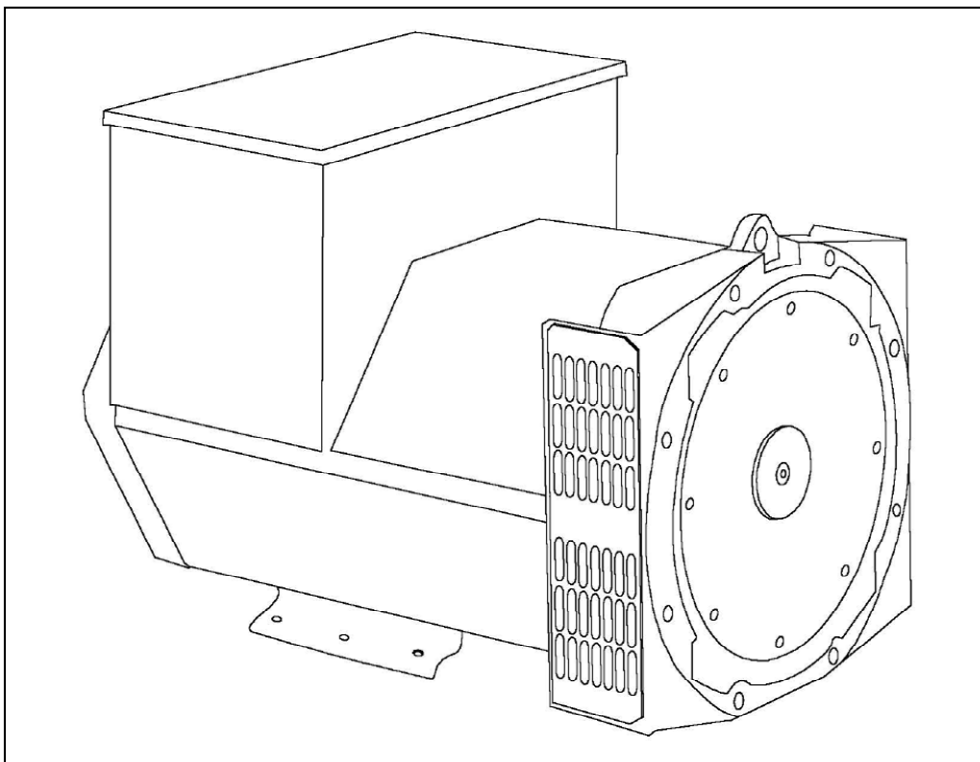


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# STAMFORD<sup>®</sup>

## Installation, Service & Maintenance Manual for BC Range of AC Generators



## SAFETY PRECAUTIONS

### First Steps to Safe Operation

Read this manual, obey all Warnings and Cautions, and become familiar with the product.

### Warnings & Notices used in this manual

The various warnings are outlined below and appear in the text in this format. Warnings and Cautions appear at the appropriate position in the, to which they refer.

**Warning: Information that draws attention to the risk of injury or death.**

**Caution: Information that draws attention to the risk of damage to the product, process or surroundings.**

**Note: Used to convey, or draw attention to, additional information or explanations.**

Notes appear after the text to which they refer.

### Skill requirements of personnel

Service and maintenance procedures should only be carried out by experienced, qualified engineers, familiar with the procedures and the equipment. Before any intrusive procedures are carried out, ensure that the engine is inhibited and the generator is electrically isolated.

### Electrical Equipment

All electrical equipment can be dangerous if not operated correctly. Always service and maintain the generator in accordance with this manual. Always use genuine 'STAMFORD' replacement parts.

**Warning: Electrical shock can cause injury or death. Ensure that all personnel operating, servicing, maintaining or working near this equipment are fully aware of the emergency procedures in case of accidents.**

Before removing the protective covers to carry out service maintenance or repair, ensure that the engine is inhibited and the generator is electrically isolated. The AVR access covers are designed to be removed while the generator is on load.

### Lifting

Lift the generator using the points provided with the aid of a spreader and chains. The angle on the chains must be vertical during the lift. Do not lift single bearing generators without the, securely fitted, transit bar. When removing the transit bar just prior to offering the generator up to the engine, be aware that the rotor is not securely held in the generator. Keep the generator in the horizontal plane to when the transit bar is not fitted.

**Warning: The lifting points provided are designed for lifting the generator only. Do not lift the Generating Set by the generator's lifting points.**

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

### EC DECLARATION OF INCORPORATION

## Foreword

### The Manual

Before operating, the generating set read this manual and all additional documentation supplied with it. Great care has been taken with the design of this product to ensure that it is safe to operate. Misuse and the failure to follow the safety precautions contained in the manual are potential causes of accidents.

Read the manual and make sure that all personnel who work on the equipment have access to the manual. The manual should be considered as part of the product and should remain with the product. Make sure that the manual is available to all users throughout the life of the product.

### Scope

This manual contains guidance and instructions for the Installation, Servicing and Maintenance of the generator.

It is not possible, within the scope of the manual, to teach the basic electrical and mechanical skills required to safely carry out the procedures enclosed. The manual is written for skilled electrical and mechanical technicians and engineers, who have prior knowledge and experience of generating equipment of this type.

We offer a range of training courses that cover all aspects of STAMFORD generators.

### Generator Designation

B	C	1	8	4	D	1	(example)
P	- Generator type						
I	- Applications, I = Industrial, M = Marine.						
1	- Frame size						
8	18 = centre height in cm.						
4	- Number of poles, 2 or 4						
C	- Core Size						
1	- Number of bearings, 1 or 2						

### The Product

The product is an AVR controlled, self excited synchronous 'ac generator'. Designed for incorporation into a generating-set. (A generating-set is defined as 'machinery' in European directives).

### Serial Number Location

Each generator has a unique serial number stamped into the upper section of the drive end of the frame.

The serial number is also shown on the nameplate.

Two other labels are located inside the terminal box, both fixed inside of the terminal box, one on the sheet metal-work and the other on the main frame of the generator. Neither of these two labels is considered to be permanently fixed.

### Rating Plate

The generator has been supplied with a self-adhesive rating plate label to enable fitting after final assembly and painting. Stick the nameplate to the outside of the non-drive end of the terminal box. The surface in 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 20 mm 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 progressively peel off the backing paper and smooth down with a clean cloth. The adhesive will achieve a permanent bond in 24 hours.

A factory fitted metal nameplate is available for some applications.

**Caution. Do not exceed the parameters marked on the rating plate.**

of a label as below.

When this manual is supplied to support a specific generator

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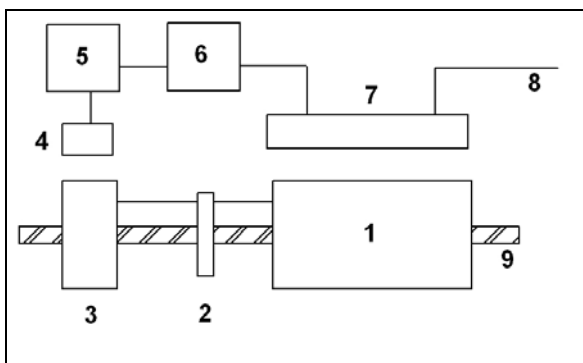
## INTRODUCTION

### General Description

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.

The BC16/18 range are self-excited with excitation power derived from the main output windings, using either the AS440 AVR or transformer controlled excitation system.

### Self-Excited AVR Controlled Generators



1	Main rotor	6	Isolating transformer (if fitted)
2	Rotating diodes	7	Main stator
3	Exciter rotor	8	Output
4	Exciter stator	9	Shaft
5	AVR		

### Main Stator Powered Avr

The main stator provides power for excitation of the exciter field via the SX460 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. The detailed function of the

AVR circuits and their adjustment are covered in the load testing section.

### For Parallel operation

The AS440 AVR also incorporates circuits which, when used in conjunction with accessories, can provide for parallel operation with 'droop' control.

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.

### Auxiliary Winding

An auxiliary winding can also provide the power for excitation of the exciter field via the AS440 AVR to provide short circuit maintenance when required.

### Transformer Controlled Generators

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. Three phase generators normally have a three phase transformer control for improved performance with unbalanced loads but a single phase transformer option is available. No accessories can be provided with this control system.

### Standards.

AC generators by Newage International meet the relevant parts of national and international standards pertaining to generators. The generator must be operated within the limits laid down in the relevant standards and within the parameters on the generator rating plate.

Marine generators meet the requirements of all the major marine classification societies.

## European Directives.

AC generators sold for use in the European Union must meet the relevant European directives. An ac generator has no intrinsic function; it must be have a mechanic input in order to provide an electrical output. The generator is supplied as a component part of a Generating-Set. To reflect this each generator is supplied with an 'EC Declaration of Incorporation' in accordance the Machinery Directive.

The ac generator meets the relevant directives applicable to an ac generator (component part) before it is incorporated into 'machinery'.

<b>EC DECLARATION OF INCORPORATION</b>	
<small>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 AND SUBSEQUENT AMENDMENTS</small>	
<b>THIS STAMFORD A.C. GENERATOR WAS MANUFACTURED BY OR ON BEHALF OF NEWAGE INTERNATIONAL LTD</b>	
<small>BARNACK ROAD, STAMFORD, LINCOLNSHIRE, ENGLAND</small>	
<small>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.</small>	
<small>FOR AND ON BEHALF OF THE MANUFACTURER NEWAGE INTERNATIONAL LIMITED</small>	
<b>NAME:</b> <b>POSITION:</b> <b>SIGNATURE:</b>	
<small>THIS COMPONENT MACHINERY CARRIES THE CE MARK FOR COMPLIANCE WITH THE STATUTORY REQUIREMENTS FOR THE IMPLEMENTATION OF THE FOLLOWING DIRECTIVES:</small>	
<b>WARNING</b>	<small>i) The EMC Directive 89/336/EEC and subsequent amendments. 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 and subsequent amendments.</small>

The directives identified as pertaining to ac generators are:  
 The Machinery (Safety) Directive, 98/37/EEC.  
 The Low Voltage Directive, 73/23/EEC.  
 The EMC Directive, 89/336/EEC

The generator is CE marked; CE labels are supplied loose in case the generating set manufacturer needs to paint the generating set before delivery to the end user.

