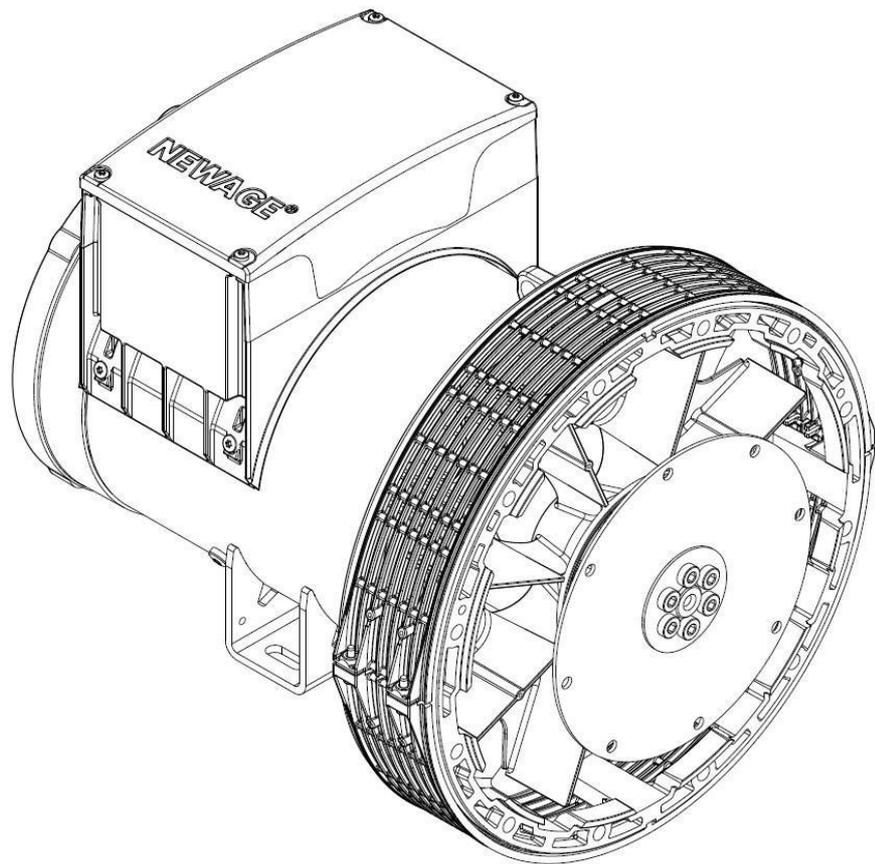


## N10G4, N15G4 and N20G4 Alternators **OWNER MANUAL**



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# 1 Foreword

## The Manual

This manual contains important information for the installation, use, and maintenance of NEWAGE alternators.

The manual was written for skilled electrical, mechanical technicians and engineers with prior knowledge and experience of generating equipment of this type. If in doubt, please seek expert advice or contact your local NEWAGE subsidiary before proceeding with any type of installation or maintenance work.

The manual should be stored in a safe place where it can easily be accessed when required.

The instructions must be followed with respect of the laws/rules in force regarding workplace safety and accident prevention in the country of use.

The unauthorized copy or alteration of this manual is prohibited. The information it contains herein is subject to modifications and/ or integrations and for such reason cannot be considered binding. Users are advised to check the manufacturers website periodically for updates.

### NOTICE

Information in this manual was correct when published. It may be superseded due to our policy of continuous improvement. Please visit [www.stamford-avk.com](http://www.stamford-avk.com) for latest documentation.

# 2 Safety Precautions

## Safety Information and Notices used in this manual

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

### ⚠ DANGER

*Danger indicates a hazardous situation which, if not avoided, WILL result in death or serious injury.*

### ⚠ WARNING

*Warning indicates a hazardous situation which, if not avoided, COULD result in death or serious injury.*

### ⚠ CAUTION

*Caution indicates a hazardous situation which, if not avoided, COULD result in minor or moderate injury.*

### NOTICE

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

## General Guidance

### NOTICE

These safety precautions are for general guidance and supplement your own safety procedures and all applicable laws and standards.

## Skill Requirements of Personnel

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

## Risk Assessment

A risk assessment has been performed on this product; however, a separate risk assessment must be performed by the user/operating company to establish all personnel-related risks. All affected users must be trained on the identified risks. Access to the Power Plant/Generator Set during operation must be restricted to persons who have been trained on these risks. The alternator will be hot during and after being operated, avoid contact and allow the alternator to cool.

