



Ministry of Defence

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

6115-G-710-522 FAILURE DIAGNOSIS MAINTENANCE INSTRUCTIONS INSPECTION STANDARDS

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MAINTENANCE INSTRUCTIONS

Chapter

- 1 Failure Diagnosis
- 2 Maintenance Instructions
- 3 Inspection Standards



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 0200-A-210-013	Repair of Threaded Holes by Inserts
AESP 0200-A-238-013	Cable Assembly Repair Techniques
AESP 6150-A-100-201	Earthing and Earthing Protection
JSP 375	MoD Health and Safety Handbook
JSP 515	Hazardous Stores Information System
SEI 14411	Safety Precautions for Electrical Equipment

WARNINGS AND CAUTIONS

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

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 DIESO 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.**
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CAUTIONS

8 The following CAUTIONS are applicable to this category:

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) **EQUIPMENT DAMAGE.** Compression testing is not to be carried out as the engine contains decompression devices.
- (3) **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.
- (4) **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.
- (5) **EQUIPMENT CAPABILITY.** Operation of the AC SW1 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.
- (6) **EQUIPMENT DAMAGE.** The engine must not be operated with the oil level below the specified minimum level.
- (7) **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.
- (8) **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.
- (9) **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.
- (10) **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:

AC	Alternating Current
AESP	Army Equipment Support Publication
Amdt	Amendment
AQL	Acceptable Quality Levels
AVM	Anti-Vibration Mount
BFPO	British Forces Post Office
Cat	Category
Chap	Chapter
cm	centimetre
dB	decibel
DC	Direct Current
DIN	Defence Instructions and Notices
EMER	Electrical Mechanical Engineering Regulation
Eqpt	Equipment
ESPD	Equipment Support Policy Directive
Fig	Figure
FRACAS	Failure Reporting Analysis and Corrective Action System
Hex	Hexagon
i.e.	that is
JAMES	Joint Asset Management and Engineering Solutions
kg	kilogramme
kW	kiloWatt
JSP	Joint Service Publication
lb ft	pounds feet
LED	Light Emitting Diode
LFG	Lightweight Field Generator
LRU	Line Replaceable Unit
mA	milliAmpere
MACMT	Mean Active Corrective Maintenance Time
MCB	Miniature Circuit Breaker
mm	millimetre
MoD	Ministry of Defence
N/A	Not Applicable
NATO	North Atlantic Treaty Organisation
Nm	Newton metre
No.	Number
NSN	NATO Stock Number
OI	Operational Infrastructure
OSP	Operational Support Programme
Para	Paragraph
PT	Project Team
RAF	Royal Air Force
RCD	Residual Current Device
REME	Royal Electrical and Mechanical Engineers
Ref	Reference
RFI	Radio Frequency Interference
rpm	revolutions per minute
SEI	Service Engineering Instruction
SME	Subject Matter Expert
SOP	Standard Operating Procedures
TDOL	Technical Documents On-Line
T&M	Test and Measurement



UK	United Kingdom
V	Volt

SYMBOLS

10 The following symbols are used in this category:

°	degree
°C	degrees Celsius
>	greater than
<	less than
Ω	ohm
%	percent
±	plus or minus

CHAPTER 1

FAILURE DIAGNOSIS

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- Introduction
- 1 General
- 3 Failure diagnosis procedure format
- 4 Tools and test equipment
- 5 Electrical circuit information
- 6 Failure diagnosis procedures
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INTRODUCTION

General

1 It is assumed for the purpose of this AESP category that the LFG start up procedures, as described in AESP 6115-G-710-201, have been carried out correctly up to the point of failure.

2 Failure diagnosis by the operator is limited to those actions described in Cat 201. When faults occur, action must be initially taken at Unit level (level 2) although the involvement of other levels may subsequently be required.

Failure diagnosis procedure format

3 The failure diagnosis procedures are presented in the form of tables providing step by step information on testing, results, possible cause of failure and the action to be taken. Each procedure must be carried out in the order given.



Tools and test equipment

4 The tools and test equipment required for carrying out the following inspection standards are detailed in Table 1.

TABLE 1 TOOLS AND TEST EQUIPMENT

Item (1)	NATO Stock No. (2)	Designation (3)	Use (4)
1	6625-99-2523606 or 6625-99-8654203	Multimeter	Voltage and continuity measurements
2	5120-01-3551734	Torque Wrench 5 to 75 lb/ft	Tightening various nuts & bolts
3	6680-99-8062943	Tachometer, Optical Hand Held	Checking engine speed
4	5210-99-796-7540	Feeler Gauge	Valve clearance check /adjustment

Electrical circuit information

5 Where a failure diagnosis procedure states a reference to a component of the electrical system, refer to the circuit diagram in Cat 302.

FAILURE DIAGNOSIS PROCEDURES

6 The following procedures assume that the Level 1 Fault Finding processes detailed in Cat 201 have been carried out and the LFG has been subsequently returned for repair.

7 It is assumed that the correct grade of fuel and oil is being used for the prevailing climatic conditions as described in Cat 601.

Engine associated faults

Engine fails to start - recoil starter

8 Engine fails to start using the recoil starting system.

TABLE 2 ENGINE FAILS TO START - RECOIL STARTER

Serial (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	Replace recoil starter unit
2	Check fuel feed to fuel injection pump by removing the pump input hose & cranking the engine, is fuel getting to the fuel injection pump?	Yes		Go to Serial 3
		No	a. Blocked fuel hose(s)	Clear blocked hose(s)
			b. Blocked fuel filter(s)	Replace fuel filter(s) as necessary
	c. Faulty fuel pulse pump	Replace pulse pump		

(continued)

TABLE 2 ENGINE FAILS TO START - RECOIL STARTER (continued)

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
		No	Faulty injection pump	Replace pump NOTE When replacing the fuel injection pump assembly, ensure that the correct fuel injection pump assembly is fitted to the correct engine type. The engine type is identified by a data plate which is glued to the air filter housing. Engine type 1B20-S-204C, fuel injection pump assembly is identified by the engine number which should start with 10028 or 10029. Engine type 1B20-S-204D, fuel injection pump assembly is identified by the engine number which should start with 30030
4	Check engine compression, is the resistance felt whilst hand cranking consistent with that experienced when hand cranking a known serviceable engine?	Yes No	a. Incorrect valve clearances b. Worn valves c. Cylinder and/or piston rings worn	Go to Serial 5 Check clearances and adjust if necessary b. Refer to repair authority c. Refer to repair authority
5	Does the engine now start?	Yes No		Return to operational use a. Replace injector assembly NOTE When replacing the fuel injector assembly, ensure that the correct fuel injector assembly is fitted to the correct engine type. The engine type is identified by a data plate which is glued to the air filter housing. Engine type 1B20-S-204C, fuel injector assembly identified by white paint dot on top of the item. Engine type 1B20-S-204D, fuel injector assembly identified by yellow paint dot on top of the item b. Replace engine assembly

Engine fails to start - electric starter

9 Engine fails to start using the electrical starting system, see Table 3.

TABLE 3 ENGINE FAILS TO START - ELECTRIC STARTER

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Press the engine Start push button, does the engine turn over?	Yes No	a. Faulty MCB 5 b. Faulty Start push button c. Open/faulty circuit between start push button and starter motor d. Starter motor failing to engage or turn the flywheel	Go to Serial 2 a. Check MCB 5 is set and there is continuity through it from the Intervehicle connector to the Start push button b. Check push button & replace if necessary c. Replace cable harness(es) as necessary d. Replace starter motor
2	At low temperatures, is the air intake pre-heater operating?	Yes No	a. Faulty pre-heat select switch b. Faulty pre-heat element	Go to Serial 3 a. Replace switch b. Replace element
3	Refer to Table 2 and continue fault diagnosis from Serial (2)			



Engine fires - but does not run

10 Engine fires but fails to run correctly, see Table 4.

TABLE 4 ENGINE FIRES - BUT DOES NOT RUN

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Operate the engine speed control lever on the DC control panel, does the cable run freely between the "Off" and "Max" positions?	Yes No	a. Sticking speed control cable b. Broken speed control cable c. Possible sticking engine speed control assembly	Go to Serial 3 a. Lubricate speed control cable b. Replace speed control cable c. Disconnect the cable at the engine speed control lever assembly and operate by hand. Free movement should be felt, if not replace engine assembly
2	Refer to Table 2 and continue fault diagnosis from Serial (2)			

Engine cuts out during operation

11 If the engine starts and runs correctly but then cuts out of its own accord, carry out the fault diagnosis procedures detailed in Table 2 from Serial 2 onwards.

Engine output and speed both drop

12 If the engine output and speed both drop, ensure that the engine speed control lever is remaining in the desired position by carrying out the fault diagnosis detailed in Table 3.

13 If the engine speed control lever is remaining in the desired position, carry out the fault diagnosis procedures detailed in Table 2 from Serial 2 onwards to ensure the engine fuel supply is operating correctly.

14 Refer to the "engine speed control lever and housing" procedure detailed in Chap 2 to set the engine speed.

Engine output and speed fall with black smoke from the exhaust

15 Engine output and speed fall off with black smoke being emitted from the exhaust, see Table 5.

TABLE 5 ENGINE OUTPUT AND SPEED FALL OFF - BLACK SMOKE FROM EXHAUST

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Check air filter, is it excessively contaminated or airflow to engine otherwise restricted?	Yes	Operating environment and conditions may require more frequent checking and routine replacement of the air filter	Replace air filter or remove restriction to airflow. Increase periodicity of routine checking and replacement until environmental conditions are less harsh, dirty or dusty.
2	Check valve clearances	No	Valve clearances out of adjustment	Go to Serial 2 Check & adjust valve clearances Go to Serial 3
3	Check fuel injector function by carrying out diagnosis detailed in Table 2, Serial 3			
4	Check oil level		Engine overfilled with oil	Drain and replenish oil to correct level

Electrical system associated faults

16 With the exception of the engine starting circuit, all electrical faults relate to the control, distribution and indication of the PMG output.

No output voltage indicated (AC or DC)

17 Neither the AC nor DC voltmeters indicate an output voltage with a load connected, see Table 6.

TABLE 6 NO OUTPUT VOLTAGE INDICATED (AC OR DC)

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Check oil press warning LED, is it illuminated?	Yes	When the oil pressure switch operates it energises the low oil pressure relay (RL1) which, as well as illuminating the LED, will trip any output circuit breakers which are set, thereby removing outputs. The oil pressure switch will operate if: a. Insufficient oil in engine b. Faulty low oil pressure switch	a. Shut down engine and, when cooled down sufficiently, replenish engine oil b. Replace low oil pressure switch
2	Has the voltage selector switch been operated whilst the engine was running?	Yes	Operation of voltage selector switch with the engine running will interrupt the output and may cause the inverter/regulator assembly to trip off line	Shut down generator, select desired voltage output and restart generator
3	Check voltages, is a voltage present when measured between the +ve and -ve terminals of the DC voltmeter or between the 250 and 0 terminals on the AC voltmeter?	No		Go to Serial 3
		Yes	Defective voltmeter	Replace voltmeter
		No	Defective wiring to voltmeter	Replace cable harness(es) as necessary

No indication on hours run or percentage load meters

18 Neither the hours run or percentage (%) load meters indicate when the LFG is operating correctly under load, see Table 7.

TABLE 7 NO INDICATION ON HOURS RUN OR PERCENTAGE (%) LOAD METERS

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Using the multimeter set on volts DC, is there 28V DC present when measured between the +ve and -ve terminals of the hours run meter?	Yes No	Defective meter Defective wiring to hours run meter	Replace meter Repair or replace cable harness
2	Using the multimeter set on mA, is there a current of between 2mA and 4mA present when measured between the two CT terminals on the percentage (%) load meter?	Yes No	Defective meter a. Defective wiring to percentage (%) load meter b. No percentage (%) load output from the inverter/regulator	Replace meter a. Repair or replace cable harness b. Replace inverter/regulator

AC circuit breaker does not open when the RCD push button is operated

19 Either the 230 V or 110 V output circuit breakers do not open when the RCD push button is operated.

NOTE

The RCD test will only trip the circuit breaker(s) respective to the voltage selected, see Table 8.