**Note: Once the generator is build into a generating-set (machinery), it is the responsibility of the generating-set manufacture to ensure that the generating-set complies with the relevant EC Directives.**

It is contrary to the EC Directives to misrepresent compliance of the EC directives by displaying the CE mark supplied with a component part of the product. The directive requires compliance to be assessed as a component part, as the complete product and during installation on site.

Applications for use within the EU

Newage ac generators are supplied on the basis that:

They are used for power generation or related functions.

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.)
- Road 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 & 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 must be made to Newage document reference N4/X/011. This publication outlines the additional equipment that may be required.

The installation 'earth/ground' arrangements require the connection of the generator frame to the site protective earth conductor using a minimum lead length.

Maintenance and servicing with unauthorised parts, not of Newage supply, will invalidate Newage from any liability for EMC compliance.

Installation, maintenance and servicing are carried out by adequately trained personnel fully aware of the requirements of the relevant EC directives.

#### Unsuitable Applications

Synchronous generators require a constant speed for power generation. Applications where the generator is not run at a constant speed are not suitable for the standard generator. Such applications may be possible within certain parameters. Contact the factory for advice, there is every possibility that we can provide you with a satisfactory technical solution to meet your requirement.

#### Additional information for EMC compliance

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 must be made to Newage document reference N4/X/011. This publication outlines the additional equipment that may be required.



## Application of the generator

### Environmental Protection

Stamford generators are protected to IP23. IP23 is not adequate protection for use outdoors without additional measures.

Ambient Temperature	<40°C
Humidity	<60%
Altitude	<1000m

This table represents the normal operating conditions that the generator is designed for. Operation outside of these parameters is possible after due consideration and will be reflected on the generator nameplate. If the operating environment for the generator

has changed after purchase, the rating of the generator needs to be revised, refer to the factory for details.

### Air Flow

The air flow requirements for the generator can be found in the Data section at the back of this manual. Ensure that the air inlets and outlets are not obstructed when the generator is running.

### Airborne Contaminates

Contaminates such as salt, oil, exhaust fumes, chemicals, dust, sand, etc., will reduce the effectiveness of the insulation and lead to premature failure of the windings. Consider using air filters or an enclosure to protect the generator.

### Air Filters

Air filters are available on request. Filters present a restriction to the airflow so the rating of the generator must be reduced by 5%. If the filters are supplied, factory fitted, the rating on the nameplate will include the reduced rating. The filters can be up-fitted after delivery in which case the customer must apply the power reduction.

Air filters remove airborne particulates above 3 microns. The frequency of changing and cleaning the filters depend on the site conditions. We recommend that the filters are monitored frequently until a suitable cycle of change is established.

Air filters do not remove water. Additional protection must be employed to prevent the filters from getting wet. If the filters are allowed to get wet the airflow will be restricted and the generator will overheat. This will reduce the life expectancy of the insulation leading to premature failure of the generator.

### High Humidity environments

The humidity of the air will allow condensation to form on the windings if the temperature of the windings falls below the dew point. The dew point is a relationship between the ambient temperature and humidity. In areas of high humidity additional protection may be required even if the generator is fitted inside an enclosure.

### Anti-condensation heaters

Anti-condensation heaters are designed to raise the temperature of the windings above the temperature of the surrounding material so that the condensation will not form on the windings.

We recommend that anti-condensation heaters are fitted to all generators that are left switched off for any period of time. The best practice is to wire the heaters such that the heaters come on when the generator is switched off. This is particularly important in applications where high humidity is a significant problem. Always check the condition of the generators windings before switching the generator on. If moisture is observed carry out one or more of the drying-out methods outlined in the Service section of this manual.

### Enclosures

An enclosure should be employed to protect the generator from adverse environmental conditions. If the generator is to be fitted inside an enclosure, ensure that there is adequate airflow to support both the engine and the generator. Ensure that the generator air supply is clean (free from moisture and contaminants) and at or below the ambient temperature stated on the rating plate.

**Vibration**

Newage generators are designed to withstand the vibration levels encountered on generating sets built to meet the requirements of ISO 8528-9 and BS 5000-3. (Where ISO 8528 is taken to be broad band measurements and BS5000 refers to the predominant frequency of any vibrations on the generating set).

**Definition of BS5000 – 3**

Generators shall be capable of continuously withstanding linear vibration levels with amplitudes of 0.25mm between 5Hz and 8Hz and velocities of 9.0mm/s rms between 8 Hz and 200 Hz, when measured at any point directly on the carcass or main frame of the machine. These limits refer only to the predominant frequency of vibration of any complex waveform.

**Definition of ISO 8528 - 9**

ISO 8528-9 refers to a broad band of frequencies; the broad band is taken to be between 2 Hertz and 300 Hertz. The table below is an example from ISO 8528 - 9 (value 1). This simplified table lists the vibration limits by kVA and speed for acceptable genset operation.

Vibration Levels As Measured On The Generator				
Engine Speed Min <sup>-1</sup>	Set Output Kva	Vibration Displacement ( <i>S rms</i> )	Vibration Velocity ( <i>V rms</i> )	Vibration Acceleration ( <i>a rms</i> )
1500 – 1800 (rpm)	>250 kVA	0.32 mm	20 mm/sec	13 m/sec <sup>2</sup>
	>250	0.29 mm	18 mm/sec	11 m/sec <sup>2</sup>
The 'Broad band' is taken as 2 Hz - 300 Hz				

**Caution: Exceeding either of the above specifications will have a detrimental effect on the life of the bearings and other components. This will invalidate the generator warranty. If you are in any doubt, contact Newage International Limited.**

**Vibration Monitoring**

Newage recommends that the set builder checks the vibration levels using vibration analysing equipment. Ensure that the vibration levels of the generating set are within the levels stated in BS 5000-3 and ISO 8528-9. If the vibration levels are not within tolerance the genset builder should investigate the root cause of the vibrations and eliminate them. The 'best practice' is for the genset builder to take initial readings as a base line and the user to periodically monitor the genset and bearings to detect any deteriorating trend. It will then be possible to plan ahead for bearing changes and eliminate vibration problems before excessive damage to the generating set occurs.

Vibration checks should be made every 3 months.

**Excessive Vibration levels**

If the vibration levels of the generating set are not within the parameters quoted above:

Consult the genset builder; the genset builder should address the genset design to reduce the vibration levels as much as possible.

Discuss, with Newage, the impact of not meeting the above levels on both bearing and generator life expectancy.

When requested, or it is deemed necessary, Newage will work with the genset builder in an attempt to find a satisfactory solution.

**Bearings**

Sealed for life or re-greasable bearings are fitted to the P range of generators. The bearings are fitted within machined housings, these housings form an assembly located and bolted, within the end brackets. All of the have bearings have pressed steel cages and are type C3. The grease used is a high specification synthetic compound that must not be mixed with grease with a different specification.

**Re-greasable Bearings**

When re-greasable bearings are fitted the bearing housings incorporate fittings for pipework to an external grease nipple. Generators with re-greasable bearings are supplied with information labels advising the user of grease type, re-lubrication frequency, and the quality of grease to be used. These

instructions must be followed. The information is repeated in the Data section of this manual. The bearing housing has a grease escapement slot at the bottom of the outer area. At the drive end the grease, expelled from the escapement slot, will discharge into the coupling area. At the non-drive end the grease, from escapement slot, is deflected by a metal plate to ensure that it cannot foul the Permanent Magnet Generator (PMG). The sheet metal cover over the PMG has a slot at the bottom to enable the excess grease to escape.

#### Bearing Life

Factors that effect bearing life:

The life of a bearing in service is subject to the working conditions and the environment:

High levels of vibration from the engine or misalignment of the set will stress the bearing and reduce its service life. If the vibration limits set out in BS 5000-3 and ISO 8528-9 are exceeded bearing life will be reduced. Refer to 'Vibration' below.

Long stationary periods in an environment where the generator is subject to vibration can cause false brinnelling, which puts flats on the balls and grooves on the races, leading to premature failure.

Very humid atmospheric or wet conditions can emulsify the grease causing corrosion and deterioration of the grease, leading to premature failure of the bearings.

#### Health Monitoring of the Bearings

Newage recommends that the user check the bearing condition, using monitoring equipment, to determine the state of the bearings. The 'best practice' is to take initial readings as a base line and periodically monitor the bearings to detect a deteriorating trend. It will then be possible to plan a bearing change at an appropriate generating set or engine service interval.

#### Bearing 'Service Life' Expectancy

Bearing manufacturers recognise that the "service life" of their bearings is dependent upon many factors that are not in their control; they cannot therefore quote a "service life".

Although "service life" cannot be guaranteed, it can be maximised by attention to the generating set design. An understanding of the generating set's application will also help the user to maximise the service life expectancy of the bearings. Particular attention should be paid to the alignment, reduction of vibration levels, environmental protection, maintenance and monitoring procedures.

Newage does not quote life expectancy figures for bearings, but suggests practicable replacement intervals based on the L10 life of the bearing, the type of grease and the recommendations of the bearing and grease manufacturers.

