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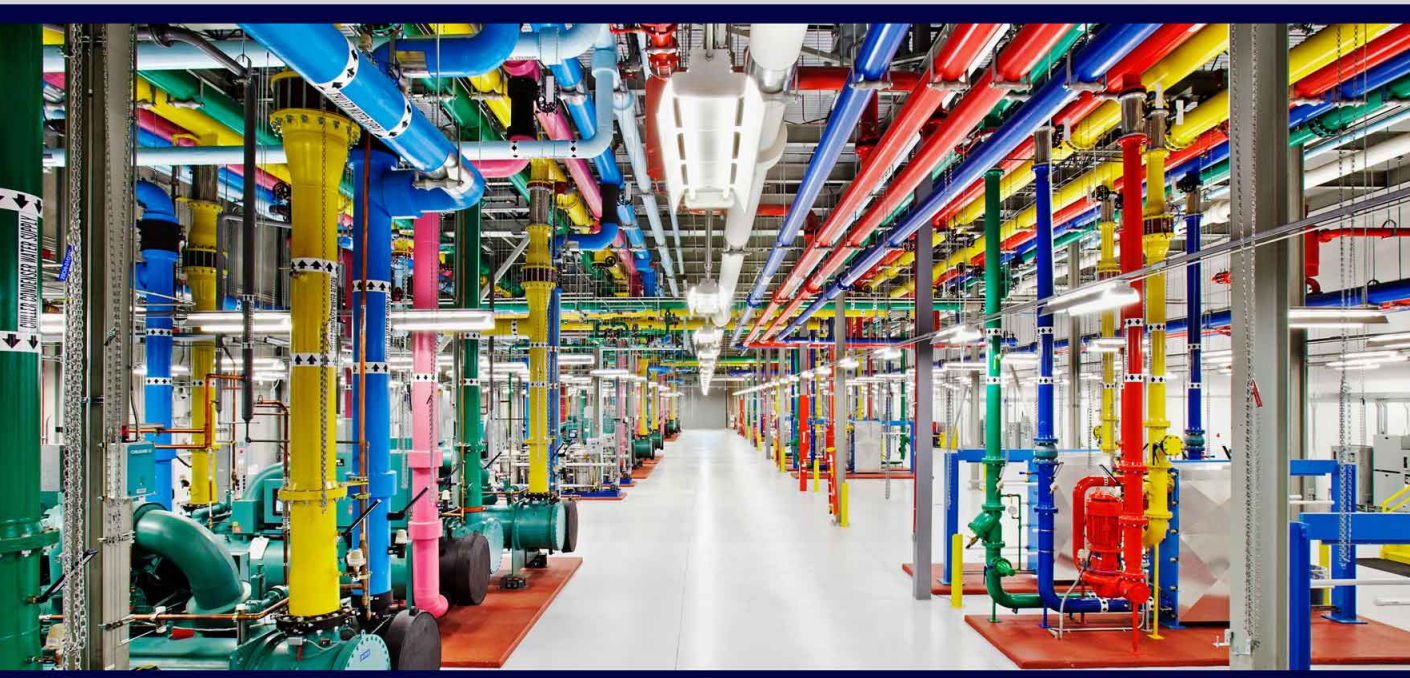

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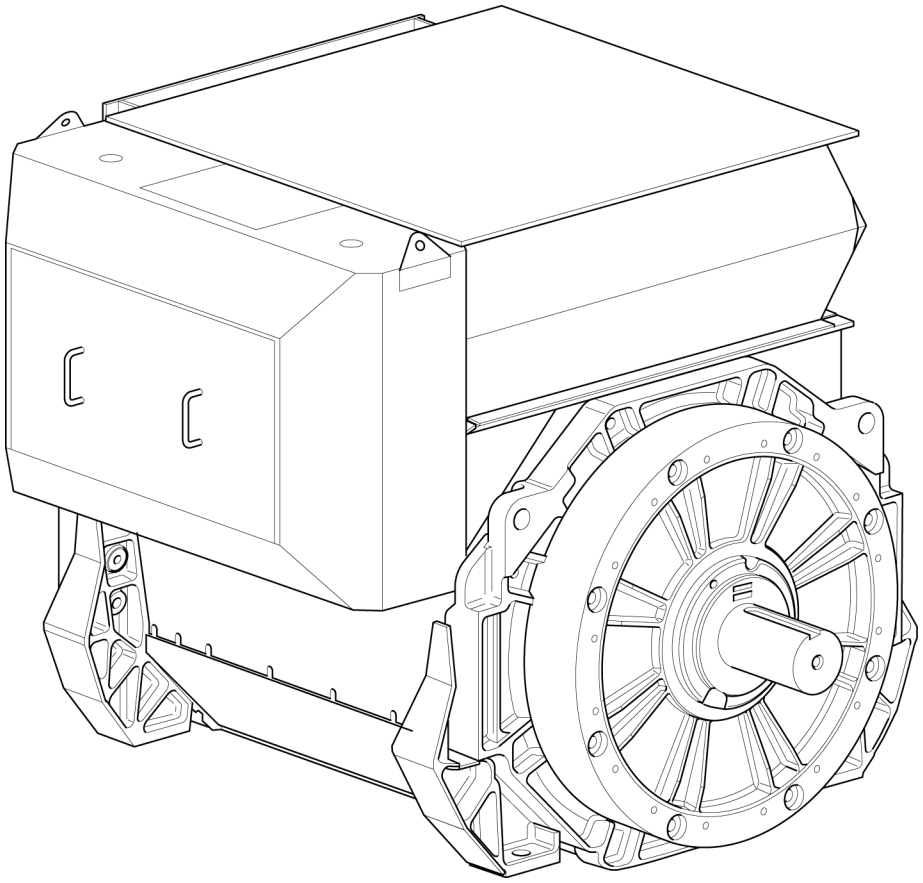
STAMFORD®

P80 AC GENERATORS

Installation, Servicing, and Maintenance



English
Original Instructions

A040J851 (Issue 1)

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1 Foreword

1.1 The Manual

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

Before operating the generator/alternator, read this manual and make sure that all personnel who work on the equipment have access to the manual and all additional documentation supplied with it. Misuse and failure to follow the operating instructions may invalidate the product warranty and lead to potential accidents.

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.

The manual is written for skilled electrical and mechanical technicians and engineers, who have prior knowledge and experience of generating equipment of this type. If in doubt, please seek expert advice or contact your local Cummins Generator Technologies subsidiary.

NOTICE
Due to our policy of continuous improvement, details in this manual were correct at time of going to print. Information included must therefore not be regarded as binding. Please visit www.cumminsgeneratortechnologies.com for latest documentation.

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2 Safety Precautions

2.1 Warnings & Notices used in this manual

Notes, Cautions and Warnings are used in this manual to emphasise important or critical instructions:

⚠ DANGER
Danger refers to immediate hazards which WILL result in severe personal injury or death.

⚠ WARNING
Refers to a hazard or unsafe method or practice which CAN result in severe personal injury or possible death.

⚠ CAUTION
Refers to a hazard or unsafe method or practice which can result in product damage or personal injury.

NOTICE
Used to convey, or draw attention to additional information or explanations.

2.2 Skill Requirements of Personnel

Service and maintenance procedures should only be carried out by experienced and qualified engineers, who are familiar with the procedures and the equipment.

2.3 Personal Protective Equipment (PPE)

Ensure that all personnel operating, servicing, maintaining or working near this equipment are wearing appropriate Personal Protective Equipment (PPE) including eye and ear protection and are fully aware of the emergency procedures in case of accidents.

2.4 Noise

Generators emit noise. Ensure appropriate ear protection is worn at all times. Maximum A weighted emissions levels may reach 104db (A) contact site for application specific details.

2.5 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.

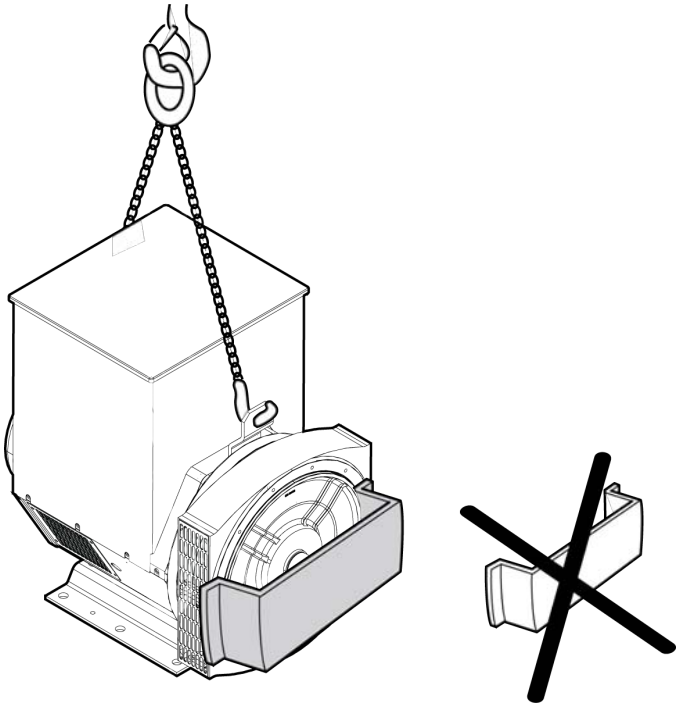
⚠ WARNING

Do not handle PMG's if you have mechanically implanted devices; ie pacemakers.

2.6 Lock Out/Tag Out

Before any maintenance work on the generator is carried out, please ensure it is isolated from any source of mechanical and electrical energy. It is suggested that a suitable lock-out/tag out process is adopted.

