



Ministry of Defence

GENERATOR SET, DIESEL ENGINE DRIVEN, 2 kW, 230 V/110 V AC/28 V DC (Drumgrange Ltd)

6115-G-710-201 TECHNICAL DESCRIPTION OPERATING INFORMATION MAINTENANCE INSTRUCTIONS

Issue No. 002

Amendment No. 003

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CONTENTS

PRELIMINARY MATERIAL	Page
Front cover.....	(i)
AMENDMENT RECORD.....	(iii)
CONTENTS (this list).....	(v)
PREFACE.....	(vi)
Introduction.....	(vi)
Related and associated publications.....	(vi)
Related publications.....	(vi)
Associated publications.....	(viii)
Hazardous substances.....	(viii)
WARNINGS AND CAUTIONS.....	(viii)
Warnings.....	(viii)
Cautions.....	(x)
ABBREVIATIONS AND SYMBOLS.....	(x)
Abbreviations.....	(x)
Symbols.....	(xi)
FORM 10.....	Final leaf

OPERATING INFORMATION

Chapter

- 1 General Description
- 2 Operating Procedures
- 3 Operator Maintenance
- 4 Destruction of Equipment



PREFACE

Sponsor: Operational Infrastructure (OI)

Project No.:

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INTRODUCTION

1 Service users should forward any comments on this publication using the procedures and templates provided on the Joint Asset Management and Engineering Solutions (JAMES) or Technical Documents On-Line (TDOL) portals. A Form 10 is also provided at the end of this publication; it may be copied and used for forwarding comments if JAMES or TDOL is not available.

2 AESPs are issued under UK MoD authority and where AESPs specify action is to be taken, the AESP will of itself be sufficient authority for such action and also for the demanding of the necessary stores, subject to the provisions of Para 3 below.

3 The subject matter of this publication may be affected by Defence Instructions and Notices (DIN), Standard Operating Procedures (SOP) or by local regulations. When any such Instruction, Order or Regulation contradicts any portion of this publication it is to be taken as the overriding authority.

RELATED AND ASSOCIATED PUBLICATIONS

Related publications

4 The Octad for the subject equipment consists of the publications shown below. All references are prefixed with the first eight digits of this publication. The availability of the publications can be checked on TDOL.

Category/Sub-category			Information Level			
			1 User/ Operator	2 Unit Maintenance	3 Field Maintenance	4 Base Maintenance
1	0	Purpose and Planning Information	101	*	*	*
	1	Equipment Support Policy Directive	111	*	*	*
2	0	Operating Information	201	*	*	*
	1	Aide-Mémoire	211	*	*	*
	2	Training Aids	*	*	*	*
3		Technical Description	201	302	*	*
4	1	Installation Instructions	*	*	*	*
	2	Preparation for Special Environments	*	*	*	*
5	1	Failure Diagnosis	201	522	*	*
	2	Maintenance Instructions	201	522	523	*
	3	Inspection Standards	*	522	*	*
	4	Calibration Procedures	*	*	*	*
6		Maintenance Schedule	601	*	*	*
7	1	Illustrated Parts Catalogue	711	*	*	*
	2	Commercial Parts List	*	*	*	*
	3	Complete Equipment Schedule, Production	*	*	*	*
	4	Complete Equipment Schedule, Service Edition (Simple Equipment)	741	*	*	*
	5	Complete Equipment Schedule, Service Edition (Complex Equipment)	*	*	*	*
8	1	Modification Instructions	*	812	*	*
	2	General Instructions, Special Technical Instructions and Servicing Instructions	*	*	*	*
	3	Service Engineered Modification Instructions (RAF only)	*	*	*	*

* Category/sub-category not published



Associated publications

5 The following associated publications should be read in conjunction with this category:

<u>Reference</u>	<u>Title</u>
AESP 6150-A-100-201	Earthing and Earthing Protection
JSP 515	Hazardous Stores Information System
SEI 14411	Safety Precautions for Electrical Equipment

HAZARDOUS SUBSTANCES

6 Before using any hazardous substance or material, the user must be conversant with the safety precautions and first aid instructions:

- 6.1 On the label of the container it was supplied in.
- 6.2 On the material Safety Data Sheet
- 6.3 In local Safety Orders and Regulations

WARNINGS AND CAUTIONS

WARNINGS

7 The following WARNINGS are applicable to this category:

(1) EARTHING. THE EARTH CABLE PROVIDED IS NOT TO BE LENGTHENED OR SHORTENED UNDER ANY CIRCUMSTANCES WITHOUT APPROVAL FROM THE DESIGN AUTHORITY.

(2) EARTHING. THE EQUIPMENT MUST BE PROPERLY EARTHED BEFORE ATTEMPTING TO OPERATE THE GENERATOR SET. WHEN USED WITH ANCILLARY EQUIPMENT, IT IS ESSENTIAL THAT THE EARTHING INSTRUCTIONS FOR THAT EQUIPMENT BE FOLLOWED. THE LFG EARTH SHOULD NOT BE REMOVED UNLESS SPECIFICALLY REQUIRED IN THE EARTHING INSTRUCTIONS FOR THE ANCILLARY EQUIPMENT.

(3) F54 DIESEL AND F34 AVTUR. DIESEL AND AVTUR FUELS ARE HIGHLY FLAMMABLE. WHEN REFUELLING:

DO NOT RUN THE LFG

DO NOT SMOKE

AVOID ALL NAKED FLAMES

AVOID OVERFILLING THE FUEL TANK/JERRYCAN

WIPE UP ANY SPILT FUEL PRIOR TO STARTING THE LFG

(4) GUARDS AND COVERS. DO NOT OPERATE THE GENERATOR WITH LOOSE OR MISSING COVERS OR GUARDS. DO NOT REMOVE ANY COVERS OR GUARDS UNTIL AT LEAST 10 MINUTES AFTER THE GENERATOR HAS STOPPED.

-
- (5) **JERRYCAN ADAPTOR. DO NOT OPERATE THE GENERATOR UNLESS A JERRYCAN IS CONNECTED VIA THE JERRYCAN ADAPTOR AND PIPES SUPPLIED WITH THE GENERATOR. FAILURE TO COMPLY MAY CAUSE THE LFG FUEL TANK TO COLLAPSE.**
- (6) **NOISE HAZARD. IF PERSONNEL ARE EXPOSED FOR PROLONGED PERIODS TO NOISE LEVELS IN EXCESS OF 80 DB(A), HEARING PROTECTION SHOULD BE PROVIDED AND WORN. THE LFG EMITS A MEASURED NOISE LEVEL OF BETWEEN 90 - 100 DB(A) THEREFORE HEARING PROTECTION MUST BE PROVIDED AND WORN WHEN WORKING WITHIN 1 METRE OF AN OPERATING LFG.**
- (7) **PERSONAL INJURY. THE GENERATOR WEIGHS 76 KG NET AND 88 KG GROSS (INCLUDING FUEL AND CES). MANUAL HANDLING OF THE GENERATOR MUST BE IN ACCORDANCE WITH LOCAL MANUAL HANDLING ASSESSMENTS CARRIED OUT IN ACCORDANCE WITH JSP375. LOCAL MANUAL HANDLING ASSESSMENTS ARE ALSO TO BE CONDUCTED FOR THE ENGINE (38 KG) AND CONTROL BOX ASSEMBLY (32 KG).**
- (8) **PERSONAL INJURY. THE LFG ALTERNATOR IS A PERMANENT MAGNET GENERATOR, CARE MUST BE TAKEN WHEN WORKING ON THE GENERATOR DUE TO THE HIGH STRENGTH OF THE MAGNETS WHICH COULD CAUSE PERSONAL INJURY.**
- (9) **SHOCK HAZARD. DO NOT ATTEMPT TO SERVICE THE GENERATOR OR CARRY OUT ANY MAINTENANCE OR REPAIRS WHILST IT IS RUNNING.**
- (10) **SHOCK HAZARD. LETHAL VOLTAGES ARE PRESENT IN THE GENERATOR EQUIPMENT. ENSURE THAT THE CIRCUIT BREAKERS ARE OPEN WHEN CONNECTING OR DISCONNECTING LOADS. CHECK THE RESIDUAL CURRENT DEVICE (RCD) OPERATION FOR EACH VOLTAGE SETTING. DO NOT CONNECT OR DISCONNECT LOADS WHILST THE GENERATOR IS RUNNING.**
- (11) **SKIN BURNS. EXERCISE EXTREME CARE WHEN CARRYING OUT TASKS ADJACENT TO THE ENGINE AND ITS EXHAUST PIPE AS BOTH ITEMS CAN RETAIN HEAT FOR SEVERAL MINUTES AFTER SHUT DOWN. ALLOW SUFFICIENT TIME FOR THE EQUIPMENT TO COOL DOWN BEFORE CARRYING OUT ANY MAINTENANCE TASKS.**
- (12) **TOXIC FUMES. EXHAUST GASES ARE TOXIC AND CAN QUICKLY REACH HARMFUL CONCENTRATIONS IF PRECAUTIONS ARE NOT FOLLOWED. THE EXHAUST GASES MUST ALWAYS BE VENTED TO FREE AIR. THIS CAN BE ACHIEVED EITHER BY POSITIONING THE LFG OUTDOORS OR BY USE OF THE EXHAUST EXTENSION WHICH SHOULD BE ROUTED SO AS TO TERMINATE IN FREE AIR. THE EXHAUST MUST NOT BE MUFFLED OR RESTRICTED IN ANY WAY AS THE RESULTING BACK PRESSURE COULD CAUSE ADDITIONAL LEAKS TO OCCUR OR DAMAGE THE ENGINE. EXTREME CARE MUST BE TAKEN TO ENSURE THAT EXHAUST GASES ARE VENTED SAFELY AWAY FROM ANY PERSONNEL WORKING IN THE VICINITY, WITH DUE CONSIDERATION GIVEN TO THE TOPOGRAPHY AND PREVAILING WIND CONDITIONS. HARMFUL CONCENTRATIONS CAN BE ODOURLESS AND NOT VISUALLY PERCEPTIBLE.**
- (13) **HEALTH HAZARD. PERSONNEL MUST BE AWARE OF THE HAZARDS INVOLVED WITH PRODUCTS THAT CAN, IF NOT PROPERLY HANDLED, BE HAZARDOUS TO HEALTH. PERSONNEL MUST ADHERE TO THE INFORMATION DETAILED IN JSP 515 AND THE CURRENT SAFETY DATA SHEET. PERSONNEL MUST WEAR APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT WHEN REQUIRED.**



CAUTIONS

8 The following CAUTIONS are applicable to this category:

- (1) **EQUIPMENT AIRFLOW.** The LFG should be operated in an open space with free air flow on all sides and at least 1 metre from other equipment and buildings. The surrounding area should be free of combustible material.
- (2) **EQUIPMENT DAMAGE.** Damage to the engine will occur if the generator is operated at very low loads for a prolonged period. A minimum running load of 500 W should always be applied. A 500 W load is displayed as approximately 25% when viewed on the % Load meter on the AC Control Panel. Additionally, if the generator is operated on a low load for a prolonged period, then a significantly higher load (approximately 70%) should be applied for a period of about 30 minutes before switching Off or for up to 1 hour until moisture condensate no longer emerges from the exhaust.
- (3) **EQUIPMENT DAMAGE.** During operation the engine and exhaust pipes can get very hot. Allow sufficient time for the equipment to cool down before carrying out tasks such as wrapping the LFG in plastic sheet during the preparation for transport.
- (4) **EQUIPMENT DAMAGE.** Operation of the AC Output Voltage Selector Switch (SW 1) when the generator is running under load will cause the inverter to trip out. Shut down must be carried out by the LFG operator to reset the inverter safety circuit.
- (5) **EQUIPMENT DAMAGE.** The engine must not be operated with the oil level below the specified minimum level.
- (6) **EQUIPMENT DAMAGE.** The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the Design Authority.
- (7) **EQUIPMENT DAMAGE.** The Low Oil Pressure Switch does not automatically shut down the engine. It only provides a warning via the illumination of the LED and, secondarily, the loss of output to any connected loads. Shut down must be carried out manually by the LFG operator.
- (8) **ENVIRONMENTAL HAZARD.** It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants. Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use only authorized waste disposal sites.
- (9) **ENVIRONMENTAL HAZARD.** There is NO requirement to place the LFG on a drip tray prior to operation; the design is such that it is capable of operating without such addition. Any contaminants found on the floor after use should be cleaned up as per local regulations and also investigated as this may indicate an issue with the LFGs operation.

ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

9 The following abbreviations are used in this category:

A	Ampere
AC	Alternating Current
AESP	Army Equipment Support Publication
Amdt	Amendment

BFPO	British Forces Post Office
C	Celsius
CANbus	Control Area Network bus
Cat	Category
CB	Circuit Breaker
Chap	Chapter
dB(A)	decibel (A scale)
dc	direct current
Def-Stan	Defence Standard
DE&S	Defence Equipment and Support
DIN	Defence Instructions and Notices
EMER	Electrical and Mechanical Engineering Regulations
Eqpt	Equipment
Fig	Figure
FRACAS	Failure Reporting Analysis and Corrective Action System
hr	hour
Hz	Hertz
JAMES	Joint Asset Management and Engineering Solutions
JSP	Joint Service Publication
kg	kilogramme
kW	kiloWatt
lb ft	pounds feet
LE	Land Equipment
LED	Light Emitting Diode
LFG	Lightweight Field Generator
mA	milliAmpere
MCB	Miniature Circuit Breaker
mm	millimetre
MoD	Ministry of Defence
NATO	North Atlantic Treaty Organisation
Nm	Newton metre
No.	Number
OI	Operational Infrastructure
OSP	Operational Support Programme
Para	Paragraph
PMG	Permanent Magnet Generator
PT	Project Team
RAF	Royal Air Force
RCD	Residual Current Device
Ref	Reference
SEI	Service Engineering Instruction
SME	Subject Matter Expert
SOP	Standard Operating Procedures
TDOL	Technical Documents On-Line
Tel	Telephone
UK	United Kingdom
V	Volt
W	Watt

SYMBOLS

10 The following symbols are used in this category:

-	minus
-ve	negative
±	plus or minus
+	plus
+ve	positive



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CHAPTER 1

GENERAL DESCRIPTION

CONTENTS

Para

- Introduction
- 1 Role
- 2 Facilities and general data (WARNINGS) (CAUTIONS)
- 9 Construction
- 12 Equipment data plate
- 13 Brief functional description
- 17 Engine
- 18 Air intake system
- 19 Exhaust system
- 20 Lubrication system
- 21 Fuel system (WARNINGS) (CAUTION)
- 23 Starting system
- 24 Cooling
- 25 Alternator
- Output control panels
- 26 AC output (WARNING)
- 27 DC output

Table

Page

1	Lightweight field generator - general data.....	2
2	AC control panel - controls and connector functions	8
3	DC control panel - controls and connector functions	10

Fig

1	AC panel side (acoustic cover fitted)	3
2	Component locations - AC panel side (acoustic cover removed).....	3
3	DC panel side (acoustic cover fitted - earth spike stowed).....	4
4	Component locations - DC panel side (acoustic cover and earth spike removed).....	4
5	Equipment data plate	5
6	LFG simplified block diagram	5
7	AC control panel - controls and connectors.....	8
8	DC control panel - controls and connectors.....	9

INTRODUCTION

Role

1 The Lightweight Field Generator (LFG) provides a portable source of 230/110 V AC and 28 V DC power with a 2 kW continuous output. The LFG is powered by a small diesel engine and is capable of running on Dieso (F54) or AVTUR (F34).



FACILITIES AND GENERAL DATA

WARNING

EARTHING. THE EARTH CABLE PROVIDED IS NOT TO BE LENGTHENED OR SHORTENED UNDER ANY CIRCUMSTANCES WITHOUT APPROVAL FROM THE DESIGN .

CAUTION

EQUIPMENT DAMAGE. Operation of the AC Output Voltage Selector Switch (SW 1) when the generator is running under load will cause the inverter to trip out. Shut down must be carried out by the LFG operator to reset the inverter safety circuit.

2 The LFG is either Dieso (F54) or AVTUR (F34) powered. The output is produced from a permanent magnet generator, with an inverter and regulator to give 230 V AC, 110 V AC and 28 V DC outputs. All outputs feature MCB over-current protection, and the ac outputs feature 30 mA earth leakage protection. The AC and DC Control panels, with associated outlet points, are mounted on opposite sides of the LFG frame.

3 Instrumentation is provided for AC Voltage, DC Voltage, Total Percentage Load and Hours Run.

4 A warning indication is provided for low oil pressure.

5 Starting is by either a recoil (rope) starter or by an integral electric starter motor powered from an external source.

WARNING

JERRYCAN ADAPTOR. DO NOT OPERATE THE GENERATOR UNLESS A JERRYCAN IS CONNECTED VIA THE JERRYCAN ADAPTOR AND PIPES SUPPLIED WITH THE GENERATOR. FAILURE TO COMPLY MAY CAUSE THE LFG FUEL TANK TO COLLAPSE.

CAUTION

EQUIPMENT DAMAGE. The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the design authority

6 Fuel is supplied to the engine externally from a jerrycan.

7 The LFG comes complete with a bag containing all necessary accessories such as earth spikes etc.

8 Leading particulars are detailed in Table 1 below.

TABLE 1 LIGHTWEIGHT FIELD GENERATOR - GENERAL DATA

Serial (1)	Item (2)	Data (3)
1	Overall Dimensions:	
	Length	600 mm
	Width	500 mm
	Height	540 mm
2	Weight	Up to 76 kg (Without fuel)
3	Operating Ambient Temperature Range	- 40 °C to + 55 °C
4	Outputs:	
	AC	1 x 230 V ± 5.75 V 2 x 110 V ± 2.75 V
	DC	1 x 28 V ± 0.5 V
5	Power	2.0 kW Continuous 2.2 kW Overload (for a maximum duration of 1 hour in every 10 hours operation)

Construction

9 The LFG is housed in a tubular steel frame, with a sound attenuating cover covering the engine, and a sheet aluminium box housing the inverters, rectifiers and control system.

10 The main items of the LFG are a single cylinder, four stroke, air cooled engine which drives a Permanent Magnet Generator (PMG). The output of the PMG is fed into an Inverter/DC Regulator whose outputs are fed to the AC and DC Output Control Panels. The Engine and Control Panels are mounted to the frame via anti-vibration mountings.

11 Fig 1 and Fig 2 show general views of the LFG from the AC Control Panel side with the Acoustic cover on and off accordingly. Fig 3 and Fig 4 show similar views but from the DC Control Panel side. On Figure 3 the Earth Spike is shown in the stowed position.



Fig 1 AC panel side (acoustic cover fitted)



Fig 2 Component locations - AC panel side (acoustic cover removed)

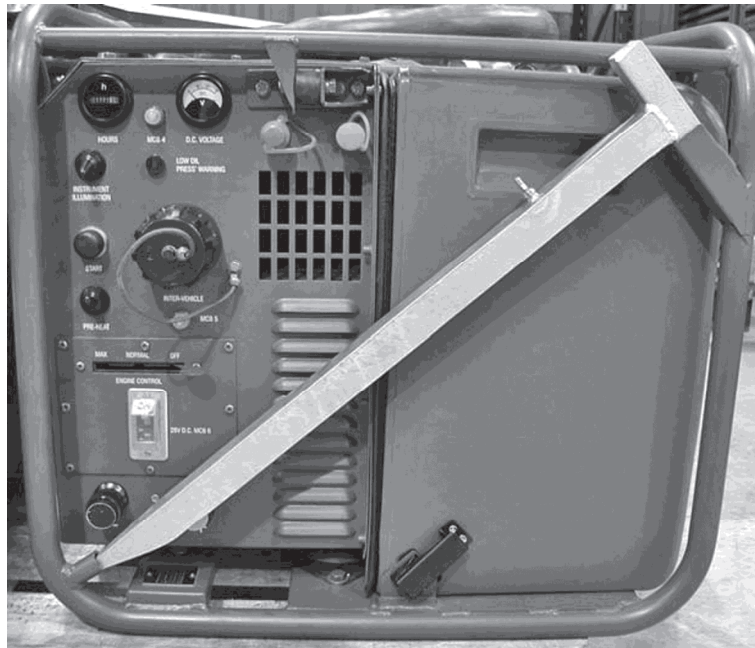


Fig 3 DC Panel side (acoustic cover fitted - earth spike stowed)

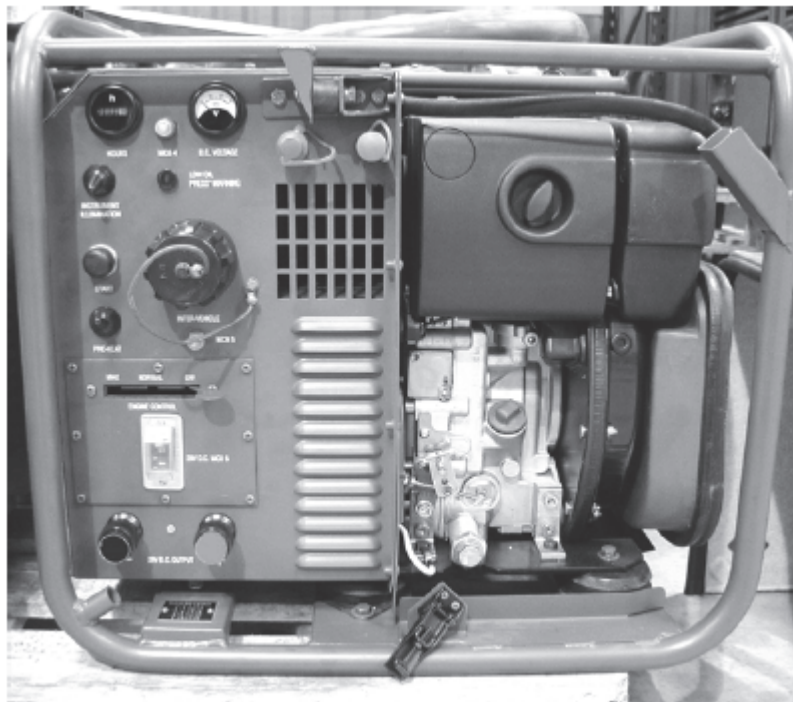


Fig 4 Component locations - DC panel side (acoustic cover and earth spike removed)

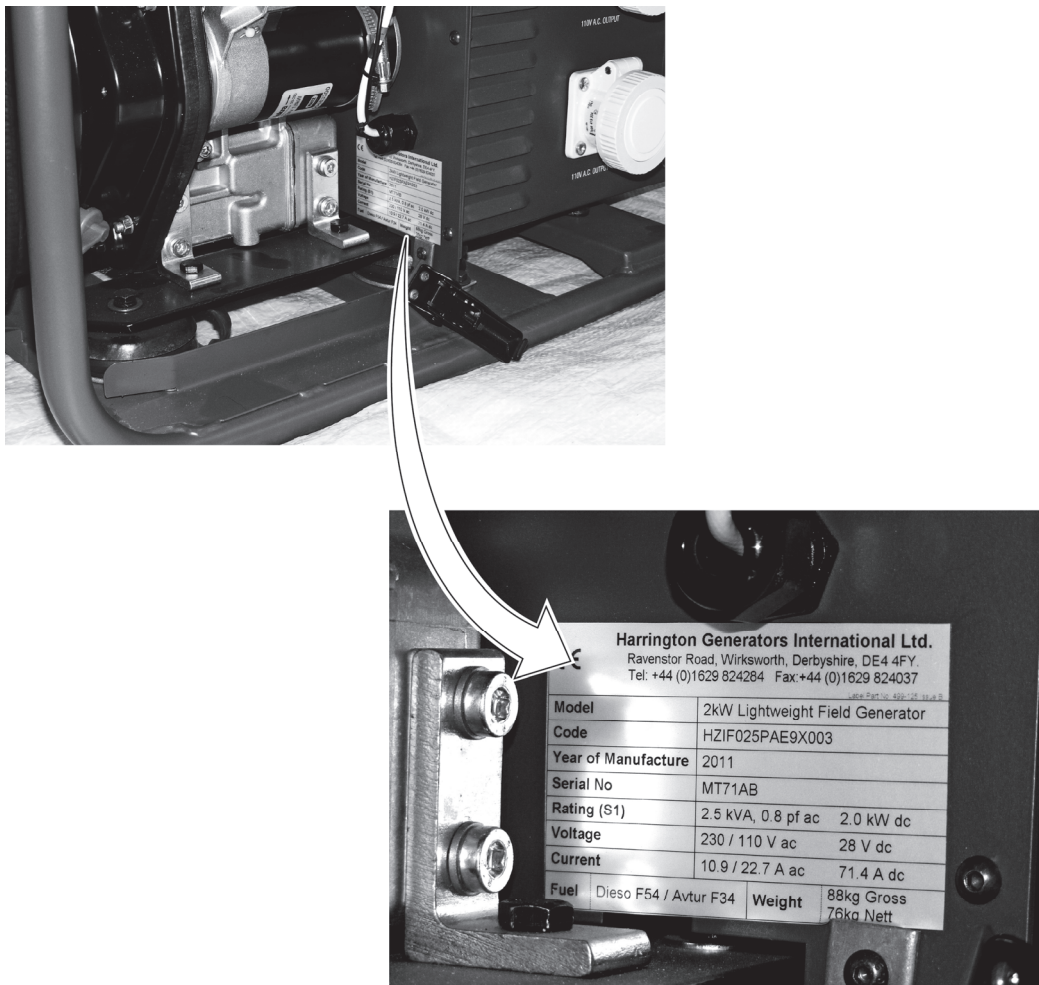


Fig 5 Equipment data plate

Equipment data plate

12 An equipment data plate is located beneath the electric starter motor, attached to the control panel casing. The plate details the manufacturer, model and code, year of manufacture, serial number, power, voltage and current ratings, usable fuel types and weight.

