ANNEX D

NEWAGE ALTERNATOR MANUAL

ANNEX D

NEWAGE ALTERNATOR MANUAL

CONTENTS

(continued)

CONTENTS (continued)

STAMFORD
AC GENERATORS FROM
NEWAGE INTERNATIONAL

Installation, Service and Maintenance Manual

For the BC Range of Generators (BCI182J)

SAFETY PRECAUTIONS

Before operating the generating set, read the generating set operation manual and this generator manual and become familiar with it and the equipment.

SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE EQUIPMENT IS CORRECTLY OPERATED AND MAINTAINED.

Many accidents occur because of failure to follow fundamental rules and precautions.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

- Ensure installation meets all applicable safety and local electrical codes. Have all installations performed by a qualified electrician.
- Do not operate the generator with protective covers, access covers or terminal box covers removed.
- Disable engine starting circuits before carrying out maintenance.
- Disable closing circuits and/or place warning notices on any circuit breakers normally used for connection to the mains or other generators, to avoid accidental closure.

Observe all **IMPORTANT, CAUTION, WARNING, and DANGER** notices, defined as:

IMPORTANT!

Important refers to hazard or unsafe method or practice which can result in product damage or related equipment damage.

CAUTION!

Caution refers to hazard or unsafe method or practice which can result in product damage or personal injury.

WARNING!

WARNING REFERS TO A HAZARD OR UNSAFE METHOD OR PRACTICE WHICH CAN RESULT IN SEVERE PERSONAL INJURY OR POSSIBLE DEATH.

DANGER!

Danger refers to immediate hazards which will result in severe personal injury or death.

Due to our policy of continuous improvement, details in this manual which were correct at time of printing may now be due for amendment. Information included must therefore not be regarded as binding.

FOREWORD

The function of this book is to provide the user of the Stamford generator with an understanding of the principles of operation, the criteria for which the generator has been designed, and the installation and maintenance procedures. Specific areas where the lack of care or use of incorrect procedures could lead to equipment damage and/or personal injury are highlighted, with WARNING and/or CAUTION notes, and it is IMPORTANT that the contents of this book are read and understood before proceeding to fit or use the generator.

The Service, Sales and technical staff of Newage international are always ready to assist and reference to the company for advice is welcomed.

WARNING

PERSONNEL INJURY. INCORRECT INSTALLATION, SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND MECHANICAL SERVICE.

EC DECLARATION OF INCORPORATION

All Stamford generators are supplied with a declaration of incorporation for the relevant EC legislation, typically in the form of a label as below.

EC DECLARATION OF INCORPORATION

IN ACCORDANCE WITH THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1992 AND THE SUPPLY OF MACHINERY (SAFETY) (AMENDMENT) REGULATIONS 1994 IMPLEMENTING THE EC MACHINERY DIRECTIVE 89/392/EEC AS AMENDED BY 91/368/EEC.

THIS STAMFORD A.C. GENERATOR WAS MANUFACTURED BY OR ON BEHALF OF NEWAGE INTERNATIONAL LTD BARNACK ROAD STAMFORD LINCOLNSHIRE ENGLAND.

THIS COMPONENT MACHINERY MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE INCORPORATED HAS BEEN DECLARED IN CONFORMITY WITH THE PROVISIONS OF THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1995/MACHINERY DIRECTIVE.

FOR AND ON BEHALF OF NEWAGE INTERNATIONAL LIMITED

NAME: LAWRENCE HAYDOCK
POSITION: TECHNICAL DIRECTOR
SIGNATURE:

THIS COMPONENT MACHINERY CARRIES THE CE MARK FOR COMPLIANCE WITH THE STATUTORY REQUIREMENTS FOR THE IMPLEMENTATION OF THE FOLLOWING DIRECTIVES

The EMC Directive 89/336/EEC
WARNING! This Component Machinery shall not be used in the Residential, Commercial and Light Industrial environment unless it also conforms to the relevant standard (EN 50081 - 1) REFER TO FACTORY FOR DETAILS

ii) The Low Voltage Directive 73/23/EEC as amended by 93/68/EEC

When this manual is supplied to support a specific generator at point of sale, the generator identity is clearly displayed on the front cover of this book.

ELECTROMAGNETIC COMPATIBILITY

Additional information

European Union Council Directive 89/336/EEC

For installations within the European Union, electrical products must meet the requirements of the above directive, and Newage ac generators are supplied on the basis that:

- They are to be used for power-generation or related function.
- They are to be applied in one of the following environments:

  Portable (open construction - temporary site supply)

  Portable (enclosed - temporary site supply)

  Containerised (temporary or permanent site supply)

  Ship-borne below decks (marine auxiliary power)

  Commercial vehicle (road transport/refrigeration etc)

  Rail transport (auxiliary power)

  Industrial vehicle (earthmoving, cranes etc)

  Fixed installation (industrial - factory/process plant)

  Fixed installation (residential, commercial and light industrial home/office/health)

  Energy management (Combined heat and power and/or peak lopping)

  Alternative energy schemes

- The standard generators are designed to meet the 'industrial' emissions and immunity standards. Where the generator is required to meet the residential, commercial and light industrial emissions and immunity standards reference should be made to Newage document reference N4/X/011, as additional equipment may be required.
- The installation earthing scheme involves connection of the generator frame to the site protective earth conductor using a minimum practical lead length.
- Maintenance and servicing with anything other than factory supplied or authorized parts will invalidate any Newage liability for EMC compliance.
- Adequately trained personnel fully aware of the requirements of the relevant EC directives carry out installation, maintenance and servicing.

INTRODUCTION

1 The BC16/18 range of generators is of brushless rotating field design, available up to 660V/50Hz (1500 rpm, 4 pole and 3000 rpm, 2 pole) or 60Hz (1800 rpm, 4 pole and 3600 rpm, 2 pole), and built to meet B.S. 5000 Part 3 and international standards.

2 The BC16/18 range are self-excited with excitation power derived from the main output windings, using either the **SX460**/SA465 AVR or transformer controlled excitation system.

3 The BC184 may be supplied fitted with an auxiliary winding in the main stator, using the SA465 AVR.

4 Detailed specification sheets are available on request.

DESIGNATION

5 To provide standardisation of systems with minimal change to customers.

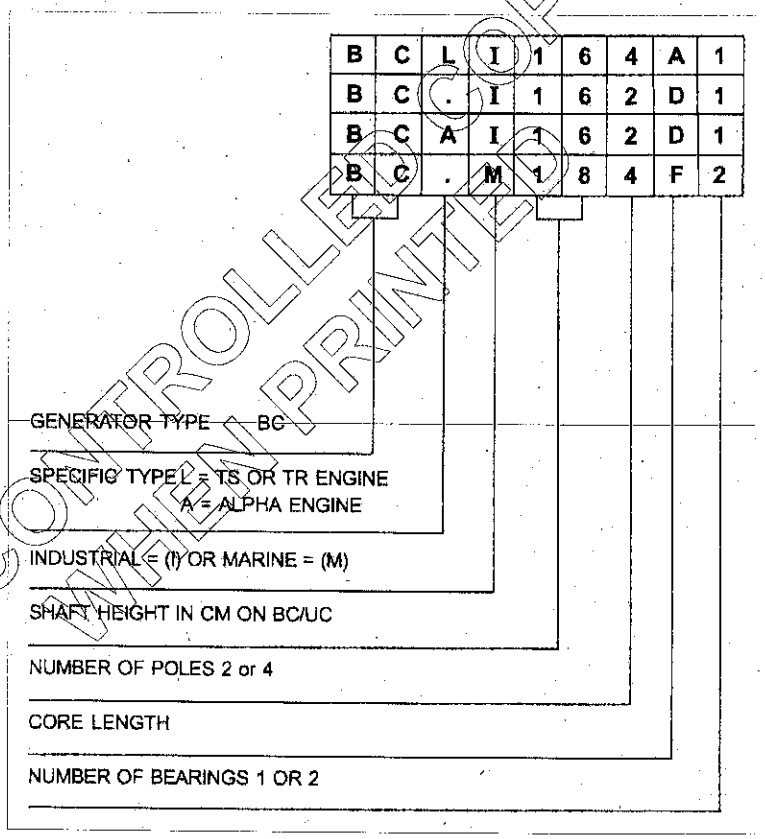

Fig 1 Designation

PACKAGED LOOSE ADAPTOR HARDWARE

6 Several adaptors are only partially fitted to generators to simplify removal prior to engine-generator assembly. The remaining hardware is contained within a plastic bag located in the terminal box.

Adaptor types

7 SAE2
SAE3
SAE5 Spacer Rings
SAE6
Coupling Plate Dowel Pins

SERIAL NUMBER LOCATION

8 Each generator has its unique serial number stamped into the upper section of the non-drive end frame.

9 Inside the terminal box two adhesive rectangular labels have been fixed, each carrying the generator's unique identity number. One to the inside of the terminal box sheet metal work, and the second label fixed to the main frame of the generator.

RATING PLATE AND CE MARK

10 The generator has been supplied with a self-adhesive rating plate label to enable fitting after final assembly and painting. It is intended that this label will be stuck to the outside of the terminal box on the left-hand side when viewed from the drive-end. To assist with squarely positioning the label, location protrusions have been made in the sheet metalwork.

11 A CE Mark label is also supplied loose for fitment after final assembly and painting. This should be attached to an external surface of the Generator at a suitable location where it will not be obscured by the customer's wiring or other fittings. Before fitting the CE Mark label the genset builder must address the requirements of the relevant EC legislation to ensure the compliance of the genset as a whole. CE compliance will also need to be addressed when installed on site.

12 The surface on the area where a label is to be stuck must be flat, clean and any paint finish must be fully dry before attempting to attach label. Recommended method for attaching label is peel and fold back sufficient of the backing paper to expose some 20mm of label adhesive along the edge which is to be located against the sheet metal protrusions. Once this first section of label has been carefully located and stuck into position the backing paper can be progressively removed, as the label is pressed down into position. The adhesive will achieve a permanent bond in 24 hours.

PRINCIPLE OF OPERATION

SELF-EXCITED AVR CONTROLLED GENERATORS

Main stator powered AVR

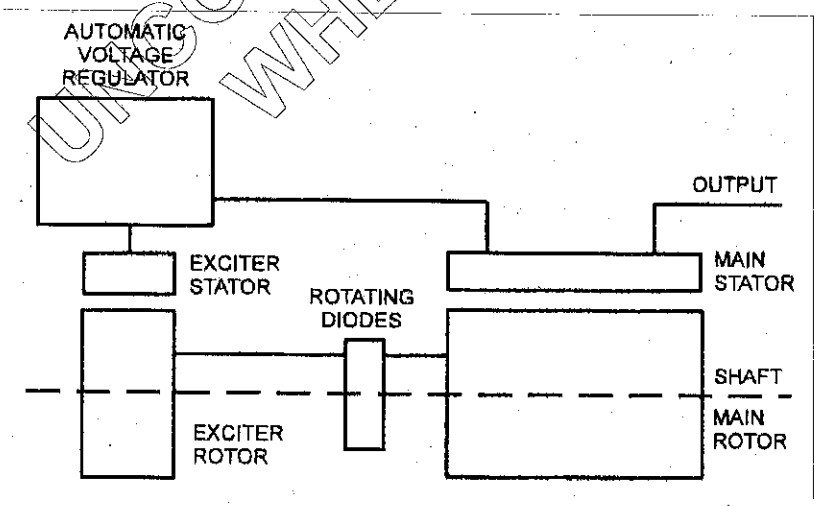

Fig 2 Main stator powered AVR

13 The main stator provides power for excitation of the exciter field via the SX460 (SA465) AVR which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature.

14 The AVR senses average voltage on two phases ensuring close regulation. In addition it detects engine speed and provides voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burden on the engine.

15 The detailed function of the AVR circuits and their adjustment are covered in the load testing section.

16 In addition the SA465 AVR incorporates circuits which, when used in conjunction with accessories, can provide for parallel operation either with 'droop' or 'astatic' control and VAR/PF control.

17 Function and adjustment of the accessories which can be fitted inside the generator terminal box are covered in the accessories section of this book.

18 Separate instructions are provided with other accessories available for control panel mounting.

Auxiliary winding powered AVR

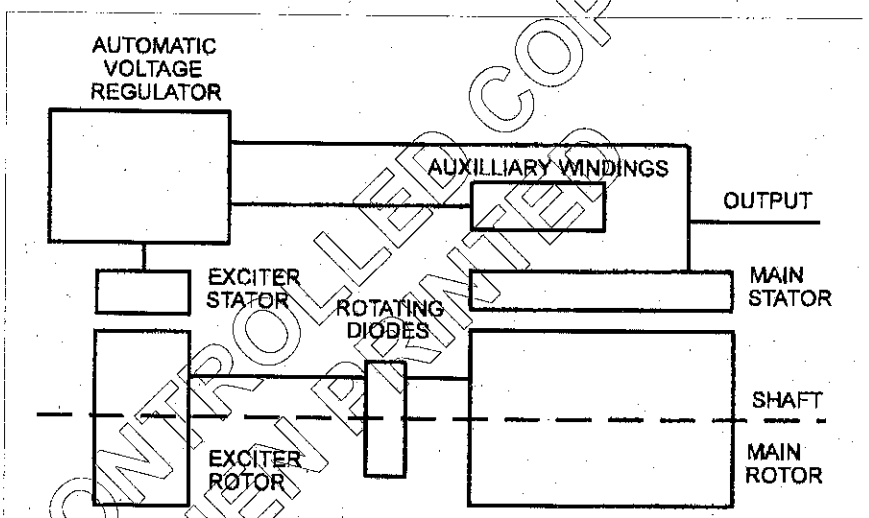

Fig 3 Auxiliary winding powered AVR

19 The auxiliary winding provides power for excitation of the exciter field via the SA465 AVR which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature. The AVR senses average voltage on two phases ensuring close regulation. In addition, it detects engine speed and provides voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burden on the engine.

20 Under fault conditions on the main stator output the auxiliary winding continues to generate voltage from the harmonic content of the magnetic field in the main stator core providing the necessary power via the SA465 AVR, to maintain short circuit fault currents.

21 The detailed function of the AVR circuits and their adjustment are covered in the load testing section.

22 Function and adjustment of the accessories which can be fitted inside the generator terminal box are covered in the accessories section of this book.

23 Separate instructions are provided with other accessories available for control panel mounting.

Transformer controlled generators

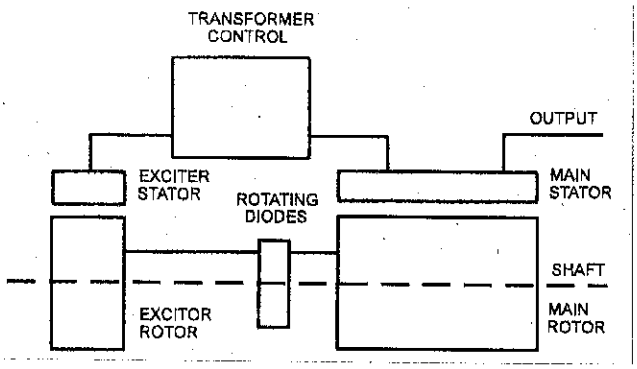

Fig 4 Transformer controlled generators

24 The main stator provides power for excitation of the exciter field via a transformer rectifier unit. The transformer combines voltage and current elements derived from the main stator output to form the basis of an open-loop control system, which is self regulating in nature. The system inherently compensates for load current magnitude and power factor and provides short circuit maintenance in addition to a good motor starting performance.

25 Three-phase generators normally have a three-phase transformer control for improved performance with unbalanced loads but a single-phase transformer option is available.

26 No accessories can be provided with this control system.

APPLICATION OF THE GENERATOR

27 The generator is supplied as a component part for installation in a generating set. It is not, therefore, practicable to fit all the necessary warning/hazard labels during generator manufacture. The additional labels required are packaged with this manual, together with a drawing identifying their locations.

