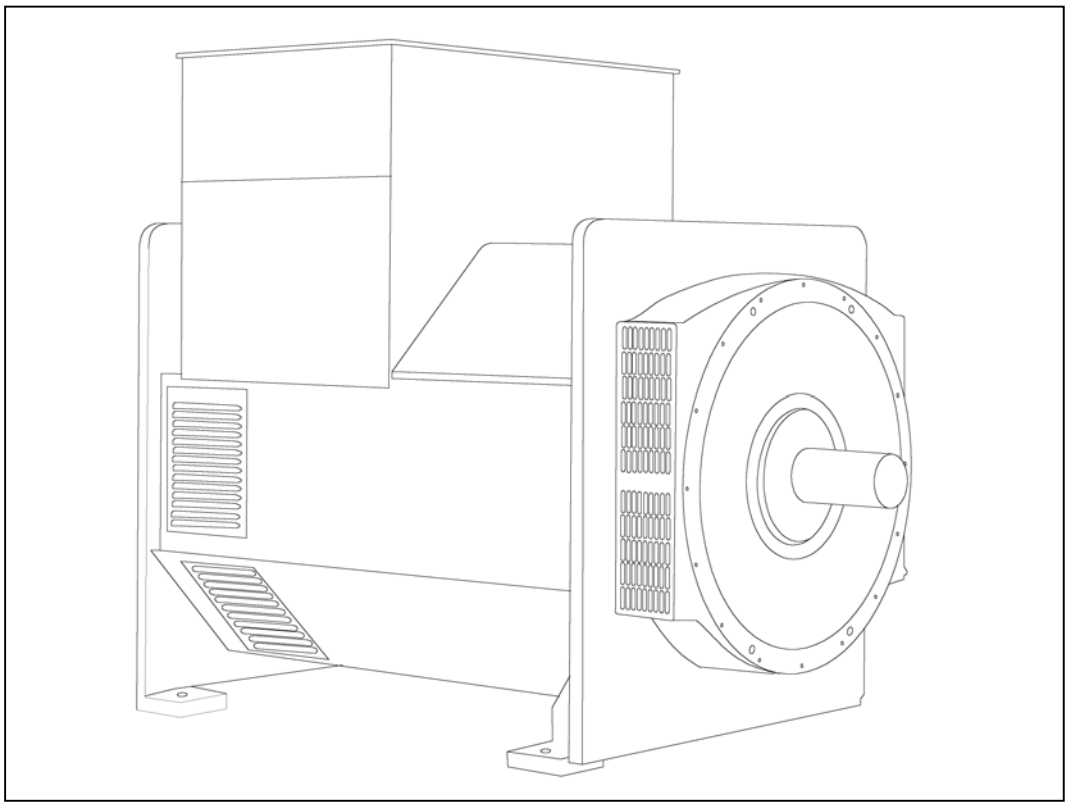
LVSI824, MVSI824, HVSI824, LVSM824 *– Installation Manual*



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.

Observe all **WARNING**/**CAUTION** notices.

- 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 injury to personnel.**

Warning!

Warning, refers to a hazard or unsafe method or practice that can result severe injury to personnel, possibly death.

Danger !

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

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. 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. Reference to the company for advice is welcomed.

Warning!

Incorrect installation, operation, servicing 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

WARNING! The EMC Directive 89/336/EEC
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

Fig.1

Under the EC Machinery Directive section 1.7.4. It is the responsibility of the generator set builder to ensure the generator serial and identity numbers are clearly displayed in the white box provided on the front cover of this book.

CE

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 (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 earth 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 authorised parts will invalidate any Newage liability for EMC compliance.
- Installation, maintenance and servicing is carried out by adequately trained personnel fully aware of the requirements of the relevant EC directives

CONTENTS

SECTION 1

INTRODUCTION

1.1 LV INTRODUCTION

The LV range of generators is of brushless rotating field design, available up to 690V/50Hz (1500 rpm, 4 pole) and 600V/60Hz (1800 rpm, 4 pole) and built to meet BSEN 60034, BS5000 Part 3 and other appropriate international standards.

All LV generators use a permanent magnet generator (PMG) excitation system incorporating the MA325/7 AVR. Detailed specification sheets are available on request.

1.1 MV INTRODUCTION

The MV range of generators is of brushless rotating field design, available up to 3.3kV/50 Hz (1500 rpm, 4 pole) and 4.16kV/60Hz (1800 rpm, 4 pole) and built to meet BSEN 60034, BS5000 Part 3 and other appropriate international standards.

All MV generators use a permanent magnet generator (PMG) excitation system incorporating the MA325/7 AVR. Detailed specification sheets are available on request.

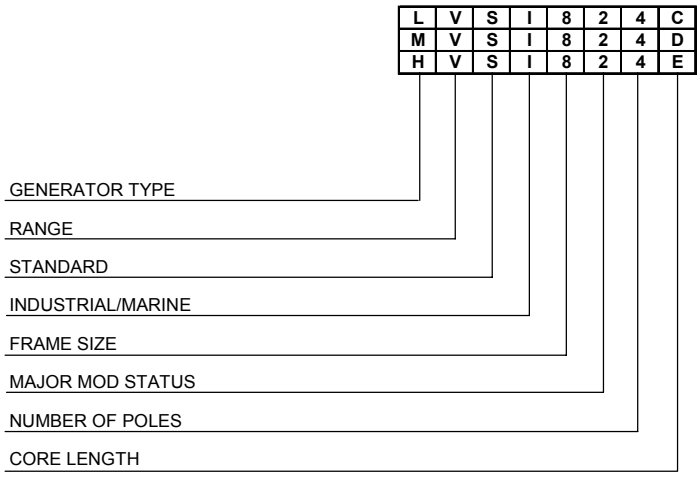
1.1 HV INTRODUCTION

The HV range of generators is of brushless rotating field design, available up to 11kV/50 Hz (1500 rpm, 4 pole) and 13.8kV/60Hz (1800 rpm, 4 pole) and built to meet BSEN 60034, BS5000 Part 3 and other appropriate international standards.

