

S2 and S3

LOW VOLTAGE ALTERNATORS

Owner Manual

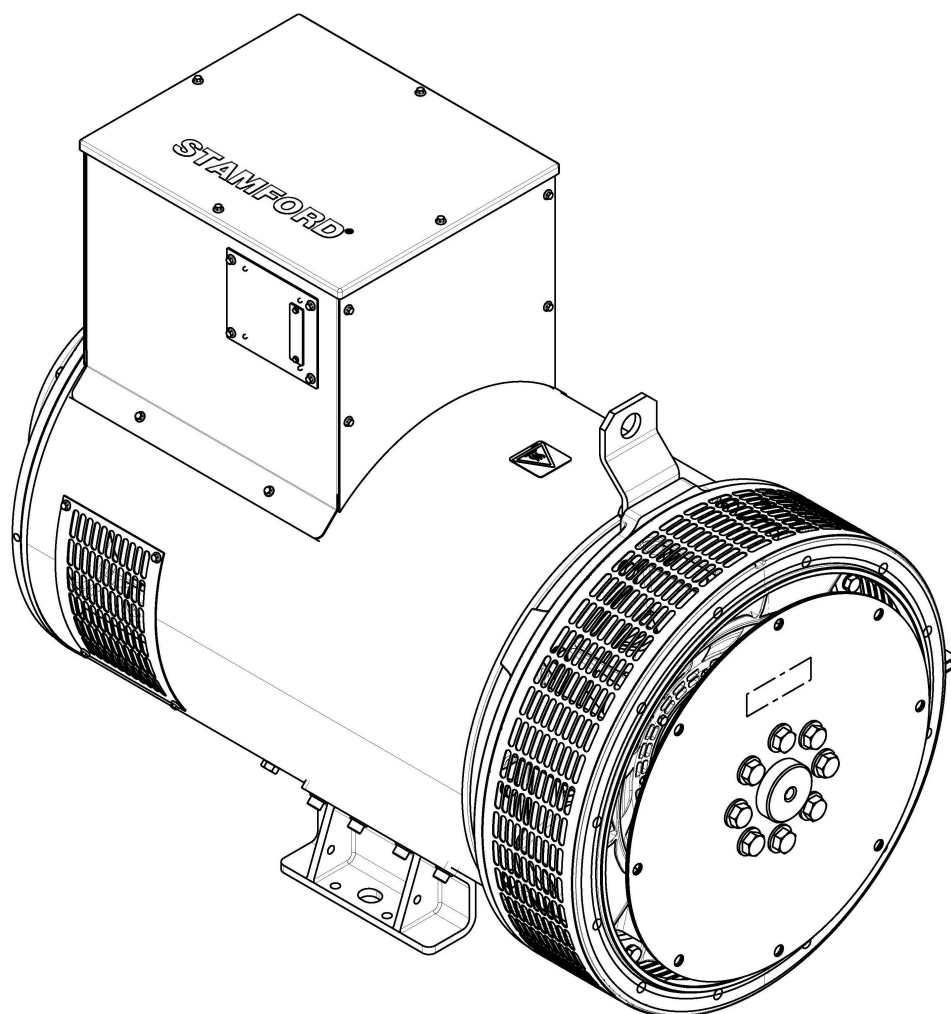


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1 Foreword

1.1 General

This document is an important guide to the intended use and operation of the product(s) detailed on the front cover. Read the information and procedures in this document. The information and procedures must be obeyed at all times, failure to obey the information and procedures can be considered misuse and can lead to injury, loss or damage to personnel or equipment.

TABLE 1. COMPANY ADDRESSES

Company and European Authorized Representative Addresses	
Cummins Generator Technologies Fountain Court Lynch Wood Peterborough PE2 6FZ United Kingdom	Cummins Generator Technologies Bvd. Decebal 116A Craiova, Dolj 200746 Romania

1.2 Legal

The alternator is the intellectual property of Cummins Generator Technologies LTD (also referred to as 'CGT' or 'the manufacturer' or by the brand names 'STAMFORD®' or 'AvK®' within this manual).

STAMFORD®, AvK® and STAMFORD VITA™, MX321™ and MX322™ are registered trademarks of Cummins Generator Technologies LTD. All rights to the alternator, the principle of the machine, the related drawings etc. lie with Cummins Generator Technologies LTD and are subject to copyright law. Copying is only permitted with prior written approval. Copyright Cummins Generator Technologies. All Rights reserved. Cummins and the Cummins logo are registered trademarks of Cummins Inc.

1.3 The Manual

This manual contains guidance and instructions for the installation and operation of the equipment specified on the manual front cover. This manual does not include instructions for servicing and maintaining the alternator. Contact Cummins Generator Technologies (CGT) Customer Service for servicing information.

Before operating, the equipment, read this manual. Make sure that all personnel who work on the equipment have access to the manual and all related documentation supplied with it. Misuse, failure to obey the instructions or use of non-approved parts, may invalidate the product warranty and lead to loss injury or damage.

This manual is an essential part of the equipment. Make sure that the manual is available to all applicable personnel throughout the life of the equipment.

The manual is written for skilled electrical and mechanical technicians and engineers, who have prior knowledge and experience of equipment of this type. If in doubt, contact your local CGT subsidiary.

NOTICE

Information in this manual was correct when published. It may be superseded due to our policy of continuous improvement. Visit www.stamford-avk.com for latest documentation.

1.4 Manual Languages

The manuals for this product are available in the languages shown below, which can be found on the STAMFORD® AvK® website: www.stamford-avk.com.

TABLE 2. S2 / S3 MANUAL LANGUAGES

Language, Manual Type and Document Part Number		
English (en-us)	Owner	A066V593
English (en-us)	Service ¹	A066V596

¹ Service manuals are only available in English (en-us), to authorized service providers who have completed Cummins accredited product training.

2 Safety Precautions

2.1 Safety Information and Notices used in this Manual

Danger, Warning and Caution panels used in this manual describe the sources of hazards, their consequences and how to avoid injury. Notice panels emphasize important or critical instructions.

 DANGER
<i>Danger indicates a hazardous situation which, if not avoided, WILL result in death or serious injury.</i>

 WARNING
<i>Warning indicates a hazardous situation which, if not avoided, COULD result in death or serious injury.</i>

 CAUTION
<i>Caution indicates a hazardous situation which, if not avoided, COULD result in minor or moderate injury.</i>

NOTICE
Notice refers to a method or practice which can result in product damage, or to draw attention to additional information or explanations.

2.2 General Guidance

- These safety precautions are for general guidance. The information is intended to supplement your own safety procedures and applicable rules, laws and regulations.

2.3 Training and Skill Requirements for Personnel

Operation, installation, service and maintenance tasks and/or procedures can only be done by personnel, who:

- Have completed related, applicable and approved training.
- Know the equipment, understand the task(s) and procedure(s) and know the related hazards / risks.
- Know and obey site / location specific emergency procedures and applicable laws and regulations.

2.4 Risk Assessment

- The installer / operator / service / maintenance company must do a risk assessment to establish all related hazards and risks.
- During operation, access to the alternator must be restricted to personnel who are trained and who know all relevant hazards and risks. Refer to: [Section 2.3 on page 3](#).

2.5 Personal Protective Equipment (PPE)

Personnel who install, operate, service or maintain the alternator must:

- Have access to the minimum recommended protective equipment (refer to the figure below). The protective equipment must be approved for the task or procedure.
- Know how to correctly use protective equipment, refer to: [Section 2.3 on page 3](#)
- Use protective equipment as directed by the risk assessment, refer to: [Section 2.4 on page 3](#).



FIGURE 1. MINIMUM RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT (PPE)

2.6 Tools and Equipment

All personnel must know how to use tools and equipment safely, refer to: [Section 2.3 on page 3](#).

All tools and equipment used, must be:

- Suitable for the task and procedure.
- Electrically insulated (not below the alternator output voltage), refer to: [Section 2.4 on page 3](#).
- In a serviceable condition for safe use.
- Included within the risk assessment, refer to: [Section 2.4 on page 3](#).

2.7 Safety Information Signs

Safety information signs are provided on the equipment to indicate hazards and emphasize instructions. Before operating the equipment:

- Personnel must know and understand alternator safety information signs and the associated hazards / risks.



FIGURE 2. EXAMPLE SAFETY INFORMATION SIGNS

Safety information signs vary depending on alternator specification.

2.8 Alternator Danger Notices

DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- **Shut down and isolate the alternator from all energy sources.**
- **Remove or isolate stored energy.**
- **Test isolated parts for electrical isolation using a suitable voltage tester.**
- **Use lock out/tag out safety procedures.**

DANGER

Testing Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before testing on or near live electrical conductors:

- **Take applicable precautions to prevent contact with live conductors, refer to: Safety Precautions Chapter.**
- **Test on or near live conductors, only if absolutely necessary.**
- **Only trained personnel may test on or near live electrical conductors.**
- **Do not test on or near live electrical conductors alone: Another competent person must be present, trained to isolate energy sources and take action in an emergency.**

DANGER

Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing or trapping. To prevent injury:

- **Before operating the alternator: The rotating coupling between the alternator and prime mover must be covered by a guard or cover.**
- **Before attempting service or maintenance tasks or removing covers from rotating parts: Shut down and isolate the generator set from all energy sources, isolate stored energy and use lock out/tag out safety procedures.**

DANGER

Testing on Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing and trapping. To prevent injury and before removing safety covers for testing:

- **Take applicable precautions to prevent contact with uncovered rotating mechanical parts, refer to Safety Precautions Chapter.**
- **Test on or near uncovered rotating mechanical parts, only if absolutely necessary.**
- **Do not test on or near uncovered rotating mechanical parts alone: Additional personnel must be present, who know how to isolate energy sources and take action in an emergency.**

⚠ DANGER**Falling Mechanical Parts**

Falling mechanical parts can cause serious injury or death by impact, crushing, severing or trapping. To prevent injury or death and before lifting:

- *Check the capacity, condition and attachment of lifting equipment.*
- *Check the capacity, condition and attachment of accessories for lifting.*
- *Check the capacity, condition and attachment of lifting point(s) on the load.*
- *Check the mass, integrity and stability of the load.*
- *If available: Install drive end and non-drive end transit fittings to prevent movement and damage to bearings.*
- *Keep the alternator horizontal when lifting.*
- *Do not use alternator lifting points for lifting a complete generator set.*
- *Do not use cooler lifting points for lifting the alternator or a complete generator set.*
- *Do not remove the lifting label attached to one of the lifting points.*

2.9 Alternator Warning Notices

⚠ WARNING**Enclosures**

Alternators may be installed within an enclosure for environmental protection, noise reduction or transportation reasons. Before entering the enclosure to prevent injury or death, personnel must:

- *Know the related hazards / risks.*
- *Have a safe access route in to and out of the enclosure, have sufficient ventilation and obey the alternator hazard zones.*
- *Wear the appropriate protective equipment.*

Additionally when working with Medium or High Voltage alternators:

- *Enter the enclosure when the alternator is operating, only if absolutely necessary.*
- *To minimize risks to personnel use remote diagnostic, monitoring and measuring systems.*

⚠ WARNING**Terminal Box**

Do not modify the terminal box panels or terminal box internal components. Modification(s) can lead to short-circuits or arc-flash events and cause injury or death by electric shock or burns. To prevent injury:

- *Refer to: Arc-Flash warning in the Safety Precaution Chapter.*
- *Contact STAMFORD® or AvK® customer services (www.stamford-avk.com) for guidance before making modifications to the terminal box panels or internal components.*

⚠ WARNING**Arc-flash**

An arc-flash event within the terminal box, on the alternator windings or at the cables exiting the terminal box can cause serious injury or death by: Noise, burns, impact from flying/molten debris and/or hot gases. To prevent injury or death from arc-flash:

- **Do not approach the alternator during operation unless wearing appropriate personal protective equipment, refer to: Personal Protective Equipment Paragraph.**
- **Personnel working close an operating alternator must be trained in arc-flash hazard awareness, refer to Training Paragraph.**

An arc-flash is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. Arc-flash can be caused by many things, such as: material failure, corrosion, or incorrect installation.

It is the responsibility of the installer/operating company to do a risk assessment of arc-flash hazard as part of the complete installation, including connection to other energy sources.

