° and then a second angle of 180° . The additional 180° angle is from the LAST tightened position. Refer to Figure 200.

Figure 200.


5. Tighten the bolt so that the line on the bolt aligns with the angle(s) marked on the item to be clamped - remember, to ensure complete accuracy an angle gauge should be used.



03 - Screws

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Introduction

Use the torque setting tables (Technical Data) only where no torque setting is specified in the text. Note: Dacromet fasteners are lubricated as part of the plating process, do not lubricate. Torque settings are given for the following conditions:

Table 70. Up to September 2017

Type	Condition 1	Condition 2
no coating	Unlubricated fasteners	Zinc flake silver (Dacromet) fasteners.
2 (obsolete from September 2017).	Zinc fasteners	Lubricated zinc and yellow plated fasteners.
3, 4 (obsolete from September 2017).	Yellow plated fasteners	Where there is a natural lubrication. For example, cast iron components.

Table 71. From September 2017

Type	Condition 1	Condition 2
no coating	Unlubricated fasteners	Dacromet) fasteners.
1	Zinc flake - silver	Zinc flake silver (Dacromet) fasteners.
5	Zinc and heavy trivalent with seal	
7	Zinc nickel - silver	
8	Zinc nickel - black	
9	Zinc flake - black	

Technical Data

**Table 72. Torque Settings - Internal
Hexagon Headed Capscrews (Zinc)**

Bolt Size	
mm	N·m
3	2
4	6
5	11
6	19
8	46
10	91
12	159
16	395
18	550
20	770
24	1,332



06 - Bolts

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Introduction

Use the torque setting tables (Technical Data) only where no torque setting is specified in the text. Note: Dacromet fasteners are lubricated as part of the plating process, do not lubricate. Torque settings are given for the following conditions:

Table 73. Up to September 2017

Type	Condition 1	Condition 2
no coating	Unlubricated fasteners	Zinc flake silver (Dacromet) fasteners.
2 (obsolete from September 2017).	Zinc fasteners	Lubricated zinc and yellow plated fasteners.
3, 4 (obsolete from September 2017).	Yellow plated fasteners	Where there is a natural lubrication. For example, cast iron components.

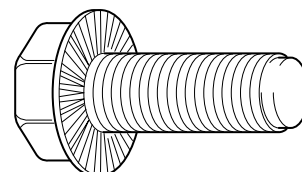
Table 74. From September 2017

Type	Condition 1	Condition 2
no coating	Unlubricated fasteners	Dacromet) fasteners.
1	Zinc flake - silver	Zinc flake silver (Dacromet) fasteners.
5	Zinc and heavy trivalent with seal	
7	Zinc nickel - silver	
8	Zinc nickel - black	
9	Zinc flake - black	

Verbus-Ripp Bolts

Torque settings for these bolts are determined by the application. Refer to the relevant procedure for the required settings.

Figure 201.



Technical Data

From JCB standard STD00019 issue 15.

1. This information does not apply to:-
 - 1.1. Hydraulic fittings (i.e. BSP, SAE O-ring boss, UNF, four bolt split flange and JIC).
 - 1.2. Locking type fasteners (those with a nylon insert, or with distorted thread nuts such as Cleveloc).
2. For information on fastener conditions, refer to fasteners and fixings, bolts, general, introduction.

Table 75. Torque Settings - UNF S Fasteners

Bolt Size	Treads per Inch	Hexa-gon (A/F)	Condition 1	Condition 2
in	in	in	N·m	N·m
(1/4 in)	28	7/16	11.2	10
(5/16 in)	24	1/2	22.3	20
(3/8 in)	24	9/16	40	36
(7/16 in)	20	5/8	64	57
(1/2 in)	20	3/4	98	88
(9/16 in)	18	13/16	140	126
(5/8 in)	18	15/16	196	177
(3/4 in)	16	1 1/8	343	309
(7/8 in)	14	1 15/16	547	492
(1 in)	12	1 1/2	814	732
(1 1/8 in)	12	1 7/8	1,181	1,063
(1 1/4 in)	12	2 1/4	1,646	1,481

