



Operator Manual

Our energy working for you.™



**Power
Generation**

with PowerCommand® Control 1301

Volume 1 – Sections 1 to 7

FOREWORD

The purpose of this manual (Volumes 1 and 2) is to provide the user with sound, general information. Sections 1 to 7 (Volume 1) cover the PCC1301 control for a typical generator set in the C13 to C550 range. Section 8 (Volume 2) covers engine specific information and additional information/anomalies required for specific generator sets and must be read before operating the set.

It is for guidance and assistance with recommendations for correct and safe procedures. Cummins Power Generation Limited cannot accept any liability whatsoever for problems arising as a result of following recommendations in this manual.

The information contained within the manual is based on information available at the time of going to print. In line with Cummins Power Generation Limited policy of continuous development and improvement, information may change at any time without notice. The users should therefore ensure that before commencing any work, they have the latest information available.

Users are respectfully advised that it is their responsibility to employ competent persons to carry out any installation work in the interests of good practice and safety. Consult your Authorised Distributor for further installation information. It is essential that the utmost care is taken with the application, installation and operation of any diesel engine due to their potentially dangerous nature. Careful reference should also be made to other Cummins Power Generation Limited literature, in particular the Health and Safety Manual 0908-0110-00, and the Engine Manual.

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Supplementary Publications

The Supplementary Publications appropriate to your system will also be supplied with the system. Where appropriate the corresponding Instruction Manual(s) will also be supplied with any accessory that you order.

Title	Publication No
Lead Acid Battery.....	0908-0101-00
Radiator Information	0908-0107-00
Health and Safety (Diesel Generator Sets)	0908-0110-00

Schedule of Abbreviations

AC	Alternating Current	MCB	Miniature Circuit Breaker
ACB	Air Circuit Breaker	MCCB	Moulded Case Circuit Breaker
ACH	Anti-Condensation Heaters	MF	Mains Failed
ATS	Automatic Transfer Switch	MFSS	Master First Start Sensor
AVR	Automatic Voltage Regulator	MR	Mains Returned
		MST	Mains Sensing Transformer
BHP	Brake Horsepower	MSU	Mains Sensing Unit
BMS	Building Management System	MV	Medium Voltage
BST	Busbar Sensing Transformer		
		NEC	Neutral Earthing Contact
CB	Circuit Breaker		
CCA	Cold Cranking Amps	PCC1301	PowerCommand®Control 1301
CHP	Combined Heat and Power	PF	Power Factor
COP	Continuous Power Rating	PFC	Power Factor Controller
CT	Current Transformer	PLC	Programmable Logic Controller
		PMG	Permanent Magnet Generator
dB(A)	Unit of noise level	PRP	Prime Power Rating
DC	Direct Current	PSU	Power Supply Unit
DIP	Dual In-line Package	PT/CT	Potential Transformer / Current Transformer
DMC	Digital Master Control		
DMSU	Demand Load Standby Unit	QCC	Quadrature Current Control
EMCU	Engine Monitoring and Control Unit	RFI	Radio Frequency Interference
EMF	Electromotive Force	RMS	Root Mean Square
EPU	Engine Protection Unit	RPM	Revolutions Per Minute
		RTD	Resistance Temperature Detector
FSS	First Start Sensor		
GCP	Generator Control Panel	V	Volts
Genset	Generator set	VAC	Volts, Alternating Current
GKWT	Global Kilowatt Transducer	VCB	Vacuum Circuit Breaker
		VDC	Volts, Direct Current
HV	High Voltage	VF	Volt-free
		VT	Voltage Transformer
IC	Integrated Circuit		
I/O	Input / Output		
kVA	Apparent Power		
kVAR	Reactive Power		
kW	Active / Real Power		
kWh	Unit of electrical energy or work		
LED	Light-Emitting Diode		
LTP	Limited Teme Power Rating		
LTA	Low Temperature Aftercooling		
LV	Low Voltage		

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SECTION 1 – PRELIMINARY AND SAFETY

1 Safety

1.1 Warning, Caution and Note Styles Used In This Manual

The following safety styles found throughout this manual indicate potentially hazardous conditions to the operator, service personnel or the equipment.

WARNING: **WARNS OF A HAZARD THAT MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.**

Caution: *Warns of a hazard or an unsafe practice that can result in product or property damage.*

Note: *A short piece of text giving information that augments the current text.*

1.2 General Information

This manual should form part of the documentation package supplied by Cummins Power Generation Limited with specific generator sets. In the event that this manual has been supplied in isolation please refer to other Cummins Power Generation Limited literature, in particular the Health and Safety Manual (0908-0110-00) and the engine manual relevant to your generator set.

Note: *It is in the user's interest to read and understand all Health and Safety information together with all Warnings and Cautions contained within the documentation relevant to the generator set and its operation and maintenance.*

1.3 Generator Plant Safety Code

Before operating the generator set, read this manual and become familiar with it and the equipment. Safe and efficient operation can be achieved only if the equipment is properly operated and maintained. Many accidents are caused by failure to follow fundamental rules and precautions.

WARNING: **IMPROPER OPERATION AND MAINTENANCE CAN LEAD TO SEVERE PERSONAL INJURY OR LOSS OF LIFE AND PROPERTY BY FIRE, ELECTROCUTION, MECHANICAL BREAKDOWN OR EXHAUST GAS ASPHYXIATION. READ AND FOLLOW ALL SAFETY PRECAUTIONS, WARNINGS AND CAUTIONS THROUGHOUT THIS MANUAL AND THE HEALTH AND SAFETY MANUAL 0908-0110-00.**

Positioning of Generator Set

The area for positioning the set should be adequate and level and the area immediately around the set must be free of any flammable material.

WARNING: **LIFTING AND REPOSITIONING ON THE GENERATOR SET MUST ONLY BE CARRIED OUT USING SUITABLE LIFTING EQUIPMENT, SHACKLES AND SPREADER BARS IN ACCORDANCE WITH LOCAL GUIDELINES AND LEGISLATION BY SUITABLY TRAINED AND EXPERIENCED PERSONNEL. INCORRECT LIFTING CAN RESULT IN SEVERE PERSONAL INJURY, DEATH AND/OR EQUIPMENT DAMAGE. FOR MORE INFORMATION CONTACT YOUR AUTHORISED DISTRIBUTOR.**

1.3.1 Spillage

Any spillage that occurs during fuelling or during oil top-up or oil change must be cleaned up before starting the generator set.

Note: *Where spillage containment is not part of Cummins supply, it is the responsibility of the installer to provide the necessary containment to prevent contamination of the environment, especially water courses/sources.*

1.3.2 Exhaust Precautions

WARNING: EXHAUST PIPES AND CHARGE AIR PIPES ARE VERY HOT AND THEY CAN CAUSE SEVERE PERSONAL INJURY OR DEATH FROM DIRECT CONTACT OR FROM FIRE HAZARD

WARNING: HOT EXHAUST GAS CAN CAUSE BURNS RESULTING IN SEVERE PERSONAL INJURY

The exhaust outlet may be sited at the top of the enclosure, or at the bottom, make sure that the exhaust outlet is not obstructed. Personnel using this equipment must be made aware of the exhaust position.

WARNING: CONTAMINATED INSULATION IS A FIRE RISK WHICH CAN RESULT IN SEVERE PERSONAL INJURY

The exhaust pipes may have some insulating covers fitted. If these covers become contaminated by fuel or oil they must be replaced before the generator set is run.

To minimise the risk of fire ensure the following steps are observed:

1. Ensure that the engine is allowed to cool thoroughly before changing the oil or fuel filters.
2. Carefully remove the lagging from the exhaust pipe and store safely away from sources of contamination.
3. When loosening the filter, place a small bowl under the filter to catch spillage.
4. Tighten the replacement filter securely following the instructions carefully.
5. Clean the exhaust pipe thoroughly.
6. Re-attach the lagging securely ensuring that items such as the coolant hoses, etc., are adequately protected.

SECTION 2 - INTRODUCTION

2 Introduction

2.1 General

Before any attempt is made to operate the generator set, the user should take time to read this manual and to familiarise him or herself with the Warnings and Operating Procedures.

A generator set must be operated and maintained properly if you are to expect safe and reliable operation. The manual includes a maintenance schedule and a troubleshooting guide.

The engine manual is included with the generator set. Where there is conflicting information, this manual takes precedence over the engine manual.

2.2 Generator set Identification

Each generator set is provided with a Generator Set Rating Plate similar to that shown below. This provides information unique to the generator set.

Model No. C22D5

Serial No. D05K579470

IMPORTANT !
Model & Serial No. Required When Ordering Parts

Cummins

Power Generation

Manston Park, Columbus Avenue,
Ramsgate, Kent, England, CT12 5BF

Made in the United Kingdom

YEAR OF MANUFACTURE		2005
RATED POWER	PRIME	STANDBY
RATED (kW)	16	17.6
RATED (kVA)	20	22
POWER FACTOR	0.8	0.8
RATED CURRENT (A)	29	32
VOLTAGE	400	
FREQUENCY (Hz)	50	
ROTATING SPEED (RPM)	1500	
BATTERY VOLTS	12	
GENSET MAX MASS (kg)	1009	
CONTROL SYSTEM	PCC1300	
ALTITUDE REFERENCE	150mASL	
AMBIENT TEMP. REFERENCE	27°C	

OPTIONS:

0099-2549A

A331	F167
R029	H536
B463	B649
H676	KS20
F190	L026
KP80	L050
KR93	L029
E074	A322
H074	C127
H670	A356
KAC01	H543
H608	
D041	
KPB01	

Figure 2-1 Typical 50 Hz Generator Set Rating Plate

2.3 After Sales Services

We offer a full range of after sales services as follows:

2.3.1 Maintenance

WARNING: INCORRECT SERVICE OR PARTS REPLACEMENT CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE TRAINED AND EXPERIENCED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

For customers who wish to have their generator sets expertly serviced at regular intervals your local distributor offers a complete maintenance contract package. This covers all items subject to routine maintenance and includes a detailed report on the condition of the generator set. In addition, this can be linked to a 24-hour call-out arrangement, providing assistance 365 days a year if necessary. Specialist engineers are available to maintain optimum performance levels from customer's generator sets, and it is recommended that maintenance tasks are only undertaken by trained and experienced engineers provided by your authorised distributor.

2.3.2 Warranty

All generator sets have a twelve months warranty from the commissioning date as standard. Extended warranty coverage is also available. In the event of a breakdown prompt assistance can normally be given by factory trained service engineers with facilities to undertake all minor and many major repairs to equipment on site.

For further warranty details contact your authorised distributor.

Note: *Any damage caused to the generator set as a direct result of running in the Battle Short mode will not be covered by the Warranty.*

2.3.3 Spares

An extensive Spare Parts Department is available for any emergency breakdown and for the engineer who carries out his own routine maintenance. Please contact your authorised Cummins distributor.

Please quote Plant Nos., Serial Nos., and Part Nos. when ordering spares.

2.3.4 Overseas

Agents and representatives in almost 100 countries throughout the world offer installation and after sales service for the equipment provided. We can provide the name and address of the agent for your specific location.

For details on any of the above services contact your distributor.

2.3.5 Additional Literature

Should you require further, more detailed information regarding the engine or alternator please contact your authorised distributor.

Please quote Plant Nos., and Serial Nos.

SECTION 3 – SYSTEM OVERVIEW

3 System Overview

3.1 Generator Components – Typical Generator Set

The main components of a typical Generator Set (C13 to C55) are shown below, and referred to within this section. Refer to Section 8 – Appendices - of this manual for additional, generator set specific information. Refer to the Engine Manual for location of other components, e.g. oil filler, dipstick, etc.

Various options are listed although they may not be available for all models.

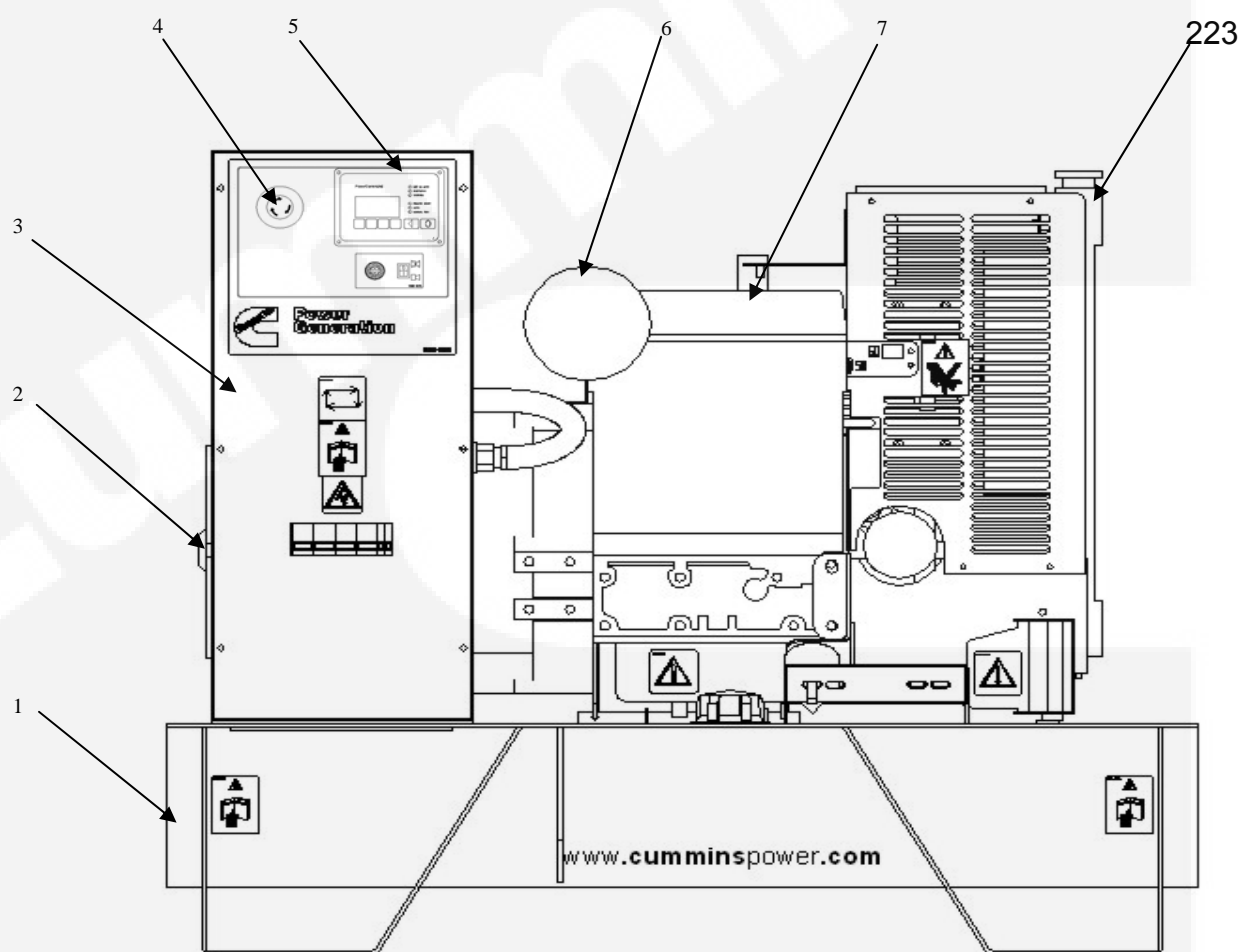


Figure 3-1

Typical Generator Set (C13 to C55)

KEY

1. Bedframe
2. Alternator
3. Control Housing
4. Emergency Stop Button
5. Control Panel
6. Air Cleaner
7. Engine
8. Radiator

OPTIONS

- Batteries and Tray
- Circuit Breaker Entrance Box
- Engine Coolant Heater
- Alternator Heater
- Battery Charger

3.1.1 AC Supply and Isolation

It is the sole responsibility of the customer to provide the AC power supply and the means to isolate the AC input to the terminal box. Refer to the wiring diagram supplied with the generator set.

Note: *A separate disconnecting device is required by BS EN 12601:2001.*

Note: *The AC supply must have the correct over current and earth fault protection according to local electrical codes and regulations.*

WARNING: THE DISCONNECTING DEVICE IS NOT PROVIDED AS PART OF THE GENERATOR SET, AND CUMMINS POWER GENERATION LIMITED ACCEPTS NO RESPONSIBILITY FOR PROVIDING THE MEANS OF ISOLATION.

3.1.2 Alternator

All generator set types use AC alternators of a brushless, rotating field design, which eliminates the maintenance associated with slip rings and brushes. Refer to the Generator Set Rating Plate for alternator type and rating details.

For further information please contact your authorised distributor.

3.1.3 Control System


The Control Panel is a micro-processor based control unit for monitoring and protecting the generator set (see Section 4). The indicators, control buttons and display screen are on the face of the control panel assembly illustrated in Figure 4-3.

The control system monitors various generator set parameters and will affect an Automatic Shutdown if a serious fault occurs.

3.1.4 Emergency Stop Button

The Emergency Stop Button is situated in the upper left corner of the Control Panel. Push this button in for Emergency Shutdown of the engine. This will immediately shut down the generator set bypassing any time delay to stop. If the engine is not running, pushing the button in will prevent the starting of the engine, regardless of the start signal source (Manual or Auto - remote).

To reset:

1. Pull, or twist and pull, the button out.
2. Press the  Off button on the Display Module to acknowledge this action.
3. Press the Auto or Manual Run Button. (Also refer to Section 4.3.4.).

Caution: *Ensure that the cause of the emergency is fully investigated and remedied before an Emergency Stop Reset, and generator set Start are attempted.*

Note: *For open generator sets it is recommended that an additional Emergency Stop button is situated in close proximity to the plant room exit.*

3.1.5 Engine

All generator sets employ a 4-stroke, water-cooled engine and incorporate a governor control and full engine protection system. Refer to the Generator Set Rating Plate for engine type and rating details.

For further information refer to the Engine Manual supplied with this manual.

3.1.6 Generator Rating

For details of your generator set rating refer to the Generator Set Rating Plate.

Refer to Section 5.4 for operation at temperatures or altitudes above those stated on the Rating Plate.

3.1.7 Generator Set Construction

Generator sets are constructed as a single module with the engine and alternator connected through a coupling chamber with resilient mountings to form one unit. The engine and alternator are mounted on a bedframe on resilient mountings. This results in one unit of immense strength and rigidity, with accurate alignment between the engine and alternator, and effective damping of engine vibration.

3.1.8 Fluid Containment

Fluid containment is incorporated into the bedframe and must be inspected at regular intervals. Any liquid present should be drained out and disposed of in line with local health and safety regulations. (See Health and Safety manual 0908-0110-00). Failure to perform this action may result in spillage of liquids which could contaminate the surrounding area.

Note: *Where spillage containment is not part of Cummins supply, it is the responsibility of the installer to provide the necessary containment to prevent contamination of the environment, especially water courses/sources.*

3.1.9 Fuel System

A base fuel tank is incorporated into the bedframe. This tank is fitted with a large filler cap with in-built coarse filter, and provides a minimum of eleven hours operation at a nominal 100% load.

3.1.9.1 Fuel/Water Separators

Set-mounted fuel/water separators are fitted to provide protection for the engine fuel injection system as water-free fuel supplies cannot be guaranteed.

3.1.9.2 Fuel Changeover System (Where Fitted)

A 3-way fuel valve system is provided to enable the generator set to be fuelled directly from an external tank.

Where the system comprises two valves it is essential that both valves are in the same position to prevent the following:

- a) Fuel spillage from the generator set tank vent when fuel is drawn from the external tank and spill returned to the generator set tank.
- b) Fuel shortage when fuel is drawn from the generator set tank and spill returned to the external tank.

WARNING: DO NOT ATTEMPT TO OPERATE THE GENERATOR SET WITH THE VALVES SET TO EXTERNAL TANK SUPPLY AND WITH THE BLANKING PLUGS FITTED AS THIS WILL CAUSE DAMAGE TO THE ENGINE'S FUEL SYSTEM.