Arc-flash hazards can include: Intense noise, hot and rapidly expanding gases, expanding pressure wave, flying debris (including molten copper) and exposure to intense UV light.

When the alternator is connected to other energy sources, the arc-flash can exceed an arc-flash produced by an individual alternator. These additional energy sources can be electrical loads that store energy (e.g. Transformers, capacitors etc.), alternators in parallel or coupled to a mains network.

While arc-flash in an alternator is rare, it is important that the installer/operating company takes applicable measures to ensure the safety of personnel. In accordance with local electrical safe working practices, personnel working around the running alternator must be trained in and aware of arc-flash hazards. Personal protective equipment must be worn when working within the vicinity of the alternator, refer to: Safety Precautions Chapter [Section 2.5 on page 4](#).

Medium Voltage and High Voltage Alternators

For Medium Voltage or High Voltage alternators:

Medium voltage and high voltage alternators can be fitted with additional warning and information stickers. Pressure relief vent(s) can be installed in the terminal box. The pressure relief vent(s) can vary from the one shown in the figure below).

If installed, make sure the pressure relief vent(s) are secure and serviceable. Do not remove, obstruct or apply a load to the pressure relief vent(s).



FIGURE 3. ARC-FLASH IMAGES

⚠ WARNING

Condensed Water

Operating an alternator with condensed water in the windings can cause serious injury by electric shock, burns or exposure to flying debris and particles. To prevent injury and before operating the alternator:

- **Use anti-condensation heaters (if fitted) to prevent condensation accumulating.**
- **Check for condensed water.**
- **If condensed water is present, drain/remove the water, dry and inspect the alternator, refer to: Maintenance and Servicing Chapter.**

⚠ WARNING

Coupling an Alternator

Moving mechanical parts during coupling can cause serious injury by crushing, severing or trapping. When coupling the alternator to a prime-mover or when installing large components, to prevent injury:

- **Personnel must keep limbs and body parts away from coupling surfaces during coupling and/or installing operations.**

⚠ WARNING

Hazardous Operating Environments (Explosive Atmospheres)

The use of the alternators in an explosive atmosphere can cause serious injury or death by burns and / or flying debris, particles and fumes. To prevent injury or death:

- **Do not install or operate the alternator where the surrounding atmosphere is potentially explosive.**

⚠ WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- **Avoid contact with hot surfaces.**
- **Always wear the appropriate personal protection equipment, refer to: Safety Precaution Chapter.**
- **Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).**
- **Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.**

⚠ WARNING***Incorrect Electrical Installation and System Protection***

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- ***Have completed related, applicable and approved training.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know related hazards / risks.***
- ***Know and obey site / location specific emergency procedures and applicable laws and regulations.***

⚠ WARNING***Live Electrical Conductors***

Live electrical conductors at the winding terminals can cause serious injury or death by electric shock or burns. After an insulation resistance test, to prevent injury or death:

- ***Discharge the windings immediately after the test has concluded by shorting to a suitable earth. The windings must discharge for the greater of:***
 - 1. A length of time equal to the duration of the test.***
 - or***
 - 2. 5 minutes.***

⚠ WARNING***Noise***

Noise from a running alternator can cause serious and permanent hearing damage. To prevent injury:

- ***Always wear appropriate personal protection equipment. Refer to Personal Protective Equipment paragraph.***

⚠ WARNING***Grounding***

Incorrectly grounded alternators can cause serious injury or death or serious equipment damage by electric shock or electrical malfunction. To avoid equipment damage, injury or death:

- ***The alternator must be permanently grounded, unless the application or applicable laws and regulations do not permit alternator grounding.***

⚠ WARNING***Reconnected Energy Source***

Accidental reconnection of energy sources during service and maintenance work can cause serious injury or death by electric shock, burns, crushing, severing or trapping. To prevent injury and before starting any service and maintenance work:

- ***Isolate the alternator from energy sources.***
- ***Prevent alternator use with lock out/tag out safety procedures.***
- ***Do not defeat or bypass the lock out/tag out safety procedures.***

⚠ WARNING

Strong Magnetic Field

The strong magnetic field from a permanent magnet generator (PMG) or excitation boost system (EBS), can cause serious injury or death by interference with implanted medical devices. To prevent injury or death:

- *Do not work near a permanent magnet generator (PMG) or excitation boost system (EBS) if you have an implanted medical device.*

⚠ WARNING

Incorrect or Improper Use

Incorrect or improper use of the alternator may result in equipment damage, serious injury or death. To prevent or equipment damage injury or death:

- *Always select the correct specification alternator for the intended use and application.*
- *Make sure the alternator and prime mover are compatible and suitable for the intended application.*
- *Always install the alternator in accordance with the original manual(s) and technical drawing(s) supplied with the alternator.*
- *Obey locally applicable rules and regulations.*
- *Make sure the alternator is operated in accordance with the manual(s) and within the limits of the alternator rating plate.*
- *Do not use a damaged or defective alternator.*

If a defect(s) is discovered:

- *Shut down and isolate the alternator from all energy sources.*
- *Remove or isolate stored energy.*
- *Use lock out / tag out safety procedures.*
- *Prevent further use of the alternator until it is repaired and returned to a serviceable condition.*

⚠ WARNING

Removing Safety Covers

A hazard exists when alternator safety covers are removed. Ejected debris and particles can cause serious injury or death by impact, severing or puncturing. Exposure to mechanically driven release of debris and particles exists in all directions (horizontally and vertically) where covers are removed. To prevent injury or death:

- *Fit the safety labels at the locations shown on the back of the label sheet supplied.*
- *Observe the safety labels.*
- *Refer to the service manual before removing covers.*



FIGURE 4. SAFETY LABEL

⚠ WARNING

Exposure to Ejected Debris and Particles

Ejected debris and particles can cause serious injury or death by impact, severing or puncturing. Exposure to mechanically driven release of debris and particles exists in all directions (horizontally and vertically) in the areas surrounding the alternator air outlet(s), air inlets(s) and the open shaft end (also commonly known as the Drive End (DE)). To prevent injury or death:

- **Keep away from the air inlet(s) and air outlet(s) when the alternator is operating.**
- **Do not position operator controls near the air inlet(s) or air outlet(s).**
- **Do not cause overheating by running the alternator outside rating plate parameters.**
- **Do not overload the alternator.**
- **Do not operate an alternator displaying excessive vibration.**
- **Do not synchronize parallel alternators outside the specified parameters.**

⚠ WARNING

Exposure to Particles and Fumes from an Alternator.

Particles and fumes can be released in all directions (horizontally and vertically) from where alternator ventilation is installed. To avoid or injury:

- **Avoid the areas around ventilation openings, air intake(s) and air outlet(s) when the alternator is operating.**
- **Use the correct personal protective equipment when working around an alternator.**

⚠ WARNING

Exposure to Particles and Fumes from Alternator Terminal Boxes.

Particles and fumes can be released in all directions (horizontally and vertically) from where terminal box pressure release flaps are installed. Terminal box pressure release flap(s) can be located at different positions and orientations. To avoid or injury:

- **Personnel must keep away from terminal box pressure release flap(s) during alternator operation.**

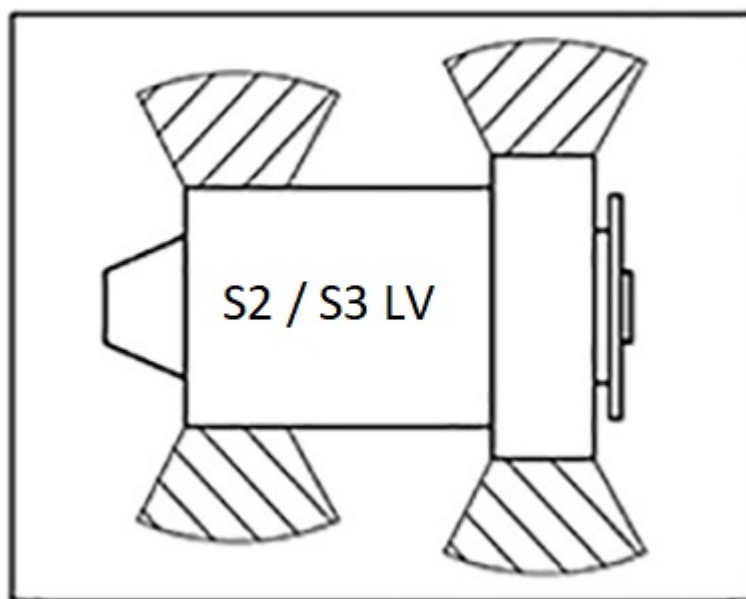


FIGURE 5. S2/S3 ALTERNATOR HAZARD ZONES

2.11 Alternator Caution Notices

⚠ CAUTION

Hazardous Substances

Hazardous substances can cause minor or moderate injury. Prolonged or repetitive exposure to hazardous substances can cause serious medical conditions. To prevent injury:

- Always read and obey the instructions provided by the product manufacturer.
- Use, handle and store substances as specified by the product manufacturer.
- Always wear appropriate personal protective equipment, refer to Safety Precautions Chapter.

⚠ CAUTION

Missing Walkways and Handrails

Walkways and handrails temporarily removed for service and maintenance access can cause minor or moderate injury by slips, trips and falls. To prevent injury and before starting work:

- Assess the hazards and risks, take applicable precautions for safe working, place warnings and prevent access by unauthorized persons.

⚠ CAUTION

Dust & Airborne Particles/Fumes

Dust and other airborne particles and fumes can cause minor or moderate injury by irritating the lungs and eyes. Prolonged or repetitive exposure can cause serious medical conditions. To prevent injury:

- Use mechanical vacuum extraction to remove dust and airborne particles or fumes.
- Ventilate the area fully.
- Always wear the appropriate personal protective equipment. Refer to Safety Precautions Chapter.

 CAUTION

Regulatory compliance must be obeyed. To prevent damage or injury and before use, make sure:

- ***Alternators are use within the applicable regulatory territories.***

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3 Safety Directives and Standards

3.1 General

STAMFORD® S2 and S3 alternators conform to IEC 60034 and ISO 8528-3. The alternators are intended for sale, installation and use within the Republic of India (Bharat Ganrajya) and its union of states and territories.

IEC 60034 is an internationally recognized standard of the International Electrotechnical Commission (IEC) for rotating electrical machinery. ISO 8528-3 is an internationally recognized standard of the International Standards Organization (ISO).

Regulatory compliance must be obeyed. STAMFORD® S2 and S3 alternators do not meet the regulatory standards of :

- United Kingdom (UKCA)
- European Union (CE)
- United States of America (UL)
- Canadian (CSA)

Do not install or use STAMFORD® S2 and/or S3 alternators within these regulatory areas.

CAUTION

Regulatory compliance must be obeyed. To prevent damage or injury and before use, make sure:

- **Alternators are used within the applicable regulatory territories.**

3.2 Additional Information for Electromagnetic Compatibility Compliance (EMC)

Where necessary STAMFORD® and AvK® alternators are designed to meet electromagnetic compatibility compliance emissions and immunity standards for industrial environments. Additional equipment may be required when the alternator is installed in residential, commercial, and light industrial environments.

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

NOTICE

Cummins Generator Technology is not liable for electromagnetic compatibility compliance if non-genuine STAMFORD® or AvK® brand parts are used for maintenance, servicing or repairs.

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4 Introduction

4.1 General Description

S2/S3 alternators are of brushless rotating field design, available up to 480V, 50 Hz (1500 RPM) or 60 Hz (1800 RPM) and built to meet IEC 60034 and ISO 8528-3 standards.

All S2/S3 range alternators are self-excited, with excitation power derived from the main output windings using an AVR.

A permanent magnet generator (PMG) powered excitation system is available as an option, using an AVR.

4.2 Noise

 WARNING
Noise Noise from a running alternator can cause serious and permanent hearing damage. To prevent injury: • Always wear appropriate personal protection equipment. Refer to Personal Protective Equipment paragraph.

Maximum A-weighted noise emissions may reach 106 dB(A). Contact the supplier for application-specific details.

4.3 Alternator Name

TABLE 3. S2 S3 ALTERNATOR NAMING FORMAT

Example:	S	2	L	1	D	-	C	4	1
	STAMFORD Brand	Family Series (2,3)	Voltage (L = low Voltage)	Revision	Descriptor		Core length (C, D, E, ...)	Number of poles	Number of bearings (1 or 2)

4.4 Serial Number Location

A unique serial number is stamped near the drive end of the alternator and shown on the rating plate and tracking labels on the side of the generator frame.