## Personal Protective Equipment (PPE)

All persons operating, servicing, maintaining, or working in or with a power plant or a generator set must wear appropriate Personal Protective Equipment (PPE) Recommended PPE includes:

- Ear and Eye Protection
- Head and face protection
- Safety footwear
- Overalls that protect the lower arms and legs. Work clothing that poses risks of getting caught in machine parts (such as loose belts, laces, etc.) must never be worn.

Ensure that all persons are fully aware of the emergency procedures in case of accidents.

## Noise

### WARNING

#### **Noise**

**Noise from a running alternator can cause serious injury by permanent hearing damage. Maximum A-weighted noise emissions may reach >97 dB(A). To prevent injury, wear appropriate personal ear protection (PPE).**

## Electrical Equipment

### DANGER

#### **Live Electrical Conductors**

**Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before removing covers over electrical conductors, isolate the generator set from all energy sources, remove stored energy and use lock out/tag out safety procedures. Use appropriate PPE**

All electrical equipment can be dangerous if not operated correctly. Always install, service and maintain the alternator in accordance with this manual. Work that requires access to electrical conductors must comply with all applicable local and national electrical safety procedures for the voltages involved and any site-specific rules.

Always use genuine branded replacement parts and check connections have been made correctly before operating.

## Hot surfaces

### WARNING

#### **Hot Surfaces**

**Skin contact with hot surfaces can cause serious injury if touched. To prevent injury, wear appropriate personal protection equipment (PPE) and assess the risk.**

Caution during and after operation, the alternator frame and associated components may be hot, possibly resulting in skin injuries, therefore avoid contact and allow the alternator to sufficiently cool.

Use suitable PPE prior to approaching.

## Lock Out/Tag Out

### ⚠ 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 service and maintenance work, use appropriate lock out/tag out safety procedures to keep the generator set isolated from energy sources. Do not defeat or bypass the lock out/tag out safety procedures.**

## Hazard Warning Labels

### ⚠ WARNING

#### **Safety Cover Removed**

**A hazard exposed when a safety cover is removed can cause serious injury or death. To prevent injury:**

- **Fit the supplied safety labels and do not cover or paint over.**
- **Observe the safety labels.**
- **Refer to the service manual before removing covers.**

The generator set manufacturer is responsible for fitting the self-adhesive hazard warning labels supplied with the alternator. Replace labels that are missing, damaged or painted over.

## Lifting

### ⚠ DANGER

#### **Falling Mechanical Parts**

**Falling mechanical parts can cause serious injury or death by impact, crushing, severing, or trapping.**

**To prevent injury and before lifting:**

- **Check the capacity, condition, and attachment of lifting equipment (crane, hoists, and jacks, including attachments to anchor, fix or support the equipment).**
- **Check the capacity, condition, and attachment of accessories for lifting.**
- **Check the capacity, condition, and attachment of lifting fixtures on the load.**
- **Check the mass, integrity, and stability (e.g. unbalanced or shifting center of gravity) of the load.**

### ⚠ WARNING

#### **Falling Mechanical Parts**

**Falling mechanical parts can cause serious injury or death by impact, crushing, severing, or trapping.**

**To prevent injury and before lifting the alternator:**

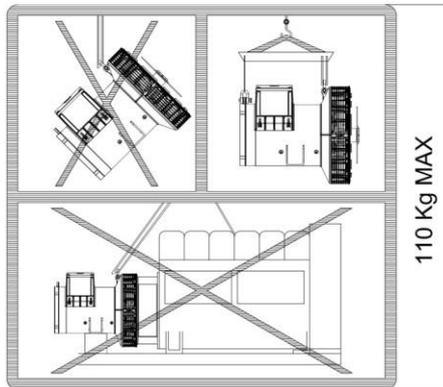
- **Do not lift the complete generator set by the alternator lifting fixtures.**
- **Keep the alternator horizontal when lifting.**
- **Fit drive end or non-drive end transit fittings to single bearing alternators to keep the main rotor in the frame.**

### NOTICE

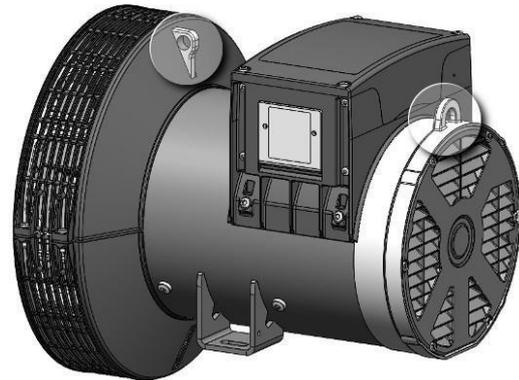
**Ensure all transit fixings securing alternator to shipping pallet are removed before attempting to lift the alternator. A spreader lifting beam or bar must be used at all times with the correct attachments fitted to ensure the lifting chains/straps are vertical before lifting the alternator, as shown on the lifting label diagram.**