**For general-purpose applications: providing the correct maintenance is carried out, vibration levels do not exceed the levels stated in ISO 8528-9 and BS5000-3, and the ambient temperature does not exceed 50°C. Plan to replace bearings within 30,000 hours of operation.**

It is important to note that bearings in service, under good operating conditions, can continue to run beyond the recommended replacement period. It should also be remembered that the risk of bearing failure increases with time.

If in doubt about any aspect of the 'bearing life' on generators supplied by Newage International, contact your nearest Newage subsidiary or contact the Stamford factory direct.

**Installation into the Generating Set**

The generator is supplied as a component part for installation into a ‘generating set’.

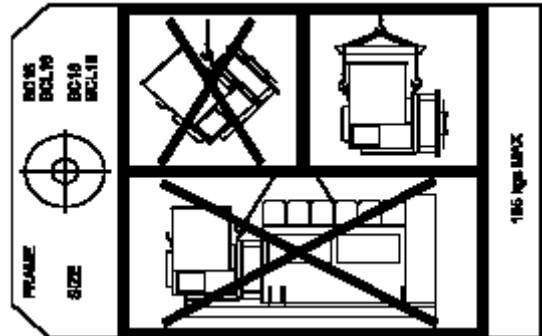
**Delivery**

Upon receipt of the generator, check the generator for damage that may have occurred during transport. Also check that the rating-plate details are correct and as ordered for the application.

**Handling the generator**

When lifting the generator use a spreader bar to ensure that the angle on the lifting chains are vertical to the lifting position on the generator.

**Warning: The generator lifting points are designed to lift the generator only. Do not lift the complete generating set by the generator lifting points.**



Single bearing generators have a transit bar fitted at the drive end. This bar holds the rotor in position during transit. The transit bar should be left in position until it is necessary to remove it to allow the generator to be coupled to the engine.

**Warning: If the generator is moved without the transit bar be aware that the rotor could fall out of the frame. When moving the generator always keep it in the horizontal plane, this will reduce the risk of the rotor falling out.**

**Storage**

If the generator is not to be used immediately, it must be stored in a clean, dry, vibration free environment. If anti-condensation heaters are fitted, switch them on. If heaters are not fitted use other means to ensure that condensation cannot form on the windings. Spin the shaft by hand every month to prevent flat spots in the bearings and to free up the grease.

**After Storage**

After a period of storage, carry out ‘pre running checks’ to determine the condition of the windings. If the winding are damp or the insulation is low, follow one of the ‘drying out procedures’, in the Service section of this manual. Replace the bearing after 12 months in storage. (see the Maintenance section)

**Rotor balancing**

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.

**Generator Vibration, Frequency**

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

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 BS5000 part 3 and ISO 8528 part 9 are not exceeded.

In standby applications where the running time is limited and reduced life expectancy is accepted, higher levels than specified in BS5000 part 3 can be tolerated, up to a maximum of 18mm/sec.

**Side Loads**

In the case of belt driven generators, ensure alignment of drive end and driven pulleys to avoid axial load on the bearings. Screw type tensioning devices are recommended to allow accurate adjustment of belt tension whilst maintaining pulley alignment.

Belt and pulley guards must be provided by the set builder.

**Important ! Incorrect belt tensioning will result in excessive bearing wear.**

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

**Coupling arrangements**

Single and two bearing arrangements are available both arrangements can be close coupled. Both arrangements also need a firm level foundation.

Two bearing generators require a substantial bedplate with engine/generator mounting pads to ensure a good base for accurate alignment. Close coupling of the engine to the generator can increase the overall rigidity of the set. A flexible coupling, designed to suit the specific engine/generator combination, is recommended to minimise the torsional effects.

**Accurate alignment of single bearing generators is essential, vibration can occur due to the flexing of the flanges between the engine and generator. A substantial bedplate with engine/generator mounting pads is required.**

For the purposes of establishing set design the bending moment at the engine flywheel housing to generator adaptor interface should not exceed 125ft.lb. (17 kgm).

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.

**Caution: Torsional incompatibility and/or excessive vibration levels can cause damage or failure of the generator and/or engine components.**

**Coupling Two Bearing Generators**

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.

Axial loading of the generator bearings should be avoided. Should it be unavoidable contact the factory for advice.

**Warning: Incorrect guarding and/or generator alignment can result in injury and/or equipment damage.**

#### Coupling Single Bearing Generators

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

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.

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: Care should be taken not to allow any cleaning agent to come into prolonged contact with skin.**

#### BCI, Single Bearing Coupling Alignment

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. Refer to the Data section of the manual for tightening torques.(75Nm : 55 lb/ft)
3. Remove air outlet covers from the drive end of the generator to gain access to coupling and adaptor bolts. Check that coupling joint interfaces are clean and lubricant free.
4. Check that coupling discs are concentric with adaptor spigot. This can be adjusted by the use of tapered wooden wedges between the fan and adaptor. Alternatively the rotor can be suspended by means of a rope sling through the adaptor opening.
5. Consider using alignment studs to ensure that the disc and the flywheel are in alignment.
6. Offer the generator to engine and engage both coupling discs and housing spigots at the same time, pushing generator towards engine until coupling discs are against flywheel face, and the housing spigots are located.

**Caution: Do not pull the generator to the engine using bolts through the flexible discs.**

7. Fit housing and coupling bolts taking care to use heavy gauge washers between coupling bolt head and coupling disc. Tighten bolts evenly around assembly sufficiently to ensure correct alignment.
8. Tighten housing bolts.
9. Tighten coupling disc to flywheel bolts. Refer to engine manufacturer's manual for correct tightening torque.
10. Remove rotor aligning aids, the sling, or wooden wedges and replace all covers.

**Caution: Incorrect generator alignment can result in damage to the generator.**

**Warning: Failure to replace protective covers can result in injury.**

#### BCA, Single Bearing Coupling Alignment

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

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

**Important !** During assembly, loss of residual voltage may occur. Refer to subsection 7.4.3 for field flashing.

Remove louvered cover "A" from non-drive endbracket "B".

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

Remove transit bar "K".

Remove side screens "G".

If the adaptor ring is an individual item, as indicated "F", bolted to the generator D.E. bracket, remove from generator and fit to engine flywheel housing.

Thread two locating pins "H" into two top flywheel holes.

Fit two locating pins "J" into two top holes of the engine flywheel housing/adaptor location holes.

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.

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

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.

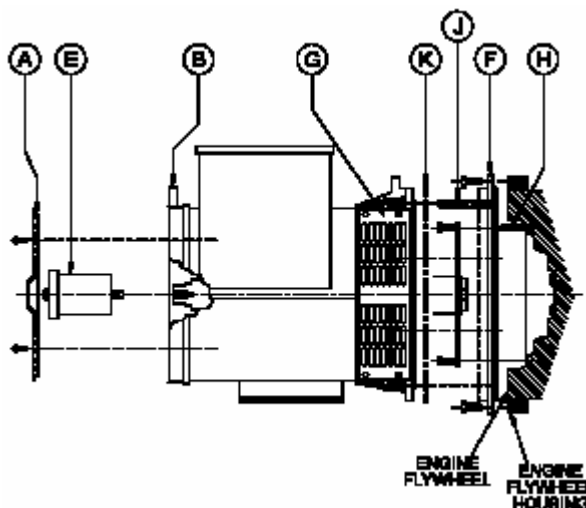
**Important !** Do not push the rotor forward too far. There is a risk that the rotor will rest on the stator winding outhang resulting in winding damage especially if any rotational movement occurs during alignment with pins "H".

Support the weight of the rotor at the coupling end whilst sliding the rotor forward to locate coupling disc holes oversupport 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.

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.

Remove locating bar "E". Replace M10 screw "C" for barring purposes.

Remove lifting tackle and replace side screens "G" and louvered cover "A".



(With Doweled Flywheels)

**Follow steps 1-5 from 4 pole instruction procedure.**

**Fit the two location dowel 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.**

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

**Follow steps 6-8 from 4 pole instruction procedure.**

**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".**

**Follow step 10 from 4 pole instruction procedure.**

**Support the weight of the rotor at the coupling end whilst sliding the rotor forward to locate coupling disc holes over support pins "H".**

**Important !      Ensure coupling disc dowel pin holes are in correct alignment.**

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

**Remove pins "H" and fit two final securing screws and washers.**

12    Follow steps 12-14 from 4 pole instruction procedure.

#### BCL Taper Shaft Arrangements

**This arrangement is used on the BCL style generators.**

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

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

**Remove louvred endcover "G" from non drive endbracket "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.**

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

**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.**

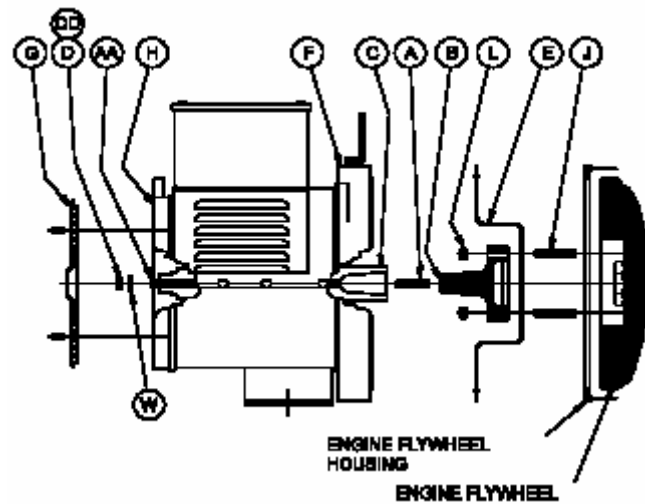
**Ensure both tapers are clean and free of burrs, oil or grease. Slide alternator complete with rotor towards engine, ensuring that shaft securing stud "A" enters central hole in rotor shaft. Refer to engine manual for torque settings.**

**Secure alternator adaptor "F" to engine flywheel housing. Tap adaptor into place before tightening. Refer to engine manufacturer for torque setting.**

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

**Fit louvred endcover "G" to non drive endbracket "H".**

**Check for excessive vibration at time of initial run-up.**



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

**Earth arrangement**

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 mounts.