All HV generators use a permanent magnet generator (PMG) excitation system incorporating the MA325/7 AVR. Detailed specification sheets are available on request.

1.2 DESIGNATION

The generator frame size is designated by a code as follows:



1.3 SERIAL NUMBER LOCATION

Each generator has its own unique serial number stamped into the upper section of the frames drive-end end-plate.

Inside the terminal box two adhesive labels have been fixed, each carrying the generators unique identity numbers.
One label has been fixed to the inside of the terminal box sheet metal work, and the second label fixed to the saddle, supporting the terminal box.

1.4 RATING PLATE

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 N.D.E. of the terminal box.

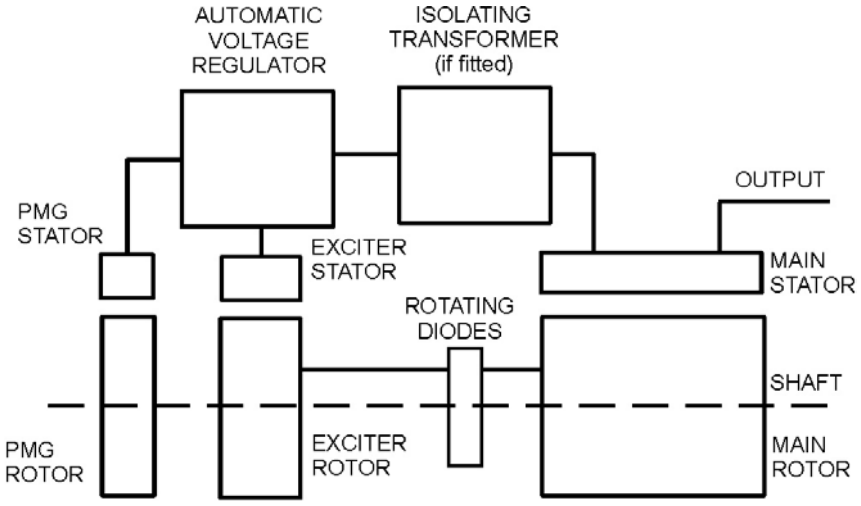
The surface in the area where a label is to be stuck must be flat, clean and any paint finish be fully dry before attempting to attach the label. Recommended method for attaching the label is to peel and fold back sufficient of the backing paper to expose some 20mm of label adhesive along the top edge.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

1.5 BEARING GREASE INFORMATION

A self adhesive label will have been fixed to the end plate above the bearing giving information about the bearing grease type, re-lubrication frequency and quantities.

SECTION 2

PRINCIPLE OF OPERATION



The permanent magnet generator provides power for excitation of the exciter field via the 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, via the isolating transformer, 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 simple control principle described above hides the complexity of the electronic AVR which drives it. The AVR senses true rms voltage on three phases ensuring close regulation even with a generator output distorted by non-linear load e.g. thyristor controlled DC drive. In addition it detects engine speed and provides variable levels of 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.

It also provides over-excitation protection during fault conditions, and over-voltage protection, with provision for operating an external circuit breaker, and additional adjustable elements are incorporated to shape and optimise the heavy load switching capability of the generating set, by varying the generator performance during load switching to match the engine performance.

The detailed function of the AVR circuits and their adjustment are covered in the load testing section 4.7.

In addition the AVR incorporates circuits which, when used in conjunction with accessories, can provide for parallel operation either with 'droop' or 'astatic' control, short circuit current limit, and VAr/PF control, during parallel operation.

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

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

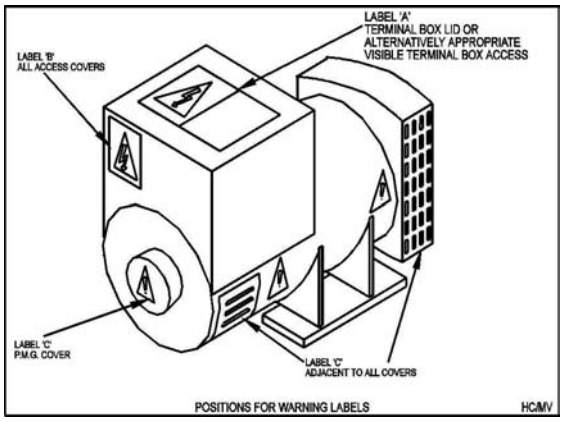
SECTION 3

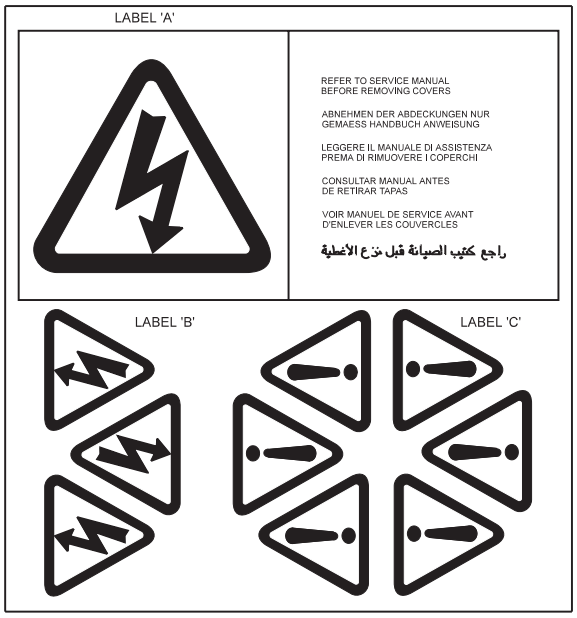
APPLICATION OF THE GENERATOR

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. (See below).

