

MARKON®

BL105 and SL105 Alternators

**INSTALLATION, SERVICE AND
MAINTENANCE**

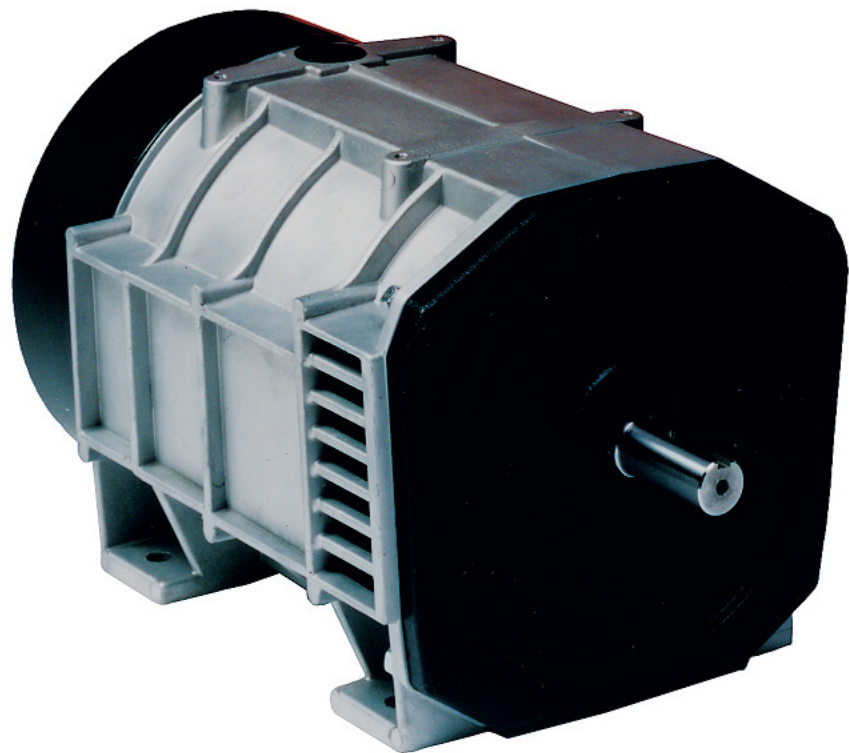


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1 Foreword

1.1 The Manual

This manual contains guidance and instructions for the installation, servicing and maintenance of the alternator.

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

This manual is an essential part of the alternator. Make sure that the manual is available to all users throughout the life of the alternator.

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

NOTICE

Information in this manual was correct when published. It may be superseded due to our policy of continuous improvement. Please visit www.cumminsgeneratortechnologies.com for latest documentation.

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2 Safety Precautions

2.1 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.

2.2 Skill Requirements of Personnel

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

2.3 Risk Assessment

A risk assessment has been performed on this product by Cummins, 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.

2.4 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

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

2.5 Noise

CAUTION

Alternators in operation emit noise. Exposure to noise can cause hearing damage. Wear appropriate ear protection at all times. Maximum A-weighted noise emissions may reach 110 dB(A). Contact the supplier for application-specific details.

2.6 Electrical Equipment

DANGER

Hazardous Voltage

Will shock, burn or cause death

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.

2.7 Lock Out/Tag Out

WARNING

Risk of serious injury or death

Alternators can retain mechanical and electrical energy

Isolate the alternator from all sources of mechanical and electrical energy before starting service or maintenance work. Adopt a suitable lock-out/tag out process.

2.8 Lifting

WARNING

Improper lifting can cause serious injuries to persons or can cause death.

Do not use the alternator lifting points to lift the complete generator set (alternator coupled to motive power source)

The lifting points provided are designed for lifting the alternator only.

Do not remove the lifting label attached to one of the lifting points.

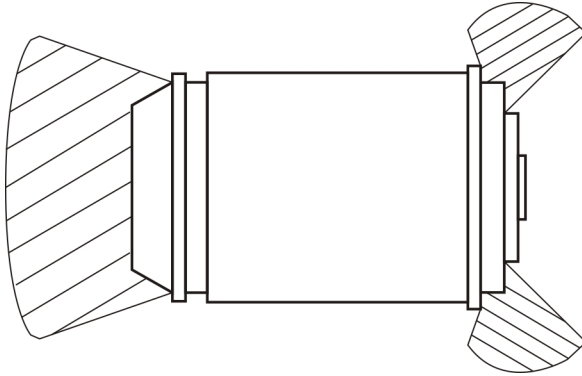
2.9 Alternator Operating Areas

⚠ WARNING

Flying debris

In the event of catastrophic failure, debris may be ejected from the alternator air inlet/outlet and may cause severe injury or death.

Avoid access to these areas while the alternator is operating.



Always wear suitable PPE when working in hatched areas or directly in-line with any air inlet/outlet.

Make sure this consideration is captured in your risk assessment.

2.10 Hazard Warning Labels

⚠ WARNING

Hazard warning labels show the type and source of potential hazards. Observe the safety labels to avoid risk of injury. The generator set manufacturer is responsible for fitting the self-adhesive hazard warning labels supplied with the alternator.

Labels must be fitted at the locations shown on the back of the label sheet supplied with the alternator manual.

Replace labels that are missing, damaged or painted over.



2.11 General Guidance

NOTICE



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

3 Safety Directives and Standards

MARKON 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.