4.5 Rating Plate

The fixed rating plate label states the intended operating parameters of the alternator.

TYPE			SERIAL No		
AVR		KVA		Hz	PH
PF		RPM		ST.WDG	
VOLT		AMP		ST.CON	
DUTY		AMB.TEMP	°C	ENCL.	
EX. VOLT		EX. AMP		INSU.CL.	
WEIGHT					
AC GENERATOR STAMFORD® IS/IEC60034-1 ISO 8528-3 G06, MIDC, RANJANGAON 412220, MAHARASHTRA, INDIA					

A064X577-B

FIGURE 6. STAMFORD AC ALTERNATOR RATING PLATE

4.6 Product Authentication

The STAMFORD® high security, anti-counterfeit hologram is located on the Tracking Label. Check that the dots are visible around the STAMFORD® logo when viewing the hologram from different angles and the word "GENUINE" appears behind the logo. Use a flashlight to see these security features in low ambient light. Check that the alternator is genuine by entering the unique 7 character hologram code at www.stamford-avk.com/verify.

 stamford-avk.com	
FRAME / CORE:	SERIAL NO:
WDG:	ORDER NO:

FIGURE 7. TRACKING LABEL



FIGURE 8. DOTS VISIBLE IN LEFT, RIGHT, UPPER AND LOWER VIEWS OF 3D HOLOGRAM

5 Lifting, Storage and Transportation

5.1 General Transport Guidance

Alternators vary in shape, size, weight, and center of gravity. For product information, refer to: The general arrangement drawing, lifting label and transport information supplied with the alternator.

Before loading a vehicle, transporting a load and/or unloading a vehicle:

- Obey applicable rules and regulations relating to transport operations at all times.
- Make sure a sufficient number of applicably configured restraints are used to lash down/secure an alternator to a vehicle.
- Do not position lashing down/securing restraints on or over sensitive components that can be damaged by the restraint.
- Do not position lashing down/securing restraints on paintwork or information/warning labeling. Protect these areas if restrains must be placed over them.
- Before transportation or storage: Apply an anti-corrosion agent to exposed machined surfaces.
- Before transportation or storage: Cover exposed connection points with a sufficient cover, cap or packaging material.
- Before transportation or storage: If necessary, protect bearings from vibration using anti-vibration pads. Do not transport unprotected alternators over an uneven surface.
- Alternators should be supplied on a transport frame if necessary.
- Bearings should be protected from damage by using a transportation lock (if available) when necessary. If a transport lock is supplied with the bearing/alternator it must be installed before transportation.
- Bearings must be protected from corrosion using an applicable anti-corrosion agent.
- Read and obey industry best practice guidance.
- Consult with a transport specialist for advice if necessary.

5.2 Lifting the Alternator

DANGER

Falling Mechanical Parts

Falling mechanical parts can cause serious injury or death by impact, crushing, severing or trapping. To prevent injury or death and before lifting:

- ***Check the capacity, condition and attachment of lifting equipment.***
- ***Check the capacity, condition and attachment of accessories for lifting.***
- ***Check the capacity, condition and attachment of lifting point(s) on the load.***
- ***Check the mass, integrity and stability of the load.***
- ***If available: Install drive end and non-drive end transit fittings to prevent movement and damage to bearings.***
- ***Keep the alternator horizontal when lifting.***
- ***Do not use alternator lifting points for lifting a complete generator set.***
- ***Do not use cooler lifting points for lifting the alternator or a complete generator set.***
- ***Do not remove the lifting label attached to one of the lifting points.***

Lift the alternator by hooks or shackles attached to the lifting points (lugs or eyes) provided. A label attached to a lifting point shows the correct lifting arrangement. Use chains or lifting straps of appropriate length, and a spreader bar if necessary, to make sure that the chains or lifting straps are vertical when lifting. Make sure that the capability of the lifting equipment is sufficient for the alternator mass shown on the label.

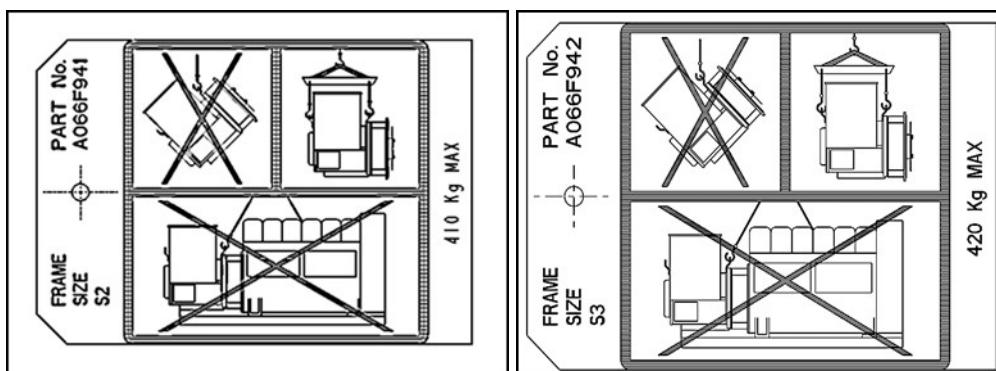


FIGURE 9. LIFTING LABELS

5.3 Alternator Dimensions

Dimensions are included in the data sheet specific to the alternator model. Refer to the rating plate to identify the alternator model.

NOTICE

Data sheets are available from www.stamford-avk.com

5.4 Storage

WARNING

Condensed Water

Operating an alternator with condensed water in the windings can cause serious injury by electric shock, burns or exposure to flying debris and particles. To prevent injury and before operating the alternator:

- **Use anti-condensation heaters (if fitted) to prevent condensation accumulating.**
- **Check for condensed water.**
- **If condensed water is present, drain/remove the water, dry and inspect the alternator, refer to: Maintenance and Servicing Chapter.**

⚠ WARNING**Hot Surfaces and Fire**

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- **Avoid contact with hot surfaces.**
- **Always wear the appropriate personal protection equipment, refer to: Safety Precaution Chapter.**
- **Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).**
- **Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.**

If the alternator will not be used immediately, it must be stored in a clean, dry, vibration-free environment. We recommend the use of anti-condensation heaters, when available.

If the alternator can be rotated, turn the rotor a minimum of 6 revolutions every month during storage.

5.5 After Storage

After a period of storage, do the pre-running checks, refer to: [Section 7.2 on page 32](#) to determine the condition of the windings. If the windings are damp or the insulation resistance is low, dry the insulation. Refer to the drying out procedures: [Chapter 8 on page 37](#).

Before putting the alternator into service, refer to the following table.

TABLE 4. BEARING STORAGE

	Not Rotated during Storage	Rotated during Storage
Sealed Bearing(s)	If stored less than 12 months, put the alternator into service. If stored more than 12 months, replace the bearing(s) then put the alternator into service.	If stored less than 24 months, put the alternator into service. If stored more than 24 months, replace the bearing(s) then put the alternator into service.

5.6 Long-term Storage

When an alternator is stationary, in storage or otherwise, it may be subjected to environmental factors, such as vibration, humidity, temperature and airborne contaminant particles, that could degrade the bearing arrangements.

Contact STAMFORD® or AvK® customer services www.stamford-avk.com for advice in advance if the alternator will be stationary for long periods.

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6 Application of the Alternator

It is the customer's responsibility to make sure that the selected alternator is suitable for the final application.

WARNING

Incorrect or Improper Use

Incorrect or improper use of the alternator may result in equipment damage, serious injury or death. To prevent or equipment damage injury or death:

- ***Always select the correct specification alternator for the intended use and application.***
- ***Make sure the alternator and prime mover are compatible and suitable for the intended application.***
- ***Always install the alternator in accordance with the original manual(s) and technical drawing(s) supplied with the alternator.***
- ***Obey locally applicable rules and regulations.***
- ***Make sure the alternator is operated in accordance with the manual(s) and within the limits of the alternator rating plate.***
- ***Do not use a damaged or defective alternator.***

If a defect(s) is discovered:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Use lock out / tag out safety procedures.***
- ***Prevent further use of the alternator until it is repaired and returned to a serviceable condition.***

6.1 Environment

The alternators are protected to IP23 as standard. IP23 is not adequate protection for use outdoors without additional measures.

TABLE 5. ENVIRONMENTAL SPECIFICATION

Ambient Temperature	-15° C to 40° C
Relative Humidity	< 65%
Altitude	< 1000 m

The alternator has been designed for the environment shown in the table. The alternator can operate outside these conditions if it is rated accordingly, the nameplate gives details. If the operating environment is changed after purchase, refer to the factory for a revised alternator rating.

6.2 Air Flow

Make sure that the air inlets and outlets are not obstructed when the alternator is running.

TABLE 6. S2 S3 AIR FLOW VALUES

Alternator Model and Frequency	50 Hz	60 Hz	Maximum Intake to outlet pressure drop, mm(in) water gauge
	Minimum Air Flow, m³/s (ft³/min)		
S2	0.223 (472.2)	0.277 (587.7)	6 (0.25)
S3	0.544 (1153.8)	0.654 (1385.2)	6 (0.25)

6.3 Airborne Contaminants

⚠ CAUTION

Dust & Airborne Particles/Fumes

Dust and other airborne particles and fumes can cause minor or moderate injury by irritating the lungs and eyes. Prolonged or repetitive exposure can cause serious medical conditions. To prevent injury:

- *Use mechanical vacuum extraction to remove dust and airborne particles or fumes.*
- *Ventilate the area fully.*
- *Always wear the appropriate personal protective equipment. Refer to Safety Precautions Chapter.*

NOTICE

Contaminants such as salt, oil, exhaust fumes, chemicals, dust, and sand will reduce the effectiveness of the insulation and the life of the windings. Consider using air filters and an enclosure to protect the alternator.

6.4 Humid Conditions

The water carrying capacity of air depends on temperature. If the air temperature falls below its saturation point, dew may form on the windings, reducing the electrical resistance of the insulation. In humid conditions, additional protection may be required even if the alternator is fitted inside an enclosure. Anti-condensation heaters are supplied on request.

6.5 Anti-Condensation Heaters

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- *Shut down and isolate the alternator from all energy sources.*
- *Remove or isolate stored energy.*
- *Test isolated parts for electrical isolation using a suitable voltage tester.*
- *Use lock out/tag out safety procedures.*

⚠ WARNING**Condensed Water**

Operating an alternator with condensed water in the windings can cause serious injury by electric shock, burns or exposure to flying debris and particles. To prevent injury and before operating the alternator:

- **Use anti-condensation heaters (if fitted) to prevent condensation accumulating.**
- **Check for condensed water.**
- **If condensed water is present, drain/remove the water, dry and inspect the alternator, refer to: Maintenance and Servicing Chapter.**

⚠ WARNING**Hot Surfaces and Fire**

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- **Avoid contact with hot surfaces.**
- **Always wear the appropriate personal protection equipment, refer to: Safety Precaution Chapter.**
- **Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).**
- **Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.**

Power to the anti-condensation heater is supplied from a separate source. Anti-condensation heaters raise the air temperature around the windings to deter condensation forming in humid conditions when the alternator is not operating. Best practice is to energize the heaters automatically when the alternator is off.

6.6 Enclosures

Fit an enclosure to protect the alternator from adverse environmental conditions. Make sure that air entering the alternator is of adequate flow rate, free from moisture and contaminants, and below the maximum ambient temperature on the rating plate.

Make sure there is sufficient access around the alternator for safe maintenance.

S2/S3 alternators have round end brackets that will create an air flow pattern that differs from previous alternators of this size. The air flow should be modeled to identify and prevent hot air from recirculating within the enclosure.

6.7 Vibration

The alternators are designed to withstand the vibration levels encountered on generator 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 generator set).

NOTICE

Exceeding either of the above specifications will have a detrimental effect on the life of the bearings and other components and may invalidate the alternator warranty.

NOTICE

The terminal box is designed to support the fitted busbars or terminals, transformers, load cables and auxiliary terminal box. Additional mass could cause excessive vibration and lead to failure of the terminal box enclosure and mounting. Refer to the Installation Manual to connect the load cables to the terminal box. Speak to STAMFORD® or AvK® customer services before fixing any additional mass to the terminal box.