Brief functional description

13 A simplified block diagram of the LFG functional areas is shown in Fig 6.

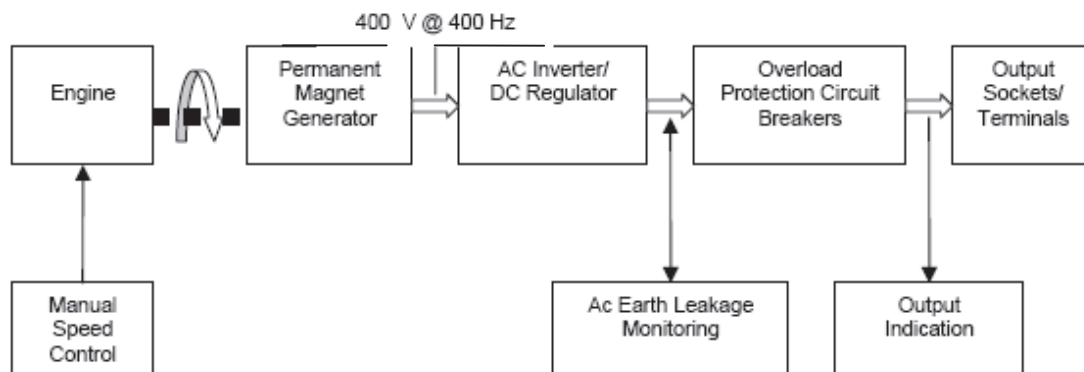


Fig 6 Simplified block diagram

14 The engine speed is controlled by an Engine Speed Control lever situated on the DC Control Panel. It has two speed settings; Normal and Max. Normal is used for the continuous 2 kW output and Max is used for the 2.2 kW Overload output condition.

15 The 400 V 400 Hz output of the Permanent Magnet Generator is conditioned by the AC Inverter/DC Regulator Assembly to provide the required AC and DC outputs via overload protection Circuit Breakers. An input socket for the external DC power required for the electric starter is provided.

16 Instrumentation is provided on both Control Panels for displaying output voltages, Percentage (%) Load and Hours run. Instrument panel lighting is selectable by an ON/OFF switch. Earth Leakage Monitoring/Testing and Low Oil Pressure Warnings are provided.

ENGINE

17 The LFG is driven by a Hatz-Diesel 1B20, single cylinder, four stroke air cooled engine which is capable of operating on either F54 Dieso or F34 AVTUR.

NOTE

There are two types of Hatz Diesel engines in service; Engine type 1B20-S-204C and Engine type 1B20-S-204D. The Engine type is identified by a data plate which is glued to the air filter housing. It is important to note the correct Engine type when undertaking any maintenance.

Air intake system

18 Air intake to the engine is via a dry type air cleaner assembly incorporating a disposable paper filter element and integrated pre-cleaner.

Exhaust system

19 Exhaust gas expelled from the engine is routed through a silencer unit and then vented to atmosphere via flexible exhaust extension piping.

Lubrication system

20 Lubrication of the engine moving parts is achieved by the pressurised circulation of oil. Oil filtering is achieved by a re-usable fine screen filter in the main oil flow. The oil filler plug/dipstick and drain plug are situated on the lower left side of the engine (as viewed from the recoil starter end).



FUEL SYSTEM

WARNINGS

(1) F54 DIESEL AND F34 AVTUR. DIESEL AND AVTUR FUELS ARE HIGHLY FLAMMABLE. WHEN REFUELLING:

DO NOT RUN THE LFG

DO NOT SMOKE

AVOID ALL NAKED FLAMES

AVOID OVERFILLING THE FUEL TANK/JERRYCAN

WIPE UP ANY SPILT FUEL PRIOR TO STARTING THE LFG

(2) JERRYCAN ADAPTOR. DO NOT OPERATE THE GENERATOR UNLESS A JERRYCAN IS CONNECTED VIA THE JERRYCAN ADAPTOR AND PIPES SUPPLIED WITH THE GENERATOR. FAILURE TO COMPLY MAY CAUSE THE LFG FUEL TANK TO COLLAPSE.

CAUTION

EQUIPMENT DAMAGE. The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the Design Authority

21 Fuel for powering the engine is supplied externally from a jerrycan, via a jerrycan adaptor which is connected to quick-release couplings on the engine. The fuel from the jerrycan passes through a pulse pump, which is operated by crank case pressure via the crank case vent hose, and then into the integral fuel tank. From the integral fuel tank the fuel passes through the fuel tank filter and then directly to the engine.

22 To connect the jerrycan adapter pipes to the generator, simply push the pipes onto the corresponding couplings. The couplings are made so that only the correct pipe can be fitted to each. To release the jerrycan adapter pipes, pull back the locking ring, and the couplings pull apart. The jerrycan adapter fastens to the jerrycan using a standard jerrycan clamp.

NOTE

It is not necessary to empty the engine fuel tank of any residual fuel when fuel types are changed.

Starting system

23 The engine can be started by a conventional recoil (rope) type starter or by an electric starter motor. The electric starter motor is powered from an external 24 V DC power source via an interconnecting cable.

Cooling

24 For engine cooling, a cooling fan is incorporated in the flywheel and draws air in through the Recoil Starter and air vents in the Acoustic Cover. Cooling air for the Inverter/Regulator Assembly and the Permanent Magnet Generator is provided by a fan mounted on the engine output shaft which draws air in through the Louvre Panel vents.

Alternator

25 The alternator is a High Frequency Permanent Magnet Generator which powers an electronic Control Unit incorporating an AC Inverter and DC Regulator to give 230 V AC, 110 V AC and 28 V DC outputs respectively.

OUTPUT CONTROL PANELS

AC output

WARNING

EARTHING. THE EARTH CABLE PROVIDED IS NOT TO BE LENGTHENED OR SHORTENED UNDER ANY CIRCUMSTANCES WITHOUT APPROVAL FROM THE DESIGN AUTHORITY.

26 The AC Output Control Panel is on the right hand side of the LFG (as viewed from the recoil starter end), Fig 1. The Controls and Connector locations are shown in Fig 7 and their functions are described in Table 2.

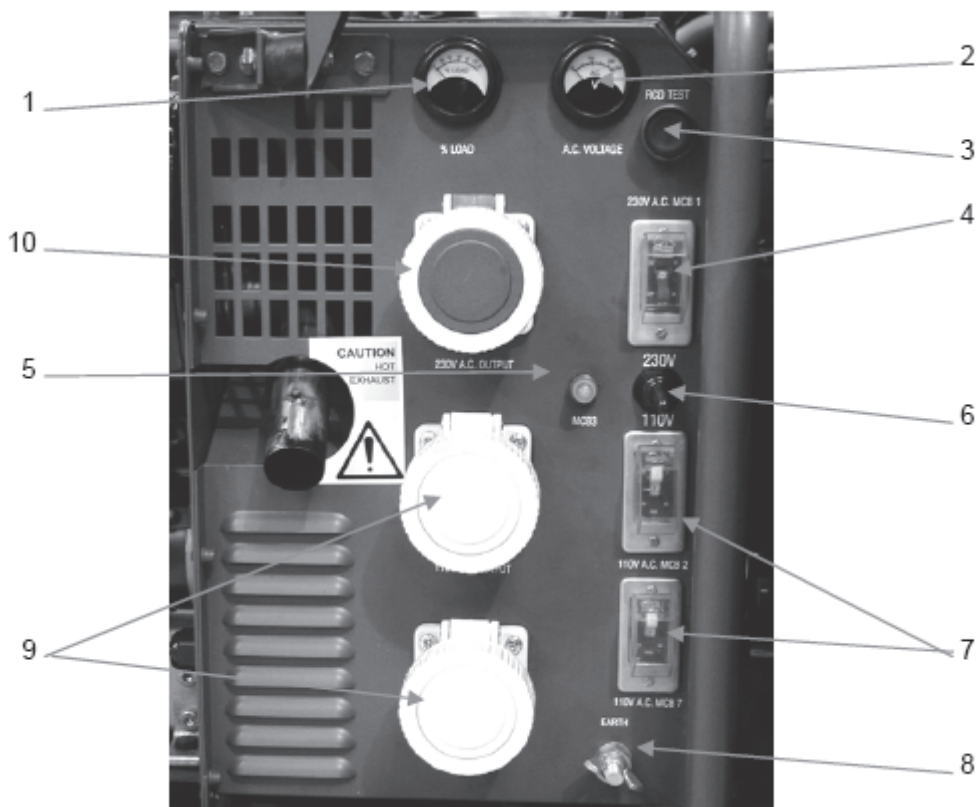


Fig 7 AC control panel - controls and connectors

TABLE 2 AC CONTROL PANEL - CONTROLS AND CONNECTOR FUNCTIONS

Serial (1)	Control/Connector (2)	Figure Item Ref (3)	Function (4)
1	PERCENTAGE(%)LOAD	1	Displays total percentage (%) load on the generator
2	AC VOLTAGE METER	2	Displays AC output voltage
3	RCD TEST	3	Pushbutton, used to test the operation of the Residual Current Detector
4	230 V AC MCB 1	4	Resettable 11 A circuit breaker providing 230 V output overload protection

(continued)

TABLE 2 AC CONTROL PANEL - CONTROLS AND CONNECTOR FUNCTIONS (continued)

Serial (1)	Control/Connector (2)	Figure Item Ref (3)	Function (4)
5	MCB 3	5	Resettable 2A circuit breaker providing overload protection for the AC control circuits
6	SW1 230 V / 110 V	6	AC Output Voltage Selector Switch
7	MCBs 2 & 7	7	Resettable 16 A circuit breakers providing individual output overload protection for the 110 V outputs
8	EARTH STUD	8	Stud for external Earth
9	110 V Output Sockets (Qty 2)	9	Individual 110 V output sockets
10	230 V Output Socket (Qty 1)	10	Single 230 V output socket

NOTE

If the AC Output Voltage Selector Switch (SW1) is inadvertently operated during running the inverter may trip off line. If this occurs, shut down and re-start the LFG to clear the trip condition.

DC output

27 The DC Output Control Panel is on the left hand side of the LFG (as viewed from the recoil starter end), Fig 2. The Controls and Connector locations are shown in Fig 8 and their functions are described in Table 3.