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

3.1 European Directives: EC Declaration of Conformity for Incorporation

2006/95/EC LOW VOLTAGE DIRECTIVE 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 EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:</p>		
2006/95/EC	Low Voltage Directive	
2004/108/EC	The Electromagnetic Compatibility (EMC) Directive	
<p>and that the standards and/or technical specifications referenced below have been applied:</p>		
EN 61000-6-2:2005	Electromagnetic compatibility (EMC). Generic standards – Part 6-2: Immunity for industrial environments	
EN 61000-6-4:2007+A1:2011	Electromagnetic compatibility (EMC). Generic standards – Part 6-4: Emission standard for industrial environments	
EN ISO 12100:2010	Safety of machinery – General principles for design – Risk assessment and risk reduction	
EN 60034-1:2010	Rotating electrical machines - Part 1: Rating and performance	
BS ISO 8528-3:2005	Reciprocating internal combustion engine driven alternating current generating sets - Part 3: Alternating current generators for generating sets	
BS 5000-3:2006	Rotating electrical machines of particular types or for particular applications - Part 3: Generators to be driven by reciprocating internal combustion engines - Requirements for resistance to vibration	
<p>The name and address of authorised representative, authorised to compile the relevant technical documentation, is the Company Secretary, Cummins Generator Technologies Limited, 49/51 Gresham Road, Staines, Middlesex, TW18 2BD, U.K.</p>		
Signed:  Date: 01 st February 2014	Name, Title and Address: Kevan J Simon Global Technical and Quality Director Cummins Generator Technologies Fountain Court Lynch Wood Peterborough, UK PE2 6FZ	
Description	Serial Number	
Registered in England under Registration No. 441273. Cummins Generator Technologies Ltd. Registered Office: Bamack Road, Stamford, Lincolnshire PE9 2NB, England.		

DRAWING REF 450-16383-D

FIGURE 1. DECLARATION OF CONFORMITY

**2006/42/EC MACHINERY DIRECTIVE
DECLARATION OF INCORPORATION
OF PARTLY COMPLETED MACHINERY**




Function: Synchronous A.C. generator designed for incorporation into an electricity generating-set.

The partly completed machinery supplied with this declaration:

- o Is designed and constructed solely as a non-functional component to be incorporated into a machine requiring completion.
- o Is designed to comply with the provisions of the following EU Directives so far as their level of build will allow:
2004/108/EC The Electromagnetic Compatibility (EMC) Directive
2006/95/EC Low Voltage Directive
- o Must not be put into service within the European Community ("EC") until the final machinery into which it is to be incorporated has been declared in conformity with the Machinery Directive and all other applicable EC Directives.
- o Is designed and constructed to comply with the essential health and safety requirements of the Machinery Directive 2006/42/EC listed on sheet 2 of this Declaration.

The relevant technical documentation is compiled in accordance with the provisions of part B of Annex VII of the Machinery Directive. All relevant information about the partly completed machinery will be provided, in writing, on a reasoned request by the appropriate national authority to its authorised representative. The name and address of authorised representative, authorised to compile the relevant technical documentation, is the Company Secretary, Cummins Generator Technologies Limited, 49/51 Gresham Road, Staines, Middlesex, TW18 2BD, U.K.

The undersigned representing the manufacturer:

Signed:  Date: 01 st February 2014	Name, Title and Address: Kevan J Simon Global Technical and Quality Director Cummins Generator Technologies Fountain Court Lynch Wood Peterborough, UK PE2 6FZ
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Description	Serial Number

Registered in England under Registration No. 441273.
 Sheet 1 Cummins Generator Technologies Ltd. Registered Office Barnack Road, Stamford, Lincolnshire PE9 2NB, England

DRAWING REF: 45016388-D

**EC Declaration of Incorporation of
Partly Completed Machinery**

**ESSENTIAL HEALTH AND SAFETY REQUIREMENTS RELATING TO THE DESIGN
AND CONSTRUCTION OF PARTLY COMPLETED MACHINERY**

- 1.1 General Remarks**
- 1.1.2 : Principles of safety integration
 - 1.1.3 : Materials and products
 - 1.1.5 : Design of machinery to facilitate its handling
- 1.3 Protection Against Mechanical Hazards**
- 1.3.1 : Risk of loss of stability
 - 1.3.2 : Risk of break-up during operation
 - 1.3.3 : Risks due to falling or ejected objects
 - 1.3.4 : Risks due to surfaces, edges or angles
 - 1.3.7 : Risks related to moving parts
 - 1.3.8.1 : Moving transmission parts
- 1.4 Guarding**
- 1.4.1 : Guards – General requirements
 - 1.4.2.1 : Fixed guards
- 1.5 Other Hazards**
- 1.5.2 : Static electricity
 - 1.5.3 : Energy supply other than electric
 - 1.5.4 : Errors of fitting
 - 1.5.6 : Fire
 - 1.5.13 : Emissions of hazardous materials and substances
- 1.7 Information**
- 1.7.1 : Information and warnings on the machinery
 - 1.7.4 : Instructions

- LEGEND**
1. Essential Health and Safety Requirements not shown are not considered applicable for this Partly Completed Machinery or must be fulfilled by the assembler of the Machinery.
 2. Essential Health and Safety Requirements shown are considered applicable for this Partly Completed Machinery and have been fulfilled by the manufacturer to the extent possible, subject to the build requirements of the Machinery assembler, the information contained in the assembly instructions and Cummins bulletins.

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

DRAWING REF: 45016388-D

FIGURE 2. DECLARATION OF INCORPORATION

Each alternator supplied in the European Economic Area (EEA) is supplied with an EC Declaration of Conformity or Declaration of Incorporation for incorporation into an electricity generator set. It is the responsibility of the generator set manufacturer to ensure that the complete generator set complies with EC Directives and standards.

Our authorized representative in the European Community is the Company Secretary, Cummins Generator Technologies Limited, 49/51 Gresham Road, Staines, Middlesex, TW18 2BD, UK.

All alternators meet the following Standards and Directives insofar as their level of build will allow:

Directives:

- 2004/108/EC The Electromagnetic Compatibility (EMC) Directive (see specific Declarations)
- 2006/95/EC Low Voltage Directive (for product below 1000 V_{a.c.} - see specific Declarations)
- 2006/42/EC Machinery Directive (as partly completed machinery - see specific Declarations)

Standards:

- EN 61000-6-2:2005 Electromagnetic Compatibility (EMC), Generic Standards - Part 6-2: Immunity for industrial environments
- EN 61000-6-4:2007 + A1:2011 Electromagnetic Compatibility (EMC), Generic Standards - Emission standard for industrial environments
- EN ISO 12100:2010 Safety of Machinery, General principles for design - Risk assessment and risk reduction
- EN 60034-1:2010 Rotating electrical machines - Part 1: Rating and performance
- BS ISO 8528-3:2005 Reciprocating internal combustion engine driven alternating current generating sets - Part 3: Alternating current generators for generating sets
- BS 5000-3:2006 Rotating electrical machines of particular types or for particular applications - Part 3: Generators to be driven by reciprocating internal combustion engines - Requirements for resistance to vibration

3.2 Additional Information for EMC Compliance

MARKON 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.