Lift the alternator using correctly sized shackles. Ensure attachment to the lifting points provided are correct and all equipment is in serviceable condition. Use chains or lifting straps of the appropriate size and length, attached to a spreader bar. Ensure chains/straps are vertical and not twisted when lifting and the alternator is horizontal to avoid damaging the lifting lugs, the main terminal box, and to prevent the main rotor moving. Use correctly sized shackles through lifting points to avoid any side loading of the alternator lifting points. Ensure the capacity of the

lifting equipment is sufficient of lifting the alternator mass safely. Refer to the nameplate, GA drawing and lifting label for details of mass and lifting lug positions.



Lifting Label



Typical lifting lug positions

## Alternator operating Areas

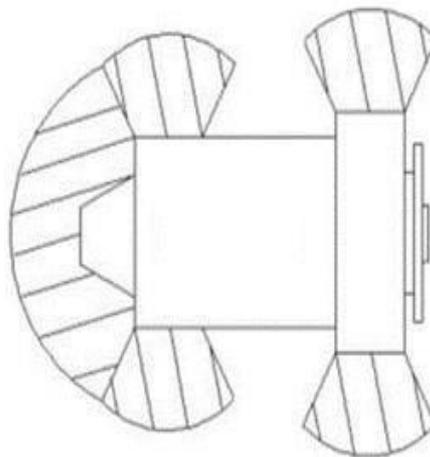
### ⚠ WARNING

#### *Ejected Debris*

***Debris ejected during catastrophic failure can cause serious injury or death by impact, severing or stabbing. To prevent injury:***

- ***Keep away from the air inlet and air outlet when the alternator is running.***
- ***Do not put operator controls near the air inlet and air outlet.***
- ***Do not cause overheating by running the alternator outside rating plate parameters.***
- ***Do not overload the alternator.***
- ***Do not run an alternator with excessive vibration.***
- ***Do not synchronize parallel alternators outside the specified parameters.***

Always wear suitable PPE when working in the hatched areas shown in the diagram or directly in-line with any air inlet/outlet. Make sure this consideration is captured in your risk assessment.



Potential hazard areas

## 3 Safety Directives and Standards

NEWAGE alternators meet applicable European safety directives, and national and international standards relevant to alternators. The alternator must be operated within the limits specified in the relevant standards and within the parameters on the alternator rating plate.

**NOTICE**

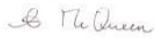
**NEWAGE are not liable for EMC compliance if unauthorized parts are used for maintenance or servicing.**

**Additional Information for EMC Compliance**

NEWAGE alternators are designed to meet EMC 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. Installation, maintenance, and servicing must be carried out by adequately trained personnel fully aware of the requirements of the relevant EC directives.

**Low voltage declaration of conformity**

(example certificate)

EU DECLARATION OF CONFORMITY		
<p>This synchronous A.C. generator is designed for incorporation into an electricity generating-set and fulfils all the relevant provisions of the following EU Directive(s) when installed in accordance with the installation instructions contained in the product documentation:</p>		
2014/35/EU 2014/30/EU 2011/65/EU  2015/863	Low Voltage Directive The Electromagnetic Compatibility (EMC) Directive Restriction on Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive Delegated Directive amending Annex II of 2011/65/EU	
<p>and that the standards and/or technical specifications referenced below have been applied:</p>		
EN 61000-6-2:2005  EN 61000-6-4:2007+A1:2011  EN ISO 12100:2010  EN 60034-1:2010 BS ISO 8528-3:2005  EN 50581:2012	Electromagnetic compatibility (EMC). Generic standards – Part 6-2: Immunity for industrial environments Electromagnetic compatibility (EMC). Generic standards – Part 6-4: Emission standard for industrial environments Safety of machinery – General principles for design – Risk assessment and risk reduction Rotating electrical machines - Part 1: Rating and performance Reciprocating internal combustion engine driven alternating current generating sets - Part 3: Alternating current generators for generating sets Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	
<p>The A.C. Generator utilizes hazardous material exemptions as detailed in Annex III of EU Directive 2011/65/EU</p>		
<p>This declaration has been issued under the sole responsibility of the manufacturer. The object of this Declaration is in conformity with the relevant Union harmonization Legislation.</p>		
<p>The name and address of authorised representative, authorised to compile the relevant technical documentation, is the Company Secretary, Cummins Generator Technologies Romania, B-dul Decebal Nr. 116A 200746 Craiova Dolj, Romania.</p>		
Signed:    Date: 14 <sup>th</sup> February 2020	Name, Title and Address:  Alastair McQueen Global Technical Director Cummins Generator Technologies Romania B-dul Decebal Nr. 116A 200746, Craiova Dolj, ROMANIA	
Model Type: <b>N20G4</b>	Part Variant Number <b>A064L062</b>	
Registered in England under Registration No. 441273. Cummins Generator Technologies Ltd. Registered Office: Fountain Court, Lynch Wood, Peterborough, PE2 6FZ UK		