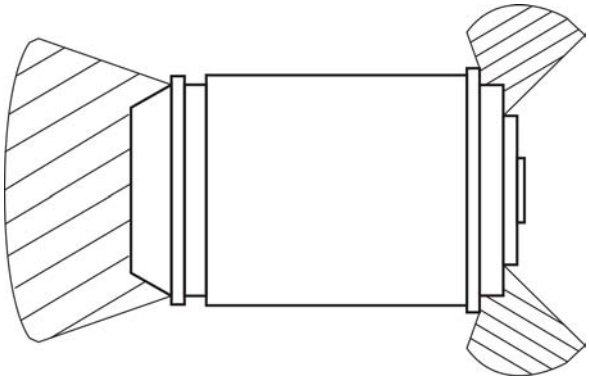
2.7 Lifting



⚠ WARNING

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

2.8 Generator Operating Areas



Operating in hatched areas or directly in-line with any air inlet/outlet should be avoided where possible. Always wear suitable PPE when working in these areas.

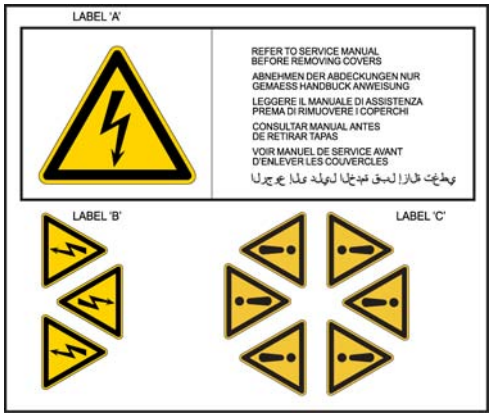
⚠ WARNING
Do not place controls within the vicinity of the air inlet/outlet of the machine and ensure personnel are restricted from these areas during operation. In the event of catastrophic failure, machine parts may exit these areas

2.9 Warning Labels

Warning labels are affixed to the generator. These must be visible at all times.

As we expect the set builder to paint the generator in his own livery, a second set of labels can be found in a wallet attached to the generator. Use the labels as per the instructions printed on the reverse of the labels.

NOTICE
If removed or painted over, it is the genset manufacturer's responsibility to reaffix warning symbols onto the generator



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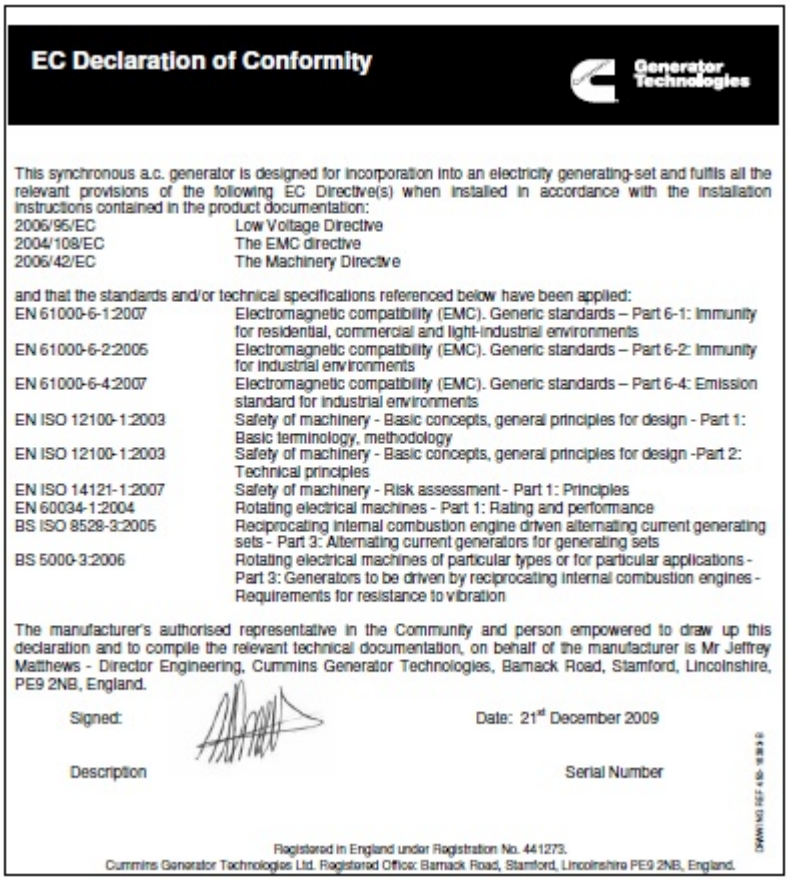
3 Standards

STAMFORD AC generators 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.

3.1 European Directives: EC Declaration of Conformity



EC Declaration of Conformity

Generator Technologies

This synchronous a.c. generator is designed for incorporation into an electricity generating-set and fulfils all the relevant provisions of the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:

2006/95/EC	Low Voltage Directive
2004/108/EC	The EMC directive
2006/42/EC	The Machinery Directive

and that the standards and/or technical specifications referenced below have been applied:

EN 61000-6-1:2007	Electromagnetic compatibility (EMC). Generic standards – Part 6-1: Immunity for residential, commercial and light-industrial environments
EN 61000-6-2:2005	Electromagnetic compatibility (EMC). Generic standards – Part 6-2: Immunity for industrial environments
EN 61000-6-4:2007	Electromagnetic compatibility (EMC). Generic standards – Part 6-4: Emission standard for industrial environments
EN ISO 12100-1:2003	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
EN ISO 12100-1:2003	Safety of machinery - Basic concepts, general principles for design -Part 2: Technical principles
EN ISO 14121-1:2007	Safety of machinery - Risk assessment - Part 1: Principles
EN 60034-1:2004	Rotating electrical machines - Part 1: Rating and performance
BS ISO 8528-3:2005	Reciprocating internal combustion engine driven alternating current generating sets - Part 3: Alternating current generators for generating sets
BS 5000-3:2006	Rotating electrical machines of particular types or for particular applications - Part 3: Generators to be driven by reciprocating internal combustion engines - Requirements for resistance to vibration

The manufacturer's authorised representative in the Community and person empowered to draw up this declaration and to compile the relevant technical documentation, on behalf of the manufacturer is Mr Jeffrey Matthews - Director Engineering, Cummins Generator Technologies, Barnack Road, Stamford, Lincolnshire, PE9 2NB, England.

Signed: Date: 21st December 2009

Description Serial Number

Registered in England under Registration No. 441273.
Cummins Generator Technologies Ltd. Registered Office: Barnack Road, Stamford, Lincolnshire PE9 2NB, England.

Each generator is supplied with an 'EC Declaration of Conformity' in accordance with the relevant EU directives designed for incorporation into an electricity generating set and is CE marked.

Our authorized representative in the Community is Mr Jeffrey Matthews, Director, Engineering, Cummins Generator Technologies Ltd.

All STAMFORD generators meet the following Standards and Directives:

Directives:

- 2004/108/EC EMC Directive
- 2006/95/EC Low Volts Directive
- 2006/42/EC Machinery Directive

Standards:

- EN 61000-6-1
- EN 61000-6-2
- EN 61000-6-4
- EN ISO 12100-1
- EN ISO 12100-1
- EN ISO 14121-1
- EN 60034-1
- BS ISO 8528-3
- BS5000-3

NOTICE
Once the generator is built into a generating set, it is the responsibility of the generating set manufacture to ensure that the generating set complies with the relevant EC Directives.

3.2 Additional Information for EMC Compliance

STAMFORD 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 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 STAMFORD brand, will invalidate Cummins Generator Technologies 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.

4 Introduction

4.1 General Description - P80

P80 - Low Voltage (LV)

The LV range of generators is of brushless rotating field design, available up to 1000 V/50 Hz (1500 rpm, 4 pole) and 1000 V/60 Hz (1800 rpm, 4 pole) and built to meet BSEN 60034-1, BS5000 Part 3 and other appropriate international standards

P80 - Medium Voltage (MV)

The MV range of generators is of brushless rotating field design, available up to 3.3 kV/50 Hz (1500 rpm, 4 pole) and built to meet BSEN 60034-1, BS5000 Part 3 and other appropriate international standards.

P80 - High Voltage (HV)

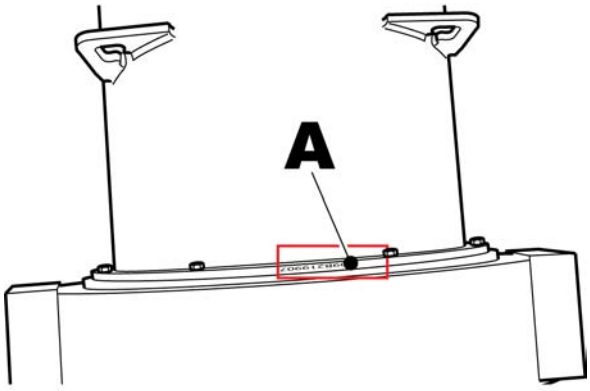
The HV range of generators is of brushless rotating field design, available up to 15 kV/50 Hz (1500 rpm, 4 pole) and 13.8 kV/60 Hz (1800 rpm, 4 pole) and built to meet BSEN 60034-1, BS5000 Part 3 and other appropriate international standards.

All P80 range generators use a permanent magnet generator (PMG) excitation system incorporating an automatic voltage regulator (AVR). AVR type and specification are dependent on P80 model and customer requirements; please refer to the AVR manual provided with the generator or download from **www.stamford-avk.com**

NOTICE
If the manufacturer supplied AVR system is to be replaced by the customers own, consult with Cummins Generator Technologies prior to use, to ensure its compatibility.

4.2 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 STAMFORD nameplate.

A typical serial number looks like: A09B219907

Year of manufacture is depicted by the first two numbers: ie example shows year of manufacture as 2009.

4.3 Rating Plate

The generator has been supplied with a self-adhesive rating plate label to enable fitting after final assembly and painting.

⚠ CAUTION
Do not exceed the parameters marked on the rating plate, as this can cause the machine to overheat, which can lead to catastrophic failure and risk of personal injury.