Table 76. Torque Settings - UNF X Fasteners

Bolt Size	Treads per Inch	Hexa-gon (A/F)	Condition 1	Condition 2
in	in	in	N·m	N·m
(1/4 in)	28	7/16	17.6	15.9
(5/16 in)	24	1/2	35.2	31.6
(3/8 in)	24	9/16	64	57
(7/16 in)	20	5/8	101	91
(1/2 in)	20	3/4	155	139
(9/16 in)	18	13/16	221	199
(5/8 in)	18	15/16	310	279
(3/4 in)	16	1 1/8	542	488
(7/8 in)	14	1 15/16	864	777
(1 in)	12	1 1/2	1,285	1,156
(1 1/8 in)	12	1 7/8	1,865	1,679
(1 1/4 in)	12	2 1/4	2,598	2,339

Table 77. Torque Settings - Coarse Metric Grade 8.8 Fasteners

Bolt Size	Tread Pitch	Hexa-gon (A/F)	Condition 1	Condition 2
mm	mm	mm	N·m	N·m
4	0.7	7	2.9	2.6
5	0.8	8	5.8	5.2
6	1	10	9.9	9
8	1.25	13	24	22
10	1.5	17	47	43
12	1.75	19	83	74
14	2	22	132	119
16	2	24	205	184
20	2.5	30	400	360
24	3	36	690	621
30	3.5	46	1,372	1,235
36	4	55	2,399	2,159

Table 78. Torque Settings - Coarse Metric Grade 10.9 Fasteners

Bolt Size	Thread Pitch	Hexa-gon (A/F)	Condition 1	Condition 2
mm	mm	mm	N·m	N·m
4	0.7	7	4	3.6
5	0.8	8	8.1	7.3
6	1	10	13.9	12.5
8	1.25	13	34	30
10	1.5	17	67	60
12	1.75	19	116	104
14	2	22	185	167
16	2	24	288	259
20	2.5	30	562	506
24	3	36	971	874
30	3.5	46	1,930	1,737
36	4	55	3,374	3,036

Table 79. Torque Settings - Coarse Metric Grade 12.9 Fasteners

Bolt Size	Thread Pitch	Hexa-gon (A/F)	Condition 1	Condition 2
mm	mm	mm	N·m	N·m
4	0.7	7	4.8	4.4
5	0.8	8	9.8	8.8
6	1	10	16.6	15
8	1.25	13	40	36
10	1.5	17	80	72
12	1.75	19	139	125
14	2	22	223	200
16	2	24	345	311



Bolt Size	Thread Pitch	Hexagon (A/F)	Condition 1	Condition 2
mm	mm	mm	N·m	N·m
20	2.5	30	674	607
24	3	36	1,165	1,048
30	3.5	46	2,316	2,084
36	4	55	4,049	3,644

Table 80. Torque Settings - Rivet Nuts / Bolts

Bolt Size	
mm	N·m
3	1.2
4	3
5	6
6	10
8	24
10	48
12	82



75 - Consumable Products

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Acronyms Glossary

DEF Diesel Exhaust Fluid



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Introduction

JCB recommend that you use the JCB lubricants shown as they have been verified by JCB for use on JCB machines. However, you could use other lubricants that are equivalent to the JCB standards and quality or offer the same machine component protection.

Before you start work, make sure that:

- All safety precautions are observed in accordance with the information contained within the relevant support documentation.
- The consumables are used in accordance with the manufacturer's recommendations.
- The consumables shown are available in the correct quantity.

Consumables other than those listed may be required. It is expected that general consumables will be available in any well equipped workshop or be available locally.

Health and Safety

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.

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear personal protective equipment. Hold a piece of cardboard close to suspected leaks and then examine the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

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.

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

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:

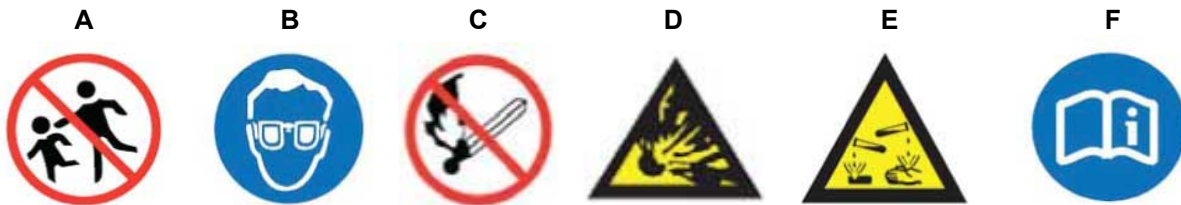
- Avoid prolonged, excessive or repeated skin contact with used oil
- Apply a barrier cream to the skin before handling used oil. Note the following when removing engine oil from skin:
 - Wash your skin thoroughly with soap and water
 - Using a nail brush will help
 - Use special hand cleansers to help 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

Battery

Warning Symbols

The following warning symbols may be found on the battery.