TABLE 8 AC CIRCUIT BREAKER DOES NOT OPEN WHEN THE RCD PUSH BUTTON IS OPERATED

Serial (1)	Procedure (2)	Result (3)	Possible Cause (4)	Action (5)
1	Is MCB 3 closed?	Yes		Go to Serial 2
2	Are circuit breaker trip coils operating correctly?	Yes No	High resistance coil	Go to Serial 3 Measure trip coil resistances. Values should be as follows: 230 V Coil - 1.45 to 1.75 k Ω , 110 V Coil - 350 to 450 Ω , 28 V Coil - 18 to 20 Ω
3	Is the push button operating correctly?	No	Faulty push button	Check continuity with push button pressed and replace button if necessary



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MAINTENANCE INSTRUCTIONS

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INTRODUCTION

1 This chapter provides the necessary maintenance instructions to enable the LFG to be repaired and details the procedures required to fulfil the scheduled maintenance and preparation for storage tasks. The instructions/procedures are divided into five parts covering the following areas:

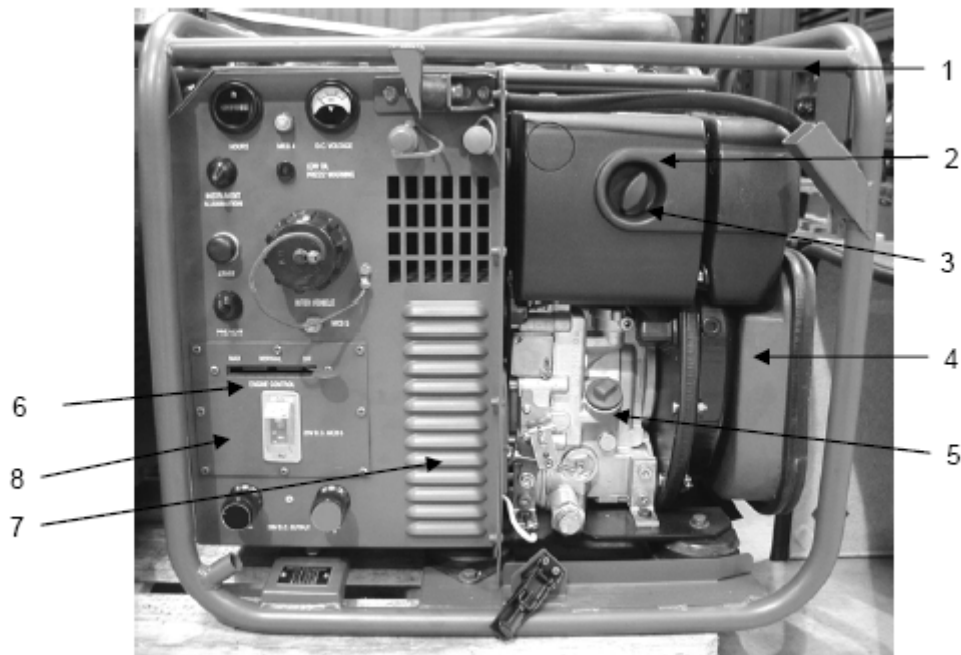
- 1.1 Frame and Covers.
- 1.2 Power Unit (engine and ancillary items).
- 1.3 Electrical System.
- 1.4 Scheduled Maintenance Tasks.
- 1.5 Preparation for Storage.

2 General views of the LFG with the acoustic cover removed are shown at Fig 1 and Fig 2.



- | | |
|-------------------------|--------------------------|
| 1 AC control panel | 4 Electric starter motor |
| 2 Earth stud | 5 Exhaust pipe |
| 3 Anti vibration mounts | 6 Silencer heat shield |

Fig 1 Component location - AC panel side (acoustic cover removed)



- | | | | |
|---|--------------------------------|---|--------------------------|
| 1 | Tubular frame | 5 | Oil dipstick |
| 2 | Air filter cover | 6 | Engine throttle assembly |
| 3 | Air filter cover securing knob | 7 | Air vents |
| 4 | Air duct/recoil starter shroud | 8 | DC control panel |

Fig 2 Component location - DC panel side (acoustic cover removed)

WARNINGS AND CAUTIONS

3 The following WARNINGS and CAUTIONS are applicable throughout this chapter:

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.**

(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) **SHOCK HAZARD.** DO NOT ATTEMPT TO SERVICE THE GENERATOR OR CARRY OUT ANY MAINTENANCE OR REPAIRS WHILST IT IS RUNNING.
- (9) **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.
- (10) **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.
- (11) **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.
- (12) **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

- (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) **EQUIPMENT DAMAGE.** Compression testing is not to be carried out as the engine contains decompression devices.
- (3) **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.
- (4) **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.
- (5) **EQUIPMENT CAPABILITY.** Operation of the AC SW1 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.
- (6) **EQUIPMENT DAMAGE.** The engine must not be operated with the oil level below the specified minimum level.
- (7) **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.
- (8) **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.
- (9) **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.
- (10) **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.

MAINTENANCE POLICY

4 Details of the maintenance and repair policy for the LFG equipment are provided within the Equipment Support Policy Directive (ESPD), AESP 6115-710-111. In accordance with that directive, responsibilities for the maintenance and repair are split between the Operators and Maintenance engineers at Levels 1, 2 and 3. Level 4 repairs will be arranged via the Equipment Support Manager under contract arrangements.

5 Operator level (Level 1) maintenance responsibilities, tasks and instructions are contained in Cat 201.

6 General fault diagnosis and guidance for tasks beyond Level 1 is provided within Cat 522. In addition, this Chapter provides instructions and guidance for those scheduled maintenance and repair procedures beyond the scope of Level 1.

7 From the ESPD, it is determined that the tasks that are to be undertaken at Level 2 are those that can be completed by competent REME and Royal Signals electricians. These are restricted to adjustment or minor repair, failure diagnosis, removal and replacement of LRUs and the removal and replacement of external mechanical or electrical fittings. Level 2 MACMT repair tasks are restricted to those, which can be carried out in the field in one hour or less, by REME tradesmen or Regimental Workshops.

8 Also from the ESPD, it is determined that field repairs are to be restricted to tasks, which can be completed by one tradesman in 10 hours or less, carried out by Regimental Workshops or other designated REME Battalion Workshop.

9 These Level 3 repairs are to be carried out by REME and Royal Signals electrician personnel in the supporting second line workshop, and are to consist of the repair, replacement or adjustment of any part of the equipment not requiring complete stripping of a major assembly.

10 Based on the limits to be applied in terms of a tradesman's time, all of the scheduled maintenance and replacement tasks detailed within this Chapter can be completed at Level 2.

GENERAL REPAIRS

Repair of stripped threads

11 If a threaded hole is stripped due to excessive force, it may be repaired by use of a coil thread insert, as detailed in AESP 0200-A-210-013 Repair of Threaded Holes by Inserts.

Wiring repairs

12 For details of repair techniques for wiring, refer to AESP 0200-A-238-013 Cable Assembly Repair Techniques.

TESTS AFTER REPAIR

13 Test procedures are provided, when applicable, for checking repaired or replaced assemblies/components.

14 Earth bonding resistance tests must be carried out after repair if the earth bonding integrity has been disturbed.

15 RCD tests must be carried out after any repair to the generator electrical system.

16 When major items are replaced, or when extensive dismantling of the LFG is required to remove/replace certain items, a full functional test of the LFG must be carried out as detailed in Chapter 3 (Inspection Standard)

ASSEMBLY/COMPONENT LOCATIONS

17 The location of the assembly/component to be replaced is described in the relevant repair instruction. However, the general views in Fig 1 and Fig 2 show the locations of the majority of items covered in the following repair instructions. All fasteners, when inserted into captive threads, will be fixed using Loctite 243, unless otherwise stated.



TOOLS, REPAIR PARTS AND CONSUMABLES

18 To enable the complete repair/replacement of the LFG components, there is a requirement to use tools, repair parts and consumables. Table 1 details the tool requirements for the repair/replacement of LFG components

TABLE 1 TOOLS REQUIRED FOR LFG REPAIR

Tool	Size	Quantity
Adjustable Mole Grips	n/a	1
Allen Key	3 mm	1
	4 mm	1
	5 mm	1
	6 mm	1
Box Spanner	27 mm	1
Hose Clamp	n/a	1
Earth Bonding Tester	NSN 6625-99-950-2497	1
Long Nosed Pliers	n/a	1
Optical Tachometer (Handheld)	NSN 6680-99-806-2943	1
Pliers	n/a	1
Plumbing Pliers (Water pump)	n/a	1
Megger RCDDT320-GEN	NSN 6625-99-842-7328	1
Screwdriver	Small electrician	1
	No. 2 Pozi-Drive	1
	Flat Blade	1
Snips	n/a	1
Socket	8 mm	1
	10 mm	1
	13 mm	1
	19 mm	1
Spanner	3/8 AF Combination	1
	9/16 AF Combination	1
	10 mm Combination	1
	10 mm Open Offset	1
	13 mm Combination	1
	30 mm Combination	1
Stanley knife	n/a	1
Torch	n/a	1
Torque Driver	1 - 6 Nm	1
Torque Wrench	8 - 60 Nm	1

19 Table 2 details the repair part and consumable requirements for the repair/replacement of LFG components.

TABLE 2 REPAIR PART AND CONSUMABLE REQUIRED FOR LFG REPAIR

Repair part	Quantity
Air Filter Gasket (3 per unit)	1
Copper Washer for Oil Drain Pipe	1
Oil Filter O-ring seal	1
Oil Filter Assembly	1
Split Pins Stainless Steel 5/64 x 1/2	1
Cable Ties	6
10 mm x 50 mm Screw	1
16 mm x 70 mm Fine Thread Screw	1
Consumable	Quantity
Loctite 243	1 Bottle
Silicone Adhesive Sealant (RTV)	1 Tube

20 It is recommended that prior to undertaking any repair/replacement of any LFG components, a selection of fasteners are available in case of loss/damage. Table 3 details the recommended spare LFG fasteners that should be made available prior to any repair/replacement of any LFG components.

TABLE 3 SPARE LFG FASTENERS

Size	Type	Colour	No. Off
M5 x 10	Hex Head Set	Green	6
M5 x 16	Hex Head Set	Green	2
M5 x 10	Skt Button Head	Green	2
M5	Form A Washer	Green	6
M5	Form A Washer	Zinc Plate	2
M5	Nyloc Nut	Green	2
M6 x 20	Hex Head Set	Green	2
M6	Nyloc	Zinc Plate	2
M8 x 12	Hex Head Set	Green	2
M8	Aerotight Nut	Green	2
M8	Form A Washer	Green	2
M6 x 20	Hex Head Set	Zinc Plate	2
M6	Spring Washer	Zinc Plate	2
M6	Form A Washer	Zinc Plate	4
M6	Form C Washer	Zinc Plate	2
M6	Brass Nut	Brass	1
M5	Nut	Zinc Plate	1
M6	Brass Nut	Brass	1

(continued)

TABLE 3 SPARE LFG FASTENERS (continued)

Size	Type	Colour	No. Off
M5	Nut	Zinc Plate	1
M5	S/Proof Washer	Zinc Plate	1
M4 x 6	Dome Head Slot Screw	Zinc Plate	1
M4	Bifurcated Washer	Zinc Plate	1
M6 x 25	Pozi Pan Screw	Zinc Plate	2
M4 x 10	Pozi Pan Screw	Zinc Plate	2
M8 x 25	Skt Cap Screw	Black	1
M8	Spring Washer	Zinc Plate	2
M8	Form A Washer	Zinc Plate	2
M8 x 50	Skt Cap Screw	Black	1
M8 x 25	Hex Set	Black	1
M8 x 30	Hex Set	Black	1
M8	Form C Washer	Zinc Plate	1
M8	Nyloc	Zinc Plate	1
Hatz fasteners			
M6 x 25	Skt Cap Screw	Zinc/Gold	1
M6 x 15	Cyl Spacer	Zinc/Gold	1
	Pulse Pump Nuts/Washer	Zinc/Gold	1

TORQUE SETTINGS

21 Unless stated otherwise in the text, the following torque settings are to be used:

TABLE 4 TORQUE SETTINGS

Item	Torque Nm
M5	6.4
M6	11.1
M8	27
Oil drain pipe	50
Oil drain plug	35

FRAME AND COVERS

Control box louvre cover

22 The following repair parts may be required to do the following procedure:

22.1 Louvre cover securing screws.

23 To remove the control box louvre cover proceed as follows:

23.1 Remove control box louvre cover top cover screws (Fig 3).

23.2 Remove and retain the 12 louvre cover securing screws fitted around the perimeter of the panel (Fig 3). Note that the two screws in the top corners of the panel are longer than the remainder as they pass through two sections of metal (the top and louvre covers). Care should be taken to ensure that these screws are refitted in the correct positions. Support the panel and ease from frame taking care not to damage the earth bonding lead.

23.3 Disconnect the earth bonding lead and retain the attaching parts.

24 Fitting is the reverse of removal.

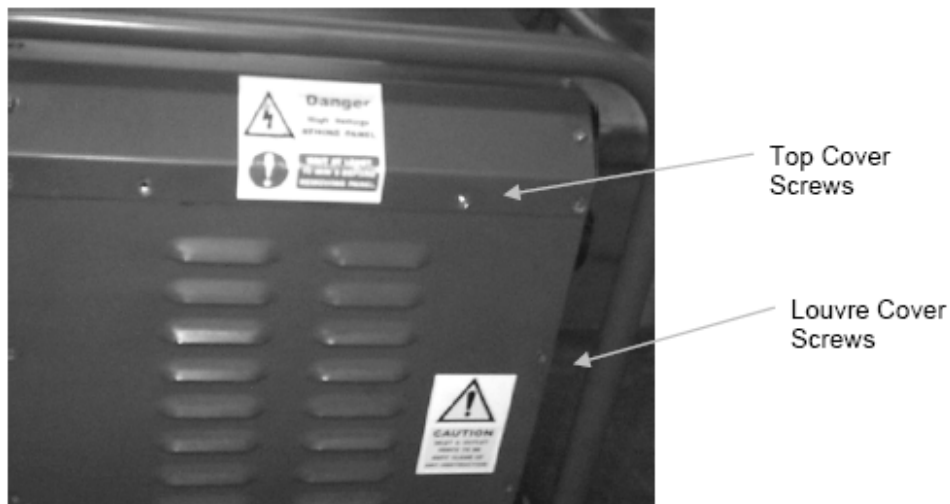


Fig 3 Louvre cover

Control cover top

25 The following repair parts may be required to do the following procedure:

25.1 Louvre cover securing screws.

26 To remove the control cover top, proceed as follows:

26.1 Remove and retain the 16 securing screws fitted around the perimeter of the panel. Note that the two screws in the bottom corners of the panel are longer than the remainder as they pass through two sections of metal (the top and louvre covers). Care should be taken to ensure that these screws are refitted in the correct positions. Support the panel and ease from frame taking care not to damage the earth bonding lead.