## 4 Introduction

NEWAGE alternators are brushless, class H insulation and self-regulated, providing AC voltage. They are built in compliance with LVD and EMC Directive guidelines and the technical regulations provided in the DoC (Declaration of Conformity), an example of which is shown above.

Such conformity ensures that the alternators pose no risk to operators whenever they are installed, used, and serviced in accordance with the instructions provided and whenever safety devices are used.

It also guarantees compliance with regulations governing "industrial" electromagnetic emissions and immunity standards. Whenever compliance with obligations specified for residential, commercial, and light industry areas is required, specific solutions must be adopted using supplementary components.

## Alternator Name Plate

A nameplate bearing the alternator's rated data is applied on the alternator frame. Example shown below.

SERIAL NUMBER		MODEL		N20G4	
POWER FACTOR	0.80	DUTY		S1 BR	
EXC.V (Vdc)	28.8	POWER (kVA)	20	20	20
EXC.A (Adc)	3.7	kW	16	16	16
ALT m.	1000	VOLTS	380	400	415
PHASE	3	AMPS	30.4	28.9	27.8
INS. CLASS	H	FREQUENCY (Hz)	50	60	
IP	IP23	RPM	1500	1800	
MACHINE TYPE	20	AMB TEMP °C	40		
WDG	212	TEMP RISE K	125		
kg	97	TL	N/A		

S10 PR						S10 PR					
21	21	21	23.1	25.7	27.3	22	22	22	24.2	27	28.6
16.8	16.8	16.8	18.5	20.6	21.8	17.6	17.6	17.6	19.4	21.6	22.9
380	400	415	380	440	480	380	400	415	380	440	480
31.9	30.3	29.2	35.1	33.8	32.8	33.4	31.8	30.6	36.8	35.4	34.4
50			60			50			60		
1500			1800			1500			1800		
40						27					
150						163					
0.84						0.84					



IEC 60034-1 ISO 8528-3

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## 5 Application of the Alternator

### Environment

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

The output power ratings are subjected to the following ambient temperature and altitude de-rates:

3% for every 5°C by which the operational ambient temperature exceeds 40°C, up to max. 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.

### Air Flow

Make sure that the air inlets and outlets are not obstructed when the alternator is running. Inadequate cooling caused by insufficient air flow will likely result in overheating and damage to the alternator.

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.

### Airborne Contaminants

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 an air filtered enclosure to protect the alternator and apply the relevant de-rate.

### 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.

### 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.

Maintain access around the alternator for safe maintenance.

NEWAGE alternators have round end brackets, therefore the air flow should be modelled to identify and prevent hot air from recirculating within the enclosure. Inadequate cooling caused by insufficient air flow could result in overheating and damage to the alternator.

### Vibration

The alternators are designed to withstand the vibration levels encountered on generator sets built to meet the requirements of ISO 8528-9. (Where ISO 8528 is taken to be broad band measurements 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**

It is the responsibility of the installer to carry out all alternator connections in accordance with the relevant electrical codes and standards. Additional mass to the terminal box could cause excessive vibration and lead to failure of the terminal box enclosure and mounting.

## 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.

## Linear Vibration Monitoring

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.

Prior to installation, ensure that the specification of the alternator is compatible with those of the generator set application.

The genset designer must take every measure necessary to ensure correct alignment and assembly, providing a solid base and adopting adequate vibration dampers to keep vibration levels within the range specified by Standard ISO 8528-9.