Note: Consult the engine manufacturer's handbook or your authorised distributor, to establish the maximum head of fuel allowable at the generator set fuel pump.

3.1.10 Cooling System

The engine cooling system consists of a radiator and pusher fan, mechanically driven water pump and a thermostat. The fan drives air through the radiator and removes surface heat from the engine and alternator. The alternator has its own internal cooling fan.

3.1.11 Engine Exhaust

Integral exhaust systems are designed to reduce engine noise to acceptable levels.

3.1.12 DC Electrical System

A 12 volt battery system provides multi-attempt engine starting and DC power for the generator set control system.

Note: *It may be necessary to upgrade the battery system if the generator set will be operating in arctic conditions.*

3.1.12.1 Battery System

Battery type, size and voltage are selected to suit the generator set capacity and application on ordering.

3.1.12.2 Charge Alternator

An engine driven charge alternator is provided as standard to maintain the battery in a charged condition when the engine is running.

3.1.12.3 Mains Powered Battery Charger – Set Mounted (Option)

Optional single phase, mains powered battery charger, which is panel mounted, is available to maintain the battery in a charged condition when the generator set is not running.

Note: *It is the sole responsibility of the Customer to provide the power supply and the means to isolate the supply to the charger.
Cummins Power Generation Limited accepts no responsibility for providing the means of isolation.*

Note: *The AC supply must have the correct over current and earth fault protection according to local electrical codes and regulations.*

3.1.13 Battery Isolator (Where Fitted)

A battery isolator is provided which isolates the negative feed from the battery to the engine. This can be used to isolate the battery to prevent battery drain through prolonged periods of generator set inactivity or where static battery charging is not available.

<p>WARNING: THE BATTERY ISOLATOR SWITCH MUST NOT BE OPERATED WHILST THE GENERATOR SET IS RUNNING, AND MUST NOT BE USED TO STOP THE GENERATOR SET.</p>
--

3.1.14 Alarm Module (Option)

The Alarm Module provides audible warning. A rocker switch provides the means to switch the alarm facility on or off.

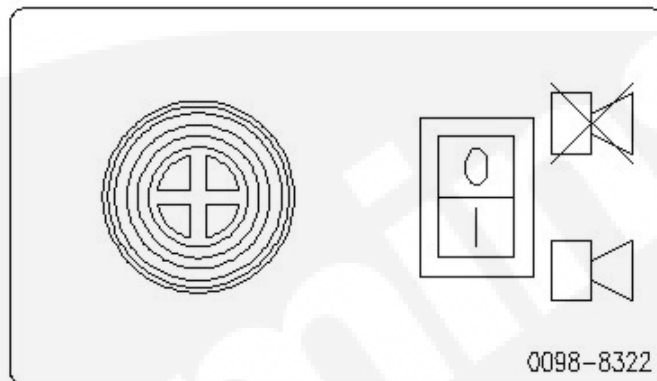


Figure 3-2 Alarm Module Front Panel

Note: *If this module has been switched off after giving an audible warning it will not be automatically re-set from the Control Panel after correcting the fault.
Ensure that the manual rocker switch reflects the On or Off mode that is required.*

3.1.15 Sensors

Various generator set parameters are measured by sensors, and the resulting signals are applied to the PCC 1301.

Engine-mounted sensors are able to monitor the following systems:

- Lube Oil Pressure
- Cooling System Temp
- Miscellaneous Areas

3.2 Heaters

Caution: Heater(s) must not be energised if the coolant system has been drained.

3.2.1 Heater Supply and Isolation

A heater supply is required for the operation of the engine and alternator heaters (if fitted). See Section 3.1.1.

A separate disconnecting device is required by BS EN 12601:2001.

Note: This disconnecting device is not provided as part of the generator set.

Note: The AC supply must have the correct over current and earth fault protection according to local electrical codes and regulations.

Note: It is the sole responsibility of the customer to provide the power supply and the means to isolate the AC input to the terminal box. Cummins Power Generation Limited accepts no responsibility for providing the means of isolation.

WARNING: THE AC SUPPLY TO THE TERMINAL BOX MUST BE ISOLATED BEFORE ATTEMPTING TO GAIN ACCESS TO THE TERMINAL BOX.

3.2.2 Engine Heater (Option)

The engine heater is designed to keep the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine, reducing start-up time and engine wear caused by cold starts. The heater is controlled by an associated thermostat, but is locked out at engine start.

WARNING: ALWAYS ISOLATE THE SUPPLY TO THE ENGINE HEATER / THERMOSTAT BEFORE CARRYING OUT ANY MAINTENANCE ON THE ENGINE. USING THE CUSTOMER'S DISCONNECTING DEVICE, ALWAYS ISOLATE THE GENERATOR SET PRIOR TO ANY MAINTENANCE.

Caution: The engine heater is not intended to protect the engine and cooling system from freezing in sub zero conditions. If there is any danger from freezing, then a suitable antifreeze agent must be added to the cooling system.

3.2.3 Alternator Heater (Option)

The alternator heater is designed to keep the alternator free of condensation when the generator set is not running. During cool and humid conditions, condensation can form within the alternator, which can result in insulation degradation, leading to failure, and a possible shock hazard. The heater is locked out at engine start.

WARNING: ALWAYS ISOLATE THE ALTERNATOR HEATER FROM THE AC SUPPLY BEFORE WORKING ON THE ALTERNATOR OR HEATER.

3.3 Mains Powered Battery Charger (Option)

<u>Caution:</u> <i>Isolate the charger before disconnecting the battery.</i>

3.3.1 Operation

This unit maintains the battery in a fully charged condition without over-charging. The unit also provides rapid charging, when necessary, at a current up to the rated output.

The charger's electronic control circuit allows the charger to be left in circuit during engine cranking and to operate in parallel with the charge alternator.

The charger will supply current to the battery system when the battery terminal voltage is equal to the set float voltage, at which point only a trickle charge current is present. When the battery becomes discharged due to a load being present and the terminal voltage falls, the charger will again supply current to restore the voltage of the battery to the float voltage.

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SECTION 4 – CONTROL SYSTEM

4 Control System

4.1 Control System Description

The PCC1301 control consists of a control module with integral AVR, and a separate display module. These units are contained within the control housing which is mounted on the bedframe, to the left of the alternator at the rear of the generator set as shown in Figure 3-1.

The control module is a micro-processor based control unit for monitoring and protecting the generator set in a stand-alone situation (non paralleling). All indicators, control buttons and the display screen are on the face of the display module as illustrated in Figure 4-1.

The control system is used to start and stop the generator set, and provides full generator set monitoring capability from the display screen. It monitors the engine for temperature, oil pressure and speed, and provides voltage and current metering. In the event of a fault the unit will indicate the fault type and automatically shut down the generator set on critical faults.

There are two fault level signals generated by the control system as follows:

1. **Warning:** - signals an imminent or non-critical fault for the engine. The control provides an indication only for this condition.
2. **Shutdown:** - signals a potentially critical fault for the engine. The control will immediately take the engine off-load and automatically shut it down.

The standard control system operates on 12V DC battery power. The auxiliary equipment operates on LV AC power. The history data is stored in non-volatile memory and will not be deleted due to loss of battery power.

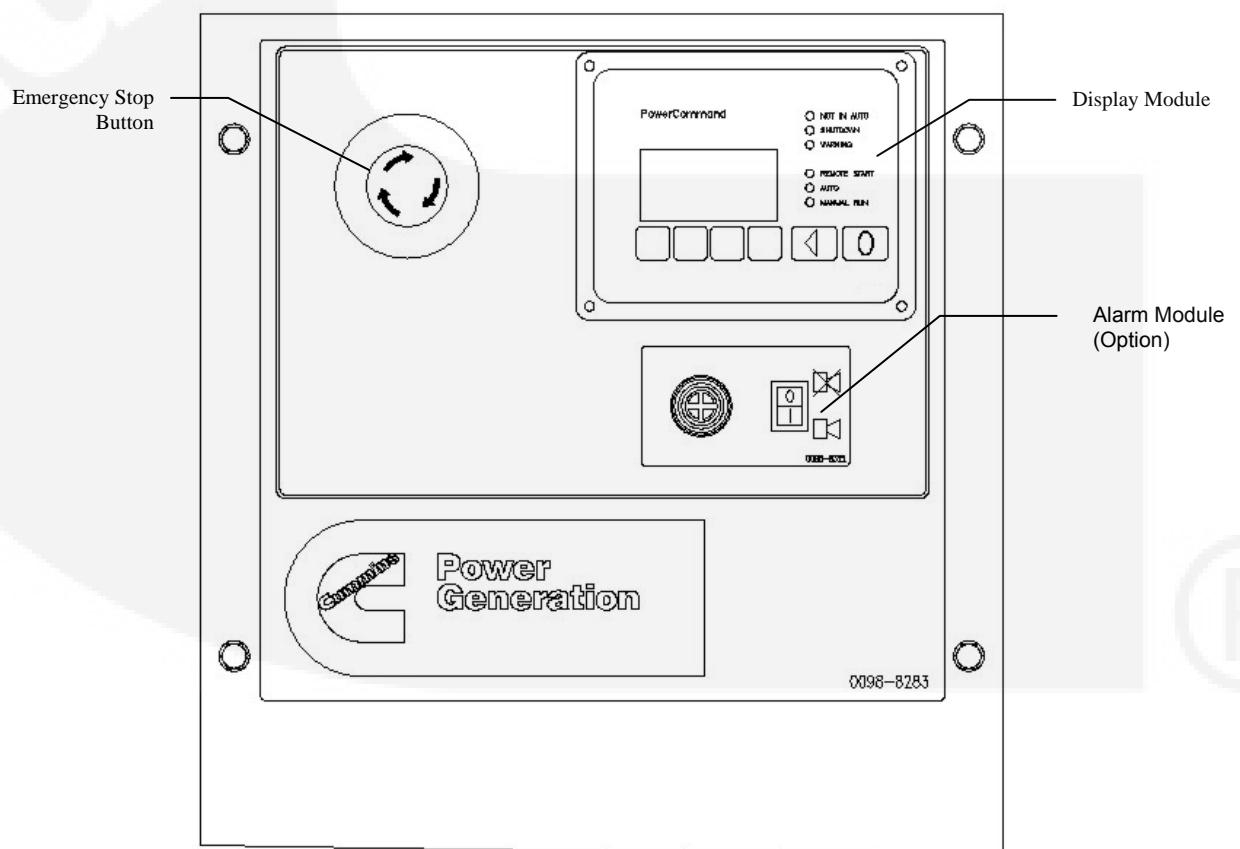



Figure 4-1 Control System Panel

4.1.1 Operating Modes


The PCC1301 is operated by the Manual Run/Off/Auto buttons on the display module face.

Off Mode

When in the Off mode, the control does not allow the generator set to start. Refer to Section 4.5 – Auto and Manual Run Modes – to re-start the generator set.

If the generator set is running, in either Manual Run or Auto mode, and the  Off button is pressed, a normal shutdown sequence will be initiated.


Manual Run Mode

When in Manual Run mode, the generator set starts and continues to run until the control is put into the Off mode. Pressing the  Off button initiates a normal shutdown sequence that does not include a time delay stop. While in the Manual Run mode, any remote start signal is ignored.

Auto Mode

When in Auto mode, the control allows the generator set to be started at any time, with a remote signal only. When a remote start signal is received, the generator set starts after a time delay start is completed.

When all remote start signals are removed, the control performs a normal shutdown sequence which includes a time delay stop.

If the generator set is running in Auto mode and the  Off button is pressed, the control immediately stops the generator set and the control transitions to the Off mode.

Sleep Mode

The PCC1301 control enters a low power (Sleep) mode of operation where the current drawn is less than 60 milliamps (DC) at normal battery voltage levels. Sleep mode is automatically enabled, and the display module will turn itself off after five minutes of keypad inactivity. It awakes from the sleep mode if any button is pressed.

Sleep mode can be disabled by connecting B+ to pin 4 (power on) of J1 or J2. This can be accomplished by installing a jumper between J1-3 and J1-4 (or between J2-3 and J2-4) on the back of the control panel (see Figure 4-2).

Note: J1 and J2 are identical. Either can be used for the harness connection between the control board and the control panel.

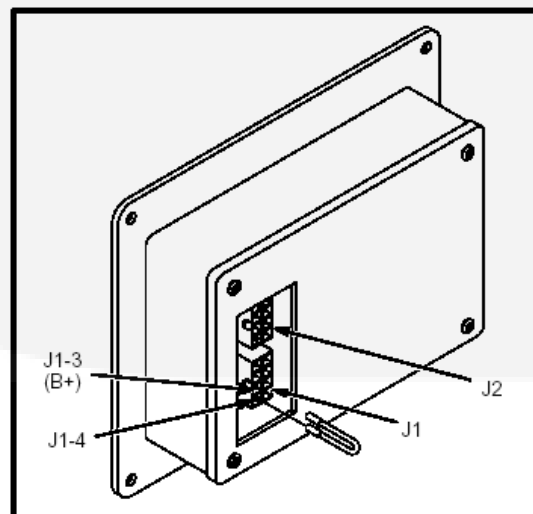


Figure 4-2 Jumper Installation to Disable Sleep Mode

Battle Short Mode

The purpose of Battle Short Mode is to satisfy local code requirements, where necessary. To use this feature, the necessary software must be installed at the factory when the PCC1301 is purchased.

Battle Short mode is a generator set mode of operation that prevents the generator set from being shutdown by all but a few, select, critical shutdown faults.

Caution: *All shutdown faults, including those overridden by Battle Short, must be acted upon immediately to ensure the safety and well being of the operator and the generator set.*

WARNING: **USE OF THE BATTLE SHORT MODE FEATURE CAN CAUSE A FIRE OR ELECTRICAL HAZARD, RESULTING IN SEVERE PERSONAL INJURY OR DEATH AND/OR PROPERTY AND EQUIPMENT DAMAGE. OPERATION OF THE SET MUST BE SUPERVISED DURING BATTLE SHORT OPERATION.**

This feature must only be used during supervised, temporary operation of the generator set. The faults that are overridden when in Battle Short mode can affect generator set performance, or cause permanent engine, alternator or connected equipment damage.

Only trained and experienced service personnel should enable this feature. When shipped from the factory, this feature is disabled.

Caution: *If this mode of operation is selected, the protection of load devices will be disabled.
Cummins Power Generation Limited will not be responsible for any claim resulting from the use of this mode.*

Battle Short is turned on or off with an external switch connected to one of the two customer configured inputs or a soft switch on the display module. The Battle Short feature must be enabled or disabled using the PC Service tool. When enabled, Battle Short switch input can be set using a Setup menu. To turn Battle Short mode on using the soft switch in the display module, Battle Short must be set to Operator Panel and enabled using the PC Service Tool. (Default is Inactive).

When Battle Short mode is enabled, the Warning status indicator lights, and code **218 – Battle Short Active** – is displayed.

When Battle Short mode is enabled and an **overridden shutdown fault** occurs, the shutdown lamp remains lit even though the set continues to run. Fault code **220 – Fail to Shutdown** – is displayed. If the ▲, ▼ or ◀ button is pressed to acknowledge the fault, the fault message is cleared from the display but remains in the Fault History file with an asterisk sign (* indicates an active fault) as long as Battle Short mode is enabled.

Battle Short is suspended and a shutdown occurs immediately if:

- Any of the following critical shutdown faults occur:
 - ❖ Overspeed Fault code 31
 - ❖ Emergency Stop Fault code 61
 - ❖ Speed Signal Lost
(Loss of Speed Sense) Fault code 45
 - ❖ Excitation Fault
(Loss of Voltage Sense) Fault code 27
- The Battle Short feature is disabled after an overridden shutdown fault occurred whilst in Battle Short mode. Fault code **77 – Shutdown After Battle Short** – is then displayed.

4.2 Display Module - Front Panel

Figure 4-3 shows the features of the front panel. It includes six LED indicators, the graphical display, and six buttons used to navigate through the menus and adjust parameters.

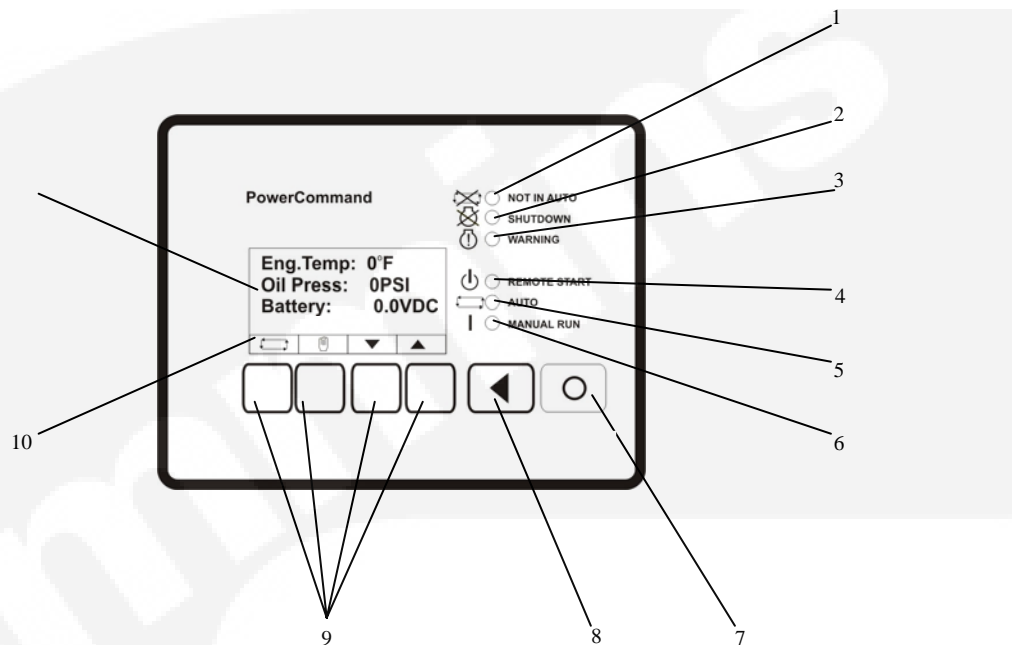


Figure 4-3 Display Module – Front Panel

- | | |
|---------------------------------|---|
| 1. LED Indicator – Not in Auto | 7. Generator Set Off Mode Button |
| 2. LED Indicator – Shutdown | 8. Previous Screen Button |
| 3. LED Indicator – Warning | 9. Selection Buttons (four)
(for use with Item 10) |
| 4. LED Indicator – Remote Start | 10. Menu Bar (provision for four symbols) |
| 5. LED Indicator – Auto | 11. Graphical LCD Display |
| 6. LED Indicator – Manual Run | |

4.2.1 Display Text or Symbols Version

This graphical display can be set to show text or symbols for fault messages, some Operator menus, and the Mode Change menu. Descriptions of commonly used symbols are included in Table 4-1. Combinations of symbols are used to display some fault conditions. Additional specialised symbols are also used for some faults (see Section 7.6).

When shipped from the factory, the display is set for symbols. Qualified service personnel are required to change the default setting.
















SYMBOL	DESCRIPTION
	Generator Warning Fault
	Generator Shutdown Fault
	Coolant Temperature
	Oil Pressure
	Voltage Alternating Current (VAC)
	Voltage Direct Current (VDC)
	AC Current
Hz	Frequency
	Battery
	Out of Range
	High or Pre-High
	Low or Pre-Low
	Annunciator
	Over or Under Speed
	Crank Fail
	Emergency Stop

Table 4-1 Symbols


4.2.2 LED Indicators

Figure 4-3 shows the front panel of the PCC1300 controller. It includes six LED indicators, the graphical display and six buttons used to navigate through the menus and adjust parameters.

Not in Auto

This red lamp is lit when the control is NOT in Auto.

Shutdown Status

This red lamp is lit when the control detects a Shutdown condition. The generator set cannot be started when this lamp is on. After the condition has been corrected, the lamp can be reset by pressing the  Off button.