4.4 Product Authentication

The STAMFORD high security, anti-counterfeit hologram is located on the Tracking Label. Visual confirmation of genuine STAMFORD AC generator is achieved by viewing the flashing 3D hologram dots from differing angles – a flashlight may assist this - then verifying the machine identity online at www.stamford-avk.com/verify. Keying in the unique 7 character hologram machine identity online provides further confirmation that the machine is genuine.

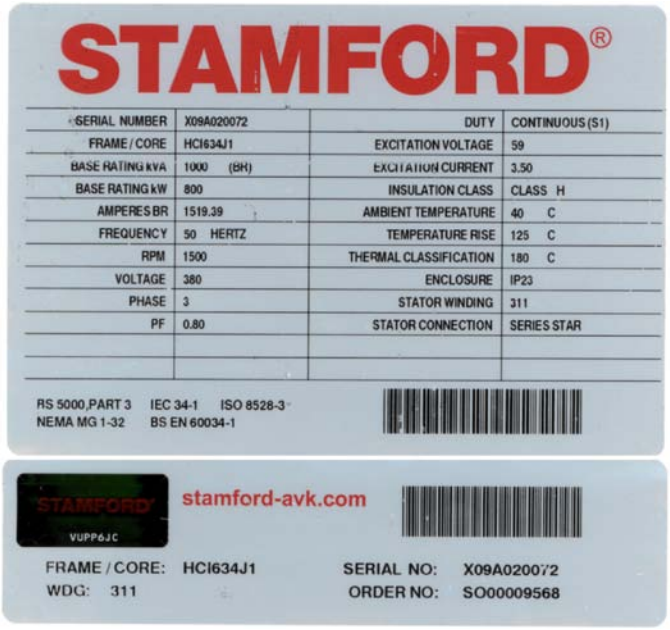
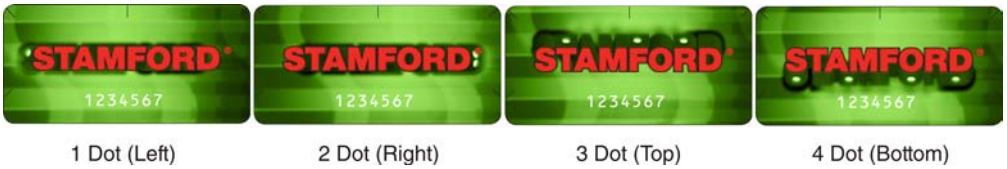


FIGURE 1. GLOBAL STAMFORD AC GENERATOR NAMEPLATE, COMPRISING RATING PLATE AND TRACKING LABEL



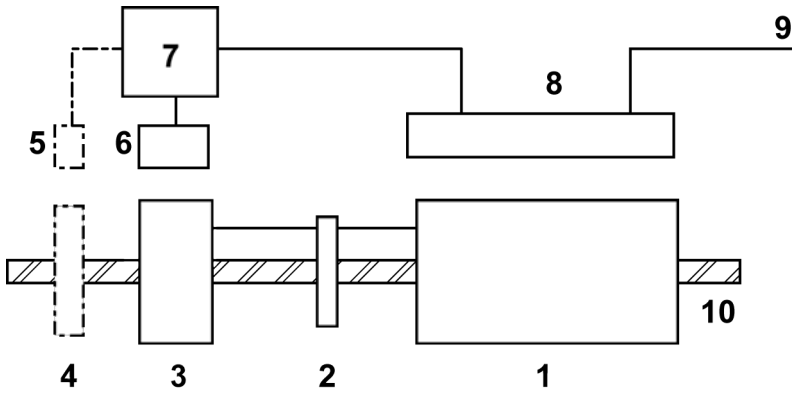
1 Dot (Left) 2 Dot (Right) 3 Dot (Top) 4 Dot (Bottom)

FIGURE 2. 3D HOLOGRAM

4.5 Separately Excited AVR Controlled Generators

4.5.1 Optional Excitation Boost System (EBS)

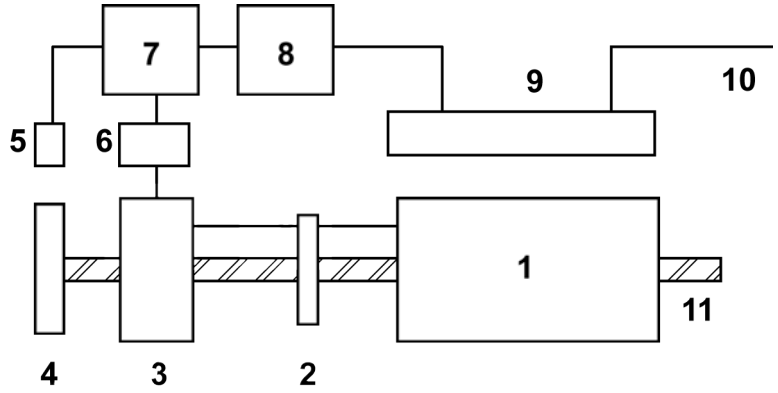
The EBS is a single, self-contained unit, attached to the non-drive end of the generator. The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.



No.	Description	No.	Description
1	Main rotor	6	Exciter stator
2	Rotating diodes	7	AVR & EBS
3	Exciter rotor	8	Main stator
4	EBG rotor (optional)	9	Output
5	EBG stator (optional)	10	Shaft

4.5.2 Permanent Magnet Generator (PMG) excited - AVR controlled generators

The Permanent Magnet Generator (PMG) provides power for the excitation of the exciter stator via the Automatic Voltage Regulator (AVR) which is the controlling device governing the level of excitation provided to the stator field. The AVR responds to a voltage-sensing signal derived, via MX321 only "where fitted", from the main stator winding. By controlling the low power of the exciter stator, control of the high power requirerment of the main rotor is achieved through the rectified output of the exciter rotor.



No.	Description	No.	Description	No.	Description
1	Main rotor	5	PMG stator	9	Main stator
2	Rotating diodes (if fitted)	6	Exciter stator	10	Output
3	Exciter rotor	7	AVR	11	Shaft
4	PMG rotor	8	Isolating transformer (if fitted)		

5 Automatic Voltage Regulators (AVR)

Cummins Generator Technologies offer a selection of Automatic Voltage Regulators designed and built to achieve maximum performance from the range of STAMFORD brushless AC generators. Both self excited and separate permanent magnet excited types are available, with a choice of specifications. All STAMFORD AVR's are encapsulated to provide protection against moisture, salt and sand in the atmosphere, and are mounted on anti-vibration mounts for added mechanical protection.

Each AVR offers a range of features dependent upon the AVR type and design. Models are available to suit most customer requirements from simple, low-cost analogue through to sophisticated digital control.

STAMFORD AVRs share several common features: All AVRs can be fitted with a 'Hand Trimmer' for fine control of the generator voltage, all have 'Under-Frequency Roll-Off' (UFRO) for reducing generator voltage proportional to speed and all can be equipped for parallel operation with other generators.

5.1 Permanent Magnet Generator (Pilot) Types

For the ultimate in control, an AVR designed to operate with the permanent magnet generator (PMG) system is often specified. In this design, the AVR receives its power from a separate source in the form of a small PMG, mounted on the main generator shaft. The advantage of this arrangement is that the AVR power source is not affected by sudden loads applied to the generator, hence the excitation remains at full capability, providing superior motor starting and short circuit performance. By having a completely electrically isolated control system the generator is better able to meet the more stringent EMC performance requirements.

5.1.1 MX321

The MX321 has all the features of the MX341, additionally achieving voltage regulation of ±0.5%* with three-phase RMS sensing, built in overvoltage protection and optional short-circuit current level adjustment.

The combination of PMG and the RMS sensing makes an ideal arrangement for supplying non-linear loads such as supplies for computers and variable speed motors etc

5.1.2 MA330

The MA330 AVR has all the features of the MX321 but has a high-power, pulse width modulated output to the exciter circuit. This allows the AVR to be used to control the larger generators. The construction of this AVR is most suitable for back panel mounting with a large heatsink and metal cover for robust applications and use. It should be noted that short-circuit current level adjustment is not available with this AVR.

5.1.3 DM110

The DM110 digital excitation control system is a microprocessor based control device aimed at the most sophisticated applications. Like the ‘MX’ and ‘MA’ models, input power to the DM110 is normally from the same multi-pole, high-frequency, permanent magnet generator. The set-up and performance parameters are set and monitored by a connected personal computer in conjunction with dedicated software. A set of annunciators allow the status of the control to be monitored when running without a PC.

5.2 AVR Features Summary

STAMFORD AC generators can be configured to meet practically every application requirement.

This chart summarises the main features of the AVR product ranges.

AVR	Type	Self Excited		PMG Excited			
	Model	**AS480**	**AS440**	**MX341**	**MX321**	**MA330**	**DM110**
Feature	Remote Voltage Adjust	A	A	A	A	A	A
	Under-Frequency Protection	A	A	A	A	A	A
	Paralleling	A	A	A	A	A	A
	Accessory Input (for PFC etc.)		A	A	A	A	(3)
	Adjustable UFRO 'Slope'			A	A	A	A
	Short-Circuit Maintenance	(1)		A	A	A	A
	110 ... 120VAC Operation	(2)	A				
	Soft-Start Ramp			A	A	A	A
	Three-Phase RMS Sensing				A	A	A
	Over-Voltage Protection				A	A	A
	Variable Dwell				A	A	
	Excitation Limiting					A	A
	Current Limiting				A		
	Full Digital Control						A

- A = Available
- (1) By add-on optional Excitation Boost System
- (2) By add-on optional special link wire
- (3) Version available with integrated Power-factor control

5.3 AVR Usage Summary

STAMFORD AC generators can be configured to meet practically every application requirement.

This chart summarises the AVR usage in conjunction with the Generator product range.