**Warning: Refer to local regulations to ensure that the correct earth requirements are incorporated in the installation. Inadequate earth installations put lives at risk.**

**Paint Finish**

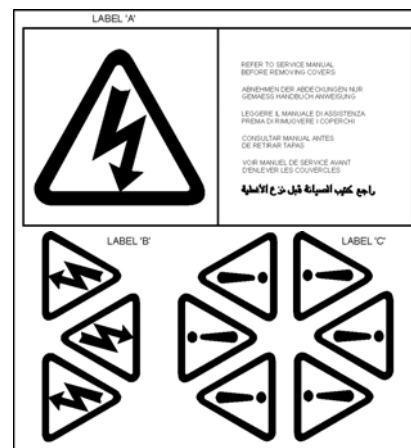
Unless previous arrangements have been agreed, the generator will be supplied in a water based primer coat. It is expected that the generating set assembler will want to paint the generating set with a final coat in their company livery.

**Note: The primer coat is not adequate protection for many applications without additional protection.**

**Warning labels**

As we expect the set builder to paint the generator in his own livery we supply the warning labels loose. The labels can be found in a wallet attached to the generator together with this manual.

Use the labels as per the instructions printed on the reverse of the labels.



**Pre-Running Checks**

- Before starting the generating set.
- Test the insulation resistance of windings.
- Check all connections are in the correct location and tight
- Check the generator air path is clear of obstructions
- Replace all covers.

Insulation resistance test

The AVR should be disconnected during this test.

A 500V Megger or similar instrument should be used. Disconnect any earth 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 5 Megohm to earth. Should the insulation resistance be less than 5 Megohm the winding must be dried out. See the Service section of this Manual.

**Caution: 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 i.e.**

**Test Voltage= 0.8 (2 X Rated Voltage + 1000)**

### **Direction of Rotation**

The direction of rotation of the generator is designed to be clockwise as viewed from the drive end of the generator, but it will run in either direction.

### **Phase Rotation**

The output from the generator will have a phase sequence of U V W with the generator running clockwise as viewed from the drive end. If the phase rotation of the generator has to be reversed the customer must rearrange the output cables to a UVW configuration. Ask for a circuit diagram of 'reverse phase connections'.

### **Voltage and Frequency**

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

### **AVR adjustment**

To make AVR selections and adjustments remove the AVR cover. Use the tool provided to make adjustments to the AVR settings. The AVR is factory set and will give satisfactory performance during initial running tests. Subsequent voltage adjustment both on and off load may be required. Guidance can be found in the section for the relevant AVR.

### **Accessories**

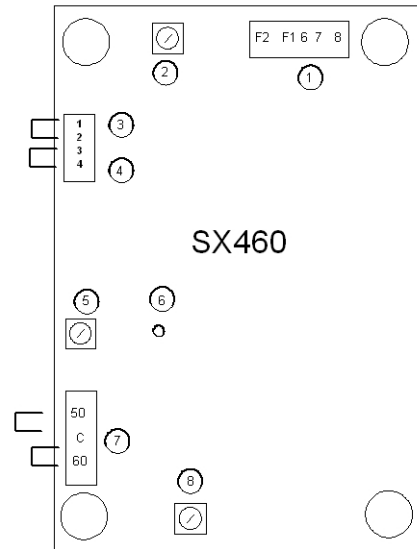
If there are accessories for control panel mounting supplied with the generator refer to the specific accessory fitting procedures inserted inside the back cover of this book.

## Automatic Voltage Regulators

### SX460 AVR

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

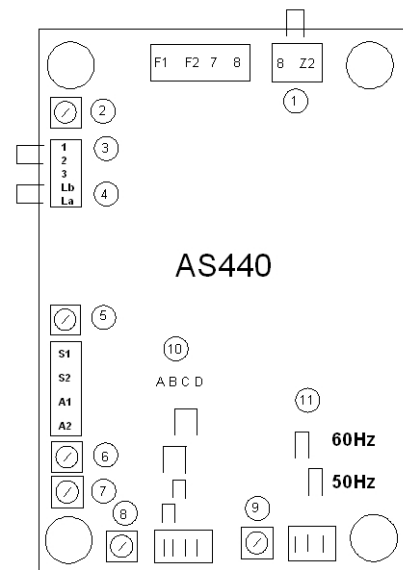
- 1) Field and sensing connections
- 2) Voltage adjustment
- 3) External hand trimmer selection  
 No external hand trimmer LINK 1-2  
 External hand trimmer required-REMOVE LINK 1-2 and connect trimmer across terminals 1 and 2.
- 4) AVR Input Selection  
 High Voltage (220/240V) INPUT No Link  
 Low Voltage (110/120V) INPUT LINK 3-4
- 5) UFRO adjustment
- 6) UFRO indication LED
- 7) Frequency selection  
 50Hz operation LINK C-50  
 60Hz operation LINK C-60
- 8) Frequency selection



### AS440 AVR

- 8 & Z2 linked for normal remove for auxiliary winding
- Output Voltage adjustment
- Hand trimmer link when not used
- Low voltage selection (110v)
- Droop adjustment
- To optimise analogue input sensitivity
- Excitement trip cut off adjustment
- Stability control
- UFRO adjustment
- Stability section
- Frequency section

Stability Selection Table		
No.	Power range	Response
B-D	< 100kW	Slow
A-C	< 100kW	Fast
B-C	100-550kW	Fast
A-B	> 550kW	Fast



### Transformer Controlled Excitation System

This control system is identified by the word 'TRANSF' against AVR type on the nameplate.

The excitation control is factory set for the specific voltage shown on the nameplate and requires no adjustment.

### Generator Set 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.

### Test Metering/Cabling

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 - 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. The load cable termination should be placed on top of the winding lead termination and clamped with the nut provided.

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.

## 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 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. 1, 2 or 3 for control potentiometer location.

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

The STABILITY control potentiometer should be set to the midway position (refer to fig 1, 2 or 3 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:-

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

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).

**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.

**Avr Controlled Generators - Avr Adjustments**

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

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

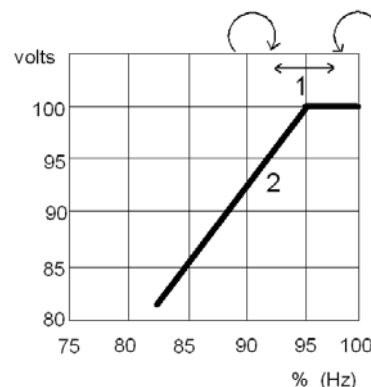
**UFRO (Under Frequency Roll Off)**

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

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

- 1) Knee point
- 2 Typical slope



### **Transformer Controlled Generators -Transformer Adjustment**

Normally no adjustment is required but should the no-load voltage and/or on-load voltage be unacceptable, adjustment of the transformer air gap can be made as follows.

Stop the generator. Remove transformer cover box. (Normally left hand side of the terminal box when viewed from the non drive end).

Slacken the three transformer mounting bolts along the top of the transformer, and the two bolts holding the mounting bracket to the base plate.

Start the set with a voltmeter connected across the main output terminals.

Adjust the air gap between the transformer top lamination section and the transformer limbs to obtain required voltage on no-load. Slightly tighten the three mounting bolts. Switch load 'on' and 'off' two or three times. Application of load will normally raise the voltage setting slightly. With the load 'off' recheck the no-load voltage.

Readjust air gap and finally tighten mounting bolts.

Refit the access cover.

**Warning ! Failure to refit covers can result in operator personal injury or death.**

### **Accessories**

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.

Accessories available are droop transformer for parallel operation applicable to generators with AS440 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).**

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

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

### **Parallel Operation**

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)

Frequency must match within close limits.

Voltages must match within close limits.  
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, 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.

It is important to recognise that

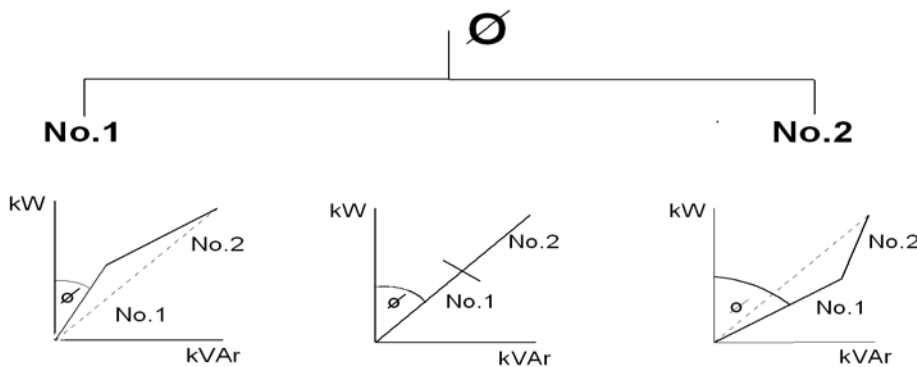
kW are derived from the engine, and speed governor characteristics determine the kW sharing between sets.

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**

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 (C.T.) which provides a signal dependent on current phase angle (i.e. 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.