Information labels regarding bearing type, bearing grease, and re-lubrication information have been fitted to each end plate adjacent to bearing.

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





The ambient conditions in which a generator is operated or stored should be fully understood, to ensure the generator is maintained in a fully serviceable condition. Areas for consideration include temperature, humidity and even vibration levels.

Temperatures should be stable, but if combined with high humidity levels, anti-condensation heaters should be connected to a suitable single phase mains supply. Within the generator's storage or installed area, thermostatic control of space heaters will be of considerable assistance.

If the generator is subjected to conditions which result in condensation forming within the generator, steps must be taken to ventilate and heat the generator. The winding insulation resistance must be measured and be above the minimum values stated in section 4.4.1.1 of this book before the generator is put into service.

Subjecting stationary generators to vibration will cause damage to the generator ball bearings, the process termed brinelling.

The generators have been designed for use in a maximum ambient temperature of 40°C. in accordance with B.S. 5000.

Ambients in excess of 40°C. 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.

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.

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.

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 two stage filter.

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:

Frame	Air Flow		Additional (intake/outlet) Pressure Drop
	50Hz	60Hz	
8	4.1m^3/sec (8680cfm)	4.8m^3/sec (10170cfm)	6mm water gauge

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

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.

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

4 pole	1500 rpm	25 Hz
4 pole	1800 rpm	30 Hz

However, vibrations induced by the engine are complex and contain frequencies of 1.5, 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 B.S. 5000 Part 3 are not exceeded.
In standby applications where the running time is limited and reduced life expectancy is accepted, higher levels than specified in BS5000 can be tolerated, up to a maximum of 18mm/sec.

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 275 kgm (2000 ft lbs) . A flexible coupling, designed to suit the specific engine/generator combination, is recommended to minimise torsional effects.

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 275 kgm (2000 ft lbs).

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

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

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.

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.

Important ! **Torsional incompatibility and/or excessive vibration levels can cause damage or failure of generator and/or engine components.**

The standard build terminal box arrangement is for cable entry into the right hand side of the terminal box when viewed from generator N. D. E.

Cable entry from the left hand side is possible if specified at time of order.

The terminal box is constructed with a removable panel 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.

The neutral is NOT connected to the frame.

Caution! **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.**

The main stator winding has six leads brought out to terminals in the terminal box. The three leads brought to the neutral terminal have been arranged to allow for the provision of differential protection with the option of clamps and mounting plates for specific current transformers supplied by Newage International.

If it becomes necessary for customers to use current transformers not of Newage supply, these should be fitted by competent technicians with particular care being taken to ensure the cables are positioned centrally within the current transformer opening.

The generator AVR incorporates protection circuits which operate on overload or fault conditions.

If a detected abnormal condition still exists after 8 seconds the AVR de-excites the generator causing a collapse in output voltage. This de-excitation may be as a result of an electronic solid state protection circuit, or the AVR tripping the excitation circuit breaker, if fitted, which would be located adjacent to the AVR.

To reset the AVR trip circuits it is necessary to stop the engine - generator. The AVR solid state trip circuits will automatically reset after the generator has been stationary for 3 seconds. The excitation trip circuit breaker needs to be manually reset if fitted.

The system designer should ensure that these AVR functions are compatible with the overall system protection.

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.

This instruction book must be read before incorporation of the generator into a generating set. Maintenance must be carried out with the generating set out of service and precautions taken to avoid accidental starting of the generator set.

Warning ! **Incorrect installation, service or replacement of parts can result in severe personal injury or death, and/orequipment damage. Service personnel must be qualified to perform electrical and mechanical service.**

SECTION 4

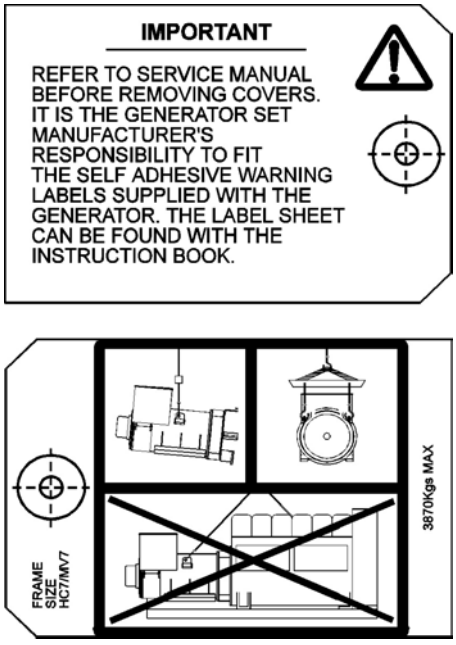
INSTALLATION - PART 1

4.1 LIFTING

Warning!

Incorrect lifting of inadequate lifting capacity can result in severe personal injury of equipment damage. Lifting capacity required for complete generator is 7 tonnes. See data sheets for weights of individual lifts. Generator lifting lugs should not be used for lifting the complete generating set.