NOTICE

Cummins Generator Technologies is not liable for EMC compliance if unauthorized parts, not of MARKON brand, are used for maintenance and servicing.

4 Introduction

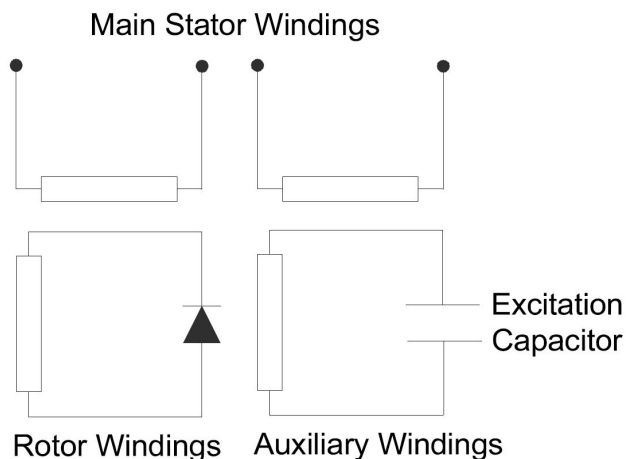
4.1 Models

The models covered by this manual are designated in the following ranges:

- BL105A, BL105B, BL105C, BL105E, BL105F and BL105G
- SL105A, SL105B, SL105C, SL105E, SL105F and SL105G

4.2 BL105 Alternator

The BL105 is a self exciting brushless alternator designed to operate with single phase loads at or near a power factor of 1.0. The principle of operation is schematically represented in the figure below. The auxiliary winding, in conjunction with the excitation capacitor, provides excitation by inducing current in the rotor (field) windings which is rectified to produce a direct current field. The main stator winding is designed for series/parallel connection to give a dual voltage output and no voltage adjustment is possible.



4.3 SL105 Alternator

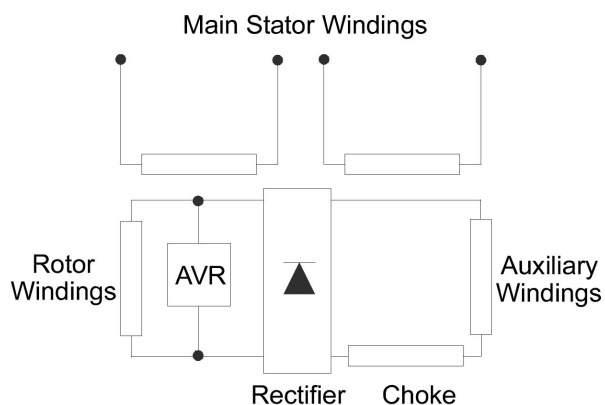
The SL105 alternator is of self-exciting, automatic voltage regulator (AVR) controlled, rotating field design. It is designed to operate with close regulation when supplying single phase loads. Primarily designed for loads at or near unity power factor, it has a capability of operation at 0.8 power factor.

The principle of operation is schematically represented in the diagram below. The auxiliary winding provides excitation power through a choke and rectifier into the rotating field via sliprings.

The AVR diverts excess excitation at low loads to maintain the main stator winding output voltage within close limits.

The main stator winding is designed for series/parallel connection to give a dual voltage output with voltage adjustment.

The SL105 alternator may be supplied without a divertor AVR for specific applications. For these alternators the instructions given in this manual for the SL105 alternator apply, but references to the AVR or its control should be ignored.



4.4 Serial Number Location

A unique serial number is stamped into the upper section of the drive end bracket and shown on two labels on the outside of the terminal box.

4.5 Rating Plate

The self-adhesive rating plate label, supplied with the alternator, must be fixed after the generator set is fully assembled and painted.

WARNING

The alternator could overheat if operated outside the parameters specified on the rating plate. Overheating can cause catastrophic failure and serious injury from ejected debris. Always operate the alternator within the rated parameters.

5 Application of the Alternator

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

⚠ CAUTION
Overloading an alternator may lead to catastrophic failure.

5.1 Environment

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

Ambient Temperature	-15 °C to 40 °C
Relative Humidity	< 60%
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.

5.2 Air Flow

The alternator should be positioned so that the cooling air may enter and leave the machine without restriction. Inadequate ventilation to the alternator will lead to serious overheating and subsequent damage to windings.

5.3 Direction of Rotation

The alternator is suitable for either direction of rotation.

5.4 Drive Arrangement

All models are designed to suit engines having a drive shaft/crankcase mounting arrangement to SAE J609a Flange A Extension 5 (3/4" Taper) or Flange B Extension 6 (7/8" Taper) depending upon output kW.

Two bearing drive arrangements are available with a 22 mm diameter 45.5 mm long shaft extension.

The minimum pulley pitch diameter to be used for belt driven application is 118 mm with a maximum side loading of 700 N, to achieve full output and a reasonable bearing life. If smaller pulleys are required refer to factory for maximum side load and bearing life. Where single bearing to two bearing conversion parts have been supplied fitting instructions are provided with the kit.

5.5 Road Vehicle Alternators

A special two bearing arrangement is used for this application to accommodate high bearing loadings and vibration. The standard 22 mm diameter, 45.5 mm long shaft extension is used.

The minimum pulley pitch diameter to be used is 118 mm with a maximum side loading of 1000 N.

5.6 Bearings

The bearing is preloaded and sealed for life and should require no further attention. Care must be taken to ensure that the anti-creep circlip is correctly located in the groove before mating with the end bell bearing housing, i.e. the bump on the circlip is in the deepest part of the groove.

On two bearing machines the drive end bearing is a standard ball bearing sealed for life.