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



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

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.

The following setting procedure will be found to be helpful.

## Setting Procedure

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%

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

Refer to Fig 2, Fig 3, for potentiometer location. After adjustment check NO LOAD voltage level and adjust if necessary.

Note 1) Reverse polarity of the C.T. 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 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.

**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.

## Installation on site

### 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.

### Glanding

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.

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.

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

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.

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.

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

### 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. 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.

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

**Protection**

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

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!**

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**

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 adjustment on site be necessary refer to Section 4 for AVR details and/or Section 6 for paralleling adjustments.

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

## Service and Maintenance

### Service

**Warning: Service and fault finding procedures present hazards which can result in severe 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.**

### Winding Condition

Guidance of Typical Insulation Resistance [IR] Values

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

The generator's Insulation Resistance, along with many other critical factors, will have been measured during the generator manufacturing process. The generator will have been transported with an appropriate packaging suitable for the method of delivery to the Generating Set assembler's works. The assembler is expected to store the generator in a suitable location, protected from adverse environmental (and other) conditions.

However, absolute assurance that the generator will arrive at the Genset production line with IR values still at the factory test levels of above 100 Megohm to be guaranteed.

#### At Generating Set Assembler's Works

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 Megohm

If the unused/new generator's IR values fall below 5 Megohm 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

It is known that a generator will give reliable service with an IR value of just 1.0 Megohm. For a relatively new generator to be so low it must have been subjected to inappropriate operating or storage conditions. Any temporary reduction in IR values can be restored to expected values by following one of the drying out procedures.

#### Winding Condition Assessment

**Caution: The AVR should be disconnected and the Resistance Temperature Detector (R.T.D.) leads grounded during this test.**

**Caution: 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 i.e.**

**Test Voltage= 0.8 (2 X Rated Voltage + 1000)**

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

Measurement of winding insulation should be carried out: -

As part of a periodic maintenance plan.

After prolonged periods of shutdown.

When low insulation is suspected, e.g. damp or wet windings.

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. If low values are suspected or immediately indicated the test should only continue for long enough to very quickly assess the situation.

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**

1. Disconnect all electronic components, AVR, electronic protection equipment etc. Ground the RTD's (Resistance Temperature Detection devices) if fitted.
2. 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.
3. Carry out the insulation test in accordance with the 'operating instructions' for the test equipment.
4. 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 is 1.0 Megohm on a 500V megger.

If low winding insulation is confirmed, one or more of the methods, given below, for drying the winding should be carried out.

### **Methods of Drying Out Generators**

#### **Cold Run**

In the case of a generator in otherwise good condition that has not been run for some time, and has been standing in damp, humid conditions a simple procedure may suffice. It is possible that simply running the generator 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 to greater than 1.0 Megohm, and so allow the unit to be put into service.

#### **Blown Air Drying**

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.

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 over heating and damage to the insulation.

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.

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

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**

**Warning: 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. Ensure the generator is safe to work on, initiate all mechanical and electrical safety procedures pertaining to the genset and the site.**

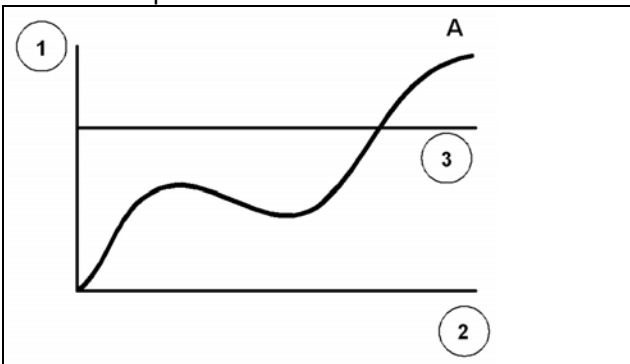
**Caution: The short circuit must not be applied with the AVR connected in circuit. Current in excess of the rated generator current will cause damage to the windings.**

1. 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.

2. Disconnect the cables from terminals “X” and “XX” of the AVR.
3. 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.
4. Position a suitable ac ammeter to measure the shorting link current.
5. 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 generator’s rated output current.
6. After every 30 minutes of this exercise:  
Stop the generator and switch off the separate excitation supply, 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.
7. Once the Insulation Resistance is raised to an acceptable level - minimum value 1.0 Megohm the dc supply may be removed and the exciter field leads “X” and “XX” re-connected to their terminals on the AVR.
8. Rebuild the genset, replace all covers and re-commission as appropriate.
9. 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**

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



- 1) Y axis = Resistance
- 2) X axis = Time
- 3) One Megohm limit

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 Megohm (If the windings are only slightly damp the dotted portion of the curve may not appear).

For general guidance, expect that the typical time to reach point ‘A’ will be around 3 hours.

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

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.

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

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

**Caution: The generator must not be put into service until the minimum values are achieved.**



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

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

**Caution: The generator must not be run if the minimum insulation value of 1.0 Megohm is not obtained.**

### **Air Filters**

Air filters for the removal of airborne particulate matter (dust) are offered as an addition to the standard build option. The filter elements do not remove and must not be allowed to get wet.

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.

**Caution: Do not charge filters with oil.**

**Warning: Removal of filter elements enables access to LIVE parts. Only remove elements with the generator out of service.**

### Air Filter Cleaning Procedure

1. Remove the filter elements from the filter frames, taking care not to damage them.
2. Invert the filters dirty side down and agitate to remove particles of dirt.  
To remove stubborn particles low-pressure air can be used, in the reverse direction of flow, to force out stubborn particles.  
If necessary use a soft brush to gently brush off any remaining dirt particles.
3. Clean the sealing gaskets and surrounding area.
4. Visually check the condition of the filter elements and sealing gaskets, replace as necessary.
5. Ensure that the filter elements are dry before putting them back into service.
6. Carefully replace the filter elements

**Maintenance**

**Fault Finding**

**Important !** Before commencing any fault finding procedures examine all wiring for broken or loose connections. 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 subsection as indicated below:-

**All Avr Types - Fault Finding**

No voltage build-up when starting set	1. Check speed 2. Check residual voltage. 3. Follow separate excitation test procedure to check generator
Unstable voltage either on no-load or with load	1. Check speed stability. 2. Check stability setting.
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. 3. Follow separate excitation procedure to check generator and AVR.

**Transformer Control - Fault Finding**

No voltage build-up when starting set	1. Check transformers rectifiers. 2. Check transformer secondary winding for open circuit.
Low voltage	1. Check speed. 2. Check transformer air gap setting.
High voltage	1. Check speed. 2. Check transformer air gap setting. 3. Check transformer secondary winding for short circuited turns.
Excessive voltage drop on-load	1. Check speed drop on-load. 2. Check transformer rectifiers. Check transformer air gap setting. .

**Residual Voltage Check (Field Flashing)**

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.

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 d.c. battery as a supply, clip leads from battery negative to AVR terminal F2, and from battery positive through a diode to AVR terminal F1.

**Important !** A diode must be used as shown below to ensure the AVR is not damaged.

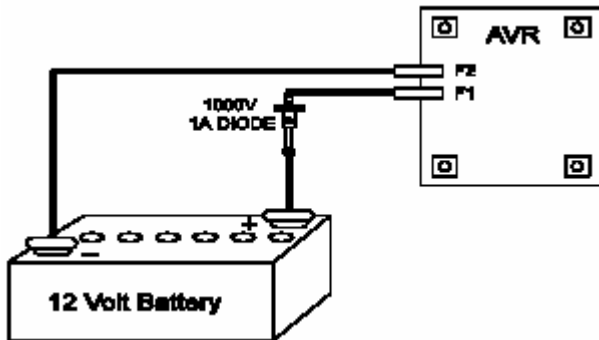


Fig. 5

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

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.

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 subsection 7.5.

**Separate Excitation Test Procedure**

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

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.

Connect a 60W 240 volt household lamp (or two 120V lamps in series) to AVR terminals F1 and F2. (Only required for section 7.5.2.1). On transformer controlled generators refer to sub section 7.5.2.2 for transformer checks.

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

The procedure is simplified by dividing into two sections:

**Generator Windings And Rotating Diodes, And Excitation Control Test.**

## Generator Windings And Rotating Diodes

**Important!** 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.

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

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

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

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 a.c.

## Balanced Main Terminal Voltages

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 subsection 7.5.2 for test procedure.

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

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

The rectifier assembly is split into two plates, the positive and negative, and the main rotor is connected across these plates. Each plate carries 3 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

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

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 Resistance Charts), 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.

Resistance values should be within 10% of the values given in the table below:-

Frame Size	Main Rotor	Exciter Stator			Exciter Rotor
		Type 1	Type 2*	Type 3**	
BC164 A	0.44	19	26	110	0.26
BC164 B	0.48	19	26	110	0.26
BC164 C	0.52	19	26	110	0.26
BC164 D	0.56	19	26	110	0.26
BC184 E	0.64	20	27	115	0.21
BC184F	0.74	22	30	127	0.23
BC184 G	0.83	22	30	127	0.23
BC184 H	0.89	24	-	-	0.24
BC184J	0.96	24	-	-	0.24
BC162 D	0.81	18	-	-	0.26
BC162 E	0.89	18	-	-	0.26
BC162F	0.95	18	-	-	0.26
BC162 G	1.09	19	-	-	0.27
BC182 H	1.17	20	-	-	0.21
BC182J	1.28	20	-	-	0.21
BC182 K	1.40	20	-	-	0.21
BCA16 2L	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.

Generators fitted with auxiliary stator windings.