26.2 Disconnect the earth bonding lead and retain the attaching parts.

27 Fitting is the reverse of removal. When refitting the panel ensure that the bottom lip of the top cover is positioned on top of the louvre cover top edge thereby overlapping the panel and forming an effective seal via the RFI sealing strips.

Acoustic cover draw latch

28 The following repair parts may be required to do the following procedure:

28.1 Securing screws.

29 To replace an acoustic cover draw latch (Fig 4), proceed as follows:

29.1 Remove the two screws securing the acoustic cover draw latch to the frame from their captive nuts and remove the acoustic cover draw latch.

30 Fitting is the reverse of removal.

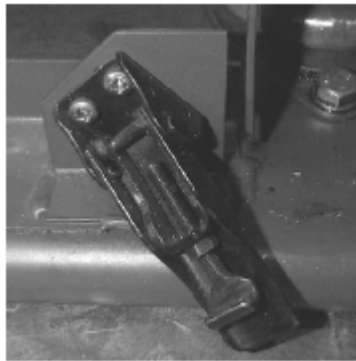


Fig 4 Acoustic cover draw latch

Keeper, black stainless

31 Securing screws may be required to do the following procedure.

32 The keeper, black stainless (Fig 5) is the catch that the draw latch locks on to. To replace it, remove the two securing screws from their captive nuts and remove the keeper.

33 Fitting is the reverse of removal.



Fig 5 Keeper, black stainless

RFI C wrap

34 The RFI C wrap is used to provide additional Radio Frequency Interference (RFI) protection in certain areas of the LFG (Fig 6). It is the form of silvered tape that is attached to the frame as required.

35 To replace damaged portions of the RFI C wrap, cut away the damaged area and replace with fresh tape. To maintain RFI integrity, ensure an overlap is made with the existing tape.

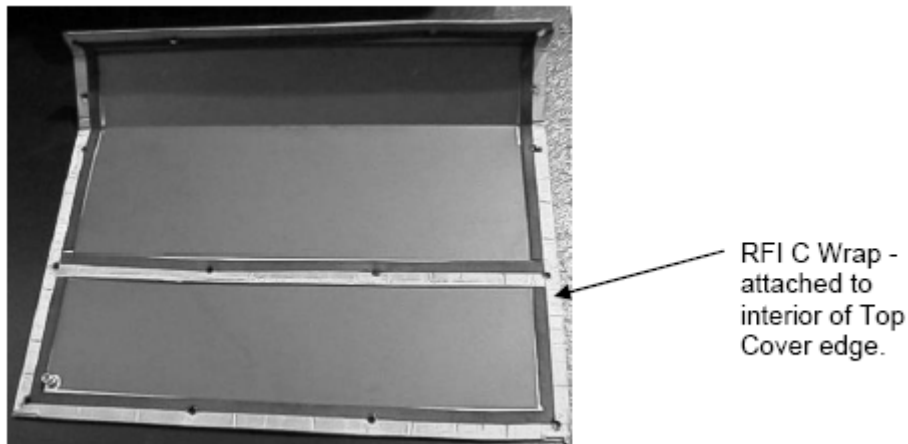


Fig 6 Top panel showing typical C wrap

Side seal

36 Side seals (Fig 7) are fitted around the edge of the acoustic cover and the recoil starter shroud/engine cooling air intake to provide an airtight seal.

37 To replace a seal, peel it away from the edge of the assembly it is fitted to. Replace by positioning the channel in the seal along the edge of the assembly and pressing down firmly to fit.

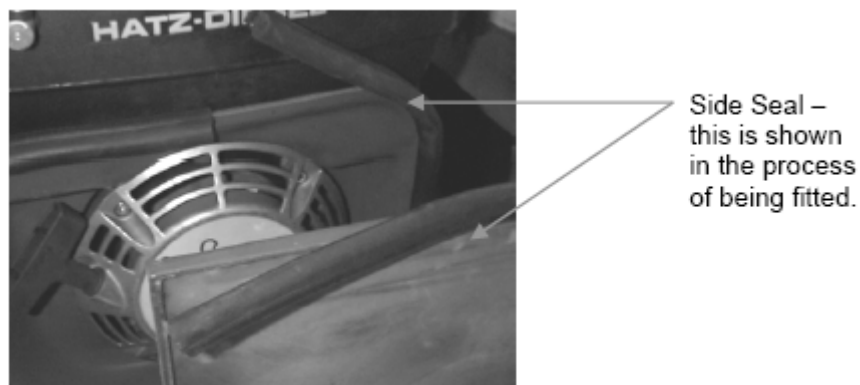


Fig 7 Side seals

Edge protection

38 Louvre cover securing screws may be required to do the following procedure.

39 Edge protection (Fig 8) is fitted to various metal edges to provide anti-chafe protection.

NOTE

The edge protection fitted to the inverter/regulator assembly also provides an airtight seal when the louvre panel is fitted, thus ensuring an adequate airflow for efficient cooling.

40 To remove damaged edge protection, peel away from the edge of the assembly. To replace, position the channel in the seal along the edge of the assembly and press down firmly to fit.

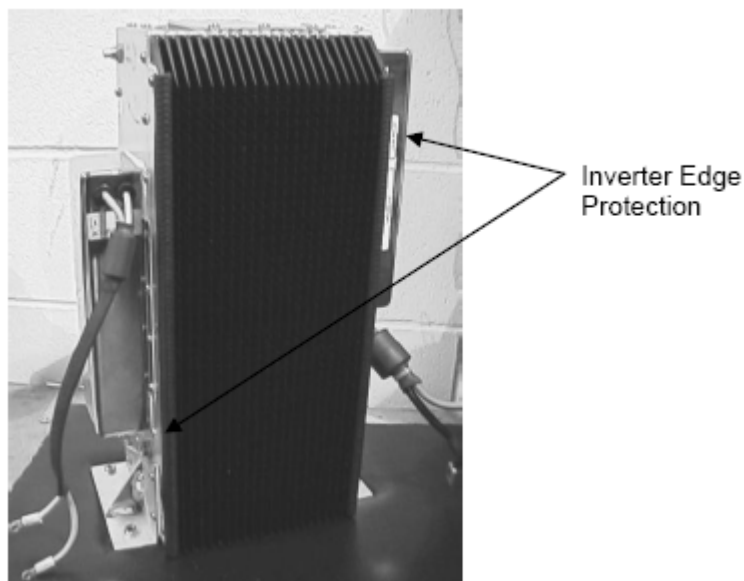


Fig 8 Edge protection

Brass sets, nuts and washers

41 M6 brass sets, brass nuts, brass washers, brass securing screws may be required to do the following procedure.

42 Brass sets, nuts and washers are the terms used to describe the brass components of the LFG earth point (Fig 9). To replace these items, proceed as follows:

42.1 Disconnect the frame bonding lead from the frame earth connection by removing the bolt, nut and washers.

42.2 Remove the wing nut and washers from the main earth point.

42.3 Identify any cables attached to the rear of the earth bolt and mark to ensure correct reconnection.

42.4 Remove the M6 earth bolt, nut and washers.

43 Fitting is the reverse of removal, ensuring the cables previously identified and marked are reconnected.



Fig 9 Earth lead connection point

POWER UNIT

44 The power unit is comprised of the engine, engine mounted accessories and the fuel system. When replacing some of these items it is necessary to apply Loctite 243 (NSN 8030-99-253-6699) to counteract the effect of engine vibration and ensure the long-term security of mounting. Where this application is appropriate, it is detailed within the individual replacement procedure. Loctite 243 should also be applied to the threads of the oil pressure switch if it requires re-securing, as indicated by signs of oil leakage.

Fuel filter

45 To replace the engine fuel tank fuel filter (Fig 10), proceed as follows:

- 45.1 Remove the fuel tank cap and lift up to expose the fuel filter (attached by a cord).
- 45.2 Pull off the fuel filter from the fuel pick-up pipe.
- 45.3 Push a replacement fuel filter fully on to the fuel pipe and re-insert in fuel tank.
- 45.4 Refit and secure fuel tank cap.



Fig 10 Engine fuel tank fuel filter

Air filter

46 To replace the air filter, proceed as follows:

- 46.1 Remove the acoustic cover. The acoustic cover is removed by releasing the two retaining clips that secure it to the LFG.
- 46.2 Locate the air filter cover (Fig 2 (2)) and undo the plastic securing knob.
- 46.3 Remove the air filter cover then undo the air filter retaining nut (Fig 11) and remove the air filter.



Fig 11 Air filter retaining nut

47 Fitting is the reverse of removal. Tighten the air filter retaining nut finger tight only.

Clean/replace engine oil filter strainer

NOTE

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

48 The following repair parts may be required to do the following procedure:

- 48.1 Oil filter strainer O-ring seal.

49 To clean or replace the oil filter strainer (Fig 12), proceed as follows:

- 49.1 Slacken the oil filter strainer socket head securing screw, approximately five turns.
- 49.2 Remove the oil filter strainer by drawing it out of the engine by pulling the securing screw.
- 49.3 If cleaning is required, clean by washing in a suitable cleaning fluid/solvent.
- 49.4 If the oil filter strainer is damaged, fully remove the securing screw and the sprung steel plates.
- 49.5 Fit a new O-ring seal to the replacement oil filter strainer, reassemble the sprung steel plates and fit the securing screw.
- 49.6 Fit the oil filter strainer into its housing and tighten the socket head securing screw.
- 49.7 Replenish oil. Refer to Cat 601.



Fig 12 Oil filter strainer assembly

Oil drain plug, gasket and extension pipe

NOTE

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

50 The following repair parts may be required to do the following procedure:

- 50.1 Oil drain plug.
- 50.2 Gasket.
- 50.3 Extension pipe.

51 To ensure that oil does not contaminate the LFG frame when it is drained, an extension pipe is fitted to the oil drain point (Fig 13 and Fig 14). To replace the oil drain pipe, plug and gasket, proceed as follows:

- 51.1 Remove the drain plug and its sealing washer/gasket.
- 51.2 Remove oil drain extension pipe and sealing washer/gasket from the engine.
- 51.3 Fit a new sealing washer/gasket to the replacement extension pipe and fit to the engine.
- 51.4 Fit a new sealing washer/gasket to the drain plug and fit to the extension pipe. Tighten the plug to 50 Nm (37 lb ft).

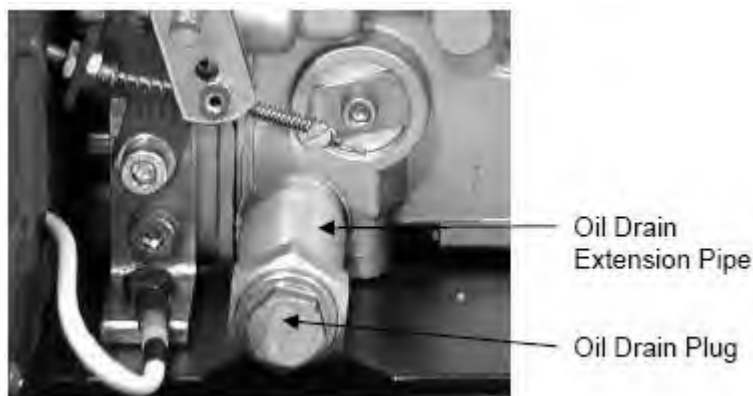


Fig 13 Oil drain extension pipe



Fig 14 Oil drain extension pipe - expanded view

Recoil starter and recoil basket

52 The following repair parts and consumables may be required to do the following procedure:

- 52.1 M6 x 10 mm socket head screws.
- 52.2 M6 x 20 mm socket head screws.
- 52.3 M6 x 25 mm washers.
- 52.4 Loctite 243.

53 This procedure describes how to remove the recoil starter assembly and recoil basket fitted to the engine flywheel. To remove the recoil starter assembly and the recoil basket (if required), proceed as follows:

- 53.1 Gain access by removing acoustic cover. The acoustic cover is removed by releasing the two retaining clips that secure it to the LFG. Once these are released it can be lifted clear.
- 53.2 The pulley assembly is held clear of the frame by four spacers fitted to four M6 x 20 mm socket head securing screws (Fig 15). Unscrew the four pulley assembly socket head securing screws ensuring that they remain in the Frame to help retain the spacers.