5.6.1 Road Vehicle Alternators

These alternators are fitted with larger bearings than standard. The drive end bearing is clamped in the drive end bracket and the non drive end bearing is fitted in a steel housing with an 'O' ring to prevent turning.

5.6.2 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) where the alternator is stationary and subjected to vibration can cause false brinelling wear (flats on the balls and grooves on the races)
- Very humid or wet conditions that cause corrosion and deterioration of the grease by emulsification.

5.6.3 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.

5.6.4 Bearing Service Life Expectancy

Bearing manufacturers recognize that 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 about any aspect of bearing life on MARKON alternators, contact your nearest supplier of MARKON alternators.

5.7 Earthing

The alternator is manufactured and delivered with the stator windings completely isolated from the frame; a suitable earth terminal mounting point is provided on the bearing support for bonding to the generating set frame.

Access to the earth terminal is gained by removal of the end cover.

5.8 Loading

The alternators are suitable for supplying, continuously, most types of load with a total load current not exceeding the current quoted on the nameplate. Two points should be noted however:

1. Engine Power.

The generator set output may be limited by the horsepower rating of the engine. As a guide the engine has to supply approximately two horsepower for each 1000 watts (1 kW) of electrical load. Refer to factory for specific alternator efficiency.

2. Electric Motor Loads.

The current taken by a motor on full load is shown on its nameplate, but it will be several times this value at the instant of starting even when there is no load on the motor. The actual value depends on the type of motor and the starting current should be checked before attempting to decide the size of alternator required.

When starting a motor the total current including any other load should not exceed twice the full-load current of the alternator on BL105 models. The total current should not exceed 1.5 times the full-load current on SL105 models.

5.9 Vibration

MARKON 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 Bad link: /opt/dzd/dzd_prog/prog_docato/docato_4.9.1/docato/work/temp/dzd_temp/topleaf/5e2def30-91b6-40b5-93db-37ff38e651d5/en-us/cgt/installation/electricalconnection_title.xml to connect the load cables to the terminal box. Refer to CGT before fixing any additional mass to the terminal box.

5.9.1 Definition of BS5000–3

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

5.9.2 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.

5.9.3 Excessive Vibration

 WARNING
Excessive vibration can cause catastrophic failure of the alternator, which could cause personal injury.

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 Installation into the Generator Set

6.1 Safety Warnings

⚠ WARNING

Refer to local regulations to ensure that the correct earthing procedure has been followed

The alternator is supplied as a component part for installation on a generating set and it is the responsibility of the generating set builder to fit the safety warning label, **Figure 3**, which is supplied packaged with this manual. The label should be attached to the alternator in a position where it is clearly visible on the generating set.

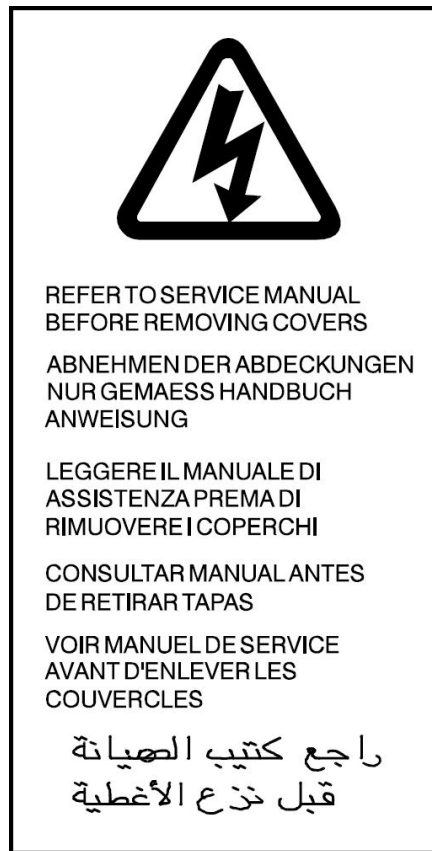


FIGURE 3. SAFETY WARNING LABEL

6.2 Inspection

When the equipment is received, all details, especially the Serial Number of the alternator, should be checked against the Advice Note. Carefully remove all dust and packing materials. In the event of any part being damaged or missing, this should be reported at once to the manufacturer and the transport company. Always quote the Serial Number on correspondence with the manufacturer.

NOTICE

When nameplates are supplied packaged with the machine, but not fitted, it is the responsibility of the installer to fit the nameplate to the alternator.

6.3 Storage

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

Refer to Service and Maintenance section ([Chapter 7 on page 21](#)) of this manual for further instructions for the bearings of stored alternators.

6.3.1 After Storage

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 (see [Chapter 7 on page 21](#)).

- For sealed bearings that have been in storage for more than 12 months, replace the bearings before first use of the alternator.

6.4 Coupling To The Engine

Refer to Assembly/Dismantling Procedure [Section 7.5](#).

6.5 Electrical Connections

The alternators are supplied from the factory with flying leads from the main stator windings. The BL105 & SL105 may be permanently connected or switched in the generator set outlet box to obtain the required output voltage(s). The installer must provide necessary overload protection. The windings are not bonded to the machine frame and it is the responsibility of the installer to provide suitable bonding to earth. Reference should be made to relevant site or safety regulations.

Note that the point of earthing the stator winding is at the discretion of the installer.

- Normally a 230 volt 2 wire output will be earthed at one end giving a maximum of 230 volts to earth (Or 115 volts in parallel mode).
- A 110 volt 2 wire output will normally be earthed at the centre tap (series connection point) giving a maximum of 55 volts to earth.
- Reference should be made to relevant site or safety regulations.

6.6 Voltage Selection

6.6.1 Dual Voltage Output for 4 Lead Models

The main stator windings are in two sections which may be connected in series or parallel to give a choice of output voltage. For example, series connection gives 230 V, parallel connection gives 115 V.

This is illustrated below [Figure 4 on page 19](#). Each winding section is capable of carrying the same current, I. When the windings are connected in series the maximum load current is I, but when the windings are connected in parallel the maximum current is 2 X I.