Frame Size	Main Rotor	Exciter Stator	Exciter Rotor
BC184E	0.64	8	0.21
BC184F	0.74	8	0.23

BC184G	0.83	8	0.23
BC184H	0.89	8	0.24
BC184J	0.96	8	0.24

Incorrect resistances indicate faulty windings and component replacement is necessary. Refer to removal and replacement of component assemblies, subsection 7.5.3.

**Unbalanced Main Terminal Voltages**

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.

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

AVR CONTROLLED GENERATORS			
Frame Size	SECTION RESISTANCE		
	Winding 311	Winding 05	Winding 06
BC164A	0.81	0.41	0.31
BC164B	0.51	0.30	0.19
BC164C	0.36	0.21	0.13
BC164D	0.30	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

Generators fitted with auxiliary stator windings.

AVR CONTROLLED GENERATORS		
Frame Size	AVR CONTROLLED GENERATORS	
	Main Stator Winding 71	Auxilliary
BC184E	0.19	1.88
BC184F	0.13	1.44
BC184G	0.10	1.32
BC184H	0.08	-
BC184J	0.066	-

TRANSFORMER CONTROLLED GENERATORS							
SECTION RESISTANCES							
Frame Size	3 Phase Windings					1 Phase Windings	
	380 V	400 V	415 V	416V	460 V	240V	240 V
BC164 A	2.4	2.56	2.62	1.98	2.36	0.37	0.25
BC164 B	1.68	1.75	1.81	1.36	1.7	0.26	0.17
BC164 C	1.16	1.19	1.21	0.91	1.16	0.17	0.12
BC164 D	0.83	0.84	0.87	0.74	0.93	0.28	0.22
BC184 E	0.59	0.60	0.63	0.48	0.61	0.16	0.12
BC184F	0.41	0.43	0.45	0.35	0.43	0.15	0.08
BC184 G	0.33	0.34	0.36	0.26	0.33	0.09	0.07
BC184 H	-	-	-	-	-	-	-
BC184J	-	-	-	-	-	-	-

Measure insulation resistance between sections and each section to earth.

Unbalanced or incorrect winding resistances and/or low insulation resistances to earth indicate rewinding of the stator will be necessary.

## Excitation Control Test

### Avr Function Test

All types of AVR'S can be tested with this procedure:

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

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

Set the AVR VOLTS control potentiometer fully clockwise.

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

Start the generating set and run at rated speed.

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

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.

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.

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

**Important !** After this test turn the VOLTS control potentiometer fully anti-clockwise.

### Transformer Control

The transformer rectifier unit can only be checked by continuity, resistance checks and insulation resistance measurement.

### Rectifier Diodes

Separate primary leads T1-T2-T3-T4 and secondary leads 10- 11. Examine windings for damage. Measure resistances across T1-T2 and T3-T4. These will be a low value but should be balanced. Check that there is resistance in the order of 5 ohms between leads 10 and 11. Check insulation resistance of each winding section to earth and to other winding sections. Low insulation resistance, unbalanced primary resistance, open or short circuited winding sections, indicates the transformer unit should be replaced.

### Three phase transformer

Separate primary leads T1-T2-T3 and secondary leads 6-7-8 and 10-11-12.

Examine windings for damage. Measure resistances across T1-T2, T2-T3, T3-T1. These will be low but should be balanced. Check that resistances are balanced across 6-10, 7-11 and 8- 12 and in the order of 8 ohms.

Check insulation resistance of each winding section to earth and to other winding sections.

Low insulation resistance, unbalanced primary or secondary winding resistances, open or short circuited winding sections indicates the transformer unit should be replaced.

### **Rectifier units - Three phase and single phase**

With the leads 10-11-12-F1 and F2 removed from the rectifier unit (lead 12 is not fitted on single phase transformer rectifier units), check forward and reverse resistances between terminals 10-F1, 11-F1, 12-F1, 10-F2, 11-F2 and 12-F2 with a multimeter.

A low forward resistance and high reverse resistance should be read between each pair of terminals. If this is not the case the unit is faulty and should be replaced.

### **Removal And Replacement Of Component Assemblies**

**Important !** 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.

**Warning!** 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**

**Important !** Position the main rotor so that a full pole face of the main rotor core is at the bottom of the stator bore.

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

Refer to main rotor assembly

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, i.e. 2 or 3 legged manual or hydraulic bearing pullers.
- 2) Remove circlip from shaft at non drive end (only fitted on single bearing machines).

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.

Refit the retaining circlip on single bearing generators.

**Main Rotor Assembly**

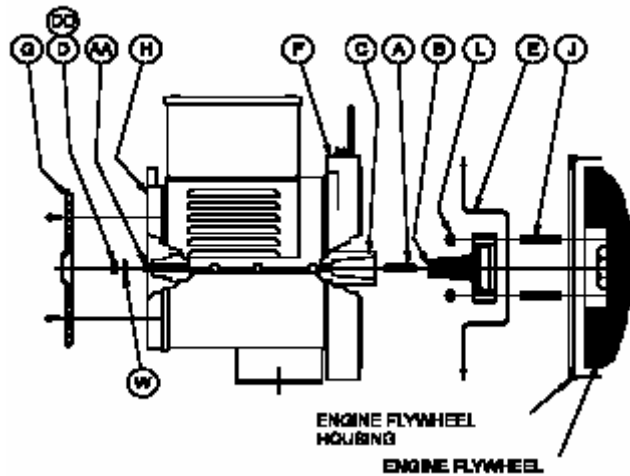
- 1) Single Bearing Generator
- 2) Remove four screws securing louvred cover at non drive end and remove cover.
- 3) Remove the screws and covers on each side of adaptor.
- 4) Ensure that rotor is supported at D.E. on a sling.
- 5) Tap the rotor from non-drive end bearing housing to push the bearing clear of the endbracket and its retaining 'O' ring.
- 6) Continue to push rotor through stator bore, gradually moving sling along rotor as it is withdrawn, to ensure full support at all times.

**Important !** When re-assembling position the rotor such that full pole face is at bottom dead centre.

**Two Bearing Generator**

- 1) Remove eight bolts securing the close coupling adaptor to the drive endbracket.
- 2) Tap off adaptor after supporting weight with sling.
- 3) Remove the screens and louvres (if fitted) on either side of drive end adaptor. Turn rotor until a full pole face is at bottom dead centre.
- 4) Remove eight cap head screws securing the drive end bracket to the drive end adaptor.
- 5) Tap off drive end bracket from drive end adaptor.
- 6) Support rotor at drive end with a sling.
- 7) Remove four screws securing louvred cover at non-drive end and remove cover.
- 8) Tap the rotor from non-drive end bearing housing to push the bearing clear of the endbracket and its retaining 'O' ring.
- 9) Continue to push rotor through stator bore, gradually moving sling along rotor, as it is withdrawn, to ensure full support at all times.

**Tapered Shaft Generator (BCL)**



- 1) Remove louvred endcover 'G' from non drive endbracket 'H'.
- 2) Remove M10 "BINX" self locking nut "DD".
- 3) The shaft securing stud "AA" has been treated with a thread locking agent before being screwed into the stub shaft "B". This may make removal of shaft securing stud "AA" difficult.
- 4) If the shaft securing stud "AA" can be removed follow steps 5 to 12 to remove generator from engine.

If the shaft securing stud "AA" cannot be removed follow steps 13 to 18 to remove complete generator from engine.

- 5) Locate a steel rectangular bar (or similar), with a central 15mm. hole, flush with rear vertical face of non-drive endbracket 'H'. Ensure that hole is aligned with tapped hole in shaft end.
- 6) Insert M14 X 25 hex. bolt through bar hole and screw into shaft end. The rotor will be drawn towards non-drive end thus releasing contact with engine taper stub shaft.
- 7) Remove M14 X 25 hed. hd. bolt.
- 8) Remove 10 bolts securing adaptor to engine.
- 9) Withdraw generator from engine.
- 10) Ensure rotor is supported at D.E. on a sling.
- 11) Tap the rotor from non-drive end bearing housing to push the bearing clear of the endbracket and a retaining 'O' ring.
- 12) Continue to push rotor through stator bore, gradually moving sling along rotor as it is withdrawn, to ensure full support at all times.
- 13) If it has not been possible to remove the shaft securing stud the following procedure is necessary.
- 14) Remove the 10 bolts securing adaptor to engine.

- 15) Using a hide mallet tap the sides of the non drive end bracket in order to release the generator adaptor from engine fly wheel housing spigot.  
Sometimes it is possible that the action of tapping the sides of the non drive end bracket with the hide mallet will in fact free the taper-lock of the rotor shaft to stub shaft.
- 16) If stator frame assembly is freed from the engine flywheel housing, yet the rotor is still firmly fixed to the stub shaft the stator frame assembly should be supported by a crane and carefully pulled back over the rotor assembly, taking care not to damage any winding outhangs.
- 17) With the rotor now exposed it will be possible to apply a sharp blow to the rotor pole face with a hide mallet to shock the rotor free of the taper stub shaft.

It may be necessary to apply the sharp blow to more than just one rotor pole.

To ensure the rotor when released cannot fall and do damage, the M10 binx nut should be re-fitted finger tight to the shaft securing stud leaving at least some 2 mm clearance between nut and rotor shaft end face.

- 18) With the "Taper Lock" now broken the rotor can be removed from the stub-shaft, once the binx nut has been removed.

Care should be taken to ensure the rotor weight can be supported during removal in a manner which ensures no damage will occur to the rotor assembly.

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

### **Re-Assembly Of Generator Engine**

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

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

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

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

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).

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.

Refer to 4.2.3. for assembly to engine.

#### **NOTE:**

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

Damaged or worn components must be replaced.