53.3 Remove the four M6 x 10 mm socket head screws and associated M6 spring and M6 x 25 mm large washers securing the air intake cowling (Fig 15) then remove the cowling.

53.4 Remove the three socket head screws and spacers securing the recoil basket to the flywheel (Fig 17).

54 Fitting is the reverse of removal. When refitting the securing screws associated with the recoil starter, recoil basket and air intake cowling, apply Loctite 243 to each of the screw threads. The recoil starter securing screws must be tightened to a torque setting of 11.1 Nm (8 lb ft).



Pulley Securing
Screws (two of four
indicated), Spacers
behind (not shown)

Fig 15 Recoil starter pulley



Air Intake Cowling Securing
Screws and Washers (two of
four indicated)

Fig 16 Air intake cowling

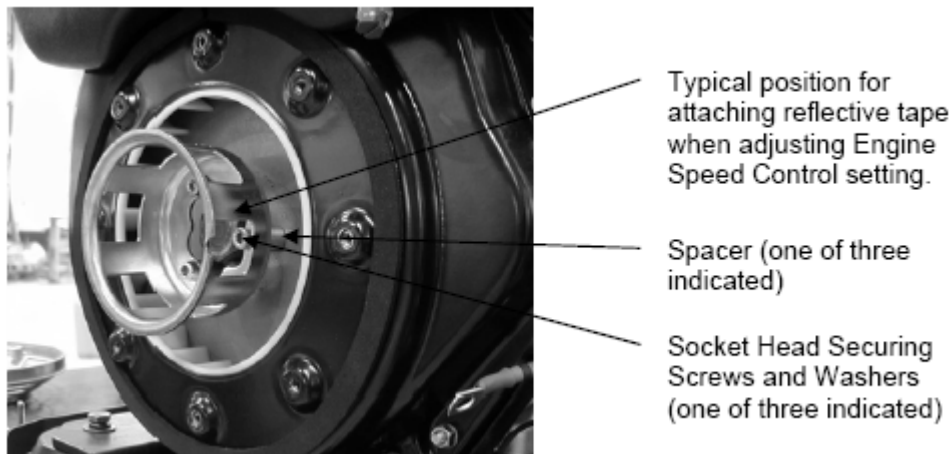


Fig 17 Recoil basket

Fuel system hoses and couplings

55 This procedure describes the removal/replacement of the hoses and couplings associated with the fuel system physically fitted to the LFG; it does not address the Jerrycan hoses.

56 To replace the fuel hoses and couplings, proceed as follows:

56.1 Remove the control box top cover and the acoustic cover for access. The removal procedures for the Control Box Top Cover is detailed in Para 25. The acoustic cover is removed by releasing the two retaining clips that secure it to the LFG. Once these are released it can be lifted clear.

56.2 Quick disconnect hoses; identify, tag and disconnect both hoses from the fuel quick disconnects.

56.3 Quick disconnects; remove the quick disconnects from the control box by undoing the securing nut.

56.4 Fuel return hose; disconnect from the fuel tank and withdraw through the bulkhead grommet.

56.5 Slacken the clips and remove the short length of hose between the fuel inlet quick disconnect and the pulse pump.

56.6 On the fuel feed hose; slacken the clip at the pulse pump end, pull the hose off of the connector at the fuel tank and withdraw through the grommet.

56.7 Fuel tank to engine pipe; pull off of the fuel tank and the injector pump connections.

56.8 Engine return pipe; pull off of the fuel tank connector and off of the one way valve assembly at the fuel injector.

56.9 To remove the injector bypass hose, the fuel injector must first be removed. To gain access to the area of the fuel pump, the air filter must be removed or the system split. The procedure for the removal of the air filter is detailed at Para 46.

Fuel pulse pump

57 To remove the fuel pulse pump, with reference to Fig 18, proceed as follows:

57.1 Slacken the clamps securing the fuel in and fuel out pipes then remove the pipes from the pulse pump.

57.2 Undo the top left and bottom right bolts which secure the pulse pump to the bulkhead.

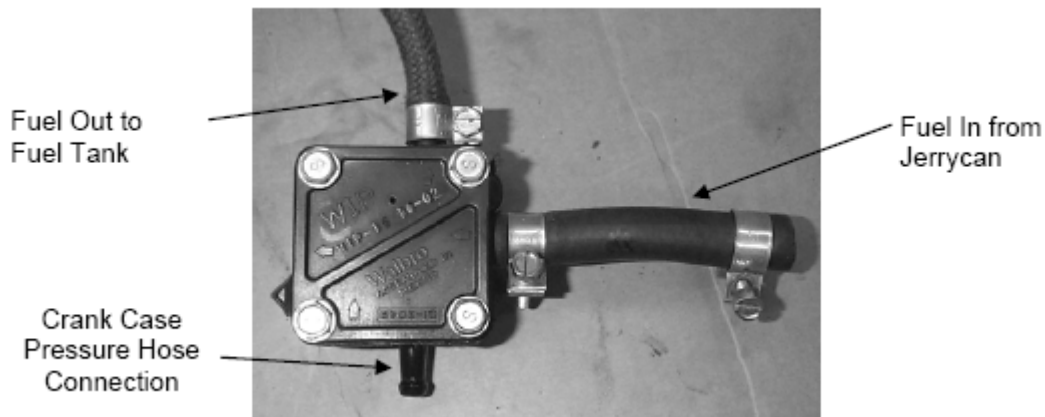


Fig 18 Fuel pulse pump

57.3 Holding the crank case pressure hose connection and pulse pump, lift them clear of the bulkhead.

58 Fitting is the reverse of removal, ensuring that the crank case pressure hose is securely fitted over the crank case pressure outlet pipe.

Engine speed control lever cable

59 The following repair parts and consumables may be required to do the following procedure:

59.1 Split pin stainless 5/64 x 1/2.

59.2 Loctite 243.

59.3 Cable inner and/or outer sheath.

60 This procedure describes the operations required to replace both the inner (wire) and outer (sheath) engine speed control cables.

61 To gain access to the engine speed control cable connections, the control box louvre cover and acoustic cover must be removed. The procedure to remove the control box louvre cover is detailed in Para 23. The acoustic cover is removed by releasing the two retaining clips that secure it to the LFG. Once these are released it can be lifted clear.

62 To replace the engine speed control inner wire cable, proceed as follows:

62.1 Remove the eight screws securing the engine speed control panel to the DC control panel.

62.2 Remove the two screws securing the engine speed control lever assembly to the engine speed control panel.

62.3 With reference to Fig 19, release the clamping screw (1) securing the inner cable at the engine end of engine speed control cable. Remove the clamp body (2) and spring (3).

62.4 Withdraw the inner cable from the ferrule (4) fitted in the engine speed control bracket then remove the ferrule and spring (5). Ensure that the spring (5) is retained separately from the spring (3) as they are not interchangeable.

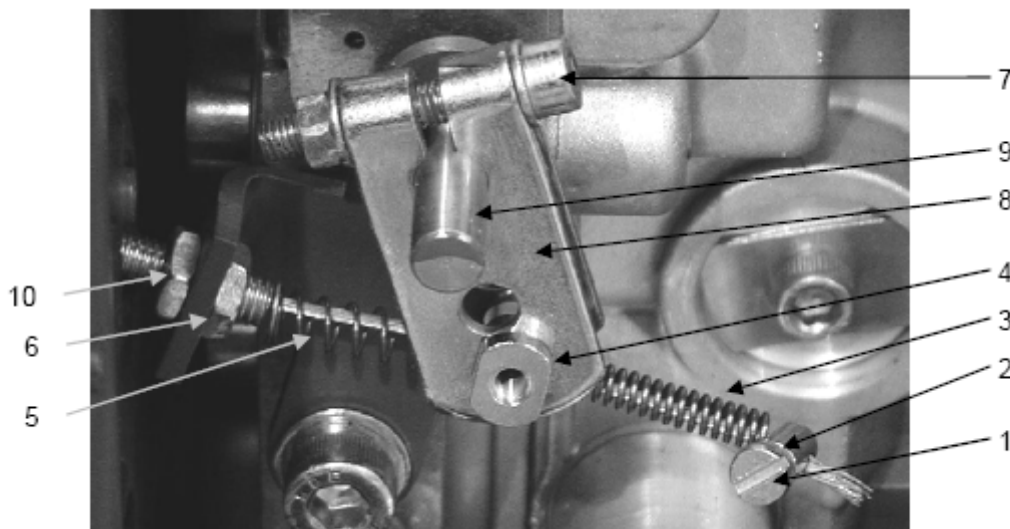


Fig 19 Engine speed control cable - engine end

62.5 Release the locknut (6) and loosen the engine speed control retaining screw (7). The engine speed control bracket (8) can then be pulled off the mounting shaft (9).

62.6 Withdraw the inner cable through to the DC control panel end.

62.7 With reference to Fig 20, unscrew the cable from the brass pivot and completely remove the inner cable.

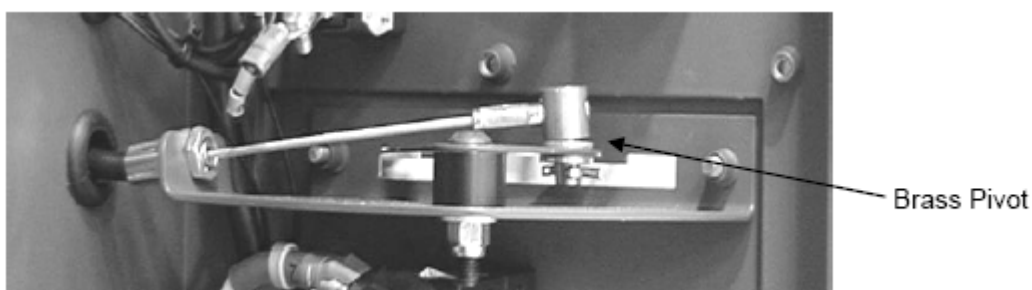


Fig 20 Engine speed control cable - DC panel end - internal view

-
- 62.8 To fit the replacement inner cable, set the engine speed control lever to the Off position.
- 62.9 Apply Loctite 243 to the threaded portion of the replacement inner cable end. Screw the new inner cable threaded portion into the brass pivot.
- 62.10 Feed the free end of the replacement inner cable through the outer sheath until it is exposed at the engine end.
- 62.11 With reference to Fig 19, secure the locknut (6).
- 62.12 Fit the spring (5) over the exposed portion of the inner cable then fit the ferrule (4) into the lower hole within the engine speed control bracket (8), this ferrule is left loose within this engine speed control bracket i.e. it is not secured into the inner of the two holes in the bracket.
- 62.13 Feed the inner cable through the ferrule (4), fit the spring (3) then the clamp (2) leaving approximately 10 mm of cable exposed to the right of the clamp. Secure the clamp using the securing screw (1).
- 62.14 Slide the engine speed control bracket (8) onto the mounting shaft (9) and secure with the retaining screw (7). The bracket should be secured at an angle of approximately 170° when viewed from the front as shown in Fig 19. Final adjustment is made during the setting-up procedure detailed in Para 71 and 72.
- 62.15 Refit the two screws removed at Step 62.2 to attach the engine speed control lever assembly to the engine speed control panel.
- 62.16 Refit the eight screws removed at Step 62.1 to attach the engine speed control panel to the DC control panel.
- 63 To replace the engine speed control cable outer sheath, (assuming the inner wire has already been removed as detailed above) proceed as follows:
- 63.1 With reference to Fig 19, remove the locknut (6) and adjustment nut (10) from the securing/adjusting assembly.
- 63.2 Attach a suitable guide wire or cord to the end of the outer cable and gently pull it through to the DC control panel end pulling the guide wire with it.
- 63.3 To refit, attach the new outer cable securely to the guide wire and carefully draw through to the engine.
- 63.4 Refit the locknut (6) and adjustment nut (10) removed in Para 63.1.
- 63.5 Refit the inner wire as detailed in Para 62.
- 64 Set up the engine speed control, following repair or replacement, in accordance with the procedure detailed in Paras 71 to 73.

Crank case pressure hose

65 The Crank Case Pressure Hose (CCPH) (Fig 21) supplies the operating air pressure for the fuel pulse pump. It is a low pressure hose and, as such, does not require a lower securing clamp.

66 To remove the CCPH, dismount the pulse pump. Undo the securing clip at the pulse pump and then pull the hose off of the crank case and pulse pump connection points. Replacement is the reverse of removal.

NOTE

There is sufficient room in the bulkhead cut out to allow for the hose to be removed/fitted to the crank case.



Fig 21 Crank case pressure hose (control box removed)

Engine speed control lever and housing

67 The following repair parts may be required to do the following procedure:

- 67.1 M4 x 10 mm Pozi Pan screws.
- 67.2 M4 x 16 mm Pozi Pan screws.