Four lifting lugs are provided for use with a shackle and pin type lifting aid in conjunction with a spreader bar. Chains of suitable length and lifting capacity must be used. Care is therefore needed to avoid personal injury or equipment damage. Correct lifting arrangement is shown on the label attached to a lifting eye. A typical label is shown below.



Single bearing generators are supplied with the rotor clamped to the stator frame with a transit strap to prevent axial movement of the rotor and two shaft support brackets have been fitted which support the rotor through the fan. Once this strap is removed and the support bracket, to couple the rotor to the engine, 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.

4.2 ASSEMBLY TO ENGINE

4.2.1 TWO BEARING MACHINES

A flexible coupling should be fitted and aligned in accordance with the coupling manufacturer's instruction.

If a close coupling adaptor is used the alignment of machined faces must be checked by offering the generator up to the engine. Shim the generator feet if necessary. Ensure adaptor guards are fitted after generator/engine assembly is complete.

Open coupled sets require a suitable guard, to be provided by the set builder.

Caution ! **Incorrect guarding and/or generator alignment can result in personal Injury and/or equipment damage.**

4.2.2 SINGLE BEARING MACHINES

4.2.2.1 INSTALLATION

All generators are transported from the factory with a shaft-locking strap fitted across the outside of the fan housing. Premature removal of this strap will result in damage to the rotor field excitor, fitted inboard of the non-drive end bearing. So that the locking strap can be safely removed, two shaft support brackets have been fitted which support the rotor through the fan. It is inessential that that the support strip is removed before the machine is run.

Before removing the strap and support brackets the following steps must be followed:

1. Once the Alternator is on site and positioned closely to its final position, remove the shaft locking strap fitted across the front of the shaft.
2. Couple the alternator to the engine. Note - the rotor support brackets have not been designed so that the alternator can not be barred over. The engine should be bared over instead.
3. It is only safe to remove the support brackets when all the engine/alternator-coupling bolts have been fully tightened. This done by removing the bolt in each support bracket and pulling it forward to clear the fan. Finally withdraw it through the side opening.

4.2.2.2 ALIGNMENT

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

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 flexible plates to the Coupling hub are tight and locked into position. For tightening torque refer to section 7 table H.

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

4. Check that coupling discs are concentric with adaptor spigot. This can be adjusted by the use of tapered wedges between the fan and adaptor. Alternatively the rotor can be suspended by means of a rope sling through the adaptor opening.

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

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

7. Remove wooden wedges.

8. Replace covers. Check for excessive vibration at the time of initial run-up.

Important! **Incorrect guarding and/or generator alignment can result in personal injury and/or equipment damage.**

4.3 EARTHING

The generator frame should be solidly bonded to the generating set bedplate. If antivibration 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 antivibration mount.

4.4 PRE-RUNNING CHECKS

Caution! **Refer to local regulations to ensure that the correct earthing procedure has been followed.**

4.4.1 INSULATION CHECKS

Before starting the generating set after completing assembly, test the insulation resistance of the main stator windings.

It should be noted that as winding temperature increases values of insulation resistance will significantly reduce. Therefore true values of insulation resistance should be established with windings at ambient temperatures.

Caution! **The AVR should be disconnected, and the resistance temperature detector. (RTD) leads grounded, during the test.**

4.4.1.1 LV GENERATORS

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.

4.4.1.2 MV GENERATORS

A 2500V motorised Megger or similar instrument should be used. Separate the three neutral leads, ground V and W leads and megger U to ground. Repeat for V phase with U and W grounded and W phase with U and V grounded.

The insulation resistance should not be less than 50MΩ and the polarisation index should be in the order of 2 or greater at 20°C.

If these values cannot be achieved the winding should be dried out as detailed in the Service and Maintenance section of this manual.

Danger!

Short stator terminals to earth with an earthing rod after HV testing, for at least 30 seconds to discharge windings.

4.4.1.3 HV GENERATORS

A 5000 V motorised Megger or similar instrument should be used. Separate the three neutral leads, ground V and W leads and megger U to ground. Repeat for V phase with U and W grounded and W phase with U and V grounded.

The insulation resistance should not be less than 200 MΩ and the polarisation index should be in the order of 2 or greater at 20°C.

If these values cannot be achieved the winding should be dried out as detailed in the Service and Maintenance section of this manual.

Danger!

Short stator terminals to earth with an earthing rod after HV testing, for at least 30 seconds to discharge windings.

4.4.2 DIRECTION OF ROTATION

Standard machines are fitted with a backward inclined radial bladed fan and therefore only suitable for running in one direction of rotation. The generator is supplied to give a phase sequence of U V W with the generator running clockwise looking at the drive end (unless otherwise specified at the time of ordering). If the generator phase rotation has to be reversed after the generator has been despatched apply to factory for appropriate wiring diagrams.

4.4.3 VOLTAGE AND FREQUENCY

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

4.4.4 AVR SETTINGS

To adjust AVR settings remove the housing cover, and refer to the label inside cover for guidance of adjustment potentiometers and selection link location. The adjacent fig 1 also shows AVR layout.

Most of the AVR adjustments are factory set in positions which will give satisfactory performance during initial running tests. Subsequent adjustment may be required to achieve optimum performance of the set under operating conditions. Refer to section 4.7 for details.

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

1) Frequency selection

Ufro switch position selected to suit operating frequency.

		Initial Switch Postion
4P/50Hz	corresponds to1500 r.p.m.	4
4P/60Hz	corresponds to1800 r.p.m.	5

Switch position to be optimised during commissioning.

2) Stability selection

Stability selection switch - select position 6.