6.7.1 Definition of BS5000–3

Alternators shall be capable of continuously withstanding linear vibration levels with amplitudes of 0.25 mm between 5 Hz and 8 Hz, and velocities of 9.0 mm/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.

6.7.2 Definition of ISO 8528-9

ISO 8528-9 refers to a broad band of frequencies, the broad band is taken to be between 10 Hertz and 1000 Hertz. The table below is an extract from ISO 8528-9 (Table C.1, value 1). This simplified table lists the vibration limits by kVA and speed for acceptable operation of standard generator set designs.

6.7.3 Vibration Frequencies

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

- 4-pole 1500 RPM 25 Hz
- 4-pole 1800 RPM 30 Hz

Vibrations induced in the alternator by the engine are complex. It is the responsibility of the generator set designer to ensure that the alignment and stiffness of the bedplate and mountings do not allow vibration to exceed BS5000 part 3 and ISO 8528 part 9 limits.

6.7.4 Linear Vibration Limits

TABLE 7. S2/S3 VIBRATION LEVEL MEASUREMENTS

Linear Vibration Levels As Measured On The Alternator - S2/S3			
Engine Speed RPM (min ⁻¹)	Power Output S (kVA)	Vibration Displacement RMS (mm)	Vibration Velocity RMS (mm/s)
1 300 ≥ n _r < 2 000	10 > but ≤ 50	0.64	40
	50 > but ≤ 125	0.4	25
	125 > but ≤ 250	0.4	25
The broad band is taken as 10 Hz - 1000 Hz			

6.7.5 Linear Vibration Monitoring

We recommend using vibration analyzing equipment to measure vibration at the positions shown below. Check that vibration of the generator set is below the limits stated in the standards. If vibration is above the limits, the generator set builder should investigate the root causes and eliminate them. Best practice is for the generator set builder to take initial readings as a reference and for the user to periodically monitor vibration, according to the recommended service schedule, to detect a deteriorating trend.

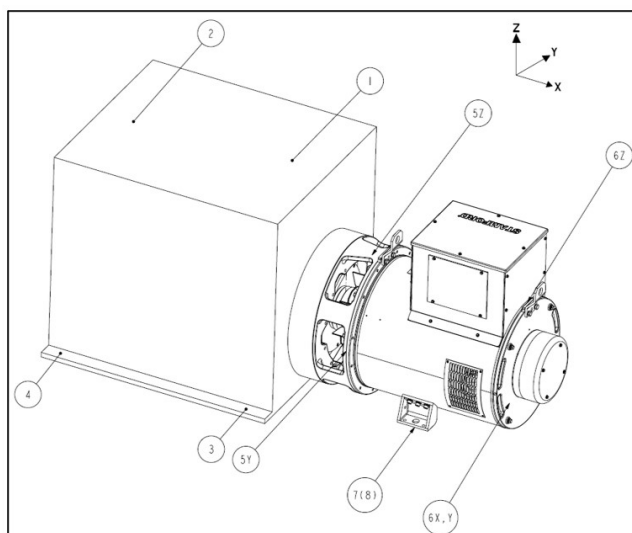


FIGURE 10. VIBRATION MEASUREMENT POSITIONS

6.7.6 Excessive Vibration

⚠ WARNING

Exposure to Ejected Debris and Particles

Ejected debris and particles can cause serious injury or death by impact, severing or puncturing. Exposure to mechanically driven release of debris and particles exists in all directions (horizontally and vertically) in the areas surrounding the alternator air outlet(s), air inlets(s) and the open shaft end (also commonly known as the Drive End (DE)). To prevent injury or death:

- ***Keep away from the air inlet(s) and air outlet(s) when the alternator is operating.***
- ***Do not position operator controls near the air inlet(s) or air outlet(s).***
- ***Do not cause overheating by running the alternator outside rating plate parameters.***
- ***Do not overload the alternator.***
- ***Do not operate an alternator displaying excessive vibration.***
- ***Do not synchronize parallel alternators outside the specified parameters.***

If the measured vibration of the generator set is not within the limits:

1. The generator set manufacturer should change the generator set design to reduce the vibration levels as much as possible.
2. Contact Cummins Generator Technologies to assess the impact on bearing and alternator life expectancy.

6.8 Bearings

6.8.1 Sealed Bearings

Inspect sealed-for-life bearings periodically, according to the recommended service schedule in this manual. Check for signs of wear, fretting or other detrimental features. Damage to seals, grease leakage or discoloration of the bearing races indicate that the bearing may need to be replaced.

6.8.2 Bearing Life

Factors that reduce bearing life or lead to bearing failure include:

- Adverse operating conditions and environment.
- Stress caused by misalignment of the generator set.
- Vibration from the engine that exceeds the limits in BS 5000-3 and ISO 8528-9.
- Long periods (including transportation) when the alternator is stationary and subjected to vibration can cause false brinelling wear (flats on the balls and grooves on the races).
- Humid or wet conditions that cause corrosion and deterioration of the grease by emulsification.

6.8.3 Health Monitoring of the Bearings

We recommend that the user checks the bearing condition using vibration monitoring equipment. Best practice is to take initial readings as a reference and periodically monitor the bearings to detect a deteriorating trend. It will then be possible to plan a bearing change at an appropriate generator set or engine service interval.

6.8.4 Bearing 'Service Life' Expectancy

Bearing manufacturers recognize that the service life of bearings depends on factors that are outside their control. Rather than quote a service life, practicable replacement intervals are 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: If 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 the bearings within 30,000 hours of operation.

If in doubt regarding any aspect of bearing life of a STAMFORD® alternator, contact the nearest authorized supplier of the alternator or STAMFORD® or AvK® customer services www.stamford-avk.com.

6.8.5 Standby Applications

Run alternators in standby applications at no load for a minimum of 10 minutes every week. For alternators fitted with regreasable bearings, re-grease the bearings every 6 months, regardless of the number of accumulated running hours.

7 Installation into the Generator Set

7.1 Generator Set Coupling

⚠ WARNING

Coupling an Alternator

Moving mechanical parts during coupling can cause serious injury by crushing, severing or trapping. When coupling the alternator to a prime-mover or when installing large components, to prevent injury:

- *Personnel must keep limbs and body parts away from coupling surfaces during coupling and/or installing operations.*

NOTICE

Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and will be damaged.

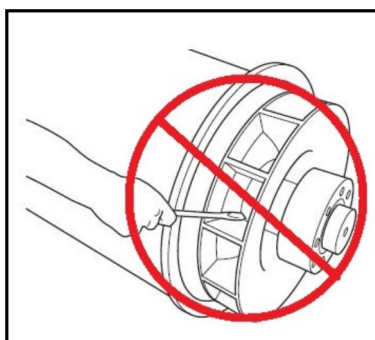


FIGURE 11. DO NOT ROTATE WITH A LEVER

Efficient operation and long component life depend on minimizing mechanical stresses on the alternator. When coupled in a generator set, misalignment and vibration interactions with the prime mover engine can cause mechanical stress.

Generator sets need a substantial, flat, continuous bedplate to suit the installation site floor loading, with engine and alternator mounting pads to make a firm base for accurate alignment. The height of all mounting pads must be within 0.25 mm for skid mounting, 3 mm for non-adjustable anti-vibration mounts (AVM), or 10 mm for adjustable height AVMs. Use shims to achieve level. The rotational axes of the alternator rotor and engine output shaft must be coaxial (radial alignment) and perpendicular to the same plane (angular alignment). The axial alignment of the alternator and engine coupling must be within 0.5 mm, to allow for thermal expansion without unwanted axial force on the bearings at operating temperature.

Vibration can occur by flexing of the coupling. The alternator is designed for a maximum bending moment not exceeding 140 kgm (1000 lbs-ft). Check the maximum bending moment of the engine flange with the engine manufacturer.

Close-coupling of alternator and engine can increase the rigidity of the generator set. Both single and two bearing alternators can be close-coupled. The generator set builder must supply guarding for open-coupled applications.

To prevent rust during transit and storage, the alternator frame spigot, rotor coupling plates, and shaft extension have been treated with a rust preventative coating. Remove this before coupling the generator set.

(a) To prevent the rotor moving during transport, a drive end (DE) transit bracket is fitted. Before coupling the generator set: Remove the DE transit bracket and fasteners from the DE bracket.

(b) To prevent the rotor moving during transport, a non-drive end (NDE) transit plate is fitted. Before coupling the generator set: Remove the non PMG cover to access the NDE transit plate. Remove the NDE transit plate and fasteners. Refit the non PMG cover.

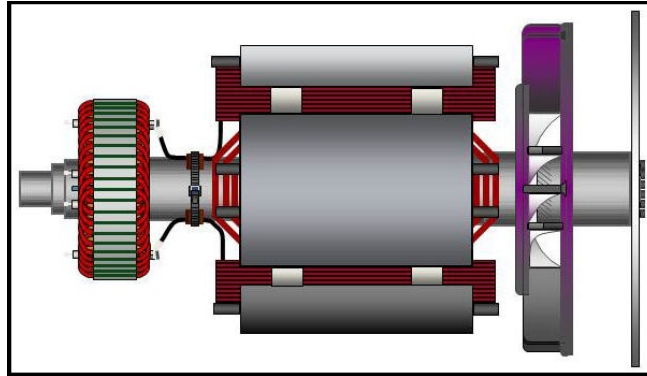


FIGURE 12. SINGLE BEARING ALTERNATOR ROTOR SHOWING COUPLING DISCS BOLTED TO DRIVE END COUPLING HUB (AT RIGHT)

7.1.1 Single Bearing

DANGER

Falling Mechanical Parts

Falling mechanical parts can cause serious injury or death by impact, crushing, severing or trapping. To prevent injury or death and before lifting:

- ***Check the capacity, condition and attachment of lifting equipment.***
- ***Check the capacity, condition and attachment of accessories for lifting.***
- ***Check the capacity, condition and attachment of lifting point(s) on the load.***
- ***Check the mass, integrity and stability of the load.***
- ***If available: Install drive end and non-drive end transit fittings to prevent movement and damage to bearings.***
- ***Keep the alternator horizontal when lifting.***
- ***Do not use alternator lifting points for lifting a complete generator set.***
- ***Do not use cooler lifting points for lifting the alternator or a complete generator set.***
- ***Do not remove the lifting label attached to one of the lifting points.***

1. If supplied, check that the bracket which supports the rotor underneath the fan hub is fitted in position.
2. Position the alternator close to the engine and remove the drive end transit bracket that keeps the rotor in place during transport.
3. Remove the air outlet covers from the drive end of the alternator to access the coupling and adaptor bolts.
4. If required, tighten the coupling disc bolts to the specified torque in the **S2 and S3 Parts and Fasteners** table and follow the sequence shown in the image below.

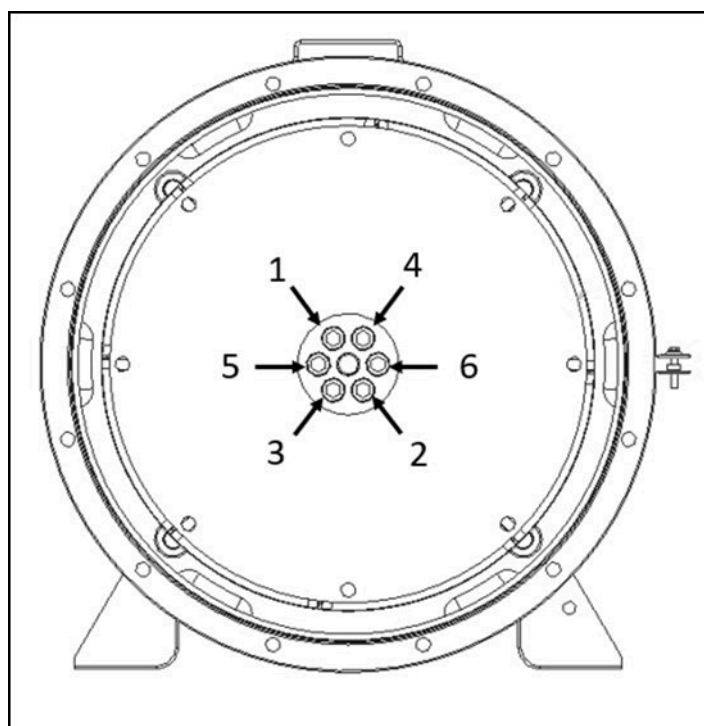


FIGURE 13. FIXING SEQUENCE TO HUB

5. Check the torque of bolts that fasten the coupling discs to the DE coupling hub in a clockwise direction around the bolt circle.
6. Make sure the coupling discs are concentric with the adaptor spigot. Use alignment studs to ensure that the disc and the flywheel are in alignment.
7. Make sure the axial distance from the coupling mating face on the flywheel to the mating face on the flywheel housing is within 0.5mm of nominal dimension. This ensures that the engine crankshaft float is maintained, and the alternator rotor position is neutral, allowing for thermal expansion. There is no axial pre-load thrust on the engine or alternator bearings.
8. Offer the alternator to the engine and engage coupling discs and housing spigots at the same time, pushing the alternator towards the engine until the coupling discs are against the flywheel face and the housing spigots are located.