Linear Vibration Levels as Measured on The NEWAGE Alternator			
Engine Speed RPM (min-1)	Power Output S (kVA)	Vibration Displacement RMS (mm)	Vibration Velocity RMS (mm/s)
1300 ≤nr < 2000	>10 but ≤50	0.64	40
	>50 but ≤125	0.4	25
The broad band is taken as 10 Hz - 1000 Hz			

## 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 ISO 8528 part 9 limits.

## Excessive Vibration

**⚠ WARNING*****Ejected Debris***

***Debris ejected during catastrophic failure can cause serious injury or death by impact, severing or stabbing. To prevent injury:***

- ***Keep away from the air inlet and air outlet when the alternator is running.***
- ***Do not put operator controls near the air inlet and air outlet.***
- ***Do not run an alternator with excessive vibration.***

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, otherwise premature failure of components can result.
2. Contact NEWAGE to assess the impact on bearing and alternator life expectancy.

## 6 Installation into the Generator Set

### 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 and before lifting:**

- **Check the capacity, condition, and attachment of lifting equipment (crane, hoists, and jacks, including attachments to anchor, fix or support the equipment).**
- **Check the capacity, condition, and attachment of accessories for lifting.**
- **Check the capacity, condition, and attachment of lifting fixtures on the load.**
- **Check the mass, integrity, and stability (e.g. unbalanced or shifting center of gravity) of the load.**

#### ⚠ WARNING

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**Falling mechanical parts can cause serious injury or death by impact, crushing, severing, or trapping.**

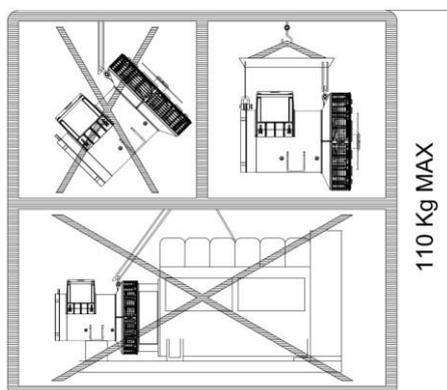
**To prevent injury and before lifting the alternator:**

- **Do not lift the complete generator set by the alternator lifting fixtures.**
- **Keep the alternator horizontal when lifting.**
- **Fit drive end and non-drive end transit fittings to single bearing alternators to keep the main rotor within the frame.**

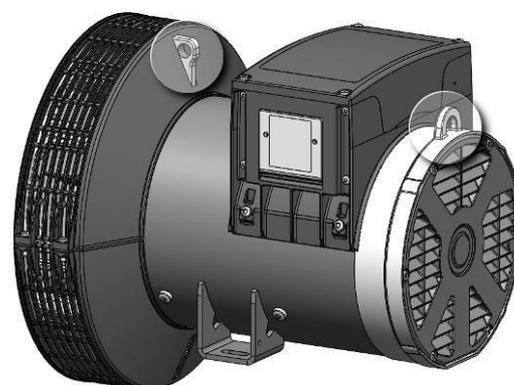
#### NOTICE

**Ensure all transit fixings securing alternator to shipping pallet are removed before attempting to lift the alternator. A spreader lifting beam or bar must be used at all times with the correct attachments fitted to ensure the lifting chains/straps are vertical before lifting the alternator, as shown on the lifting label diagram.**

Lift the alternator using correctly sized shackles. Ensure attachment to the lifting points provided are correct and all equipment is in serviceable condition. Use chains or lifting straps of the appropriate size and length, attached to a spreader bar. Ensure chains/straps are vertical and not twisted when lifting and the alternator is horizontal to avoid damaging the lifting lugs, the main terminal box, and to prevent the main rotor moving. Use correctly sized shackles through lifting points to avoid any side loading of the alternator lifting points. Ensure the capacity of the lifting equipment is sufficient of lifting the alternator mass safely. Refer to the nameplate, GA drawing and lifting label for details of mass and lifting lug positions.



Lifting label



Typical lifting lug positions

### Storage

If the alternator is not to be used immediately, it must be stored in a clean, dry, vibration-free environment. If the alternator can be rotated, turn the rotor a minimum of 6 revolutions every month during storage.

## After Storage

**NOTICE**

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

After a period of storage, carry out the pre-running checks to determine the condition of the windings. If the windings are damp or the insulation resistance is low, follow one of the drying out procedures. Prior to placing the alternator into operation after extended periods of storage or when signs of humidity or condensation are identified, measure the level of insulation resistance between the winding phases and to earth by a qualified technician. Prior to conducting the test, the voltage regulator (AVR) must be disconnected. If this test provides a result below 1 MΩ, the alternator must be dried inside an oven at 60-70°C for around 6 hours (or by directing fan heaters, each at least 300mm from the windings). The insulation test must then be repeated at ambient temperature. Repeat the process until a satisfactory result is obtained.