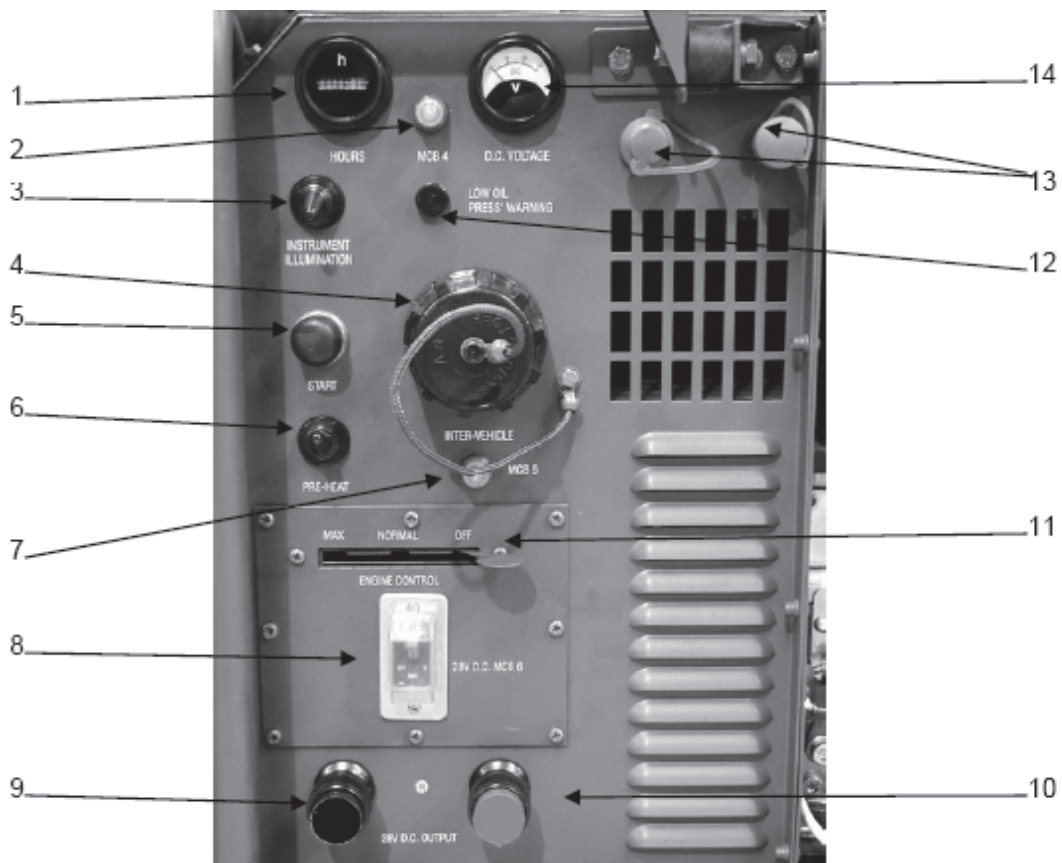


Fig 8 DC control panel - controls and connectors

TABLE 3 DC CONTROL PANEL - CONTROLS AND CONNECTOR FUNCTIONS

Serial (1)	Control/Connector (2)	Figure Item Ref (3)	Function (4)
1	HOURS RUN METER	1	Displays total hours run
2	MCB 4	2	Resettable 2 A circuit breaker providing overload protection for the DC control circuits
3	INSTRUMENT ILLUMINATION	3	Instrument panel lights ON/OFF switch
4	INTERVEHICLE CONNECTOR SOCKET	4	Connects external DC source of power for electric starting of the LFG
5	START	5	Engine electric start push button
6	PRE HEAT	6	Engine glow plug pre-heater push button
7	MCB 5	7	Resettable 15 A circuit breaker providing protection for the electric starter and pre-heater circuits
8	MCB 6	8	Resettable 80 A circuit breaker providing overload protection for the DC output circuits
9	28 V DC OUTPUT -ve (Black)	9	Negative DC output terminal
10	28 V DC OUTPUT +ve (Red)	10	Positive DC output terminal
11	ENGINE SPEED CONTROL LEVER	11	Controls the speed of the engine
12	LOW OIL PRESSURE WARNING	12	Low oil pressure warning LED
13	JERRYCAN QUICK RELEASE CONNECTIONS (blanking caps shown fitted)	13	Provide for the connection of the jerrycan adaptor pipes
14	DC VOLTAGE METER	14	Displays DC Output voltage



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CHAPTER 2

OPERATING PROCEDURES

CONTENTS

Para

- 1 Introduction
- 2 Siting (WARNINGS) (CAUTIONS)
- 3 Pre start activities
- 4 Visual inspection (CAUTION)
- 6 Earthing (WARNINGS)
- 7 Exhaust extension (WARNINGS)
- 8 Lubricating oil level (CAUTION)
- 10 Recoil starter cord
- 11 Connecting the fuel supply (WARNING) (CAUTION)
- 13 Voltage selection (CAUTION)
- 14 Starting procedure (WARNING)
- 15 Manual start
- 16 Electric start
- 17 Earth leakage unit test
- 18 Connecting a load (WARNING) (CAUTIONS)
- 21 Shut down procedure (CAUTION)

Fig

Page

1	Earth spike and LFG earth terminal	3
2	Exhaust extension	4
3	LFG DC side view.....	5
4	Recoil starter cord	5
5	Jerrycan connected to fuel quick disconnect couplings	6
6	AC output selector switch (SW 1).....	7
7	Engine speed control lever	8

INTRODUCTION

1 This Chapter provides the information necessary to enable personnel to prepare the Lightweight Field Generator (LFG) for use and to operate it efficiently. The Operator must be fully conversant with the equipment and the contents of Chapter 1 before attempting to operate the LFG.

SITING

WARNINGS

(1) NOISE HAZARD. IF PERSONNEL ARE EXPOSED FOR PROLONGED PERIODS TO NOISE LEVELS IN EXCESS OF 80 DB(A), HEARING PROTECTION SHOULD BE PROVIDED AND WORN. THE LFG EMITS A MEASURED NOISE LEVEL OF BETWEEN 90 - 100 DB(A) THEREFORE HEARING PROTECTION MUST BE PROVIDED AND WORN WHEN WORKING WITHIN 1 METRE OF AN OPERATING LFG.

(2) PERSONAL INJURY. THE GENERATOR WEIGHS 76 KG NET AND 88 KG GROSS (INCLUDING FUEL AND CES). MANUAL HANDLING OF THE GENERATOR MUST BE IN ACCORDANCE WITH LOCAL MANUAL HANDLING ASSESSMENTS CARRIED OUT IN ACCORDANCE WITH JSP375. LOCAL MANUAL HANDLING ASSESSMENTS ARE ALSO TO BE CONDUCTED FOR THE ENGINE (38 KG) AND CONTROL BOX ASSEMBLY (32 KG).



CAUTIONS

(1) **EQUIPMENT AIRFLOW.** The generator should be operated in an open space with free air flow on all sides and at least 1 metre from other equipment and buildings. The surrounding area should be free of combustible material.

(2) **ENVIRONMENTAL HAZARD.** There is NO requirement to place the LFG on a drip tray prior to operation; the design is such that it is capable of operating without such addition. Any contaminants found on the floor after use should be cleaned up as per local regulations and also investigated as this may indicate an issue with the LFGs operation.

2 The ground site for LFG operation is to be as level and firm as possible. It is to be sited in open ground with free airflow around all sides and at least 1 metre from other equipment or buildings. If no level ground is available, the LFG may be operated at an angle up to 15 degrees from the horizontal plane, along any axis.

PRE START ACTIVITIES

3 Every time prior to using the LFG, the activities detailed in the following paragraphs must be carried out. Remove the Acoustic Cover before carrying out these activities and re-fit prior to starting the LFG.

Visual inspection

CAUTION

EQUIPMENT DAMAGE. The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the Design Authority.

4 Inspect all cables, connectors, hoses, hose couplings, linkages, anti vibration mounts, switches, sockets, covers, exhaust extension, attaching parts and earth point etc for signs of damage, distortion or loose fitting. Visually inspect engine and hoses for leaks. Inspect the fuel drainage tube directly beneath the Fuel Tank for signs of water contamination and drain off any water that is present.

5 Inspect all cables, connectors, hoses and hose couplings to be connected during the LFG operation for signs of damage. Damaged items are not to be connected to the LFG.

Earthing

WARNINGS

(1) **EARTHING.** THE EARTH CABLE PROVIDED IS NOT TO BE LENGTHENED OR SHORTENED UNDER ANY CIRCUMSTANCES WITHOUT APPROVAL FROM THE DESIGN AUTHORITY.

(2) **EARTHING.** THE EQUIPMENT MUST BE PROPERLY EARTHED BEFORE ATTEMPTING TO OPERATE THE GENERATOR SET. WHEN USED WITH ANCILLARY EQUIPMENT, IT IS ESSENTIAL THAT THE EARTHING INSTRUCTIONS FOR THAT EQUIPMENT BE FOLLOWED. THE LFG EARTH SHOULD NOT BE REMOVED UNLESS SPECIFICALLY REQUIRED IN THE EARTHING INSTRUCTIONS FOR THE ANCILLARY EQUIPMENT.

6 Whenever the LFG is used it must be earthed, using the earth cable and spike provided in the Accessories Bag, as follows:

6.1 In accordance with Def Stan 61-05, select an area of ground which is most easily penetrated by the earth spike and drive the spike into the ground.

NOTE

Wetting the ground will improve penetration by the earth spike and will also improve electrical contact

- 6.2 Securely connect the earth cable between the LFG and the Earth Spike (Figure 1).



Fig 1 Earth spike and LFG earth terminal

Exhaust extension**WARNINGS**

(1) TOXIC FUMES. EXHAUST GASES ARE TOXIC AND CAN QUICKLY REACH HARMFUL CONCENTRATIONS IF PRECAUTIONS ARE NOT FOLLOWED. THE EXHAUST GASES MUST ALWAYS BE VENTED TO FREE AIR. THIS CAN BE ACHIEVED EITHER BY POSITIONING THE LFG OUTDOORS OR BY USE OF THE EXHAUST EXTENSION WHICH SHOULD BE ROUTED SO AS TO TERMINATE IN FREE AIR. THE EXHAUST MUST NOT BE MUFFLED OR RESTRICTED IN ANY WAY AS THE RESULTING BACK PRESSURE COULD CAUSE ADDITIONAL LEAKS TO OCCUR OR DAMAGE THE ENGINE. EXTREME CARE MUST BE TAKEN TO ENSURE THAT EXHAUST GASES ARE VENTED SAFELY AWAY FROM ANY PERSONNEL WORKING IN THE VICINITY, WITH DUE CONSIDERATION GIVEN TO THE TOPOGRAPHY AND PREVAILING WIND CONDITIONS. HARMFUL CONCENTRATIONS CAN BE ODOURLESS AND NOT VISUALLY PERCEPTIBLE.

(2) SKIN BURNS. EXERCISE EXTREME CARE WHEN CARRYING OUT TASKS ADJACENT TO THE ENGINE AND ITS EXHAUST PIPE AS BOTH ITEMS CAN RETAIN HEAT FOR SEVERAL MINUTES AFTER SHUT DOWN. ALLOW SUFFICIENT TIME FOR THE EQUIPMENT TO COOL DOWN BEFORE CARRYING OUT ANY MAINTENANCE TASKS.

7 The exhaust extension is a bayonet fit. Connect it by pushing it firmly onto the exhaust pipe, ensuring the bayonet lugs engage, and turn to lock it in position. Ensure the exhaust extension is routed so as to discharge outside of any confined spaces.



Fig 2 Exhaust extension

Lubricating oil level

CAUTION

EQUIPMENT DAMAGE. The engine must not be operated with the oil level below the specified minimum level.

8 The oil dipstick is located on the DC Control Panel side of the engine (Figure 3). To check the oil level, remove the Acoustic Cover to gain access to the dipstick. Unscrew the dipstick to remove it, wipe off any excess oil, and re-insert it ensuring it is screwed down correctly. Remove it again and ensure the oil level is between the "Min" and "Max" levels marked on the dipstick. If the oil level is below the "Min" level then it should be replenished. The type of oil to be used is dependent on the temperature of the intended operating environment. Refer to Cat 601.

9 To replenish with either oil via the Oil Filler Cap on the Rocker Cover, fill until the "Max" mark on the dipstick is covered. Fill a little at a time, allowing sufficient time for the oil to settle between each fill before checking the level. Do not overfill.