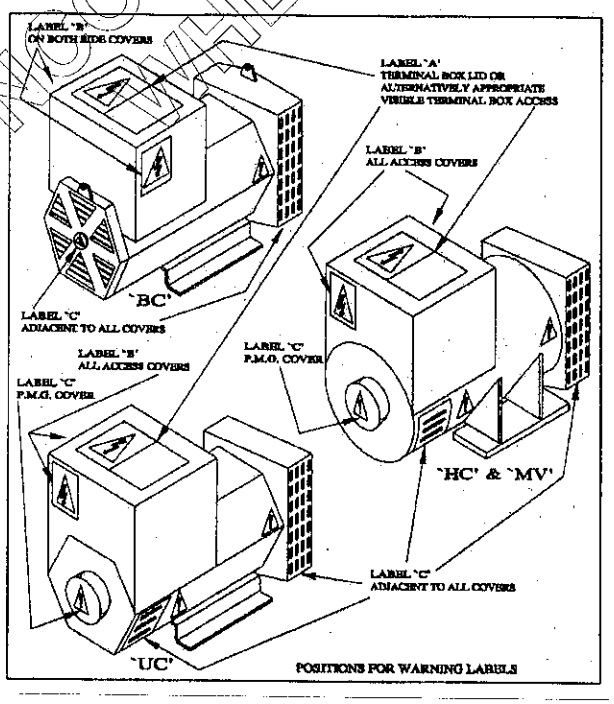

Fig 5 Warning/hazard label locations

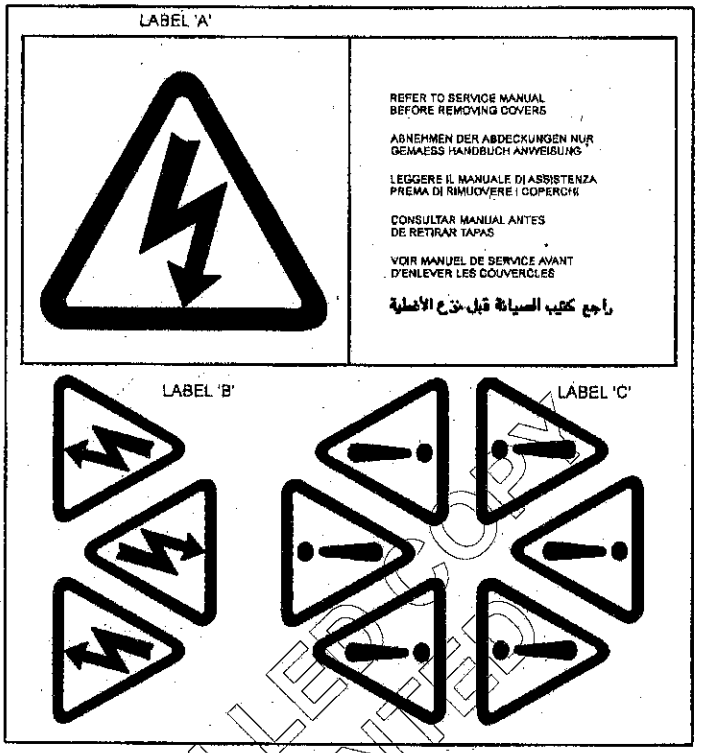

Fig 6 Warning/hazard labels

28 It is the responsibility of the generating set manufacturer to ensure that the correct labels are fitted, and are clearly visible.

29 The generators have been designed for use in a maximum ambient temperature of 40°C and altitude less than 1000 metres above sea level in accordance with BS 5000.

30 Ambients in excess of 40°C and altitudes above 1000 metres can be tolerated with reduced ratings - refer to the generator nameplate for rating and ambient. In the event that the generator is required to operate in an ambient in excess of the nameplate value or at altitudes in excess of 1000 metres above sea level, refer to the factory.

31 The generators are of air-ventilated screen protected drip-proof design and are not suitable for mounting outdoors unless adequately protected by the use of canopies. Anti-condensation heaters are recommended during storage and for standby duty to ensure winding insulation is maintained in good condition.

32 When installed in a closed canopy it must be ensured that the ambient temperature of the cooling air to the generator does not exceed that for which the generator has been rated.

33 The canopy should be designed such that the engine air intake to the canopy is separated from the generator intake, particularly where the radiator cooling fan is required to draw air into the canopy. In addition the generator air intake to the canopy should be designed such that the ingress of moisture is prohibited, preferably by use of a 2 stage filter.

34 The generator air intake is through the non-drive end cover and the generating set and canopy design must be such that the intake is not restricted. It is recommended that a minimum clearance of 50mm is allowed between the generator air intake and any vertical flat surface.

35 The air intake/outlet must be suitable for the air flow given in the following table with additional pressure drops less than or equal to those given below:

TABLE 1 AIR FLOW

Frame	Air flow		Additional (intake/outlet) Pressure drop
	50 Hz	60 Hz	
BC164	0.071 m³/sec	0.09 m³/sec	3mm water gauge (0.1")
	150 cfm	190 cfm	
BC184 EFG	0.095 m³/sec	0.119 m³/sec	
	200 cfm	250 cfm	
BC184 HJ	0.15 m³/sec	0.19 m³/sec	
	318 cfm	403 cfm	
BC162	0.19 m³/sec	0.23 m³/sec	
	403 cfm	487 cfm	
BC182	**0.254 m³/sec**	**0.304 m³/sec**	
	538 cfm	**644 cfm**	

36 If specified at the time of ordering, the generator itself may be fitted with air filters.

37 The BCL construction has no fan fitted to the generator. The engine flywheel fan draws air through the generator and additional restrictions on air flow such as filters on the generator or canopies are not permissible.

CAUTION

EQUIPMENT DAMAGE. Reduction in cooling air flow or inadequate protection to the generator can result in damage and/or failure of windings.

38 Dynamic balancing of the generator rotor assembly has been carried out during manufacture in accordance with BS 6861 Part 1 Grade 2.5 to ensure vibration limits of the generator are in accordance with BS 4999 Part 142.

39 The main vibration frequencies produced by the component generator are as follows:

4 pole 1500 r.p.m. 25 Hz

4 pole 1800 r.p.m. 30 Hz

2 pole 3000 r.p.m. 50 Hz

2 pole 3600 r.p.m. 60 Hz

40 However, vibrations induced by the engine are complex and contain frequencies of 1, 3, 5 or more times the fundamental frequency of vibration. These induced vibrations can result in generator vibration levels higher than those derived from the generator itself. It is the responsibility of the generating set designer to ensure that the alignment and stiffness of the bedplate and mountings are such that the vibration limits of BS 5000 Part 3 are not exceeded.

41 In standby applications where the running time is limited and reduced life expectancy is accepted, higher levels than specified in BS 5000 can be tolerated, up to a maximum of 18mm/sec.

42 Two bearing generators require a substantial bedplate with engine/generator mounting pads to ensure a good base for accurate alignment. Close coupling of engine to generator can increase the overall rigidity of the set. For the purposes of establishing set design the bending moment at the engine flywheel housing to generator adaptor interface should not exceed 125 ft.lb (17 kgm). A flexible coupling, designed to suit the specific engine/generator combination, is recommended to minimise torsional effects.

43 Belt driven applications of two bearing generators require the pulley diameter and design to be such that the side load or force applied to the shaft is central to the extension and does not exceed the values given in the table below:

TABLE 2 SIDE LOAD

Frame 2/4 Pole	Side Load		Shaft extension mm
	kgf	N	
BC16	92	900	82
BC18	**173**	**1700**	**82**

44 In instances where shaft extensions greater than specified in the table have been supplied, reference must be made to the factory for appropriate loadings.

45 Alignment of single bearing generators is critical and vibration can occur due to the flexing of the flanges between the engine and generator. As far as the generator is concerned the maximum bending moment at this point must not exceed 125 ft.lb (17 kgm).

46 Single bearing generators require a substantial bedplate with engine/generator mounting pads to ensure a good base for accurate alignment.

47 It is expected that the generator will be incorporated into a generating set operating in an environment, where the maximum shock load experienced by the generator will not exceed 3g in any plane. If shock loads in excess of 3g are to be encountered, anti-vibration mountings must be incorporated into the generating set to ensure they absorb the excess.

48 The maximum bending moment of the engine flange must be checked with the engine manufacturer.

CAUTION

EQUIPMENT DAMAGE. Single bearing drive end brackets are designed to be bolted to the engine flywheel housing using cap head screws.

49 Torsional vibrations occur in all engine-driven shaft systems and may be of a magnitude to cause damage at certain critical speeds. It is therefore necessary to consider the torsional vibration effect on the generator shaft and couplings.

50 It is the responsibility of the generator set manufacturer to ensure compatibility, and for this purpose drawings showing the shaft dimensions and rotor inertias are available for customers to forward to the engine supplier. In the case of single bearing generators coupling details are included.

CAUTION

EQUIPMENT DAMAGE. Torsional incompatibility and/or excessive vibration levels can cause damage or failure of generator and/or engine components.

51 The terminal box is constructed with removable panels for easy adaptation to suit specific glanding requirements. Within the terminal box there are insulated terminals for line and neutral connections and provision for earthing. A hole is provided on the generator foot which may be tapped to give an additional earthing point.

52 The neutral is NOT connected to the frame.

53 The main stator winding has 12 leads brought out to the terminals in the terminal box.

WARNING

PERSONNEL INJURY. NO EARTH CONNECTIONS ARE MADE ON THE GENERATOR AND REFERENCE TO SITE REGULATIONS FOR EARTHING MUST BE MADE. INCORRECT EARTHING OR PROTECTION ARRANGEMENTS CAN RESULT IN PERSONAL INJURY OR DEATH.

WARNING

PERSONNEL INJURY. INCORRECT INSTALLATION AND/OR PROTECTIVE SYSTEMS CAN RESULT IN PERSONAL INJURY AND/OR EQUIPMENT DAMAGE. INSTALLERS MUST BE QUALIFIED TO PERFORM ELECTRICAL INSTALLATION WORK.

54 Fault current curves (decrement curves), together with generator reactance data, are available on request to assist the system designer to select circuit breakers, calculate fault currents and ensure discrimination within the load network.

INSTALLATION – PART 1

LIFTING

WARNING

PERSONNEL INJURY. INCORRECT LIFTING OR INADEQUATE LIFTING CAPACITY CAN RESULT IN SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE. MINIMUM LIFTING CAPACITY REQUIRED IS 250kg. GENERATOR LIFTING LUGS SHOULD NOT BE USED FOR LIFTING THE COMPLETE GENERATOR SET.

55 Lifting lugs are provided at each end of the generator for use with a shackle and pin type lifting aid or lifting hooks. Chains of suitable length and lifting capacity, with spreader bar to avoid damage to the terminal box, must be used.

56 The correct lifting arrangement is shown on a label attached to the generator. A typical example is shown below.

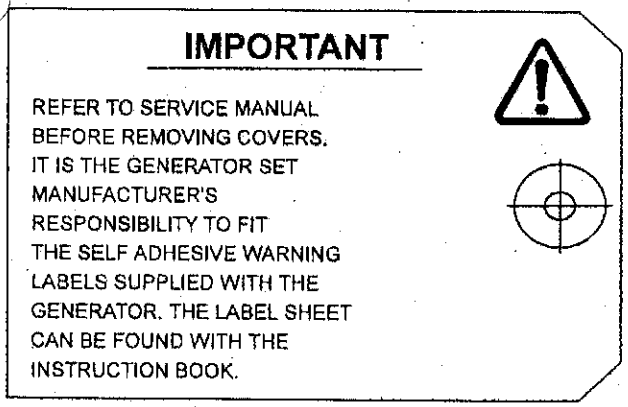

Fig 7 Typical lifting warning label

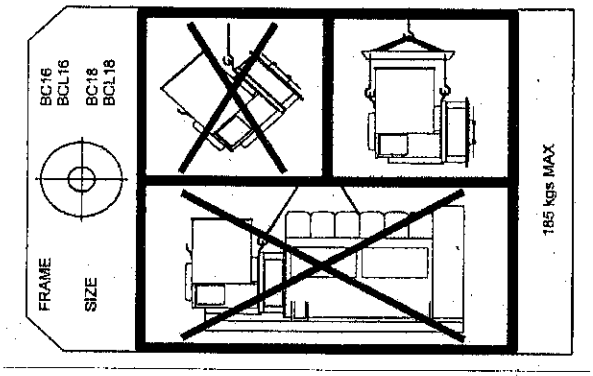

Fig 8 Lifting warning label

57 BCL generators have no fan to support the drive end and are supplied fitted with a transit strap clamping the coupling hub to the drive end adaptor ring.

58 Once the transit strap is removed the rotor is free to move in the frame, and care is needed during coupling and alignment to ensure the frame is kept in the horizontal plane.

ASSEMBLY TO ENGINE

Engine to generator coupling assembly

59 During the assembly of the Generator to the Engine it will be necessary to firstly carefully align, then rotate, the combined Generator rotor - Engine crankshaft assembly, as part of the construction process, to allow location, insertion and tightening of the coupling bolts. This requirement to rotate the combined assemblies exists for both single and two bearing units. During the assembly of single bearing units it is necessary to align the generator's coupling holes with the engine flywheel holes: it is suggested that two diametrically opposite location dowel pins are fitted to the engine flywheel, over which the generator coupling can slide into final location into the engine flywheel spigot recess. The dowels must be removed and replaced by coupling bolts before the final bolt tightening sequence.

60 While fitting and tightening the coupling bolts it will be necessary to rotate the Engine crankshaft - Generator rotor assembly. Care should be taken to ensure that rotation is carried out in an approved manner that ensures safe working practice when reaching inside the machine to insert or tighten coupling bolts, and that no component of the assembly is damaged by non-approved methods of assembly rotation.

61 Engine Manufacturers have available a proprietary tool designed to enable manual rotation of the crankshaft assembly. This tool must always be used, having been engineered as an approved method of assembly rotation, by engaging the manually driven pinion with the engine flywheel starter ring-gear.

UNDER NO CIRCUMSTANCES SHOULD A LEVER BE USED AGAINST THE FAN BLADES OR BAFFLE TO ROTATE THE GENERATOR ROTOR/ENGINE CRANKSHAFT ASSEMBLY.

WARNING

PERSONNEL INJURY. BEFORE WORKING INSIDE THE GENERATOR, DURING THE ALIGNING AND FITTING OF COUPLING BOLTS, CARE SHOULD BE TAKEN TO LOCK THE ASSEMBLY TO ENSURE THERE IS NO POSSIBILITY OF ASSEMBLY ROTATIONAL MOVEMENT. INCORRECT GUARDING AND/OR GENERATOR ALIGNMENT CAN RESULT IN PERSONAL INJURY AND/OR EQUIPMENT DAMAGE.

Single bearing generators

62 Alignment of single bearing generators is critical. If necessary shim the generator feet to ensure alignment of the machined surfaces.

63 For transit and storage purposes the generator frame spigot and rotor coupling plates have been coated with a rust preventative. This MUST BE removed before assembly to engine.

64 A practical method for removal of this coating is to clean the mating surface areas with a de-greasing agent based on a petroleum solvent.

WARNING

PERSONNEL INJURY. CARE SHOULD BE TAKEN NOT TO ALLOW ANY CLEANING AGENT TO COME INTO PROLONGED CONTACT WITH SKIN.

65 For coupling to the various engine flywheel housings, the generators can be supplied with an end bracket-adaptor arrangement as outlined below.

End bracket/adaptor

SAE5
SAE4
SAE3
SAE2
SAE5 Plus SAE6 Adaptor Ring

CAUTION

EQUIPMENT DAMAGE. Drive end adaptors are designed for use with cap head screws. BC18 generators fitted with an SAE 5 drive end adaptor must also be fitted with a reduced diameter fan and must be operated at reduced output. Fan securing screws should be tightened to 0.59kgm (6Nm 4.4lb. ft.)

66 The sequence of assembly to the engine should generally be as follows:

(1) On the engine check the distance from the coupling mating face on the flywheel to the flywheel housing mating face. This should be within 0.5mm of nominal dimension. This is necessary to ensure that a thrust is not applied to the ac generator bearing or engine bearing.

(2) Check that the bolts securing the coupling disc to the coupling hub are tight and locked into position. Torque tightening is 7.6kgm (75Nm; 55 lb ft).

(3) Remove covers from the drive end of the generator to gain access to coupling disc and adaptor bolts.

(4) Check that coupling disc is concentric with adaptor spigot. This can be adjusted by suspending the rotor by means of a rope sling through the adaptor opening.

(5) Offer the ac generator to engine and engage both coupling disc and housing spigots at the same time, finally pulling home by using the housing and coupling bolts. Use heavy gauge washers between bolt head and discs on disc to flywheel bolts.

(6) Tighten coupling disc to flywheel. Refer to engine manual for torque setting of disc to flywheel bolts.

CAUTION

EQUIPMENT DAMAGE. When fitting drive disc ensure that flywheel fixing bolt holes fall between fan blades to allow access for flywheel bolts. Use engine pulley to turn rotor.

Single bearing 4-pole and 2-pole generators

67 Generators offered in the BCA range can be specified to suit different engine build configurations of specific flywheel and flywheel housing combinations.

CAUTION

EQUIPMENT DAMAGE. It is most important that the appropriate generator build is ordered with prior knowledge of the intended engine flywheel/housing arrangement.

CAUTION

EQUIPMENT DAMAGE. During assembly, loss of residual voltage may occur. Refer to Para 188 for field flashing.

Generator to engine assembly instructions

68 Generator to engine assembly instructions:

(1) Remove louvered cover 'A' from non-drive end bracket 'B'.

(2) Assemble locating bar 'E' (Newage No AF1609) by screwing into shaft.

(3) Remove transit bar 'K'.

(4) Remove side screens 'G'.

(5) If the adaptor ring is an individual item, as indicated 'F', bolted to the generator DE bracket, remove from generator and fit to engine flywheel housing.

(6) Thread two locating pins 'H' into two top flywheel holes.

(7) Fit two locating pins 'J' into two top holes of the engine flywheel housing/adaptor location holes.

(8) Pick up generator by the cast lifting lugs on both ends with 1/2 ton shackles (TO BS3032) or lifting hooks (Newage No.LE130) using suitable lifting equipment.

(9) Rotate generator rotor such that two top holes of coupling disc are in close axial alignment.

(10) Push the generator rotor forward only half (50mm) the available movement provided by locating bar 'E'. It may be necessary to tap bar E' with a hide mallet to ease the bearing out of housing.

CAUTION

EQUIPMENT DAMAGE. Do not push the rotor forward too far. There is a risk that the rotor will rest on the stator winding outhang resulting in winding damage especially if any rotational movement occurs during alignment with pins 'H'.