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

	Not Rotated during Storage	Rotated during Storage
<b>Sealed Bearing(s) NDE bearing type 6207 2RSC3</b>	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.

## Generator Set Coupling

**⚠ WARNING**

***Moving Mechanical Parts***  
***Moving mechanical parts during generator set coupling can cause serious injury by crushing, severing, or trapping.***  
***To prevent injury, keep arms, hands, and fingers away from mating surfaces when coupling the generator set.***

**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.**



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 17 kgm (125 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.

To prevent movement of the rotor during transport, a drive end (DE) restraint is fitted. Remove the DE transit restraint from the DE bracket before coupling the generator set.

## Single Bearing

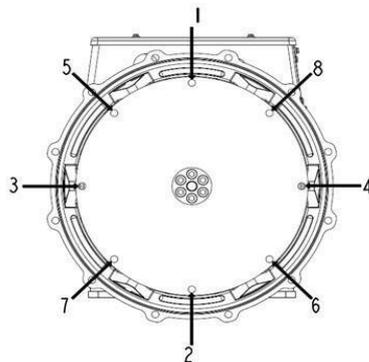
### NOTICE

**Do not pull the alternator to the engine using bolts through the flexible discs. Failure to secure bolts can lead to excessive vibration, which in turn can lead to catastrophic alternator failure.**

### NOTICE

**Typical coupling disc arrangement shown. Please refer to GA Drawing as the number of holes may vary.**

1. Position the alternator close to the engine and remove the drive end transit restraint that keeps the rotor in place during transport.
2. Remove the air outlet cover from the drive end of the alternator to access the coupling and adaptor bolts.
3. Make sure the coupling discs are concentric with the adaptor spigot. Use alignment studs to ensure that the disc and the flywheel are in orientation.
4. 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.
5. 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.
6. 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.



7. Tighten the bolts to fix the coupling disc to the flywheel, Following the method shown in the example diagram above by tightening in opposing bolt sequence.
8. 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.
9. Replace all covers.
10. Make sure a distance of at least 1.5 mm between the bearing and its seat within the NDE bracket exists for bearing/rotor float.

## Pre-Running Checks

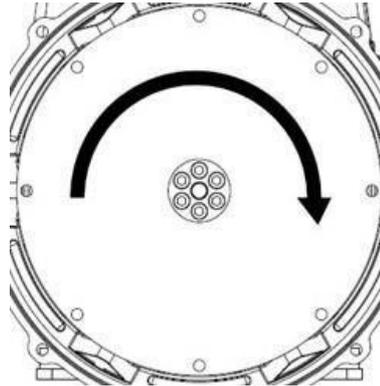
Before starting the generator set, test the insulation resistance of windings and check that all connections are tight and in the correct location. Make sure the alternator air path is clear of obstructions. Visually inspect for loose items inside the alternator and remove if found. Replace all covers.

## Standby Applications

For sealed bearings, run alternators in standby applications at no load for a minimum of ten minutes every week regardless of accumulated running hours.

## 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, please seek advice.



## 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. Ask for a circuit diagram of 'reverse phase connections'.

## Voltage and Frequency

Check that the voltage and frequency shown on the alternator rating plate meet the requirements of the generator set application.

## Electrical Connections

### **⚠ WARNING**

#### ***Incorrect Electrical Installation and System Protection***

***Incorrect electrical installation and system protection can cause serious injury or death by electric shock and burns.***

***To prevent injury, installers must be qualified and are responsible for meeting appropriate inspectorate and local electricity authority requirements and site safety rules.***

### **NOTICE**

**Additional equipment attached to the terminal box could cause excessive vibration and lead to failure of the terminal box enclosure and mounting.**

**Refer to the relevant wiring diagrams before making any electrical connections.**

**Connections should be made by qualified, skilled technicians/engineers.**

Prior to proceeding with any modification and/or making the electric connections, ensure there are no parts under voltage or with stored energy, the alternator frame is at ambient temperature and the generator set is isolated and cannot be started accidentally, automatically or intentionally.