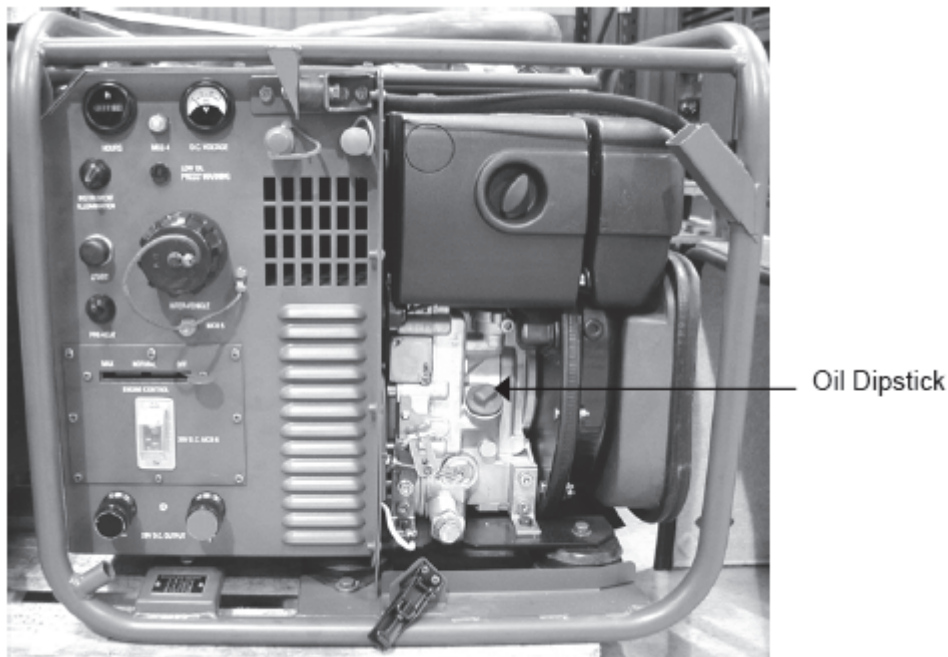


Fig 3 LFG DC side view

Recoil starter cord

10 To inspect the starter cord, gently pull the starter cord from the recoil starter to its full length (approx 1.6 metres) and inspect for signs of wear or damage. Inspect the exit hole on the recoil starter assembly for signs of damage (Fig 4).



Fig 4 Recoil starter cord

Connecting the fuel supply

WARNING

JERRYCAN ADAPTOR. DO NOT OPERATE THE GENERATOR UNLESS A JERRYCAN IS CONNECTED VIA THE JERRYCAN ADAPTOR AND THE PIPES SUPPLIED WITH THE GENERATOR. FAILURE TO COMPLY MAY CAUSE THE LFG FUEL TANK TO COLLAPSE.

CAUTION

EQUIPMENT DAMAGE. The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the Design Authority.

11 Inspect the jerrycan hoses and fuel filter for signs of damage. Any damaged items must be replaced before the jerrycan is connected to the LFG and fit the jerrycan adaptor to the jerrycan. Fill the jerrycan with sufficient clean fuel for the task (either F54 Diesel or F34 AVTUR) and connect to the LFG fuel quick disconnect couplings. Ensure the integral fuel tank filler cap is securely closed and locked.

12 Check Fuel Tank Drain Pipe for fuel contamination (water presence), drain off water if present. Fit the Acoustic Cover.

NOTE

It is not necessary to empty the engine fuel tank of any residual fuel when fuel types are changed



Fig 5 Jerrycan connected to fuel quick disconnected couplings

Voltage selection

CAUTION

EQUIPMENT DAMAGE. Operation of the AC Output Voltage Selector Switch (SW 1) when the generator is running under load will cause the inverter to trip out. Shut down must be carried out by the LFG operator to reset the inverter safety circuit.

13 Ensure there are no output connectors or cables attached to the LFG, check that the main output Circuit Breakers (CBs) are open and select the AC Output Voltage Selector Switch (SW1) to the AC output voltage required (230 V AC or 110 V AC).

NOTE

If the AC Output Voltage Selector Switch (SW1) is inadvertently operated during running, the inverter may trip off line. If this occurs, shut down and re-start the LFG to clear the trip condition.

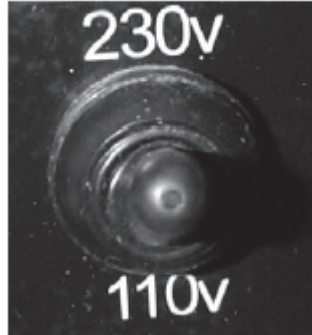


Fig 6 AC output selector switch (SW1)

STARTING PROCEDURE**WARNING**

JERRYCAN ADAPTOR. DO NOT OPERATE THE GENERATOR UNLESS A JERRYCAN IS CONNECTED VIA THE JERRYCAN ADAPTOR AND THE PIPES SUPPLIED WITH THE GENERATOR. FAILURE TO COMPLY MAY CAUSE THE LFG FUEL TANK TO COLLAPSE.

14 Before starting the LFG ensure that the Acoustic Cover is securely fitted and a jerrycan containing sufficient fuel for the task is connected. Ensure that the AC Output Voltage Selector Switch has been set to the voltage required, either 230 V AC or 110 V AC.

Manual start

15 To start the LFG using the Recoil Starter, proceed as follows:

15.1 Set the Engine Speed Control Lever, on the DC Control Panel, to the "Max" position.

15.2 Pull the starter handle gently until resistance is felt, release the cord back into the recoil starter, then pull smartly to start the LFG.

NOTE

If the engine fails to start after three attempts, carry out the Fault Finding procedures detailed in Chap 3.

15.3 Once the LFG has started and is running evenly, set the Engine Speed Control Lever to the "Normal" position and allow the engine to warm up for 1 minute.

Electric start

16 To start the LFG using the Electric Starter, proceed as follows:

16.1 Connect a 24 V DC supply to the LFG via the Inter-Vehicle Connector.

16.2 Set the LFG Engine Speed Control Lever to the "Max" position. In cold weather conditions hold the Pre-Heat switch to Pre-Heat for 20 seconds then release.

16.3 Press the Start button and hold until the engine fires, then release.

NOTE

If the engine turns over but fails to start, release the Start button and try again. If the engine fails to start after three attempts, carry out Fault Finding procedures detailed in Chap 3.

16.4 Once the LFG has started, set the Engine Speed Control Lever to the "Normal" position and allow the engine to warm up for 1 minute.

Earth leakage unit test

17 With the LFG running and no loads connected, close the AC CBs. Press the RCD push button and the AC CBs should open. If they do not, carry out Fault Finding procedures detailed in Chap 3.



Fig 7 Engine speed control lever

CONNECTING A LOAD

WARNING

SHOCK HAZARD. LETHAL VOLTAGES ARE PRESENT IN THE GENERATOR EQUIPMENT. ENSURE THAT THE CIRCUIT BREAKERS ARE OPEN WHEN CONNECTING OR DISCONNECTING LOADS. CHECK THE RESIDUAL CURRENT DEVICE (RCD) OPERATION FOR EACH VOLTAGE SETTING. DO NOT CONNECT OR DISCONNECT LOADS WHILST THE GENERATOR IS RUNNING.

CAUTIONS

- (1) **EQUIPMENT DAMAGE.** Damage to the engine will occur if the generator is operated at very low loads for a prolonged period. A minimum running load of 500 W should always be applied. A 500 W load is displayed as approximately 25% when viewed on the % Load meter on the AC Control Panel. Additionally, if the generator is operated on a low load for a prolonged period, then a significantly higher load (approximately 70%) should be applied for a period of about 30 minutes before switching Off or for up to 1 hour until moisture condensate no longer emerges from the exhaust.
- (2) **EQUIPMENT DAMAGE.** Operation of the AC Output Voltage Selector Switch (SW 1) when the generator is running under load will cause the inverter to trip out. Shut down must be carried out by the LFG operator to reset the inverter safety circuit.

18 The LFG has two speed settings; "Normal" and "Max". Normal is used for the continuous 2 kW output and Max is used for the 2.2 kW Overload output condition. Engine Speed Control Lever setting required before connecting any loads.

19 To connect AC loads to the LFG proceed as follows:

19.1 Connect the desired AC load to the correct output socket.

19.2 Close the relevant AC CB(s).

20 To connect a DC load to the LFG proceed as follows:

20.1 Connect the DC load to the DC output terminals ensuring correct polarity of connection.

20.2 Close the DC CB.

SHUT DOWN PROCEDURE

CAUTION

EQUIPMENT DAMAGE. Damage to the engine will occur if the generator is operated at very low loads for a prolonged period. A minimum running load of 500 W should always be applied. A 500 W load is displayed as approximately 25% when viewed on the % Load meter on the AC Control Panel. Additionally, if the generator is operated on a low load for a prolonged period, then a significantly higher load (approximately 70%) should be applied for a period of about 30 minutes before switching Off or for up to 1 hour until moisture condensate no longer emerges from the exhaust.

21 To shut down the LFG, proceed as follows:

21.1 Switch off any connected equipment/load.

21.2 Trip the relevant load CBs.

21.3 Disconnect the load from the connector/terminals.

21.4 With the Engine Speed Control Lever set to the "Normal" position, allow the LFG to run off load for 2 minutes to cool down.

21.5 Move the Engine Speed Control Lever to the "Off" position to shut down the engine.

22 If the LFG is to be moved or not used again soon after shut down, disconnect the Fuel Hoses and Earth Lead and remove the Earth Spike from the ground.

23 In order to avoid fuel contamination and damage to the quick release couplings on the Fuel Adaptor, the male and female connectors should be joined together once they have been disconnected from the LFG.



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CHAPTER 3
OPERATOR MAINTENANCE
CONTENTS

Para

- 1 Introduction
- 3 Operator level routine maintenance schedule
- 7 Operator level unscheduled maintenance
- 9 Level 2 maintenance
- 11 Transportation - preparation and recovery
- Equipment and materials
- 12 Special equipment and spares (WARNING) (CAUTION)
- 14 Routine maintenance
- 15 Physical inspection
- 16 Covers
- 18 Tubular frame
- 19 Cables, connectors and hoses (WARNING) (CAUTION)
- 20 Recoil starter
- 21 Engine fuel tank cap and drain
- 23 Lubricating oil level - check and top-up (CAUTION)
- 25 Air inlet and outlet vents
- 26 Change engine oil
- 27 Clean/replace engine oil filter strainer
- 28 Fuel filter
- 29 Labels and warning notices
- 30 Unscheduled maintenance (WARNINGS)
- 31 Replacement of components (CAUTION)
- 32 Acoustic cover
- 33 Jerrycan adapter and hoses (CAUTION)
- 34 Air filter
- 35 Accessories bag
- 36 Earth spike and earth lead (WARNING)
- 37 Exhaust extension
- Fluid level warnings/checks
- 38 Engine low oil pressure warning LED illuminated
- 39 Fuel level
- 40 Transportation (CAUTION)
- Preparation for transport
- 41 Normal operating conditions
- 42 Battlefield conditions
- 43 Air transport
- Recovery post transportation
- 44 Normal operating conditions
- 45 Battlefield conditions
- 46 Air transport
- 47 Fault finding
- 48 Engine associated faults
- 50 Electrical system associated faults

(continued)



CONTENTS (continued)

Table	Page
1 Routine maintenance schedule	3
2 Unscheduled maintenance tasks	3
3 Transportation - preparation and recovery	4
4 Service spares	5
5 Materials	6
6 Engine fails to start - recoil starter	17
7 Engine fails to start - electric starter	18
8 AC circuit breakers do not open	20

Fig	Page
1 Recoil starter exit hole	7
2 Fuel tank drain pipe and drainage tap	8
3 Oil dipstick	8
4 Bulkhead vent holes	9
5 Oil filler cap	10
6 Oil dipstick and drain plug	10
7 Oil filter strainer assembly	11
8 Engine fuel tank fuel filter	12
9 Air filter cover securing knob	13
10 Air filter retaining nut	13
11 Low oil pressure warning LED	15
12 Engine fuel tank cap	15

INTRODUCTION

1 This Chapter provides the Operator level information and step-by-step instructions relating to the procedures, tools and materials necessary to enable personnel to maintain the Lightweight Field Generator (LFG) in an operational condition.

2 All maintenance tasks and fault remedies which are outside of the scope of these procedures must be carried out by suitably qualified personnel in accordance with the relevant maintenance schedule / repair procedure.

Operator level routine maintenance schedule

3 Routine Operator maintenance tasks are restricted to those listed in Table 1 and these must be carried out at the intervals specified or at any time a fault is suspected.

4 As part of the pre-start and routine maintenance activities, users are required to ensure that all labels and warning notices are clean and legible and that air vents and air flow paths are clear.

5 When completing these tasks and when undertaking general cleaning of the LFG, avoid the use of caustic and solvent cleaners and do not point high pressure water jets into air vents.

6 If, for any reason, it is necessary to alter any part of the maintenance schedule, then the revision and authorisation must be carried out by appropriately qualified personnel.