Figure 202.



A Keep away from children

C No smoking, no naked flames, no sparks

E Battery acid

B Shield eyes

D Explosive gas

F Note operating instructions

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.

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.

First Aid - DEF (if applicable)

Do not drink or inhale DEF (Diesel Exhaust Fluid). If large quantities of DEF have been swallowed a doctor should be called immediately. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.

Avoid prolonged or repeated skin contact. After contact with skin wash thoroughly with plenty of soap and water. If irritation develops seek medical advice.

Avoid contact with eyes, skin and clothing. Wear chemical resistant gloves, overalls and safety goggles complying with an approved standard. If in contact with eyes, rinse immediately with plenty of clean water. If irritation occurs seek medical attention. Always wash hands and arms thoroughly after handling before eating, drinking, smoking or using the lavatory.



Technical Data

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).

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

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.

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

Recommended Oils

Table 81.

Item	Capacity	Fluid/Lubricant	JCB Part Number	Container Size	Specification
Engine Oil	12.70 US gallons	JCB Ultra Performance 5W40	4001/3405U	5 US gallons	API CH4
Cooling System	12.70 US gallons	VCS OAT coolant pre-mix			
Fuel tank	593 US gallons	Diesel oil			ASTM D975 (2D)
DEF (Diesel Exhaust Fluid) tank	42.3 US gallons	DEF			ISO 22241-1



03 - Parts List



03 - Oil

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00 - General

Introduction

New Oil

There are no special precautions needed for the handling or use of new oil, besides the normal health and safety practices mentioned in the relevant section of this service manual.

Used Oil

Used engine crankcase lubricants contain harmful contaminants. Here are precautions to protect your health when handling used engine oil:

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

First Aid

EYES - In the case of eye contact, flush with water for 15 minutes. 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 on sand or a locally approved brand of absorbent granules. Scrape up and remove to a chemical disposal area.

FIRES - Extinguish with carbon dioxide, dry chemical or foam. Firefighters should use self-contained breathing apparatus.



03 - Engine

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Introduction

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).

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 technical data section provides guidance as to the temperature range that can be accommodated by standard oil viscosities and can be used to select an appropriate grade.

When selecting the oil viscosity grade, make sure that the oil conforms with or exceeds the recommended specification.

**Technical Data****Table 82.**

Engine Code	Oil API Specification	Viscosity	Minimum Temperature °C (°F)	Maximum Temperature °C (°F)
SA, SB, SC, SK, SG, SD, SE, SF, DA, DB, DC, DE, DG, DD, DK, DF, DR, EC, EE, EF, EK	CF/ CH-4	SAE 5W30	-30°C (-22.0°F)	30°C (86.0°F)
	CH-4	SAE 15W40	-5°C (23.0°F)	50°C (121.9°F)
	CH-4	SAE 10W40	-15°C (5.0°F)	46°C (114.7°F)
	CH-4	SAE 5W40	-30°C (-22.0°F)	46°C (114.7°F)

Table 83.

Engine Code	Oil API Specification	Viscosity	Minimum Temperature °C (°F)	Maximum Temperature °C (°F)
SL, SH, DH, DM, SM	CH-4	SAE 5W40	-30°C (-22.0°F)	46°C (114.7°F)
	CJ-4	SAE 5W40	-30°C (-22.0°F)	46°C (114.7°F)
	CH-4	SAE 15W40	-5°C (23.0°F)	50°C (121.9°F)

Table 84.

Engine Code	Oil API Specification	Viscosity	Minimum Temperature °C (°F)	Maximum Temperature °C (°F)
SJ, DJ, DP, FL, FN	CJ-4	SAE 5W40	-30°C (-22.0°F)	46°C (114.7°F)
	CJ-4	SAE 5W30	-30°C (-22.0°F)	30°C (86.0°F)
	CJ-4	SAE 10W30	-15°C (5.0°F)	46°C (114.7°F)

Table 85.