(11) Support the weight of the rotor at the coupling end whilst sliding the rotor forward to locate coupling disc holes over support pins 'H'. Locating bar 'E' will allow the rotor to move forward a further 50mm, the total movement bar 'E' allows being 100mm. With coupling discs positioned against flywheel location fit securing screws and washers. Remove pins 'H' and fit two final securing screws and washers.

(12) Push generator onto engine guiding adaptor over locating pins 'J' and onto engine flywheel housing location, or ring 'F', secure with screws and washers. Remove pins and replace with two screws and washers.

(13) Remove locating bar 'E'. Replace M10 screw 'C' for barring purposes.

(14) Remove lifting tackle and replace side screens 'G' and louvred cover 'A'.

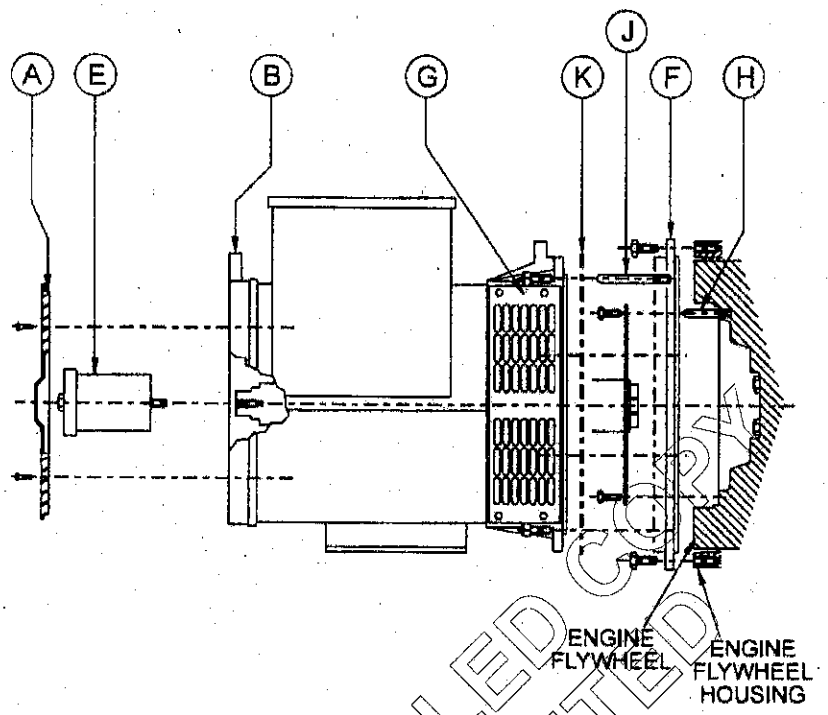

Fig 9 Generator to engine assembly

Single bearing 2-pole generator to engine assembly instructions (with doweled flywheels)

69 Follow Para 68 steps 1 to 5 from the 4-pole instruction procedure.

(1) Fit the two location dowels pins into appropriate diametrically opposite holes in engine flywheel, leaving sufficient parallel diameter exposed to allow for positive location of the disc-spacer-ring and coupling discs.

(2) Fit the disc-spacer-ring over the two dowel pins and position firmly against the flywheel face.

(3) Follow Para 68 steps 6 to 8 from the 4-pole instruction procedure.

(4) Rotate generator rotor such that the two coupling disc dowel holes align with flywheel dowel pins, and two top holes of coupling discs are in close axial alignment with the two flywheel location pins 'H'.

(5) Follow Para 68 step 10 from the 4-pole instruction procedure.

(6) Support the weight of the rotor at the coupling end whilst sliding the rotor forward to locate coupling disc holes over support pins 'H'.

CAUTION

EQUIPMENT DAMAGE. Ensure coupling disc dowel pin holes are in correct alignment.

a. With the coupling disc positioned against flywheel location fit securing screws and washers.

b. Remove pins 'H' and fit two final securing screws and washers.

(7) Follow Para 68 steps 12 to 14 from 4-pole instruction procedure.

Taper shaft arrangements

70 This arrangement is used on the BCL style generators.

71 As with single bearing generators alignment is critical. If necessary shim the generator feet to ensure alignment of the machined surfaces.

72 The following procedure should be adopted to assemble the generator to the engine:

(1) Remove louvred end cover 'G' from non-drive end bracket 'H' and M10 Hex Nut 'D' from shaft securing stud 'AA'. Remove transit bar 'E' and withdraw stub shaft/shaft securing stud 'A/B' from rotor.

(2) Ensure alternator, engine flywheel and flywheel housing locating spigots, faces and recesses are free from paint or preservatives.

(3) Locate stub shaft/shaft securing stud assembly 'A'/'B' on engine flywheel spigot and secure with studs 'J', M12 hex nut 'L' or bolts. Refer to engine manual for torque settings.

(4) Ensure both tapers are clean and free of burrs, oil or grease. Slide alternator complete with rotor towards engine, ensuring that shaft securing stud 'A' enters central hole in rotor shaft. Refer to engine manual for torque settings.

(5) Secure alternator adaptor 'F' to engine flywheel housing. Tap adaptor into place before tightening. Refer to engine manufacturer for torque setting.

(6) Fit M10 Binx nut 'D'" to protruding shaft securing stud 'AA'. M10 Binx nut tightening torque 45.0Nm (33.0 lbs.ft).

(7) Fit louvred end cover 'G' to non-drive end bracket 'H'.

(8) Check for excessive vibration at time of initial run-up.

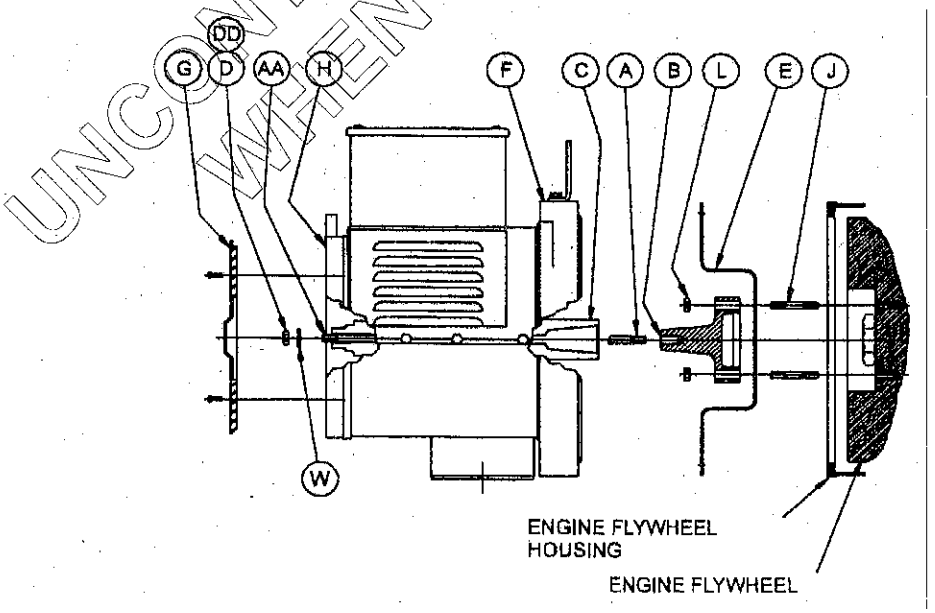

Fig 10 Taper shaft arrangements

CAUTION

EQUIPMENT DAMAGE. Incorrect guarding and/or generator alignment can result in personal injury and/or equipment damage.

EARTHING

73 The generator frame should be solidly bonded to the generating set bedplate. If anti vibration mounts are fitted between the generator frame and its bedplate a suitably rated earth conductor (normally one half of the cross sectional area of the main line cables) should bridge across the anti vibration mount.

WARNING

PERSONNEL INJURY. REFER TO LOCAL REGULATIONS TO ENSURE THAT THE CORRECT EARTHING PROCEDURE HAS BEEN FOLLOWED.

PRE-RUNNING CHECKS

Insulation check

74 Before starting the generating set, both after completing assembly and after installation of the set, test the insulation resistance of windings.

75 The AVR should be disconnected during this test.

76 A 500V Megger or similar instrument should be used. Disconnect any earthing conductor connected between neutral and earth and megger an output lead terminal U, V or W to earth. The insulation resistance reading should be in excess of 5MΩ to earth. Should the insulation resistance be less than 5MΩ the winding must be dried out as detailed in the Service and Maintenance section of this manual (Para 134).

CAUTION

EQUIPMENT DAMAGE. The windings have been H.V tested during manufacture and further H.V testing may degrade the insulation with consequent reduction in operating life. Should it be necessary to demonstrate H.V testing, for customer acceptance, the tests must be carried out at reduced voltage levels, ie Test Voltage = 0.8 (2 x Rated Voltage + 1000).

Direction of rotation and phase rotation

77 BC generators can rotate efficiently in either direction. However phase rotation is fixed for clockwise rotation as viewed from the drive end. If the generator is to be rotated in a counter-clockwise direction it will be necessary for the customers to adjust their cabling to the output terminals accordingly. Refer to the factory for a reverse wiring diagram.

Voltage and frequency

78 Check that the voltage and frequency levels required for the generating set application are as indicated on the generator nameplate.

79 Three-phase generators normally have a 12 ends out reconnectable winding. If it is necessary to reconnect the stator for the voltage required, refer to diagrams in the back of this manual.

AVR initial settings

80 To make AVR selections remove the AVR cover and refer to the following sections depending upon type of AVR fitted.

81 Reference to the generator nameplate will indicate AVR type.

AVR type SX460 - Refer to Para 83

82 Most of the AVR adjustments are factory set in positions which will give satisfactory performance during initial running test. Subsequent adjustment may be required to achieve optimum performance of the set under operating conditions. Refer to Para 92 for details.

Type SX460 AVR

83 The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

84 Refer to Figure 11 for location of selection links.

(1) Frequency selection

50Hz operation LINK C-50
60Hz operation LINK C-60

(2) External hand trimmer selection

No external hand trimmer - LINK 1-2
External hand trimmer required - REMOVE LINK 1-2 and connect trimmer across terminals 1 and 2.

(3) AVR Input Selection

High Voltage	**(220/240V)**	**INPUT**	**No Link**
Low Voltage	(110/120V)	INPUT	LINK 3-4

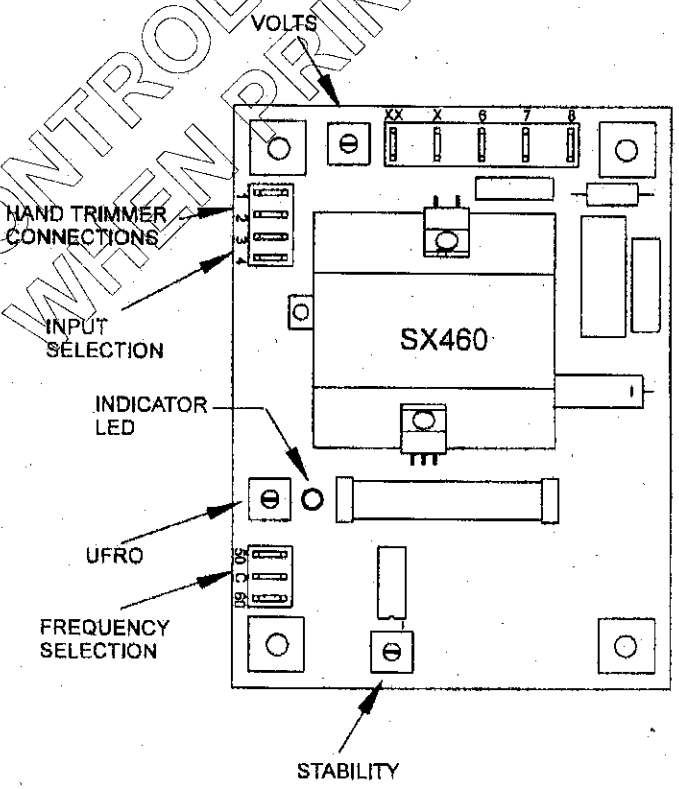

Fig 11 Type SX460 AVR

GENERATOR SET TESTING

WARNING

PERSONNEL INJURY. DURING TESTING IT MAY NE NECESSARY TO REMOVE COVERS TO ADJUST CONTROLS EXPOSING 'LIVE' TERMINALS OR COMPONENTS. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL SERVICE SHOULD CARRY OUT TESTING AND/OR ADJUSTMENT.

Test metering/cabling

85 Connect any instrument wiring and cabling required for initial test purposes with permanent or spring-clip type connectors.

86 Minimum instrumentation for testing should be line - line or line to neutral voltmeter, Hz meter, load current metering and kW meter. If reactive load is used a power factor meter is desirable.

CAUTION

(1) EQUIPMENT DAMAGE. Check that all wiring terminations for internal or external wiring are secure, and fit all terminal box covers and guards. Failure to secure wiring and/or covers may result in personal injury and/or equipment failure.

(2) EQUIPMENT DAMAGE. When fitting power cables for load testing purposes, ensure cable voltage rating is at least equal to the generator rated voltage. The load cable termination should be placed on top of the winding lead termination and clamped with the nut provided.

INITIAL START-UP

WARNING

PERSONNEL INJURY. DURING TESTING IT MAY BE NECESSARY TO REMOVE COVERS TO ADJUST CONTROLS EXPOSING 'LIVE' TERMINALS OR COMPONENTS. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL SERVICE SHOULD CARRY OUT TESTING AND/OR ADJUSTMENTS. REFIT ALL ACCESS COVERS AFTER ADJUSTMENTS ARE COMPLETED.

87 On completion of generating set assembly and before starting the generating set ensure that all engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

CAUTION

EQUIPMENT DAMAGE. Overspeeding of the generator during initial setting of the speed governor can result in damage to the generator rotating components.

88 In addition remove the AVR access cover (on AVR controlled generators) and turn VOLTS control fully anti-clockwise. Start the generating set and run on no-load at nominal frequency. Slowly turn VOLTS control potentiometer clockwise until rated voltage is reached. Refer to Fig. 11 for control potentiometer location.

CAUTION

EQUIPMENT DAMAGE. Do not increase the voltage above the rated generator voltage shown on the generator nameplate.

89 The STABILITY control potentiometer should be set to the midway position (refer to Fig 11 for its location) and with the stability selection correctly set should not normally require adjustment. Should adjustment be required, usually identified by oscillation of the voltmeter proceed as follows:

90 On SA465 major adjustment of the stability can be made by selection on switch SW2.

91 Switch position 8 will give SLOW AVR response
Switch position 0 will give FAST AVR response

(1) Run the generating set on no-load and check that speed is correct and stable.

(2) Turn the STABILITY control potentiometer clockwise, then turn slowly anti-clockwise until the generator voltage starts to become unstable. The correct setting is slightly clockwise from this position (ie where the machine volts are stable but close to the unstable region).

LOAD TESTING

WARNING

PERSONNEL INJURY. DURING TESTING IT MAY BE NECESSARY TO REMOVE COVERS TO ADJUST CONTROLS EXPOSING 'LIVE' TERMINALS OR COMPONENTS. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL SERVICE SHOULD CARRY OUT TESTING AND/OR ADJUSTMENTS. REFIT ALL ACCESS COVERS AFTER ADJUSTMENTS ARE COMPLETED.

AVR controlled generators - AVR adjustments

92 Refer to Figure 11 for control potentiometer locations.

93 Having adjusted VOLTS and STABILITY during the initial start-up procedure, the AVR control function UFRO should not normally need adjustment.

94 If however, poor voltage regulation on-load is experienced, refer to the following paragraph to check that the symptoms observed do indicate adjustment is necessary, and also to make the adjustment correctly.

UFRO (under frequency roll off)

95 The AVR incorporates an underspeed protection circuit which gives a voltage/speed (Hz) characteristic as shown:

96 The UFRO control potentiometer sets the 'knee point'.

97 Symptoms of incorrect setting are that the light emitting diode (LED) indicator, adjacent to the UFRO Control potentiometer, being permanently lit when the generator is on load, and poor voltage regulation on load, ie operation on the sloping part of the characteristic.

98 Clockwise adjustment lowers the frequency (speed) setting of the 'knee point' and extinguishes the LED. For Optimum setting the LED should illuminate as the frequency falls just below nominal frequency, ie 47Hz on a 50Hz generator or 57Hz on a 60Hz generator.

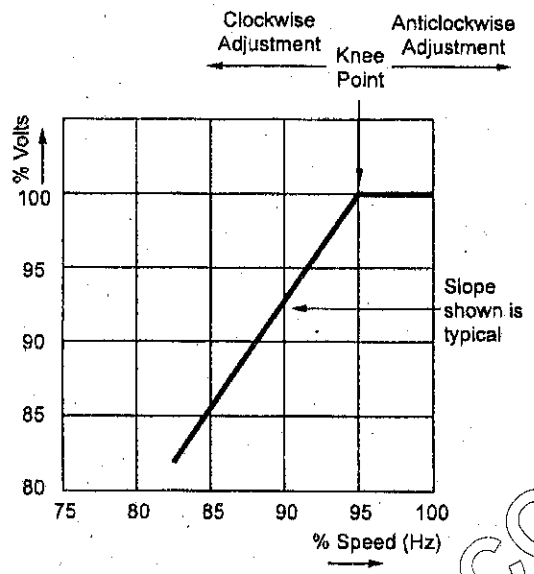

Fig 12 Under frequency roll off (UFRO)

Accessories

99 Refer to the Para 114 accessories for setting up procedures related to generator mounted accessories.

100 If there are accessories for control panel mounting supplied with the generator, refer to the specific accessory fitting procedures inserted inside the back cover of this book.