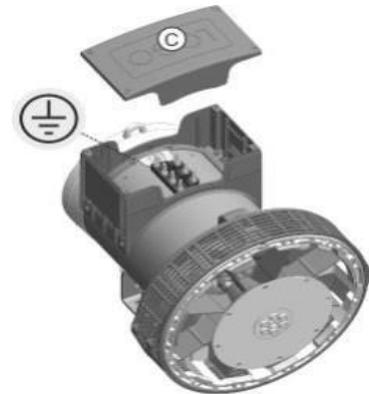
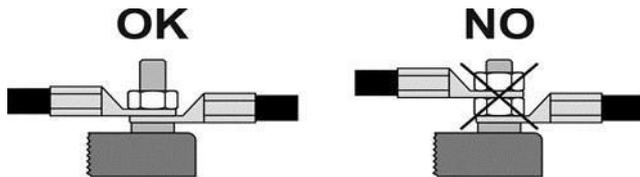
The installer must check that the alternator frame is bonded to the generator set bedplate and must bond to the site earth. If anti-vibration mounts are fitted between the alternator frame and its bedplate, a suitably rated earth conductor must bridge across the anti-vibration mount.

As standard, the alternator neutral is not bonded to the alternator frame. If required, the 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.

It is the responsibility of the installer to ensure that the connection of the alternator is completed in accordance with the relevant electrical codes and standards.

It is recommended to install a circuit breaker switch of appropriate rating near the alternator.

**The palm (flattened part) of load cable lugs must be clamped in direct contact with the main stator output conductors so that the whole palm area conducts the output current. The tightening torque of fasteners is 6 to 6.6 Nm.**



Earth point within the terminal box

## Wiring diagram

Refer to the relevant diagrams before making any electrical connections.

## 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.

### Dry with Ambient Air

In many cases, the alternator can be dried sufficiently using its own cooling system. Disconnect the cables from the F1 and 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 anticondensation 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.

### 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.

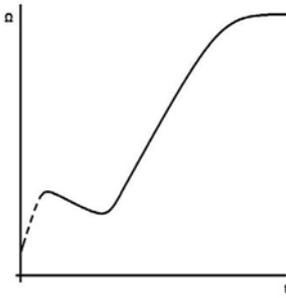
After drying, remove the fan heaters and re-commission as appropriate.

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.

## 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).

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.



## 7 Technical Data

### NOTICE

Compare measurements with the technical data sheet, GA, and the test certificate for the alternator.

Refer to the nameplate attached to the frame. Use the unique serial number for additional information.

[www.stamford-avk.com](http://www.stamford-avk.com)

Email: [emea.service@cummins.com](mailto:emea.service@cummins.com).

## 8 Windings

### ⚠ DANGER

#### **Live Electrical Conductors**

*Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before removing covers over electrical conductors, isolate the generator set from all energy sources, remove stored energy and use lock out/tag out safety procedures.*

### NOTICE

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

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.

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 (500 V).

### Insulation Resistance of Windings and Test

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. Ensure AVR sensing harness is disconnected before test.
  - b. Disconnect the neutral to earth conductor (if fitted).
  - c. Connect the three leads of all phase windings together (if possible).
  - d. Apply the test voltage from the table between any phase lead and earth.
  - e. Measure the insulation resistance after 1 minute ( $IR_{1min}$ ).
  - f. Discharge the test voltage with an earth rod for five minutes.
  - g. If the measured insulation resistance is less than the minimum acceptable value, dry the insulation, then repeat the method.
  - h. Reconnect neutral to earth conductor (if fitted), and AVR sensing harness connection.
3. For exciter stators, and combined exciter and main rotors:
  - a. Ground main stator winding during the test.
  - b. Connect both ends of the winding together (if possible).
  - c. Apply the test voltage from the table between the winding 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. Repeat the method for each winding.
- h. Remove the connections made for testing and reconnect in the correct positions and apply the correct torque.
- i. Remove the grounding connection.

#### TEST VOLTAGE AND MINIMUM ACCEPTABLE INSULATION RESISTANCE FOR NEW AND IN-SERVICE ALTERNATORS

Component	Test Voltage (V)	Minimum Insulation Resistance at 1 minute (M $\Omega$ )	
		New	In-service
Main Stator	500	10	5
Exciter Stator	500	10	5
Exciter rotor, rectifier & main rotor combined	500	10	5

### Winding Resistances and Test (20°C)

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.
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 the 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 the 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. Main rotor winding resistance can be taken directly from the rectifier studs/plates.
  - b. Measure and record the electrical resistance between the main rotor leads and the rectifier studs/plates (+ve and -ve). A specialist micro ohmmeter must be used.
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 U3 and U4 (if present). A specialist micro ohmmeter must be used.
  - c. Measure and record the electrical resistance between V1 and V2 leads and between V3 and V4 (if present). A specialist micro ohmmeter must be used.
  - d. Measure and record the electrical resistance between W1 and W2 leads and between W3 and W4 (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. Refer to the Technical Data to verify the measured resistances of all windings agree with the reference values.