Generator Product:	Standard AVR:	Optional AVR:
P0; P1	AS480	
UCI22; UCI27; UCD27	AS440	MX341; MX321
UCM22; UCM27	MX341	MX321
HCI4; HCI5; HCKI5	AS440	MX341; MX321
HCM4; HCM5	MX341	MX321
HCI6	MX321	
HCM6	MX321	
PI7; PE7	MX341	MX321
P80	DM110	MX321

5.4 AVR Accessories

A selection of accessories is available for connection to the AVR to provide the additional functions normally expected in generator installations. Control accessories can be factory fitted or supplied separately for fitting by a competent technician. When supplied separately, the accessory will be provided with fitting and wiring instructions.

This chart shows which accessory can be connected to the chosen AVR model.

AVR		Accessory					
Type	Model	Hand Trimmer (for Remote Voltage Adjust)	Droop Tranformer (for Paralleling)	Power Factor Controller	Excitation Boost System (for Short-Circuit Maintenance)	Low Voltage Link/Selector (for 110 ... 120VAC Operation)	Current Limiting Transformers
Self Excited	AS480	A	A		A	A	
	AS440	A	A	A		A	
PMG Excited	MX341	A	A	A			
	MX321	A	A	A			A
	MA330	A	A	A			
	DM110	A	A	(1)			

- A = Available
- (1) = Version available with integrated Power-factor control

5.4.1 Hand Trimmer (for remote voltage adjustment)

A hand trimmer can be fitted in a convenient position (typically in the generator set control panel) and connected to the AVR to provide fine adjustment of the generator voltage. The hand trimmer value and the adjustment range obtained is as defined in the Technical Specification. On all AVRs, the hand trimmer is connected to terminals 1;2 after first removing the shorting link.

5.4.2 Droop Transformer (for parallel operation – generator to generator)

A droop transformer can be fitted in a defined position in the generator main output wiring and connected to the AVR to enable parallel operation with other generators. The adjustment range is as defined in the Technical Specification. On all AVRs, the droop transformer is connected to terminals S1;S2 after first removing the shorting link. The droop transformer MUST be connected in the correct main output terminal for proper operation (details are as shown in the machine wiring diagram).

5.4.3 Power Factor Controller (for parallel operation – generator to mains utility)

An electronic control module is available for use with the AVR to provide power factor control of the generator output. The module uses generator voltage and output current as inputs and interfaces with the AVR to ensure the necessary flexibility of the generator excitation and hence control of the exported (or imported) kVAr. This allows full closed-loop control of the generator power factor at the point of connection into the mains utility. Other features allow the generator (or generators) to be automatically 'voltage-matched' prior to paralleling. This accessory is not available with the AS480 AVR.

5.4.4 Current Limiting Transformers (MX321 AVR only)

Generator main output current can be electronically limited by connecting additional current transformers to the MX321 AVR. In any situation where the output current attempts to rises above a preset threshold (set on AVR) then the AVR will reduce the terminal voltage to restore the set current level. For unbalanced loads, operation is based on the highest of the three phase currents.

5.5 AVR Fault Finding

⚠ WARNING
Fault finding procedures present hazards, which can result in 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.

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

Problem	Action
Voltage does not build-up to normal when starting the generator set.	1. Check link K1:K2 on AVR (not AS480) or auxiliary terminals: - Replace if necessary and restart. 2. MX321 or MX341 only; - Check the output from the PMG, Go to {Checking the PMG}.
Voltage builds-up but is at an incorrect value.	1. Check AVR [VOLTS] control potentiometer setting: - Correct if necessary. - Check 'Hand Trimmer' if one is fitted - adjust if necessary. 2. Check generator speed: - Correct if necessary and restart. 3. Check AVR 'UFRO' indicator: - If it is illuminated, Go to {UFRO Setting Procedure}.
Voltage is very slow to build up.	1. Check generator accelerates as expected: - Correct if necessary and restart. 2. MX321 only; Check setting of ramp potentiometer: - Correct if necessary and restart.
Voltage rises and remains at a high level.	1. Check AVR wiring:
Voltage rises to a high level and then falls to a low level.	1. Check AVR wiring:
Voltage is normal and then falls to a low level while the generator set is running.	1. Check generator loading: 2. Check machine Rotating Rectifiers
Voltage is unstable either on no-load or with load.	1. Check that the generator speed is stable: - Correct if necessary and restart. 2. Check AVR wiring: 3. Adjust the AVR [Stability] control slowly clockwise until steady.
Voltage falls to a low level when load is applied to the generator.	1. Check generator speed is not dropping as load is applied: - Correct if necessary and restart. 2. Check AVR 'UFRO' indicator: - If it illuminates as load is applied, Goto {UFRO Setting Procedure}.

If all the tests and checks listed above fail to locate the generator fault then it must be assumed that the AVR is faulty. There are no serviceable items on the AVR.

The AVR should be replaced only by a genuine STAMFORD part.

5.5.1 Checking The PMG (MX341 and MX321 AVRs only)

1. Start the generator set and run it at rated speed.
2. Measure the voltages at the AVR terminals P2, P3 and P4.These should be balanced and within the following ranges:

   50Hz generators: 170 ... 185VAC.

   60Hz generators: 200 ... 220VAC.
3. Stop the generator.

4. Measure the PMG winding resistances (at the connections under the PMG cover). These should be balanced and within the following range:

   4 pole generators: 2.6 ohms +/-10%

   6 pole generators: 5.6 ohms +/-10%

5. Use the results from tests 2) and 3) above together with the table below to identify the fault.

PMG Voltages:		**Phase/Phase Resistances:**	
		Correct	**Incorrect**
Correct	Balanced	No fault with PMG	Recheck resistances
	Unbalanced	Connector ?	Change PMG Stator
Low	Balanced	Change PMG Rotor	Change PMG Stator
	Unbalanced	Connector ?	Change PMG Stator

5.5.2 UFRO Setting Procedure

1. Stop the generator.
2. Check that the AVR UFRO selection link is set for the required 50Hz or 60Hz operation.
3. Start the generator set and run it at rated speed.
4. If the voltage is now correct and the UFRO indicator is not illuminated, return to the fault finding procedure.
5. If the UFRO indicator is illuminated, continue as follows.
6. Adjust the [UFRO] control fully clockwise.
7. Set the generator speed at 95% of rated speed.

   For 50Hz installations: 1425rpm or 47.5Hz

   For 60Hz installations: 1710rpm or 57.0Hz

8. Adjust the [UFRO] control slowly counter-clockwise until the UFRO indicator just illuminates.Return the control slightly clockwise until the indicator is just extinguished.
9. The UFRO setting is now correct - return to the fault finding procedure.

6 Application of the Generator

It is the customers' responsibility to ensure that the sizing selection of the generator is suitable for the final application.

⚠ CAUTION
Overloading the generator may lead to catastrophic failure.

6.1 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.

6.2 Air Flow

The airflow 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.

6.3 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.

6.4 Air Filters

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.

6.5 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.

6.6 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.

6.7 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 contaminates) and at or below the ambient temperature stated on the rating plate.

Also ensure that there are sufficient clearances around the generator for ease and safety of maintenance.

6.8 Vibration

STAMFORD 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).

6.8.1 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.

6.8.2 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.

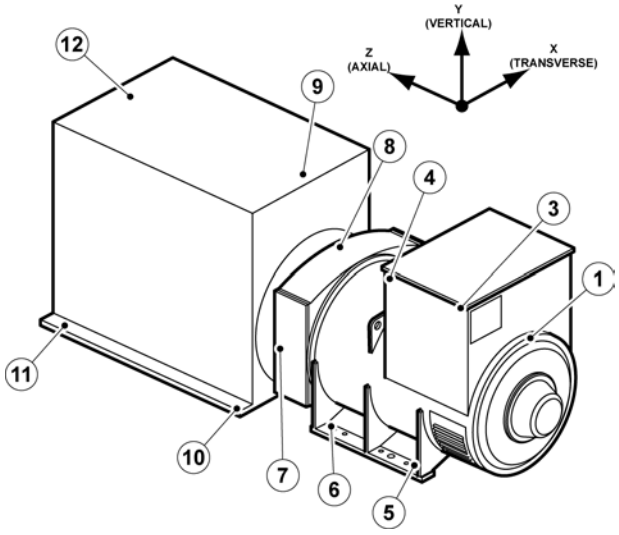
6.8.3 Linear Vibration Levels as Measured on the Generator - P80

Linear Vibration Levels As Measured On The Generator				
Engine Speed Min $^{-1}$	Set Output Kva	Vibration Displacement (*S rms*)	Vibration Velocity (*V rms*)	Vibration Acceleration (*a rms*)
1500 – 1800 (rpm)	< 250 kVA	0.32 mm	20 mm/sec	13 m/sec^2
	> 1250	0.29 mm	18 mm/sec	11 m/sec^2
The 'Broad band' is taken as 2 Hz - 300 Hz				

NOTICE
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.

6.8.4 Linear Vibration Monitoring

We recommend 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 ISO 10816-1. 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.

6.8.5 Excessive Vibration levels

⚠ CAUTION
Excessive vibration can cause catastrophic failure of the generator, which could cause personal injury.

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

1. Consult the genset builder; the genset builder should address the genset design to reduce the vibration levels as much as possible.
2. Contact Cummins Generator Technologies to understand the impact of not meeting the above levels on both bearing and generator life expectancy.

6.9 Bearings

All STAMFORD generators are fitted with either sealed for life or re-greasable bearings.

6.9.1 Re-greasable Bearings

When re-greasable bearings are fitted the bearing housings incorporate fittings for pipe work 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 grease used is a high specification synthetic compound that must not be mixed with grease of a different specification.

6.9.2 Bearing Life

Factors that affect 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 ‘Brunnelling’, 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.

6.9.3 Health Monitoring of the Bearings

We recommend that the user checks the bearing condition, using monitoring equipment 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.

6.9.4 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", however, suggest 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.