Engine Code	Oil API Specification	Viscosity	Minimum Temperature °C (°F)	Maximum Temperature °C (°F)
SS	CI-4+	SAE 15W40	-10°C (14.0°F)	50°C (121.9°F)
ST, DT, KG	CK-4	SAE 10W30	15°C (59.0°F)	46°C (114.7°F)

Table 86. Capacity

Engine Code	Minimum	Maximum
SA, SB, SC, SK, SG, SD, SE, SF, DA, DB, DC, DE, DG, DD, DK, DF, DR, SL, SH, SM, DH, SJ, SS, ST, DJ, DM, DP, DT	11.5L	14L
EC, EE, EF, EK	20L	24L
FL, FN	12.3L	14.5L
SS, ST, DT, KG	12L	15L



09 - Fluids

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00 - General

Introduction

It is most important that you read and understand this information and the publications referred to. Make sure all your colleagues who are concerned with lubricants read it too.

Hygiene

JCB lubricants are not a health risk when used properly 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 should 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

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

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



03 - Antifreeze

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Introduction

Coolant Mixtures

Use the coolant specified in this manual. Different types of coolants must not be used or mixed. Refer to: PIL 75-00-00.

Volvo Penta Coolant VCS (yellow) and Volvo Penta Coolant (green) are two completely different types of coolants, which contain different types of inhibitors. Different types of coolants (colors) must not be mixed. If the concentrated coolant must be diluted with water, the water's chemical composition may impair the corrosion protection. In areas with high levels of sodium and calcium in tap water, the coolant must be diluted with distilled water. Alternatively, Volvo Penta coolant is available for purchase ready diluted.

Check the strength of the coolant mixture at least once a year, preferably at the start of the cold period. Do not use solutions of more than 60% or damage to the engine may occur. Replace the coolant mixture according to the intervals shown in the machine's maintenance schedule.

Table 87.

Solution	Protection against freeze bursting down to:
40% Concentration	-25°C (-13.0°F)
460% Concentration	-30°C (-22.0°F)
54% Concentration	-38°C (-36.3°F)
60% Concentration	-46°C (-50.7°F)

Health and Safety

▲ **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.

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



18 - Fuel

Contents

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00 - General

Health and Safety

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.

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.



Notes:



78 - After Sales

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24 - Maintenance Schedules

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Notes:

00 - General

Introduction

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 89.

○	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.



03 - Maintenance Intervals

Introduction

Table 90.

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



06 - Pre-start Cold Checks, Service Points and Fluid Levels

Introduction

Table 91.

	Operation	Interval (h)							Annually
		10	50	500	1000	2000	6000	8000	
Overall Machine									
Visual inspection	Overall visual check	○	○	□	□	□	□	□	
Control Panel	Check operation	○	○	□	□	□	□	□	
Safety decals	Check condition		○	□	□	□	□	□	
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 (as per usage and applications)	Load Test @ 100% of maximum load								□
Engine									
Coolant Quality and Level	Check	○	○	□	□	□	□	□	
Oil Level	Check	○	○	□	□	□	□	□	
Water Separator and Engine Fuel Filter	Drain/Clean		○	□	□	□	□	□	
Oil and Filter	Change			□	□	□	□	□	
Water Separator Fuel Filter	Change				□	□	□	□	
Engine Fuel Filter	Change			□	□	□	□	□	
Front End Accessory Drive (FEAD) Belt ,Belt Tensioner and Idler Wheels Condition	Check			□	□	□	□	□	
Engine Mounting Bolts for Tightness	Check			□	□	□	□	□	



	Operation	Interval (h)							Annually
		10	50	500	1000	2000	6000	8000	
All Hoses - Condition	Check			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Radiator	Check			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Breather Gauze	Clean					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Valve Clearances	Check and Adjust				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Oil Filler and Dipstick Seals	Check and Adjust					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Rocker Cover and Injector Seals	Change					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Injectors	Change						<input type="checkbox"/>		
Injector(s) Leak Off Rail	Change						<input type="checkbox"/>		
High Pressure Fuel Lines	Inspect						<input type="checkbox"/>		
Front End Accessory Drive (FEAD) Belt	Change					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Battery Terminals and Voltage	Check			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Software status	Check			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Air Cleaner	Check			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Air Cleaner	Change				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Coolant	Replace							<input type="checkbox"/>	
Main Alternator									
Generator Alternator cables ⁽³⁾	Check condition			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Generator Alternator Terminals	Check tightness			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

(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) Replace if there is any sign of wear.