Example:

A 2.5 kVA alternator when connected in series for 230 V operation has a capacity of 10.9 A; when connected in parallel for 115 V it has a capacity of 21.7 A.

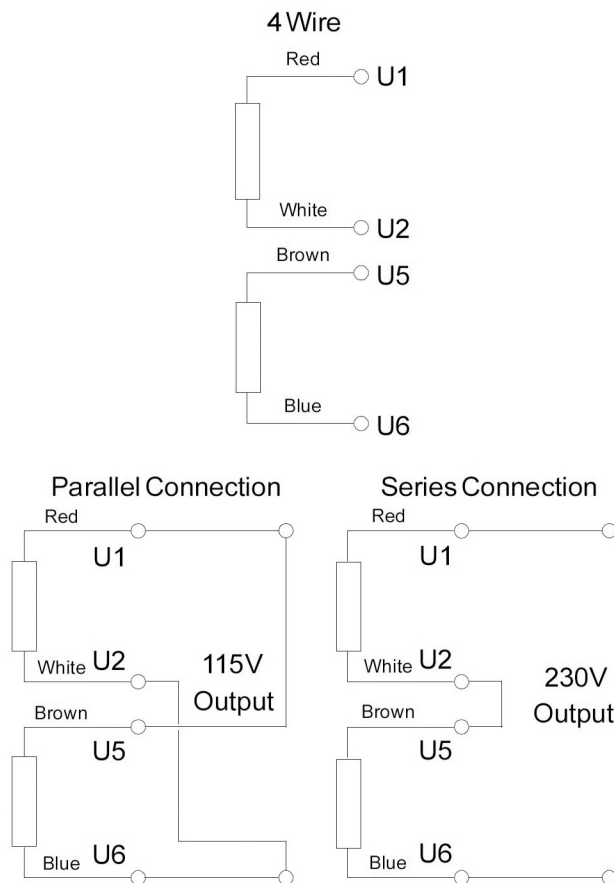


FIGURE 4. DUAL VOLTAGE EXAMPLE

6.6.2 110V CTE Output (BL105 range only)

The main stator windings are in two sections which should be connected in series to give 110 V output, with the centre tap taken from the series connection point.

6.7 Voltage Adjustment For The SL105 - AVR MD1C

The voltage is set during manufacture to give the mid-voltage of the range of voltages shown on the nameplate, ie: an alternator whose nameplate is marked 220-240 / 110-120 V will be set to give 230 volts with the output windings connected in series and 115 volts when connected in parallel.

The voltage may be reset to any value within the nameplate range. To RAISE the voltage turn the volts adjust potentiometer VR1 CLOCKWISE and to LOWER the voltage turn the potentiometer ANTI-CLOCKWISE.

The volts adjust potentiometer is the one at the bottom of the board.

6.8 Pre-Running Checks

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

6.9 Stability

This control should not normally require adjustment having been set during manufacture, but should the output voltage fluctuate with a steady load connected, this may be improved by turning the potentiometer anti-clockwise which will increase the damping effect.

NOTICE

Do not use undue force when turning the potentiometers - they can be damaged by attempting to adjust beyond the internal stops.

When making either adjustment the speed must be correct.

6.10 Varying Load

Under certain conditions, load variations can reduce alternator life.

Identify any possible risk, especially the following:

- Large capacitive loads (for example Power Factor Correction equipment) can affect alternator stability and cause pole slip.
- Stepped grid voltage variation (for example Tap Changing).

If the alternator is at risk from varying load, include adequate protection into the generator set system by under-excitation protection.

7 Service and Maintenance

7.1 General

 **WARNING**

The following procedures present hazards which can result in personal injury or death. Only persons qualified to carry out electrical and mechanical servicing should undertake this work.

The BL model alternator is fitted with sealed for life bearings and requires no regular maintenance.

The SL model alternator similarly requires no regular mechanical maintenance. It is, however, fitted with slip-rings and brushgear which require regular attention.

Inspect brushes and sliprings at 500 hour intervals. Replace brushes when they are worn to a depth of 8 mm. The new brush should be bedded using a medium grade abrasive cloth. If the sliprings are pitted or badly marked the rotor should be removed and the sliprings lightly skimmed.

The alternator must periodically be inspected and any accumulation of dirt or oil must be removed. Air inlet and outlet openings must be kept unobstructed.

For BL and SL models it is recommended that:-

1. After storage or long periods of standing idle the condition of windings should be checked. Refer to 'Insulation Resistance Check' [Section 7.2](#)
and
2. During generating set overhaul, the bearing is replaced. Refer to Assembly/Dismantling Procedure, [Section 7.5](#).

7.2 Insulation Resistance Test

If the equipment has been stored or allowed to get damp the insulation resistance of the windings should be checked.

On BL models before carrying out this test disconnect the capacitor and any earthed connections.

On SL models disconnect AVR, rectifier, RI suppressor [17] and any earthed connections.

The check should be carried out on the stator winding between each winding group and the alternator frame, and between the rotor winding and rotor core using a 500 volt Megger or similar instrument. The resistance value obtained should be at least one megohm. If the resistance is less than one megohm the windings should be dried out in a warm atmosphere. The resistance values should be rechecked every 30 minutes until this value is obtained.

7.3 Residual Voltage/Field Flashing

If the rotor has been removed, the alternator stored for a considerable time or the rotor (field) connections reversed during servicing, the residual magnetism may have been destroyed.

To check residual voltage, remove the end cover for access.

Remove capacitor leads (BL Model) or Z2 from the rectifier assembly (SL Model).

Run the alternator at normal no-load speed. Measure the voltage as indicated below:

- Model BL105 across output leads U1 6 U2 Voltage 1.5 (min)
- Model SL105 across output leads U1 6 U2 Voltage 1.5 (min)

7.3.1 BL Model

Reconnect capacitor leads to original position. Run alternator at normal no-load speed. A 12 volt battery should then be instantaneously flashed (that is connected for only one second) across the capacitor. The auxiliary leads must still be connected to the capacitor. The output voltage should then build up to the normal no-load level.