If in doubt about any aspect of the ‘bearing life’ on STAMFORD generators, contact your nearest supplier of STAMFORD generators or contact the Stamford factory direct.

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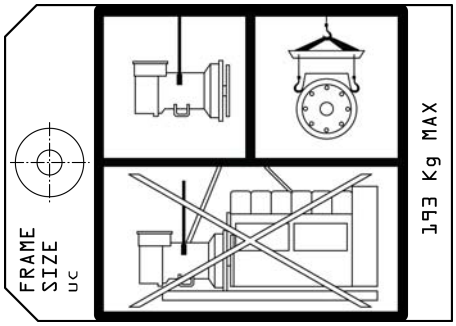
7 Installation into the Generating Set

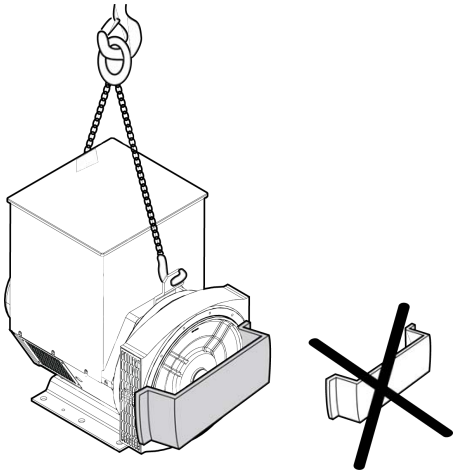
7.1 Danger Zones:

Please refer to the Safety section for details on the danger zones with the machine.

7.2 Handling the Generator

When lifting the generator use the lifting points provided. Use extension chains where necessary to ensure that the angle on the lifting chains are vertical at all times.





⚠ CAUTION

The generator lifting points are designed to lift the generator only. Do not lift the complete generating set by the generator lifting points. When moving the generator always keep it in the horizontal plane and ensure that the transit bar is in place to prevent the rotor falling out of the frame.

7.3 Storage

If the generator is not to be used immediately, it must be stored in a clean, dry, vibration free environment. We recommend the use of anti-condensation heaters.

7.3.1 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 and Maintenance section of this manual.

If the generator has re-greasable bearings and has been in storage for 6 months or more, re-lubricate the bearings before use. If the bearings are sealed for life replace the bearings after 12 months in storage.

7.4 Generator Vibration, Frequency

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

- 4-pole 1500 r.p.m. 25 Hz
- 4-pole 1800 r.p.m. 30 Hz

However, vibrations induced by the engine are complex. It is the responsibility of the generating set designer to ensure that the alignment and stiffness of the bedplate and mountings do not exceed BS5000 part 3 and ISO 8528 part 9.

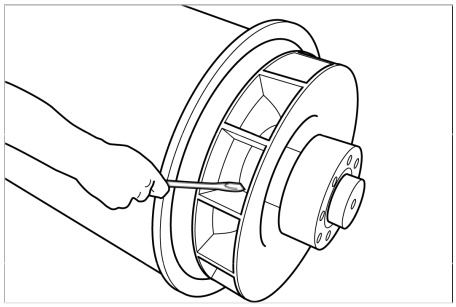
7.5 Coupling Arrangements

⚠ CAUTION

Care should be taken when coupling generator to engine to avoid personal injury.

⚠ CAUTION

Incorrect generator alignment can result in damage to the generator.



⚠ CAUTION

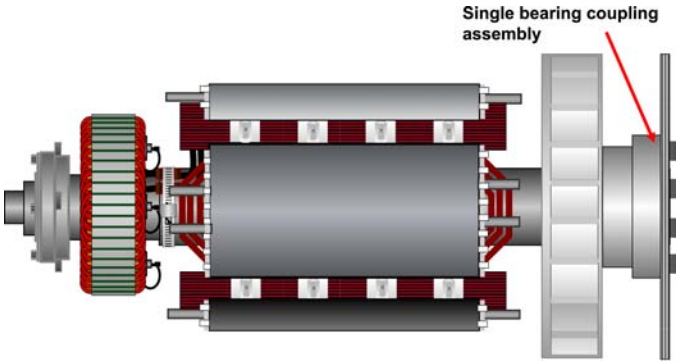
Do not use the fan to rotate the shaft as this can lead to damage and personal injury, this is particularly important when the engine and the alternator are connected.

Single and two bearing arrangements are available, both can be close coupled. Both arrangements need a firm level foundation. Please ensure that the generator is secured using suitably sized hardware through the mounting holes provided.

For transit and storage purposes the generator frame spigot, rotor coupling plates and shaft extension have been coated with a rust preventative. This must be removed before assembly.

For the purposes of establishing set design the bending moment at the engine flywheel housing to generator adaptor interface should not exceed 275 kgm (2000 ft.lbs). The maximum bending moment of the engine flange must be checked with the engine manufacturer.

7.6 Single Bearing Arrangement



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. If necessary, shim the generator feet to ensure alignment of the machined surfaces.

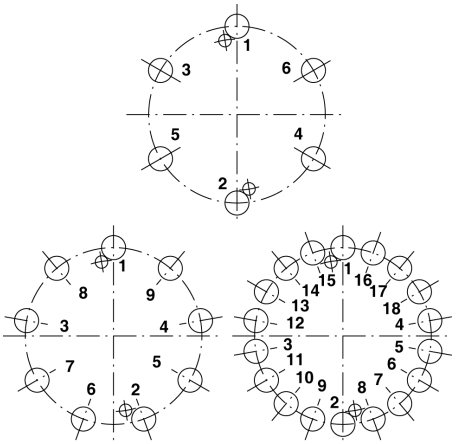
1. Remove air outlet covers from the drive end of the generator to access the coupling and adaptor bolts.
2. Check that coupling discs are concentric with adaptor spigot. Adjust by suspending the rotor into position. Use alignment studs to ensure that the disc and the flywheel are in alignment.
3. Offer 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.

4. On the engine ensure the distance from flywheel coupling mating face to the flywheel housing mating face is within 0.5mm of nominal dimension. This ensures there is no thrust applied to the engine or generator bearings. Ensure securing bolts are tightened to relevant torques.

⚠ CAUTION
Failure to secure bolts can lead to excessive vibration, which in turn can lead to catastrophic generator failure.

5. Use heavy gauge washers to fit housing and coupling bolts. Tighten bolts evenly around assembly sufficiently to ensure correct alignment.



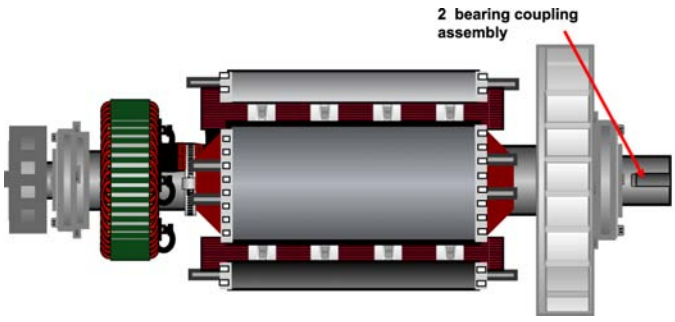
Torque the bolts in the above sequence according to the correct bolt patten.

Then check the torque in each bolt in a clockwise direction around the bolt circle to ensure all the bolts are properly torqued.

6. Tighten coupling disc to flywheel bolts. Refer to engine manufacturer's manual for correct tightening torque.
7. Remove rotor aligning aids and replace all covers.

⚠ CAUTION
Failure to replace protective covers can result in injury.

7.7 Two Bearing Arrangements



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.

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.

⚠ CAUTION
Ensure all guards are refitted after generator/engine assembly is complete. Incorrect guarding and/or generator alignment can result in injury and/or equipment damage.

⚠ CAUTION
Torsional incompatibility and/or excessive vibration levels can cause damage or failure of the generator and/or engine components. It is the responsibility of the generator set manufacturer to ensure compatibility.

7.8 Pre-Running Checks

Before starting the generating set, test the insulation resistance of windings, check all connections are tight and in the correct location. Ensure the generator air path is clear of obstructions. Replace all covers.

7.9 Insulation Resistance Test

A resistance test by qualified personnel should be carried out based on the relevant operating voltage:

NOTICE
The AVR should be disconnected during this test

Voltage	Test Voltage	Minimum Required Insulation Resistance	
		In Service	New
LV – up to 1kv	500V Megger	5 MΩ	10
MV – 1 - 4.6kv	2500V motorized Megger	50 MΩ	100
HV – 4.6 - 20v	5000V motorized Megger	150 MΩ	300

Should the insulation resistance be less than the quoted limits, drying out the generator windings is essential. See the Service & Maintenance section of this Manual.

7.10 MV & HV Machines

NOTICE
The AVR plus any voltage transformers should be disconnected. Any temperature detector devices (RTDs/Thermistors) should be disconnected and grounded during the test. Refer to the generator winding diagram for details.

The insulation resistance values quoted is for windings at an ambient temperature of 20 °C. Insulation resistance significantly reduces as winding temperatures increase, based on the assumption that IR reduces by 50% for every 10 °C increases in temperature, the reduction factors are:

Temperature	Factor
20 °C	1.0
30 °C	0.5
40 °C	0.25
50 °C	0.125
60 °C	0.625
70 °C	0.313
80 °C	0.015

⚠ WARNING

Insulation testing leaves a high voltage. Discharge windings by shorting to earth through an earthing rod for at least 5 minutes after testing.