**Returning To Service**

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

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

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

**Warning !** 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

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

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

Diode Set (6 diodes with surge suppressor)	RSK	1101
AS440 AVR	E000	
SX460 AVR	E000	24602
Non drive end Bearing	051	01058
BC16 & BC18 Drive end Bearing	051	01032

### Transformer Controlled Generators

Diode Set (6 diodes with surge suppressor)	RSK	1101
Diode Assembly	E000	22006
Non drive end Bearing	051	01058
BC16 & BC18 Drive end Bearing	051	01032

When ordering parts the machine serial number or machine identity number and type should be quoted, together with the part description.

Orders and enquiries for parts should be addressed to:

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

Locating Bar (Single Bearing) AF1609.  
8mm Ratchet Box Wrench (for M10 socket screws) AF1599.

### After Sales Service

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.

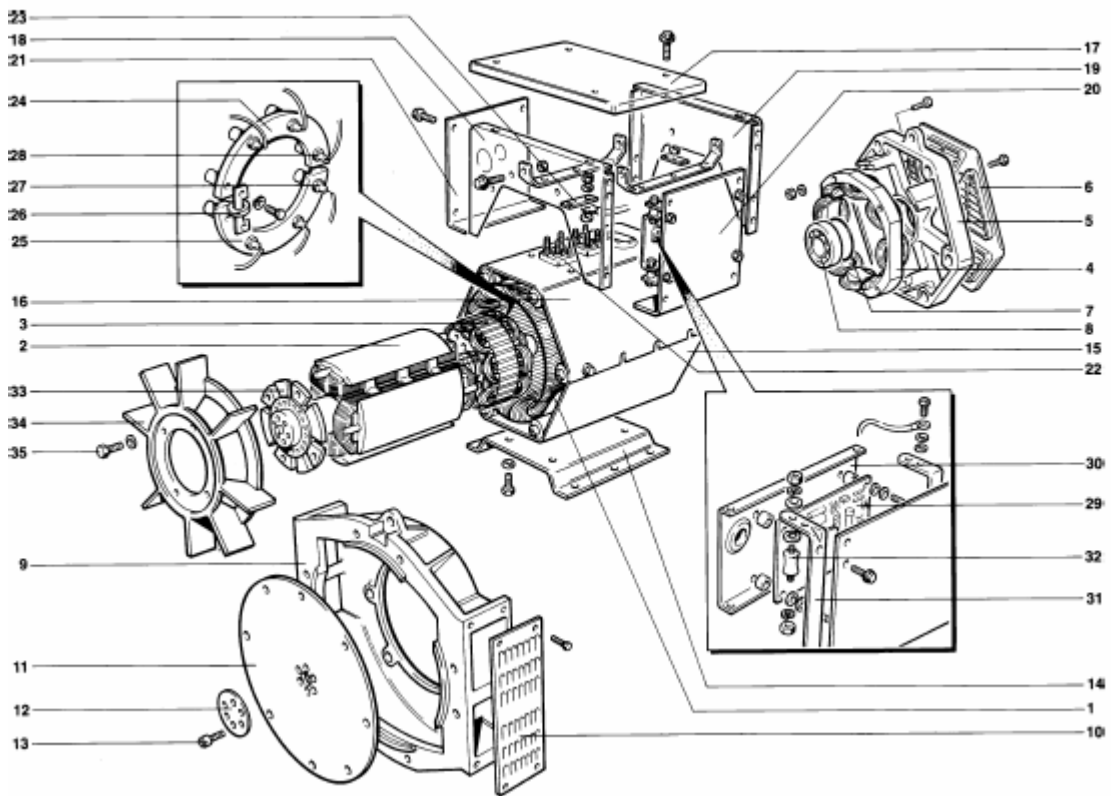
PARTS LIST  
TYPICAL SINGLE BEARING GENERATOR

Plate Ref.	Description
1	Stator
2	Rotor
3	Exciter Rotor
4	Exciter Stator
5	N.D.E. Endbracket
6	Cover N.D.E.
7	Bearing 'O' Ring N.D.E.
8	Bearing N.D.E.
9	D.E. Adaptor
10	D.E. 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	Endpanel D.E.
19	Endpanel N.D.E.
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

N.D.E. Non Driven End  
D.E. Driven End  
A.V.R. Automatic Voltage Regulator  
A.V.M. Anti-Vibration Mount

TYPICAL SINGLE BEARING GENERATOR

**Fig. 6**  
**TYPICAL SINGLE BEARING GENERATOR**



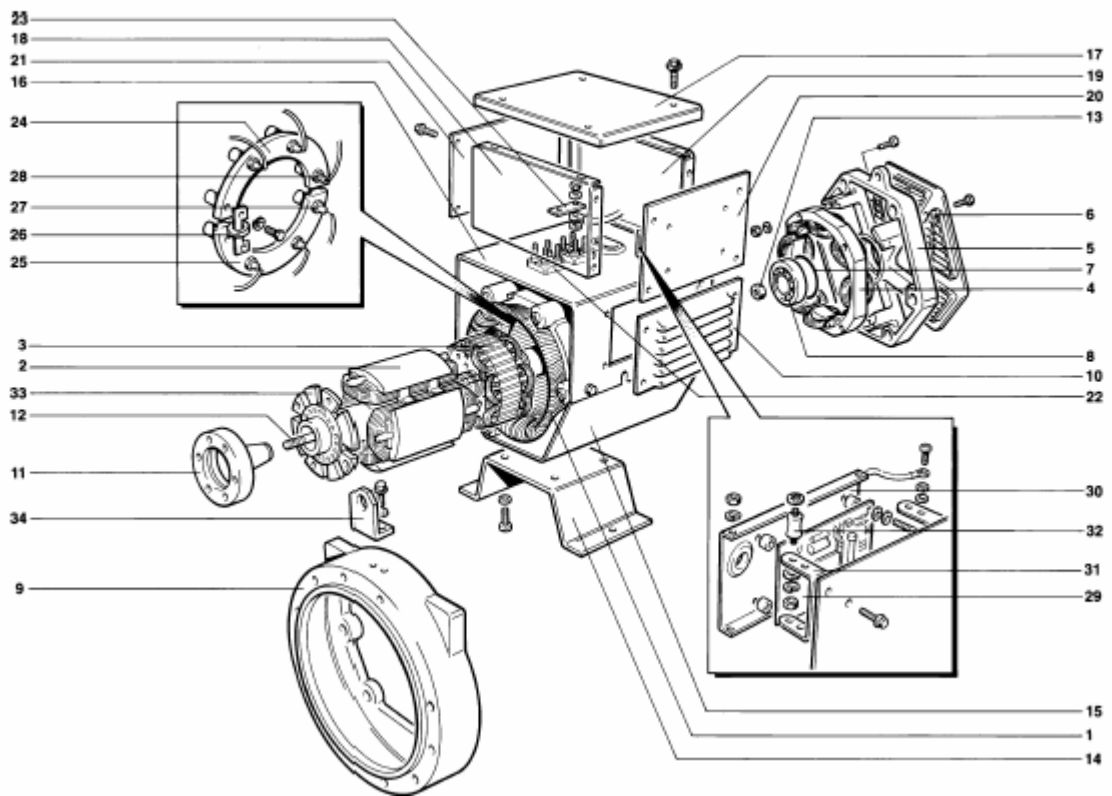
**PARTS LIST**  
**TYPICAL SINGLE BEARING GENERATOR – TAPER SHAFT ARRANGEMENT (BCL)**

Plate Ref.	Description
1	Stator
2	Rotor
3	Exciter Rotor
4	Exciter Stator
5	N.D.E. Endbracket
6	Cover N.D.E.
7	Bearing 'O' Ring N.D.E.
8	Bearing N.D.E.
9	D.E. Adaptor
10	Air Intake Side Pannel
11	Coupling Hub
12	Rotor Shaft Stud
13	Binx Nut
14	Foot
15	Frame Cover Bottom
16	Frame Cover Top
17	Terminal Box Lid
18	Endpanel D.E.
19	Endpanel N.D.E.
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 (For Balancing Purpose Only)
34	Lifting Lug

N.D.E. Non Driven End  
D.E. Driven End  
A.V.R. Automatic Voltage Regulator  
A.V.M. Anti-Vibration Mount

TYPICAL SINGLE BEARING GENERATOR – TAPER SHAFT ARRANGEMENT (BCL)