INSTALLATION – PART 2

GENERAL

101 The extent of site installation will depend upon the generating set build, eg if the generator is installed in a canopied set with integral switchboards and circuit breaker, on site installation will be limited to connecting up the site load to the generating set output terminals. In this case reference should be made to the generating set manufacturer's instruction book and any pertinent local regulations.

102 If the generator has been installed on a set without switchboard or circuit breaker the following points relating to connecting up the generator should be noted.

GLANDING

103 The terminal box will normally be supplied with the right hand side panel, viewed from the non-drive end, available for cable exit. The side panel is removable for drilling/punching to suit glands or glanding boxes. Should the cable exit be required from the left-hand side of the generator when viewed from the non-drive end, the left and right-hand panels may be interchanged. Sufficient length of wiring to the AVR has been provided for this purpose.

104 Incoming cables should be supported from either below or above the box level and at a sufficient distance from the centre line of the generating set so as to avoid a tight radius at the point of entry into the terminal box panel, and allow movement of the generator set on its anti-vibration mountings without excessive stress on the cable.

105 Before making final connections, test the insulation resistance of the windings. The AVR should be disconnected during this test.

106 A 500V Megger or similar instrument should be used. Should the insulation resistance be less than 5MW the windings must be dried out as detailed in the Service and Maintenance section of this manual.

107 When making connections to the terminals the incoming cable termination should be placed on top of the winding lead termination(s) and clamped with the nut provided.

CAUTION

EQUIPMENT DAMAGE. To avoid the possibility of swarf entering any electrical components in the terminal box, panels must be removed for drilling.

EARTHING

108 The neutral of the generator is not bonded to the generator frame as supplied from the factory. An earth terminal is provided inside the terminal box adjacent to the main terminals. Should it be required to operate with the neutral earthed a substantial earth conductor (normally equivalent to one half of the section of the line conductors) must be connected between the neutral and the earth terminal inside the terminal box. A hole is provided on the generator foot which may be tapped to give an additional earthing point. The feet should be already bonded to the generating set bedplate by the generating set builder, but will normally be required to be connected to the site earth system.

CAUTION

EQUIPMENT DAMAGE. Reference to local electricity regulations or safety rules should be made to ensure correct earthing procedures have been followed.

PROTECTION

109 It is the responsibility of the end user and his contractors/ sub-contractors to ensure that the overall system protection meets the needs of any inspectorate, local electricity authority or safety rules, pertaining to the site location.

110 To enable the system designer to achieve the necessary protection and/or discrimination, fault current curves are available on request from the factory, together with generator reactance values to enable fault current calculations to be made.

WARNING

PERSONNEL INJURY. INCORRECT INSTALLATION AND/OR PROTECTIVE SYSTEMS CAN RESULT IN PERSONAL INJURY AND/OR EQUIPMENT DAMAGE. INSTALLERS MUST BE QUALIFIED TO PERFORM ELECTRICAL INSTALLATION WORK.

COMMISSIONING

111 Ensure that all external cabling is correct and that all the generating set manufacturer's pre-running checks have been carried out before starting the set.

112 The generator AVR controls will have been adjusted during the generating set manufacturer's tests and should normally not require further adjustment. Should adjustment on site be necessary refer to Para 80 for AVR details and/or Para 118 for paralleling adjustments.

113 Should malfunction occur during commissioning refer to the Service and Maintenance section 'Fault Finding' procedure at Para 187.

ACCESSORIES

114 Generator control accessories may be fitted, as an option, in the generator terminal box. If fitted at the time of supply, the wiring diagram(s) in the back of this book shows the connections. When the options are supplied separately, fitting instructions are provided with the accessory.

115 Accessories available are droop transformer for parallel operation applicable to generators with SA465 AVR, and remote voltage adjust (hand trimmer). The latter being available for all AVR types but not fitted on the generator.

NOTE

None of the accessories can be fitted with a transformer controlled generator.

REMOTE VOLTAGE ADJUST (all AVR types)

116 A remote voltage adjust can be fitted to the control panel.

117 Remove link 1-2 on the AVR and connect adjuster to terminals 1 and 2.

PARALLEL OPERATION

118 Understanding of the following notes on parallel operation is useful before attempting the fitting or setting of the droop kit accessory. When operating in parallel with other generators or the mains, it is essential that the phase sequence of the incoming generator matches that of the busbar and also that all of the following conditions are met before the circuit breaker of the incoming generator is closed on to the busbar (or operational generator).

(1) Frequency must match within close limits.

(2) Voltages must match within close limits.

(3) Phase angle of voltages must match within close limits.

119 A variety of techniques, varying from simple synchronising lamps to fully automatic synchronisers, can be used to ensure these conditions are met.

CAUTION

EQUIPMENT DAMAGE. Failure to meet conditions (1), (2) and (3) when closing the circuit breaker, will generate excessive mechanical and electrical stresses, resulting in equipment damage.

120 Once connected in parallel a minimum instrumentation level per generator of voltmeter, ammeter, watt meter (measuring total power per generator), and frequency meter is required in order to adjust the engine and generator controls to share kW in relation to engine ratings and kVAr in relation to generator ratings.

121 It is important to recognise that:

(1) kW are derived from the engine, and speed governor characteristics determine the kW sharing between sets.

(2) kVAr are derived from the generator, and excitation control characteristics determine the kVAr sharing. Reference should be made to the generating set manufacturer's instructions for setting the governor controls.

Droop

122 The most commonly used method of kVAr sharing is to create a generator voltage characteristic which falls with decreasing power factor (increasing kVAr). This is achieved with a current transformer (CT) which provides a signal dependent on current phase angle (ie power factor) to the AVR. The current transformer has a burden resistor on the AVR board, and a percentage of the burden resistor voltage is summed into the AVR circuit. Increasing droop is obtained by turning the DROOP control potentiometer clockwise.

123 The diagrams below indicate the effect of droop in a simple two-generator system:

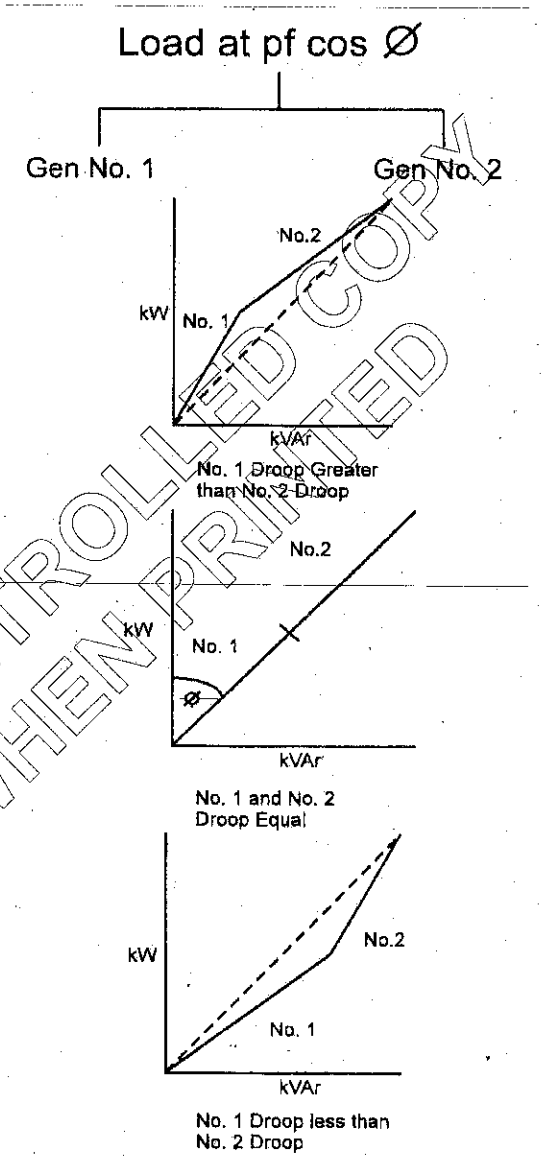

Fig 13 Droop in a simple two-generator system

124 Generally 5% droop at full load current zero pf is sufficient to ensure kVAr sharing.

125 If the droop accessory has been supplied with the generator it will have been tested to ensure correct polarity and set to a nominal level of droop. The final level of droop will be set during generating set commissioning.

126 The following setting procedure will be found to be helpful.

Setting procedure

127 Depending upon available load the following settings should be used - all are based on rated current level.

0.8 P.F. LOAD	(at full load current)	SET DROOP TO 3%
0 P.F. LOAD	(at full load current)	SET DROOP TO 5%

128 Setting the droop with low power factor load is the most accurate.

129 Run each generator as a single unit at rated frequency or rated frequency + 4% depending upon type of governor and nominal voltage. Apply available load to rated current of the generator. Adjust 'DROOP' control potentiometer to give droop in line with above table. Clockwise rotation increases amount of droop. Refer to Fig 11 for potentiometer location. After adjustment check NO LOAD voltage level and adjust if necessary.

NOTES

(1) Reverse polarity of the CT will raise the generator voltage with load. The polarities S1-S2 shown on the wiring diagrams are correct for clockwise rotation of the generator looking at the drive end. Reversed rotation requires S1-S2 to be reversed.

(2) The most important aspect is to set all generators equal. The precise level of droop is less critical.

(3) A generator operated as a single unit with a droop circuit set at rated load 0.8 power factor is unable to maintain the usual % regulation. A shorting switch can be connected across S1-S2 to restore regulation for single running.

CAUTION

EQUIPMENT DAMAGE. LOSS OF FUEL to an engine can cause its generator to motor with consequent damage to the generator windings. Reverse power relays should be fitted to trip main circuit breaker. LOSS OF EXCITATION to the generator can result in large current oscillations with consequent damage to generator windings. Excitation loss detection equipment should be fitted to trip main circuit breaker.

Astatic control

130 The 'droop' current transformer can be used in a connection arrangement which enables the normal regulation of the generator to be maintained when operating in parallel.

131 This feature is only supplied from the factory as a fitted droop kit, however, if requested at the time of order, the diagrams inside the back cover of this book will give the necessary site connections. The end user is required to provide a shorting switch for the droop current transformer secondary.

132 Should the generator be required to be converted from standard droop to 'astatic' control, diagrams are available on request.

133 The setting procedure is exactly the same as for DROOP (Para 127).

CAUTION

EQUIPMENT DAMAGE. When using this connection arrangement a shorting switch is required across each CT burden (terminals S1 and S2). The switch must be closed when a generating set is not running and when a generating set is selected for single running.

SERVICE AND MAINTENANCE

WINDING CONDITION

WARNING

PERSONNEL INJURY. SERVICE AND FAULT FINDING PROCEDURES PRESENT HAZARDS THAT CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH. ONLY PERSONAL INJURY OR DEATH. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL AND MECHANICAL SERVICE SHOULD CARRY OUT THESE PROCEDURES. ENSURE ENGINE STARTING CIRCUITS ARE DISABLED BEFORE COMMENCING SERVICE OR MAINTENANCE PROCEDURES. ISOLATE ANY ANTI-CONDENSATION HEATER SUPPLY.

Guidance of typical insulation resistance [IR] values

134 The following is offered as general information about IR values and is aimed at providing guidance about the typical IR values for generators from new through to the point of refurbishment.

New machines

135 The generators Insulation Resistance, along with many other critical factors, will have been measured during the alternator manufacturing process. The generator will have been transported with an appropriate packaging suitable for the method of delivery to the Generating Set assemblers works. Where we expect it to be stored in a suitable location protected from adverse environmental conditions.

136 However, absolute assurance that the generator will arrive at the Gen-set production line with IR values still at the factory test levels of above 100 MΩ cannot be guaranteed.

At generating set manufacturers works

137 The generator should have been transported and stored such that it will be delivered to the assembly area in a clean dry condition. If held in appropriate storage conditions the generator IR value should typically be 25 MΩ.

138 If the unused/new generators IR values fall below 10 MΩ then a drying out procedure should be implemented by one of the processes outlined below before being despatched to the end customer's site. Some investigation should be undertaken into the storage conditions of the generator while on site.

Generators in service

139 Whilst it is known that a generator will give reliable service with an IR value of just 1.0 MΩ. For a relatively new generator to be so low it must have been subjected to inappropriate operating or storage conditions.

140 Any temporarily reduction in IR values can be restored to expected values by following one of the drying out procedures.

Winding condition assessment

CAUTION

EQUIPMENT DAMAGE. The AVR should be disconnected and the Resistance Temperature Detector (RTD) leads grounded during this test.

141 The condition of the windings can be assessed by measurement of insulation resistance [IR] between phase to phase, and phase to earth.

142 Measurement of winding insulation should be carried out:

(1) As part of a periodic maintenance plan.

(2) After prolonged periods of shutdown.

(3) When low insulation is suspected, eg damp or wet windings.

143 Care should be taken when dealing with windings that are suspected of being excessively damp or dirty. The initial measurement of the [IR] Insulation Resistance should be established using a low voltage (500V) megger type instrument. If manually powered the handle should initially be turned slowly so that the full test voltage will not be applied, and only applied for long enough to very quickly assess the situation if low values are suspected or immediately indicated.

144 Full megger tests or any other form of high voltage test should not be applied until the windings have been dried out and if necessary cleaned.

Procedure for insulation testing

145 Disconnect all electronic components, AVR, electronic protection equipment etc. Ground the [RTDs] Resistance Temperature Detection devices if fitted. Short out the diodes on the rotating diode assembly. Be aware of all components connected to the system under test that could cause false readings or be damaged by the test voltage.

146 Carry out the insulation test in accordance with the operating instructions for the test equipment.

147 The measured value of insulation resistance for all windings to earth and phase to phase should be compared with the guidance given above for the various 'life stages' of a generator. The minimum acceptable value must be greater than 1.0 MΩ.

148 If low winding insulation is confirmed, use one or more of the methods given below for drying the winding.

Methods of drying out generators

Cold run

149 Consider a good condition generator that has not been run for some time, and has been standing in damp, humid conditions. It is possible that simply running the gen set unexcited (AVR terminals K1 K2 open circuit) for a period of say 10 minutes will sufficiently dry the surface of the windings and raise the IR sufficiently, to greater than 1.0 MΩ, and so allow the unit to be put into service.

Blown air drying

150 Remove the covers from all apertures to allow the escape of the water-laden air. During drying, air must be able to flow freely through the generator in order to carry off the moisture.

151 Direct hot air from two electrical fan heaters of around 1 – 3 kW into the generator air inlet apertures. Ensure the heat source is at least 300mm away from the windings to avoid overheating and damage to the insulation.

152 Apply the heat and plot the insulation value at half hourly intervals. The process is complete when the parameters covered in the section entitled, 'Typical Drying Out Curve', are met.

153 Remove the heaters, replace all covers and re-commission as appropriate.

154 If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest prior to running.

Short circuit method

NOTE

This process should only be performed by a competent engineer familiar with safe operating practices within and around generator sets of the type in question.

155 Ensure the generator is safe to work on. Initiate all mechanical and electrical safety procedures pertaining to the gen set and the site.

156 Bolt a short circuit of adequate current carrying capacity, across the main terminals of the generator. The shorting link should be capable of taking full load current.

157 Disconnect the cables from terminals 'X' and 'XX' of the AVR.

158 Connect a variable dc supply to the 'X' (positive) and 'XX' (negative) field cables. The dc supply must be able to provide a current up to 2.0 Amp at 0 - 24 Volts.

159 Position a suitable ac ammeter to measure the shorting link current.

160 Set the dc supply voltage to zero and start the generating set. Slowly increase the dc voltage to pass current through the exciter field winding. As the excitation current increases, so the stator current in the shorting link will increase. This stator output current level must be monitored, and not allowed to exceed 80% of the generators rated output current.

161 After every 30 minutes of this exercise:

(1) Stop the generator and switch off the separate excitation supply, and measure and record the stator winding IR values, and plot the results. The resulting graph should be compared with the classic shaped graph. This drying out procedure is complete when the parameters covered in the section entitled 'Typical Drying Out Curve' are met.

162 Once the Insulation Resistance is raised to an acceptable level - minimum value 1.0MΩ, the dc supply may be removed and the exciter field leads 'X' and 'XX' re-connected to their terminals on the AVR.

163 Rebuild the gen set, replace all covers and re-commission as appropriate.

164 If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest the generator prior to running.

Typical drying out curve

165 Whichever method is used to dry out the generator the resistance should be measured every half-hour and a curve plotted as shown in Fig 14.