Note: *When Battle Short mode has been enabled and an overridden shutdown fault occurs, the Shutdown lamp will be lit even though the generator set will continue to run.*


Warning

This yellow lamp is lit whenever the control detects a Warning condition. This lamp is automatically shut off when the Warning condition no longer exists.


Remote Start

This green lamp indicates the control is receiving a remote run signal.

Auto

This green lamp indicates that the control is in Auto mode. Auto mode can be selected by pressing the  selection button from any of the Operator menus (see Section 4.5).

Manual Run

This green lamp indicates that the control is in the Manual Run mode. Manual Run can be selected by pressing the  selection button from any of the Operator menus (see Section 4.5).

4.2.3 Graphical Display and Buttons

Figure 4-3 shows the graphical display and the relevant menu selection buttons.

The graphical display is used to view menus of the menu-driven operating system. The Menu Bar at the bottom of the display indicates the functions that are available by pressing the four selection buttons. Refer to the menu trees later in this section.



Note: *In the following menu trees, the submenus are shown in the order in which they are displayed when scrolling up ▲, or when scrolling down ▼.*

System messages (communication, event, and fault) are also shown on the display. For more information see Section 4.3.


4.2.3.1 Selection Buttons

Four momentary (soft-key) buttons are used to step through the various menus. These selection buttons are active when a word or symbol in the Menu Bar of the graphical display is shown above the button. Some sub-menus do not include any active buttons.

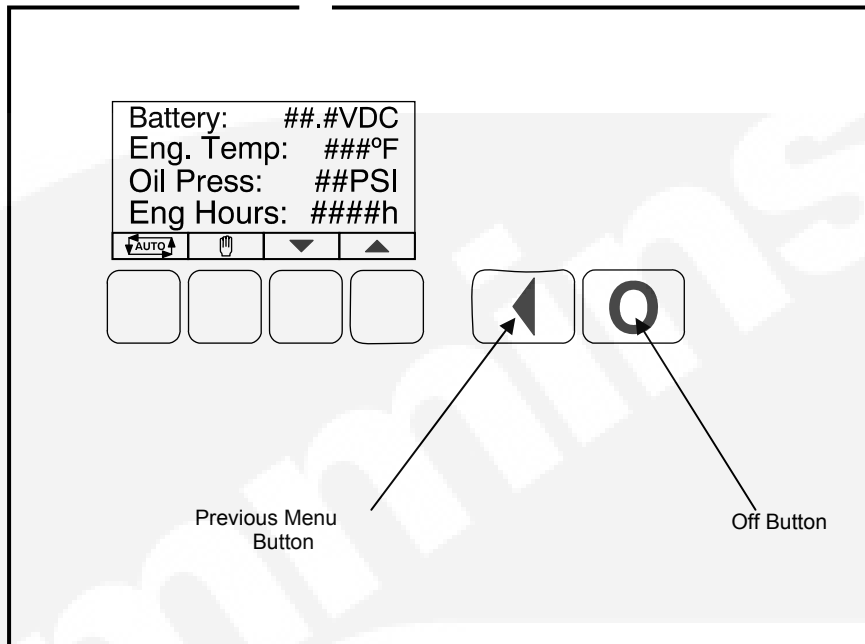
The function of the four selection buttons varies with each menu.

- When the  symbol is displayed, the selection button can be used to switch to Auto mode.
- When the  symbol is displayed, the selection button can be used to switch to Manual Run mode.
- When the up and down triangles (▲ and ▼) are displayed, the selection buttons are used to navigate between a series of submenus.

Note: *When a fault is displayed, it can be cleared from the front panel by pressing the ▲ or ▼ button.*

- When a ◀ symbol is displayed, the selection button can be used to abort the Auto or Manual Run mode and return to the Operator menu that was displayed before the Auto or Manual Run mode was selected.
- When the → symbol is displayed, the selection button is used to navigate to an editable field within a menu.
- When the + and – symbols are displayed, the selection buttons are used to increase or decrease a parameter or value shown on the screen.
When changing values, pressing the button below the + symbol increases the value and pressing the button below the – symbol decreases the value.
- When a black box  is displayed, the selection button has no function.

4.2.3.2 Control Buttons



Previous Main Menu Button ◀

Press this button to view the previously displayed main menu.

The ◀ button is also used to acknowledge Warning and Shutdown messages after the fault has been corrected. Pressing this button clears the fault from the front panel display and the previous menu is re-displayed.

Note: Pressing the ▲ or ▼ button also clears the fault from the front panel display.

Off Button ○

Press this button to switch to the Off mode. The Off Mode will disable the control Auto or Manual Modes. Pressing the ○ button resets the control.

If the ○ button is pressed during generator set operation (manual or remote start), the engine will immediately shut down. If possible, hot shutdown under load should be avoided to help prolong the reliability of the generator set.

If a Shutdown fault occurs and the fault condition is corrected, pressing the ○ button clears the fault from the front panel and resets the control.

This ○ button is also used to reset the control after the emergency stop button has been used and then disabled (unlocked).

4.2.4 Default Settings

The control panel can display SAE or Metric units of measurement and should be set during the initial setup of the generator set. Qualified service personnel are required to change the default setting. Contact your authorised distributor.

4.3 Display Module - System Messages

A system pop-up message is displayed when the event it is displaying becomes active. These pop-up messages remain displayed until pre-empted by another pop-up message or until the ▼ or ◀ display button is pressed. Once the ▼ or ◀ button is pressed, the previous menu is re-displayed.

4.3.1 Communication Messages

System messages are displayed for initial power-up or when there is a subsequent loss of communications. Auto and Manual Run modes can also be selected when communication messages are displayed (for more information see Section 4.5).

Upon initial power-up, the message *Establishing Communication with Control* is displayed (see Figure 4-4). This menu also displays the screen's software number and version.



Figure 4-4 *Establishing Communications Message*

When the display detects that it is no longer communicating with the control, the Shutdown, Warning, and Remote Start LEDs are turned off.

If communications are lost, the message *Re-establishing Communications with Control* is displayed (see Figure 4-5) until communications have been re-established. The LEDs then return to the state determined by the control.

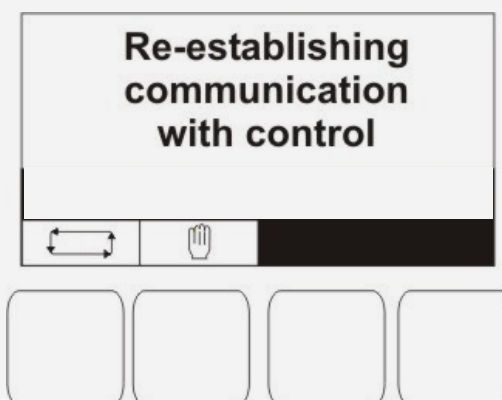


Figure 4-5 *Re-establishing Communications Message*

Note: *If either communication message remains displayed (cannot view other menus), this indicates that communications between the control panel and the control logic has been lost. Contact your authorised distributor for assistance.*

4.3.2 Event Messages

When pre-set events (Start or Stop) are activated, Event messages are displayed showing the time remaining until the event occurs (see Figure 4-6).

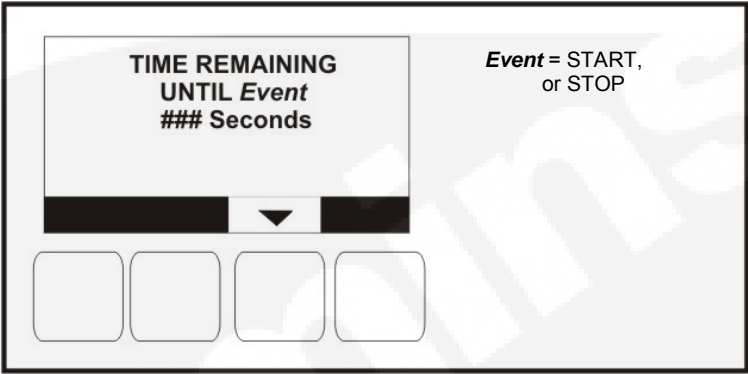




Figure 4-6 Event Message

4.3.3 Fault Messages

A Fault message is an indicator of a Warning or Shutdown condition. It includes the fault number, a short description, and when the fault occurred (see Figure 4-7). Symbolic fault messages include the fault code number and symbols indicating the type of fault (see Figure 4-8). With the symbolic versions of fault messages, the  and  symbols flash.

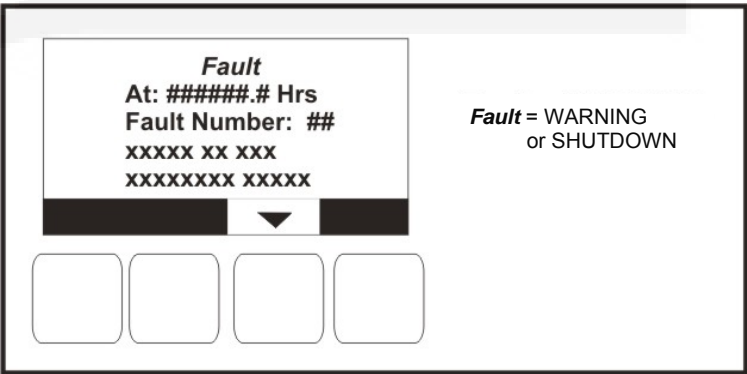






Figure 4-7 Fault Message

Table 7-1 provides a list of fault codes, fault types, messages displayed, and descriptions of the faults.

4.3.4 Fault Acknowledgement

Faults shall be acknowledged after a shutdown when all start orders are removed. In Manual mode, the start order is removed when the  Off button, on the display panel, is pressed.

Faults may also be acknowledged when in Auto, and the Off/Manual/Auto switch is set to off. If the **Remote Start** command is removed the fault will **reset without manual intervention**.

Faults are cleared from the control panel display by pressing the , , or  button.

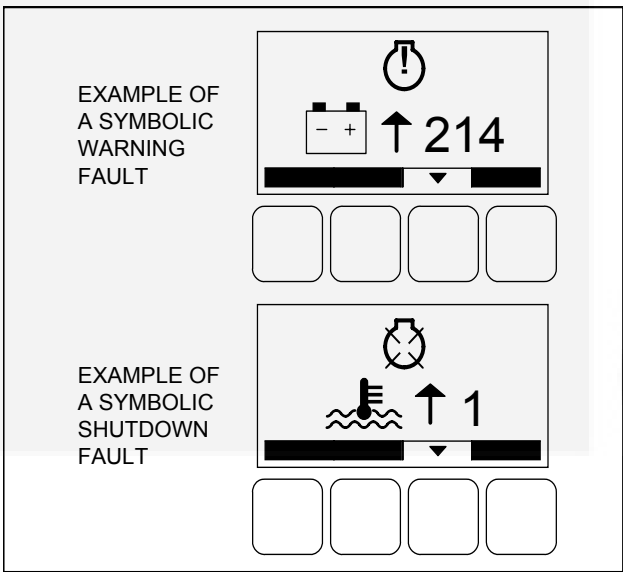


Figure 4-8 Fault Messages – Symbolic Version

Note: Faults are re-announced if they are detected again after being acknowledged.

4.3.5 Status Messages

Status messages for some events are displayed on the control panel with a code number but are not announced with a lamp indicator. Text status messages include the event code, a short description, and the time the event occurred. Symbolic status messages include the event code and symbols to indicate the type of event that occurred. Status messages and their code numbers are listed here. These events are not currently displayed. Additional information on these events is included in Table 7-1.

STATUS EVENT	CODE
Ready to Load	150
Not in Auto	153
Common Alarm	155
Common Warning	156
Common Shutdown	157
Cust Input 1	158
Cust Input2	159

4.4 Display Module - Operator Menus

Figure 4-9 shows a block representation of the following Operator menus:

- Engine Status
- Alternator Status
- Line-to-Line Voltage
- Line-to-Neutral Voltage
- Alternator Amperage

To navigate between the Operator menus, press the buttons below the ▼ and ▲ symbols in the graphical display.

The Operator menus can be used to select Auto or Manual Run modes (see Section 4.5).

Engine Status Menu

This menu displays the engine starting battery voltage, engine coolant temperature, engine oil pressure, and hours of engine operation.

Alternator Status Menu

This menu displays generator set load (in kVA), frequency (Hz), and engine speed (RPM).

Alternator Line-to-Line Voltage Menu

This menu displays L1-L2, L2-L3, and L3-L1 line-to-line voltages for 3-phase applications only.

Alternator Line-to-Neutral Voltage Menu

This menu displays line-to-neutral voltages for L1, L2, and L3 for 3-phase wye configurations only. In delta configurations, this menu is not shown.

Alternator Single Phase Voltage Menu

This menu displays L1-N, L2-N, and L3-N voltages for single phase applications only.

Alternator Amperage Menu

For applications that include current transformers, this menu displays L1, L2, and L3 current sense amperage. In applications without CTs, this menu is not shown.

Figure 4-9 Operator Menus – Text Version

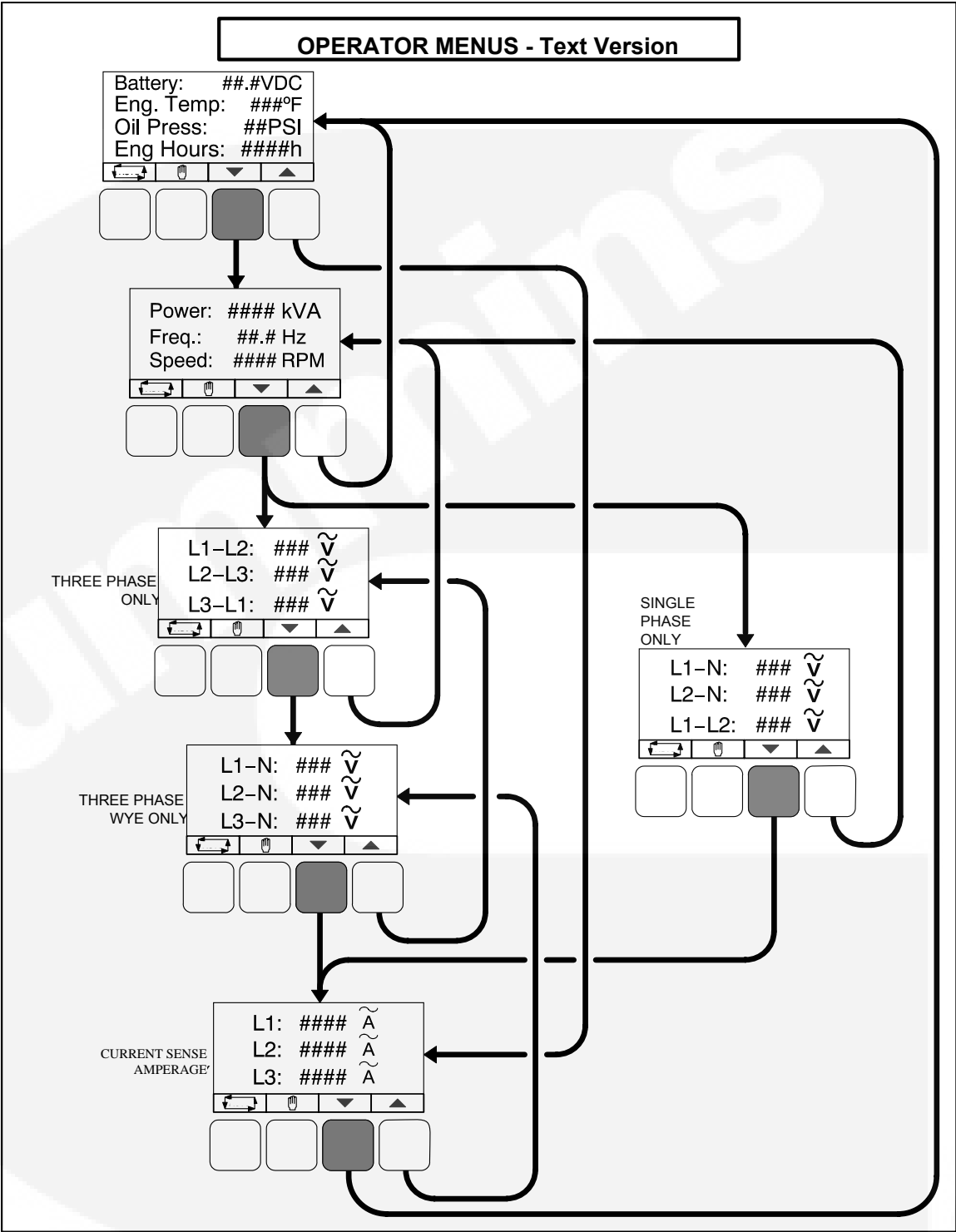
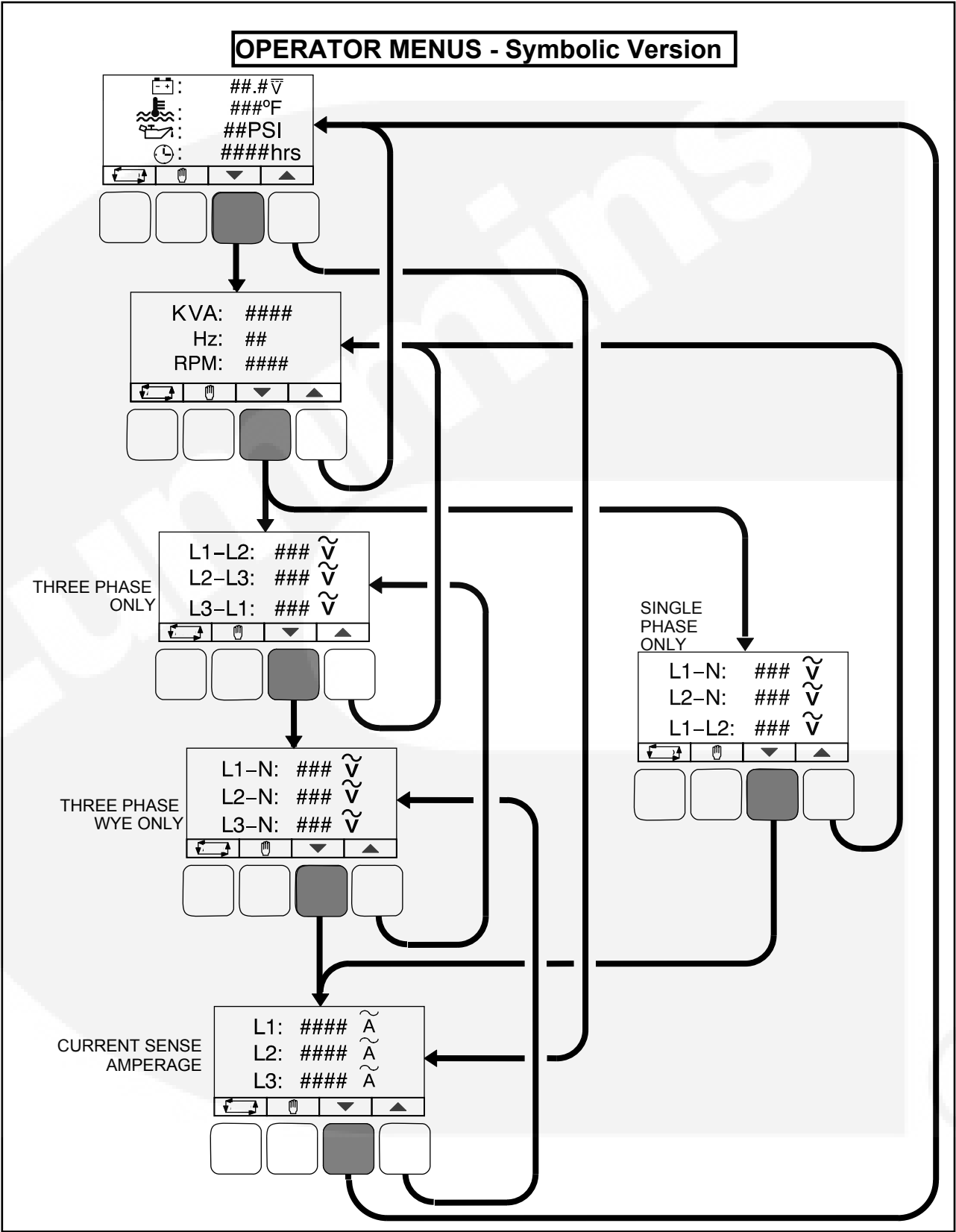


Figure 4-10 Operator Menus – Symbolic Version



4.5 Display Module - Auto and Manual Run Modes

WARNING: WHEN CHANGING MODES, THE GENERATOR SET MAY START OR STOP WITHOUT WARNING. ENSURE THERE IS NO DANGER TO PERSONNEL OR EQUIPMENT SHOULD THE GENERATOR SET START OR STOP WHEN CHANGING MODES.