**Fig. 7.**  
**TYPICAL SINGLE BEARING GENERATOR - TAPER SHAFT ARRANGEMENT (BCL)**



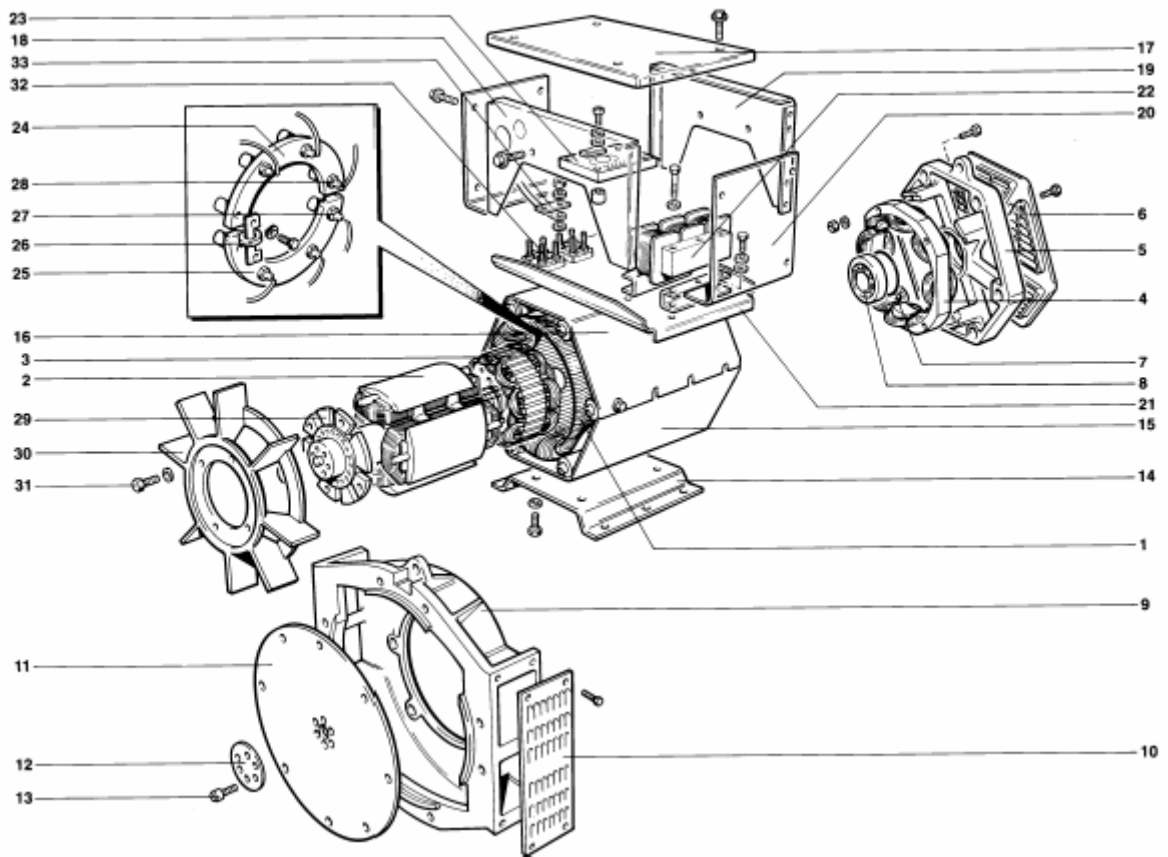
**PARTS LIST**  
**TYPICAL SINGLE BEARING (SERIES 5) TRANSFORMER CONTROLLED GENERATOR**

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

N.D.E. Non Driven End  
D.E. Driven End

TYPICAL SINGLE BEARING (SERIES 5) TRANSFORMER CONTROLLED GENERATOR

**Fig. 8.**  
**TYPICAL SINGLE BEARING (SERIES 5) TRANSFORMER CONTROLLED GENERATOR**



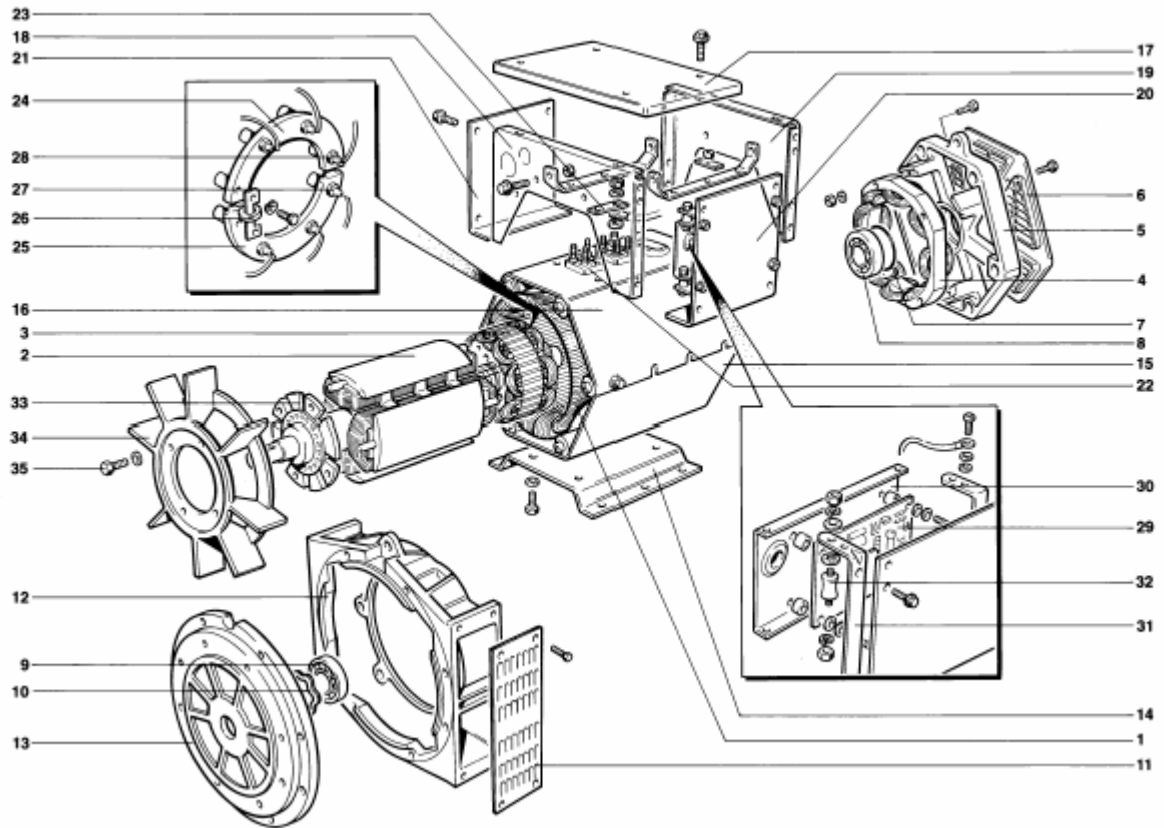
PARTS LIST  
TYPICAL TWO BEARING GENERATOR

Plate Ref.	Description
1	Stator
2	Rotor
3	Exciter Rotor
4	Exciter Stator
5	N.D.E. Endbracket
6	Cover N.D.E.
7	Bearing 'O' Ring N.D.E.
8	Bearing N.D.E.
9	Bearing D.E.
10	Bearing Wave Washer D.E.
11	D.E. Screen
12	D.E. Adaptor
13	D.E. Endbracket
14	Foot
15	Frame Cover Bottom
16	Frame Cover Top
17	Terminal Box Lid
18	Endpanel D.E.
19	Endpanel N.D.E.
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

N.D.E. Non Driven End  
D.E. Driven End  
A.V.R. Automatic Voltage Regulator  
A.V.M. Anti-Vibration Mount

**TYPICAL TWO BEARING GENERATOR**

**Fig. 9.**  
**TYPICAL TWO BEARING GENERATOR**



ROTATING RECTIFIER ASSEMBLY

**Fig. 10.**  
**ROTATING RECTIFIER ASSEMBLY**

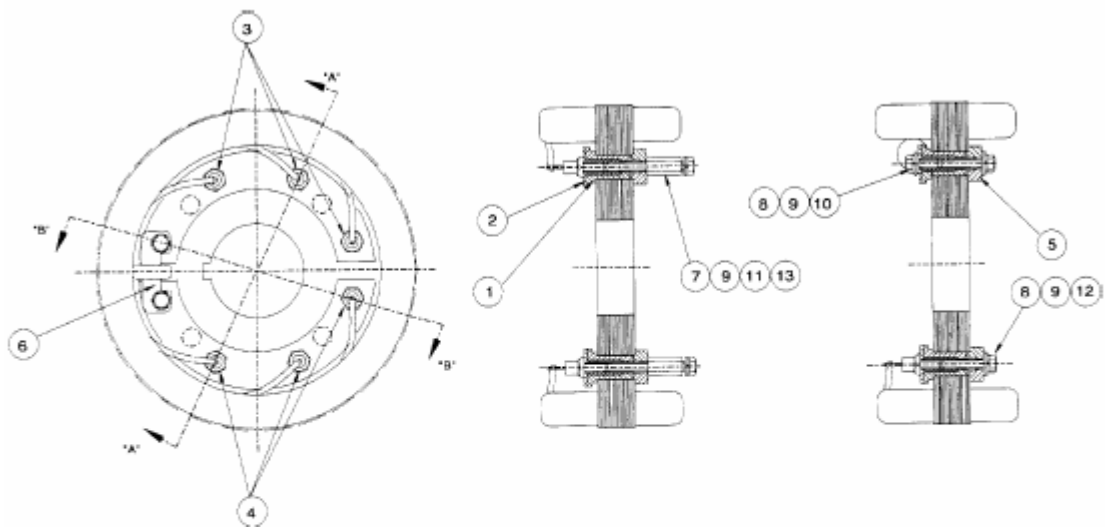


Plate Ref.	Description	Quantity
1	Diode Hub	2
2	Rectifier Fin	2
3	Forward Diode	3
4	Reverse Diode	3
5	Insulating Washer	4
6	Varistor	1
7	M5 Plain Washer	2
8	M5 Plain Washer (Large)	6
9	M5 Lockwasher	6
10	Tomillo hex.	2
11	No. 10 UNF Brass Screw	2
12	No. 10 UNF Brass Screw	2
13	Spacer	2

**NOTE:**  
Underside of diodes to be smeared with Midland Silicons Heat Sink compound type MS2623 Newage Code No 030-02318. This compound must not be applied to diode thread.

Diodes to be tightened to a torque load of 2.03/2.37Nm.

Strip insulation for 10mm from end of cable. If conductor is un-tinned this section should be tinned before threading through hole in diode tag solder in accordance with DD15500.

**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 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 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.

MACHINE SERIAL NUMBER

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