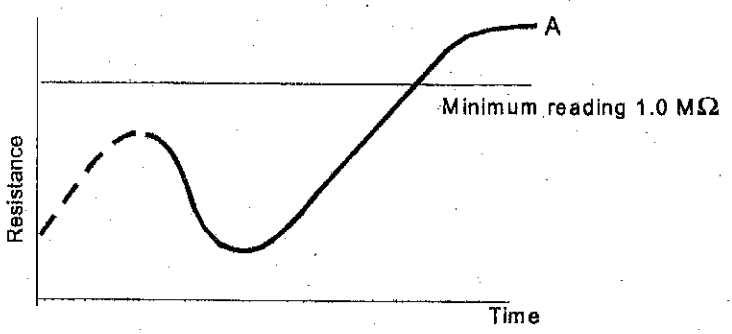

Fig 14 Drying time/resistance plot

166 The illustration shows a typical curve for a machine that has absorbed a considerable amount of moisture. The curve indicates a temporary increase in resistance, a fall and then a gradual rise to a steady state. Point 'A', the steady state, must be greater than 1.0 MΩ. (If the windings are only slightly damp the dotted portion of the curve may not appear.)

167 For general guidance expect that the typical time to reach point 'A' will be:

1 hour for a BC16/18,
2 hours for a UC22/27
3 hours for an HC4, 5, 6 and 7

Drying should be continued after point 'A' has been reached for at least one hour.

168 It should be noted that as winding temperature increases, values of insulation resistance may significantly reduce. Therefore, the reference values for insulation resistance can only be established with windings at a temperature of approximately 20°C.

169 If the IR value remains below 1.0 MΩ, even after the above drying methods have been properly conducted, then a Polarisation Index test [PI] should be carried out.

170 If the minimum value of 1.0 MΩ for all components cannot be achieved rewinding or refurbishment of the generator will be necessary.

171 The generator must not be put into service until the minimum values can be achieved.

CAUTION

EQUIPMENT DAMAGE. The short circuit must not be applied with the AVR connected in circuit. Current in excess of the rated generator current will cause damage to the windings.

172 After drying out, the insulation resistances should be rechecked to verify minimum resistances quoted above are achieved. On re-testing it is recommended that the main stator insulation resistance is checked as follows:

173 Separate the neutral leads: Ground V and W phase and megger U phase to ground.

Ground U and W phase and megger V phase to ground.

Ground U and V phase and megger W phase to ground.

174 If the minimum value of 1.0 MΩ is not obtained, drying out must be continued and the test repeated.

BEARINGS

175 All bearings are supplied sealed for life and are, therefore, not regreasable.

CAUTION

(1) EQUIPMENT DAMAGE. The life of a bearing in service is subject to the working conditions and the environment.

(2) EQUIPMENT DAMAGE. Long stationary periods in an environment where there is vibration can cause false brinnelling, which puts flats on the ball, and grooves on the races. Very humid atmospheres or wet conditions can emulsify the grease and cause corrosion.

(3) EQUIPMENT DAMAGE. High axial vibration from the engine or misalignment of the set will stress the bearing.

176 The bearing, in service, is affected by a variety of factors that together will determine the bearing life. We recommend that the health of the bearings be monitored, using 'spike energy' vibration monitoring equipment. This will allow the timely replacement of bearings that exhibit a deteriorating trend, during a major engine overhaul.

177 If excessive heat, noise or vibration is detected, change the bearing as soon as practicable. Failure to do so could result in bearing failure.

178 In the event that 'spike energy' vibration monitoring equipment is not available, it is strongly recommend that consideration be given to changing the bearing during each 'major engine overhaul'.

179 Belt driven application will impose an additional load on bearings. The bearing life will therefore be significantly affected. It is important that the side load limits (given in Table 2) are not exceeded and the health of the bearing is monitored more closely.

AIR FILTERS

WARNING

PERSONNEL INJURY. REMOVAL OF FILTER ELEMENTS ENABLES ACCESS TO LIVE PARTS. ONLY REMOVE ELEMENTS WITH THE GENERATOR OUT OF SERVICE.

180 The frequency of filter maintenance will depend upon the severity of the site conditions. Regular inspection of the elements will be required to establish when cleaning is necessary.

Cleaning procedure

181 Remove the filter elements from the filter frames. Immerse or flush the element with a suitable degreasing agent until the element is clean.

182 Alternatively, after removing the filter elements a high-pressure water hose with a flat nozzle can be used. Sweep the water spray back and forth across the element from the clean side (fine mesh side of element) holding the nozzle firmly against the element surface. Cold water may be adequate depending upon type of contamination although hot water is preferable.

183 The element can be inspected for cleanliness by looking through the filter towards the light. When thoroughly clean, no cloudy areas will be seen.

184 Dry elements thoroughly before attempting to carry out the recharging procedure.

Recharging (charging)

185 Charging is best done by totally immersing the dry element into a dip tank containing 'Filterkote Type K' or commercial lubricating oil SAE 20/50. Oils of higher or lower viscosity are not recommended.

186 Allow elements to completely drain before refitting the elements into the frames and putting into service.

FAULT FINDING

CAUTION

EQUIPMENT DAMAGE. Before commencing any fault finding procedures examine all wiring for broken or loose connections.

187 Three excitation control systems can be fitted to the range of generators covered by this manual, identified by the last digit of the generator frame size designation. Refer to the nameplate then proceed to the appropriate sub-section as indicated below:

SERIES	EXCITATION CONTROL	PARA
4	SA465 AVR	
5	Transformer control	
6	**SX460 AVR**	**13**

All AVR types - fault finding

TABLE 3 FAULT FINDING

Symptom	Actions
No voltage build-up when starting set	1 Check speed. 2 Check residual voltage. Refer to Para 188. 3 Follow separate excitation test procedure to check generator and AVR. Refer to Para 192.
Unstable voltage either on no-load or with load	1 Check speed stability. 2. Check stability setting. Refer to Para 87.
High voltage either on no-load or with load	1 Check speed. 2 Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1 Check speed. 2 Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1 Check speed. 2 Check UFRO setting. Refer to Para 95. 3 Follow separate excitation procedure to check generator and AVR. Refer to Para 192.

Residual voltage check (field flashing)

188 This procedure applies to all generators fitted with AVR control. With the generator set stationary remove AVR access cover and leads F1 and F2 from the AVR.

189 Start the set and measure voltage across AVR terminals 7-8. A minimum level of 5 Volts is required at these terminals. If the voltage is less than 5 Volts stop the set, because it will be necessary to carry out the following Field Flashing procedure. Replace leads F1 and F2 on the AVR terminals. Using a 12 Volt dc battery as a supply, clip leads from battery negative to AVR terminal F2, and from battery positive through a diode to AVR terminal F1. See Fig 15.

CAUTION

EQUIPMENT DAMAGE. A diode must be used as shown below to ensure the AVR is not damaged.

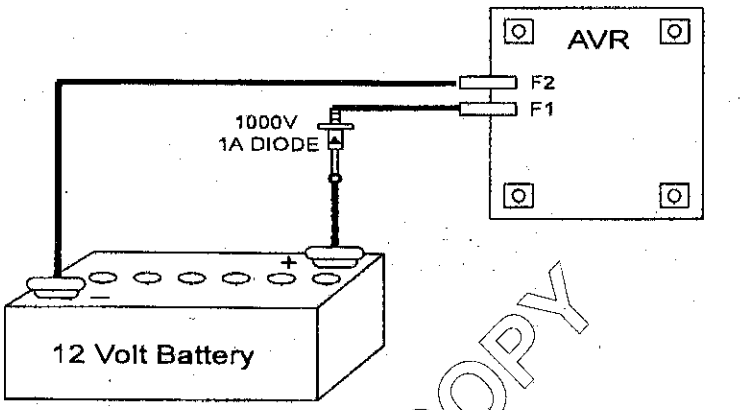

Fig 15 Residual voltage check

CAUTION

EQUIPMENT DAMAGE. If the generating set battery is used for field flashing, the generator main stator neutral must be disconnected from earth.

190 Restart the set and note output voltage from the main stator, which should be approximately nominal voltage, or voltage at AVR terminals 7 and 8, which should be between 170 and 250 Volts.

191 Stop the set and unclip battery supply from terminals F1 and F2. Restart the set. The generator should now operate normally. If no voltage build-up is obtained it can be assumed a fault exists in either the generator or the AVR circuits. Follow the Separate Excitation Procedure to check generator windings, rotating diodes and AVR. Refer to Para 192.

SEPARATE EXCITATION TEST PROCEDURE

192 The generator windings, diode assembly and AVR can be checked using this procedure.

(1) With the generating set stationary remove AVR access cover and leads F1 and F2 from the AVR. On transformer controlled generators remove the terminal box lid for access and remove leads F1 and F2 from the control rectifier bridge.

(2) Connect a 60W 240 Volt household lamp (or two 120V lamps in series) to AVR terminals F1 and F2. (Only required for Para 209.)

(3) Connect a 0-12 volt, 1.0 Amp dc supply to leads F1 and F2. The positive of the dc supply is connected to the lead marked F1 and the negative to the lead marked F2.

193 The procedure is simplified by dividing into two sections:

(1) Generator windings and rotating diodes and excitation control test.

(2) Excitation control test.

Generator windings and rotating diodes

CAUTION

EQUIPMENT DAMAGE. The resistances quoted apply to a standard winding. For generators having windings or voltages other than those specified refer to factory for details. Ensure all disconnected leads are isolated and free from earth.

194 This procedure is carried out with leads F1 and F2 disconnected at the AVR or transformer control rectifier bridge and using a 12 Volt dc supply to leads F1 and F2.

195 Start the set and run at rated speed, on no-load.

196 Measure the voltages at the main output terminals U, V and W. These should be balanced and within 10% of the generator nominal voltage.

197 On generators fitted with an auxiliary winding in the main stator, applicable only with the SA665 AVR, the voltage at AVR terminals 8 and Z2 should be approximately 150 Volts ac.

Balanced main terminal voltages

198 If all voltages are balanced within 1% at the main terminals, it can be assumed that all exciter windings, main windings and main rotating diodes are in good order, and the fault is in the AVR or transformer control. Refer to Para 209 for test procedure.

199 If voltages are balanced but low, there is a fault in the main excitation windings or rotating diode assembly. Proceed as follows to identify:

Rectifier diodes

200 The diodes on the main rectifier assembly can be checked with a multimeter. The flexible leads connected to each diode should be disconnected at the terminal end, and the forward and reverse resistance checked. A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction. A faulty diode will give a full deflection reading in both directions with the test meter on the 10,000 ohms scale, or an infinity reading in both directions.

Replacement of faulty diodes

201 The rectifier assembly is split into two plates, the positive and negative, and the main rotor is connected across these plates. Each plate carries three diodes, the negative plate carrying negative biased diodes and the positive plate carrying positive biased diodes. Care must be taken to ensure that the correct polarity diodes are fitted to each respective plate. When fitting the diodes to the plates they must be tight enough to ensure a good mechanical and electrical contact, but should not be overtightened. The recommended torque tightening is 4.06 - 4.74Nm (36-42lb in).

Surge suppressor

202 The surge suppressor is a metal-oxide varistor connected across the two rectifier plates to prevent high transient reverse voltages in the field winding from damaging the diodes. This device is not polarised and will show a virtually infinite reading in both directions with an ordinary resistance meter. If defective this will be visible by inspection, since it will normally fail to short circuit and show signs of disintegration. Replace if faulty.

Main excitation windings

203 If after establishing and correcting any fault on the rectifier assembly the output is still low when separately excited, then the main rotor, exciter stator and exciter rotor winding resistances should be checked (see Table 4), as the fault must be in one of these windings. The exciter stator resistance is measured across leads F1 and F2. The exciter rotor is connected to six studs which also carry the diode lead terminals. The main rotor winding is connected across the two rectifier plates. The respective leads must be disconnected before taking the readings.

204 Resistance values should be within 10% of the values given in Table 4 below:

TABLE 4 MAIN EXCITATION WINDINGS

Frame size	Main rotor	Exciter stator			Exciter rotor
		Type 1	Type 2 *	Type 3**	
BC164A	0.44	19	26	110	0.26
BC164B	0.48	19	26	110	0.26
BC164C	0.52	19	26	110	0.26
BC164D	0.56	19	26	110	0.26
BC184E	0.64	20	27	115	0.21
BC184F	0.74	22	30	127	0.23
BC184G	0.83	22	30	127	0.23
BC184H	0.89	24	-	-	0.24
BC184J	0.96	24	-	-	0.24
BC162D	0.81	18	-	-	0.26
BC162E	0.89	18	-	-	0.26
BC162F	0.95	18	-	-	0.26
BC162G	1.09	19	-	-	0.27
BC182H	1.17	20	-	-	0.21
BC182J	**1.28**	**20**	**-**	**-**	**0.21**
BC182K	1.4	20	-	-	0.21
BCA162L	1.55	20	-	-	0.21

* Used with 1-phase transformer controlled 3-phase or 1-phase generators

** Used with 3-phase transformer controlled 3-phase generators.

Unbalanced main terminal voltages

205 If voltages are unbalanced, this indicates a fault on the main stator winding or main cables to the circuit breaker.

NOTE

Faults on the stator winding or cables may also cause noticeable load increase on the engine when excitation is applied. Disconnect the main cables and separate the winding leads U1-U2, U5-U6, V1-V2, V5-V6, W1-W2, W5-W6 to isolate each winding section.

206 Measure each section resistance - values should be balanced and within 10% of the value given in Table 5 below:

TABLE 5 AVR CONTROLLED GENERATORS

Frame size	Section resistances		
	Winging 311	Winging 05	Winging 06
BC164A	0.81	0.41	0.31
BC164B	0.51	0.30	0.19
BC164C	0.36	0.21	0.13
BC164D	0.3	0.32	0.21
BC184E	0.20	0.20	0.13
BC184F	0.13	0.14	0.09
BC184G	0.11	0.11	0.07
BC184H	0.085	0.041	0.029
BC184J	0.074	0.034	0.024
BC162D	0.68	0.30	0.25
BC162E	0.42	0.21	0.15
BC162F	0.31	0.17	0.11
BC162G	0.21	0.10	0.095
BC182H	0.16	0.075	0.055
BC182J	**0.13**	**0.06**	**0.042**
BC182K	0.10	0.047	0.030
BCA162L	0.65	0.03	0.02

207 Measure insulation resistance between sections and each section to earth.

208 Unbalanced or incorrect winding resistances and/or low insulation resistances to earth indicate rewinding of the stator will be necessary. Refer to removal and replacement of component assemblies commencing at Para 213.

EXCITATION CONTROL TEST

AVR function test

209 All types of AVR can be tested with this procedure:

(1) Remove exciter field leads X and XX (F1 and F2) from the AVR terminals X and XX (F1 and F2).

(2) Connect a 60W 240V household lamp to AVR terminals X and XX (F1 and F2).

(3) Set the AVR VOLTS control potentiometer fully clockwise.

(4) Connect a 12V, 1.0A dc supply to the exciter field leads X and XX (F1 and F2) with (F1) to the positive.

(5) Start the generating set and run at rated speed.

(6) Check that the generator output voltage is within +/- 10% of rated voltage.

210 Voltages at AVR terminals 7-8 on SX460 AVR or P2-P3 on SX421 AVR SHOULD BE BETWEEN 170 AND 250 VOLTS. If the generator output voltage is correct but the voltage on 7-8 (or P2-P3) is low, check auxiliary leads and connections to main terminals.

211 The lamp connected across X-XX should glow. In the case of the SX460 and SA465 AVRs the lamp should glow continuously. Failure to turn off indicates faulty protection circuit and the AVR should be replaced. Turning the 'VOLTS' control potentiometer fully anti-clockwise should turn off the lamp with all AVR types.

212 Should the lamp fail to light the AVR is faulty and must be replaced.

CAUTION

EQUIPMENT DAMAGE. After this test turn the VOLTS control potentiometer fully anti-clockwise.

REMOVAL AND REPLACEMENT OF COMPONENT ASSEMBLIES

CAUTION

(1) EQUIPMENT DAMAGE. The following procedures assume that the generator has been removed from the generating set. On single bearing generators before removal from the engine, position the rotor such that a full pole face is at bottom dead centre. Use engine pulley to turn rotor. Metric threads are used throughout.

(2) EQUIPMENT DAMAGE. When lifting single bearing generators, care is needed to ensure the generator frame is kept in the horizontal plane. The rotor is free to move in the frame and can slide out if not correctly lifted. Incorrect lifting can cause serious personal injury.

Removal of bearings

CAUTION

EQUIPMENT DAMAGE. Position the main rotor so that a full pole face of the main rotor core is at the bottom of the stator bore.

213 Removal of bearings may be effected either after the rotor assembly has been removed or simply by removal of end bracket(s).

214 Refer to main rotor assembly at Para 218.

215 The bearings are pre-packed with grease and sealed for life.

(1) The bearing(s) are a press fit on the shaft and can be removed with standard tooling, ie 2 or 3 legged manual or hydraulic bearing pullers.

(2) Remove circlip from shaft at non-drive end (only fitted on single bearing machines).

216 When fitting new bearings use a bearing heater to expand the bearing before fitting to the shaft. Tap the bearing into place ensuring that it contacts the shoulder on the shaft.

217 Refit the retaining circlip on single bearing generators.

Main rotor assembly

Single bearing generator

218 (1) Remove four screws securing louvred cover at non-drive end and remove cover.

(2) Remove the screws and covers on each side of adaptor.

(3) Ensure that rotor is supported at DE on a sling.

(4) Tap the rotor from non-drive end bearing housing to push the bearing clear of the end bracket and its retaining 'O' ring.