Auto, Manual Run and Off modes can be selected as follows:

- From any of the Operator menus.
- When the message 'Establishing communication with control' is displayed.
- When the message 'Re-establishing communication with control' is displayed.

Switching to Auto, Manual Run, or Off mode can be restricted to authorised personnel. If a control panel is set-up with the mode change access code feature enabled, an access code must first be entered before the mode can be changed.

Note: *The default setting for switching between Auto, Manual Run and Off modes is restricted to authorised personnel with an Access code. Qualified service personnel are required to change the default setting. Contact your authorised distributor for assistance.*

4.5.1 Entering the Mode Change Access Code

The Mode Change submenus are intended for qualified service personnel and site personnel only and by default will require an Access password. If a password is required the Mode Change – Access Code menu will appear when you try to change the run mode. The text and symbolic versions of the Mode Change menu are shown in Figure 4-11.

To enter the mode change access code use the + and – buttons to increase or decrease the values in the relevant field. Use the → button to move the cursor within a field. Selected fields will be highlighted.

1. With the required character highlighted, press the button below the + or – symbols until the required value is displayed.
2. Press the arrow selection button → to move to the next numeric character.
3. Repeat steps 1 and 2 until all three characters of the Access Code are correct.
4. After you have completed entering the password, press the → arrow selection button.

Note: *If an incorrect password is entered, the Operator menu that was displayed before Auto, Manual Run, or Off mode was selected is re-displayed.*

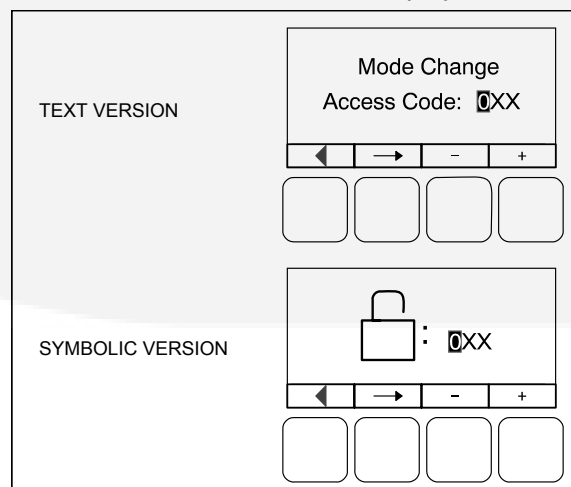








Figure 4-11 Mode Change Menu

4.5.1.1 Selecting Auto Mode

WARNING: WHEN CHANGING MODES, THE GENERATOR SET MAY START OR STOP WITHOUT WARNING. ENSURE THERE IS NO DANGER TO PERSONNEL OR EQUIPMENT SHOULD THE GENERATOR SET START OR STOP WHEN CHANGING MODES.

To switch to Auto mode (see Figure 4-12).

1. Ensure that it is safe to do so before proceeding to change the mode.
2. Press the  Auto button on any of the Operator menus, or the 'Establishing/re-establishing communication with control' menus.
3. If the mode change access code feature is enabled, the Mode Change Access Code menu will be displayed. Enter the Mode Change Access Code as described above.
4. A menu with alternating arrows will then be displayed above a second  Auto symbol.
5. Press this second  Auto button. The Operator menu that was displayed before Auto mode was selected is re-displayed, but with the  Auto symbols blacked out and  Manual Run symbols visible.

To disable Auto mode, press the  button.

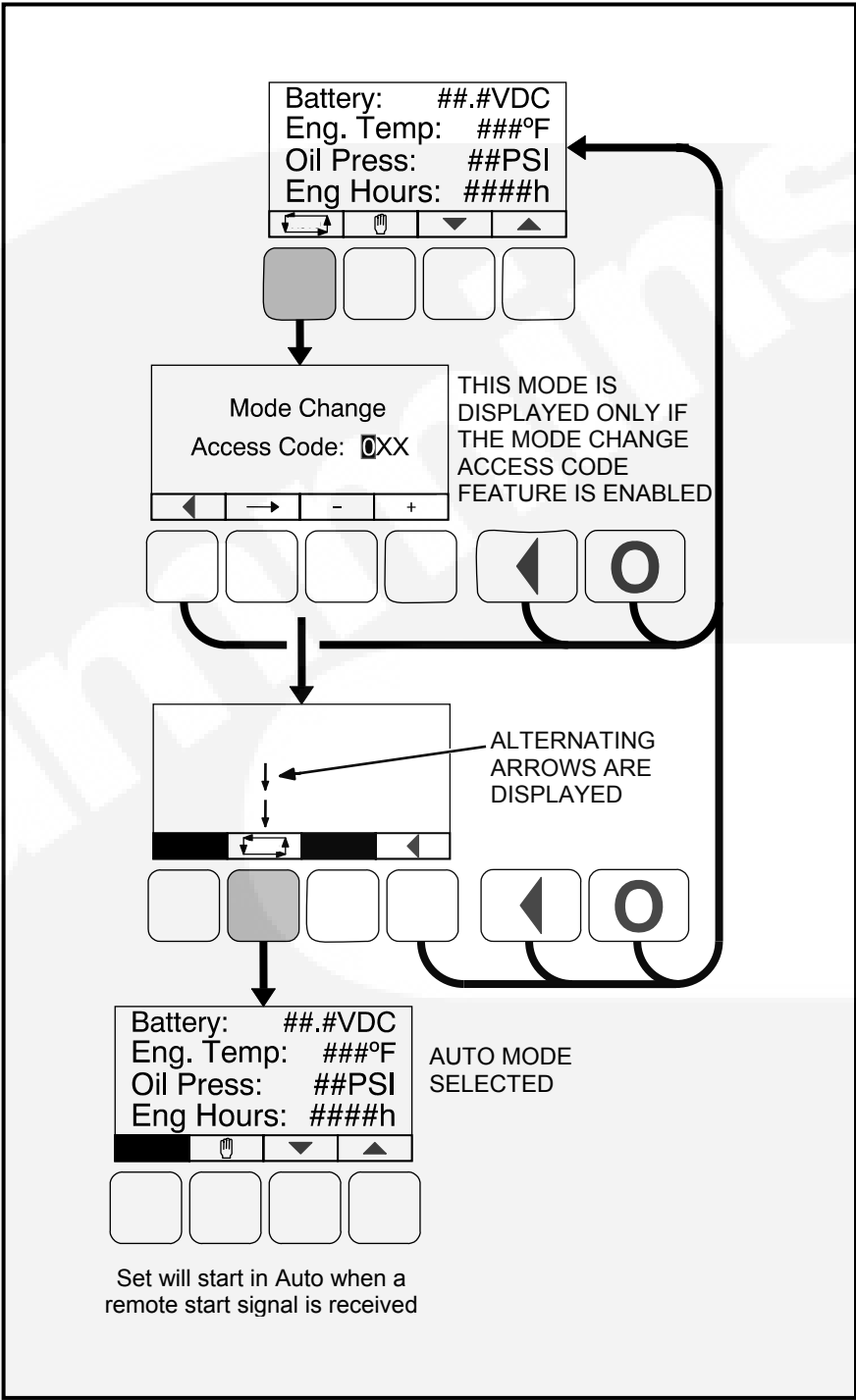
The generator set is now ready to receive a remote start signal that will initiate the Auto run mode.

Note: The Green LED is lit indicating that the generator set is in Auto mode.

WARNING: SHOULD A REMOTE START SIGNAL BE RECEIVED, THE GENERATOR SET WILL START AUTOMATICALLY. ENSURE THERE IS NO DANGER TO PERSONNEL OR EQUIPMENT SHOULD THE GENERATOR SET START WITHOUT WARNING.

WARNING: MANUAL RUN MODE CAN ALSO BE SELECTED FROM AUTO MODE. SWITCHING TO MANUAL RUN MODE WILL RESULT IN THE GENERATOR SET STARTING UP.





Figure 4-12 Selecting Auto Mode



4.5.1.2 Selecting Manual Run Mode

WARNING: WHEN CHANGING MODES, THE GENERATOR SET MAY START OR STOP WITHOUT WARNING. ENSURE THERE IS NO DANGER TO PERSONNEL OR EQUIPMENT SHOULD THE GENERATOR SET START OR STOP WHEN CHANGING MODES.

To switch to Manual Run mode (see Figure 4-13).



1. Ensure that it is safe to do so before proceeding to change the mode.
2. Press the  Manual Run button on any of the Operator menus or the 'Establishing/re-establishing communication with control' menus.
3. If the Mode Change Access Code menu is enabled, the Mode Change Access Code will be displayed. Enter the Mode Change Access Code as previously described (see Section 4.5.1).
4. A menu with alternating arrows is displayed above a second  symbol.
5. Press the second  Manual Run button, and the generator set will now begin the Manual start sequence. The Operator menu that was displayed before Manual Run mode was selected is re-displayed, but with the  symbol blacked out




Note: The red (Not-in-Auto) LED is lit, together with the green (Manual Run) LED.

Caution: Ensure that there is no danger to personnel or equipment when the generator set is started.

Note: Auto mode can also be selected whilst in Manual Run mode. Switching to Auto mode may result in the generator set shutting down.

4.5.1.3 Aborting the Transition to Auto or Manual Run Mode

If the Mode Change Access Code menu or the menu showing alternating arrows above the  or  buttons is displayed, the transition to Auto or Manual Run mode is aborted when:

- Either the , , or  button is pressed.
- A selection button is not pressed within ten seconds.

If the transition to Auto or Manual Run mode is aborted, the Operator menu that was displayed before Auto or Manual Run mode was selected is re-displayed.

4.5.1.4 Selecting Off Mode


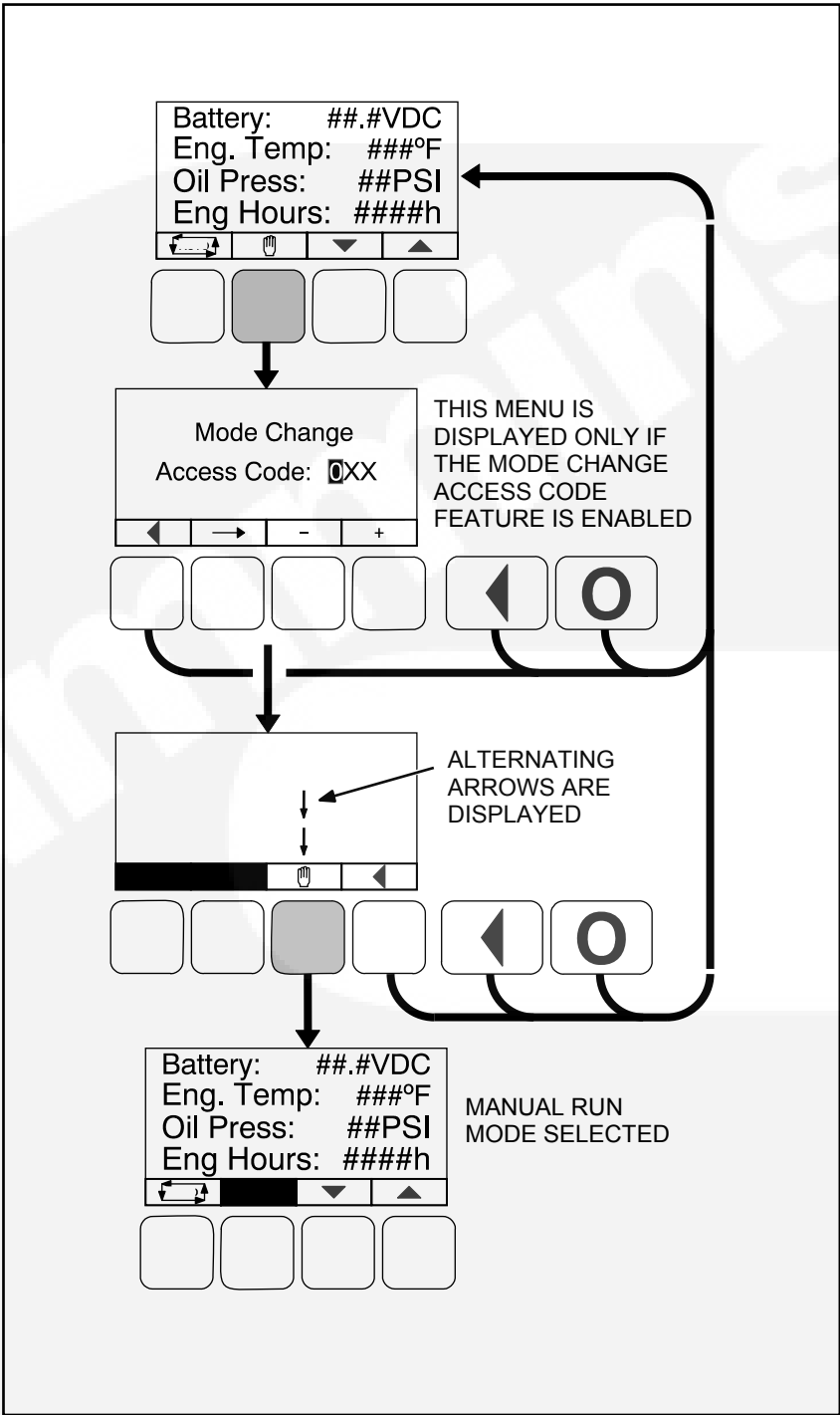

To switch to Off mode, press the  button. If the generator set is running and the Off mode is selected, a normal shutdown sequence is initiated. More information on the use of the Off button is included in Section 4.2.3.

Figure 4-13 Selecting Manual Run Mode



4.6 Emergency Stop Button

The Emergency Stop push-switch is located in the upper, left hand corner of the PCC1301 front panel. This is a mechanically latched switch that will unconditionally stop the engine when pressed. When the switch is pressed the PCC1301 panel will display the Shutdown condition by illuminating the red Shutdown status LED  and displaying the following message on the graphical LCD display:


**Fault Number: 61
EMERGENCY STOP**

Caution: *The Emergency Stop push-switch must not be used for a normal shutdown, as this will prevent a cooling run in which the lubricating oil and engine coolant carry heat away from the engine combustion chamber and bearings in a safe manner.*

If the generator set is not running, pushing the button in will prevent the starting of the engine, regardless of the Start signal source.

Caution: *Ensure the remote start control is not active or when the Emergency Stop is reset the generator set could start running.*

To reset:

- Pull, or twist and pull, the button out.
- Press the  Off button on the Display Module to acknowledge this action.
- Press the Auto or Manual Run Button. (Also refer to Section 4.3.4.).

Caution: *Ensure that the cause of the emergency is fully investigated and remedied before an emergency stop Reset, and generator set Start are attempted.*

Note: *On enclosed sets an external Emergency Stop button is situated in close proximity to the control panel viewing window. For open sets it is recommended that an additional Emergency Stop button is situated in close proximity to the plant room exit.*

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SECTION 5 – SYSTEM OPERATION

5 Operation

5.1 Safety

Only suitably qualified and experienced personnel should carry out generator set operations. Before operating the system, the operator should become familiar with Section 1 of this manual – Preliminary and Safety Instructions, together with the Health and Safety Manual (0908-0110-00). Observe all of the WARNINGS and CAUTIONS at all times.

WARNING: BEFORE OPERATING THE PLANT BECOME FAMILIAR WITH THE EQUIPMENT AND HOW IT IS OPERATED (INCLUDING ALL CONTROLS, MANUALLY OPERATED VALVES AND ALARM DEVICES). SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE PLANT IS OPERATED CORRECTLY.

WARNING: CONTACTING HIGH VOLTAGE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH BY ELECTROCUTION. DO NOT OPEN THE GENERATOR OUTPUT BOX WHILE THE GENERATOR SET IS RUNNING. READ AND OBSERVE ALL WARNINGS AND CAUTIONS IN YOUR GENERATOR SET MANUALS.

Caution: *Only technically qualified personnel should open the control housing. Voltages are present which can cause electrical shock, resulting in personal injury. Even with the power removed, improper handling of components can cause electrostatic discharge and damage circuit board components.*

5.2 Introduction

This section describes the operation of the generator set. The text should be read in conjunction with the System Description, Control System Operation, and the engine manual.

All indicators, control switches/buttons, and graphical display are located on the face of the Control Panel as illustrated in Figure 4-1.

5.3 Maintenance

To ensure maximum performance and reliability from your generator set it is essential that certain components are inspected periodically and, where necessary, maintenance procedures carried out as detailed in Section 6 – Maintenance.

5.4 Operating Recommendations

5.4.1 Running –in

Drain and replace the crankcase oil and oil filter cartridge after the first 50 hours of operation on new generator sets. Refer to the Maintenance section of this manual for the recommended procedures.

5.4.2 No Load Operation

Periods of off-load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a load of at least 30% rated load, but not to exceed rated load. Such a load could consist of heater element or load bank.

5.4.3 Exercise Period

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts.

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts, and in general helps provide reliable engine starting.

Exercise the set for a minimum of ten minutes off-load at least once a week and for a minimum of 30 minutes with load at least once each month so the engine reaches normal operating temperatures.

5.4.4 Low Operating Temperatures

Use a coolant heater if a separate source of power is available. The optional heater available from Cummins will help provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

Note: *C13 type generator sets have glow plugs suitable for use in temperatures down to minus 12°C (10°F). Within the generator set Setup menus there is the option to choose glow plug facility (default is No). Qualified service personnel are required to change the default setting.*

5.4.5 High Operating Temperatures

Refer to the generator set nameplate for the maximum operating temperature, if applicable.

5.4.6 Operating Conditions for Prime, Standby and Continuous Power Ratings

Note: *All generator sets supplied by The Company must be run under the following operating conditions.*

5.4.6.1 Continuous Power rating (COP) for constant load applications

The Continuous Power Rating is applicable to utility parallel and other non-variable load applications for supplying power continuously to a load of up to 100% of the continuous rating for an unlimited number of hours per year between the stated maintenance intervals and under stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. No sustained overload capability is available at this rating. This rating is applicable for utility base load operation. In these applications, generator sets are operated in parallel with a utility source and run under constant loads for extended periods of time.

5.4.6.2 Prime power rating

The prime power rating is the maximum power available during a variable load sequence which may be run for an unlimited number of hours per year, between the stated maintenance intervals and under the stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. Prime power applications fall into one of the following two categories:

a) Unlimited time prime power (for variable load applications)

Prime power is available for an unlimited number of annual operating hours in variable load applications. The permissible average power output under variable load shall not exceed a 70% average of the prime power rating during any operation of 250 hours. The total operating time at 100% prime power shall not exceed 500 hours per year. A 10% overload capability is available for a period of 1 hour within a 12-hour period of operation, in accordance with ISO 3046-1. Total operating time at the 10% overload power shall not exceed 25 hours per year.

b) Limited running time prime power (for constant load applications)

Prime power is available for a limited number of hours in a non-variable load application. It is intended for use in situations where power outages are contracted, such as utility power curtailment. Generators may be operated in parallel with the public utility up to 750 hours per year at power levels never to exceed the prime power rating. No sustained overload capability is available at this rating. The customer should be aware, however, that the life of any generator will be reduced by constant high load operation. Any operation exceeding 750 hours per year at the prime power rating should use the Continuous Power Rating.