68 The engine speed control lever and housing assembly is mounted on the dc control panel assembly. to replace the engine speed control lever and housing assembly, proceed as follows:

- 68.1 Remove the eight M4 x 10 Pozi Pan screws securing the engine speed control panel to the DC control panel.
- 68.2 Remove the two M4 x 10 Pozi Pan screws securing the engine speed control lever assembly to the engine speed control panel.
- 68.3 Refer to Fig 20, release the inner engine speed control cable locknut and remove the cable from the brass pivot.
- 68.4 Remove the nut and washer securing the lever to the frame and remove the engine control lever from the frame.

-
- 69 To remove the engine speed control lever mounting bracket assembly, proceed as follows:
- 69.1 Disconnect the inner engine speed control lever cable from the engine and pull through the outer cable housing, refer to Para 62 for disconnection and removal procedure.
 - 69.2 Disconnect inner cable from the brass pivot.
 - 69.3 Release the locknut securing the outer cable sheath to the mounting bracket assembly and remove the sheath.
 - 69.4 Remove the split pin securing the brass pivot and remove the brass pivot and associated washers.
- 70 For both tasks, fitting is the reverse of removal. Reference should be made to Paras 61 and 62 for guidance on refitting the inner and outer cables.
- 71 On replacement of the engine speed control lever assembly and/or having replaced the engine speed control cable (inner or outer), the associated engine speed must be set-up in relation to the lever position. This procedure assumes that the LFG is fully assembled with the exception of the acoustic cover which must be removed to enable viewing of the engine rotation. This procedure also assumes that fuel is available and that the LFG is capable of being run.
- 72 This procedure should be completed with the engine cold, i.e. at the ambient temperature of the surroundings.
- 73 To set the engine speed control lever assembly and associated engine speed control cable proceed as follows (Steps 71.1 and 71.2 are unnecessary if reflective tape is already in place):
- 73.1 Remove the recoil starter assembly to gain access to the recoil basket, refer to Para 52. Attach a small strip (approximately 2 cm x 1 cm) of reflective tape to one of the horizontal sections of the recoil basket; refer to Fig 17 for position. The reflective tape is supplied with the tachometer, optical hand held kit, see paragraph 73.5. This tape provides a point of reference when viewing the engine speed of rotation and it can be left in place post completion of set-up.
 - 73.2 Refit the recoil starter.
 - 73.3 Disconnect any loads then start the engine.
 - 73.4 Once the engine is started, set the engine speed control lever assembly on the DC control panel to the "Normal" position.
 - 73.5 Using a tachometer, optical hand held, (NSN 6680-99-806-2943), suitably positioned adjacent to the recoil starter assembly vent holes, view the engine rotation in relation to the tachometer via the recoil basket, check the engine speed of rotation.
 - 73.6 If the engine speed control lever assembly and associated engine speed control cable are correctly set then the engine speed should be 2,800 rpm +/- 50 rpm.
 - 73.7 If the engine speed requires adjustment, then the engine speed control cable tension is adjusted at the engine end.
 - 73.8 To adjust the engine speed control cable, release the locknut Fig 19 (6)) and adjustment nut (10) on the engine speed control cable at the engine end. This will enable rotation and adjustment of the tension of the inner cable with a resultant change in engine speed control position and engine speed.
-



73.9 Make the necessary adjustment and re-check the speed of rotation using the optical tachometer.

73.10 Fine adjustments should be completed until both the required rotation speed of 2,800 rpm +/- 50 rpm has been achieved with the engine speed control lever set in the "Normal" position and the engine automatically shuts down once the lever is set in the Off position.

73.11 Once the speed has been set correctly then the engine speed control cable adjuster locknut (6) and adjustment nut (10) is to be re-secured, the engine can be shut-down and the acoustic cover re-fitted.

ELECTRICAL SYSTEM

74 Removal/replacement of the majority of the electrical system components requires that the louvre cover and the control box top cover are removed for access. Removal procedures are detailed within Paras 22 and 25 respectively. The following procedures assume that both covers have already been removed.

Meters/indicators

75 Meter/indicator O-ring seals may be required to do the following procedure.

76 This task refers to the percentage (%) load, AC voltage, DC voltage meters and hours run indicator. To replace the meters/indicator, proceed as follows:

76.1 Identify, tag and disconnect the cables attached to the meter/indicator.

NOTE

The earth leads are soldered to the meter and connected to common earth points on the frame. The earth lead remains part of the indicator, therefore disconnect from the common earth point when replacing a meter/indicator.

76.2 Unscrew the meter locking ring from the rear of the meter/indicator and withdraw through the front of the panel.

76.3 Remove the O-ring seal.

77 Fitting is the reverse of removal, plus the following tasks:

77.1 Connect the earth lead to the common earth point.

77.2 Replace the O-ring seal.

77.3 Ensure the meter face is vertical before fully tightening the locking ring.

External AC connectors

78 To remove an AC connector (Fig 22), proceed as follows:

78.1 Remove the four screws securing the AC connector to the front panel and draw the connector out of the panel.

78.2 Identify, tag and disconnect the cables to the connector and remove the connector.

NOTE

The lower two screws of the upper 110V ac connector and the upper two on the lower 110V ac connector screw into locknuts not captive nuts. These locknuts secure the AC varistor mounting bracket.

79 Fitting of an AC connector is the reverse of removal.

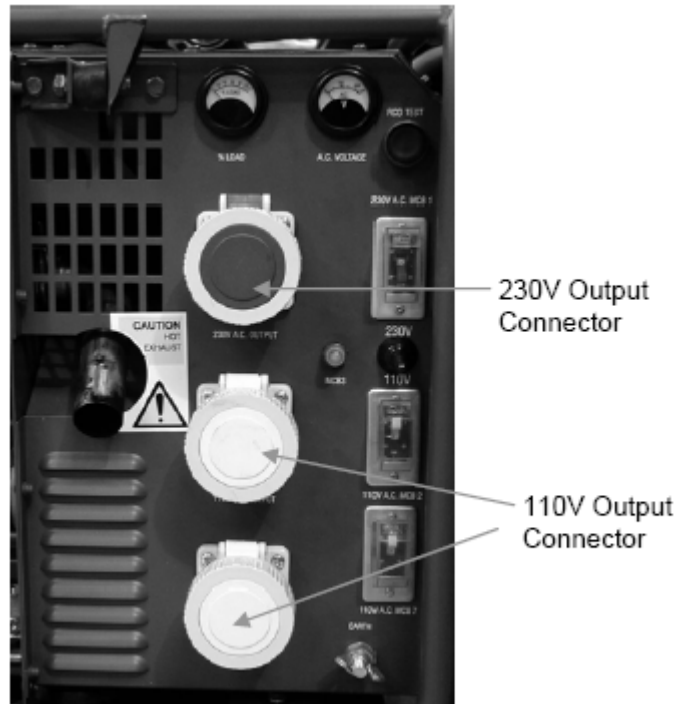


Fig 22 External AC connector

28V DC terminals

80 Locking nuts, washers and insulating rings may be required to do the following procedure.

81 Removal of a DC terminal is the same whether it is the positive or negative terminal. To replace a terminal, proceed as follows:

81.1 Remove the nut securing the lead from the rear of the terminal.

81.2 Remove the locking nut, washer and insulating ring securing the terminal assembly and remove the terminal assembly.

82 Fitting is the reverse of removal. When fitting, ensure that the locator lug, on the terminal post, is located in its locator hole.

Circuit Breakers (CBs)

83 To replace the main AC and DC output circuit breakers (MCBs 1, 2, 6 & 7), proceed as follows:

83.1 Identify, tag and disconnect the cables to the CB.

83.2 Remove the two screws securing the rubber boot cover and remove the cover.

83.3 Withdraw the CB from the rear of the panel.

84 To replace MCBs 3, 4 & 5, proceed as follows:

84.1 Identify, tag and disconnect the cables to the CB.

84.2 Unscrew rubber boot cover securing nut and remove cover.

84.3 Withdraw CB through the rear of the panel.

85 For both types of CB, fitting is the reverse of removal.

Circuit breaker protective boots/covers

86 The removal of circuit breaker protective boots/covers is described in Para 84 above. Fitting a boot/cover is the reverse of removal.

230/110 Voltage selector switch

87 The 230/110 Voltage selector switch (Fig 23) is mounted on the AC control panel. To replace the switch, proceed as follows:

87.1 Identify, tag and disconnect the cables to the selector switch.

87.2 Remove the rubber boot from over the switch toggle and unscrew the cover securing ring.

87.3 Undo the securing nut and withdraw the selector switch from the rear of the panel.

88 Fitting is the reverse of removal.

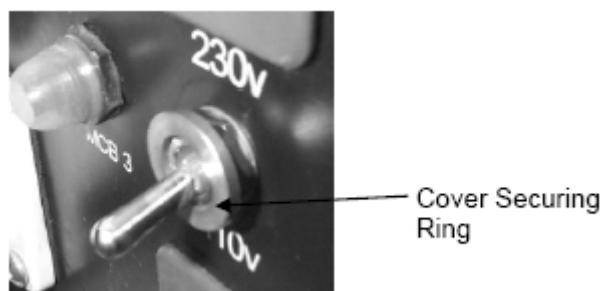


Fig 23 240/110 Voltage selector switch (cover removed)

Instrument illumination on/off switch

89 The procedure for the replacement of the instrument illumination On/Off switch is the same as that for the 230/110 V selector switch detailed in Para 87.

Push buttons

90 To replace the Residual Current Device (RCD) push button, proceed as follows:

90.1 Release the terminal carrier from the rear of the switch (Fig 24) and identify, tag and disconnect the cables.

90.2 Release the intermediate terminal assembly using a small electrician's screwdriver to release the clips, undo the switch locking ring and remove the switch from the front of the panel.

91 To replace the start push button, proceed as follows:

91.1 Identify, tag and disconnect the cables to the button.

91.2 Unscrew the weather cover and remove the switch through the rear of the panel.

92 Fitting of both switch types is the reverse of removal.

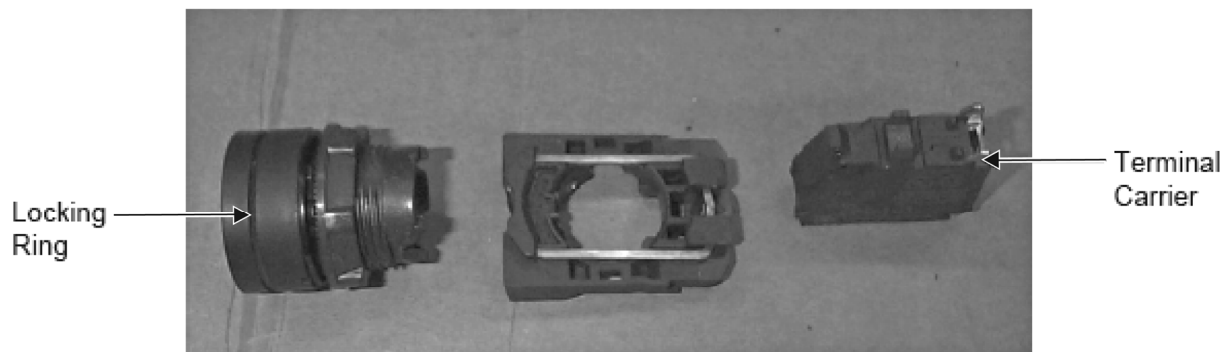


Fig 24 RCD push button connector (exploded view)

Low oil pressure warning LED and seal

93 For access to the LED, remove MCB 4 from the DC control panel but DO NOT electrically disconnect it. To replace the LED, proceed as follows:

93.1 Identify, tag and disconnect the cables to the LED.

93.2 Undo the locking ring and remove the LED and its seal from the panel.

94 Fitting is the reverse of removal, ensuring MCB 4 is re-fitted to the DC control panel.

Switch biased, 10 A momentary (pre-heat switch)

95 This is the pre-heat switch. The procedure for the replacement of the pre-heat switch is the same as that for the 230/110V selector switch detailed in Para 87.

Switch weather covers

96 The removal/replacement of switch protective boots/covers is described in Para 87.

Switch body/collar

97 The removal/replacement of switch bodies and collars is described in Para 87.

Electrical tests

RCD tests

NOTES

(1) The Residual Current Device (RCD) tester depicted in this procedure is a typical RCD tester and may not be the tester detailed in Table 1. However, the functionality is the same.

(2) The RCD tester (Fig 25) has two rotary switches; the RCD RATING (mA) switch (1) and the RCD TEST switch (2).