NOTICE

Do not pull the alternator to the engine using bolts through the flexible discs.

NOTICE

Failure to secure bolts can lead to excessive vibration, which in turn can lead to catastrophic alternator failure.

9. Fit heavy gauge washers under the heads of housing and coupling bolts. Screw in the bolts evenly around the coupling assembly to maintain correct alignment.
10. Tighten the bolts to fix the coupling disc to the flywheel, follow the sequence shown in the image below.

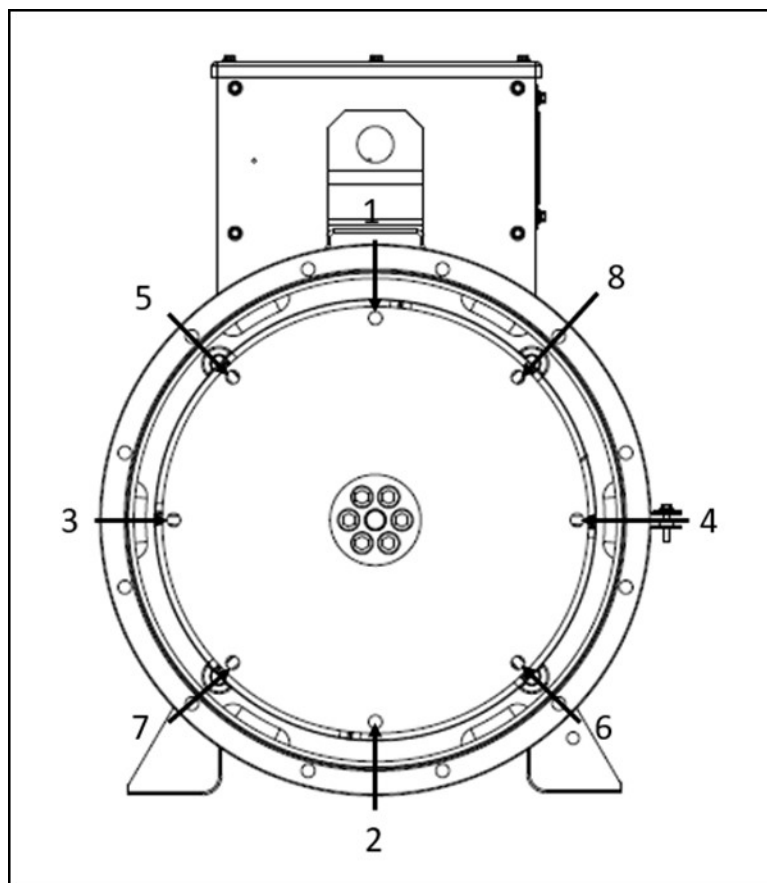


FIGURE 14. FIXING SEQUENCE TO FLYWHEEL

11. Check the torque of each bolt in a clockwise direction around the bolt circle to ensure all the bolts are tight. Refer to the engine manufacturer's manual for correct tightening torque.
12. Replace all covers.

NOTICE

1. To avoid damaging the coupling assembly due to incorrect mounting or misalignment. Correctly locate the alternator AVM mounts on the skid frame and secure.
2. Fit and hand tighten the AVM studs to the engine foot to allow movement during engine and alternator coupling.
3. Lower the engine into position on the AVM mounts following an approved process and secure by hand.
4. Lower the alternator into position and couple the DE to the engine using an approved process, Secure the foot by hand tightening the AVM securing fixings.
5. Settle both the engine and alternator into the new mountings position by horizontally rocking the newly assembled alternator and engine.
6. Fully tighten the Engine and alternator AVM bolts to the correct torque.
7. Engage the AVM plate to the skid bolts in the slot and apply the correct torque.

7.2 Pre-Running Checks

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

7.3 Direction of Rotation

The fan is designed for clockwise rotation, as viewed from the drive end of the alternator (unless otherwise specified when ordered). If the alternator must run counter-clockwise, speak to STAMFORD® or AvK® customer services www.stamford-avk.com.

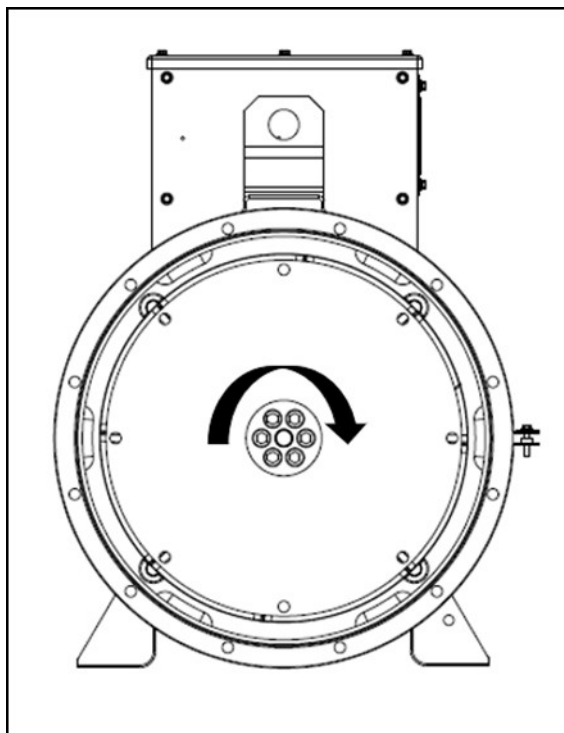


FIGURE 15. DIRECTION OF ROTATION

7.4 Phase Rotation

Main stator output is connected for a phase sequence of U V W when the alternator runs clockwise, as viewed from the drive end. If the phase rotation must be reversed, the customer must re-connect the output cables in the terminal box. STAMFORD® or AvK® customer services www.stamford-avk.com for a circuit diagram of 'reverse phase connections'.

7.5 Voltage and Frequency

Check that the voltage and frequency shown on the alternator rating plate meet the requirements of the generator set application. Refer to detailed instructions in the AVR manual for adjustments.

7.6 AVR Settings

The AVR is factory set for initial running tests. Check that the AVR settings are compatible with your required output. Refer to detailed instructions in the AVR manual for on- and off-load adjustments.

7.7 Electrical Connections

WARNING

Incorrect Electrical Installation and System Protection

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- ***Have completed related, applicable and approved training.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know related hazards / risks.***
- ***Know and obey site / location specific emergency procedures and applicable laws and regulations.***

NOTICE

The terminal box is designed to support the fitted busbars or terminals, transformers, load cables and auxiliary terminal box. Additional mass could cause excessive vibration and lead to failure of the terminal box enclosure and mounting. Speak to STAMFORD® or AvK® customer services www.stamford-avk.com before fixing any additional mass to the terminal box. Panels must be removed to be drilled or cut, to prevent swarf entering the terminal box or alternator.

NOTICE

AVR Position Change:

If you need technical assistance to change the position of the AVR speak to STAMFORD® or AvK® customer services www.stamford-avk.com.

When carrying out modifications to the position of the AVR:

- **Ensure adequate clearance between the main stator lead and the AVR mounting bracket (minimum 28mm).**
- **Observe all points from the Safety Precautions chapter.**
- **Service and maintenance procedures must only be carried out by experienced and qualified personnel, who are familiar with the procedures and the equipment.**

Fault current curves and alternator reactance values are available on request from the factory so that the system designer can calculate the necessary fault protection and/or discrimination.

The installer must check that the alternator frame is bonded to the generator set bedplate, and must bond to site earth. If anti-vibration mounts are fitted between the alternator frame and its bedplate, a suitably-rated earth conductor must bridge across the anti-vibration mount.

Refer to wiring diagrams for electrical connection of the load cables. Electrical connections are made in the terminal box. Route single core cables through the insulated or non-magnetic gland plates supplied. Panels must be removed to be drilled or cut to prevent swarf entering the terminal box or alternator. After wiring, inspect the terminal box, remove all debris using a vacuum cleaner if necessary and check that no internal components are damaged or disturbed.

As standard, the alternator neutral is not bonded to the alternator frame. If required, neutral may be connected to the earth terminal in the terminal box, by a conductor of at least one half of the sectional area of a phase lead.

Load cables must be supported appropriately to avoid a tight radius at the point of entry into the terminal box, clamped at the terminal box gland, and allow at least ± 25 mm movement by the alternator on its anti-vibration mountings, without causing excessive stress to the cables and alternator load terminals.

The palm (flattened part) of load cable lugs must be clamped in direct contact with the main stator load output terminals so that the whole palm area conducts the output current. Refer to the table, **Parts and Fasteners** for the main terminal lug torque value.

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8 Service and Maintenance

8.1 Recommended Service Schedule

Refer to: Safety Precautions in [Chapter 2 on page 3](#) before starting any service and maintenance activity.

Refer to: Parts Identification in [Chapter 9 on page 57](#) for an exploded view of components and fastener information.

The recommended service schedule shows the recommended service activities in table rows, grouped by alternator subsystem. Columns of the table show the types of service activity, whether the alternator must be running, and the service levels. Service frequency is given in running hours or time interval, whichever is sooner. A cross (X) in the cells where a row intersects the columns shows a service activity type and when it is required. An asterisk (*) shows a service activity done only when necessary.

All service levels in the recommended service schedule can be purchased directly from STAMFORD® or AvK® customer services www.stamford-avk.com.

1. Proper service and repair are vital to the reliable operation of your alternator and the safety of anyone coming into contact with the alternator.
2. These service activities are intended to maximize the life of the alternator but shall not vary, extend or change the terms of the manufacturer's standard warranty or your obligations in that warranty.
3. Each service interval is a guide only, and developed on the basis that the alternator was installed and is operated in accordance with the manufacturer's guidelines. If the alternator is located and/or operated in adverse or unusual environmental conditions, the service intervals may need to be more frequent. The alternator should be continually monitored between services to identify any potential failure modes, signs of misuse, or excessive wear and tear.

TABLE 8. ALTERNATOR SERVICE SCHEDULE

System	SERVICE ACTIVITY	Alternator running	TYPE				SERVICE LEVEL								
	X = required * = if necessary		Inspect	Test	Clean	Replace	Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Alternator	Alternator rating		X				X								
	Bedplate arrangement		X				X								
	Coupling arrangement		X				X					*		X	
	Environmental conditions and cleanliness		X				X	X		X		X		X	
	Ambient temperature (inside & outside)			X			X	X		X		X		X	
	Complete machine - damage, loose parts & earth bonds		X				X	X		X		X		X	
	Guards, screens, warning and safety labels		X				X	X		X		X		X	
	Maintenance access		X				X								
	Electrical nominal operating conditions & excitation	X		X			X	X		X		X		X	
	Vibration	X		X			X	X		X		X		X	
Windings	Condition of windings		X				X	X		X		X		X	
	Insulation resistance of all windings (PI test for MV/HV)			X			X	*		*		X		X	
	Insulation resistance of rotor, exciter and AUX			X				X		X					
Bearings	Condition of bearings		X				X							X	
	Sealed bearing(s)		X					every 4000 to 4500 hours							
	Sealed bearing(s)					X					*		X		
Terminal Box	All alternator/customer connections and cabling		X				X	X		X		X		X	

System	SERVICE ACTIVITY	Alternator running	TYPE				SERVICE LEVEL								
	X = required * = if necessary		Inspect	Test	Clean	Replace	Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Controls & Auxiliaries	Initial AVR set up	X		X			X								
	AVR settings	X		X				X		X		X		X	
	Customer connection of auxiliaries			X			X			X		X		X	
	Function of auxiliaries			X			X	X		X		X		X	
	Anti condensation heater					X						*		X	
Rectifier	Diodes and varistors		X				X	X		X		X			
	Diodes and varistors					X								X	
Cooling	Air inlet temperature	X		X			X	X		X		X		X	
	Air flow (rate & direction)	X	X				X								
	Condition of fan		X				X	X		X		X		X	

8.2 Bearings

8.2.1 Introduction

NOTICE

Store removed parts and tools in static- and dust-free conditions, to prevent damage or contamination.