TABLE 1 ROUTINE MAINTENANCE SCHEDULE

Serial (1)	Maintenance Task (2)	Periodicity (3)
	<u>PHYSICAL INSPECTION</u>	
1	Acoustic, Louvre and Top Cover condition and attachment)
2	Tubular Frame condition)
3	Serviceability of Cables, Connectors and Hoses)
4	RCD Press to Test button for functionality) Prior to use
5	Starter Pull Cord for signs of wear)
6	Engine Fuel Tank Cap undamaged and securely fitted)
7	Ensure all Labels and Warning Notices are clean and legible)
	<u>FUEL SYSTEM</u>	
8	Fuel Tank Drain Pipe for fuel contamination (water presence), drain off water if present)
9	Fuel Filter - Replace	Every 500 Hrs or 12 Months
	<u>ENGINE LUBRICATING OIL SYSTEM</u>	
10	Oil Level - check and top-up	Prior to use and every 12 Hrs
11	Oil filter strainer - Clean/Replace only if damaged	Every 1000 Hrs or 24 Months
12	Engine Oil - Replace	Every 250 Hrs or 6 Months
	<u>AIR INLET AND OUTLET VENTS, ENGINE AIR FILTER</u>	
13	Check Air Inlet and Outlet vents are not blocked	Prior to use and every 12 Hrs
14	Check engine Air Filter for damage and contamination. Replace Air Filter if necessary	Every 12 Hrs in harsh, dusty or dirty environments. The periodicity should be adjusted in response to the results of the initial series of checks

Operator level unscheduled maintenance

7 Unscheduled maintenance tasks are restricted to those listed in Table 2 and these must be carried out whenever a fault is identified or suspected or if an item is physically damaged or lost.

8 If, for any reason, it is necessary to revise this task list, then the revision and authorisation must be carried out by appropriately qualified personnel.

TABLE 2 UNSCHEDULED MAINTENANCE TASKS

Serial (1)	Maintenance Task (2)	Periodicity (3)
1	Check engine oil level)
2	Check fuel level)
3	Replace Air Filter)
4	Replace jerrycan Adaptor and Hoses)

(continued)

**TABLE 2 UNSCHEDULED MAINTENANCE TASKS (continued)**

Serial (1)	Maintenance Task (2)	Periodicity (3)
5	Replace Earth Spike) As required
6	Replace Earth Lead 2m)
7	Replace Exhaust Extension)
8	Replace Acoustic Cover)
9	Replace Accessories Bag)

Level 2 maintenance

9 In addition to the maintenance tasks identified in Tables 1 and 2, the Operator must be aware that there are a series of Level 2 maintenance tasks to be completed every 250 running hours.

10 Details of the tasks and the responsibility for their completion are provided within the AESP Cat 601.

Transportation - preparation and recovery

11 The tasks required to prepare the LFG for transportation and to recover it to operating condition post transportation are detailed in Table 3.

TABLE 3 TRANSPORTATION - PREPARATION AND RECOVERY

Serial (1)	Maintenance Task (2)	Periodicity (3)
	<u>PREPARATION</u>	
	<u>Normal Operating Conditions</u>	
1	Disconnect jerrycan and drain Engine Fuel Tank	Whenever the LFG is to be transported from one location to another
2	Fit and secure fuel tank filler cap and fuel line blanking caps	
3	Secure all covers	
4	Wrap and seal in plastic sheet (optional, depending on weather conditions and method of transport)	
	<u>Battlefield Conditions</u>	
5	Disconnect jerrycan	Whenever the LFG is to be moved on the Battlefield
6	Fit and secure fuel tank filler cap and fuel line blanking caps	
	<u>Air Transport</u>	
7	Prepare for Air Transport in accordance with JSP 335, Part II, Section 9, Leaflet 6	Prior to transportation by air
	<u>RECOVERY POST TRANSPORTATION</u>	
	<u>Normal Operating Conditions</u>	
8	Remove plastic sheeting (if used)	Following transportation from one location to another
9	Remove fuel line blanking caps and connect jerrycan. Fill the onboard fuel tank to approximately 2/3rd full	

(continued)

TABLE 3 TRANSPORTATION - PREPARATION AND RECOVERY (continued)

Serial (1)	Maintenance Task (2)	Periodicity (3)
10	<u>Battlefield Conditions</u> Remove fuel line blanking caps and connect jerrycan. Fill the onboard fuel tank to approximately 2/3rd full	Following movement on the Battlefield
11	<u>Air Transport</u> Prepare for use in accordance with Chapter 2	Following air transport

EQUIPMENT AND MATERIALS
Special equipment and spares
WARNING

EARTHING. THE EARTH CABLE PROVIDED IS NOT TO BE LENGTHENED OR SHORTENED UNDER ANY CIRCUMSTANCES WITHOUT APPROVAL FROM THE DESIGN AUTHORITY.

CAUTION

EQUIPMENT DAMAGE. The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the Design Authority.

12 The LFG does not require any special-to-type equipment for its maintenance. The service spares required to carry out the procedures detailed in this Chapter are listed in Table 4.

TABLE 4 SERVICE SPARES

Serial (1)	Spare (2)	NATO Stock Number (3)
1	Acoustic Cover	6115-99-225-8717
2	Manifold Fuelling, Jerrycan Adaptor Assembly	4730-99-151-3452
3	Air Filter	2940-99-355-8118
4	Accessories Bag	5140-99-939-0976
5	Earth Spike	5975-99-901-0148
6	Earth Lead	6150-99-811-2625
7	Exhaust Extension	4720-99-611-7784



13 The items listed in Table 5 are the materials required to carry out the procedures detailed in this Chapter.

TABLE 5 MATERIALS

Serial (1)	Spare (2)	Use (3)
1	Fuel, either Dieso (F54) or AVTUR (F34)	For all operating environmental temperatures
2	Oil, OMD 90, OX 90 or OMD 55 capacity 0.9 litres	Engine lubricating oil
3	Plastic sheet, as required	Wrapping of LFG prior to transportation
4	Adhesive tape, as required	Securing plastic sheet

ROUTINE MAINTENANCE

14 Routine maintenance tasks to be carried out by the Operator are those specified in Table 1.

Physical inspection

15 The following inspection procedures should be carried out on initial receipt of the equipment and then prior to use of the LFG. The inspection involves a physical scrutiny of the equipment to make sure there is no evidence of physical defects, contamination, leakages or the presence of foreign matter which may render the LFG unfit for use. Any defects found shall be reported and repaired in strict accordance with the appropriate maintenance procedures.

Covers

16 Inspect the external and internal surfaces of the Acoustic Cover as follows:

- 16.1 Examine all surfaces for signs of cracks or deformation.
- 16.2 Examine the two securing clips for damage and security of fixing.
- 16.3 Examine the Edge Seal for signs of damage or wear.

17 Inspect the external surfaces of the Louvre and Top Covers as follows:

- 17.1 Examine visible surfaces for signs of cracks or deformation.

Tubular frame

18 Inspect the Tubular Frame structure as follows:

- 18.1 Examine for evidence of physical damage such as dents scratches or corrosion.
- 18.2 Examine welded items for security and damage.
- 18.3 Examine the two Acoustic Cover draw latches for damage and security of fixing.

Cables, connectors and hoses**WARNING**

EARTHING. THE EARTH CABLE PROVIDED IS NOT TO BE LENGTHENED OR SHORTENED UNDER ANY CIRCUMSTANCES WITHOUT APPROVAL FROM THE DESIGN AUTHORITY.

CAUTION

EQUIPMENT DAMAGE. The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the Design Authority.

19 Inspect Cables, Connectors and Hoses as follows:

19.1 Remove the Acoustic Cover and examine, as far as possible, the cables, hoses and fuel pipes on the engine for signs of overheating, deformation or damage.

19.2 Examine the Connectors and Terminals on the AC and DC Control Panels for signs of damage, the presence of foreign matter and corrosion.

19.3 Examine the jerrycan fuel hoses, quick release connectors, LFG fuel quick disconnect hoses and jerrycan dip tube fuel filter for the presence of foreign matter, evidence of leaks, damage and corrosion.

Recoil starter

20 Pull the Starter Cord fully from the Recoil Starter and examine for signs of wear. Examine the Pull Cord exit hole on the Recoil Starter for signs of wear and corrosion (Figure 1).



Figure 1 Recoil starter exit hole

Engine fuel tank cap and drain

21 With the Acoustic Cover removed, examine the Engine Fuel Tank Cap for signs of damage and security of attachment.

22 Inspect the Fuel Tank Drain Pipe (Figure 2) for signs of water contamination of the fuel. If water is visible within the Fuel Tank Drain Pipe then it should be drained off via the Fuel Tank Drain Tap fitted to the pipe. Refit the Acoustic Cover on completion.

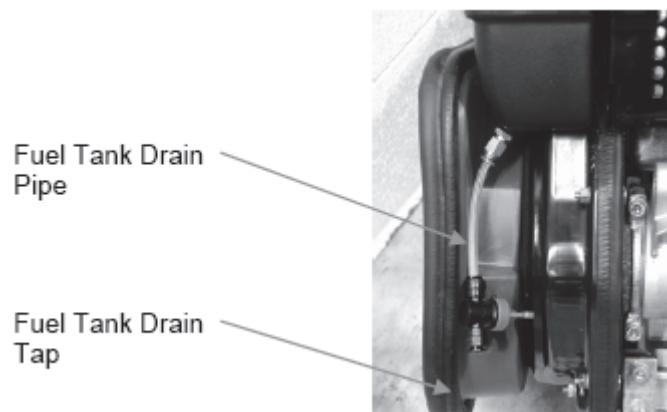


Figure 2 Fuel tank drain pipe and drainage tap

Lubricating oil level - check and top-up

CAUTION

EQUIPMENT DAMAGE. The engine must not be operated with the oil level below the specified minimum level.

23 The engine lubricating oil level should be checked prior to starting the LFG and every 12 hours after that; topping up if required. The Oil Filler Cap is located on the Rocker Cover and the dipstick is located on the DC Control Panel side of the engine.

24 To check and top-up the engine lubricating oil, proceed as follows:

24.1 Place the LFG on a level surface and remove the Acoustic Cover to gain access to the dipstick (Figure) and filler cap.

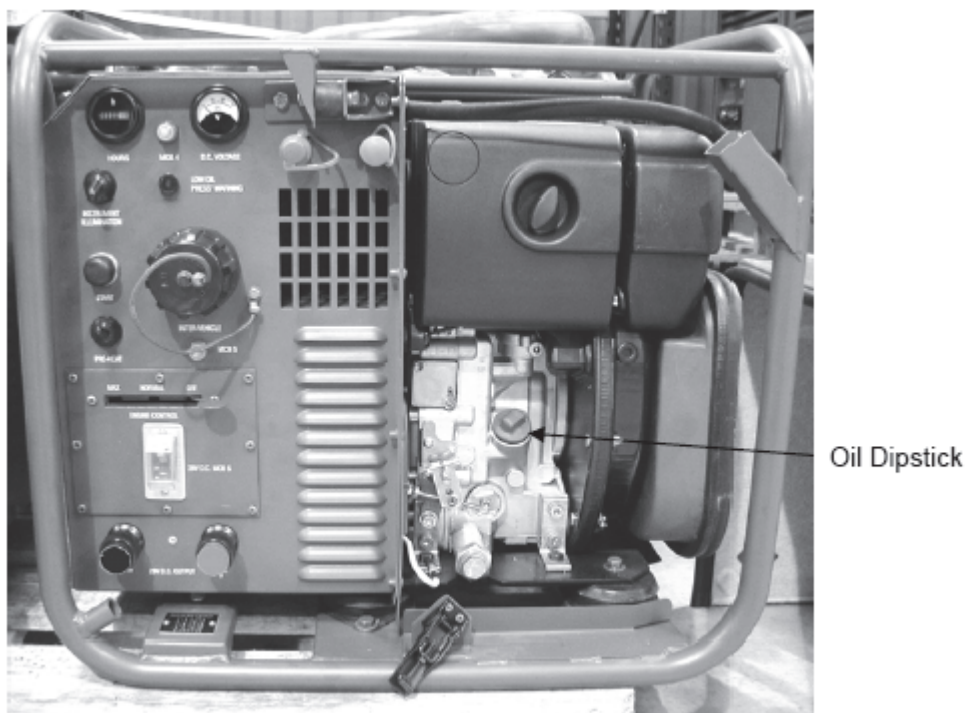


Figure 3 Oil dipstick

24.2 Unscrew the dipstick to remove it, wipe off any excess oil, and re-insert it ensuring it is screwed down correctly. Remove it again and check that the oil level is between the "Min" and "Max" levels marked on the dipstick. If the oil level is below the "Min" level then it should be replenished. The type of oil to be used is dependent on the temperature of the intended operating environment. Refer to Cat 601.