7.3.2 SL Model

Reconnect lead Z2 to rectifier assembly and disconnect leads F1 - F2. Run alternator at normal no-load speed and apply a 12 volt supply, from the battery, to the brush -holder for about 3 seconds. Ensure the positive lead is applied to the brush holder nearest the bearing housing.

The output voltage of the alternator, with the 12 volt supply connected, should be approximately normal voltage. Stop the alternator and reconnect leads F1 - F2.

NOTICE

Important ! Ensure the battery leads are connected to the brush holder with the correct polarity, and leads F1 - F2 are isolated from each other and earth.

Check windings for continuity and resistance values to the following table [Section 7.4](#).

7.4 Resistance Charts

WARNING

Replace all guards and protective covers after servicing. Failure to do so may result in operator personal injury.

All figures are approximate values in ohms.

TABLE 1. 50HZ WINDINGS RESISTANCE VALUES

MODEL	VOLTAGE	ROTOR	MAIN STATOR	AUXILLIARY
			PER SECTION	WINDING
BL105A	240/120	7.88	1.964	1.291
BL105A	220/110	7.88	1.613	1.291
BL105A	230/115	7.88	2.15	1.48
BL105B	240/120	4.13	1.805	1.16
BL105B	230/115	4.13	1.65	1.16
BL105B	230/115	4.13	1.65	1.13
BL105C	240/120	8.60	1.49	1.21
BL105C	220/110	8.60	1.36	1.21
BL105C	230/115	8.60	1.43	1.21

MODEL	VOLTAGE	ROTOR	MAIN STATOR	AUXILLIARY
			PER SECTION	WINDING
BL105E	240/120	9.57	0.954	1.16
BL105E	230/115	9.57	0.911	1.21
BL105F	240/120	10.05	0.753	0.926
BL105F	220/110	10.05	0.666	0.926
BL105F	230/115	10.05	0.684	0.991
BL105G	240/120	10.53	0.669	0.862
BL105G	220/110	10.53	0.489	0.829
SL105A	230/115	11.13	2.641	4.24
SL105B	230/115	11.66	1.58	4.227
SL105C	230/115	12.15	1.326	3.18
SL105E	230/115	10.66	0.858	2.155
SL105F	230/115	11.31	0.726	1.935
SL105G	230/115	11.85	0.565	1.771

TABLE 2. 60HZ WINDINGS RESISTANCE VALUES

MODEL	VOLTAGE	ROTOR	MAIN STATOR	AUXILLIARY
			PER SECTION	WINDING
BL105A	240/120	7.88	1.467	0.906
BL105A	220/110	7.88	1.182	0.906
BL105B	240/120	4.13	1.27	0.826
BL105B	220/110	4.13	1.27	0.826
BL105B	240/120	4.13	1.65	1.16
BL105C	240/120	8.60	1.09	0.873
BL105C	220/110	8.60	0.89	0.873
BL105E	240/120	9.57	0.693	0.82
BL105E	220/110	9.57	0.553	0.82
BL105E	240/120	9.57	0.656	0.82
BL105F	240/120	10.05	0.554	0.789
BL105F	220/110	10.05	0.436	0.66
BL105G	240/120	10.53	0.467	0.646
BL105G	220/110	10.53	0.41	0.646
BL105G	230/115	10.53	0.607	0.829
SL105A	240/120	11.13	1.934	4.24
SL105B	240/120	11.66	1.206	3.758
SL105C	240/120	12.15	0.971	3.18
SL105E	240/120	10.66	0.665	1.946
SL105F	240/120	11.31	0.5	1.756
SL105G	240/120	11.85	0.397	1.735
SL105G	240/120	11.85	0.423	1.624

7.5 Assembly/Dismantling Procedure

Component identification numbers refer to those shown in [Chapter 9 on page 33](#).

7.5.1 Assembling Alternator To Engine

1. Apply LOCTITE 'THREADLOCK' or equivalent to one end of the shaft securing stud [1]. Fit this end of the shaft securing stud [1] into the engine shaft, ensuring the full length of thread is engaged.
2. Fit appropriate engine adaptor plate and fit studs supplied into the alternator side of the adaptor plate and tighten.
3. Remove end cover fixing screws [2] and end cover [3].
4. Remove transit bolt from shaft end and discard both bolt and large washer.

NOTICE

On SL and TL models care must be taken to avoid damage to the carbon brushes by excessive axial movement of the rotor. Lift brushes if in doubt.

5. Offer stator frame assembly [4] complete with rotor assembly up to the engine, feeding rotor over securing stud and frame on to the adaptor studs. Tap frame over the adaptor spigot.
6. Fit nuts and washers securing the frame to the adaptor studs and tighten.
7. Fit the 5/16" UNF SELF LOCKING nut (Shaft Securing Nut) [5] to the shaft securing stud [1] and tighten.
8. Replace end cover [3].
9. Secure stator frame assembly to the bedplate foot fixing(s). Where the stator frame assembly is rigidly mounted to the bedplate, shims must be fitted to ensure accurate alignment.

Refer to [Section 7.5.13 on page 28](#) for torque settings.

7.5.2 Dismantling Stator Frame Assembly

NOTICE

On SL models remove end cover fixing screws [2] and end cover [3] and lift brushes [12] (part of brushbox assembly).

1. Remove nuts securing frame to adaptor studs.
2. Remove feet fixing bolts (or nuts).
3. Tap frame away from the engine to release the adaptor spigot. Withdraw stator frame assembly over the rotor.

7.5.3 Withdrawing Rotor From Engine

1. Remove the shaft securing nut [5].
2. Release rotor from engine taper shaft by supporting rotor in one hand and with a hide / soft faced mallet striking firmly on a pole face.

NOTICE

Do not use the fan [6] to prevent the rotor turning when releasing the shaft securing nut.

7.5.4 Removal/Replacement of Capacitor - BL Models

1. Remove end cover fixing screws [2] and end cover [3] and disconnect capacitor leads.
2. Remove capacitor fixing nut [11] and cut nylon tie support [12].
3. Remove capacitor [13].