5.4.6.3 Standby power rating (for variable load applications)

The standby power rating is applicable for supplying emergency power for the duration of a utility power interruption, between the stated maintenance intervals and under the stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. No overload capability is available for this rating and utility parallel operation is not permitted at the standby power rating. For applications requiring sustained utility parallel operation the limited time prime power rating or continuous power rating must be utilised as applicable.

This rating is applicable to installations served by a reliable normal utility source. Generators should be sized for a maximum average load factor of 80% of the standby power rating with a maximum of 200 hours of operation per year, which includes less than 25 hours per year at the standby power rating. In installations served by unreliable utility sources (where outages last longer or occur more frequently), where operation is likely to exceed 200 hours per year, the prime power rating should be applied. The standby rating is only applicable for emergency and standby applications where the generator set serves as the back up to the normal utility source. Negotiated power outages are not considered as emergencies.

5.4.6.4 Notes applicable to all ratings

The following notes are applicable to all ratings, unless otherwise agreed by the Regional Sales Manager of The Company in writing:

1. When determining the actual average power output of a variable power sequence in any of the ratings above, powers of less than 30% of the emergency standby power shall be taken as 30% and time at standstill shall not be counted.
2. Variable load is calculated in accordance with methods and formulae given in ISO 8528-1:1993.
3. All three-phase generators are rated for 0.8 power factor lag. Single-phase generators are rated for 1.0 power factor.
4. All ratings are based on the following reference conditions:
 - a) Ambient temperature — 27°C
 - b) Altitude above sea level — 150 metres
 - c) Relative humidity — 60%
 - d) Output power may be subject to de-rate if the above conditions are exceeded.
5. If any of the above conditions are not satisfied, the operational life of the generating set may be reduced.
6. Short term parallel operation with the utility for load transfer purposes only is permitted with all ratings.

5.4.7 De-Rating Factors

For de-rating factors applicable at specific sites please contact your authorised distributor.

5.5 Generator Set Operation

5.5.1 Sequence of Operation

The generator set is run Automatically using a Remote Start signal, or Manually using the generator set control panel buttons. LEDs are provided on the display module front panel to indicate the operating run mode of the generator set. The PCC1301 initiates a starter cranking signal and will perform an automatically sequenced manual start, under a complete engine protection system combined with full monitoring capability. If a fault is sensed at Start-up, the engine is locked out and will not start.

The choice of Auto or Manual run mode is decided by authorised personnel when the generator set is setup. An access code is required to switch between the run modes, and this facility may be permitted or denied by the authorised personnel during the initial setup of the generator set.

5.6 Starting

Caution: *One operator should be in complete charge, or working under the direction of someone who is. Remember that, upon starting the engine, cables and switchgear will become energised, possibly for the first time. Furthermore, equipment that does not form part of the generator set installation may become electrically charged. Only authorised and competent personnel should carry out this work.*

Caution: *Do not use the Emergency Stop switch to shut down an engine unless a serious fault develops. The Emergency Stop push-switch must not be used for a normal shut-down as this will prevent a cooling down run in which the lubricating oil and engine coolant carry the away from the engine combustion chamber and bearings in a safe manner.*

Caution: *Avoid off-load running for other than short periods. A minimum loading of 30% is recommended. This loading will help to prevent the build up of carbon deposits in the injectors, due to unburnt fuel, and reduce the risk of fuel dilution of the engine lubricating oil. The engine must be shut down as soon as possible after the appropriate functions have been checked.*

Before attempting to start the generator set, the operator should read through this entire section and become familiar with the Engine Manual. It is essential that the operator be completely familiar with the generator set and the PCC1301 control.

The following sub-sections cover the systems used to start and stop the generator set.

Before starting the generator set, make sure that exhaust and fuel fittings are tight and properly positioned, and that proper maintenance and pre-start checks have been performed.

During starting automatic checks are carried out for the integrity of various protection systems. The PCC1301 will not allow the generator set to continue the starting sequence if the integrity of a sensor is considered to be in doubt.

The generator set can be configured for a number of starting cycles (one to seven) with set times for crank and rest periods for all starting modes (manual/remote). The default setting is for three start cycles, composed of fifteen seconds of cranking and 30 seconds of rest.

Note: *The number of starting cycles, and the crank and rest times are set from within the Setup menu. Qualified service personnel are required to change the default setting. Contact your authorised distributor.*

5.6.1 Pre-start Checks

WARNING: VOLTAGE PRESENTS SPECIAL HAZARDS OF SEVERE PERSONAL INJURY OR DEATH. EVEN AFTER GENERATOR SET SHUTDOWN AN ELECTRICAL SHOCK HAZARD MAY STILL EXIST, CAUSED BY INDUCED OR RESIDUAL VOLTAGE WITHIN THE ALTERNATOR OR CABLES. SERVICE PERSONNEL MUST BE WELL TRAINED/QUALIFIED TO WORK WITH DISTRIBUTION VOLTAGES.

Before starting, be sure competent personnel have made the following checks to ensure that the unit is ready for operation:

- Generator Set Grounding Procedure – This must be followed prior to performing service or inspection procedures that may expose personnel to conductors normally energized with voltages greater than 600 volts. Contact your authorised distributor.
- Megger and Insulation Testing – This must be performed on all generator sets before initial start-up and after the generator set Grounding Procedure has been completed. Insulation testing for low voltage (less than 600 volts) generator sets is recommended by Cummins Power Generation Limited. These tests are used to verify that the windings are dry before the generator set is operated, and to develop a base line for future test comparisons. Contact your authorised distributor.

Caution: When Megger testing an alternator, failure to protect the voltage regulator, control and diodes could result in permanent damage to one or more of the electronic components.

- Lubrication - Check the engine lubrication oil level and ensure that the level is always maintained as detailed in the engine manual.

Note: Generator sets may be shipped dry. They must be filled with the correct type and quantity of oil before use. Be sure to check oil level before initial start. Refer to Section 8 – Appendices, for specific information.

- Coolant - Check the engine coolant level and ensure that the level is always maintained at the coolant expansion tank. Fill the cooling system to the bottom of the fill neck in the radiator fill or expansion tank. Do not check while the engine is hot.

Note: Some radiators have two fill necks, both of which **must** be filled when the cooling system has been drained.

Caution: Do not attempt to remove a radiator pressure cap while the generator is running, or is stationary but hot. Always allow it to cool before removing.

Note: Generator sets may be shipped dry. They must be filled with the correct type and quantity of coolant before use. Be sure to check coolant level(s) before initial start. Refer to Section 8 – Appendices, for specific information.

- Cooling Air Inlet / Outlets - Ensure that the cooling air inlets/outlets are unobstructed.
- Exhaust Outlet - Ensure that exhaust components are secured and not warped; that the exhaust outlet is unobstructed; that no combustible materials are near the system, and gases are discharged away from building openings. Ensure that there are no leaks and that all fittings are tight.
- Fuel Supply - Ensure that the fuel tank is filled to the normal level and that the fuel system is primed and all the valves required for operation are open. Ensure that there are no leaks and that all fittings are tight.
- Batteries – Ensure that the batteries are charged, that the electrolyte is at the correct level and that all connections are correct.
- Auxiliary AC Supplies - Ensure that all auxiliary equipment is receiving power from the customer's supply.

- Emergency Stop/Fire Detection Equipment - Ensure that all related equipment is fully operational.


5.6.2 Starting at Display Panel (Manual Run Mode)

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE GENERATOR UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

Caution: *One operator should be in complete charge, or working under the direction of someone who is. Remember that, upon starting the engine, cables and switchgear will become energised, possibly for the first time. Furthermore, equipment that does not form part of the generator installation may become electrically charged. Only authorised and competent personnel should carry out this work.*

Caution: *Do not use an Emergency Stop switch to shut down an engine unless a serious fault develops. The Emergency Stop push-switch must not be used for a normal shut-down, as this will prevent a cooling down run in which the lubricating oil and engine coolant carry heat away from the engine combustion chamber and bearings in a safe manner.*

Caution: *Avoid off-load running for other than short periods. A minimum loading of 30% is recommended. This loading will help to prevent the build up of carbon deposits in the injectors, due to unburnt fuel, and reduce the risk of fuel dilution of the engine lubricating oil. The engine must be shutdown as soon as possible after the appropriate functions have been checked.*

To start the generator set in the Manual Run mode, select the  symbol from the menu bar of the display module front panel. Follow the instructions in Section 4.5.1.2 (Selecting Manual Run Mode).

Note: Any Remote Start/Stop signal is ignored whilst in Manual Run Mode.

The PCC1301 will initiate a starter cranking signal and will perform an automatically sequenced manual start, under a complete engine protection system combined with full monitoring capability. This will activate the engine control system and the starting procedure. The starter will begin cranking, and after a few seconds the engine will start and the starter will disconnect.

In the Manual Run mode the control will not complete the Time Delay to Start or Time Delay to Stop.


The Not in Auto red LED, and the Manual Run, green LED will be lit.

If the engine does not start, the starter will disengage after a specified period of time and the control will indicate a Fail to Start Shutdown.

Wait a minimum of two minutes for the starter motor to cool and then repeat the starting procedure. If the engine does not run after a second attempt, refer to Section 7 – Troubleshooting.

5.6.3 Starting from Remote Location (Auto Mode)

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE GENERATOR UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

To start the generator set in the Auto Run mode, select the  symbol from the menu bar of the display module front panel. Follow the instructions in Section 4.5.1.1 (Selecting Auto Mode).

The Auto, green LED will be lit.

Only on receipt of a remote start signal, and after a Time Delay to Start, will the PCC1301 initiate the starting sequence as above.

The Remote Start LED will be lit.

5.6.4 Cold Starting with Loads

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE GENERATOR UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.


Use a coolant heater if a separate source of power is available. The optional heater available from Cummins will help provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

Cummins Power Generation recommends equipping diesel standby generator sets (life safety systems) with engine water jacket coolant heaters to maintain the coolant at a minimum of 32°C (90°F) and, for most applications, accept the emergency load in ten seconds or less. Although most Cummins Power Generation generator sets will start in temperatures down to -32°C (-25°F) when equipped with engine water jacket coolant heaters, it might take more than ten seconds to warm the engine up before a load can be applied when ambient temperatures are below 4°C (40°F).


To advise the user of a possible delay in accepting the load, the Low Coolant Temp (code 203) message, in conjunction with illumination of the Warning LED, is provided. The engine cold sensing logic initiates a warning when the engine water jacket coolant temperature falls below 21°C (70°F). In applications where the ambient temperature falls below 4°C (40°F), a cold engine may be indicated even though the coolant heaters are connected and functioning correctly. Under these conditions, although the generator set may start, it may not be able to accept load within ten seconds. When this condition occurs, check the coolant heaters for correct operation. If the coolant heaters are operating correctly, other precautions may be necessary to warm the engine before applying a load.

5.7 Stopping

5.7.1 Stopping at Display Panel (Manual Mode)

The module will not respond to any Remote Stop signal whilst in Manual Run Mode. When in Manual run mode, pressing the  Off button will initiate a normal (Manual) shutdown sequence.


In the Manual Run mode the control will not complete the Time Delay to Stop.

Note: *Remove load and run set for five minutes to reduce engine heat before pressing the  Off button*

5.7.2 Stopping from Remote Location (Auto Mode)

In Auto mode, the control allows the generator set to be started with a Remote Start Signal only.

If the control receives a Remote Stop signal, the generator set will complete its normal shutdown sequence which includes a Time Delay Stop.


If the generator set is running in Auto mode and the  Off button is pressed, the control immediately stops the generator set and the control transitions to the Off mode.

5.7.3 Emergency Stop (Code 61)

The Emergency Stop Button is situated in the upper left corner of the Control Panel. Push this button in for Emergency Shutdown of the engine. If the engine is not running, pushing the button in will prevent the starting of the engine, regardless of the start signal source (Manual or Auto - remote). The Red Shutdown status LED will be lit and the graphical display message will be:

**Fault Number: 61
EMERGENCY STOP**

To reset:

1. Pull, or twist and pull, the button out.
2. Press the  Off button on the Display Module to acknowledge this action.
3. Press the Auto or Manual Run Button, as previously determined. (See Section 4.5).

Caution: *Do not use an Emergency Stop switch to shut down an engine unless a serious fault develops.*

Caution: *Ensure that the cause of the emergency stop is fully investigated and remedied before a fault Reset and generator Start are attempted.*

Note: *On enclosed sets an external Emergency Stop button is situated in close proximity to the control panel viewing window. For open generator sets it is recommended that an additional Emergency Stop button is situated in close proximity to the plant room exit.*

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SECTION 6 – MAINTENANCE

6 Maintenance

All maintenance tasks must be assessed for health and safety risks, the preventative measures identified must be actioned. Accompaniment is required for tasks where the presence of someone else will add significantly to the safety of the task.

Read, understand and comply with all Caution and Warning notes in this section, those contained within Section 1 - Preliminary and Safety, and those contained within the Health and Safety Manual (0908-0110-00). Refer also to the Operator's engine specific manual supplied as part of the generator set documentation pack. This latter manual will contain further information regarding the running and care of the generator set and also specific equipment instructions that may differ from the standard generator set.

Ensure adequate lighting and staging (where required) are installed.

Caution: *Maintenance. must only be carry out by authorised and qualified maintenance engineers, who are familiar with the equipment and its operation.*

WARNING: **DEPENDENT UPON THE CONTROL SYSTEM FITTED, THIS UNIT MAY OPERATE AUTOMATICALLY AND COULD START WITHOUT WARNING.**

Caution: *Before carrying out any maintenance work, become familiar with the Generator Plant Safety Code given in Section 1 of this manual, together with the Health and Safety Manual (0908-0110-00).*

Caution: *Always disconnect a battery charger from its AC source before disconnecting the battery leads. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.*

WARNING: **ACCIDENTAL STARTING OF THE GENERATOR SET WHILE WORKING ON IT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. PREVENT ACCIDENTAL STARTING BY DISCONNECTING THE STARTING BATTERY LEADS (NEGATIVE [-] FIRST).**

ENSURE BATTERY AREA HAS BEEN WELL-VENTILATED BEFORE SERVICING THE BATTERY. SPARKS OR ARCING CAN IGNITE EXPLOSIVE HYDROGEN GAS GIVEN OFF BY BATTERIES, CAUSING SEVERE PERSONAL INJURY. ARCING CAN OCCUR WHEN LEADS ARE REMOVED OR REPLACED, OR WHEN THE NEGATIVE (-) BATTERY LEAD IS CONNECTED AND A TOOL USED TO CONNECT OR DISCONNECT THE POSITIVE (+) BATTERY LEAD TOUCHES THE FRAME OR OTHER GROUNDED METAL PART OF THE GENERATOR SET.

**INSULATED TOOLS MUST BE USED WHEN WORKING IN THE VICINITY OF THE BATTERIES.
ALWAYS REMOVE THE NEGATIVE (-) LEAD FIRST AND RECONNECT LAST.**

ENSURE HYDROGEN FROM THE BATTERY, ENGINE FUEL AND OTHER EXPLOSIVE FUMES ARE FULLY DISSIPATED. THIS IS ESPECIALLY IMPORTANT IF THE BATTERY HAS BEEN CONNECTED TO A BATTERY CHARGER.

WARNING: TO COMPLETE MAINTENANCE TASKS AT HEIGHT REFER TO LOCAL LEGISLATIVE REQUIREMENTS. SUITABLE EQUIPMENT FOR PERFORMING THESE TASKS MUST BE USED IN ACCORDANCE WITH THE LOCAL GUIDELINES AND LEGISLATION. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH.

WARNING: DO NOT USE THE SKID (BEDFRAME) OR ANY PART OF THE GENERATOR SET AS A MEANS OF ACCESS. USE OF THE GENERATOR SET AS ACCESS MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH AND/OR PROPERTY AND EQUIPMENT DAMAGE.

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE WORK, LOCK OFF FOR SAFE WORKING:

1. PRESS THE OFF MODE SWITCH ON THE GENERATOR SET CONTROL PANEL.
2. AS AN ADDITIONAL PRECAUTION, PRESS THE EMERGENCY STOP BUTTON, AND HOLD IN FOR 30 SECONDS.
3. ISOLATE ALL SUPPLIES TO THE GENERATOR SET.
4. ISOLATE THE BATTERY CHARGER.
5. DISCONNECT THE BATTERY.
6. REMOVE THE STARTER CONTROL WIRES.
7. A SUITABLE WARNING PLATE STATING 'MAINTENANCE IN PROGRESS' SHOULD BE DISPLAYED PROMINENTLY.

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE (LOCK AND TAG) ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

6.1 Locking the Generator Set Out of Service

6.1.1 Introduction

Before any work is carried out for maintenance, etc., the plant must be immobilised. Even if the plant is put out of service by pressing the Off switch on the control panel, the plant cannot be considered safe to work on until the engine is properly immobilised as detailed in the following procedures.

Caution: *Refer also to the Operator's engine specific manual included in the documentation package supplied with the generator set. This manual will contain specific equipment instructions that may differ from the standard generator set.*

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE, ISOLATE ALL SUPPLIES TO THE GENERATOR SET AND ANY CONTROL PANELS. RENDER THE SET INOPERATIVE BY DISCONNECTING THE PLANT BATTERY.


Caution: *If the engine has been running recently explosive gases (given off during battery charging) may be present in the vicinity of the batteries. Ensure the area is well ventilated before disconnecting batteries.*

6.1.2 Immobilising the Generator Set for Safe Working

Note: *Shutdown the engine first, as described in Section 5.7 - Stopping.*

To immobilise the engine:

1. Press the Off Mode switch on the display panel.
2. Press the Emergency Stop Button, (and hold in for 30 seconds). This will prevent the starting of the generator set regardless of the Start signal source and will therefore provide an additional safety step for immobilising the generator set. (See also Section 5.7).

Note: *When this Stop Button is pressed the display panel will indicate the Shutdown condition by illuminating the red Shutdown status LED  and displaying the following message on the graphical LCD display:*

**Fault Number: 1433
EMERGENCY STOP**

or

**Fault Number: 1434
REMOTE EMERGENCY STOP**

Note: *This Fault will affect the Fault History memory bank.*

3. As an additional precaution, thoroughly ventilate the plant room before disconnecting any leads.
4. Isolate and lock off the supply to the heater, where fitted.
5. Isolate and lock off the supply to the battery charger, where fitted.
6. Isolate the fuel supply to the engine.
7. Disconnect the starting batteries and control system batteries, (if separate). Disconnect the negative (-) lead first. Attach a padlock through one of the battery leads and tag for safe working.
8. Fit warning notices at each of the above points to indicate Maintenance in Progress - Plant Immobilised for Safe Working.

6.2 General

The maintenance procedures covered in this manual are intended for Operator-level service only and must be performed at whichever interval occurs first. At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

Table 1 covers the recommended service intervals for a generator set on Standby service. If the generator set will be subjected to Prime usage or extreme operating conditions, the service intervals should be reduced accordingly. Consult your authorised distributor.

- Some of the factors that can affect the maintenance schedule are:
- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand.

Consult with an authorised distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable schedule of maintenance. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated, or after the number of operating hours indicated, whichever comes first.

Use Table 1 to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

Refer also to the Operator's engine manual supplied with the generator set.



Table 2 Periodic Maintenance Schedule

MAINTENANCE ITEMS		Daily or after 8 Hours	Weekly or after 50 Hours ⁷	Monthly or after 100 Hours ⁷	3 Months or after 250 Hours ^{5, 7}
Perform maintenance tasks as specified using Daily or Hourly periods – whichever is the sooner					
Check:	Fuel tank level	■			
	Fuel lines and hoses	■ ¹			
	Bedframe fluid containment (where fitted), drain if necessary	■ ⁸			
	Engine oil level	■ ¹	■ ⁶		
	Coolant level of radiator(s) (water jacket & LTA)	■ ⁴			
	Coolant lines and radiator hoses for wear and cracks	■ ¹			
	Cooling fan blades	■			
	All exhaust components, and hardware (fittings, clamps, fasteners, etc.)	■ ¹			
	Drive belt, condition and tension		■ ²		
	Air cleaner restriction indicator (where fitted)	■			
	Air intake system for leaks	■			
	Electrical connections (battery, starter motor and alternator connections)		■		
	Safety controls and alarms	■			
	Operation of Emergency Stop Button		■		
Drain:	Water from fuel pre-filter (where fitted)	■ ³			
Clean:	Radiator matrix			■ ^{4,5}	

■1 – Check for oil, fuel, coolant and exhaust system leaks. Check exhaust system audibly and visually with generator set running. (Refer to [Sections 6.8](#) and [6.9](#)).