(5) Continue to push rotor through stator bore, gradually moving sling along rotor as it is withdrawn, to ensure full support at all times.

CAUTION

EQUIPMENT DAMAGE. When re-assembling position the rotor such that full pole face is at bottom dead centre.

219 This may make removal of shaft securing stud 'AA' difficult.

220 Replacement of rotor assemblies is a reversal of the procedures above.

Re-assembly of generator engine

221 Before commencing re-assembly, components should be checked for damage and bearing(s) examined for loss of grease.

222 Fitting of new bearing(s) is recommended during major overhaul.

223 Before re-assembling to the engine drive shafts and couplings or drive disc should be checked for damage or wear.

224 Where fitted the drive disc should be examined for cracks, signs of fatigue or elongation of fixing holes.

225 Ensure that the disc to shaft end fixing bolts are fitted with the pressure plate and are torque tightened to 7.6kgm (75Nm 55lbs.ft).

226 Taper shaft drive end arrangements should be checked for damage to the taper on both shaft and coupling hub. Ensure both tapers are free from oil before refitting.

227 Refer to Para 69 for assembly to engine.

NOTE

The M10 'BINX' nut should always be renewed. Tightening torque 4.6kgm, (45Nm; 33lbs.ft).

228 Damaged or worn components must be replaced.

RETURNING TO SERVICE

229 After rectification of any faults found, remove all test connections and reconnect all control system leads.

230 Restart the set and adjust VOLTS control potentiometer on AVR by slowly turning clockwise until rated voltage is obtained.

231 Refit all terminal box covers/access covers and reconnect heater supply.

CAUTION

EQUIPMENT DAMAGE. Failure to refit all guards, access covers and terminal box covers can result in personal injury or death.

SPARES AND AFTER SALES SERVICE

RECOMMENDED SPARES

232 Service parts are conveniently packaged for easy identification. Genuine parts may be recognised by the Nupart name.

233 We recommend the following for Service and Maintenance. In critical applications a set of these service spares should be held with the generator.

AVR controlled generators

234	(1)	Diode set (6 diodes with surge suppressor)	RSK	1101
	(2)	SA465 AVR	E000	24650
		SX460 AVR	**E000**	**24602**
	(3)	Non-drive end bearing	051	01058
	(4)	BC16 and BC18 Drive end bearing	051	01032

235 When ordering parts the machine serial number or machine identity number and type should be quoted, together with the part description. For location of these numbers see Para 8.

236 Orders and enquiries for parts should be addressed to:

Newage International Limited
Nupart Department
PO Box 17, Barnack Road
STAMFORD
Lincolnshire
PE9 2NB
ENGLAND

Telephone: 44 (0) 1780 484000
Fax: 44 (0) 1780 766074

Or any of our subsidiary companies listed on the back cover.

Assembly tools

237 Locating bar (Single bearing) AF1609.

8mm ratchet box wrench (for M10 socket screws) AF1599.

AFTER SALES SERVICE

238 A full technical advice and on-site service facility is available from our Service Department at Stamford or through our Subsidiary Companies. A repair facility is also available at our Stamford Works.

TABLE 6 PARTS LIST TYPICAL SINGLE BEARING GENERATOR

Fig 16 Ref.	Description
1	Stator
2	Rotor
3	Exciter Rotor
4	Exciter Stator
5	NDE End bracket
6	Cover NDE.
7	Bearing 'O' Ring NDE
8	Bearing NDE
9	DE Adaptor
10	DE Screen
11	Coupling Hub
12	Pressure Plate
13	Coupling Bolt
14	Foot
15	Frame Cover Bottom
16	Frame Cover Top
17	Terminal Box Lid
18	End Panel DE
19	End Panel NDE
20	Side Panel (AVR)
21	Side Panel
22	Main Terminal Panel
23	Terminal Link
24	Main Rectifier Assembly - Forward
25	Main Rectifier Assembly - Reverse
26	Varistor
27	Diode Reverse Polarity
28	Diode Forward Polarity
29	AVR
30	AVR Mounting Plate
31	AVR Mounting Bracket
32	AVM
33	Fan Hub
34	Fan
35	Fan Securing Screw

NDE	Non-Drive End
DE	Drive End
AVR	Automatic Voltage Regulator
AVM	Anti-Vibration Mount

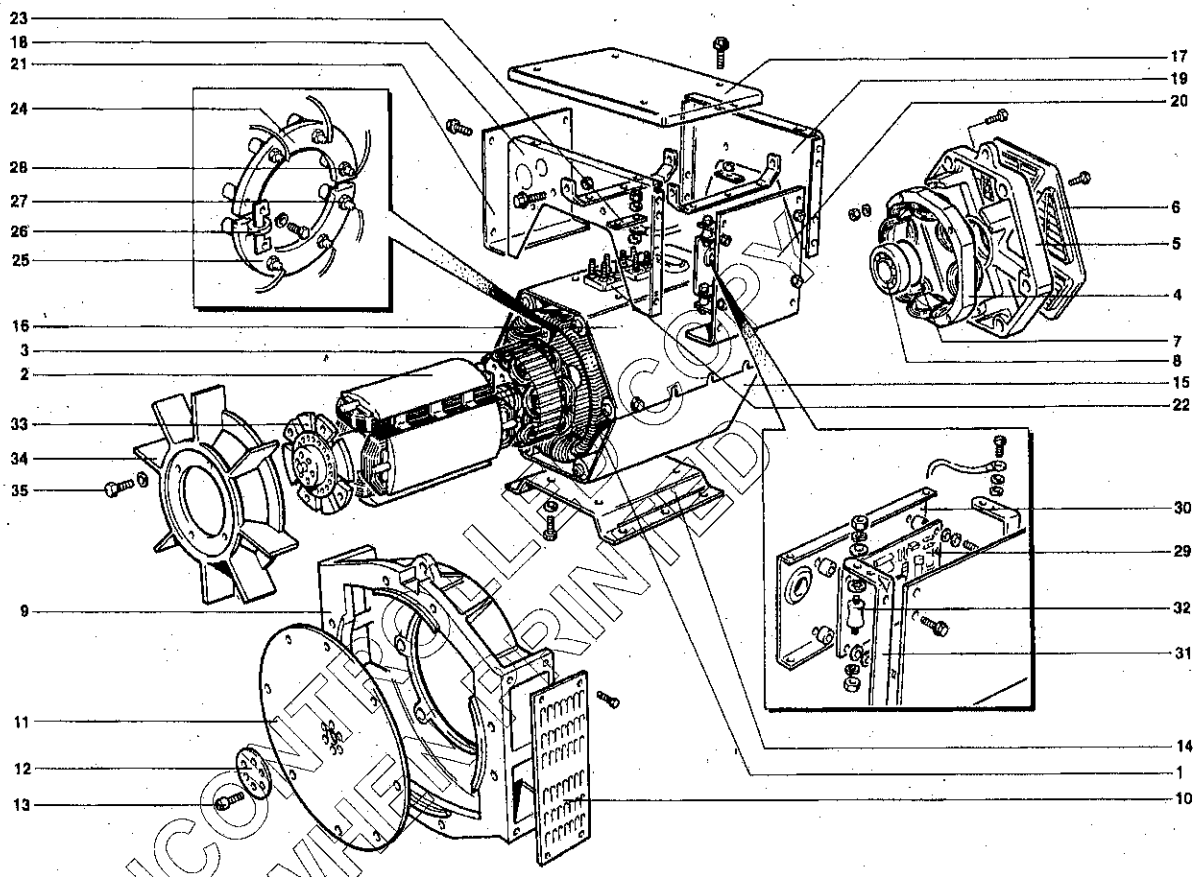

Fig 16 Typical single bearing generator

AC GENERATOR WARRANTY

WARRANTY PERIOD

AC Generators

In respect of ac generators the Warranty Period is eighteen months from the date when the goods have been notified as ready for despatch by NI or twelve months from the date of first commissioning (whichever is the shorter period).

DEFECTS AFTER DELIVERY

We will make good by repair or, at our option, by the supply of a replacement, any fault which under proper use appears in the goods within the period specified on Clause 12, and is found on examination by us to be solely due to defective material and workmanship; provided that the defective part is promptly returned, carriage paid, with all identification numbers and marks intact, or our works or, if appropriate to the Dealer who supplied the goods.

Any part repaired or replaced, under warranty, will be returned by NI free of charge (via sea freight if outside the UK).

We shall not be liable for any expenses which may be incurred in removing or replacing any part sent to us for inspection or in fitting any replacement supplied by us. We shall be under no liability for defects in any goods which have not been properly installed in accordance with NI recommended installation practices as detailed in the publications 'NI Installation, Service and Maintenance Manual' and 'NI Application Guidelines', or which have been improperly stored or which have been repaired, adjusted or altered by any person except ourselves or our authorised agents, or in any second-hand goods, proprietary articles or goods not of our own manufacture although supplied by us, such articles and goods being covered by the warranty (if any) given by the separate manufacturers.

Any claim under this clause must contain fully particulars of the alleged defect, the description of the goods, the date of purchase, and the name and address of the Vendor, the Serial Number (as shown on the manufacturers identification plate) or for Spares the order reference under which the goods were supplied.

Our judgement in all cases of claims shall be final and conclusive and the claimant shall accept our decision on all questions as to defects and the exchange of a part or parts.

Our liability shall be fully discharged by either repair or replacement as above, and in any event shall not exceed the current list price of the defective goods.

Our liability under this clause shall be in lieu of any warranty or condition implied by law as to the quality or fitness for any particular purpose of the goods, and save as expressly provided in this clause we shall not be under any liability, whether in contract, tort or otherwise, in respect of defects in goods delivered or for any injury, damages or loss resulting from such defects or from any work undone in connection therewith.

MACHINE SERIAL NUMBER

NEWAGE INTERNATIONAL LIMITED

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ANNEX E

DEEP SEA ELECTRONICS plc

ENGINE MANAGEMENT SYSTEM

ANNEX E

DEEP SEA ELECTRONICS plc - ENGINE MANAGEMENT SYSTEM

CONTENTS

ANNEX E

ENGINE MANAGEMENT SYSTEM

INTRODUCTION

1 The DSE **520** Remote Start Module has been designed to allow the OEM to meet most of the industry's complex specifications. It has been primarily designed to start a generator when a remote start signal from a remote transfer switch or other monitoring system applies an earthing signal to the remote start input of the **520**. Transfer the load to the generator when the operating criteria have been met, then shutdown the engine on removal of the remote start signal.

2 Once activated the **520** module carries out all the start and stop procedures of the engine, indicating the operational status and fault conditions; automatically shutting down the engine and giving a true first up fault condition of an engine failure by a flashing LED and other simultaneous faults by a steady LED. This information is indicated by the LEDs on the front panel.

3 Selective operational sequences, timers and alarm trips can be altered by the customer. Alterations to the system are made by using a PC with the **808** interface.

4 Access to critical operational sequences and settings for use by qualified engineers, are barred by a security code. Timers are protected by a separated code allowing operator changes to be made.

5 The module is housed in a robust plastic case for the front panel mounting. Connections to the module are via locking plug and sockets.

Clarification of notation used within this publication

NOTE	Highlights an essential element of a procedure to ensure correctness.
CAUTION	Indicates a procedure or practice that, if not strictly observed, could result in damage or destruction of equipment.
WARNING	Indicates a procedure or practice that could result in injury to personnel or loss of life if not followed correctly.
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OPERATION

6 On connection of the dc power supply to the module, the module becomes active.

CONTROL

7 Control of the **520** module is by a three position rotary switch or key-switch (specified on ordering), mounted on the front of the module with OFF, AUTO and MANUAL positions.

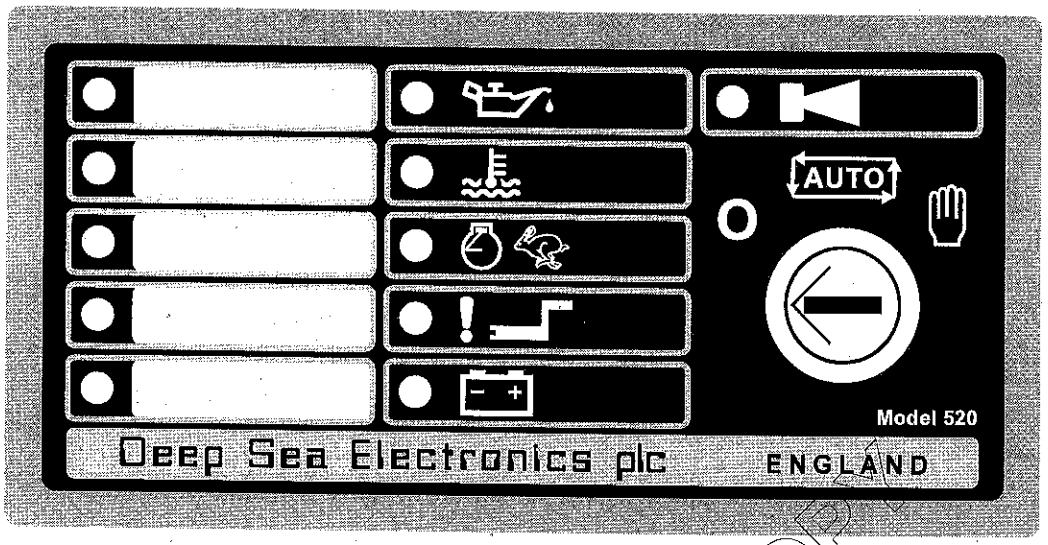


Fig 1 DSE 520 remote start module front panel

AUTOMATIC MODE OF OPERATION

8 The module is activated by turning the selector switch to the AUTO position.

(1) When a Remote Start signal is applied to the remote start input, the following sequence is initiated:

(2) The Remote Start Present LED illuminates.

(3) To allow for false signals the Start Delay timer is initiated, after this delay, if the pre-heat output option is selected this timer is then initiated, and the corresponding auxiliary output that is selected energises.

NOTE

If the Remote Start signal is removed during the Start Delay timer, the unit will return to a stand-by state.

(4) After the above delays, the Fuel Solenoid is energised and the Starter Motor is engaged.

(5) The engine is cranked for a pre-set time period. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and Fail to Start fault will be displayed by a flashing LED.

(6) When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency from the Alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection. (This is selected by PC using the **808** interface.) The warning lamp output of the charge alternator can also be used to disconnect the starter motor, however it cannot be used for underspeed or overspeed. This is explained in the calibration section.

(7) After the starter motor has disengaged, the Safety On timer is activated, allowing Oil Pressure, High Engine Temperature, Underspeed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

(8) Once the engine is running, the Warm Up timer if selected is initiated, allowing the engine to stabilise before accepting the load.

(9) If an auxiliary output has been selected to give a load transfer signal, this would then activate.

NOTE

A load transfer will not be initiated until the Oil Pressure has risen and the Oil Pressure switch has operated. This prevents excessive wear on the engine.

(10) On removal of the Remote Start signal, the Stop delay timer is initiated, once it times out the Load Transfer signal is de-energised, removing the load. The Cooling timer is then initiated, allowing the engine a cooling down period off load before shutting down. Once the Cooling timer expires, the Fuel Solenoid is de-energised, bringing the generator to a stop.

(11) Should the Remote Start signal be re-activated during the cooling down period, the set will return on load after the Warming timer has expired.

MANUAL OPERATION

NOTE

The following sequence is only applicable to controllers not using external start/stop pushbutton control.

9 To initiate a start sequence in MANUAL, turn the selector switch to MANUAL.

NOTE

There is no Start Delay in this mode of operation.

(1) If the pre-heat output option is selected, this timer is then initiated and the auxiliary output selected is energised.

(2) After the above delay, the Fuel Solenoid is energised and the Starter Motor is engaged.

(3) The engine is cranked for a pre-set time period. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and Fail to Start fault will be displayed by a flashing LED.

(4) When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency from the Alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection. (This is selected by PC using the **808** interface.) The warning lamp output of the charge alternator can also be used to disconnect the starter motor, however it cannot be used for underspeed or overspeed.

(5) After the starter motor has disengaged, the Safety On timer is activated, allowing Oil Pressure, High Engine Temperature, Underspeed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

(6) Once the engine is running, the Warm Up timer if selected is initiated, allowing the engine to stabilise before it can be loaded.

(7) The generator will run off load, unless a Remote Start signal is applied, and if Load Transfer has been selected as a control source, the appropriate auxiliary output selected will activate.

(8) If the Remote Start signal is removed, the generator will continue to run On load until the selector switch is turned to Auto. The Remote Stop Delay timer will time out, the load is then disconnected. The generator will then run Off load allowing the engine a cooling down period.

(9) Turning the selector to STOP de-energises the FUEL SOLENOID, bringing the generator to a stop.

MANUAL OPERATION WITH EXTERNAL START AND STOP PUSHBUTTONS

10 If the module has been configured to use external Start and Stop pushbuttons, the normal 'Manual' mode of operation is over-ridden and the following sequence is observed:

(1) Turn the selector switch to MANUAL.

(2) To start the set operate the 'Start' pushbutton, the pre-heat output (if selected) will energise and the timer is initiated.

(3) Once the above delay has expired, the Fuel Solenoid is energised and the Starter Motor is engaged.

(4) The engine is cranked for a pre-set time period. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and Fail to Start fault will be displayed by a flashing LED.