Replacement is a reversal of removal.

7.5.5 Removal/Replacement of Rectifier Hub - Single Diode

NOTICE

Take careful note of connections and positions of the solder tags before carrying out the following procedure. Incorrect polarity of the diode varistor assembly will destroy residual magnetism.

1. Rotor must be removed from the alternator/engine to carry out this procedure [Section 7.5.3](#).
2. Remove Non-Drive End bearing from rotor shaft.
3. Carefully cut the ties which hold the winding wires in place.
4. Unsolder all leads from the diode
5. Using a hammer and chisel, knock off the old hub assembly, (this may require a significant amount of effort owing to the hub being held in place by adhesive).
6. Using abrasive paper, remove any excess old adhesive from the shaft where the hub was located. Do this until the new hub slides with ease into the correct position.
7. Apply a fast drying adhesive (LOCTITE 648 used in conjunction with Activator N LOCTITE 7649 is recommended) to the shaft where the new hub will be located.
8. Slide the new hub into position, turning it through 360°, two or three times to ensure an even film over the entire shaft.
9. Push the hub into place make sure that the diode is located centrally between the two coils.
10. Allow approximately 10 minutes for the adhesive to harden and then proceed to re-solder all the wires to the diode as described below:

With the rotor standing upright, resting on the fan and the diode facing you, take the nearest two wires from the coil along with one from the varistor and one from the snubber and solder them to the top pin of the diode. Take the other two wires from the coils and the wire from the snubber and solder them to one of the bottom tags. Take the remaining varistor wire and solder it to the other bottom diode tag.

11. Re-fit the bearing, ensuring the anti-creep groove is located closest to the hub.
12. Re-assemble rotor into stator/frame assembly.
13. As the rotor has been removed from the stator it will probably need to be flashed to put the residual magnetism back into it.

7.5.6 Removal/Replacement of Rectifier Hub - Twin Diodes

NOTICE

Take careful note of connections and positions of the solder tags before carrying out the following procedure. Incorrect polarity of the diode varistor assembly will destroy residual magnetism.

NOTICE

1. Rotor must be removed from the alternator/engine to carry out this procedure [Section 7.5.3](#).
2. Remove Non-Drive End bearing from rotor shaft.
3. Carefully cut the ties which hold the winding wires in place.
4. Unsolder all leads from both diodes
5. Using a hammer and chisel, knock off the old hub assembly, (this may require a significant amount of effort owing to the hub being held in place by adhesive).
6. Using abrasive paper, remove any excess old adhesive from the shaft where the hub was located. Do this until the new hub slides with ease into the correct position.
7. Apply a fast drying adhesive (LOCTITE 648 used in conjunction with Activator N LOCTITE 7649 is recommended) to the shaft where the new hub will be located.
8. Slide the new hub into position, turning it through 360°, two or three times to ensure an even film over the entire shaft .
9. Push the hub into place make sure that the diodes are located between the two coils
10. Allow approximately 10 minutes for the adhesive to harden and then proceed to re-solder all the wires to the diodes as described below:

With the rotor standing upright, resting on the fan, take the wire from the right-hand coil and solder it to the centre stem pin of the diode facing you. Take the other wire from the same coil and solder it to one of the diode tags. Make sure the remaining varistor wire is soldered to the other diode tag.

Turn the rotor 180° and repeat for the other diode.
11. Re-fit the bearing, ensuring the anti-creep groove is located closest to the hub.
12. Re-assemble rotor into stator/frame assembly.
13. As the rotor has been removed from the stator it will probably need to be flashed to put the residual magnetism back into it.

7.5.7 Removal/Replacement of AVR - SL Models

1. Remove end cover fixing screws [2] and end cover [3].
2. Disconnect the four leads (three black and one grey) from the four spade terminals on the right hand side of the AVR, taking note that the grey lead is always connected to the terminal marked F1.
3. Remove the three AVR fixing screws [13] and remove AVR [14].

Replacement is a reversal of removal. Ensure that the leads to the AVR are correctly replaced and the grey lead is connected to terminal F1.

If grey (F1) and black (F2) leads are reversed it will be necessary to flash the field when restarting. Refer to [Section 7.3 on page 21](#).

7.5.8 Removal/Replacement of Diode Bridge - SL Models

NOTICE

Note positions of leads on the assembly before removal.

1. Remove end cover fixing screws [2] and end cover [3].

-
2. Remove leads from diode bridge [16]. Remove diode bridge fixing screw [22] and remove diode bridge.

Replacement is a reversal of removal.

7.5.9 Removal/Replacement of Choke - SL Models

1. Remove end cover fixing screws [2] and end cover [3].
2. Remove diode bridge fixing screws [22].
3. Lift away choke and remove connecting leads. Remove choke [15].

Replacement is a reversal of removal.

7.5.10 Removal/Replacement of Radio Interference Suppressor (RIS) - SL Models When Applicable

1. Remove connecting leads.
2. Remove RIS fixing screw [19] and remove RIS [17].

Replacement is a reversal of removal.

NOTICE

Ensure that the RIS spacer [20] is fitted between the RIS and frame.

7.5.11 Removal/Replacement of Bearing

NOTICE

On SL Models ensure brushes are lifted before attempting to refit the rotor assembly into the stator frame assembly.

1. With the rotor withdrawn, use a standard bearing puller to remove the bearing from the shaft.
2. Place new bearing squarely on the shaft end with anti-creep circlip groove inboard and drift into place using a suitably sized soft tubular drift on the bearing inner race.

Care must be taken to ensure that the anti-creep circlip is correctly located in the groove before mating with the bearing housing, i.e. the bump on the circlip is in the deepest part of the groove.
3. Refit the rotor assembly into the stator frame assembly taking care to avoid damaging wound components.
4. Locate the bearing in the housing and tap into position.
5. Assemble alternator to engine. Refer to [Section 7.5.1 on page 24](#).