■2 – Visually check belt for evidence of wear or slippage. Replace if hard or brittle (to be undertaken by a Service Engineer).

■3 – Drain one cup, or more, of fuel to remove water and sediment.

■4 – Refer to Section 6.4 of this manual and to the Radiator Information Manual 0908-0107-00 supplied with this generator set.

■5 – To be undertaken by a Service Engineer. Please refer to your Authorised Distributor.

■6 – Engine oil and filter must be replaced after the initial running-in period of 50 hours. Please refer to your authorised distributor.

■7 – All maintenance checks and inspections listed at lesser maintenance intervals must also be carried out at this time.

■8 – For generator sets with QSB7 engines refer to Engine Operators manual for that model.

6.3 Daily or Refuelling Maintenance Procedures

Monitor fluid levels, oil pressure, and coolant temperature frequently. During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. The following sections cover areas that must be frequently inspected for continued safe operation.

6.3.1 General Information

Preventative maintenance begins with day-to-day awareness of the condition of the generator set.

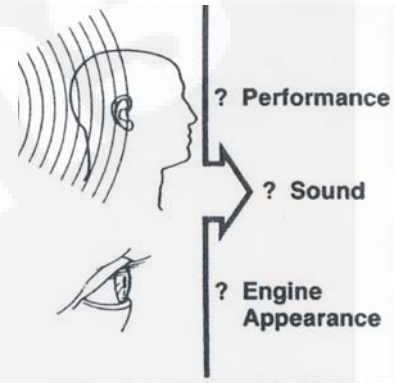
Before starting the generator set check the oil and coolant levels and look for:

Leaks

Loose or damaged parts

Worn or damaged belts

Any change in engine or generator set appearance.



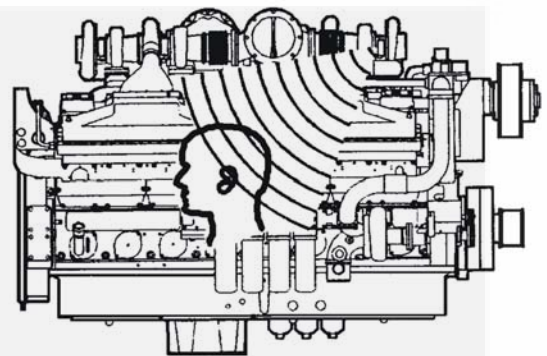
6.3.2 Engine Operation Report

The engine must be maintained in good mechanical condition if the operator is to obtain optimum satisfaction from its use. Running reports are necessary to enable programmed or emergency servicing to be carried out.

Comparison and intelligent interpretation of the running report, together with a practical follow-up action will eliminate most failures and emergency repairs.

Most engine problems give an early warning. Look and listen for changes in engine performance, sound, or appearance that can indicate service or repair is needed. Some engine changes to look for and report on are:

- Low lubricating oil pressure
- Low power
- Abnormal water or oil temperature
- Unusual engine noise
- Excessive exhaust smoke
- Excessive use of coolant, fuel or lubricating oil
- Any coolant, fuel or lubricating oil leaks.
- Misfire
- Vibration



6.4 Cooling System

WARNING: CONTACT WITH HOT COOLANT CAN RESULT IN SERIOUS SCOLDING. ALLOW COOLING SYSTEM TO COOL BEFORE RELEASING PRESSURE AND REMOVING WATER JACKET RADIATOR CAP OR LTA EXPANSION TANK CAP.

Caution: Loss of coolant can allow engine to overheat without protection of shutdown device, and cause severe damage to the engine. Maintain coolant level for proper operation of high engine temperature shutdown system.

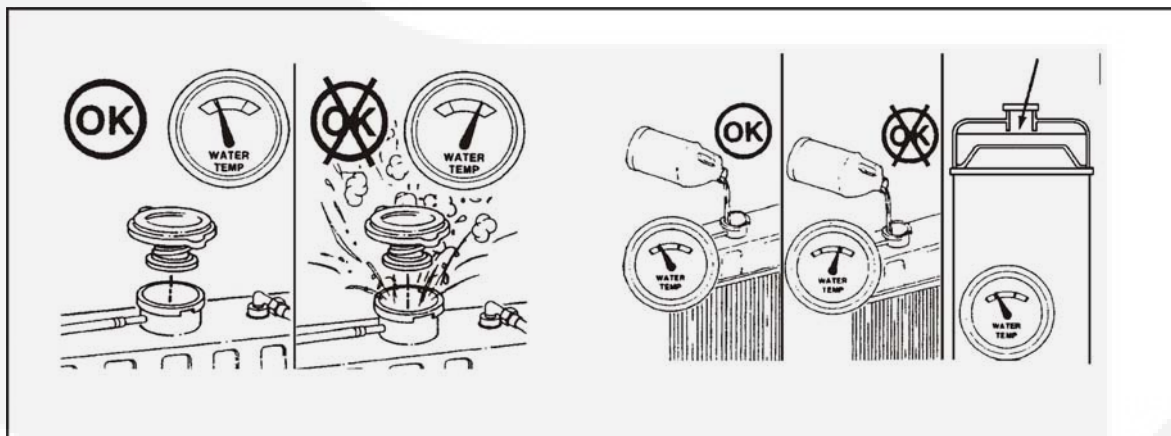
6.4.1 Coolant Level - Check

WARNING: DO NOT REMOVE THE RADIATOR CAP FROM A HOT ENGINE; WAIT UNTIL THE TEMPERATURE IS BELOW 50°C (122°F) BEFORE REMOVING PRESSURE CAP. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY FROM HEATED COOLANT SPRAY OR STEAM. REMOVE FILLER CAP SLOWLY TO RELEASE COOLANT SYSTEM PRESSURE.

Caution: Avoid prolonged or repeated skin contact with antifreeze. Refer to the Health and Safety Manual 0908-0110-00 for handling and disposal of antifreeze.

Note: Never use a sealing additive to stop leaks in the coolant system. This can result in a blocked coolant system and inadequate coolant flow causing the engine to overheat.

Coolant level must be checked daily. The standard coolant concentration is either 25% or 50% Ethylene Glycol and water, this concentration must be maintained. Warranty claims for damage will be rejected if the incorrect mix of anti-freeze has been used. Consult your authorised distributor for the correct anti-freeze specifications and concentration for your operating conditions. The recommended antifreeze is Fleetguard® Compleat ES which is a low-silicate antifreeze, or its equivalent.



Caution: Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50°C (122°F) before adding coolant.

Note: On applications that use a coolant recovery system, check to ensure the coolant is at the appropriate level on the coolant recovery tank dependent on engine temperature.

Fill the cooling system with coolant to the bottom of the fill neck in the radiator or expansion tank, with the coolant temperature at 50°C (122°F) or lower.

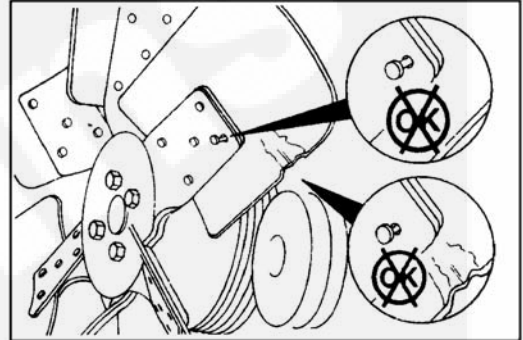
Note: Some radiators have two fill necks, both of which must be filled. Refer to the generator set specific drawings supplied with the set.

6.4.2 Cooling Fan - Inspect

WARNING: PERSONAL INJURY CAN RESULT FROM A FAN BLADE FAILURE. NEVER PULL OR PRY ON THE FAN, THIS CAN DAMAGE THE FAN BLADE(S) AND CAUSE FAN FAILURE.

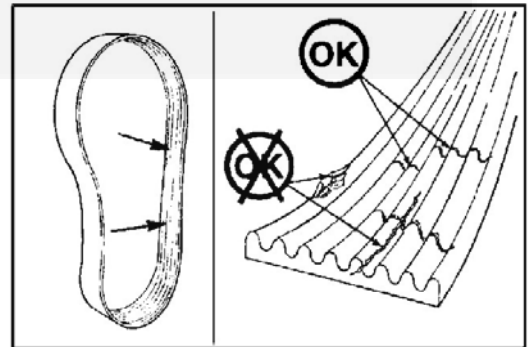
A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted.

Contact your authorised distributor if the fan is damaged.



6.4.3 Drive Belt - Inspect

Visually inspect the belt through the guarding, checking for intersecting cracks. Small transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are NOT acceptable. Contact your authorised distributor if the belt is frayed or has pieces of material missing.

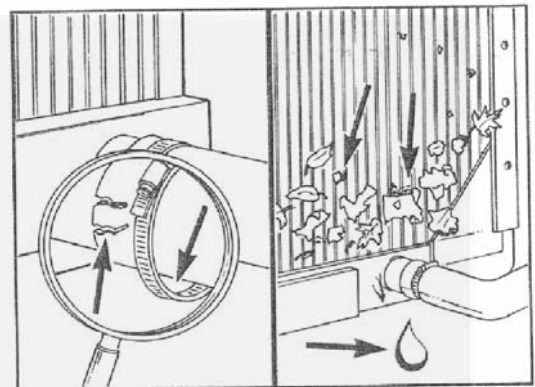


6.4.4 Radiator - Check

Check for damaged hoses, and loose and damaged hose clamps.

Inspect the exterior of the radiator (through the guarding) for obstructions. During the service life of a radiator a build up of foreign matter can obstruct the flow of air through the radiator cores, reducing the cooling capability. To ensure the continued efficiency of the radiator, the core will require cleaning.

Refer to the Radiator Information Manual 0908-0107-00 for further details on cleaning the radiator.



6.5 Engine Oil

6.5.1 Engine Oil Level – Check

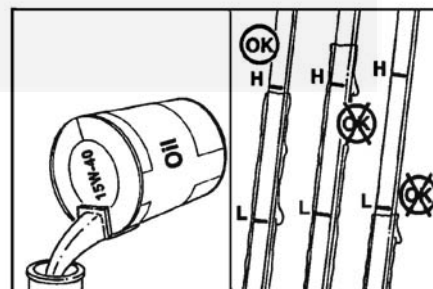
WARNING: CRANKCASE PRESSURE CAN BLOW OUT HOT OIL AND CAUSE SEVERE BURNS. DO NOT CHECK OIL WHILE THE GENERATOR SET IS OPERATING.

Caution: Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling can cause foaming or aeration of the oil while operation below the low mark may cause loss of oil pressure.

Caution: Prolonged and repeated skin contact with used engine oils can cause skin disorders or other bodily injury.
Refer to the Health and Safety Manual (0908-0110-00) supplied with your generator set for precautions when handling or disposing of used engine oil.

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Table 1.

Never operate the engine with the oil level below the L (Low) mark, or above the H (High) mark. Wait at least fifteen minutes, after shutting off the engine, before checking the oil level. This allows time for the oil to drain back to the oil pan.



Note: Use high-quality 15W-40 multi-viscosity lubricating oil such as Cummins Premium Blue® or its equivalent. Consult your authorised distributor for the correct lubricating oil for your operating conditions.



6.6 Fuel System

WARNING: IGNITION OF FUEL CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH BY FIRE OR EXPLOSION. DO NOT PERMIT ANY FLAME, CIGARETTE, OR OTHER IGNITER NEAR THE FUEL SYSTEM, OR IN AREAS SHARING VENTILATION.

WARNING: ENGINE FUEL ACTUATORS CAN OPERATE AT VOLTAGES UP TO 140 VOLTS DC.

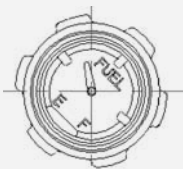
WARNING: DO NOT MIX GASOLINE OR ALCOHOL WITH DIESEL FUEL. THIS MIXTURE CAN CAUSE AN EXPLOSION AND DAMAGE TO THE ENGINE – GASOLINE AND ALCOHOL HAVE INFERIOR LUBRICITY.

Caution: Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.

Use ASTM No. 2D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 are often needed in high altitudes, or extremely low ambient temperatures, to prevent misfires and excessive smoke. Contact your authorised distributor for your operating conditions.

Note: A diesel fuel to BS 2869:2006; (Fuel oils for agricultural, domestic and industrial engine and boilers), conforming to the requirements and test methods of that specification would be an acceptable alternative to ASTM No. 2D.

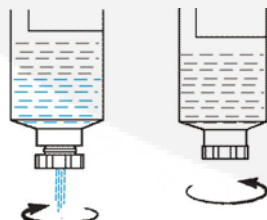
6.6.1 Fuel Level



To avoid condensation problems, keep fuel supply tanks as full as possible by filling up each time the engine is used. Condensation (water) can cause clogging of the fuel filters as well as possible freezing problems. In addition, water mixing with the sulphur in the fuel forms acid which can corrode and damage engine parts.

A base fuel tank may be incorporated into the bedframe. This tank is fitted with a large filler cap with in-built coarse filter, and provides a minimum of eleven hours operation at a nominal 100% load.

6.6.2 Fuel/Water Separator - Drain



Drain the water and sediment from the separator daily.

Set-mounted fuel/water separators are fitted to provide protection for the engine fuel injection system as water-free fuel supplies cannot be guaranteed.

Turn the valve counterclockwise, four complete turns, until the valve drops down one inch. Drain the filter sump of water until clear fuel is visible.

Push the valve up and turn the valve clockwise to close drain valve.

Caution: Do not over tighten the valve. Over tightening can damage the threads.



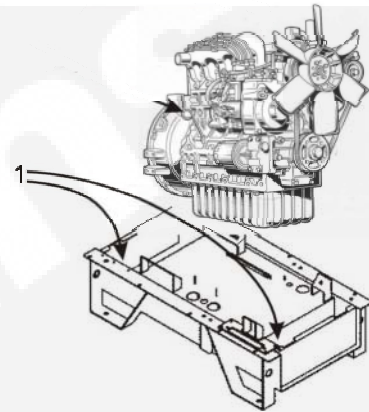
Note: If more than 2 oz is drained, refilling of the filter is required to prevent hard starting.

6.7 Fluid Containmentment

The bedframe fluid containment area (if applicable) must be inspected at regular intervals and any liquid must be drained off and disposed off in line with local health and safety regulations. (Refer also to Health and Safety manual 0908-0110-00). Failure to perform this action may result in spillage of liquids likely to contaminate the surrounding area.

KEY

1. Containment Area

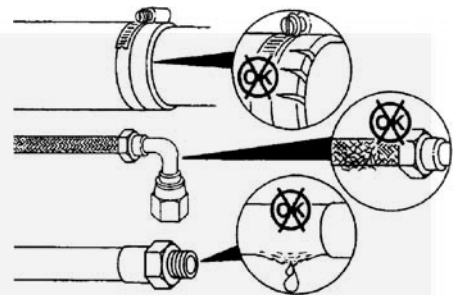


Any other fluid containment area must also be checked and emptied, as above.

6.8 Hoses and Fuel Lines – Check

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC. TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT METAL PARTS SUCH AS RADIATOR, TURBOCHARGER AND EXHAUST SYSTEM.

With the generator set operating, inspect the supply lines, return lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions and ensure they are not rubbing against anything that could cause breakage. If any leaks are detected, shut down the generator set (if possible), contact your authorised distributor and have the leaks corrected immediately.



6.9 Exhaust System

WARNING: EXHAUST COMPONENTS BECOME VERY HOT WHEN THE GENERATOR SET IS IN USE AND REMAIN HOT FOR A PERIOD OF TIME AFTER THE GENERATOR SET HAS BEEN SHUT DOWN. THESE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH FROM CONTACT. ALLOW THESE COMPONENTS TO COOL COMPLETELY BEFORE PERFORMING ANY MAINTENANCE TASKS.

WARNING: INHALATION OF EXHAUST GASES CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH. BE SURE DEADLY EXHAUST GAS IS PIPED OUTSIDE AND AWAY FROM WINDOWS, DOORS OR OTHER INLETS TO BUILDINGS. DO NOT ALLOW TO ACCUMULATE IN HABITABLE AREAS.

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC.

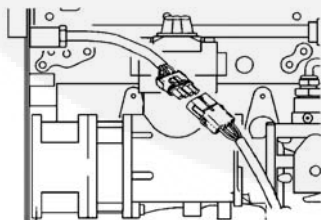
With the generator set operating, inspect the exhaust system visually and audibly where possible checking for leaks within the system, with out removing guarding and panels. If any leaks are detected, shut down the generator set, contact your authorized distributor and have the leaks corrected immediately.

6.10 Generator Set Output - AC Electric System

Check the following while the generator set is operating:

- Frequency: The generator set frequency should be stable and the reading should be the same as the generator set nameplate rating (50Hz/1500RPM or 60Hz/1800RPM).
- AC Voltage: At no load, the line-to-line voltage(s) should be the same as the generator set nameplate rating.
- AC Ammeter: At no load, the current readings should be zero. With a load applied, each line current should be similar.
- Panel Lamps: When the Operating Panel is first connected to the DC supply, the system runs a check by illuminating each of the indicator lamps in turn.

6.11 DC Electrical System



ignite explosive battery gases.

Check the terminals on the batteries for clean and tight connections. Loose or corroded connections create resistance, which can hinder starting. Use insulated tools when disconnecting battery cables. Clean and reconnect the battery cables if loose. Always disconnect both ends of the negative battery cable. Reconnect one end of the cable to the negative battery terminal and the other end to ground. This will ensure that any arcing will be away from the battery and least likely to

WARNING: IGNITION OF EXPLOSIVE BATTERY GASES CAN CAUSE SEVERE PERSONAL INJURY. DO NOT SMOKE, DO NOT USE NAKED FLAMES OR CAUSE SPARKS WHILE SERVICING BATTERIES.

Refer to Supplementary Publication 0908-0101-00 for cleaning and safety precautions of the battery

All maintenance tasks must be assessed for health and safety risks, the preventative measures identified must be actioned. Accompaniment is required for tasks where the presence of someone else will add significantly to the safety of the task.

Read, understand and comply with all Caution and Warning notes in this section, those contained within Section 1 - Preliminary and Safety, and those contained within the Health and Safety Manual (0908-0110-00). Refer also to the Operator's engine specific manual supplied as part of the generator set documentation pack. This latter manual will contain further information regarding the running and care of the generator set and also specific equipment instructions that may differ from the standard generator set.

Ensure adequate lighting and staging (where required) are installed.

Caution: *Maintenance must only be carried out by authorised and qualified maintenance engineers, who are familiar with the equipment and its operation.*

WARNING: DEPENDENT UPON THE CONTROL SYSTEM FITTED, THIS UNIT MAY OPERATE AUTOMATICALLY AND COULD START WITHOUT WARNING.

Caution: *Before carrying out any maintenance work, become familiar with the Generator Plant Safety Code given in Section 1 of this manual, together with the Health and Safety Manual (0908-0110-00).*

Caution: *Always disconnect a battery charger from its AC source before disconnecting the battery leads. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.*

WARNING: ACCIDENTAL STARTING OF THE GENERATOR SET WHILE WORKING ON IT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. PREVENT ACCIDENTAL STARTING BY DISCONNECTING THE STARTING BATTERY LEADS (NEGATIVE [-] FIRST).