81 - Clothing and Personal Protective Equipment (PPE)

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00 - General

Introduction

Do not wear loose clothing or jewellery that can get caught on controls or moving parts. Wear protective clothing and personal safety equipment issued or called for by the job conditions, local regulations or as specified by your employer.



93 - Special Tools

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00 - General

Introduction

The tools shown are the special tools required for completing the procedures described in this manual. These tools are available from JCB Service or in some instances can be manufactured locally.

The tools are divided into three categories:

- Special Tool = Only available from JCB.
- Recommended Tool = Available from JCB but other tool manufacturers/suppliers may offer a tool with the same characteristics.
- General Tool = A tool which is widely available.

Tools other than those listed will be required. It is expected that such general tools will be available in any well equipped workshop or be available locally from any good tool supplier.

Before you start work, make sure that all safety precautions are observed in accordance with the information contained within the relevant support documentation.



03 - Parts List

Introduction

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33 - Electrical System

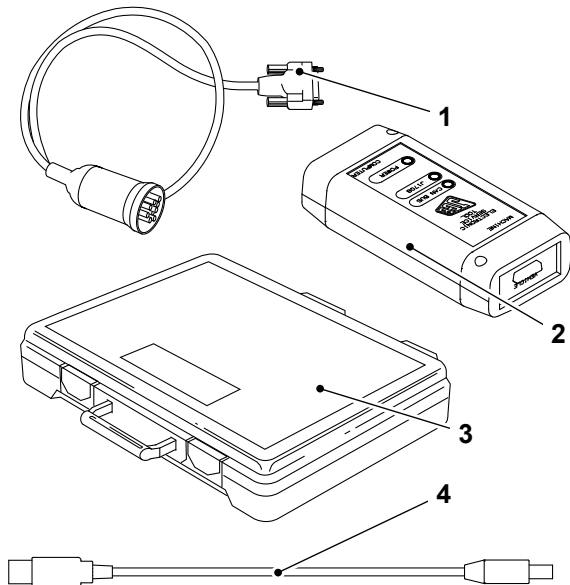
Tool Category	Part No.	Description	Qty.	Comments
General Tool	400/G9956	Battery Tester	1	
General Tool	892/00349	Wiring Crimp Tool	1	
Special Tool	892/01174 728/H5409	Data Link Adaptor (DLA) Kit Data Link Adaptor (DLA 2.0) Kit	1	Unless otherwise stated, you can use any of the tools shown.

Component Identification

General Tool - 400/G9956 - Battery Tester

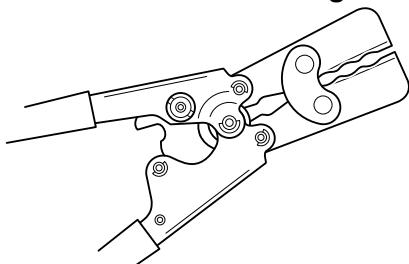


Special Tool - 728/H5409 - Data Link Adaptor (DLA 2.0) Kit



Item	Part No.	Description	Qty.
1		Interconnecting cable, DLA to machine ECU diagnostics socket.	1
2		Data Link Adaptor (DLA 2.0), enables data exchange between the machine ECU (Electronic Control Unit) and a laptop PC loaded with the applicable diagnostics software.	1
3		Kit carrying case.	1
4		Interconnecting cable, DLA to laptop PC.	1

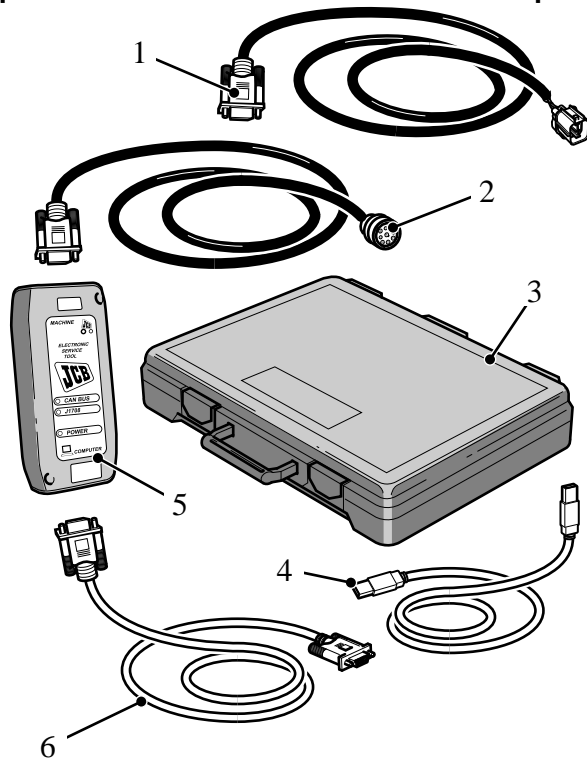
General Tool - 892/00349 - Wiring Crimp Tool