A bearing is damaged by the axial force needed to remove it from the rotor shaft. Do not reuse a bearing.

A bearing is damaged if the insertion force is applied through the bearing balls. Do not press fit the outer race by force on the inner race, or vice versa.

Do not try to turn the rotor by levering against the cooling fan vanes. The fan will be damaged.

The alternator rotor is supported by a bearing at the non-drive end (NDE) and a coupling to the prime mover at the drive end (DE).

- Refer to guidelines for bearings in the alternator applications ([Section 6.8 on page 27](#)) and storage ([Section 5.4](#)) sections of this manual.
- Inspect the bearing according to the recommended service schedule. speak to STAMFORD® or AvK® customer services www.stamford-avk.com if grease has leaked out of the bearing, notifying the bearing type and quantity leaked.
- Replace the bearing according to the recommended service schedule by one of identical type (stamped on the bearing), sourced from the original equipment manufacturer (OEM). Contact STAMFORD® or AvK® customer services www.stamford-avk.com for advice if an exact replacement is not available.

8.2.2 Safety

DANGER

Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing or trapping. To prevent injury:

- **Before operating the alternator:** The rotating coupling between the alternator and prime mover must be covered by a guard or cover.
- **Before attempting service or maintenance tasks or removing covers from rotating parts:** Shut down and isolate the generator set from all energy sources, isolate stored energy and use lock out/tag out safety procedures.

WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- **Avoid contact with hot surfaces.**
- **Always wear the appropriate personal protection equipment, refer to: Safety Precaution Chapter.**
- **Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).**
- **Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.**

WARNING

Exposure to Ejected Debris and Particles

Ejected debris and particles can cause serious injury or death by impact, severing or puncturing. Exposure to mechanically driven release of debris and particles exists in all directions (horizontally and vertically) in the areas surrounding the alternator air outlet(s), air inlets(s) and the open shaft end (also commonly known as the Drive End (DE)). To prevent injury or death:

- **Keep away from the air inlet(s) and air outlet(s) when the alternator is operating.**
- **Do not position operator controls near the air inlet(s) or air outlet(s).**
- **Do not cause overheating by running the alternator outside rating plate parameters.**
- **Do not overload the alternator.**
- **Do not operate an alternator displaying excessive vibration.**
- **Do not synchronize parallel alternators outside the specified parameters.**

⚠ CAUTION**Hazardous Substances**

Hazardous substances can cause minor or moderate injury. Prolonged or repetitive exposure to hazardous substances can cause serious medical conditions. To prevent injury:

- *Always read and obey the instructions provided by the product manufacturer.*
- *Use, handle and store substances as specified by the product manufacturer.*
- *Always wear appropriate personal protective equipment, refer to Safety Precautions Chapter.*

8.3 Controls

8.3.1 Introduction

An operating alternator is a harsh environment for control components. Heat and vibration can cause electrical connections to loosen and cables to fail. Routine inspection and test can identify an issue before it becomes a failure that incurs unplanned downtime.

8.3.2 Safety

⚠ DANGER**Live Electrical Conductors**

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- *Shut down and isolate the alternator from all energy sources.*
- *Remove or isolate stored energy.*
- *Test isolated parts for electrical isolation using a suitable voltage tester.*
- *Use lock out/tag out safety procedures.*

⚠ WARNING**Hot Surfaces and Fire**

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- *Avoid contact with hot surfaces.*
- *Always wear the appropriate personal protection equipment, refer to: Safety Precaution Chapter.*
- *Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).*
- *Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.*

⚠ WARNING***Incorrect Electrical Installation and System Protection***

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- ***Have completed related, applicable and approved training.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know related hazards / risks.***
- ***Know and obey site / location specific emergency procedures and applicable laws and regulations.***

8.3.3 Connection Test Requirements

TABLE 9. CONNECTION TEST REQUIREMENTS

Requirements	Description
Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	• None
Parts	• None
Tools	• Insulation test meter • Multimeter • Torque wrench

8.3.4 Inspect and Test

1. Remove the terminal box lid.
2. Check the tightness of fasteners securing the load cables.
3. Check that cables are firmly clamped at the terminal box gland, and allow ± 25 mm movement by an alternator on anti-vibration mounts.
4. Check that all cables are anchored and unstressed within the terminal box.
5. Check all cables for signs of damage.
6. Check that AVR accessories and current transformers are correctly fitted, and cables pass centrally through current transformers (if fitted).
7. If an anti-condensation heater is fitted:
 - a. Isolate the supply and measure the electrical resistance of the heater element(s). Replace the heater element if open circuit.
 - b. Connect together both ends of the heater leads.
 - c. Apply the test voltage between the winding and earth.
 - d. Measure the insulation resistance after 1 minute (IR 1min).
 - e. Discharge the test voltage.
 - f. If the measured insulation resistance is less than the minimum acceptable level, replace the heater element. Refer to: [Table 10 on page 43](#) for values.

8. Test the supply voltage to the anti-condensation heater at the heater connection box. 120 VAC or 240 VAC. (depending on cartridge option and shown on a label) should be present when the alternator is stopped.
9. Check that the AVR and AVR accessories fitted in the terminal box are clean, securely fitted on anti-vibration mounts, and the cable connectors are firmly attached to the terminals.
10. For parallel operation, check that the synchronization control cables are securely connected.
11. Refit and secure the terminal box lid.

TABLE 10. TEST VOLTAGE AND MINIMUM ACCEPTABLE INSULATION RESISTANCE FOR NEW AND IN-SERVICE ANTI-CONDENSATION HEATERS

Component	Test Voltage (V)	Minimum Insulation Resistance at 1 minute (MΩ)	
		New	In-service
Anti-condensation heater	500	10	1

8.4 Cooling System

8.4.1 Introduction

NOTICE

The values below are cumulative dependent on environmental conditions. Efficient cooling depends on maintaining the condition of the cooling fan, air filters and gaskets.

The alternators are designed to meet standards supporting EU Directives and UK Statutory Instruments, and are rated for the effect of operating temperature on winding insulation.

BS EN 60085 (≡ IEC 60085) Electrical insulation – Thermal Evaluation and Designation classifies insulation by the maximum operating temperature for a reasonable service life. Although chemical contamination and electrical and mechanical stresses also contribute, temperature is the dominant aging factor. Fan cooling maintains a stable operating temperature below the insulation class limit.

If the operating environment differs from the values shown on the rating plate, rated output must be reduced by

- 3% for class H Insulation for every 5 °C that the temperature of the ambient air entering the cooling fan exceeds 40 °C, up to a maximum of 60 °C.
- 3% for every 500 m increase in altitude above 1000 m, up to 4000 m, due to the reduced thermal capacity of lower density air, and
- 5% if air filters are fitted, due to restricted air flow.

8.4.2 Safety

DANGER

Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing or trapping. To prevent injury:

- *Before operating the alternator: The rotating coupling between the alternator and prime mover must be covered by a guard or cover.*
- *Before attempting service or maintenance tasks or removing covers from rotating parts: Shut down and isolate the generator set from all energy sources, isolate stored energy and use lock out/tag out safety procedures.*

WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- *Avoid contact with hot surfaces.*
- *Always wear the appropriate personal protection equipment, refer to: Safety Precaution Chapter.*
- *Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).*
- *Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.*

CAUTION

Dust & Airborne Particles/Fumes

Dust and other airborne particles and fumes can cause minor or moderate injury by irritating the lungs and eyes. Prolonged or repetitive exposure can cause serious medical conditions. To prevent injury:

- *Use mechanical vacuum extraction to remove dust and airborne particles or fumes.*
- *Ventilate the area fully.*
- *Always wear the appropriate personal protective equipment. Refer to Safety Precautions Chapter.*

NOTICE

Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and will be damaged.

NOTICE

Filters are designed to remove dust, not moisture. Wet filter elements can cause reduced air flow and overheating. Do not allow filter elements to get wet.

8.4.3 Requirements

The following requirements must be observed.

TABLE 11. COOLING SYSTEM TEST REQUIREMENTS

Requirement	Description
Personal Protective Equipment (PPE)	Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
	Wear eye protection
	Wear respiratory protection
Consumables	Lint-free cleaning cloths
	Thin disposable gloves
Parts	None
Tools	None

8.4.4 Inspect and Clean

1. Remove the DE adapter screen.
2. Inspect the fan for damaged vanes and cracks.
3. Re-install the DE adapter screen.
4. Reinstall the generator set for running.
5. Make sure the air inlets and outlets are not blocked.

8.5 Coupling

8.5.1 Introduction

Efficient operation and long component life rely on minimizing mechanical stresses on the alternator. When coupled in a generator set, misalignment and vibration interactions with the prime mover engine can cause mechanical stress.

The rotational axes of alternator rotor and engine output shaft must be coaxial (radial and angular alignment).

Torsional vibration can cause damage to internal combustion engine shaft-driven systems, if not controlled. The generator set manufacturer is responsible for assessing the effect of torsional vibration on the alternator: Rotor dimensions and inertia, and coupling details are available on request.

8.5.2 Safety

NOTICE

Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and will be damaged.

WARNING

Coupling an Alternator

Moving mechanical parts during coupling can cause serious injury by crushing, severing or trapping. When coupling the alternator to a prime-mover or when installing large components, to prevent injury:

- ***Personnel must keep limbs and body parts away from coupling surfaces during coupling and/or installing operations.***

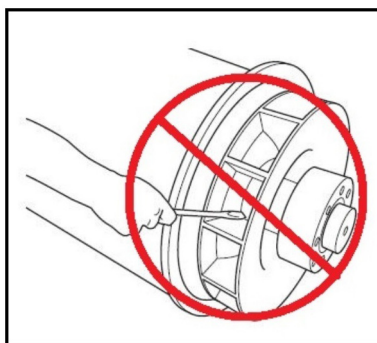


FIGURE 16. DO NOT ROTATE THE ALTERNATOR ROTOR WITH A LEVER

8.5.3 Coupling Test Requirements

TABLE 12. COUPLING TEST REQUIREMENTS

Requirements	Description
Personal Protective Equipment (PPE)	Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	None
Parts	None
Tools	- Dial gauge - Torque wrench

8.5.4 Inspect Mounting Points

1. Check the generator set bedplate and mounting pads are in good condition, not cracked.
2. Check that rubber in anti-vibration mounts has not perished.
3. Check vibration monitoring historical records for a trend of increasing vibration.

8.5.4.1 Single Bearing Coupling

1. Remove the DE adapter screen and cover to access the coupling.
2. Check that the coupling discs are not damaged, cracked or distorted, and the coupling disc holes are not elongated. If any are damaged, replace the complete set of discs.
3. Check tightness of bolts fixing the coupling discs to the engine flywheel. Tighten in the sequence shown for alternator coupling in the Installation chapter, to the torque recommended by the engine manufacturer.
4. Replace the DE adapter screen.

8.6 Rectifier System

8.6.1 Introduction

The rectifier converts alternating current (AC) induced in the exciter rotor windings into direct current (DC) to magnetize the main rotor poles. The rectifier comprises two semi-circular annular positive and negative plates, each with three diodes. In addition to connecting to the main rotor, the DC output of the rectifier also connects to a varistor. The varistor protects the rectifier from voltage spikes and surge voltages that may be present on the rotor under various loading conditions of the alternator.

Diodes provide a low resistance to current in one direction only: Positive current will flow from anode to cathode, or another way of viewing it is that negative current will flow from cathode to anode.

The exciter rotor windings are connected to 3 diode anodes to form the positive plate and to 3 diode cathodes to form the negative plate to give full wave rectification from AC to DC. The rectifier is mounted on and rotates with the exciter rotor, facing the non-drive end (NDE) with solder diode connections or facing the drive end (DE) using nuts.