ENSURE BATTERY AREA HAS BEEN WELL-VENTILATED BEFORE SERVICING THE BATTERY. SPARKS OR ARCING CAN IGNITE EXPLOSIVE HYDROGEN GAS GIVEN OFF BY BATTERIES, CAUSING SEVERE PERSONAL INJURY. ARCING CAN OCCUR WHEN LEADS ARE REMOVED OR REPLACED, OR WHEN THE NEGATIVE (-) BATTERY LEAD IS CONNECTED AND A TOOL USED TO CONNECT OR DISCONNECT THE POSITIVE (+) BATTERY LEAD TOUCHES THE FRAME OR OTHER GROUNDED METAL PART OF THE GENERATOR SET.

INSULATED TOOLS MUST BE USED WHEN WORKING IN THE VICINITY OF THE BATTERIES.
ALWAYS REMOVE THE NEGATIVE (-) LEAD FIRST AND RECONNECT LAST.

ENSURE HYDROGEN FROM THE BATTERY, ENGINE FUEL AND OTHER EXPLOSIVE FUMES ARE FULLY DISSIPATED. THIS IS ESPECIALLY IMPORTANT IF THE BATTERY HAS BEEN CONNECTED TO A BATTERY CHARGER.

WARNING: TO COMPLETE MAINTENANCE TASKS AT HEIGHT REFER TO LOCAL LEGISLATIVE REQUIREMENTS. SUITABLE EQUIPMENT FOR PERFORMING THESE TASKS MUST BE USED IN ACCORDANCE WITH THE LOCAL GUIDELINES AND LEGISLATION. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH.

WARNING: DO NOT USE THE SKID (BEDFRAME) OR ANY PART OF THE GENERATOR SET AS A MEANS OF ACCESS. USE OF THE GENERATOR SET AS ACCESS MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH AND/OR PROPERTY AND EQUIPMENT DAMAGE.

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE WORK, LOCK OFF FOR SAFE WORKING:

1. PRESS THE OFF MODE SWITCH ON THE GENERATOR SET CONTROL PANEL.
2. AS AN ADDITIONAL PRECAUTION, PRESS THE EMERGENCY STOP BUTTON, AND HOLD IN FOR 30 SECONDS.
3. ISOLATE ALL SUPPLIES TO THE GENERATOR SET.
4. ISOLATE THE BATTERY CHARGER.
5. DISCONNECT THE BATTERY.
6. REMOVE THE STARTER CONTROL WIRES.
7. A SUITABLE WARNING PLATE STATING 'MAINTENANCE IN PROGRESS' SHOULD BE DISPLAYED PROMINENTLY.

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE (LOCK AND TAG) ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

6.12 Locking the Generator Set Out of Service

6.12.1 Introduction

Before any work is carried out for maintenance, etc., the plant must be immobilised. Even if the plant is put out of service by pressing the Off switch on the control panel, the plant cannot be considered safe to work on until the engine is properly immobilised as detailed in the following procedures.

Caution: *Refer also to the Operator's engine specific manual included in the documentation package supplied with the generator set. This manual will contain specific equipment instructions that may differ from the standard generator set.*

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE, ISOLATE ALL SUPPLIES TO THE GENERATOR SET AND ANY CONTROL PANELS. RENDER THE SET INOPERATIVE BY DISCONNECTING THE PLANT BATTERY.


Caution: *If the engine has been running recently explosive gases (given off during battery charging) may be present in the vicinity of the batteries. Ensure the area is well ventilated before disconnecting batteries.*

6.12.2 Immobilising the Generator Set for Safe Working

Note: *Shutdown the engine first, as described in Section 5.7 - Stopping.*

To immobilise the engine:

9. Press the Off Mode switch on the display panel.
10. Press the Emergency Stop Button, (and hold in for 30 seconds). This will prevent the starting of the generator set regardless of the Start signal source and will therefore provide an additional safety step for immobilising the generator set. (See also Section 5.7).

Note: *When this Stop Button is pressed the display panel will indicate the Shutdown condition by illuminating the red Shutdown status LED  and displaying the following message on the graphical LCD display:*

**Fault Number: 1433
EMERGENCY STOP**

or

**Fault Number: 1434
REMOTE EMERGENCY STOP**

Note: *This Fault will affect the Fault History memory bank.*

11. As an additional precaution, thoroughly ventilate the plant room before disconnecting any leads.
12. Isolate and lock off the supply to the heater, where fitted.
13. Isolate and lock off the supply to the battery charger, where fitted.
14. Isolate the fuel supply to the engine.
15. Disconnect the starting batteries and control system batteries, (if separate). Disconnect the negative (-) lead first. Attach a padlock through one of the battery leads and tag for safe working.
16. Fit warning notices at each of the above points to indicate Maintenance in Progress - Plant Immobilised for Safe Working.

6.13 General

The maintenance procedures covered in this manual are intended for Operator-level service only and must be performed at whichever interval occurs first. At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

Table 1 covers the recommended service intervals for a generator set on Standby service. If the generator set will be subjected to Prime usage or extreme operating conditions, the service intervals should be reduced accordingly. Consult your authorised distributor.

Some of the factors that can affect the maintenance schedule are:

Use for continuous duty (prime power)

Extremes in ambient temperature

Exposure to elements

Exposure to salt water

Exposure to windblown dust or sand.

Consult with an authorised distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable schedule of maintenance. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated, or after the number of operating hours indicated, whichever comes first.

Use Table 1 to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

Refer also to the Operator's engine manual supplied with the generator set.



Table 3 Periodic Maintenance Schedule

MAINTENANCE ITEMS		Daily or after 8 Hours	Weekly or after 50 Hours ⁷	Monthly or after 100 Hours ⁷	3 Months or after 250 Hours ^{5, 7}
Perform maintenance tasks as specified using Daily or Hourly periods – whichever is the sooner					
Check:	Fuel tank level	■			
	Fuel lines and hoses	■ ¹			
	Bedframe fluid containment (where fitted), drain if necessary	■ ⁸			
	Engine oil level	■ ¹	■ ⁶		
	Coolant level of radiator(s) (water jacket & LTA)	■ ⁴			
	Coolant lines and radiator hoses for wear and cracks	■ ¹			
	Cooling fan blades	■			
	All exhaust components, and hardware (fittings, clamps, fasteners, etc.)	■ ¹			
	Drive belt, condition and tension		■ ²		
	Air cleaner restriction indicator (where fitted)	■			
	Air intake system for leaks	■			
	Electrical connections (battery, starter motor and alternator connections)		■		
	Safety controls and alarms	■			
	Operation of Emergency Stop Button		■		
Drain:	Water from fuel pre-filter (where fitted)	■ ³			
Clean:	Radiator matrix			■ ^{4,5}	

■1 – Check for oil, fuel, coolant and exhaust system leaks. Check exhaust system audibly and visually with generator set running. (Refer to [Sections 6.8](#) and [6.9](#)).

■2 – Visually check belt for evidence of wear or slippage. Replace if hard or brittle (to be undertaken by a Service Engineer).

■3 – Drain one cup, or more, of fuel to remove water and sediment.

■4 – Refer to Section 6.4 of this manual and to the Radiator Information Manual 0908-0107-00 supplied with this generator set.

■5 – To be undertaken by a Service Engineer. Please refer to your Authorised Distributor.

■6 – Engine oil and filter must be replaced after the initial running-in period of 50 hours. Please refer to your authorised distributor.

■7 – All maintenance checks and inspections listed at lesser maintenance intervals must also be carried out at this time.

■8 – For generator sets with QSB7 engines refer to Engine Operators manual for that model.

6.14 Daily or Refuelling Maintenance Procedures

Monitor fluid levels, oil pressure, and coolant temperature frequently. During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. The following sections cover areas that must be frequently inspected for continued safe operation.

6.14.1 General Information

Preventative maintenance begins with day-to-day awareness of the condition of the generator set.

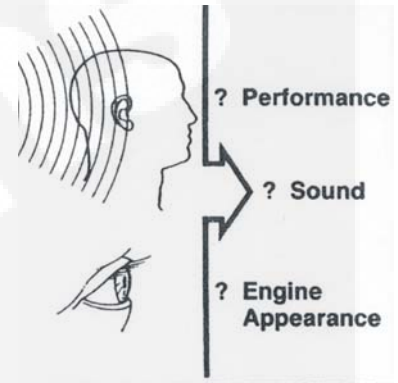
Before starting the generator set check the oil and coolant levels and look for:

Leaks

Loose or damaged parts

Worn or damaged belts

Any change in engine or generator set appearance.



6.14.2 Engine Operation Report

The engine must be maintained in good mechanical condition if the operator is to obtain optimum satisfaction from its use. Running reports are necessary to enable programmed or emergency servicing to be carried out.

Comparison and intelligent interpretation of the running report, together with a practical follow-up action will eliminate most failures and emergency repairs.

Most engine problems give an early warning. Look and listen for changes in engine performance, sound, or appearance that can indicate service or repair is needed. Some engine changes to look for and report on are:

Low lubricating oil pressure

Low power

Abnormal water or oil temperature

Unusual engine noise

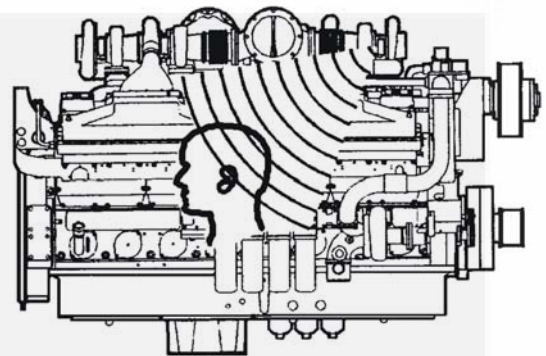
Excessive exhaust smoke

Excessive use of coolant, fuel or lubricating oil

Any coolant, fuel or lubricating oil leaks.

Misfire

Vibration



6.15 Cooling System

WARNING: CONTACT WITH HOT COOLANT CAN RESULT IN SERIOUS SCOLDING. ALLOW COOLING SYSTEM TO COOL BEFORE RELEASING PRESSURE AND REMOVING WATER JACKET RADIATOR CAP OR LTA EXPANSION TANK CAP.

Caution: Loss of coolant can allow engine to overheat without protection of shutdown device, and cause severe damage to the engine. Maintain coolant level for proper operation of high engine temperature shutdown system.

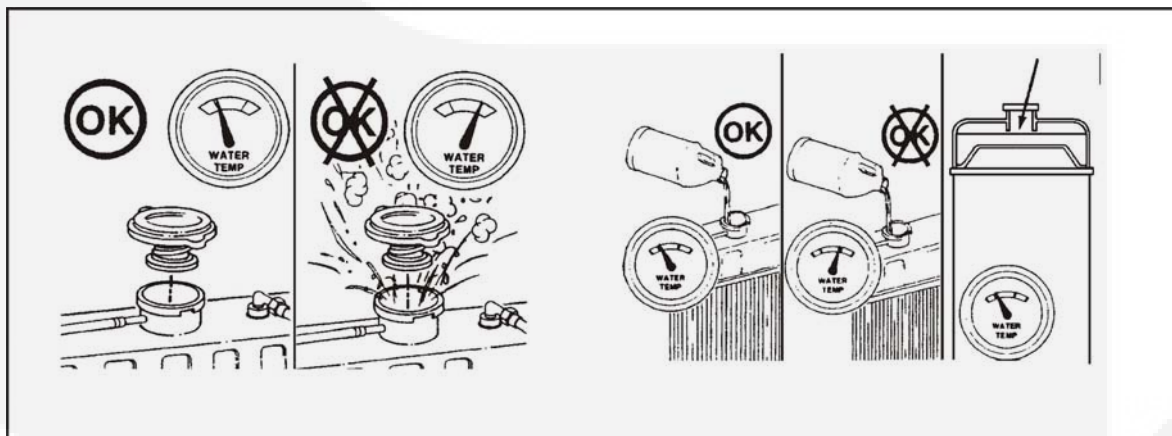
6.15.1 Coolant Level - Check

WARNING: DO NOT REMOVE THE RADIATOR CAP FROM A HOT ENGINE; WAIT UNTIL THE TEMPERATURE IS BELOW 50°C (122°F) BEFORE REMOVING PRESSURE CAP. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY FROM HEATED COOLANT SPRAY OR STEAM. REMOVE FILLER CAP SLOWLY TO RELEASE COOLANT SYSTEM PRESSURE.

Caution: Avoid prolonged or repeated skin contact with antifreeze. Refer to the Health and Safety Manual 0908-0110-00 for handling and disposal of antifreeze.

Note: Never use a sealing additive to stop leaks in the coolant system. This can result in a blocked coolant system and inadequate coolant flow causing the engine to overheat.

Coolant level must be checked daily. The standard coolant concentration is either 25% or 50% Ethylene Glycol and water, this concentration must be maintained. Warranty claims for damage will be rejected if the incorrect mix of anti-freeze has been used. Consult your authorised distributor for the correct anti-freeze specifications and concentration for your operating conditions. The recommended antifreeze is Fleetguard® Compleat ES which is a low-silicate antifreeze, or its equivalent.



Caution: Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50°C (122°F) before adding coolant.

Note: On applications that use a coolant recovery system, check to ensure the coolant is at the appropriate level on the coolant recovery tank dependent on engine temperature.

Fill the cooling system with coolant to the bottom of the fill neck in the radiator or expansion tank, with the coolant temperature at 50°C (122°F) or lower.

Note: Some radiators have two fill necks, both of which must be filled. Refer to the generator set specific drawings supplied with the set.

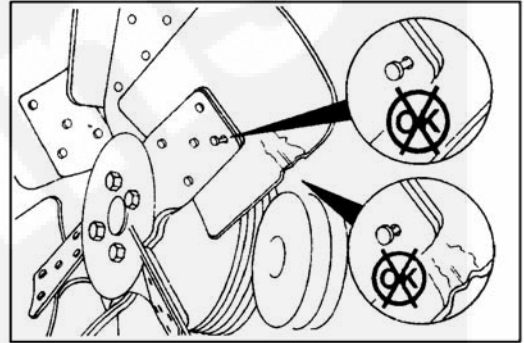
6.15.2 Cooling Fan - Inspect

WARNING: PERSONAL INJURY CAN RESULT FROM A FAN BLADE FAILURE. NEVER PULL OR PRY ON THE FAN, THIS CAN DAMAGE THE FAN BLADE(S) AND CAUSE FAN FAILURE.

Note: Manually rotate the crankshaft by using a wrench on the accessory drive pulley nut.

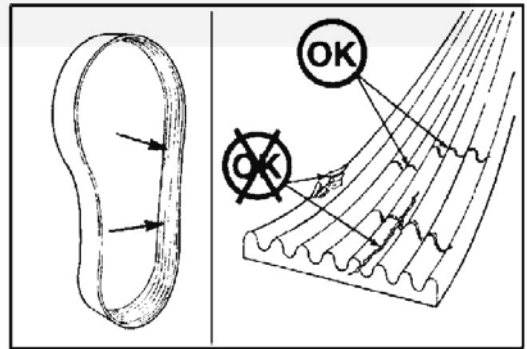
A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted.

Contact your authorised distributor if the fan is damaged.



6.15.3 Drive Belt - Inspect

Visually inspect the belt through the guarding, checking for intersecting cracks. Small transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are NOT acceptable. Contact your authorised distributor if the belt is frayed or has pieces of material missing.

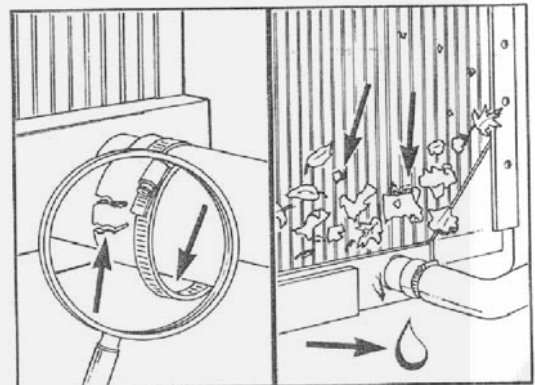


6.15.4 Radiator - Check

Check for damaged hoses, and loose and damaged hose clamps.

Inspect the exterior of the radiator (through the guarding) for obstructions. During the service life of a radiator a build up of foreign matter can obstruct the flow of air through the radiator cores, reducing the cooling capability. To ensure the continued efficiency of the radiator, the core will require cleaning.

Refer to the Radiator Information Manual 0908-0107-00 for further details on cleaning the radiator.



6.16 Engine Oil

6.16.1 Engine Oil Level – Check

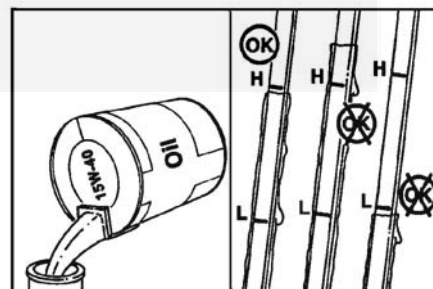
WARNING: CRANKCASE PRESSURE CAN BLOW OUT HOT OIL AND CAUSE SEVERE BURNS. DO NOT CHECK OIL WHILE THE GENERATOR SET IS OPERATING.

Caution: Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling can cause foaming or aeration of the oil while operation below the low mark may cause loss of oil pressure.

Caution: Prolonged and repeated skin contact with used engine oils can cause skin disorders or other bodily injury.
Refer to the Health and Safety Manual (0908-0110-00) supplied with your generator set for precautions when handling or disposing of used engine oil.

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Table 1.

Never operate the engine with the oil level below the L (Low) mark, or above the H (High) mark. Wait at least fifteen minutes, after shutting off the engine, before checking the oil level. This allows time for the oil to drain back to the oil pan.



Note: Use high-quality 15W-40 multi-viscosity lubricating oil such as Cummins Premium Blue® or its equivalent. Consult your authorised distributor for the correct lubricating oil for your operating conditions.



6.17 Fuel System

WARNING: IGNITION OF FUEL CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH BY FIRE OR EXPLOSION. DO NOT PERMIT ANY FLAME, CIGARETTE, OR OTHER IGNITER NEAR THE FUEL SYSTEM, OR IN AREAS SHARING VENTILATION.

WARNING: ENGINE FUEL ACTUATORS CAN OPERATE AT VOLTAGES UP TO 140 VOLTS DC.

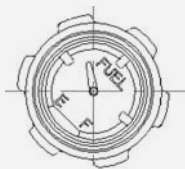
WARNING: DO NOT MIX GASOLINE OR ALCOHOL WITH DIESEL FUEL. THIS MIXTURE CAN CAUSE AN EXPLOSION AND DAMAGE TO THE ENGINE – GASOLINE AND ALCOHOL HAVE INFERIOR LUBRICITY.

Caution: *Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.*

Use ASTM No. 2D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 are often needed in high altitudes, or extremely low ambient temperatures, to prevent misfires and excessive smoke. Contact your authorised distributor for your operating conditions.

Note: *A diesel fuel to BS 2869:2006; (Fuel oils for agricultural, domestic and industrial engine and boilers), conforming to the requirements and test methods of that specification would be an acceptable alternative to ASTM No. 2D.*

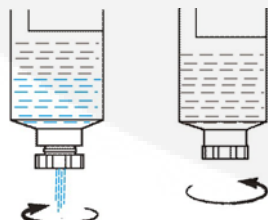
6.17.1 Fuel Level



To avoid condensation problems, keep fuel supply tanks as full as possible by filling up each time the engine is used. Condensation (water) can cause clogging of the fuel filters as well as possible freezing problems. In addition, water mixing with the sulphur in the fuel forms acid which can corrode and damage engine parts.

A base fuel tank may be incorporated into the bedframe. This tank is fitted with a large filler cap with in-built coarse filter, and provides a minimum of eleven hours operation at a nominal 100% load.

6.17.2 Fuel/Water Separator - Drain



Drain the water and sediment from the separator daily.

Set-mounted fuel/water separators are fitted to provide protection for the engine fuel injection system as water-free fuel supplies cannot be guaranteed.

Turn the valve counterclockwise, four complete turns, until the valve drops down one inch. Drain the filter sump of water until clear fuel is visible.