(5) When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency from the Alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection. (This is selected by PC using the **808** interface.) The warning lamp output of the charge alternator can also be used to disconnect the starter motor, however it cannot be used for underspeed or overspeed.

(6) After the starter motor has disengaged, the Safety On timer is activated, allowing Oil Pressure, High Engine Temperature, Underspeed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

(7) Once the engine is running, the Warm Up timer if selected is initiated, allowing the engine to stabilise before it can be loaded.

(8) The generator will run off load, unless a Remote Start signal is applied, and if Load Transfer has been selected as a control source, the appropriate auxiliary output selected will activate.

(9) If the Remote Start signal is removed, the generator will continue to run On load until the selector switch is turned to Auto. The Stop Delay timer will time out, the load is then disconnected. The generator will then run Off load allowing the engine a cooling down period.

(10) Turning the selector to STOP or pressing the 'Stop' Pushbutton de-energises the FUEL SOLENOID, bringing the generator to a stop.

PROTECTIONS

11 The LEDs will indicate the fault condition and one of the auxiliary outputs, if selected to be a common alarm output, will activate. First up fault is indicated by a flashing LED, subsequent faults which happen simultaneously are indicated by a steady LED. Warnings are also indicated by a steady LED. Indications are fed directly from the appropriate input and are indicated by a steady LED, which will be present for as long as the input is active, this feature can be used to allow the module to operate as an Annunciator.

NOTES

(1) An auxiliary output may be configured as one of three alarm options, Shutdown, Warning or Common Alarm (Shutdown and Warnings). This is in addition to the list of other control sources from which it may be driven.

(2) There is a Common alarm LED on the front panel which illuminates to indicate all Shutdown and Warning faults. This is mainly used to indicate fault conditions such as Emergency Stop, Fail to Stop, Underspeed, Sensor Fail and Oil Pressure Switch which do not have their own individual LED to indicate the fault. A warning indication is illuminated steady, while shutdown indications flash.

(3) A corrupt configuration is indicated by all the LEDs flashing. The module must then be re-configured.

WARNINGS

12 Warnings are self-resetting, once the fault has been removed the input is reset.

(1) **CHARGE FAIL**, if charge alternator voltage falls below the pre-set trip voltage after the end of Safety On timer, the Charge Fail LED is illuminated.

(2) **AUXILIARY INPUTS**, if an auxiliary input has been configured as a warning the appropriate **LED** will illuminate.

(3) **OIL PRESSURE SWITCH,** the **520** will only attempt to crank the engine if the Oil Pressure is initially low, (engine at rest, not running). It is also possible that this could indicate that the Oil Pressure switch is faulty if engine not running. The Common Alarm LED will illuminate.

SHUTDOWNS

13 Shutdowns are latching and stop the Generator. The selector switch must be turned to Stop Reset and the fault removed to reset the module.

(1) **EMERGENCY STOP**, removal of the +ve dc supply from the Emergency Stop input initiates the following sequence. Firstly it will initiate a controlled shutdown of the Generator and prevent any attempt to restart the Generator until the Emergency Stop pushbutton has been reset. Secondly, it removes the +ve dc supply from both the Fuel Solenoid and Starter Solenoid. This input is always active when AUTO or MANUAL is selected.

NOTE

The Emergency Stop signal must be present otherwise the unit will shutdown.

(2) **LOW OIL PRESSURE**, activation of the Low Oil Pressure input after the Safety On timer has expired, initiates a shutdown. The Low Oil Pressure LED will flash.

(3) **HIGH ENGINE TEMPERATURE**, activation of the High Engine Temperature input after the Safety On timer has expired, initiates a shutdown. The High Engine Temperature LED will flash.

(4) **OVERSPEED**, if the engine speed exceeds the pre-set trip a shutdown is initiated. The Overspeed LED will flash. Overspeed is not delayed, it is an immediate shutdown.

(5) **FAIL TO START**, if the engine fails to fire after the pre-set number of attempts to crank, the start sequence is terminated. The Fail to Start LED will flash.

(6) **FAIL TO STOP**, if the generator fails to stop after the pre-set time, the Common Alarm LED will flash. Two conditions must be met to signal that the generator has stopped, Oil Pressure has gone low, and that no speed is sensed from either Magnetic Pickup or Alternator speed sensing sources.

(7) **UNDERSPEED**, if the engine speed falls below the pre-set trip after the Safety On timer has expired a shutdown is initiated. The Common Alarm LED will flash.

(8) **SENSOR FAIL**, if the speed-sensing signal is lost during cranking, the Generator will shutdown and the Common Alarm LED will flash.

NOTE

This will only occur if the speed-sensing signal is lost during cranking or during the safety on timer. If the signal is lost during normal operation, the Generator will shutdown with an Underspeed alarm.

(9) **AUXILIARY INPUTS**, if an auxiliary input has been configured as a shutdown the appropriate LED will illuminate.

NOTE

It is possible for the LEDs to be configured to indicate any of the 32 different control sources in addition to the shutdowns and warnings detail above. Please refer to the **808** Software Manual for detail on how to achieve this.

INSTALLATION INSTRUCTIONS

14 The model **520** Remote Start Module has been designed for front panel mounting. Fixing is by two spring loaded clips for easy assembly.

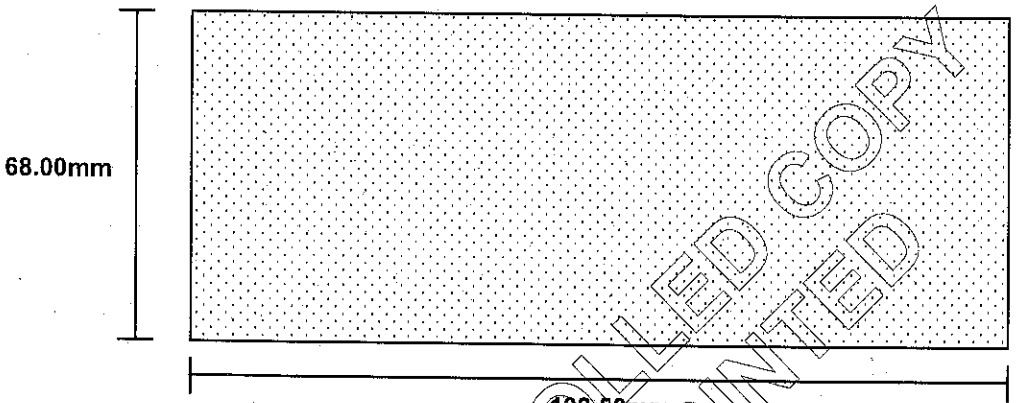


Fig 2 Panel cut-out

15 In conditions of excessive vibration the module should be mounted on suitable anti-vibration mountings.

COOLING

16 The module has been designed to operate over a wide temperature range -30° C to +55° C. However allowances should be made for the temperature rise within the control panel enclosure. Care should be taken NOT to mount possible heat sources near the module unless adequate ventilation is provided. The relative humidity inside the control panel enclosure should not exceed 85%.

UNIT DIMENSIONS

17 All dimensions are in mm.

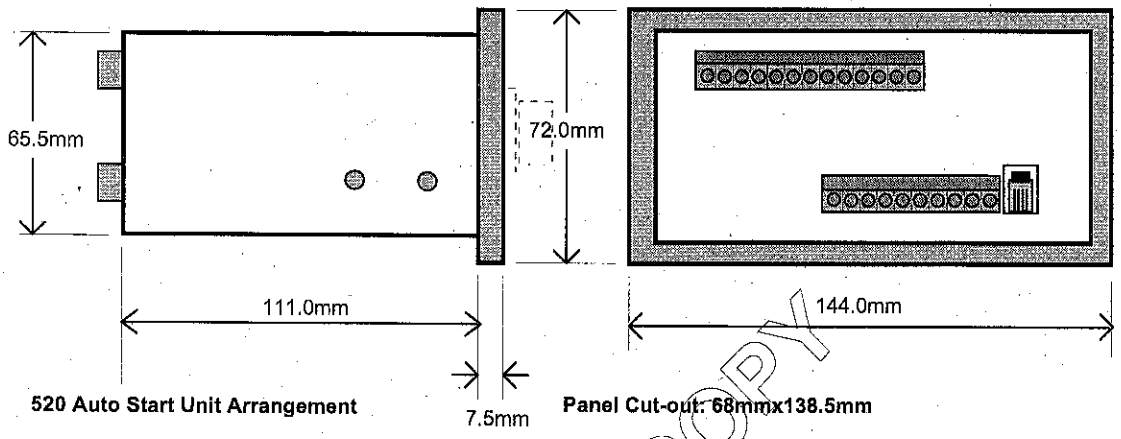


Fig 3 Unit dimensions

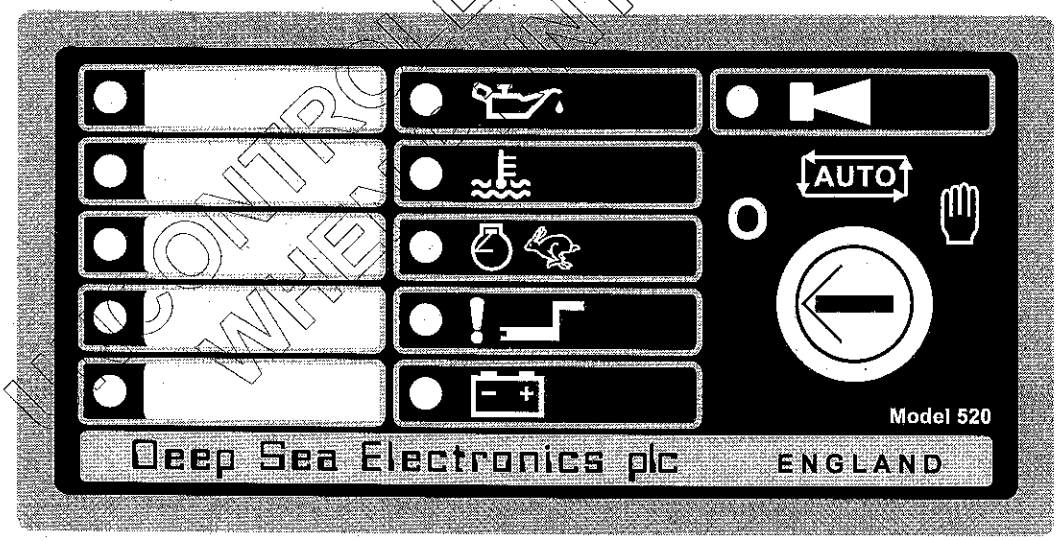


Fig 4 Front panel layout

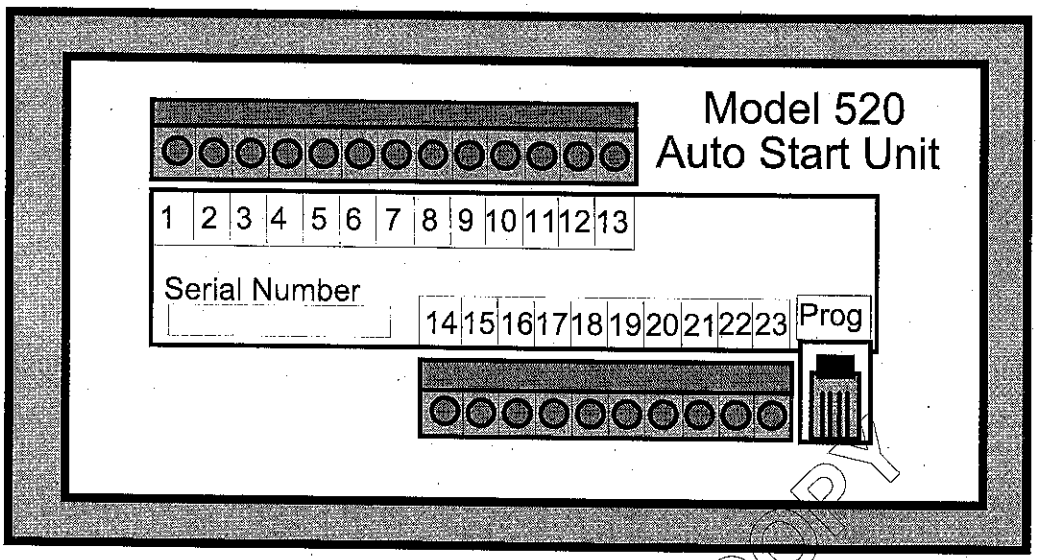


Fig 5 Rear panel layout

ELECTRICAL CONNECTIONS

18 Connections to the **520** Module are via plug and sockets.

CONNECTION DETAILS

19 The following describes the connections and recommended cable sizes to the two plugs and sockets on the rear of the **520** Module. See rear panel layout Fig 5.

TABLE 1 PLUG A 13 WAY

Pin No.	Description	Cable Size	Notes
1	dc Plant Supply Input (-ve)	2.5mm	
2	dc Plant Supply Input (+ve)	2.5mm	(Recommended Fuse 16A)
3	Emergency Stop Input	2.5mm	Plant Supply +ve. Also supplies fuel and start outputs. (Recommended Fuse 32A)
4	Fuel relay Output	2.5mm	Plant Supply +ve from Pin 3. 16 Amp rated.
5	Start relay Output	2.5mm	Plant Supply +ve from Pin 3. 16 Amp rated.
6	Auxiliary Output Relay 1	1.0mm	Plant Supply +ve. 5 Amp rated.
7	Auxiliary Output Relay 2	1.0mm	Plant Supply +ve. 5 Amp rated.
8	Charge Fail Input/ Excitation Output	1.0mm	Must NOT be connected to plant supply -ve if not used.
9	Low Oil Pressure Input	0.5mm	Switch to -ve
10	High Engine Temp Input	0.5mm	Switch to -ve
11	Auxiliary Input 1	0.5mm	Switch to -ve
12	Auxiliary Input 2	0.5mm	Switch to -ve
13	Remote Start Input	0.5mm	Switch to -ve

TABLE 2 PLUG B 10 WAY

Pin No.	Description	Cable Size	Notes
14	Alternator Input L1	1.0mm	Do not connect if not used. (2A Fuse)
15	Alternator Input N	1.0mm	Do not connect if not used.
16	DO NOT USE		Ensure no connection is made to this pin.
17	Auxiliary Output 3	1.0mm	Plant Supply +ve. 5 Amp rated.
18	Auxiliary Input 3	0.5mm	Switch to -ve
19	Auxiliary Input 4	0.5mm	Switch to -ve
20	Magnetic Pickup Input (+ve)	0.5mm	Connect to Magnetic Pickup device.
21	Magnetic Pickup Input (-ve)	0.5mm	Connect to Magnetic Pickup device.
22	Tachometer Output (+ve)	0.5mm	Optional, specified on ordering. Tachometer must be completely isolated.
23	Tachometer Output (-ve)	0.5mm	Optional, specified on ordering. Tachometer must be completely isolated.

NOTE

Screened cable must be used for connecting the Magnetic Pickup, ensuring that the screen is earthed at one end ONLY.

CONNECTOR FUNCTION DETAILS

20 The following describes the functions of the two connectors on the rear of the module. See rear panel layout Fig 5.

TABLE 3 PLUG A FUNCTIONS

Pin No.	Description
1	dc Supply -ve. System dc negative input. (Battery Negative).
2	dc Supply +ve. System dc positive input. (Battery Positive).
3	Emergency Stop input. Internally linked to Starter and Fuel outputs. If this input is not connected to positive the module will be locked out, and if the engine is running will shutdown immediately. Positive Supply also removed from Starter and Fuel therefore only a single-pole Emergency Shutdown button is required.
4	Fuel Relay output. Plant Supply +ve from Pin 3. Used to control the fuel solenoid.
5	Starter Relay output. Plant Supply +ve from Pin 3. Used to control the Starter Motor.
6	Auxiliary Relay output 1. Plant Supply +ve. Configurable output, see Calibration Manual for options available.
7	Auxiliary Relay output 2. As for Auxiliary output 1 (Pin No 6).
8	Charge Fail input/Excitation output. Supplies excitation to the Plant Battery Charging Alternator, also an input for the Charge Fail detection circuitry.

(continued)

TABLE 3 PLUG A FUNCTIONS (continued)

Pin No.	Description
9	Low Oil Pressure input. This is a negative switched input, it is possible to calibrate the input to be a normally closed signal or a normally open signal. This input is used to signal to the module that the oil pressure is low.
10	High Engine Temperature input. This is a negative switched input, it is possible to calibrate the input to be a normally closed signal or a normally open signal. This input is used to signal to the module that the engine temperature is high.
11	Auxiliary input 1. This is a negative switched configurable input, see Calibration Manual for options available. It is possible to configure the input to be a normally closed signal or a normally open signal.
12	Auxiliary input 2. As for Auxiliary input 1 (Pin 11).
13	Remote Start input. This is a negative switched input that will start the generator when Auto is selected. It is possible to configure the input to be a normally open signal or a normally closed signal.