8.6.2 Safety

DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- **Shut down and isolate the alternator from all energy sources.**
- **Remove or isolate stored energy.**
- **Test isolated parts for electrical isolation using a suitable voltage tester.**
- **Use lock out/tag out safety procedures.**

DANGER

Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing or trapping. To prevent injury:

- **Before operating the alternator: The rotating coupling between the alternator and prime mover must be covered by a guard or cover.**
- **Before attempting service or maintenance tasks or removing covers from rotating parts: Shut down and isolate the generator set from all energy sources, isolate stored energy and use lock out/tag out safety procedures.**

WARNING

Incorrect Electrical Installation and System Protection

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- **Have completed related, applicable and approved training.**
- **Know the equipment, understand the task(s) and procedure(s).**
- **Know related hazards / risks.**
- **Know and obey site / location specific emergency procedures and applicable laws and regulations.**

8.6.3 Requirements

TABLE 13. RECTIFIER SYSTEM: TEST AND REPLACE COMPONENT REQUIREMENTS

Personal Protective Equipment (PPE)	Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	Dow Corning silicone heat sink compound type 340 or similar
	Solder (For NDE Facing Rectifier)
	Solder remover wick (If Required)

Parts	Full set of three anode lead diodes and three cathode lead diodes (all from the same manufacturer)
	One varistor
Tools	Multimeter
	Insulation tester
	Torque wrench
	Soldering gun (If Required)

8.6.4 Test and Replace Varistor

1. Inspect the varistor.
2. Record varistor as faulty if there are signs of overheating (discoloration, blisters, melting) or disintegration.
3. Disconnect one varistor lead. Store fastener and washers.
4. Measure the resistance across the varistor. Good varistors have a resistance greater than 100 MΩ.
5. Record the varistor as faulty if the resistance is short circuit or open circuit in either direction. (Some multi-meters will read O.L. at high resistance levels. Be aware of the limits of tools).
6. If the varistor is faulty, replace it and replace all diodes.
7. Reconnect and check that all leads are secure, washers fitted and fasteners tight.

8.6.5 Test and Replace Diodes

WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- **Avoid contact with hot surfaces.**
- **Always wear the appropriate personal protection equipment, refer to: Safety Precaution Chapter.**
- **Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).**
- **Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.**

NOTICE

Do not tighten a diode above the stated torque. The diode will be damaged.

NOTICE

S2 C, D and E cores, the diodes are accessible from the NDE side of the exciter rotor and require soldering to remove or replace.

NOTICE

Make sure no solder falls onto any component of the alternator.

1. Using a soldering gun and solder wick, remove the solder that connects the exciter rotor lead to one diode or disconnect the lead of one diode where it joins the winding insulated terminal post and store the fastener and washer (Use the appropriate method).
2. Measure the voltage drop across the diode in the forward direction, using the diode test function of a Multimeter.
3. Measure the resistance across the diode in the reverse direction, using the 1000 VDC test voltage of an insulation tester.
4. Diode is faulty if the voltage drop in the forward direction is outside the range 0.3 to 0.9 V, or the resistance is below 20 MΩ in the reverse direction.
5. Repeat the tests for the five remaining diodes.
6. If any diode is faulty, replace the full set of six diodes with new (same type, same manufacturer):
 - a. Remove diode(s).
 - b. Apply a small amount of heat sink compound **only** to the base of the replacement diode(s), not the threads.
 - c. Check polarity of diode(s).
 - d. Screw each replacement diode into a threaded hole in the rectifier plate.
 - e. Apply 2.0 to 2.25 Nm (18 to 20 in-lb) torque to give good mechanical, electrical and thermal contact.
 - f. Replace the varistor.

NOTICE

Make sure no solder falls onto any component of the alternator.

7. Using a solder gun and solder, reconnect and check that all six leads are secure and correctly soldered, or the nuts and washers are fitted and correctly torqued (Use the appropriate method).

8.7 Windings

8.7.1 Introduction

NOTICE

Disconnect all control wiring and customer load leads from alternator winding connections before conducting these tests.

NOTICE

The Automatic Voltage Regulator (AVR) contains electronic components which would be damaged by high voltage applied during insulation resistance tests. The AVR must be disconnected before doing any insulation resistance test. Temperature sensors must be grounded to earth before doing any insulation resistance test.

Damp or dirty windings have a lower electrical resistance and could be damaged by insulation resistance tests at high voltage. If in doubt, test the resistance at low voltage (500 V) first.

Alternator performance depends on good electrical insulation of the windings. Electrical, mechanical and thermal stresses, and chemical and environmental contamination, cause the insulation to degrade. Various diagnostic tests indicate the condition of insulation by charging or discharging a test voltage on isolated windings, measuring current flow, and calculating the electrical resistance by Ohm's law.

When a DC test voltage is first applied, three currents can flow:

- **Capacitive Current:** To charge the winding to the test voltage (decays to zero in seconds),
- **Polarizing Current:** To align the insulation molecules to the applied electric field (decays to near-zero in ten minutes), and
- **Leakage Current:** Discharge to earth where the insulation resistance is lowered by moisture and contamination (increases to a constant in seconds).

For an insulation resistance test, a single measurement is made one minute after a DC test voltage is applied, when capacitive current has ended. For the polarization index test, a second measurement is made after ten minutes. An acceptable result is where the second insulation resistance measurement is at least double the first, because the polarization current has decayed. In poor insulation, where leakage current dominates, the two values are similar. A dedicated Insulation Tester takes accurate, reliable measurements and may automate some tests.

8.7.2 Safety

DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- **Shut down and isolate the alternator from all energy sources.**
- **Remove or isolate stored energy.**
- **Test isolated parts for electrical isolation using a suitable voltage tester.**
- **Use lock out/tag out safety procedures.**

DANGER

Testing Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before testing on or near live electrical conductors:

- **Take applicable precautions to prevent contact with live conductors, refer to: Safety Precautions Chapter.**
- **Test on or near live conductors, only if absolutely necessary.**
- **Only trained personnel may test on or near live electrical conductors.**
- **Do not test on or near live electrical conductors alone: Another competent person must be present, trained to isolate energy sources and take action in an emergency.**

⚠ WARNING**Condensed Water**

Operating an alternator with condensed water in the windings can cause serious injury by electric shock, burns or exposure to flying debris and particles. To prevent injury and before operating the alternator:

- *Use anti-condensation heaters (if fitted) to prevent condensation accumulating.*
- *Check for condensed water.*
- *If condensed water is present, drain/remove the water, dry and inspect the alternator, refer to: Maintenance and Servicing Chapter.*

⚠ WARNING**Exposure to Particles and Fumes from an Alternator.**

Particles and fumes can be released in all directions (horizontally and vertically) from where alternator ventilation is installed. To avoid or injury:

- *Avoid the areas around ventilation openings, air intake(s) and air outlet(s) when the alternator is operating.*
- *Use the correct personal protective equipment when working around an alternator.*

⚠ WARNING**Live Electrical Conductors**

Live electrical conductors at the winding terminals can cause serious injury or death by electric shock or burns. After an insulation resistance test, to prevent injury or death:

- *Discharge the windings immediately after the test has concluded by shorting to a suitable earth. The windings must discharge for the greater of:*
 1. *A length of time equal to the duration of the test.*
 - or
 2. *5 minutes.*

⚠ WARNING**Incorrect Electrical Installation and System Protection**

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- *Have completed related, applicable and approved training.*
- *Know the equipment, understand the task(s) and procedure(s).*
- *Know related hazards / risks.*
- *Know and obey site / location specific emergency procedures and applicable laws and regulations.*

8.7.3 Requirements

TABLE 14. WINDING TEST REQUIREMENTS

Requirement	Description
Personal Protective Equipment (PPE)	Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	None
Parts	None
Tools	- Insulation test meter - Multimeter - Milliohm meter or microohm meter - Clamp ammeter - Infrared thermometer - Earth rod

8.7.4 Test the Electrical Resistance of Windings

1. Stop the alternator.
2. Verify the electrical resistance of the exciter field (stator) winding:
 - a. Disconnect the exciter field leads F1 and F2 from the AVR.
 - b. Measure and record the electrical resistance between F1 and F2 leads with a multimeter.
 - c. Reconnect the exciter field leads F1 and F2.
 - d. Make sure the fasteners are secure.
3. Verify the electrical resistance of the exciter armature (rotor) winding:
 - a. Mark the leads attached to diodes on one of the two rectifier plates.
 - b. Disconnect all exciter rotor leads from all diodes at the rectifier.
 - c. Measure and record the electrical resistance between pairs of marked leads (between phase windings). A specialist micro ohmmeter must be used.
 - d. Reconnect all exciter rotor leads to the diodes.
 - e. Make sure the fasteners are secure.
4. Verify the electrical resistance of the main field (rotor) winding:
 - a. Disconnect the two main rotor DC leads from the rectifier plates.
 - b. Measure and record the electrical resistance between the main rotor leads. A specialist micro ohmmeter must be used.
 - c. Reconnect the two main rotor DC leads to the rectifier plates.
 - d. Make sure the fasteners are secure.
5. Verify the electrical resistance of the main armature (stator) winding:
 - a. Disconnect the leads of the main stator from the output terminals.
 - b. Measure and record the electrical resistance between U1 and U2 leads and between U5 and U6 (if present). A specialist micro ohmmeter must be used.

- c. Measure and record the electrical resistance between V1 and V2 leads and between V5 and V6 (if present). A specialist micro ohmmeter must be used.
 - d. Measure and record the electrical resistance between W1 and W2 leads and between W5 and W6 (if present). A specialist micro ohmmeter must be used.
 - e. Reconnect the leads to the output terminals, as before.
 - f. Make sure the fasteners are secure.
6. Verify the electrical resistance of the PMG armature (stator) winding, if fitted:
 - a. Disconnect the three PMG output leads P2, P3 and P4 from the AVR.
 - b. Measure and record the electrical resistance between pairs of the PMG output leads, with a multimeter.
 - c. Reconnect the three PMG output leads P2, P3 and P4 to the AVR.
 - d. Make sure the fasteners are secure.
 7. Refer to the Technical Data ([Chapter 10 on page 59](#)) to verify the measured resistances of all windings agree with the reference values.

8.7.5 Test the Insulation Resistance of Windings

NOTICE

The alternator must not be put into service until the minimum insulation resistance is achieved.

TABLE 15. TEST VOLTAGE AND MINIMUM ACCEPTABLE INSULATION RESISTANCE FOR NEW AND IN-SERVICE ALTERNATORS

Part	Test Voltage (V)	Minimum Insulation Resistance at 1 Minute (MΩ)	
		New	In-Service
Main Stator	500	10	5
PMG Stator	500	5	3
Exciter Stator	500	10	5
Exciter Rotor, Rectifier & Main Rotor Combined	500	10	5

1. Inspect the windings for mechanical damage or discoloration from overheating. Clean the insulation if there is hygroscopic dust and dirt contamination.
2. For main stators:
 - a. Disconnect the neutral to earth conductor (if fitted).
 - b. Connect together the three leads of all phase windings (if possible) or do the test at individual lead ends.
 - c. Apply the test voltage from the table between any phase lead and earth.
 - d. Measure the insulation resistance after 1 minute (IR_{1min}).
 - e. Discharge the test voltage with an earth rod for five minutes.
 - f. If the measured insulation resistance is less than the minimum acceptable value, dry the insulation, then repeat the method.
 - g. Reconnect neutral to earth conductor (if fitted).

3. For PMG and exciter stators, and combined exciter and main rotors:
 - a. Connect the ends of the winding together (if possible) or do the test at individual lead ends.
 - b. Apply the test voltage from the table between the winding and earth.
 - c. Measure the insulation resistance after 1 minute (IR_{1min}).
 - d. Discharge the test voltage with an earth rod for five minutes.
 - e. If the measured insulation resistance is less than the minimum acceptable value, dry the insulation, then repeat the method.
 - f. Repeat the method for each winding.
 - g. Remove the connections made for testing.

8.7.6 Dry the Insulation

Use the methods below to dry the insulation of the main stator windings. To prevent damage as water vapor is expelled from the insulation, make sure the winding temperature does not increase faster than 5 °C per hour or exceed 90 °C.

Plot the insulation resistance graph to show when drying is complete.