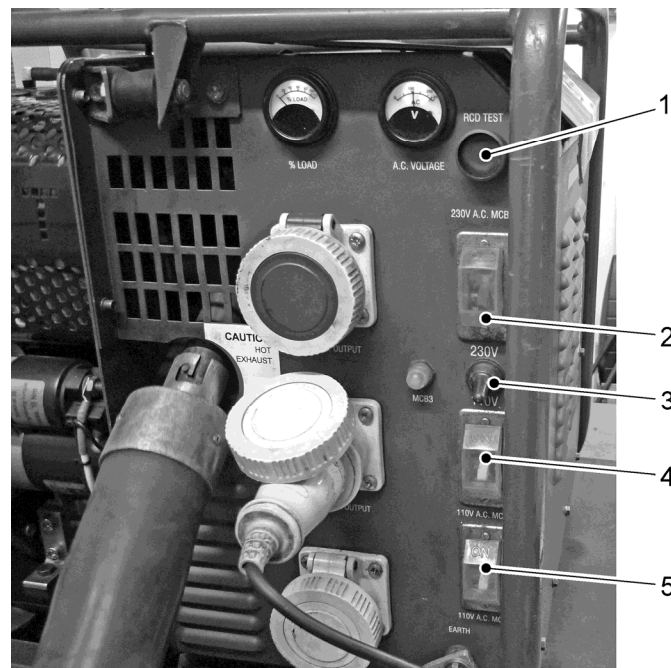


- 1 RCD RATING (mA) switch
- 2 RCD TEST switch dial
- 3 TEST button

Fig 25 RCD tester

98 To carry out a test of the RCDs:

- 98.1 Ensure the RCD test switch is set to the OFF position.
- 98.2 Set the RCD Rating (mA) switch to the 30 mA position.
- 98.3 Connect the RCD tester to the top 110 V AC output of the LFG (Fig 26).
- 98.4 Ensure the 230V/110V selection switch (3) is set to the 110V position.



- | | | | |
|---|------------------------------|---|-----------------|
| 1 | RCD TEST pushbutton | 4 | 110V A.C. MCB 2 |
| 2 | 230V A.C. MCB 1 | 5 | 110V A.C. MCB 7 |
| 3 | 230V / 110V Selection switch | | |

Fig 26 LFG connection and switches

NOTE

Do not switch between 110V and 230V when the LFG is running.

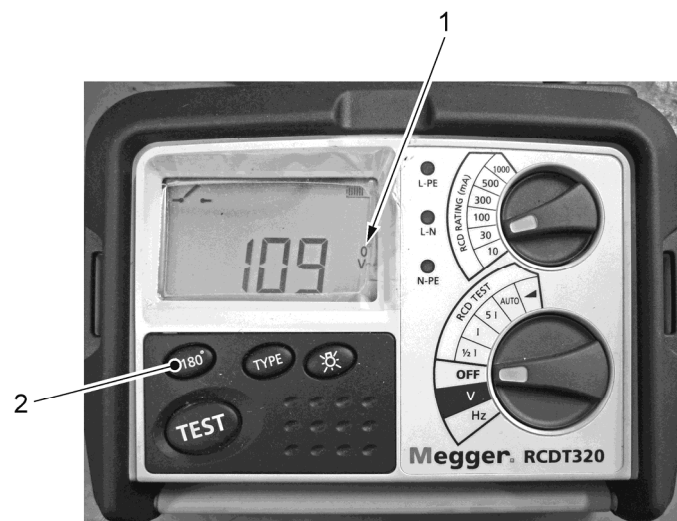
- 98.5 Start the LFG. Refer to Cat 201.
- 98.6 Set the RCD TEST switch dial (Fig 25 (2)) to the 1/2 I position.
- 98.7 Set the CB to be tested to the ON (upright position).
- 98.8 Press the RCD TEST pushbutton (Fig 26 (1)).
- 98.9 Ensure the 110V A.C. MCB 2 (4) trips.
- 98.10 Reset the 110V A.C. MCB 2.
- 98.11 Press the TEST button (Fig 25 (3)).
- 98.12 Ensure the RCD tester indicates >1999 ms (timed out) (Fig 27) and the 110V A.C. MCB 2 (4) does not trip.



Fig 27 RCD tester - timed out

98.13 Set the RCD TEST switch dial (Fig 25 (2)) to the I position.

98.14 Ensure the phase indication (Fig 28 (1)) reads 0°. Press the 0°/180° button (2) if required.



- 1 Phase indication
- 2 0°/180° button

Fig 28 RCD tester

98.15 Press the TEST button (Fig 25 (3)).

98.16 Ensure the 110V A.C. MCB 2 (Fig 26 (4)) trips and the reading on the RCD tester indicates < 200 ms.

98.17 Reset the 110V A.C. MCB 2.

98.18 Press the 0°/180° button (Fig 28 (2)) to select to 180°.

98.19 Ensure the phase indication (1) reads 180°.

98.20 Carry out sub-Paras 98.15 and 98.16 again.

98.21 Set the RCD TEST switch dial (Fig 25 (2)) to the 5 I position.

-
- 98.22 Reset the 110V A.C. MCB 2.
 - 98.23 Ensure the phase indication (Fig 28 (1)) reads 0°. Press the 0°/180° button (2) if required.
 - 98.24 Press the TEST button (Fig 25 (3)).
 - 98.25 Ensure the 110V A.C. MCB 2 (Fig 26 (4)) trips and the reading on the RCD tester indicates < 40 ms.
 - 98.26 Reset the 110V A.C. MCB 2.
 - 98.27 Press the 0°/180° button (Fig 28 (2)) to select to 180°.
 - 98.28 Ensure the phase indication (1) reads 180°.
 - 98.29 Carry out sub-Paras 98.24 and 98.25 again.
 - 98.30 Carry out sub-Paras 98.6 to 98.29 again for 110V A.C. MCB 7 (Fig 26 (5)) and the 230V A.C. MCB (1).

NOTE

Ensure the 230V / 110V Selection switch is set to 230V when testing the 230V A.C. MCB.

Earth bonding resistance tests

- 99 Earth bonding resistance tests are to be carried out between earth and the individual sub-assemblies of the generator set.
- 100 Use the earth bonding tester (Table 1) to measure the resistance:
 - 100.1 Between all the LFG earth bonding leads connected between the LFG frame, covers, engine and LRUs required to be earthed and the protective earth terminal, or earth contact.
 - 100.2 Ensure the resistance is 0.05 Ohm or less.

SCHEDULED MAINTENANCE TASKS

FIRST 25 OPERATING HOUR TASKS

Clean/replace oil filter strainer

NOTES

- (1) This task is to be carried out concurrently with the oil change task.
 - (2) The engine oil must be drained before commencement of this task.
- 101 To clean or replace the oil filter strainer (Fig 12), proceed as follows:
 - 101.1 Slacken the oil filter strainer socket head securing screw, approximately five turns.
 - 101.2 Remove the oil filter strainer by drawing it out of the engine by pulling the securing screw.

- 101.3 If cleaning is required, clean by washing in a suitable cleaning fluid/solvent.
- 101.4 If the oil filter strainer is damaged, fully remove the securing screw and the sprung steel plates.
- 101.5 Fit a new O-ring seal to the replacement oil filter strainer, reassemble the sprung steel plates and fit the socket head securing screw.
- 101.6 Fit the oil filter strainer into its housing and tighten the socket head securing screw.
- 101.7 Replenish oil. Refer to Cat 601.

Change engine oil

102 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:

- 102.1 Remove the oil filler cap (Fig 29) and oil drain plug (Fig 30) and allow the oil to drain into a suitable container. Dispose of the waste oil in accordance with local regulations.
- 102.2 Clean the oil drain plug, fit a new washer and refit to the engine housing.
- 102.3 Tighten the oil drain plug to a torque of 50 Nm (37 lb ft).
- 102.4 With the oil filler cap removed, fill with 0.9 litres of oil.
- 102.5 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".
- 102.6 Finally, replace the filler cap and oil dipstick and wipe off any spilt oil.



Fig 29 Oil filler cap

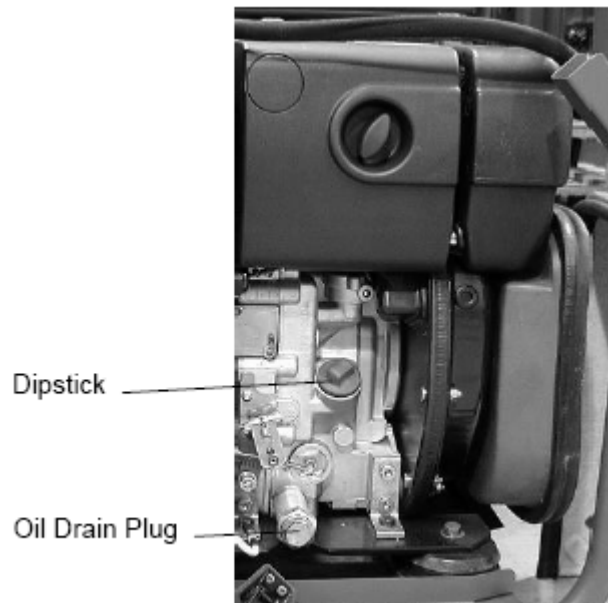


Fig 30 Oil dipstick and drain plug

Check/adjust valve clearances

103 Only carry out adjustments when the engine is cold (10 °C - 30 °C). To check the valve clearances, proceed as follows:

- 103.1 Remove the acoustic cover and gain access to the cylinder head cover. The acoustic cover is removed by releasing the two retaining clips that secure it to the LFG. Once these are released it can be lifted clear
- 103.2 Remove any contamination adhering to the rocker cover.
- 103.3 Remove the two securing screws and remove the cylinder head cover.
- 103.4 Remove the rubber cap from the flywheel cover inspection hole (Fig 31).



Fig 31 Flywheel cover inspection hole

103.5 Turn the engine over in the normal direction of rotation until the valves are in the overlap position (exhaust valve not yet closed, inlet valve starts to open).

103.6 Turn the crankshaft through 360° in the normal direction of rotation and align exactly to the OT marking (Fig 31).

103.7 Check the valve clearances using small feeler gauge (Item 1, Fig 32). The clearance should be 0.10 mm.

NOTE

A small feeler gauge, NSN 5210-99-796-7540, is supplied with each LFG. It is located within the inside of the air filter cover where it is held in place by a magnetic strip attached to the bottom of the cover. It is to be replaced in this position after use.

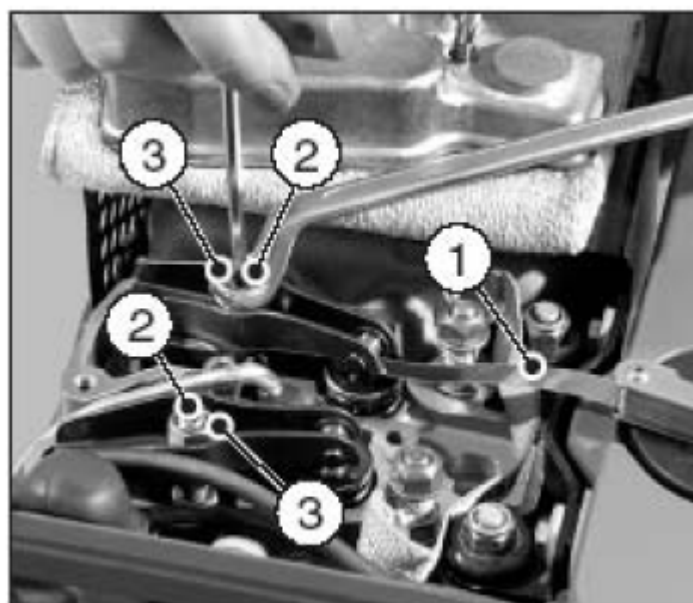


Fig 32 Valve clearance - check and adjustment

104 To adjust the valve clearances refer to Fig 32 and proceed as follows:

104.1 If the valve clearances need adjusting, slacken screw (2) and turn hex nut (3) until feeler gauge can be pulled through with just slight resistance when screw (2) is retightened.

104.2 With the screw tight, check the valve clearance again and ensure it is 0.10 mm.

105 On completion of checks/adjustment:

105.1 Using a new gasket, refit the cylinder head cover and tighten all screws evenly.

105.2 Refit the rubber cap to the flywheel inspection hole.

105.3 Replace the small feeler gauge in its storage position.

105.4 Refit the acoustic cover.

Check screw connections

106 With the exception of the cylinder head bolts, engine governor and injection system adjusting screws, check the tightness of all threaded connections that can be reached during this scheduled maintenance. Tighten as necessary in accordance with torque settings as detailed within Cat 601, Table 3. Take particular care not to over-tighten the attaching parts associated with the fuel tank.

107 Check the tightness of all anti vibration mount fittings, removing the louvre cover to gain access to the control box AVMs.

Check starter motor operation

108 Check the operation of the starter motor by connecting a 24 V dc supply to the inter-vehicle connector, setting the engine speed control lever to the 'Max' position and pushing the Start button (hold the Start button until the engine fires).

109 In cold weather conditions, it may be necessary to operate the pre-heat switch for a short time before attempting to start the LFG.

110 If the starter motor does not turn or the engine does not fire, carry out fault diagnosis in accordance with Chapter 1 of this Category.

250 OPERATING HOUR TASKS

111 The 250 operating hour tasks include (with the exception of the clean engine oil filter strainer task) all of the first 25 operating hour tasks plus the following:

Clean cooling area

112 If the cooling fins on the engine cylinder and the flywheel fan blades are severely contaminated they will not cool the engine as efficiently as they are required.