4.5 GENERATOR SET TESTING

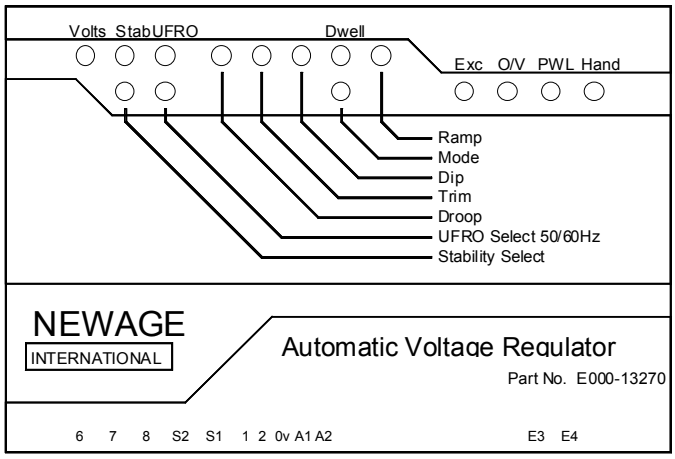


Fig. 1

4.5.1 TEST METERING/CABLING

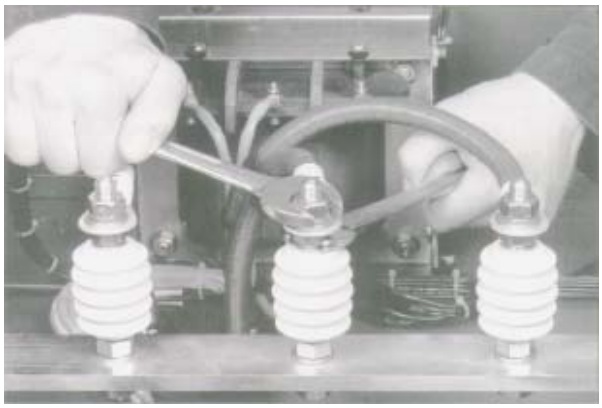
Warning!

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.

Connect any instrument wiring and cabling required for initial test purposes with permanent or spring-clip type connectors. Minimum instrumentation for testing should be line to 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.

Important! **When fitting power cables for load testing purposes, ensure cable voltage rating is at least equal to the generator rated voltage. Support the cables to prevent side load on the terminal.**

The load cable termination should be placed on top of the winding lead termination and clamped between the two nuts provided, as shown below.



Caution! **MV/HV LOAD CABLE TERMINATION**
Extending the load terminals by means of an extension bar may cause excessive side loads on the ceramic terminal insulators and should be avoided.

Caution! **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.**

4.6 INITIAL START-UP

Warning!

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.

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.

Important! **Overspeeding of the generator during initial setting of the speed governor can result in damage to the generator rotating components.**

In addition remove the AVR housing cover 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. 1 for potentiometer location.

Important! Do not increase the voltage above the rated generator voltage shown on the generator nameplate.

The "STABILITY" control potentiometer will have been pre-set and should normally not require adjustment, but should this be required, usually identified by oscillation of the voltmeter, refer to Fig. 1 for potentiometer location and proceed as follows:-

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 (i.e. where the machine volts are stable but close to the unstable region).

4.7 LOAD TESTING

Warning!

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.

4.7.1 AVR ADJUSTMENTS

Refer to Fig. 1 for control potentiometer locations.

Having adjusted "VOLTS" and "STABILITY" during the initial start-up procedure, the AVR control functions "UFRO", "OVER/V" and "EXC. TRIP" should not normally need adjustment.

If however, poor voltage regulation on-load, or voltage collapse is experienced, refer to the following paragraphs on each function to a) check that the symptoms observed do indicate adjustment is necessary, and b) to make the adjustment correctly.

4.7.2 UFRO (Under Frequency Roll Off)

The AVR incorporates an underspeed protection circuit which gives a voltage/speed (Hz) characteristic as shown in Fig. 2.

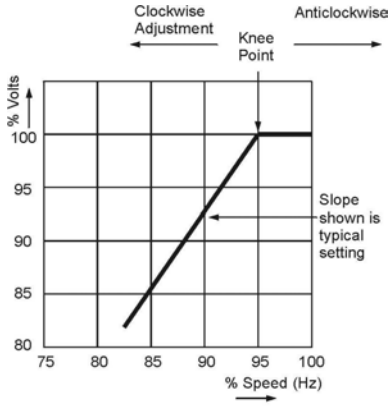


Fig. 2

The UFRO control potentiometer sets the "knee point".

Symptoms of incorrect setting are a) the light emitting diode (LED) indicator, adjacent to the "UFRO" control potentiometer, being permanently lit when the generator is on load, and b) poor voltage regulation on load, i.e. operation on the sloping part of the characteristic.

Important! If the LED is illuminated and no output voltage is present, refer to EXC TRIP and/or OVER/V sections below.

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, i.e. 47Hz on a 50Hz generator or 57Hz on a 60Hz generator.

4.7.3 OVER/V (Over Voltage)

Over voltage protection circuitry is included in the AVR to remove generator excitation in the event of loss of AVR sensing input or a short circuit of AVR power device. AVR terminals E1, E0 are connected to the generator windings independently of the AVR serving terminals.

A shunt trip circuit breaker is connected across AVR terminals K1, K2 these connections under normal operation being connected together.

If an over voltage condition is detected the AVR generates an output pulse via terminals B0, B1 which activates the shunt trip mechanism within the shunt trip circuit breaker. This in turn opens circuits AVR terminals K1., K2., and de-excites the generator.