7.11 H.V. Testing

NOTICE

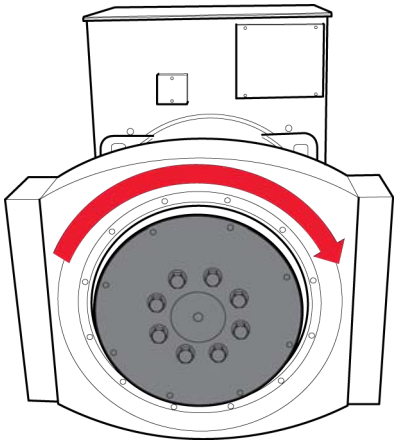
The windings have been H.V. tested during manufacture and further H.V. testing may degrade the insulation with consequent reduction in operating life. Should it be necessary to demonstrate H.V. testing, for customer acceptance, the tests must be carried out at reduced voltage levels i.e.

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

This applies only to new machines, After being in service, testing levels should be further reduced to 1.5 x Rated Voltage for maintenance testing. This HV test should only be completed after megger tests and evaluation.

7.12 Direction of Rotation

The direction of rotation of the generator is designed to be clockwise as viewed from the drive end of the generator. If it needs to run in reverse direction, please seek advice from Cummins Generator Technologies.



7.13 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’.

7.14 Voltage and Frequency

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

7.15 AVR adjustment

To make AVR selections and adjustments remove the AVR cover. 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.

7.16 Installation on Site

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

Cables should be supported appropriately to avoid a tight radius at the point of entry into the terminal box panel and allow movement for the generator set on its anti vibration mountings without causing excessive stress to the cables and generator load terminals.

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.

7.17 Grid Connection: Voltage Surges and Micro-Interruptions

Precautions should be taken to prevent transient voltages generated by the connected load and/or the distribution system from causing damage to the generator components.

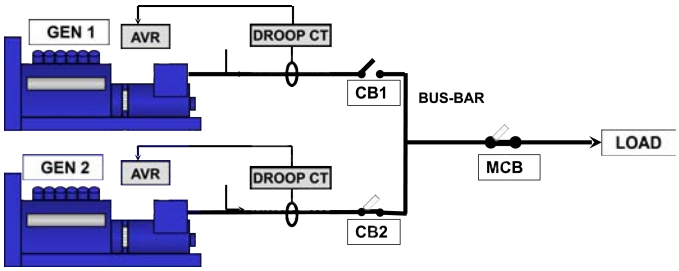
To identify any possible risk, all aspects of the generator’s proposed application should be considered, especially the following:

- Loads with characteristics that result in large load step changes.
- Load control by Switchgear, and power control by any method likely to generate transient voltage spikes.

- Distribution systems susceptible to external influences, such as overhead lines and lightning strikes.
- Applications involving parallel operation to a mains supply, where the risk of a mains disturbance in the form of a micro-interruption could occur.

If the generator is at risk of voltage surges or micro-interruptions adequate protection must be incorporated into the generation system. This is normally in the form of surge arrestors and suppressors.

7.18 Parallel or Synchronizing AC Generators



- The synchronising switch/breaker should be of a type that will not cause “contact bounce” when it operates.
- The synchronising switch/breaker should be adequately rated to withstand the continuous full load current of the generator.
- The switch/breaker should be able to withstanding the rigorous closing cycles during synchronising and the currents produced if the generator is parallelled out of synchronism.
- The closing time of the synchronising switch/breaker should be under the control of the synchroniser settings.
- The switch/breaker should be capable of operation under fault conditions such as short circuits. Generator data sheets are available

NOTICE
The fault level may include a contribution from other generators as well as from the grid/mains utility.

The method of synchronising should be either automatic, or by check synchronising. The use of manual synchronising is not recommended. The settings on the synchronising equipment should be such that the generator will close smoothly.

The Phase sequence must match	
Voltage difference	+/- 0.5%
Frequency difference	0.1 Hz/sec
Phase angle	+/- 10°
C/B closing time	50 ms

The settings for the synchronising equipment to achieve this must be within these parameters.

The voltage difference when paralleling with the grid/mains utility is +/- 3% .

⚠ CAUTION
Synchronising outside these parameters may result in catastrophic failure of the generator.

7.19 Regreasable bearing machines

After long storage periods grease in the exit port may become hard. To ensure correct function of machine remove any hard grease and refill with correct fresh grease.

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8 Service & Maintenance

8.1 Lock Out/Tag Out

It is suggested that a suitable lock-out/tag out process is adopted.

⚠ WARNING

Before any dissembling or assembling procedures are carried out ensure that the generating set is inhibited mechanically and isolated electrically.

⚠ 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.

8.2 Methods of Drying Out Generators

8.2.1 Cold Run

In many cases, the generator can be dried suitably using its own ventilation system. However, it should not be electrically live whilst this is being carried out. De-excite the machine as indicated in its circuit diagram. Operate the anti-condensation heater, where fitted, when drying out with the machine's own ventilation system. Run the machine in this condition until the minimum IR is achieved.

8.2.2 Blown Air Drying

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 – 3kW 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, 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.

8.2.3 Short Circuit Method

⚠ DANGER

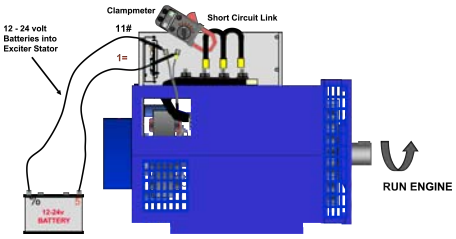
Risk of electric shock. Do not touch line or neutral terminals during the short circuit run. Some winding designs may produce a voltage between the 3 shorted line terminals and the neutral.

⚠ CAUTION

This process should only be performed by a qualified engineer..

⚠ 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.



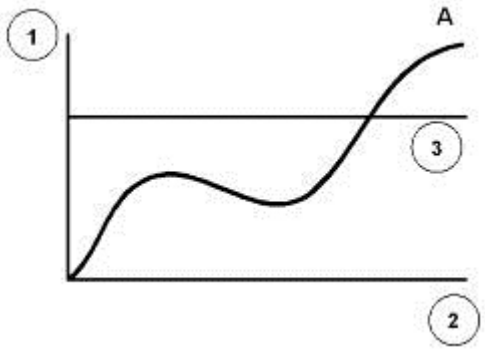
1. Bolt a short circuit of adequate current carrying capacity, across the main terminals of the generator. The shorting link should be capable of taking full load current.
2. Disconnect the cables from terminals “X” and “XX” of the AVR.
3. Connect a variable dc supply to the “X” (positive) and “XX” (negative) 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.

After every 30 minutes of this exercise:

1. 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.
2. Once the Insulation Resistance is raised to an acceptable level, the dc supply may be removed and the exciter field leads “X” and “XX” re-connected to their terminals on the AVR.
3. Rebuild the genset, replace all covers and re-commission as appropriate.
4. If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest the generator prior to running.

8.3 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. Refer to One Megahom 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 megahom. (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.

Values of insulation resistance significantly reduce as winding temperature increases, Therefore, the reference values can only be established with windings at a temperature of approximately 20°C.

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

NOTICE
The generator must not be put into service until the minimum values are achieved.

8.4 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 water and therefore 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.

NOTICE
Do not charge filters with oil.

⚠ CAUTION
Only remove filter elements with the generator out of service, to avoid damage to the generator

8.4.1 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.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

8.5 Generator Cleaning

Ensure generator is isolated prior to any cleaning operation. Avoid exposure of generator windings to cleaning agents.

9 Fault Finding

⚠ WARNING
Fault finding procedures present hazards, which can result in 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 and refer to detailed AVR instructions. Always use insulated screwdrivers when adjusting AVR. Isolate any anti-condensation heater supply

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

Loss of voltage, excessive noise, overheating, high bearing temperatures and unstable operation from the generator are all symptomatic of a generator malfunction. However, these faults are often wrongly attributed to the generator because defects in other components or generator installationcan produce the same symptoms. This checklist provides a comprehensive list of the most common symptoms related to the generator and its installation. Before replacing the generator, verify the problem by consulting the chart below. If after taking the appropriate action the problem still persists, please contact your nearest authorised MARKON/STAMFORD/AVK for advice	High Voltage	Low voltage	No Voltage	Unstble Voltage	High excitation voltage	Incorect power factor	Cracked panels	Generator noisy	High bearing temperature	Broken/Loose terminals	High Winding Temperature	High kVar	Unable to syncronise	Rapidly rising current
Incorrect AVR Sensing Voltage Check sensing supply voltage, repair or replace as necessary	●	●												
AVR Volts Control or Hand Trimmer Incorrectly Set or Faulty Adjust as necessary, ensure engine speed is correct	●	●			●									
Sensing Transformer Faulty Check sensing supply	●	●												
AVR Faulty Replace AVR and re-test	●	●	●	●	●	●						●		
Loose, Broken,or Corroded Connections Check connections on auxiliary terminal board and AVR terminals Repair or replace as necessary	●	●	●	●	●	●						●		
High Voltage on Load Unbalanced load, re-distriute load over all three phases	●										●			
Leading Power Factor Corect power factor	●			●										
Voltmeter faulty or Sticking Check and verify voltage across machine output terminals with a multimeter	●	●	●	●										
Loss of Residual magnetism Restore residual magnetism in exciter stator			●											
Under Frequency Roll Off Protections Incorrectly Set Adjust as necessary		●												
Faulty Winding or Rotating Diodes Find and correct cause of failure, repair or replace winding and/or diodes as necessary		●	●	●										
Surge Suppressor or main Rotating Diode Short Circuit Find and correct cause of failure, repair or replace with relevant service rectifier kit			●		●									
Load applied to Generator During Run Up Follow correct procedure for applying load (self excited generator)			●											
AVR K1 and K2 Link Open Circuit Verify connection and take necessary action to repair			●											
AVR Stability Incorrctly Adjusted Adjust AVR until voltage stabilises				●										
Intermittent Earth Check IR windings				●										
Fluctuation in Load Current Check the load current on a stable supply and take necessary action				●										
Faulty Exciter Rotor/Ststor Winding Checkresistance and iR of windings and replace if necessary					●									