113 Examine the engine cylinder cooling fins for contamination. Clean as necessary.

114 If accessible, examine the flywheel fan blades for contamination. Clean as necessary.

115 Examine all inlet and outlet vents for signs of blockage or contamination and clean as necessary.

Inspect labels and warning notices

116 Ensure all labels and warning notices are clean, legible and securely attached to the LFG.

500 OPERATING HOUR TASKS

117 The 500 operating hour tasks include all of the 250 operating hour tasks plus the following:

Change air filter

118 Remove the air filter as follows:

118.1 Remove the acoustic cover. The acoustic cover is removed by releasing the two retaining clips that secure it to the LFG.

118.2 Locate the air filter cover and undo the plastic securing knob.

118.3 Remove the air filter cover.

118.4 Undo the air filter retaining nut (Fig 11) and remove the air filter.

119 Fitting is the reverse of removal. Tighten the air filter retaining nut finger tight only.

Change engine fuel filter

120 To replace the engine fuel tank fuel filter (Fig 10), proceed as follows:

120.1 Remove the fuel tank cap and lift up to expose the fuel filter (attached to the cap by a cord).

120.2 Pull off the fuel filter from the fuel pick-up pipe.

120.3 Push a replacement fuel filter fully on to the fuel pipe and re-insert in fuel tank.

121 Refit and secure fuel tank cap.

RCD tests

122 Carry out RCD tests as detailed in Para 98.

1000 OPERATING HOUR TASKS

123 The 1000 operating hour tasks include all of the 250 and 500 operating hour tasks plus the following:

Clean/replace oil filter strainer**NOTES**

(1) This task is to be carried out concurrently with the oil change task.

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

124 To clean or replace the oil filter strainer (Fig 12), proceed as follows:

124.1 Slacken the oil filter strainer socket head securing screw, approximately five turns.

- 124.2 Remove the oil filter strainer by drawing it out of the engine by pulling the securing screw.
- 124.3 If cleaning is required, clean by washing in a suitable cleaning fluid/solvent.
- 124.4 If the oil filter strainer is damaged, fully remove the securing screw and the sprung steel plates.
- 124.5 Fit a new O-ring seal to the replacement oil filter strainer, reassemble the sprung steel plates and fit the socket head securing screw.
- 124.6 Fit the oil filter strainer into its housing and tighten the socket head securing screw.
- 124.7 Replenish oil. Refer to Cat 601.

LONG TERM STORAGE

PREPARATION FOR LONG-TERM STORAGE - ENGINE

125 The following procedures relate to preparing the engine only for long-term storage. Refer to Para 131 for details of preparing the control box assembly and 133 for the LFG complete. If the procedures detailed in the following paragraphs are carried out correctly, it is possible to store the engine outside but under cover for a maximum of one year. However, after this time, to ensure continued protection, the procedure should be repeated.

126 Storing the engine in a constant temperature, low humidity environment should ensure that it remains in perfect condition for up to four years. However, it should be noted that rubber seals used within the engine may deteriorate over time.

Internal surface conservation procedure

127 To conserve the internal surfaces, proceed as follows:

- 127.1 Test run the engine to confirm serviceability and allow to cool down.

WARNING

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.

- 127.2 When the engine has cooled down sufficiently to not present a burn hazard, drain the engine oil.
- 127.3 Fill the engine to maximum dipstick level with corrosion protection oil PX-4.
- 127.4 To prevent water contamination of the fuel system, replace the fuel filter.
- 127.5 Fill the fuel system with a mixture of PX-4 and Kerosene F-58 in the ratio 1 part PX-4 to 9 parts F-58.
- 127.6 Start and run the engine at approximately 75% of rated speed to reach an oil temperature of 70 °C - 80 °C.
- 127.7 When the required oil temperature has been reached, stop the engine and allow the oil to cool to 30 °C - 50 °C.
- 127.8 Drain the PX-4 oil from the engine. Retain this oil for use on additional engines if required.



127.9 When the engine has cooled, remove the exhaust silencer and air filter and retain with the engine.

127.10 Spray into the inlet and exhaust ports approximately 2 cm² of PX-4 and turn the engine 5 revolutions to disperse the oil. Do not restart the engine once this procedure has been carried out.

127.11 The PX-4/F-58 mixture should remain in the entire fuel system.

External surface conservation procedure

128 To conserve the exterior of the engine, proceed as follows:

WARNING

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.

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.

128.1 Treat all parts susceptible to corrosion with PX-4 either by painting or spraying on. If the engine is not part of a complete LFG, pay particular attention to the crankshaft stub shaft.

128.2 Close all engine ports and openings with suitable bungs or cover to prevent the ingress of moisture. Sealing should include the air filter intake, exhaust discharge, fuel system and engine breather system.

128.3 Seal the engine in a plastic enclosure, or other non-permeable enclosure, then place in a crate to protect the enclosure and allow for ease of transport.

RECOVERY FROM LONG-TERM STORAGE - ENGINE

129 To recover the engine from long-term storage, proceed as follows:

129.1 Remove external sealing/wrapping.

129.2 Remove all bungs and covers sealing engine ports and openings.

129.3 Fill the engine with oil. Refer to Cat 601.

129.4 Refit exhaust and air filter assemblies.

130 It is not necessary to remove external conservation providing it does not interfere with external fittings, i.e. attachments to the crank shaft stub shaft. Furthermore, the fuel system can be operated with the inhibiting mixture in situ alongside the normal fuel.

PREPARATION FOR LONG-TERM STORAGE - CONTROL BOX ASSEMBLY

131 If the control box assembly, separated from the LFG, is to be stored for any length of time, protect it as follows:

- 131.1 Ensure any removed covers, panels and their attaching parts are suitably bagged and attached to the control box assembly.
- 131.2 Ensure any loose/open electrical connections are sealed against the ingress of moisture.
- 131.3 Protect instrument glass with suitable padding material.
- 131.4 Wrap and seal control box assembly in protective plastic sheeting.

RECOVERY FROM LONG-TERM STORAGE - CONTROL BOX ASSEMBLY

132 To recover the control box assembly from long-term storage. Remove all protective wrapping/padding from the control box assembly, instrument glass and electrical connectors.

PREPARATION FOR LONG-TERM STORAGE - LFG COMPLETE

133 To prepare the LFG complete for long-term storage, proceed as follows:

- 133.1 Remove the acoustic cover and carry out the engine procedures detailed in Paras 127 and 128. Ensure there is sufficient room left after wrapping the engine in protective sheeting to refit the acoustic cover. Do not attempt to crate the engine.
- 133.2 Carry out, as required, the control box assembly procedures detailed in Para 131.
- 133.3 Connect the fuel adaptor male and female quick release couplings together to prevent dirt ingress and place the fuel adaptor, earth spike and lead within the accessories bag. Attach the accessories bag to the LFG frame and secure.
- 133.4 Coil-up the exhaust extension, place it on top of the LFG and secure it to the frame.
- 133.5 Wrap the entire LFG in plastic sheet and crate for storage and ease of transport.

RECOVERY FROM LONG-TERM STORAGE - LFG COMPLETE

134 To recover the LFG complete from long-term storage, proceed as follows:

- 134.1 Remove all external wrapping.
- 134.2 Detach remove and retain the exhaust extension and accessories bag.
- 134.3 Remove protective wrapping/padding from the control box assembly.
- 134.4 Carry out the engine procedures as detailed in Paras 129 and 130.

PROCEDURE CHECKLIST

135 A checklist showing that the engine procedures have been completed should accompany the engine. An example check list is shown below.

136 The list of engine port sealing bungs is not exhaustive and the person carrying out the conservation procedure should list any additional ports sealed in the vacant rows provided.



ENGINE CONSERVATION PROCEDURE CHECKLIST

Engine Type and Serial Number	
NATO Stock Number	
Order Number (if applicable)	
Conservation Date	
Packaging Date	
Quality/Type of Packaging	

Item	Procedure	Completed (Initials)
	Conservation Process	
1	Internal surfaces, cylinder head and valves treated. Oil drained	
2	Fuel system filled with inhibiting mixture	
3	External Conservation complete	
4	Air Filter Intake sealed	
5	Exhaust sealed	
6	Fuel System sealed	
7	Breather System sealed	
8	Additional Ports sealed (list):	
	Return to Service	
1	Engine filled with oil. Refer to Cat 601	
2	Air Filter Intake sealing removed	
3	Exhaust sealing removed	
4	Fuel system sealing removed	
5	Breather System sealing removed	
6	Additional sealing listed in (8) above removed	
7	Exhaust assembly refitted	
8	Air Filter assembly refitted	

Engine Storage Procedure Complete	
Signature:	
Date:	

Engine Prepared for Use	
Signature:	
Date:	

Fig 33 Engine conservation procedure checklist

CHAPTER 3

INSPECTION STANDARDS

CONTENTS

Para

- 1 Introduction
- 2 Inspection plan
- 5 Inspection/test schedule compliance
- 6 Tools and test equipment
- Inspection schedules
- 7 Static inspection schedules
- 10 Physical inspection schedule
- 11 Functional test schedule

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3	Functional test schedule	5

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2	Component location - AC control panel	10

INTRODUCTION

1 The purpose of these inspection standards is to define those examinations, inspections and tests that need to be carried out to ensure that the complete generator set meets Acceptable Quality Levels (AQL) as defined in EMER T & M A 028, Chapter 001 06A.

INSPECTION PLAN

2 The inspection plan is divided into two categories designated Static Inspection Schedules and Functional Test Schedule.

3 The inspection/test schedules incorporated within each category, apart from the insulation resistance tests, are presented in tabular form.

4 The content of the schedules is arranged in the sequence given in Paragraphs 9 and 15, but any inspection/test may be performed independently in support of a particular maintenance operation.

Inspection/test schedule compliance

5 When an inspection/test does not meet the specified requirements, the fault must be located and rectified by suitably qualified personnel only, using the failure diagnosis procedures provided in Chapter 1 as a guide.

Tools and test equipment

6 The tools and test equipment required for carrying out the inspections are listed in Table 1.

TABLE 1 TOOLS AND TEST EQUIPMENT

Item (1)	NATO Stock No. (2)	Designation (3)	Schedule Reference (4)
1	6625-99-2523606 or 6625-99-8654203	Multimeter	Functional Test Schedule - Table 3
2	6680-99-8062943	Tachometer, Optical Hand Held	Checking engine speed control settings
3	5210-99-796-7540	Feeler Gauges (supplied with each LFG)	Tappet setting
4	5120-01-3551734	Torque Wrench 5-16 lb ft	Repair and maintenance

INSPECTION SCHEDULES

Static inspection schedules

7 Static inspection schedules are conducted with the engine stationary.

8 The static inspection schedules cover a physical examination of the complete equipment in a logical sequence.

9 The content of the static inspection schedules is as follows:

9.1 Physical inspection schedule (Table 2):

9.1.1 Frames and covers.

9.1.2 Power unit.

9.1.3 Fuel system.

9.1.4 Starting system.

9.1.5 Control box assembly.

Physical inspection schedule

10 Table 2 contains the step-by-step procedures for carrying out a Physical Inspection of the generator set.

TABLE 2 PHYSICAL INSPECTION SCHEDULE

Item (1)	Test/Operation (2)	Reference(s) (3)	Acceptable Quality Level		Result or Sentence (6)	Remarks (7)
			Unit (4)	Field (5)		
	FRAME AND COVERS					
1	Frame	Cat 302	No cracks, dents or corrosion. Fixings secure and anti vibration mounts sound and secure. Paintwork clean and sound			
2	Acoustic cover	Cat 302	Catches serviceable, edge seal intact, air vents free from blockage			
3	Louvre cover top cover	Cat 522	Securely attached to the control box assembly, no damaged to securing screws, air vents free from blockage			
4		Cat 522	Securely attached to the control box assembly, no damaged to securing screws			
5	Earth bonding leads		Securely attached to frame or individual cover. Not physically damaged or corroded			
6	Labels/markings		All labels and markings are intact and legible			
	POWER UNIT					
7	Engine	Cat 302	No discernible leakage of fuel or oil, all fixing bolts secure			
8	Air filter assembly	Cat 302	Securely attached, filter element clean and serviceable			
9	Exhaust system	Cat 302	Silencer unit, heat shield and exhaust pipe intact. Extension pipe not damaged			
10	Lubricating oil	Cat 302	Oil clean and to correct level			

(continued)

TABLE 2 PHYSICAL INSPECTION SCHEDULE (continued)

Item (1)	Test/Operation (2)	Reference(s) (3)	Acceptable Quality Level		Result or Sentence (6)	Remarks (7)
			Unit (4)	Field (5)		
	FUEL SYSTEM					
11	Jerrycan adaptor assembly	Cat 302		All parts securely assembled, jerrycan filler neck adaptor seal undamaged and serviceable, fuel pipes and connectors undamaged with no perishing or cracks, dip tube filter unblocked		
12	LFG mounted quick release connectors and fuel pipes	Cat 302		All parts undamaged and serviceable, all pipes securely attached		
13	Fuel tank	Cat 302		Fuel free from water contamination when viewed via fuel drainage pipe		
	STARTING SYSTEM					
14	Recoil starter	Cat 302		Pull rope not chafed or cut, no binding or slipping when operated, rope withdraws fully into starter casing when released, air vents free from blockage		
15	Electric starter	Cat 302		Securely fixed to engine, all electrical connections sound		
	CONTROL BOX ASSEMBLY					
16	Mountings	Figures 1 & 2		Anti vibration mounts secure and undamaged		
17	Switches and pushbuttons	Figures 1 & 2		Switches and pushbuttons secure, positive in mechanical action		
18	Meters and indicators	Figures 1 & 2		Meters and indicators secure, glasses clean		
19	Labels/markings			All labels and markings are intact and legible		

Functional test schedule

11 The functional test schedule consists of a series of elementary tests designed to highlight any deviation from acceptable operating parameters.