Push the valve up and turn the valve clockwise to close drain valve.

Caution: *Do not over tighten the valve. Over tightening can damage the threads.*

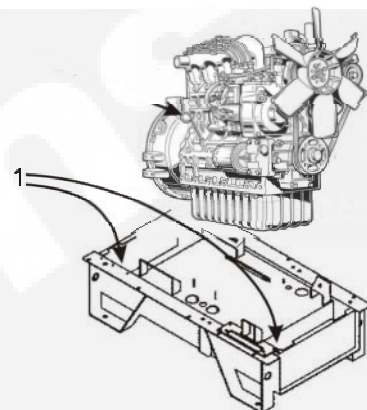
Note: *If more than 2 oz is drained, refilling of the filter is required to prevent hard starting.*

6.18 Fluid Containment

The bedframe fluid containment area (if applicable) must be inspected at regular intervals and any liquid must be drained off and disposed off in line with local health and safety regulations. (Refer also to Health and Safety manual 0908-0110-00). Failure to perform this action may result in spillage of liquids likely to contaminate the surrounding area.

KEY

1. Containment Area

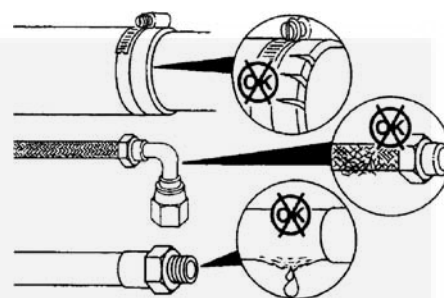


Any other fluid containment area must also be checked and emptied, as above.

6.19 Hoses and Fuel Lines – Check

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC. TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT METAL PARTS SUCH AS RADIATOR, TURBOCHARGER AND EXHAUST SYSTEM.

With the generator set operating, inspect the supply lines, return lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions and ensure they are not rubbing against anything that could cause breakage. If any leaks are detected, shut down the generator set (if possible), contact your authorised distributor and have the leaks corrected immediately.



6.20 Exhaust System

WARNING: EXHAUST COMPONENTS BECOME VERY HOT WHEN THE GENERATOR SET IS IN USE AND REMAIN HOT FOR A PERIOD OF TIME AFTER THE GENERATOR SET HAS BEEN SHUT DOWN. THESE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH FROM CONTACT. ALLOW THESE COMPONENTS TO COOL COMPLETELY BEFORE PERFORMING ANY MAINTENANCE TASKS.

WARNING: INHALATION OF EXHAUST GASES CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH. BE SURE DEADLY EXHAUST GAS IS PIPED OUTSIDE AND AWAY FROM WINDOWS, DOORS OR OTHER INLETS TO BUILDINGS. DO NOT ALLOW TO ACCUMULATE IN HABITABLE AREAS.

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC.

With the generator set operating, inspect the exhaust system visually and audibly where possible checking for leaks within the system, with out removing guarding and panels. If any leaks are detected, shut down the generator set, contact your authorized distributor and have the leaks corrected immediately.

6.21 Generator Set Output - AC Electric System

Check the following while the generator set is operating:

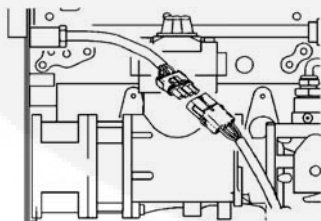
Frequency: The generator set frequency should be stable and the reading should be the same as the generator set nameplate rating (50Hz/1500RPM or 60Hz/1800RPM).

AC Voltage: At no load, the line-to-line voltage(s) should be the same as the generator set nameplate rating.

AC Ammeter: At no load, the current readings should be zero. With a load applied, each line current should be similar.

Panel Lamps: When the Operating Panel is first connected to the DC supply, the system runs a check by illuminating each of the indicator lamps in turn.

6.22 DC Electrical System



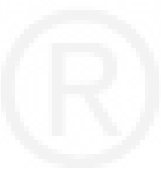
ignite explosive battery gases.

Check the terminals on the batteries for clean and tight connections. Loose or corroded connections create resistance, which can hinder starting. Use insulated tools when disconnecting battery cables. Clean and reconnect the battery cables if loose. Always disconnect both ends of the negative battery cable. Reconnect one end of the cable to the negative battery terminal and the other end to ground. This will ensure that any arcing will be away from the battery and least likely to

WARNING: IGNITION OF EXPLOSIVE BATTERY GASES CAN CAUSE SEVERE PERSONAL INJURY. DO NOT SMOKE, DO NOT USE NAKED FLAMES OR CAUSE SPARKS WHILE SERVICING BATTERIES.

Refer to Supplementary Publication 0908-0101-00 for cleaning and safety precautions of the battery

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SECTION 7 – TROUBLESHOOTING

7 Troubleshooting

7.1 Introduction

Fault codes information together with Warning and Shutdown information is provided in this section to assist in locating and identifying the possible causes of faults in the generator set system.

7.2 Control Unit

The generator set control system continuously monitors engine sensors for abnormal conditions, such as low oil pressure and high coolant temperature. If any of these conditions occur, the control will light a yellow Warning lamp or a red Shutdown lamp and will display a message on the graphical display panel. In the event of an engine shutdown fault (red Shutdown LED), the control will stop the engine immediately.

This section lists the Warning and Shutdown Fault Codes/Messages (Table 7-1), and suggests possible causes of the fault.

Note: *Displayed error codes that are not listed in Table 7-1 will require an authorised service representative to correct the fault. Contact an authorised service centre for assistance.*

7.3 Safety Considerations

Fault finding work, particularly in confined areas, should be carried out by two engineers working together. Read, understand and comply with all safety precautions listed within Section 1 – Preliminary and Safety – and observe all instructions and precautions throughout this manual and the Health and Safety Manual (0908-0110-00).

The installation of a generator set can be designed for remote starting. When troubleshooting a generator set that is shutdown ensure that the set cannot be accidentally re-started. Refer to Section 6.2 – Locking the Generator Set out of Service.

WARNING: HIGH VOLTAGES ARE PRESENT WHEN THE GENERATOR SET IS RUNNING. DO NOT OPEN THE OUTPUT BOX WHILE THE GENERATOR SET IS RUNNING.

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

WARNING: CONTACTING HIGH VOLTAGE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH BY ELECTROCUTION. KEEP THE OUTPUT BOX COVERS IN PLACE DURING TROUBLESHOOTING. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL SERVICING SHOULD CARRY OUT TESTING AND/OR ADJUSTMENTS.

Caution: *Always disconnect a battery charger from its AC source before disconnecting the battery leads. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.*

WARNING: VENTILATE BATTERY AREA BEFORE WORKING ON OR NEAR BATTERY – WEAR GOGGLES – STOP GENERATOR SET AND DISCONNECT CHARGER BEFORE DISCONNECTING BATTERY CABLES – DISCONNECT NEGATIVE (-) CABLE FIRST AND RECONNECT LAST

WARNING: IGNITION OF EXPLOSIVE BATTERY GASES CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. ARCING AT BATTERY TERMINALS, LIGHT SWITCH OR OTHER EQUIPMENT, FLAME, PILOT LIGHTS AND SPARKS, CAN IGNITE BATTERY GAS. DO NOT SMOKE, OR SWITCH TROUBLE LIGHT ON OR OFF NEAR BATTERY. DISCHARGE STATIC ELECTRICITY FROM BODY BEFORE TOUCHING BATTERIES BY FIRST TOUCHING A GROUNDED METAL SURFACE.

WARNING: ACCIDENTAL STARTING OF THE GENERATOR SET WHILE WORKING ON IT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. PREVENT ACCIDENTAL STARTING BY DISCONNECTING THE STARTING BATTERY LEADS (NEGATIVE [-] FIRST).

7.4 Fault Finding

Should a fault condition occur during operation follow the procedures in the following tables to locate and correct the problem. For any symptom not listed, contact an authorised service centre for assistance.

Before starting any fault finding, ensure that the following basic checks are carried out:

- All switches and controls are in their correct positions
- The fuel oil level is correct
- The lubricating oil level is correct
- The coolant level is correct
- The radiator matrix is free from obstruction
- The battery charge condition is satisfactory and the connections are secure
- The generator set electrics and alternator connections are secure
- The panel connections are secure
- The protection circuits have been reset
- Blown fuses have been replaced
- Tripped contactors or circuit breakers have been reset

WARNING: MANY TROUBLESHOOTING PROCEDURES PRESENT HAZARDS THAT CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH. ONLY QUALIFIED SERVICE PERSONNEL WITH KNOWLEDGE OF FUELS, ELECTRICITY, AND MACHINERY HAZARDS SHOULD PERFORM SERVICE PROCEDURES.
REVIEW SAFETY PRECAUTIONS LISTED WITHIN SECTION 1 - PRELIMINARY AND SAFETY SECTION - OF THIS MANUAL TOGETHER WITH THE HEALTH AND SAFETY MANUAL (0908-0110-00).

7.5 Status Indicators

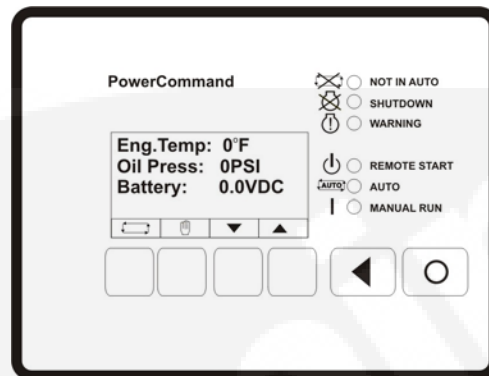



Figure 7-1 Display Panel

Not in Auto

This red lamp is lit when the control is NOT in Auto

Shutdown Status

This red lamp is lit when the control detects a Shutdown condition. The generator set cannot be started when this lamp is on. After the condition has been corrected, the lamp can be reset by pressing the  Off button.

Note: When Battle Short mode has been enabled and a non-critical shutdown fault occurs, the Shutdown lamp will be lit even though the generator set will continue to run.

Warning

This yellow lamp is lit whenever the control detects a Warning condition. This lamp is automatically shut off when the Warning condition no longer exists.


Remote Start

This green lamp indicates the control is receiving a remote run signal.

Auto

This green lamp indicates the control is in Auto mode. Auto mode can be selected by pressing this selection button from any of the Operator menus (see Section 4.5).

Manual Run

This green lamp indicates the control is in the Manual Run mode. Manual Run can be selected by pressing the  selection button from any of the Operator menus (see Section 4.5).

7.6 Fault/Status Codes

The fault codes have been divided into four categories to help you determine what corrective action to take for safe operation of the generator set. Use Table 7-1 to find the category (CTG) and fault description for all codes.

Note: *Gaps in the code numbers are for codes that do not apply to this generator set. Some of the codes listed are feature dependent and will not be displayed by this control.*

Category A Fault Codes:

Pertain to engine or alternator shutdown faults that require immediate repair by trained and experienced service personnel (generator set non-operational). The control prevents the set from being re-started if shutdown fault is not corrected.

Category B Fault Code:

Consists of faults that can affect generator set performance or can cause engine, alternator, or connected equipment damage. Operate the set only when it is powering critical loads and cannot be shut down. Requires repair by trained and experienced service personnel.

Category C Fault Codes:



Consist of faults that are repairable by site personnel. Service will be required by trained and experienced service personnel if site personnel cannot resolve the problem after taking the corrective actions suggested in Table 7-1.

Category D Fault Codes:








Indicates non-critical operational status of the generator set, external faults, or customer fault inputs. These faults require repair by trained and experienced service personnel.

Table 7-1 Fault Codes

CTG	CODE	LAMP	DISPLAYED MESSAGE/SYMBOLS		DESCRIPTION
			TEXT VERSION	SYMBOLIC VERSION	
C	1**	Shutdown	HIGH COOLANT TEMP	 1	Indicates that the engine coolant temperature is above normal and has reached the Shutdown trip point.
A	2**	Shutdown	LOW OIL PRESSURE	 2	Indicates the engine oil pressure has dropped below normal and has reached the Shutdown trip point.
A	12**	Shutdown	HIGH AC VOLTAGE	 12	Indicates that one or more measured AC output voltages have exceeded the threshold for longer than a specified time limit. The threshold and time limits are 130% of nominal for zero seconds or 110% of nominal for ten seconds.
A	13**	Shutdown	LOW AC VOLTAGE	 13	Indicates that the measured AC output voltage is below the threshold for longer than a specified time limit. The threshold and time limits are 85% of nominal for ten seconds.
A	14**	Shutdown	OVER FREQUENCY	Hz↑ 14	Indicates that the alternator frequency is 6 Hertz above the governor reference.
A	15**	Shutdown	UNDER FREQUENCY	Hz↓ 15	Indicates that the alternator frequency is 6 Hertz under the governor reference.
A	27	Shutdown	EXCITATION FAULT	 27	Indicates that a loss of voltage or frequency sensing from the generator has occurred.
A	31**	Shutdown	OVERSPEED	 31	Indicates that the engine has exceeded normal operating speed. The default thresholds are 1725RPM (50Hz) or 2075RPM (60Hz).
A	38	Shutdown	FIELD OVERLOAD	 38	Indicates that the Field AVR Duty Cycle has been at the maximum for at least fifteen seconds.
A	45	Shutdown	SPEED SIGNAL LOST	 45	Indicates that no magnetic pickup pulses are sensed for a Loss of Speed delay. If a magnetic pickup is not installed, then speed sensing is performed by monitoring AC line frequency.
A	46**	Shutdown	HIGH AC CURRENT	 46	Indicates that alternator output current (one or more phases) has exceeded 150% of the rated output current continuously for more than ten seconds.
C	61	Shutdown	EMERGENCY STOP	 61	Indicates an Emergency Stop has been activated.
* For more information on these events, refer to the Battle Short Mode description in Section 4.					
** Any values listed in the Description column for these faults are default values.					

CTG	CODE	LAMP	DISPLAYED MESSAGE/SYMBOLS		DESCRIPTION
			TEXT VERSION	SYMBOLIC VERSION	
A	71**	Shutdown	SPEED HZ MATCH	$N \neq \text{HZ}$ 71	Indicates that measured engine speed and measured alternator AC output frequency do not agree.
C	72	Shutdown	FAIL TO CRANK	 72	The generator set has failed to sense rotation for two start attempts. This indicates a possible fault with the control, speed sensing, or the starting system.
C	73	Shutdown	FAIL TO START	 73	The system has failed to start after a set number of crank attempts. This indicates a possible fuel system problem (engine cranks but fails to start).
B	74	Shutdown	FAIL TO STOP	 74	The generator set continues to run after receiving a shutdown command from the controller. This may indicate that the Battle Short feature has been enabled.
D	75	Shutdown	Customer Input 1	 75	The nature of the fault is an optional customer selection.
D	76	Shutdown	Customer Input 2	 76	The nature of the fault is an optional customer selection.
B	77*	Shutdown	SHUTDOWN AFTER BS	 77	A shutdown fault occurred while the Battle Short mode was enabled.
D	81	Shutdown	Annunciator Fault 1	 81	The nature of the annunciator fault is an optional customer selection.
D	82	Shutdown	Annunciator Fault 2	 82	The nature of the annunciator fault is an optional customer selection.
D	83	Shutdown	Annunciator Fault 3	 83	The nature of the annunciator fault is an optional customer selection.
D	150	None	READY TO LOAD	 150	The generator set is at rated voltage and frequency.
D	153	None	NOT IN AUTO	 153	Indicates that the PCC1301 control is not in the Auto mode.
D	155	None	COMMON ALARM	 155	The control has detected a Warning or Shutdown fault.
D	156	None	COMMON WARNING	 156	The control has detected a Warning fault.
D	157	None	COMMON SHUTDOWN	 157	The control has detected a Shutdown fault.
D	158	None	Customer Input 1	 158	The nature of the fault is an optional customer selection.
D	159	None	Customer Input 2	 159	The nature of the fault is an optional customer selection.
<p>* For more information on these events, refer to the Battle Short Mode description in Section 4.</p> <p>** Any values listed in the Description column for these faults are default values.</p>					

CTG	CODE	LAMP	DISPLAYED MESSAGE/SYMBOLS		DESCRIPTION
			TEXT VERSION	SYMBOLIC VERSION	
D	160	None	Annunciator Fault 1	 160	The nature of the annunciator fault is an optional customer selection.
D	161	None	Annunciator Fault 2	 161	The nature of the annunciator fault is an optional customer selection.
D	162	None	Annunciator Fault 3	 162	The nature of the annunciator fault is an optional customer selection.
C	202**	Warning	PRE-HIGH COOLANT TEMP	 202	Indicates that the engine has begun to overheat and the engine coolant temperature has risen to an unacceptable level.
C	203**	Warning	LOW COOLANT TEMP	 203	Indicates that the engine coolant temperature is below the adjusted setpoint. This may indicate that the coolant heater is not operating or is not circulating coolant.
D	204	Warning	Customer Input 1	 204	The nature of the fault is an optional customer selection
D	205	Warning	Customer Input 2	 205	The nature of the fault is an optional customer selection
B	212	Warning	COOLANT SENSOR OOR	 212	Indicates the coolant temperature sensor output is out of range (OOR), high or low.
C	213**	Warning	LOW BATTERY	 213	Indicates battery voltage supply to the control is approaching a low level at which unpredictable operation can occur.
C	214**	Warning	HIGH BATTERY	 214	Indicates battery voltage supply to the control is approaching a high level at which damage to the control can occur.
c	215**	Warning	PRE-LOW OIL PRESSURE	 215	Indicates that the engine oil pressure is approaching an unacceptable level.
B	216**	Warning	HIGH AC CURRENT	 216	Indicates that the alternator output current (one or more phases) has exceeded 130% of nominal, or has exceeded 110% of nominal for 60 seconds.
B	217	Warning	OIL PRESS SENSOR OOR	 217	Indicates the oil pressure sensor output is out of range (OOR), high or low.
C	218**	Warning	BATTLE SHORT ACTIVE	 218	Indicates that the control is in Battle Short mode – used to bypass several fault shutdowns for generator set operation during emergencies.
<p>* For more information on these events, refer to the Battle Short Mode description in Section 4.</p> <p>** Any values listed in the Description column for these faults are default values.</p>					

CTG	CODE	LAMP	DISPLAYED MESSAGE/SYMBOLS		DESCRIPTION
			TEXT VERSION	SYMBOLIC VERSION	
B	219**	Warning	CHARGER FAILURE	 219	Indicates the battery charging alternator has not reached an acceptable voltage range within the selected time period (default = 120 seconds). This warning is also displayed if your alternator is a type that does not support the control's charging alternator logic functionality. If this occurs, this warning can be disabled if the Charger Alt. Enable setting is set to "No".
B	220*	Warning	FAIL TO SHUTDOWN	 220	Indicates that a shutdown fault is active, but is being bypassed by Battle Short.
C	221**	Warning	WEAK BATTERY	 221	Indicates that the generator set battery voltage is below battery thresholds during cranking.
D	222	Warning	Annunciator Fault 1	 222	The nature of the annunciator fault is an optional customer selection.
D	223	Warning	Annunciator Fault 1	 223	The nature of the annunciator fault is an optional customer selection.
D	224	Warning	Annunciator Fault 1	 224	The nature of the annunciator fault is an optional customer selection.
D	225	Warning	ANNUNCIATOR OUTPUT CONFIGURATION ERROR	 225	The nature of the annunciator fault is an optional customer selection.
* For more information on these events, refer to the Battle Short Mode description in Section 4.					
** Any values listed in the Description column for these faults are default values.					

7.6.1 Customer Input Faults

Dependent on Customer Options specified, the Customer Input Faults may indicate the following:

ACTUAL TEXT SHOWN	TRANSLATION
Earth Fault	Earth Fault
Low Fuel	Low Fuel
High Fuel	High Fuel
High Alternator Temperature	High Alternator Temperature

Dependent on the number of Customer Options required, an adjacent display panel may be fitted where these Faults will be displayed.

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