The generator must be stopped to reset an overvoltage trip.

Incorrect setting would cause the generator output voltage to collapse at no-load or on removal of load, and the LED to be illuminated,

The correct setting is 300V +/-5% across terminals E1, E0.

Clockwise adjustment of the “OVER/V” control potentiometer will increase the voltage at which the circuit operates.

4.7.4 EXC TRIP (Excitation Trip)

An AVR supplied from a permanent magnet generator inherently delivers maximum excitation power on a line to line or line to neutral short circuit. In order to protect the generator windings the AVR incorporates an over excitation circuit which detects high excitation and removes it after a pre-determined time, i.e. 8-10 seconds.

Symptoms of incorrect setting are the generator output collapses on load or small overload, and the LED is permanently illuminated.

The correct setting is 70 volts +/-5% between terminals X and XX.

4.7.5 TRANSIENT LOAD SWITCHING ADJUSTMENTS

The additional function controls of "DIP" and "DWELL" are provided to enable the load acceptance capability of the generating set to be optimised. The overall generating set performance depends upon the engine capability and governor response, in conjunction with the generator characteristics.

It is not possible to adjust the level of voltage dip or recovery independently from the engine performance, and there will always be a 'trade off' between frequency dip and voltage dip.

4.7.5.1 DIP

The dip function control potentiometer adjusts the slope of the voltage/speed (Hz) characteristic below the knee point as shown in Fig.3.

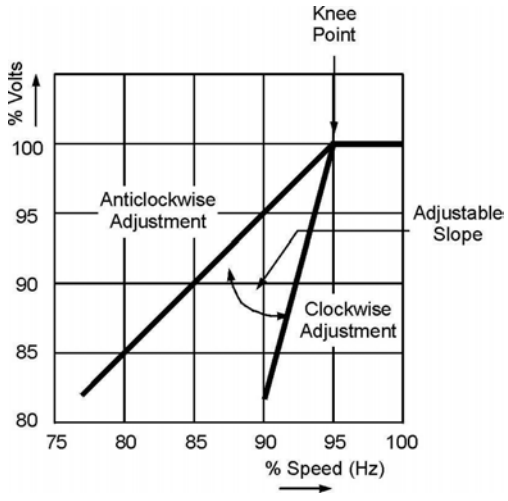


Fig. 3

4.7.5.2 DWELL

The dwell function introduces a time delay between the recovery of voltage and recovery of speed.

The purpose of the time delay is to reduce the generator kW below the available engine kW during the recovery period, thus allowing an improved speed recovery.

Again this control is only functional below the "knee point", i.e. if the speed stays above the knee point during load switching there is no effect from the "DWELL" function setting.

Clockwise adjustment gives increased recovery time.

Fig. 4 shown below, is a representation only, since it is impossible to show the combined effects of voltage regulator and engine governor performance.

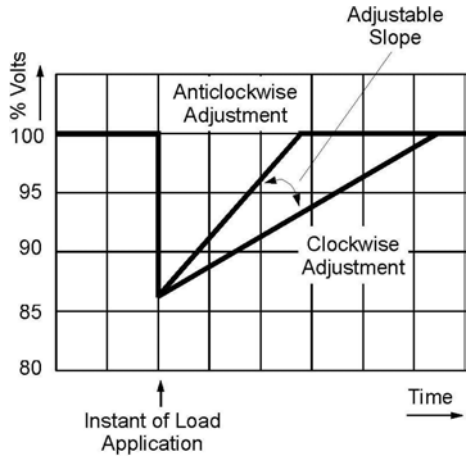


Fig. 4

4.8 ACCESSORIES

Refer to the "ACCESSORIES" Section of this Manual for setting up procedures related to generator mounted accessories.

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.

Replace AVR access cover after all adjustments are completed.

SECTION 5

INSTALLATION - PART 2

5.1 GENERAL

The extent of site installation will depend upon the generating set build, e.g. 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.

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.

5.2 GLANDING

The standard build terminal box arrangement is for cable entry into the right hand side of the terminal box when viewed from generator N.D.E. with removable panel for easy adaptation to suit specific glanding requirements.

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.

In addition the cable should be clamped at the gland so that forces on the cable due to set movement cannot be transmitted to the insulated terminals in the terminal box.

Before making final connections, test the insulation resistance of the windings. The AVR should be disconnected during this test and RTD leads grounded.

For the MAIN STATOR WINDINGS the following type of megger or similar instrument should be used.

LV Generators: 500V Motorised Instrument.
MV Generators: 2500V Motorised Instrument.
HV Generators: 5000V Motorised Instrument.

The measured Insulation Resistance should be above the value stated in the table below.

GENERATOR TYPE		
LV	MV	HV
5 Meg Ohms	50 Meg Ohms	200 Meg Ohms

If these values cannot be achieved the windings should be dried out as detailed in the Service and Maintenance Section of this manual.

A 1000V instrument is suitable for all other windings and a minimum insulation resistance value of 1Meg Ohms should be recorded.