24.3 To replenish with oil, fill via the Oil Filler Cap on the Rocker Cover, fill until the "Max" mark on the dipstick is covered. Fill pouring a little at a time, allowing sufficient time for the oil to settle between each fill before checking the level. Do not overfill.

24.4 On completing the oil level check and top-up procedures, replace the filler cap and dipstick and refit the Acoustic Cover.

Air inlet and outlet vents

25 The LFG has air inlet and outlet vents built into the covers and frame. To ensure efficient cooling of the LFG, every 12 hours, check that the vents are not blocked as follows:

25.1 Remove the Acoustic Cover.

25.2 The Recoil Starter forms part of the air cooling path for the engine. Examine the vents on the Recoil Starter for signs of damage or blockage. Remove any blockages.

25.3 Examine the vent holes in the Bulkhead (Figure 4) for signs of damage or blockage. Clear any blockages.

25.4 Examine all louver vents (both on the Louvre Panel and on either side of the LFG) for signs of damage or blockage. Remove any blockages.



Figure 4 Bulkhead vent holes

Change engine oil

26 Prior to changing the engine oil, ensure that the LFG is standing on level ground and that the oil in the engine is warm, but not hot. To change the oil, proceed as follows:

26.1 Remove the oil filler cap (Fig 5) and oil drain plug (Fig 6) and allow the oil to drain into a suitable container. Dispose of the waste oil in accordance with local regulations.

26.2 Clean the oil drain plug, fit a new washer and refit to the engine housing.

- 26.3 Tighten the oil drain plug to a torque of 50 Nm (37 lb ft).
- 26.4 With the oil filler cap removed, fill with 0.9 litres of oil.
- 26.5 Check the oil level periodically during filling by wiping the oil dipstick, screwing it back in and then removing it again. Check the oil level on the dipstick and, if necessary, "top up to the "Max" level".
- 26.6 Finally, replace the filler cap and oil dipstick and wipe off any spilt oil.



Figure 5 Oil filler cap

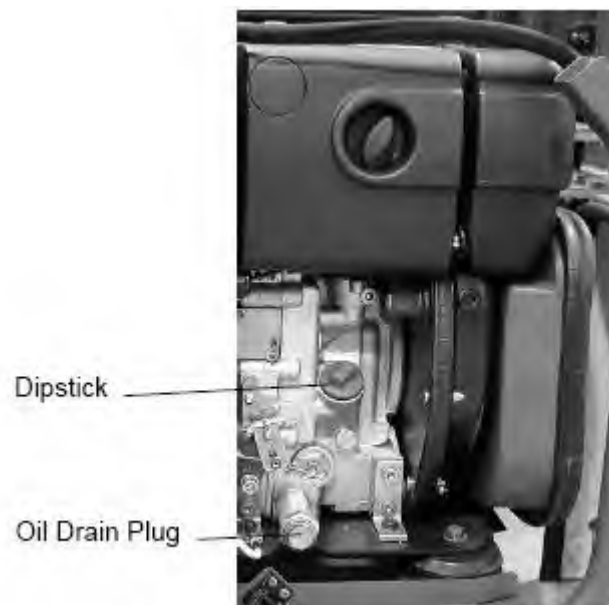


Figure 6 Oil dipstick and drain plug

Clean/replace engine oil filter strainer**NOTE**

The engine oil must be drained before commencement of this task.

27 To clean or replace the oil filter strainer (Fig 7), proceed as follows:

- 27.1 Slacken the oil filter strainer socket head securing screw, approximately five turns.
- 27.2 Remove the oil filter strainer by drawing it out of the engine by pulling the securing screw.
- 27.3 If cleaning is required, clean by washing in a suitable cleaning fluid/solvent.
- 27.4 If the oil filter strainer is damaged, fully remove the securing screw and the sprung steel plates.
- 27.5 Fit a new O-ring seal to the replacement oil filter strainer, reassemble the sprung steel plates and fit the securing screw.
- 27.6 Fit the oil filter strainer into its housing and tighten the socket head securing screw.



Figure 7 Oil filter strainer assembly

- 27.7 Replenish oil. Refer to Cat 601.

Fuel filter

- 28 To replace the engine fuel tank fuel filter (Fig 8), proceed as follows:
- 28.1 Remove the fuel tank cap and lift up to expose the fuel filter (attached by a cord).
 - 28.2 Remove the fuel filter from the fuel tank and pull off of the fuel pipe.
 - 28.3 Push a replacement fuel filter fully on to the fuel pipe and re-insert in fuel tank.



Figure 8 Engine Fuel Tank Fuel Filter

Labels and warning notices

- 29 Ensure all Labels and Warning Notices are clean, legible and securely attached to the LFG.

UNSCHEDULED MAINTENANCE**WARNINGS**

(1) SKIN BURNS. EXERCISE EXTREME CARE WHEN CARRYING OUT TASKS ADJACENT TO THE ENGINE AND ITS EXHAUST PIPE AS BOTH ITEMS CAN RETAIN HEAT FOR SEVERAL MINUTES AFTER SHUT DOWN. ALLOW SUFFICIENT TIME FOR THE EQUIPMENT TO COOL DOWN BEFORE CARRYING OUT ANY MAINTENANCE TASKS.

(2) SHOCK HAZARD. DO NOT ATTEMPT TO SERVICE THE GENERATOR OR CARRY OUT ANY MAINTENANCE OR REPAIRS WHILST IT IS RUNNING.

- 30 Unscheduled Maintenance tasks to be carried out by the Operator are those specified in Table 2.

Replacement of components

- 31 Items should be replaced if damage is found during any of the inspections detailed in this Chapter. To replace an item, complete the appropriate replacement procedure as detailed below.

Acoustic cover

- 32 Release the two clips securing the Acoustic Cover to the LFG and remove the Cover. Fit a replacement Acoustic Cover by locating it on the LFG and securing the two retaining clips.

Jerrycan adapter and hoses**CAUTION**

EQUIPMENT DAMAGE. The fuel flow and return hoses provided are not to be lengthened or shortened under any circumstances without approval from the Design Authority.

33 Disconnect the hoses from the LFG Fuel Quick Disconnect couplings and remove the jerrycan Adapter from the jerrycan. Fit a replacement Adapter to the jerrycan and connect the hoses to the Quick Disconnect couplings.

Air filter

34 Replace the Air Filter as follows:

34.1 Remove the Acoustic Cover.

34.2 Locate the Air Filter Cover and undo the plastic Air Filter Cover Securing Knob (Figure 9).

34.3 Remove the Air Filter Cover.

34.4 Undo the Air Filter Retaining Nut (Figure 10) and remove the Air Filter. The Air Filter is a tight fit on the centre spindle and may require rotating along the threads to release and withdraw it.

34.5 Replacement is the reverse of removal. Tighten the Air Filter Retaining Nut finger tight only.

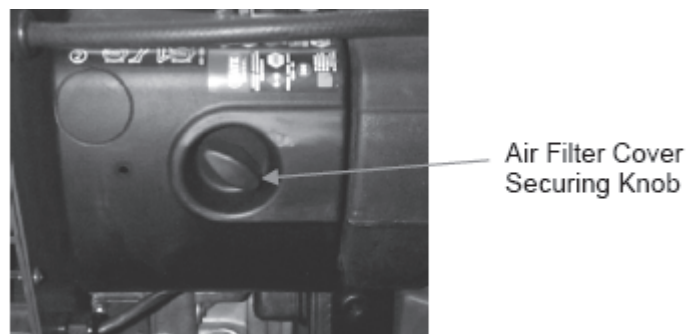


Figure 9 Air filter retaining nut

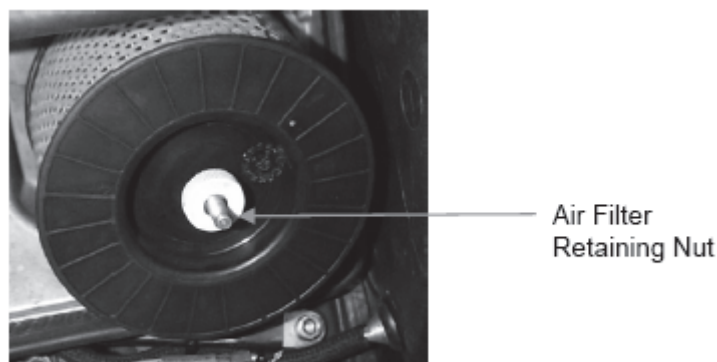


Figure 10 Air filter retaining nut



Accessories bag

35 The Accessories Bag is secured to the LFG end frame by straps. To replace a defective bag: undo the straps and remove the bag from the LFG, transfer its contents to a new bag and secure the new bag to the LFG frame using the available straps. Earth Spike and Earth Lead.

Earth spike and earth lead

WARNING

EARTHING. THE EARTH CABLE PROVIDED IS NOT TO BE LENGTHENED OR SHORTENED UNDER ANY CIRCUMSTANCES WITHOUT APPROVAL FROM THE DESIGN AUTHORITY.

36 When not in use the Earth Spike is stowed in its transit bracket on the DC side of the generator. The Earth Lead is stored in the Accessories Bag. To replace a defective item, remove it from its stowage/storage position and replace it with a serviceable item.

Exhaust extension

37 The Exhaust Extension will be transported with, but not secured to, the LFG. Therefore, replacement is by exchange of the unserviceable item with a serviceable item.

Fluid level warnings/checks

Engine low oil pressure warning LED illuminated

38 If the Low Oil Press' Warning LED illuminates (Figure 11) the output load Circuit Breakers (CBs) will trip. On illumination of the LED, or when alerted by the tripping of the output load CBs, immediately stop the LFG. Disconnect any loads. Allow the LFG to cool down for at least 5 minutes then check the engine oil level and replenish as detailed in paras 23 and 24. If the fault persists then further investigation is required to locate the fault in the oil circulation and pressure system. Shut down the generator, categorise it as unserviceable and return it to the repair facility.

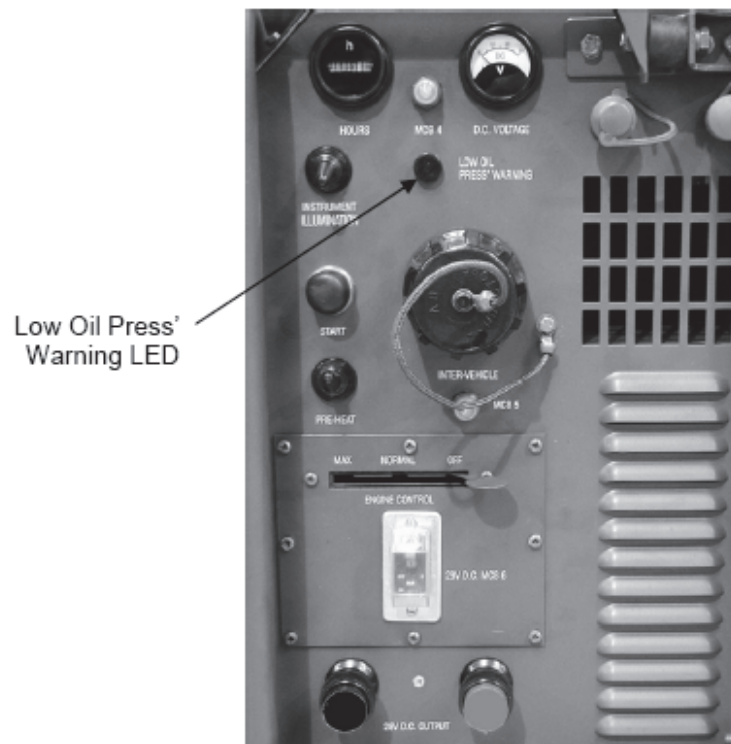


Figure 11 Low oil pressure warning LED

Fuel level

39 Check the level of fuel in the jerrycan and Engine Fuel tank as follows:

39.1 Jerrycan. Remove the jerrycan Adapter and check the level of fuel in the jerrycan; replenish if necessary.

39.2 Engine Fuel Tank. Release the Fuel Tank Cap locking lever (Figure 12), remove the cap and ensure there is fuel in the tank.

39.3 If the tank is empty, fill with 1 - 2 litres of fuel.

NOTE

The Engine Fuel tank does not have to be full for the LFG to operate.