Frame	Winding	Main Stator L-N $\Omega$	Main Rotor $\Omega$	Ex Rotor L-L $\Omega$	Ex Stator $\Omega$
N10G4	212	1.01	13.6	4.65	7.60
N15G4	212	0.54	13.0	4.65	7.60
N20G4	212	0.34	14.0	4.65	7.60

## Requirements

Type	Description
<b>Personal Protective Equipment (PPE)</b>	Wear mandatory site PPE
<b>Consumables, Parts</b>	None
<b>Tools</b>	Insulation test meter
	Multimeter
	Milliohm Meter or Micro Ohmmeter
	Clamp Ammeter
	Infrared thermometer
	Earth rod

## 9 Fault finding

### No-load voltage absent

- Demagnetized machine: With the alternator stationary restore the residual magnetism by removing the F1 and F2 harness from the AVR. Apply 12V DC voltage to the harness lead terminals for 10 seconds (F1 Red Positive, F2 Black Negative). Reconnect the harness to the AVR. Ensure 12V DC is applied to the lead terminals not the AVR.
- AVR fuse blown: Replace the fuse with the same type and value.
- Defective AVR: Replace the AVR with a serviceable component.
- Winding anomaly: Compare the resistances (see table); Decommission the alternator until rectified.
- Insulation value low: Proceed with drying out procedure until above 1MΩ is maintained at ambient temperature.
- Incorrect electrical connections: Inspect/test component and reconnect if serviceable.

### No-load voltage very low

- Engine speed too low: Calibrate it to 1560-1575 rpm (50 Hz alternator) or 1860-75rpm (60 Hz alternator).
- Trimmer P1 incorrectly positioned: Adjust position until corrected.
- Dip switches in wrong position; check them against diagram.
- Defective AVR: Replace the AVR with a serviceable component.
- Winding anomaly: Compare the resistances (see table); Decommission the alternator until rectified.
- Missed or incorrect AVR connections: Inspect and reconnect if serviceable.

### No-load voltage too high

- Missed or incorrect AVR connections: Inspect and reconnect if serviceable.
- Trimmer P1 incorrect position: adjust position until corrected.
- Defective AVR: Replace the AVR with a serviceable component.

### Load voltage very low

- Engine slowdown: Possible undersized engine, check specification.
- Possible overload: Check current and LED signals.
- Trimmer P3 incorrect position: Rotate trimmer counter-clockwise as far as possible using insulated tooling. Do not force.
- Trimmer P5 incorrect position: This is factory set, check that it is in the correct position for alternator model.
- Defective AVR: Replace the AVR with a serviceable component.

### Load voltage very high

- Defective AVR: Replace the AVR with a serviceable component.

### Unbalanced voltage

- Winding anomaly: Decommission the alternator until rectified.
- Unbalanced load: Check connections (phase wire missing).

### Unstable voltage

- Trimmer P2 not calibrated: Rotate the trimmer using insulated tooling until a stable voltage is reached.
- Defective AVR: Replace the AVR with a serviceable component.
- Protection cut-outs have triggered: Switch off, reset the protection, and restart the generator set.

### The fuse has blown

- Incorrect AVR connection: Inspect and reconnect if serviceable.
- Voltage value set too high: Adjust the value of Trimmer P1 using insulated tooling.
- Defective AVR: Replace the AVR with a serviceable component.
- Possible overload: Check current and LED signals.
- Ensure that the size and type of the fuse is correct.

#### **Machine overheating**

- Air intake/exhaust vents blocked in both alternator and cowling – when present: Remove and clean screens.
- Possible overload: Check current and LED signals.
- Alternator air intake temperature too high: Check and apply the respective power output de-rate value.

#### **Unusual machine noise**

- Bearing noise: Replace the bearing.
- Defective coupling: Inspect and correct the issue.
- Inadequate or damaged vibration-damping supports can cause excessive vibration: Replace the vibration dampers.

## **10 End of Life Disposal**

### **Recyclable material**

Mechanically separate the base materials, iron, copper, and steel, removing paint, polyester resin, and insulation tape and/or plastics residues from all components. Dispose of this 'waste material' The iron, steel and copper can now be recycled.

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

### **Items requiring specialist treatment**

Remove electrical cable, electronic accessories, and plastic materials from the alternator. These components need special treatment to remove the waste from the reclaimable material. Forward the reclaimed materials for recycling.

### **Waste material**

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

## **11 Product support**

For advice please contact us using the below website.

[www.stamford-avk.com](http://www.stamford-avk.com)

Email: [emea.service@cummins.com](mailto:emea.service@cummins.com).

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