8.7.6.1 Dry with Ambient Air

In many cases, the alternator can be dried sufficiently using its own cooling system. Disconnect the cables from the X+ (F1) and XX- (F2) terminals of the AVR so there is no excitation voltage supply to the exciter stator. Run the generator set in this de-excited state. Air must flow freely through the alternator to remove the moisture. Operate the anti-condensation heater (if fitted) to assist the drying effect of the air flow.

After drying is complete, re-connect the cables between the exciter stator and AVR. If the generator set is not put into service immediately, turn on the anti-condensation heater (if fitted) and retest the insulation resistance before use.

8.7.6.2 Dry with Hot Air

Direct the hot air from one or two 1 to 3 kW electrical fan heaters into the alternator air inlet. Make sure each heat source is at least 300 mm away from the windings to avoid scorching or over-heating damage to the insulation. Air must flow freely through the alternator to remove the moisture.

After drying, remove the fan heaters and re-commission as appropriate.

If the generator set is not put into service immediately, turn on the anti-condensation heaters (where fitted) and retest the insulation resistance before use.

8.7.6.3 Plot IR Graph

Whichever method is used to dry out the alternator, measure the insulation resistance and temperature (if sensors fitted) of the main stator windings every 15 to 30 minutes. Plot a graph of insulation resistance, IR (y axis) against time, t (x axis).

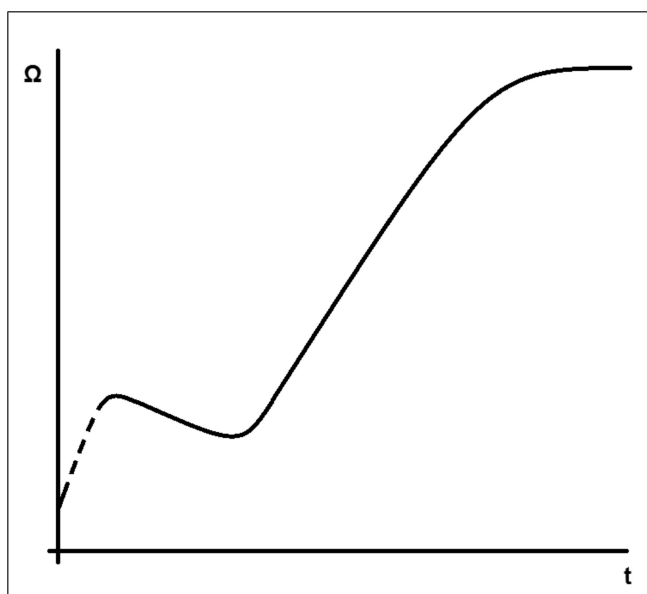


FIGURE 17. INSULATION RESISTANCE GRAPH

A typical curve shows an initial increase in resistance, a fall and then a gradual rise to a steady state. If the windings are only slightly damp the dotted portion of the curve may not appear. Continue drying for another hour after steady state is reached.

NOTICE

The alternator must not be put into service until the minimum insulation resistance is achieved.

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9 Parts Identification

9.1 S2 and S3 Single Bearing Alternator

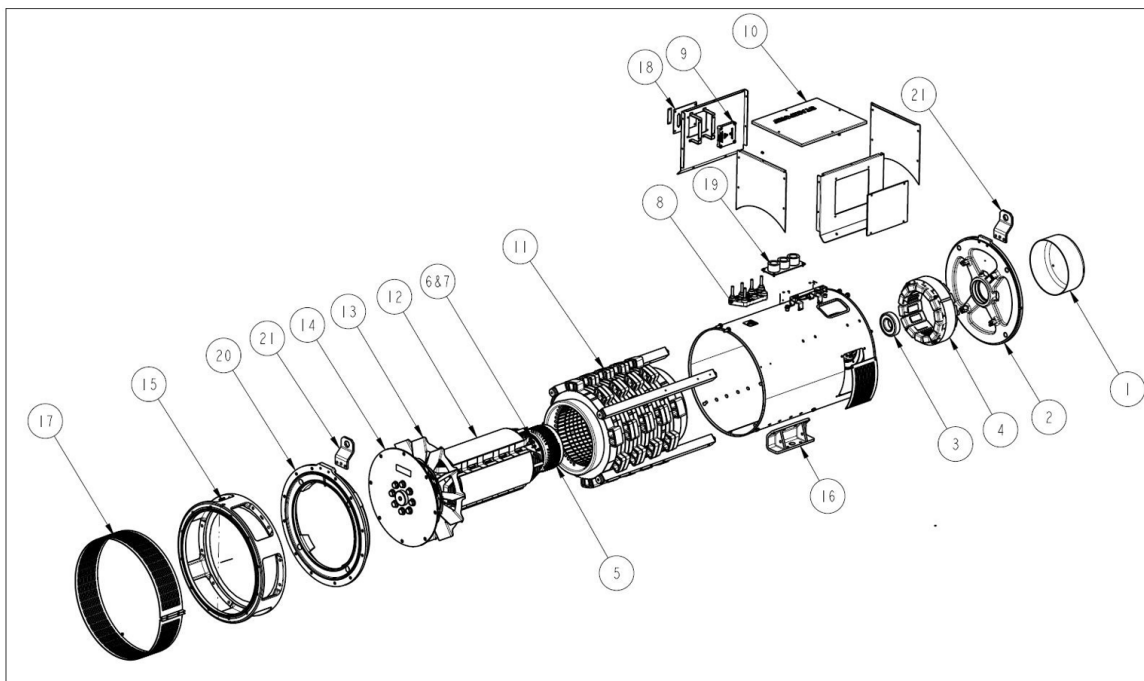


FIGURE 18. S2/S3 SINGLE BEARING ALTERNATOR

9.2 S2 and S3 Parts and Fasteners

TABLE 16. COMPONENTS, FASTENERS AND TORQUE VALUES

Ref	Component	S2			S3		
		Fastener	Qty	Torque Nm	Fastener	Qty	Torque Nm
1	NDE Cover	M6 x 40	4	6	M6 x 40	4	6
2	NDE Bracket	M8 x 25/35	4	28	M10 x 40	4	56
3	NDE Bearing Kit	-	-	-	-	-	-
4	Exciter Stator (Field)	M6	4	10	M6	4	10
5	Exciter Rotor (Armature)	-	-	-	-	-	-
6	Rectifier Assembly	M10 UNF	2	2.8-3.6	M10 UNF	2	2.8-3.6

7	Diode / Varistor	M10 UNF	2	2.8-3.6	M10 UNF	2	2.8-3.6
8	Terminal Board to Frame	M5 / M8	2	6	M8 x 30	2	6
N/A	Terminal Lug to Board	M8	5	15	M10	5	15
9	AVR	AVM	4	-	AVM	4	-
10	Main Terminal Box to Frame	M5 x 25	4	6	M5 x 25	4	6
11	Main Stator (Armature)	-	-	-	-	-	-
12	Main Rotor (Field)	-	-	-	-	-	-
13	Fan	M5 x 16	4	6	M6 x 25	8	6
14	Coupling Disc (Fastener Length as per SAE)	M12	6	150	M16	8	250
15	DE Adaptor	M8 x 35	4	28	M10 x 35	12	56
16	Foot	M8 x 35	6	40	M10 x 35	6	62
17	DE Screen	M6 x 25	2	6	M5 x 25	2	6
18	AVR cover	M5 x 10	4	5	M5 x 10	4	5
19	CT	M5 x 40	4	3	M5 x 40	4	3
20	DE Ring	-	-	-	M10 x 40	4	56
21	Lifting Lug	M10	2	56	M10	2	56

10 Technical Data

NOTICE

Compare measurements with the technical data sheet and the test certificate supplied with the alternator.

10.1 S2 and S3 Winding Resistances

Resistance of windings at 20°C (Measured values should be within 10%)							
Rating 400/415 kVA	Alternator Model	Main Stator (Ohms) Winding 312 Line to Line	Exciter Stator (Ohms)	Exciter Rotor, L-L (Ohms)	Main Rotor (Ohms)	PMG Stator, L-L (Ohms)	Ambient (C)
40	S2L1-C	0.316	17.3	0.197	0.619	-	20
50	S2L1-D	0.244	13.5	0.210	0.682	-	20
62.5	S2L1-E	0.170	14.4	0.229	0.807	-	20
72.5	S2L1-F	0.140	14.2	0.156	0.850	-	20
82.5	S2L1-G	0.114	14.2	0.156	0.902	-	20
100	S3L1-C	0.100	14.2	0.156	1.145	-	20
125	S3L1-D	0.084	14.2	0.156	1.287	-	20
140	S3L1D-E4	0.0528	17.50	0.206	1.415	-	20
160	S3L1D-F4	0.0420	17.50	0.206	1.601	-	20
180	S3L1D-G4	0.0382	17.50	0.206	1.719	-	20
200	S3L1D-H4	0.0296	17.50	0.206	1.921	-	20
230	S3L1D-J4	0.0304	17.50	0.206	2.100	-	20
250	S3L1D-K4	0.0270	17.50	0.206	2.100	-	20

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11 Service Parts and After Sales Service

11.1 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.

11.2 Customer Service

CGT service engineers are experienced professionals, trained extensively to deliver the best support possible. Our global service offers:

- On-site a.c. alternator commissioning
- On-site bearing maintenance & bearing condition monitoring
- On-site insulation integrity checks
- On-site AVR & accessories set-up

For details of your nearest service outlet visit www.stamford-avk.com.

11.3 Recommended Service Parts

In critical applications a set of these service spares should be held with the alternator.

TABLE 17. S2/S3 SERVICE PARTS

	S2	S3
Description	Part Number	Part Number
DM740 AVR	A065W250	A065W250
NDE Bearing Kit	45-0866	45-0868
Anti-Fretting Paste	45-0280	45-0280
Rectifier Service Kit	RSK-1101 (Core C, D and E) RSK-2001 (Core F and G)	RSK-2001
Rectifier Assembly	45-0427 (Core C, D and E) 210-10191 (Core F and G)	210-10191

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12 End of Life Disposal

12.1 General Guidance

When disposing of an alternator, component parts or packaging:

- When processing waste materials obey applicable rules and regulations.
- Process waste in an environmentally responsible manner, reuse, reclaim and/or recycle materials where applicable.
- If necessary, speak to a waste processing company for advice and/or guidance.

12.2 Packaging Material

After the alternator, replacement components or service items have arrived, the packing material must be disposed of.

- Wooden packaging must be recycled. However, wood treated with preservative chemicals must be processed appropriately. **Do not burn chemically treated wood.**
- Plastic packaging must be recycled.
- Paper and cardboard packaging must be recycled.
- Anti-corrosion agents can be removed using a cleaning agent and a cloth. The cloth must be disposed as contaminated waste, refer to [Section 12.4 on page 64](#).
- Desiccants/drying agents must be disposed of as hazardous waste, refer to [Section 12.4 on page 64](#)

12.3 Recyclable Material

Separate items containing recyclable base materials, such as: iron, copper and steel, by removing non-recyclable and/or hazardous materials from alternator components.

- Items containing: iron, steel and copper can now be recycled via specialized material recycling companies.
- Separate the removed material into hazardous waste and non-hazardous waste. Obey applicable rules and regulations.
 - Dispose of any contaminated and/or hazardous materials as hazardous waste, refer to: [Section 12.4 on page 64](#).
 - Non-hazardous materials that cannot be reused, re-purposed or recycled can now be processed as general waste.

12.4 Hazardous or Contaminated Waste

CAUTION

Hazardous Substances

Hazardous substances can cause minor or moderate injury. Prolonged or repetitive exposure to hazardous substances can cause serious medical conditions. To prevent injury:

- ***Always read and obey the instructions provided by the product manufacturer.***
- ***Use, handle and store substances as specified by the product manufacturer.***
- ***Always wear appropriate personal protective equipment, refer to Safety Precautions Chapter.***

Waste materials such as, but not limited to: oil, grease, lubricant, fuel, adhesive, desiccants (drying agents), battery acid, cleaning agent, solvent or corrosive substance, paint, polyester resin and/or plastic residues or articles contaminated with such substances are designated as 'Hazardous Waste' by international regulations.

- Obey applicable rules and regulations when handling, storing, transporting, processing and/or disposing of hazardous waste.
- If necessary, speak to a hazardous waste disposal company for assistance and/or advise in the disposal of hazardous waste or contaminated articles.