39.4 Refit the cap and secure the locking lever.

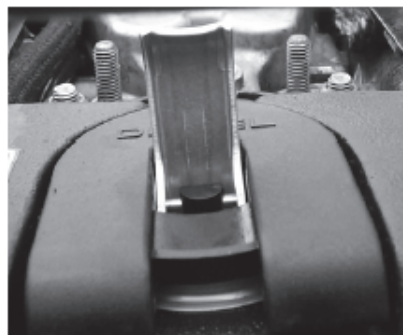


Figure 12 Engine fuel tank cap



TRANSPORTATION

CAUTION

EQUIPMENT DAMAGE. During operation the engine and exhaust pipes can get very hot. Allow sufficient time for the equipment to cool down before carrying out tasks such as wrapping the LFG in plastic sheet during the preparation for transport.

40 Transportation tasks to be carried out by the Operator are those specified in Table 3.

Preparation for transport

Normal operating conditions

41 To prepare the LFG for transport under normal operating conditions, proceed as follows:

- 41.1 Disconnect the jerrycan from the Quick Disconnects and stow jerrycan Adapter in the Accessories Bag.
- 41.2 Drain the fuel from the Engine Fuel Tank, into a suitable container, by releasing the Fuel Tank Drainage Tap located beneath the Fuel Tank (Figure 2).
- 41.3 Ensure the Engine Fuel Tank Cap and Quick Disconnect blanking caps are fitted securely.
- 41.4 Wrap and seal the LFG in plastic sheet if appropriate, see Note below.

NOTE

This is optional dependant upon the weather conditions and method of transport.

Battlefield conditions

42 To prepare the LFG for transport under battlefield conditions, proceed as follows:

- 42.1 Disconnect the jerrycan from the Quick Disconnects and stow jerrycan Adapter in the Accessories Bag.
- 42.2 Ensure the Engine Fuel Tank cap and Quick Disconnect blanking caps are fitted securely.

Air transport

43 Prepare the LFG for Air Transport in accordance with JSP 335, Part II, Section 9, Leaflet 6.

Recovery post transportation

Normal operating conditions

44 To recover the LFG from transportation under normal operating conditions, proceed as follows:

- 44.1 Remove plastic sheeting (if used).
- 44.2 Put 1 - 2 litres of fuel in the Engine Fuel Tank and re-fit fuel tank cap.
- 44.3 Remove fuel line blanking caps and connect jerrycan.
- 44.4 Proceed with normal operating procedures as detailed in Chapter 2.

Battlefield conditions

- 45 To recover the LFG from transportation under battlefield
 - 45.1 Remove fuel line blanking caps and connect jerrycan.
 - 45.2 Proceed with normal operating procedures as detailed in Chapter 2.

Air transport

- 46 To recover the LFG from air transportation, proceed as follows:
 - 46.1 If the LFG has been transported with the fuel system drained, put 1 - 2 litres of fuel in the Engine Fuel Tank and re-fit the fuel tank cap.
 - 46.2 Remove fuel line blanking caps and connect jerrycan.
 - 46.3 Proceed with normal operating procedures as detailed in Chapter 2.

FAULT FINDING

47 The following Fault Finding procedures are intended for use at Level 1 to enable simple faults to be rectified without recourse to further lines of Maintenance. For Fault Finding it is assumed that the correct grade of fuel and oil is being used for the prevailing climatic conditions as described in CAT 601 Table 2. If these procedures fail to rectify the fault, the LFG must be classified as unserviceable and returned to a suitable repair facility.

Engine associated faults

- 48 Engine fails to start when using Recoil Starter, see Table 6.

TABLE 6 ENGINE FAILS TO START - RECOIL STARTER

Ser. (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Crank engine using Recoil Starter, does the engine turn over when the cord is pulled?	Yes		Go to Serial 2
		No	Recoil Starter failing to engage with engine flywheel.	Categorise as unserviceable & return LFG to repair facility
2	Check the Engine Speed Control Lever setting, is it set at "Max"?	Yes		Go to Serial 3
		No	Engine Speed Control Lever set incorrectly.	Set Engine Control to "Max" position and operate Recoil Starter
3	Check jerrycan fuel, is there fuel in the jerrycan?	Yes		Go to Serial 4
		No		Fill jerrycan and operate Recoil Starter

(continued)

TABLE 6 ENGINE FAILS TO START - RECOIL STARTER (continued)

Ser. (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
4	Check Engine fuel tank cap security, is the cap secure?	Yes		Go to Serial 5
		No	When fuel in the tank is used up it will not be replenished by fuel from the jerrycan as the system requires a small positive pressure to produce this fuel flow. An insecure fuel tank cap will not allow this pressure to build up. Note: The engine may run for a short while with the residual fuel in the tank before stopping.	Secure Engine fuel tank cap and operate Recoil Starter
5	Check Engine fuel tank fuel level, is there a small amount of fuel in the tank?	Yes		Go to Serial 6
		No	A small amount of fuel is necessary to enable the system to pressurise.	Put 1 - 2 litres of fuel in the tank and re-secure the cap. Operate the Recoil Starter.
6	Crank engine using Recoil Starter, does the engine now start?	Yes		Proceed with normal operations
		No		Attempt an Electric Start iaw Table 7 to complete task. Then, categorise LFG as unserviceable & return to repair facility

49 Engine fails to start using the Electric Starter Motor, see Table 7.

TABLE 7 ENGINE FAILS TO START - ELECTRIC STARTER

Ser. (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Check that the Inter-vehicle lead is correctly connected to the generator Inter-vehicle Connector and the external 24VDC power supply. Crank the engine using the Electric Starter, does the engine now start?	Yes		Proceed with normal operations
		No		Go to Serial 2

(continued)

TABLE 7 ENGINE FAILS TO START - ELECTRIC STARTER (continued)

Ser. (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
2	Operate the Electric Starter, can the Starter Motor be heard turning when it is operated?	Yes		Go to Serial 3
		No	a. Insufficient output from power source b. Open circuit in starter motor electrical harness c. Faulty Starter Motor	a. Replace power source b. Categorise LFG as unserviceable and return to repair facility c. Categorise LFG as unserviceable and return to repair facility
3	Can the Engine be heard turning over when the electric start is operated?	Yes		Go to Serial 4
		No	Starter failing to engage with engine flywheel	Categorise as unserviceable and return to repair facility
4	Check the Engine Speed Control Lever setting, is it set at "Max"?	Yes		Go to Serial 5
		No	Engine Speed Control Lever set incorrectly	Set Engine Control to "Max" position and operate Electric Starter
5	Check jerrycan fuel, is there fuel in the jerrycan?	Yes		Go to Serial 6
		No		Fill jerrycan and operate Electric Starter
6	Check Engine fuel tank cap security, is the cap secure?	Yes		Go to Serial 7
		No	When fuel in the tank is used up it will not be replenished by fuel from the jerrycan as the system requires a small positive pressure to produce this fuel flow. An insecure fuel tank cap will not allow this pressure to build up. Note: The engine may run for a short while with the residual fuel in the tank before stopping	Secure Engine fuel tank cap and operate Electric Starter

(continued)

TABLE 7 ENGINE FAILS TO START - ELECTRIC STARTER (continued)

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
7	Check Engine fuel tank fuel level, is there a small amount of fuel in the Engine fuel tank?	Yes		Go to Serial 8
		No	A small amount of fuel is necessary to enable the system to pressurise	Put 1 - 2 litres of fuel in the tank and re-secure the cap. Operate Electric Starter.
8	Crank engine using the Electric Starter, does the engine now start?	Yes		Proceed with normal operations
		No		Categorise the LFG as unserviceable and return to repair facility

Electrical system associated faults

50 AC Circuit Breakers do not open when the RCD push button is pressed, see Table 8.

NOTE

The RCD test will only trip the MCB(s) for the selected output on SW1.

TABLE 8 AC CIRCUIT BREAKERS DO NOT OPEN

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Check the AC Circuit Breakers, are they set to the ON position?	Yes		Go to Serial 2
		No		Set CBs and test again. If test passes, proceed with normal operations
2	Check MCB 3 is closed			Close MCB 3 and test again. If test fails, categorise the LFG as unserviceable and return to repair facility

CHAPTER 4

DESTRUCTION OF EQUIPMENT

CONTENTS

Para

- 1 Mandatory directive
- 3 Degree of damage
- 5 Priorities of destruction
- 6 Methods of destruction
- 8 Mechanical
- 9 Burning (WARNING)
- 10 Gunfire (WARNING)

Table

Page

1	Priorities of destruction	2
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MANDATORY DIRECTIVE

1 Destruction of the equipment when subject to capture by the enemy will be undertaken by the user arm, ONLY WHEN, in the judgement of the unit commander concerned, such action is necessary in accordance with orders of, or policy established by the Army or Divisional Commanders.

2 The destruction of equipment is to be reported through appropriate command channels.

Degree of damage

3 The degree of damage inflicted, to prevent the equipment being used by an enemy, shall be as follows:

3.1 Methods of destruction should achieve such damage to equipment and essential spare parts, that it will not be possible to restore the equipment to a usable condition in the combat zone either by repair or cannibalisation.

3.2 Classified equipment must be destroyed to such degree as to prevent, whenever possible, duplication, or determination of operation or function by the enemy.

3.3 Any classified documents, notes, instructions or other written material pertaining to function, operation, maintenance or employment, including drawings or parts lists, must be destroyed in a manner to render them useless to the enemy.

4 In general, destruction of essential parts, followed by burning will usually be sufficient to render the equipment useless. However, selection of the particular method of destruction requires imagination and resourcefulness in utilisation of the facilities at hand under the existing conditions. Time is usually critical.

PRIORITIES OF DESTRUCTION

5 The priorities of destruction should be considered, as follows:

5.1 Priority must be given to the destruction of classified equipment and associated documents.

5.2 When lack of time and/or means prevents complete destruction of equipment, priority must be given to the destruction of essential parts. The same parts are to be destroyed on all like equipment and in spare part storage areas.



5.3 A guide to priorities of destruction of the equipment is shown in Table 1.

TABLE 1 PRIORITIES OF DESTRUCTION

Serial (1)	Item (2)	Priority (3)
1	Engine Fuel Tank and Jerrycan Quick Disconnect points	1st
2	Recoil Starter and Electric Starter Motor	2nd
3	Engine Block	3rd
4	Control Panels	4th
5	Inverter/Regulator assembly (if time permits removal of louvre cover panel)	5th

METHODS OF DESTRUCTION

6 If destruction is ordered, due consideration should be given to:

6.1 Selection of a point of destruction that will cause greatest obstruction to enemy movement and also prevent hazard to friendly troops.

6.2 Observance of appropriate safety precautions.

7 The following information is for guidance only. Of the possible methods of destruction, those most generally applicable are mechanical, burning and gunfire.

Mechanical

8 This method requires the use of an axe, pick, crowbar or similar implement. The equipment should be destroyed in accordance with the priorities given on Table 1.

Burning

WARNING

GASOLINE HAZARD. DUE CONSIDERATION SHOULD BE GIVEN TO THE HIGHLY FLAMMABLE NATURE OF GASOLINE. CARELESSNESS IN ITS USE MAY RESULT IN SERIOUS BURNS.

9 This method requires the use of gasoline, oil or other flammables. To destroy the equipment by burning, proceed as follows:

9.1 Remove and retain any portable fire extinguishers until the LFG is destroyed, then discharge.

9.2 If quantities of combustibles are limited, smash all vital elements such as switches, instruments and control levers.

9.3 Place ammunition and charges in and about the equipment so that the greatest damage will result from the explosion.

9.4 Pour gasoline and oil liberally over the equipment.

9.5 Ignite the equipment, using one of the following methods and exercise all necessary personal safety precautions:

- 9.5.1 An incendiary grenade.
- 9.5.2 A burst from a flame thrower.
- 9.5.3 A combustible train of suitable length.
- 9.5.4 Or any other appropriate means.

Gunfire

WARNING

ARTILLERY HAZARD. FIRING ARTILLERY AT RANGES OF 500 YARDS OR LESS, AND FIRING RIFLE GRENADES OR ANTI-TANK ROCKETS SHOULD BE FROM COVER.

10 When destroying equipment by gunfire, proceed as follows:

- 10.1 Remove and retain any portable fire extinguishers until the LFG is destroyed, then discharge.
- 10.2 Smash all vital elements such as switches, instruments and control levers.
- 10.3 Destroy the equipment by gunfire, using any of the following methods:
 - 10.3.1 Tank guns.
 - 10.3.2 Self propelled guns.
 - 10.3.3 Artillery.
 - 10.3.4 Rifle grenades.
 - 10.3.5 Anti-tank rockets from launchers.



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