12 The test content of the functional test schedule (Table 3) is as follows:

12.1 Starting sequence.

12.2 Engine operation.

12.3 Alternator output.

13 Table 3 contains the step-by-step functional test procedure for the generator set. The warnings listed in the preface of this document must be strictly observed.

TABLE 3 FUNCTIONAL TEST SCHEDULE

Item (1)	Test/Operation (2)	Reference(s) (3)	Acceptable Quality Level		Result or Sentence (6)	Remarks (7)
			Unit (4)	Field (5)		
1	STATIC INSPECTION A Static inspection must be carried out before performing the following functional tests.	Tables 2, 3 & 4	Static inspection satisfactory			
	STARTING SEQUENCE (MANUAL START)					
2	Connect the fuel supply to the LFG	Cat 201				
3	Select the desired AC output (SW1)	Cat 201				
4	Set the engine speed control lever to the "Max" position	Cat 201				
5	Pull starter handle until resistance is felt, then pull smartly to start	Cat 201		Engine starts Hours run indicator working		Repeat until engine starts (maximum three attempts)
6	Set engine speed control lever to the "Normal" position and allow the engine to warm up for one minute	Cat 201		Engine speed 2800 +/- 50 rpm		

(continued)

TABLE 3 FUNCTIONAL TEST SCHEDULE (CONTINUED)

Item (1)	Test/Operation (2)	Reference(s) (3)	Acceptable Quality Level		Result or Sentence (6)	Remarks (7)
			Unit (4)	Field (5)		
7	Set engine speed control lever to the "Max" position		Engine speed	3300 +/- 50 rpm		
8	Set the engine speed control lever to the "Off" position	Cat 201	Engine stops			
	STARTING SEQUENCE (ELECTRIC START)					
9	Connect the fuel supply to the LFG	Cat 201				
10	Select the desired AC output (SW1)	Cat 201				
11	Set the engine speed control lever to the "Max" position	Cat 201				
12	Connect a 24V DC supply to the LFG via the inter-vehicle connector	Cat 201				
13	Press and hold the "Start" button until the engine fires then release	Cat 201	Engine starts			Repeat until engine starts (maximum three attempts)
			Hours run indicator working			
14	Set engine speed control lever to the "Normal" position and allow the engine to warm up for one minute	Cat 201	Engine speed	2800 +/- 50 rpm		
15	Set engine speed control lever to the "Max" position		Engine speed	3300 +/- 50 rpm		
16	Set engine speed control lever to the "Off" position	Cat 201	Engine stops			

(continued)

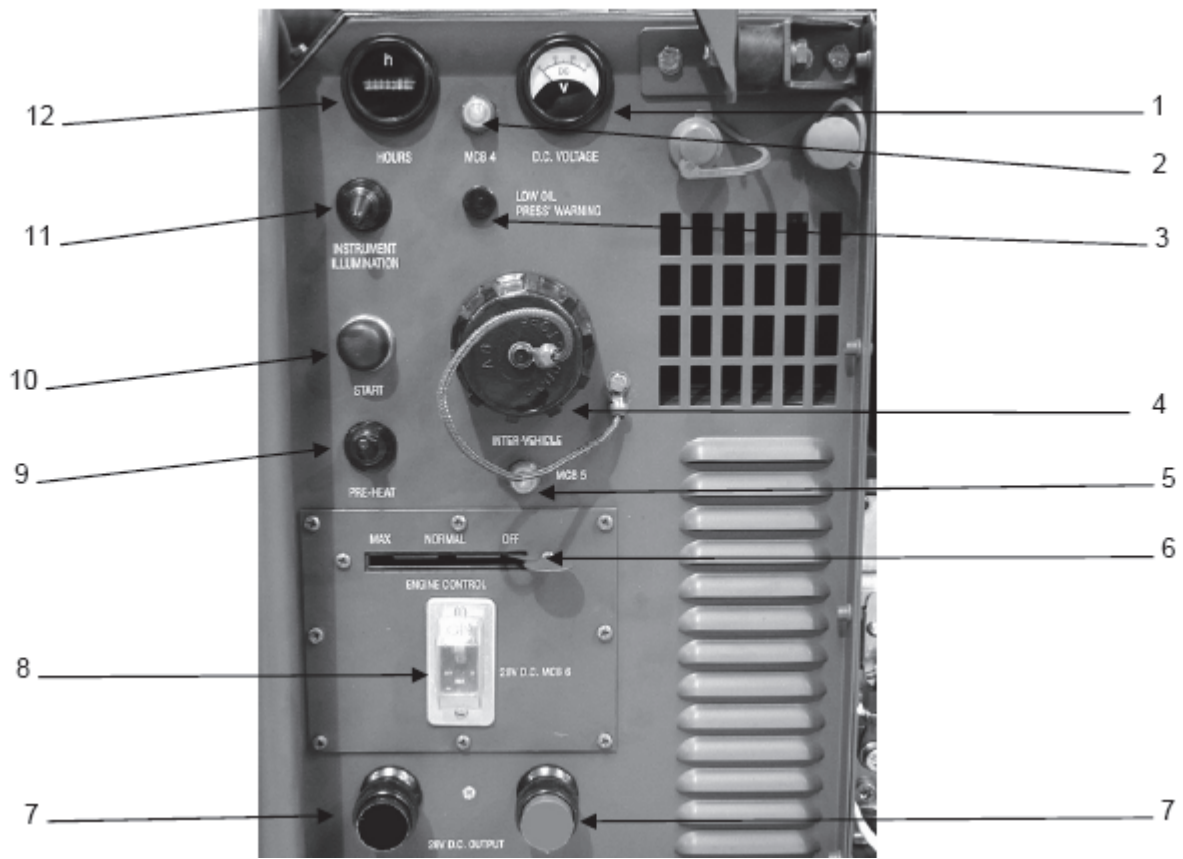
TABLE 3 FUNCTIONAL TEST SCHEDULE (continued)

Item (1)	Test/Operation (2)	Reference(s) (3)	Acceptable Quality Level		Result or Sentence (6)	Remarks (7)
			Unit (4)	Field (5)		
17	ENGINE OPERATION General performance		Engine runs evenly with no abnormal noises. Exhaust fumes normal (not black). No leaks of exhaust, fuel or oil			LFG started and run up to normal operating speed and temperature
18	ELECTRICAL OUTPUT (DC) Connect a DVM to the DC output terminals	Figure 1				
19	Set the DC circuit breaker to "On" (up position)		Ensure output indicated on the DVM is 28 V DC +/- 0.5V			LFG DC voltmeter reading to be approximately 28V DC
20	ELECTRICAL OUTPUT (AC) Set the engine speed control lever to the "Off" position					
21	Select 230V AC Output on SW1	Figure 2				
22	Start the LFG and set the engine speed control lever to the "Max" position					
23	Connect a DVM across the 230V output socket Live and Neutral pins	Figure 2				
24	Set the 230V AC Circuit Breaker to "On" (up position)	Figure 2	Ensure output indicated on the DVM is 230V AC +/- 5.75V			LFG AC voltmeter reading to be approximately 230V AC
25	Set the engine speed control lever to the "Off" position					
26	Select 110V AC Output on SW1	Figure 2				

(continued)

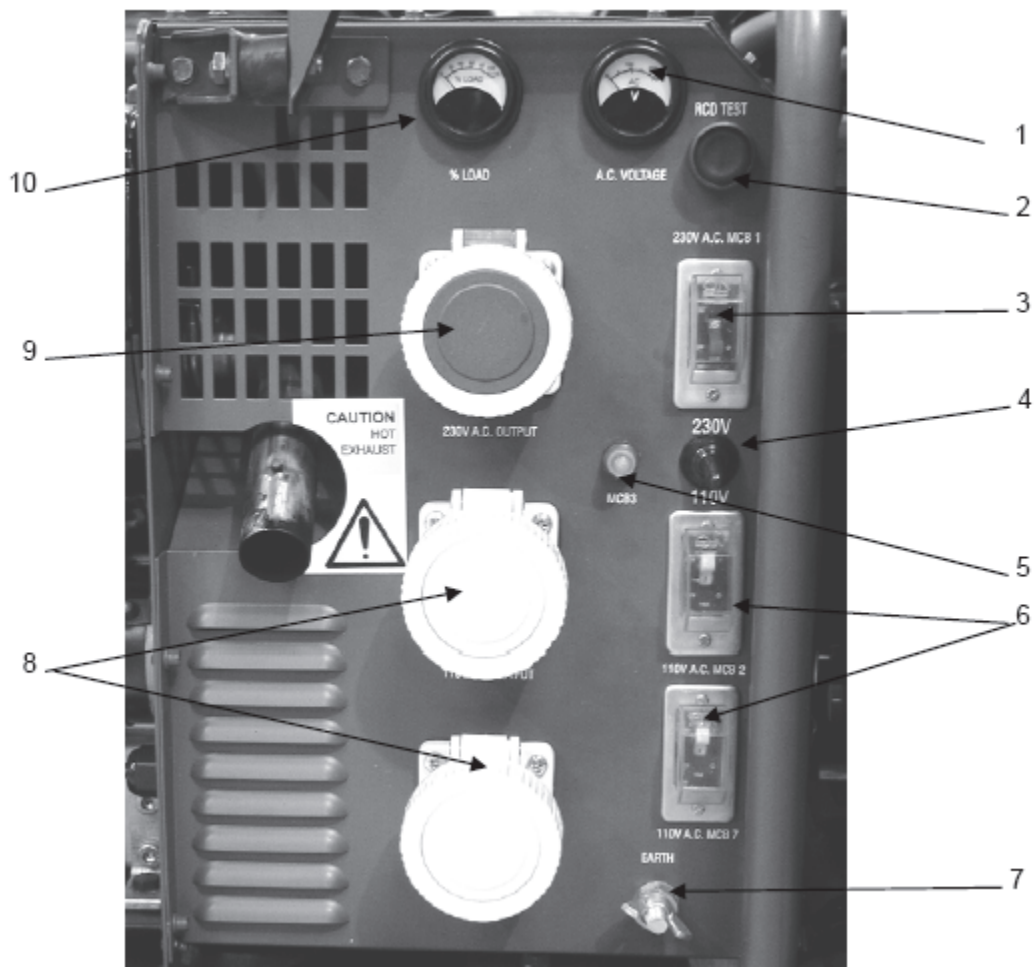
TABLE 3 FUNCTIONAL TEST SCHEDULE (continued)

Item (1)	Test/Operation (2)	Reference(s) (3)	Acceptable Quality Level		Result or Sentence (6)	Remarks (7)
			Unit (4)	Field (5)		
27	Start the LFG and set the engine speed control lever to the "Max" position	Figure 2				
28	Connect a DVM across the 110V output socket Live and Neutral pins					
29	Set the 110V AC Circuit Breaker to "On" (up position)	Figure 2			Ensure output indicated on the DVM is 110V AC +/- 2.75V	LFG AC voltmeter reading to be approximately 110V AC
EARTH LEAKAGE TESTING						
30	Set the engine speed control lever to the "Off" position	Figure 2				
31	Select 230V on SW1					
32	Start the LFG and set the engine speed control lever to the "Max" position	Figure 2				
33	Set 230V AC circuit breakers to "On" (up position)					
34	Push RCD test button	Figure 2			230V circuit breaker trips	
35	Set the engine speed control lever to the "Off" position	Figure 2				
36	Select 110V on SW1					
37	Start the LFG and set the engine speed control lever to the "Max" position	Figure 2				
38	Set 110V AC circuit breakers to "On" (up position)					
39	Push RCD test button	Figure 2			110V circuit breakers trip	



- | | | | |
|---|-------------------------------|----|--------------------------------|
| 1 | DC voltage meter | 7 | DC output terminals |
| 2 | MCB 4 | 8 | DC output circuit breaker |
| 3 | Low oil pressure warning LED | 9 | Pre-heat switch |
| 4 | Intervehicle connector socket | 10 | Start push button |
| 5 | MCB 5 | 11 | Instrument illumination switch |
| 6 | Engine speed control lever | 12 | Hours run meter |

Fig 1 Component location - DC control panel



- | | | | |
|---|---------------------------------|----|---------------------------------|
| 1 | AC voltage meter | 6 | 110V AC output circuit breakers |
| 2 | RCD (earth leakage) test button | 7 | Earth stud |
| 3 | 230V AC output circuit breaker | 8 | 110V AC output sockets |
| 4 | Voltage selector switch | 9 | 230V AC output socket |
| 5 | MCB 3 | 10 | Percentage (%) load meter |

Fig 2 Component location - AC control panel

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