TABLE 4 PLUG B FUNCTIONS

Pin No.	Description
14	Alternator Input L1. Used for Alternator speed sensing.
15	Alternator Input N. Used for Alternator speed sensing.
16	DO NOT USE
17	Auxiliary Relay output 3. Plant Supply +ve. Configurable output, see Calibration Manual for options available.
18	Auxiliary input 3. This is a negative switched configurable input, see Calibration Manual for options available. It is possible to configure the input to be a normally closed signal or a normally open signal.
19	Auxiliary input 4. As for Auxiliary input 3 (Pin 18).
20	Magnetic Input +ve. An AC signal from the magnetic pickup +ve for speed sensing.
21	Magnetic Input -ve. An AC signal from the magnetic pickup -ve for speed sensing.
22	Tachometer output +ve. 0.5 or 1.0 mA Tachometer can be used.
23	Tachometer output -ve. ---------- " ----------

TABLE 5 CALIBRATION SOCKET

Pin No.	Description
1	Ground
2	Transmit Data
3	Receive Data
4	+5 Supply

CAUTION

EQUIPMENT DAMAGE. This socket is for the connection of appropriate products manufactured by Deep Sea Electronics plc only. Connection of any other device may cause damage and will invalidate the warranty.

SPECIFICATION

21	dc Supply	-	8.0 to 35 V Continuous.
	Cranking Dropouts	-	Able to survive 0 V for 50 mS, providing supply was at least 10 V before dropout and supply recovers to 5 V.
	Max. Operating Current	-	290 mA at 12 V. 210 mA at 24 V.
	Max. Standby Current	-	50 mA at 12 V. 30 mA at 24 V.
	Alternator Input Range	-	15 - 300 V ac RMS.
	Alternator Input Frequency	-	50 - 60 Hz at rated engine speed.
	Magnetic Input Range	-	0.5 V to +/- 70 V (Clamped by transient suppressors)
	Magnetic Input Frequency	-	10Hz to 10,000 Hz at rated engine speed.
	Start Relay Output	-	16 Amp DC at supply voltage.
	Fuel Relay Output	-	16 Amp DC at supply voltage.
	Auxiliary Relay Outputs	-	5 Amp DC at supply voltage.
	Dimensions	-	144 x 72 x 118.5 (Excluding Key-switch or Knob)
	Charge Fail / Excitation Range	-	0 V to 35 V.
	Operating Temperature Range	-	-30 to +55°C.

COMMISSIONING

Pre-commissioning

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

(1) The unit is adequately cooled and all the wiring to the module is of a standard and rating compatible with the system.

(2) The unit dc supply is fused and connected direct to the battery, and is of correct polarity.

(3) The Emergency Stop input is wired to an external normally closed switch connected to dc positive.

NOTE

If Emergency Stop feature is not required, link this input to the dc positive.

(4) To check the start cycle, take appropriate measures to prevent the engine from starting (disable the operation of the fuel solenoid). After a visual inspection to ensure it is safe to proceed, connect the battery supply. Turn the selector switch to MANUAL. The unit start sequence will commence.

(5) The starter will engage and operate for the pre-set crank period. After the starter motor has attempted to start the engine for the pre-set number of attempts, the FAIL TO START LED will be illuminated. Turn to OFF to reset the unit.

(6) Restore the engine to operational status (reconnect the fuel solenoid), again select MANUAL and this time the engine should start and the starter motor should disengage automatically. If not then check that the engine is fully operational (fuel available, etc.) and that the fuel solenoid is operating. The engine should now run up to operating speed. If not, and an alarm is present, check the alarm condition for validity, then check the input wiring. The engine should continue to run for an indefinite period.

(7) Select AUTO on the front panel, the engine will run for the pre-set cooling down period, then shutdown. The generator should stay in the standby mode. If not check that there is not a signal present on the Remote Start input.

(8) Initiate a remote start by grounding the Remote Start input. The start sequence will start and the engine will run up to operational speed. If one of the Auxiliary Outputs has been configured for Load Transfer, the Generator will accept the load. If not, check the wiring to the Generator Contactor Coil. Check the Warming timer has timed out.

(9) Remove the Remote Start signal, the return sequence will start. After the pre-set time period, the load will be removed from the generator. The generator will then run for the pre-set cooling down period, then shutdown.

(10) All internal timers and selections should now be adjusted to the customer's specifications or to the engine and alternator manufacturers recommendations.

(11) If despite repeated checking of the connections between the **520** and the customer's system, satisfactory operation cannot be achieved, then the customer is requested to contact the factory for further advice on:

INTERNATIONAL TEL: 44 (0) 1723 377566
INTERNATIONAL FAX: 44 (0) 1723 354453
E-mail: Support@Deepseaplc.com

FAULT FINDING

23 Management system fault symptoms and possible remedies are shown below:

TABLE 6 FAULT FINDING

Symptom	Possible remedy
Unit is inoperative	Select AUTO on the front panel. Check the battery and wiring to the unit. Check the DC supply. Check the DC fuse.
Unit shuts down	Check DC supply voltage is not above 35 Volts or below 8 Volts Check the operating temperature is not above 55°C. Check the dc fuse.
Unit locks out on Emergency Stop	If an Emergency Stop Switch is not fitted, ensure that a positive is connected to the Emergency Stop input. Check emergency stop switch is functioning correctly. Check wiring is not open circuit.
Intermittent sensor fault	Ensure that Magnetic pickup screen is only connected at one end, if connected at both ends this enables the screen to act as an aerial and will pick up random voltages.
Low oil pressure fault operates after engine has fired	Check engine oil pressure. Check oil pressure switch and wiring. Check configured polarity is correct.

(continued)

TABLE 6 FAULT FINDING (continued)

Symptom	Possible remedy
High engine temperature fault operates after engine has fired.	Check engine temperature. Check switch and wiring. Check configuration of input, ie Normally Open or Normally Closed.
Shutdown fault operates	Check relevant switch and wiring of illuminated fault LED. Check configuration of input. If only common alarm LED illuminated, please refer to Para 11, Note 2.
Warning fault operates	Check relevant switch and wiring of illuminated fault LED. Check configuration of input. If only common alarm LED illuminated, please refer to Para 11, Note 2.
Fail to Start is activated after pre-set number of multi attempts to start	Check wiring of fuel solenoid. Check fuel. Check battery supply. Check battery supply is present on the Fuel output of the module. Check the speed-sensing signal is present on the **520** inputs. Refer to engine manual.
Continuous starting of generator when in AUTO	Check that there is no signal present on the Remote Start input. Check configured polarity is correct.
Generator fails to start on receipt of Remote Start signal	Check Start Delay timer has timed out. Check signal is on Remote Start input.
Pre-heat inoperative	Check wiring to engine heater plugs. Check battery supply. Check battery supply is present on the Pre-heat output of module. Check pre-heat has been selected in the configuration menu.
Starter motor inoperative	Check wiring to starter solenoid. Check battery supply. Check battery supply is present on the Starter output of module. Ensure that the Emergency Stop input is at +Ve.
Engine runs but generator will not take load	Check Warm up timer has timed out. Check configuration to ensure output has been selected to give Load Transfer.

NOTE

Fault finding can be assisted greatly by utilising the Diagnostic feature available from the PC Interface. This will display the module state, any alarm conditions present and the state of all inputs and outputs. It is recommended that diagnostics are used to aid fault finding wherever possible.

TYPICAL WIRING DIAGRAM

24 A typical wiring diagram of the Model 520 module is shown in Fig 6.

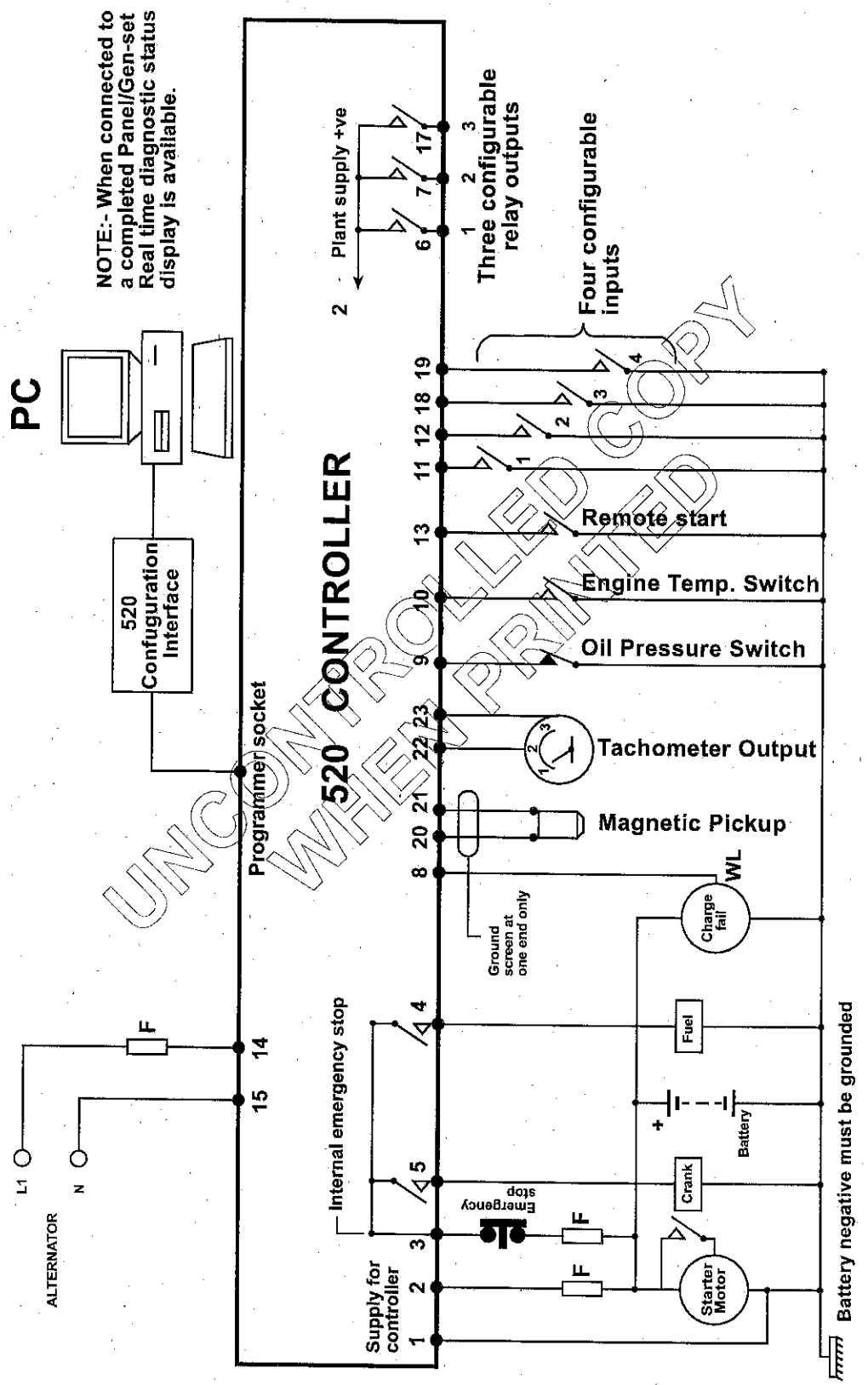


Fig 6 Typical wiring diagram

CALIBRATION

25 The **520** module can be calibrated by using a PC with the Interface Module **808**.

PC INTERFACE MODULE 808

26 The PC interface **808** kit comprises the following:

(1) **808** Interface module.

(2) 25 to 9 way adaptor.

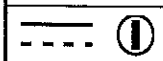
(3) FCC 68 (4 Pin) connecting lead.

(4) Floppy disk with configuration software.

ICON DESCRIPTIONS

27 The **DSE P520** module is available with graphical icons instead of text. This is for use where text in the English language may cause problems and also allows for a standard module for all world markets to be used.

TABLE 7 ICONS

Symbol	Meaning	Description
	Stop/Reset	Stop the generator and reset any alarm conditions. Refer to the Operation section of this Manual.
	Auto	The controller will automatically start the generator when given a remote start command. Refer to Para 8 of this Manual.
	Manual	The controller will start the generator under manual control. Refer to Para 9 of this Manual.
	Low Oil Pressure	A low oil pressure shutdown has occurred. Refer to Para 13 of this Manual.
	High Engine Temperature	A High Engine Temperature shutdown has occurred. Refer to Para 13 of the Manual.
	Overspeed	An overspeed shutdown has occurred. Refer to Para 13 of this Manual.
	Fail to start/Over-crank	The engine has failed to start after the pre-set number of attempts. Refer to Para 13 of this Manual.
	Charge Fail	The charge alternator on the engine is not giving sufficient output. Refer to Para 12 of this Manual.
	Common Alarm	An alarm condition has been detected. Refer to Para 11 of this Manual. (Warning = Steady, Shutdown = *Flashing*)
	Remote Start Active	The remote start signal is being applied to the module.
	dc Power On	The module is being supplied with a suitable dc supply.

APPENDIX 1

FACTORY DEFAULT CONFIGURATION

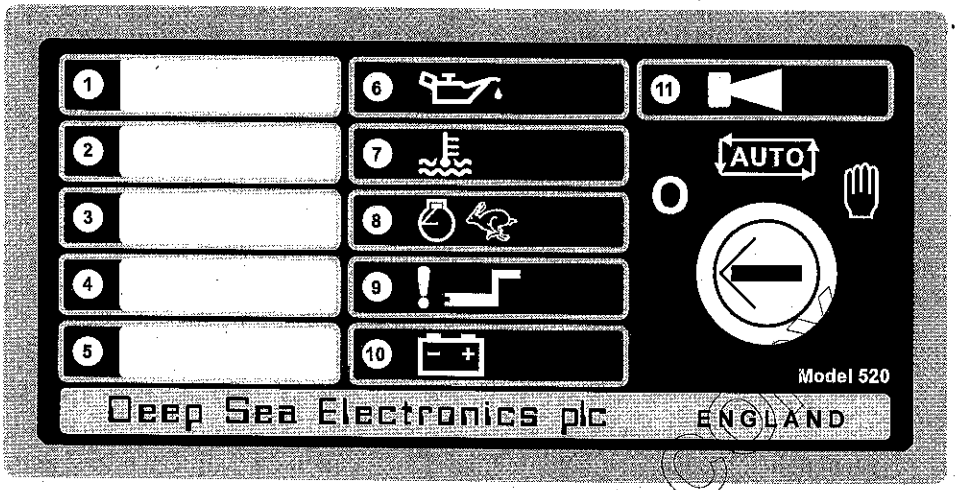


Fig 7 LED identification diagram

NOTE

The software disk supplied with the Calibration Interface (**808**) contains a Microsoft Word document for the automatic creation of suitable label inserts for the Auxiliary LEDs.

FACTORY DEFAULT CONFIGURATION

1 The **520** module when shipped contains the following configuration, allowing it to be used as a standard module if no configuration interface is available.

MISCELLANEOUS ITEMS

Item	Value
Start attempts	3
Alternator frequency input present	Yes
Nominal frequency	50Hz
Alternator poles	4
Magnetic pickup input present	No
Flywheel teeth	118
Nominal RPM	1500
Lamp test enabled	No
Start button	None
Stop button	None
Safety on delay time termination	Premature
Load transfer mode	Normal
Pre-heat mode	Normal
Tachometer full scale current	0.5mA
Tachometer full scale RPM	2500
Electrical trip enabled	No

CONFIGURABLE INPUTS

Input channel	Polarity	Type	Activation time
Remote start	Close to activate		
Low oil pressure	Close to activate	Shutdown	Active from safety on
High engine temp.	Close to activate	Shutdown	Active from safety on
Auxiliary input 1	Close to activate	Warning	Always active
Auxiliary input 2	Close to activate	Warning	Active from safety on
Auxiliary input 3	Close to activate	Shutdown	Active from safety on
Auxiliary input 4	Close to activate	Indication	Always active

RELAY OUTPUTS

Output channel	Polarity	Control source
Auxiliary output 1	Energize	1 Pre-heat
Auxiliary output 2	Energize	18 Common alarm
Auxiliary output 3	Energize	4 Load transfer

FRONT PANEL LEDs

LED	Polarity	Control source
LED 1	Lit	29 Auxiliary IP 1 active
LED 2	Lit	30 Auxiliary IP 2 active
LED 3	Lit	31 Auxiliary IP 3 active
LED 4	Lit	32 Auxiliary IP 4 active
LED 5	Lit	25 Remote start present
LED 6	Lit	27 Low oil pressure alarm
LED 7	Lit	28 High engine temp. alarm
LED 8	Lit	20 Overspeed alarm
LED 9	Lit	7 Fail to start alarm
LED 10	Lit	21 Charge fail alarm
LED 11	Lit	18 Common alarm

SYSTEM TIMERS

Timer	Mins:Secs
Remote start delay time	0:05
Remote stop delay time	0:30
Cranking time	0:10
Crank rest time	0:10
Safety on delay time	0:10
Warm up time	0:05
Cooling time	0:30
Fail to stop time	0:30
ETS hold time	0:00
Pre-heat time	0:00
Sensor fail delay time	0:02
Smoke limiting time	0:00
Smoke limiting ramp time	0:00

ANALOGUE LEVELS

Level	Value
Overspeed on alternator frequency	57.0 Hz
Overspeed on magnetic pickup	1750 RPM
Overspeed overshoot during safety on delay	0 %
Underspeed on alternator frequency	30.0 Hz
Underspeed on magnetic pickup	1250 RPM
Crank disconnect on alternator frequency	21.0 Hz
Crank disconnect on magnetic pickup	600 RPM
Crank disconnect charge alternator voltage	30.0 V
Charge fail voltage	8.0 V

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