5.2.1. CONNECTIONS ON MV & HV GENERATORS

When making connections to the insulated terminals the incoming cable termination should be placed on top of the winding lead termination(s) and clamped between the two nuts provided as shown in Fig. 5

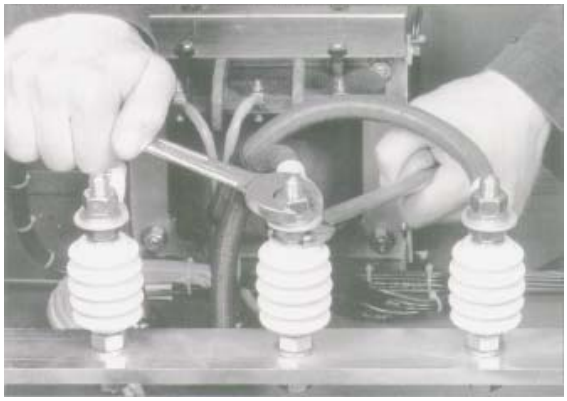


Fig. 5

Caution! **The load cables must not be connected via any rigid right-angled extension bar to the main terminals. This will cause excessive side loads on the ceramic insulations.**

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

5.3 EARTHING

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. The generator feet should be already bonded to the generating set bedplate by the generating set builder, and will normally be required to be connected to the site earth system.

Caution! **Reference to local electricity regulations or safety rules should be made to ensure correct earthing procedures have been followed.**

5.4 PROTECTION

Although the AVR incorporates certain protective elements as already described, 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.

High voltage transient surges generated by a switching device or lightning strikes on overhead cables must be prevented from reaching the generator terminals by the fitting of correctly designed surge suppression devices. These must be connected as close to the generator terminals as practicable, and ideally consist of surge arresters and surge capacitors.

A separate Newage publication, entitled Applications Guidelines, covers this topic more fully and is available upon request.

Where generators are connected to overhead transmission lines either directly or via transformers, the overhead lines should be fitted with surge arresters to reduce surge levels on the more immediate generator protection. Overhead line arresters should ideally be at a distance of 350m from the generator.

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.

On LV generators the star point busbars arrangement allows for the fitting of differential protection current transformers.

Provision has been made for an earth leakage detection current transformer which is positioned between the star point and neutral terminal.

On MV and HV generators the main stator winding has six leads brought out to terminals in the terminal box. The three leads brought to the neutral terminal have been arranged to allow for the provision of differential protection with the option of clamps and mounting plates for specific current transformers supplied by Newage International.

If it becomes necessary for customers to use current transformers not of Newage supply, these should be fitted in an engineered manner with particular care being taken to ensure the cables are positioned centrally within the current transformer opening.

Generator output terminals can be offered in an arrangement to suit the fitting of specific DIFFERENTIAL PROTECTION current transformers supplied by Newage International. This requirement should be specified at time of order.

Incorrect installation and/or protective Systems can result in personal injury and/or equipment damage.
Installers must be qualified to perform electrical installation work.

5.5 COMMISSIONING

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.

The generator AVR controls will have been adjusted during the generating set manufacturer's tests and should normally not require further adjustment.

Should malfunction occur during commissioning refer to Service and Maintenance section 'Fault Finding' procedure.

SECTION 6

ACCESSORIES

6.1 GENERAL

Generator control accessories may be fitted, as an option. 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.

Available accessories for generator mounting are as follows:

Quadrature droop current transformer;
VAr/PF controller and associate current transformers;
Fault level limiting current transformers.

There are two terminal box mounted accessories, which relate to parallel operation i.e. DROOP and VAr/PF controller. (See Paragraph 6.2 and 6.5 respectively). Understanding of the following notes on parallel operation is essential before attempting the fitting or setting of either 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.

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

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

Once connected in parallel a minimum instrumentation level per generator of voltmeter, ammeter, wattmeter (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.

It is important to recognise that:

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

and

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.

6.2 DROOP

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 (i.e. power factor) to the AVR.

Note:if 'current limit' transformers are fitted the "W' phase CT provides both droop and current limit.

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.

Fig. 6 indicates the effect of droop in a simple two generator system.

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

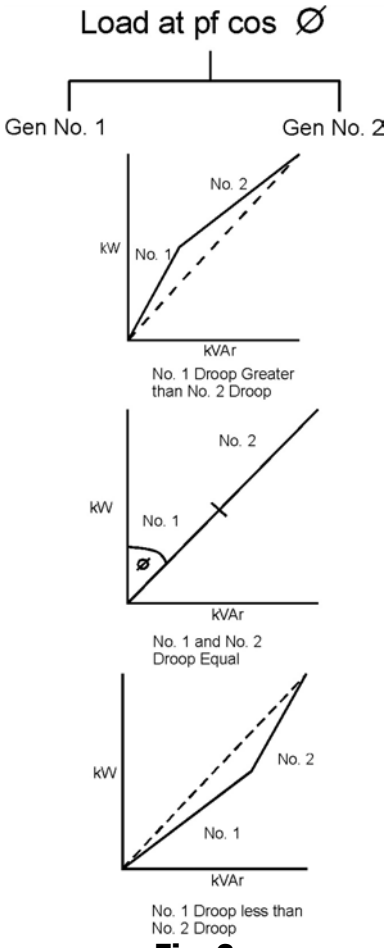


Fig. 6

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.

6.2.1 SETTING PROCEDURE

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

0.8pf LOAD	(at full load current)	SET DROOP TO 3%
Zero pf LOAD	(at full load current)	SET DROOP TO 5%

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

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 to give droop in line with above table. Clockwise rotation increases amount of droop.

Note 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.

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

Note 3
A generator fitted with droop circuit, operated as a single unit at rated load 0.8pf, is unable to maintain the usual +/-½% regulation.

A shorting switch can be connected across S1-S2 to restore regulation for single running.

Important ! **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.

6.3 OVERVOLTAGE DE-EXCITATION BREAKER

This provides positive interruption of the excitation power in the event of overvoltage due to loss of sensing or internal AVR faults including the output power device.