Special Tool - 892/01174 - Data Link Adaptor (DLA) Kit

No longer available to order.

Replaced by special tool 728/H5409 (Data Link Adaptor (DLA 2.0) Kit)



Item	Part No.	Description	Qty.
1		Interconnecting cable, DLA to machine ECU diagnostics socket.	1
2		Interconnecting cable, DLA to machine ECU diagnostics socket.	1
3		Kit carrying case.	1
4		Interconnecting cable, DLA to laptop PC.	1
5		Data Link Adaptor (DLA), enables data exchange between the machine ECU (Electronic Control Unit) and a laptop PC loaded with the applicable diagnostics software.	1
6		Interconnecting cable, DLA to laptop PC.	1



96 - Units of Measurement

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00 - General

Technical Data

The standard units of measurement used by JCB are listed below together with the formula for conversion for countries using non metric standards.

Standard Units

Table 92. Force

Measurement (unit)	Convert to	Multiply by
Newton (N)	Kilogram force (kgf)	0.102
	Pound force (lbf)	0.225

Table 93. Length

Measurement (unit)	Convert to	Multiply by
Millimetre (mm)	Inch (in)	0.0394
Metre (m)	Feet (ft)	3.281
	Yard (yd)	1.094
Kilometre (km)	Mile (mile)	0.621

Table 94. Mass

Measurement (unit)	Convert to	Multiply by
Gram (g)	Ounce (oz)	0.035
Kilogram (kg)	Pound (lb)	2.205
Tonne	Ton	0.984

Table 95. Speed

Measurement (unit)	Convert to	Multiply by
Kilometre/Hour (km/h)	mile/hour (mph)	0.621
Metre/Second (m/s)	feet/second (ft/s)	3.281

Table 96. Volume

Measurement (unit)	Convert to	Multiply by
Cubic Centimetre (cm ³)	Cubic Inch (in ³)	0.061
Cubic Metre (m ³)	Cubic Foot (ft ³)	35.315
	Cubic Yard (yd ³)	1.308
Millilitre (ml)	Fluid ounce (fl oz)	0.035
Litre (l)	UK Gallon	0.220
	US Gallon	0.264

Table 97. Flow

Measurement (unit)	Convert to	Multiply by
Litre/Minute (L/m)	UK Gal- lon/Minute	0.220
	US Gal- lon/Minute	0.264

Table 98. Area

Measurement (unit)	Convert to	Multiply by
Square Millimetre (mm ²)	Square Inch (in ²)	0.0015
Square Metre (m ²)	Square Foot (ft ²)	10.764
	Square Yard (yd ²)	1.196

Table 99. Torque

Measurement (unit)	Convert to	Multiply by
Newton metre (Nm)	Pound force foot (lb f ft)	0.7376

Table 100. Pressure

Measurement (unit)	Convert to	Multiply by
Bar	Pound force/ inch ² (psi)	14.5

Table 101. Fuel Consumption

Measurement (unit)	Convert to	Multiply by
Kilometre/Litre (km/l)	Miles/Gallon (mpg)	2.825
	Miles/ US Gal- lon	2.352

Table 102. Temperature

Measurement (unit)	Convert to	Formula
Degrees Celsius (°C)	Degrees Fahrenheit (°F)	Multiply by 9, Divide by 5, Add 32

Table 103. Power

Measurement (unit)	Convert to	Multiply by
KiloWatt (kW)	Horsepower (hp)	1.341

Table 104. Time

Measurement (unit)
Second (s)
Minute (min)
Hour (h)



Table 105. Current

Measurement (unit)
Ampere (A)

Table 106. Voltage

Measurement (unit)
Volt (V)

Table 107. Noise Levels

Measurement (unit)
Sound pressure level (LpA)
Sound power level (LwA)