FIGURE 3. ELECTRICAL FAULT FINDING CHART PRT 1

Loss of voltage, excessive noise, overheating, high bearing temperatures and unstable operation from the generator are all symptomatic of a generator malfunction. However, these faults are often wrongly attributed to the generator because defects in other components or generator installationcan produce the same symptoms. This checklist provides a comprehensive list of the most common symptoms related to the generator and its installation. Before replacing the generator, verify the problem by consulting the chart below. If after taking the appropriate action the problem still persists, please contact your nearest authorised MARKON/STAMFORD/AVK for advice	High Voltage	Low voltage	No Voltage	Unstble Voltage	High excitation voltage	Incorect power factor	Cracked panels	Generator noisy	High bearing temperature	Broken/Loose terminals	High Winding Temperature	High kVar	Unable to syncronise	Rapidly rising current
Non-Linear Loads Contact factory for further advice				•										
Faulty Power factor Controller Check and Replace where necessary					•	•					•			
Faulty Main Rotor Winding Check resistance and IR of windings and replace if necessary					•									
PMG Damaged Find and correct cause of failure, repair or replace PMG as necessary		•		•										
Droopp CT Fitted or Connected Incorrectly Inspect fitting and connection and repair as necessary														•
Faukty Winding RTD Probe Investigate RTD probe and repair or replace where necessary											•			
Overload Re-instate correct loading		•			•						•			
Excessive KVAr Adjust load or power factor accordingly					•						•	•		
Phase Window Ensure phase window is within set parameters													•	
Phase Sequence Incorrect Investigate and rectify sequence													•	
Incorrect Selection of Control System Review selection and make necessary remedial actions													•	
Unstable Speed Regulate speed to meet necessary synchronising requirements				•									•	

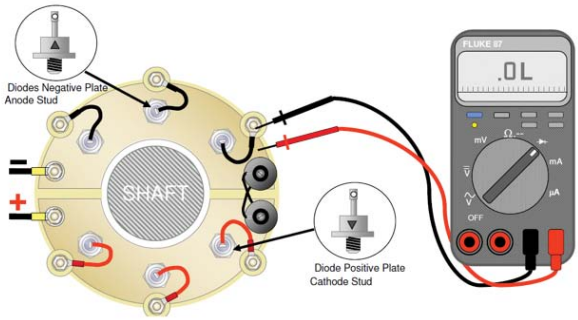
FIGURE 4. ELECTRICAL FAULT FINDING CHART PRT 2

Loss of voltage, excessive noise, overheating, high bearing temperatures and unstable operation from the generator are all symptomatic of a generator malfunction. However, these faults are often wrongly attributed to the generator because defects in other components or generator installationcan produce the same symptoms. This checklist provides a comprehensive list of the most common symptoms related to the generator and its installation. Before replacing the generator, verify the problem by consulting the chart below. If after taking the appropriate action the problem still persists, please contact your nearest authorised MARKON/STAMFORD/AVK for advice	High Voltage	Low voltage	No Voltage	Unstble Voltage	High excitation voltage	Incorect power factor	Cracked panels	Generator noisy	High bearing temperature	Broken/Loose terminals	High Winding Temperature	High kVar	Unable to syncronise	Rapidly rising current
Prime Mover Over Speed Correct Speed	●													
Prime Mover Under Speed Correct Speed		●			●									
Prime Mover Unstable (hunting) Check and rectify as necessary				●										
Vibration Check vibration levels are within the set standards							●	●	●	●				
Torsional Vibration Genset manufacturer to conduct review of application								●	●					
Loose Panels Check and rectify as necessary								●						
Incorrect Bearing Greasing Follow set procedure and recommendations								●	●					
Worn or Damaged Bearing Investigate cause of bearing damage, replace where necessary								●	●					
Faulty Bearing RTD Probe Investigate RTD probe and repair or replace where necessary									●					
Misalignment Repair or replace any damaged components and correct alignment							●	●	●					
PMG Damaged Find and correct cause of failure, repair or replace PMG as necessary		●	●	●										
Air Flow Inadequate Check and restore airflow requiremenents as stated in generator data sheets											●			
Re-circulating Air Flow Investigate cause of re-circulating air and take necessary remedial action					●				●		●			
Dirty Air Filters Clean, repair or replace as necessary											●			

FIGURE 5. MECHANICAL FAULT FINDING CHART

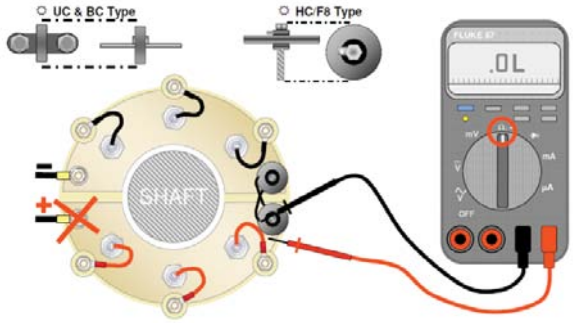
9.1 Fault Finding Procedure for Rotating Diodes and Surge Suppressor:

9.1.1 Check Rectifier Diodes



- Reverse the multimeter leads so that the Positive lead is on the Anode side of the diode, the Multimeter should now read OL. (no electron flow).
- A faulty diode will give a short circuit reading in both directions, or an open circuit reading in both directions, (usually because the solder joing has failed).

9.1.2 Testing the Surge Suppressor (Varistor)



- Disconnect one of the main rotor leads (+ or -)
- Switch the Multimeter to the position indicated for resistance "Ω" testing
- The Varistor should read Inifinity in both directions, and has no polarity
- A faulty Varistor will be short circuit, or burnt (destroyed) by fault current

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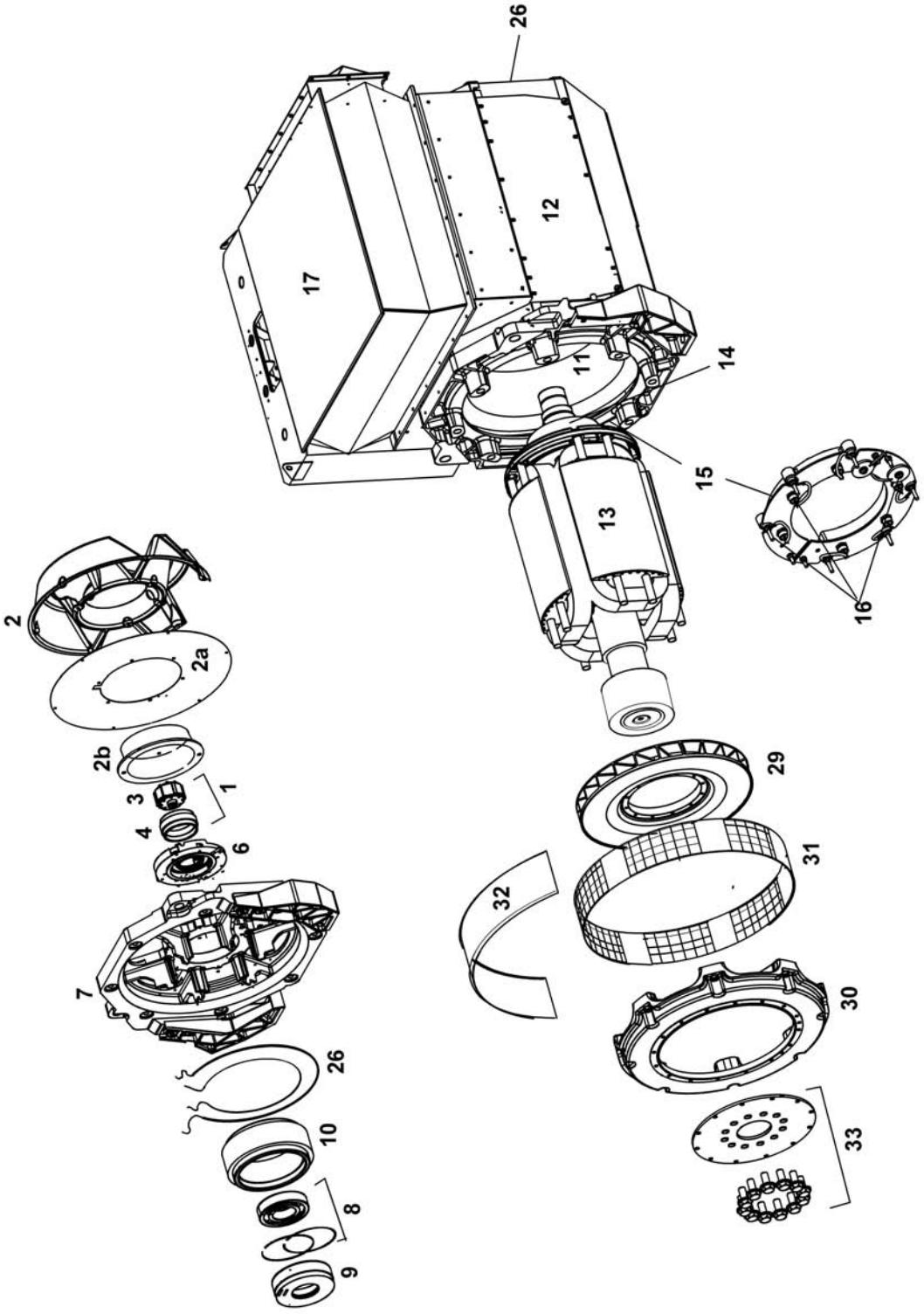
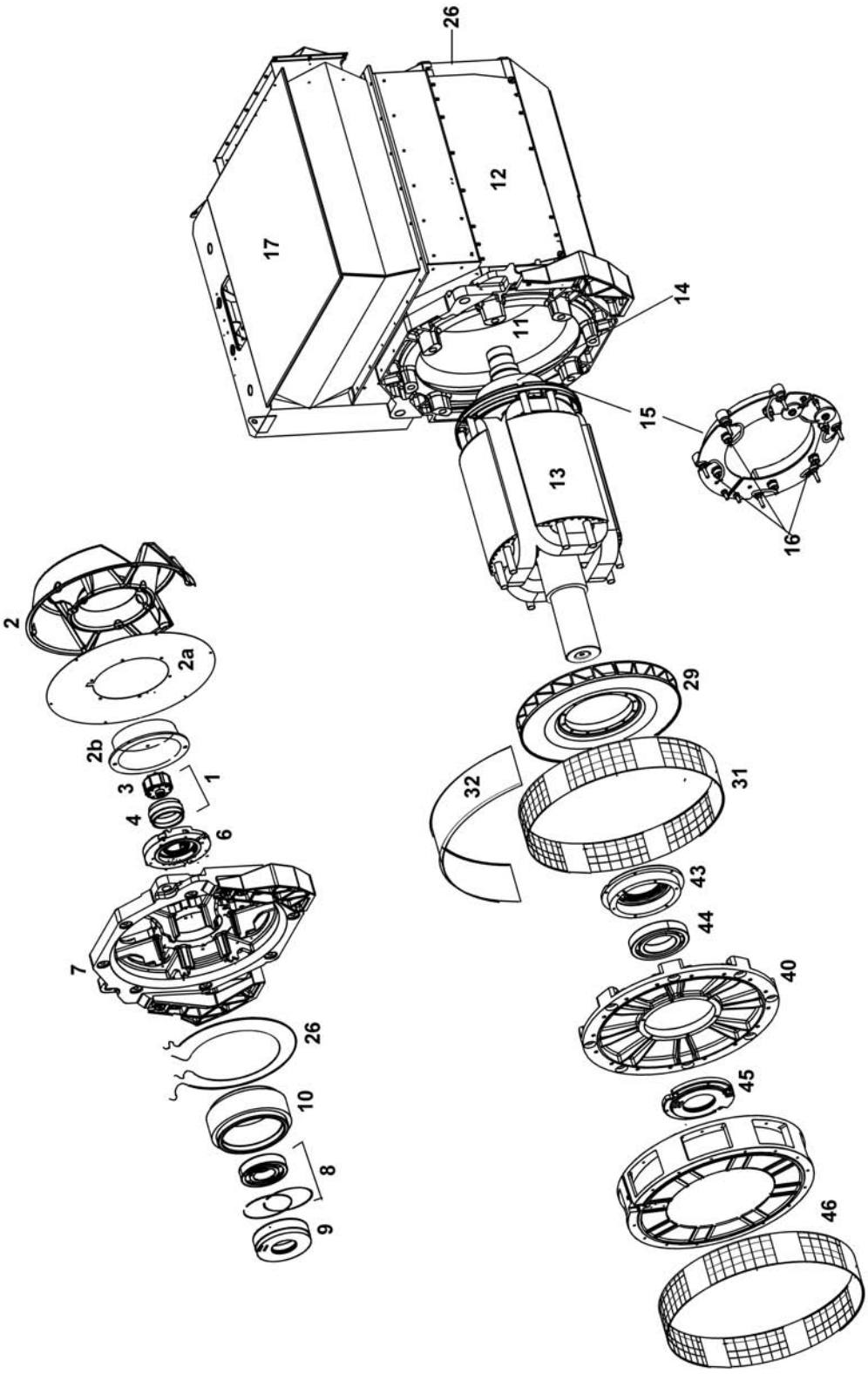
10 Parts Identification