Important ! **When the circuit breaker is supplied loose the AVR is fitted with a link on terminals K1-K2 to enable operation of AVR. When connecting the circuit breaker this link must be removed.**

6.3.1 RESETTING THE BREAKER

In the event of operation of the circuit breaker, indicated by loss of generator output voltage, manual resetting is required. When in the "tripped" state the circuit breaker switch lever shows "OFF". To reset move the switch lever to the position showing "ON".

Danger !

Terminals which are 'LIVE' with the generating set running are exposed when the AVR access cover is removed. Resetting of the circuit breaker must be carried out with he generating set stationary, and engine starting circuits disabled.

When fitted in the generator, access to the breaker is gained by removal of the AVR access cover.

The circuit breaker is mounted on the AVR mounting bracket either to the left or to the right of the AVR depending upon AVR position. After resetting the circuit breaker replace the AVR access cover before restarting the generating set. Should resetting of the circuit breaker not restore the generator to normal operation, refer to section 7, following Fault Finding Procedure.

6.4 FAULT LEVEL CURRENT LIMIT - TRANSFORMERS

These accessories work in conjunction with the AVR circuits to provide an adjustment to the level of current delivered into a fault. One current transformer (CT) per phase is fitted to provide current limiting on any line to line or line to neutral fault.

Note: The W phase CT can also provide "DROOP". Refer to 6.2.1. for setting droop independent of current limit.

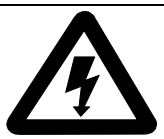
Adjustment means is provided with the "I/LIMIT" control potentiometer on the AVR. Refer to Fig. 1 in section 4.5 for location. If current limit transformers are supplied with the generator the limit will be set in accordance with the level specified at the time of order, and no further adjustment will be necessary. However, should the level need to be adjusted, refer to the setting procedure given in 6.4.1.

6.4.1 SETTING PROCEDURE

Run the generating set on no-load and check that engine governor is set to control nominal speed.

Stop the generating set. Remove the wires to terminals - K1,K2, and insulate the 'BARE ENDS' to make safe. Connect a 5 amp 240V AC switch across the terminals K1-K2.

Turn the "I/LIMIT" control potentiometer fully anticlockwise. Short circuit the stator winding with a bolted 3 phase short at the main terminals. An AC current clip-on ammeter is required to measure the winding lead current.



Danger !

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

With the switch across K1-K2 open start the generating set.

Close the switch across K1-K2 and turn the "I/LIMIT" control potentiometer clockwise until required current level is observed on the clip-on ammeter. As soon as correct setting is achieved open the K1-K2 switch.

Should the current collapse during the setting procedure, the internal protective circuits of the AVR will have operated. In this event shut down the set and open the K1-K2 switch. Restart the set and run for 10 minutes with K1-K2 switch open, to cool the generator windings, before attempting to resume the setting procedure.

Important ! **Failure to carry out the correct COOLING procedure may cause overheating and consequent damage to the generator windings.**

6.5 POWER FACTOR CONTROLLER (PFC3)

This accessory is primarily designed for those generator applications where operation in parallel with the mains supply is required.

Protection against loss of mains voltage or generator excitation is not included in the unit and the system designer must incorporate suitable protection.

The electronic control unit requires both droop and kVAr current transformers. When supplied with the generator, wiring diagrams inside the back cover of this manual show the connections and the additional instruction leaflet provided gives details of setting procedures for the power factor controller (PFC3).

The unit monitors the power factor of the generator current and adjusts excitation to maintain the power factor constant.

This mode can also be used to control the power factor of the mains if the point of current monitoring is moved to the mains cables. Refer to the factory for appropriate details.

It is also possible to operate the unit to control kVAr of the generator if required. Refer to the factory for appropriate details.

A.C. GENERATOR WARRANTY

WARRANTY PERIOD

A.C. Generators

In respect of a.c. generators the Warranty Period is eighteen months from the date when the goods have been notified as ready for despatch by N.I. 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 N.I. free of harge (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 N.I. recommended installation practices as detailed in the publications 'N.I. Installation, Service and Maintenance Manual' and 'N.I. 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.

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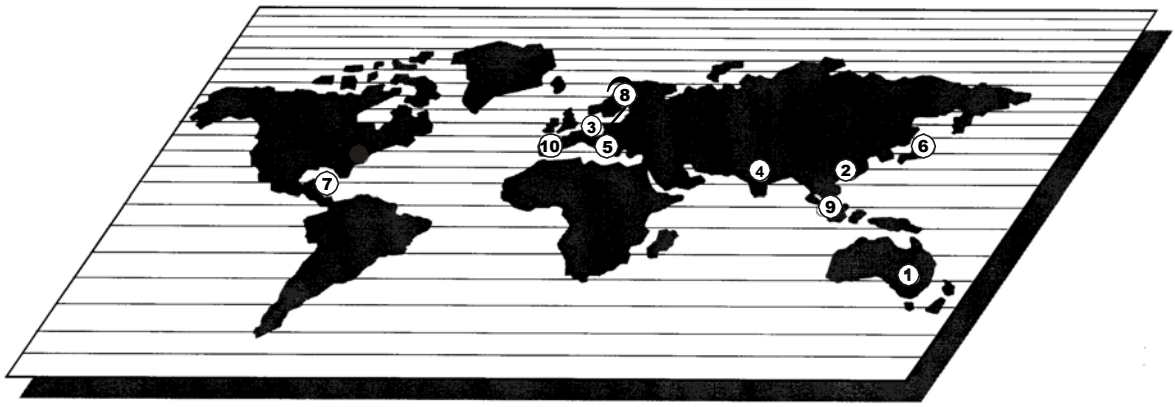

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