10.1 P80 Single Bearing Generator



No	Description	Common Parts	Qty	No	Description	Common Parts	Qty
1	Complete P.M.G Upfit Kit	45-1082	1	15	Rectifier assy	810-1015	1
2	N.D.E Air Inlet Cover	800-30254	1	16	Diodes & Varistor	RSK-6001	1
2a	N.D.E Air Inlet Screen	800-30060	1	17	Complete terminal box assy	Q.M.S.N	1
2b	P.M.G Cover (Metal)	450-14360	1	26	Heater kit	45-1029	1
3	Current P.M.G. Rotor/Stator Repair Kit	See Item 1	1	29	Fan (clockwise)	800-30049	1
4	Current P.M.G. Rotor/Stator Repair Kit	See Item 1	1		Fan (anti-clockwise)	800-30014	1
6	N.D.E Cap	800-30017	1	30	Adaptor SAE 0	45-1139	1
7	N.D.E End bracket	800-30020	1		Adaptor SAE 00	45-1140	1
8	N.D.E Bearing kit	45-0407	1		Adaptor special R-T MHI	45-1141	1
9	N.D.E Bearing cartridge	800-30015	1	31	D.E. Adaptor screen (included in adaptor kit)	See item 30	2
10	Exciter stator R-T	800-1055	1	32	Drip proof cover	800-30186	1
	Exciter stator W-Y	800-1065	1	33	Coupling kit SAE 18	45-1144	1
11	Main stator frame assy	Q.M.S.N	1		Coupling kit SAE 21	45-1145	1
12	Main stator frame work	Q.M.S.N	1		Coupling kit SAE 24	45-1145	1
13	Main rotar assy	Q.M.S.N	1		A.V.R MA330 (not shown)	E000-13300	1
14	Exciter Stator R-T	800-1048	1				
	Exciter Stator W-Y	800-1049	1				

10.2 P80 Two Bearing Generator



No	Description	Common Parts	Qty	No	Description	Common Parts	Qty
1	Complete P.M.G Upfit Kit	45-1082	1	29	Fan (clockwise)	800-30049	1
2	N.D.E Air Inlet Cover	800-30254	1		Fan (anti-clockwise)	800-30014	1
2a	N.D.E Air Inlet Screen	800-30060	1	31	D.E. Bracket screen	800-30187	2
2b	P.M.G Cover (Metal)	450-14360	1	32	Drip proof cover	800-30186	1
3	Current P.M.G. Rotor/Stator Repair Kit	See Item 1	1	40	D.E. Bracket R-T	800-30022	1
4	Current P.M.G. Rotor/Stator Repair Kit	See Item 1	1		D.E. Bracket W-Y	800-30165	1
6	N.D.E Cap	800-30017	1	43	D.E. Bearing cartridge R-T	800-10475	1
7	N.D.E End bracket	800-30020	1		D.E. Bearing cartridge W-Y	820-10137	1
8	N.D.E Bearing kit	45-0407	1	44	D.E. Bearing kit R-T	45-0408	1
9	N.D.E Bearing cartridge	800-30015	1		D.E. Bearing kit W-Y	45-0409	1
10	Exciter stator R-T	800-1055	1	45	D.E. Bearing cap R-T	800-10477	1
	Exciter stator W-Y	800-1065	1		D.E. Bearing cap W-Y	820-10138	1
11	Main stator frame assy	Q.M.S.N	1	46	Adaptor kit SAE 0 R-T	45-1142	1
12	Main stator frame work	Q.M.S.N	1		Adaptor kit SAE 00 R-T (32 hole)	45-1135	1
13	Main rotar assy	Q.M.S.N	1		Adaptor kit SAE 0 W-Y	45-1136	1
14	Exciter Stator R-T	800-1048	1		Adaptor kit SAE 00 W-Y	45-1137	1
	Exciter Stator W-Y	800-1049	1		Adaptor kit SAE 00 W-Y (32 hole)	45-1138	1
15	Rectifier assy	810-1015	1	47	Adaptor screen included in adaptor kit	See item 46	1
16	Diodes & Varistor	RSK-6001	1		A.V.R. MA330 (not shown)	E000-133300	1
17	Complete terminal box assy	Q.M.S.N	1				
26	Heater kit	45-1029	1				

11 Spares and After Sales Service

We recommend the use of genuine STAMFORD service parts supplied from an authorised service outlet. For details of your nearest service outlet visit www.stamford-avk.com.

Aftermarket Help Desk

Phone: +44 (0) 1780 484744

Email: parts.enquires@cummins.com

11.1 Recommended Service Parts

In critical applications a set of these service spares should be held with the generator. Diode set (6 diodes with surge suppressors).

Part	Number
Frame P80	RSK6001
DM110 AVR	

Bearings

Part	DE	NDE
R.S.T Cores	051-01059	051-01066
W.X.Y Cores	051-01066	051-01066

11.2 Kluber Asonic GHY72 Grease

All bearings trials and calculated life expectancy are based on the use of Kluber Asonic GHY72. We recommend the use of this Ester Oil/Polyurea grease or am alternative grease with the same specification. The grease specification is available by request. Kluber has a worldwide distribution network, contact the manufacturers for your nearest stockist.

11.3 Parts Orders

When ordering parts the machine serial number or machine identity number and type should be quoted, together with the part description. The machine serial number can be found on the name plate or frame.

11.4 Customer Service

Cummins Generator Technologies' service engineers are experienced professionals, trained extensively to deliver the best support possible. Our global service offers:

- 24/7 response to service emergencies, 365 days of the year.
- On-site ac generator commissioning
- On-site bearing maintenance & bearing condition monitoring

- On-site insulation integrity checks
- On-site AVR & accessories set-up
- Multi-lingual local engineers

Customer Service Help Desk:

Phone: +44 1780 484732 (24 hours)

Email: service-engineers@cumminsgeneratortechnologies.com

12 End of Life Disposal

Companies specialising in reclaiming material from scrap products can reclaim most of the iron, steel and copper from the generator. For more details, please contact STAMFORD Customer Service.

12.1 Recyclable material

Mechanically separate the base materials, iron, copper and steel, removing paint, polyester resin, and insulation tape and/or plastics residues from all components. Dispose of this ‘waste material’

The iron, steel and copper can now be recycled.

12.2 Items requiring specialist treatment

Remove electrical cable, electronic accessories and plastic materials from the generator. These components need special treatment to remove the waste from the reclaimable material.

Forward the reclaimed materials for recycling.

12.3 Waste material

Dispose of waste material from both of the above processes via a specialist disposal company

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