7.5.12 Removal/Replacement of Brushes/BrushBox Assembly - SL Models

1. Remove end cover fixing screws [2] and end cover [3].
2. On SL models remove AVR [14]. Refer to [Section 7.5.7 on page 26](#).
3. Remove fixing screw [21] and lift away brushbox assembly.

Replacement is a reversal of removal.

On SL models refit AVR as detailed in [Section 7.5.7 on page 26](#).

If brushes only are to be changed remove brush terminal plate and withdraw springs and brushes. New brushes must be bedded using a medium grade abrasive cloth.

7.5.13 Torque Settings

 **CAUTION**

After servicing ensure all protective guards and access covers are fitted. Failure to do so can result in operator injury.

Adaptor to engine - Refer to engine manufacturer.

Adaptor to frame - 5.4 Nm (0.55 kgf.m)

Shaft securing nut - 20.4 Nm (2.1 kgf.m)

7.5.14 After Sales Service

A full technical advice and on-site service facility is available from our Service Department in Oakham or through our Subsidiary Companies.

Call for quotation.

8 Fault Finding

 **DANGER**

Hazardous voltage.

Will shock, burn or cause death.

Fault finding methods include tests on live electrical conductors carrying high voltage. Risk of serious injury or death by electric shock. Fault finding must be done by competent, qualified persons trained in safe working practices.

Assess risk and work on or near live conductors only if absolutely necessary. Do not work on or near live conductors alone; another competent person must be present, trained to isolate energy sources and take action in an emergency.

Place warnings and prevent access to test area by unauthorized persons.

Make sure that tools, test instruments, leads and attachments are designed, inspected and maintained for use on the maximum voltages likely under normal and fault conditions.

Take suitable precautions to prevent contact with live conductors, including personal protective equipment (PPE), insulation, barriers and insulated tools.

Before starting any fault finding procedure, examine all wiring for broken or loose connections. If in doubt, refer to the wiring diagram supplied with the alternator. Compare measurements with the test report supplied with the alternator.

The following list is to aid in troubleshooting and is not exhaustive. If in doubt, consult Cummins service department.

8.1 Fault Finding Procedures

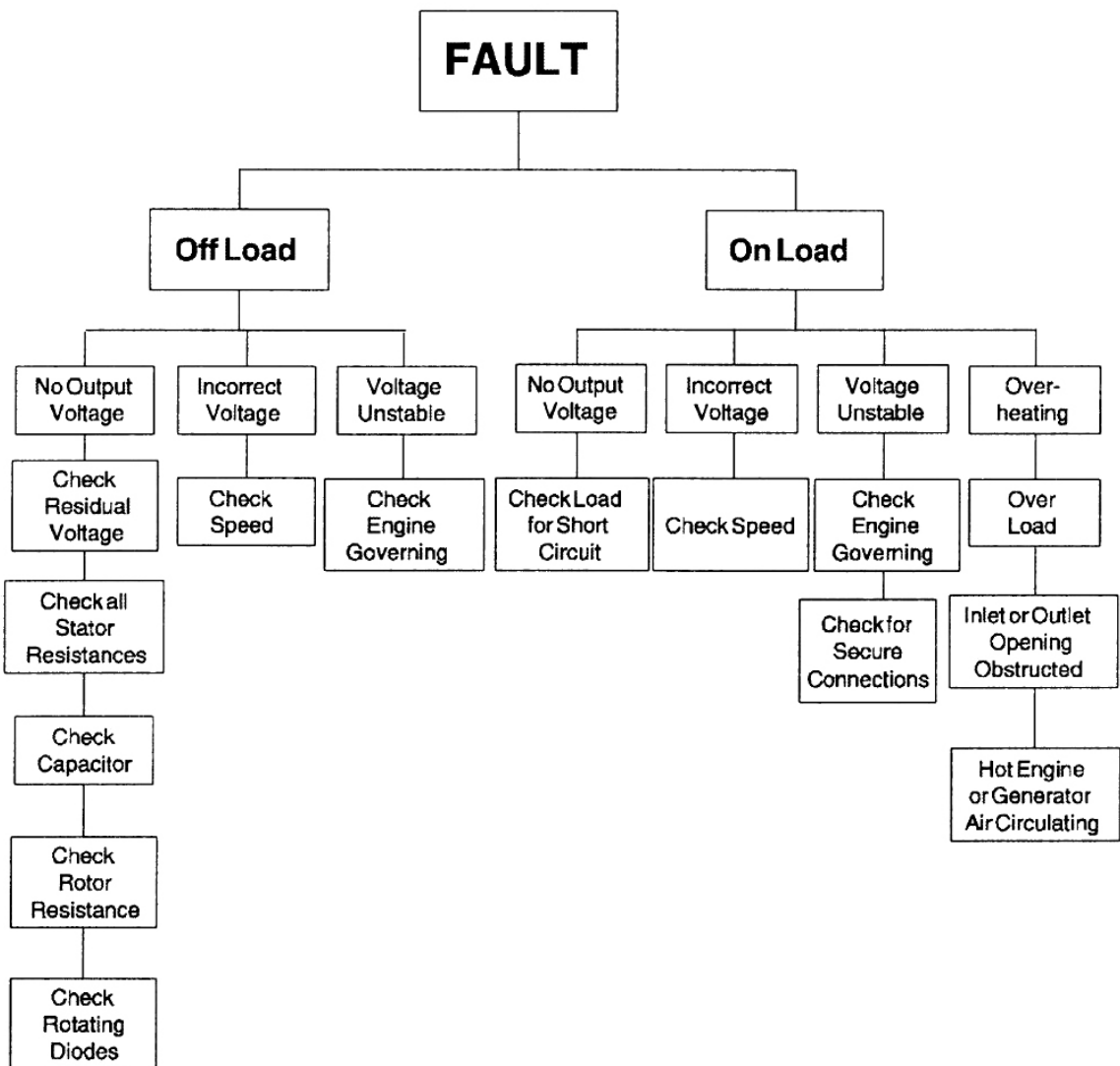
Should a fault develop during operation it is best identified by carrying out the checks identified in the following fault finding guides.

Refer to Assembly / Dismantling section when attempting to replace components.

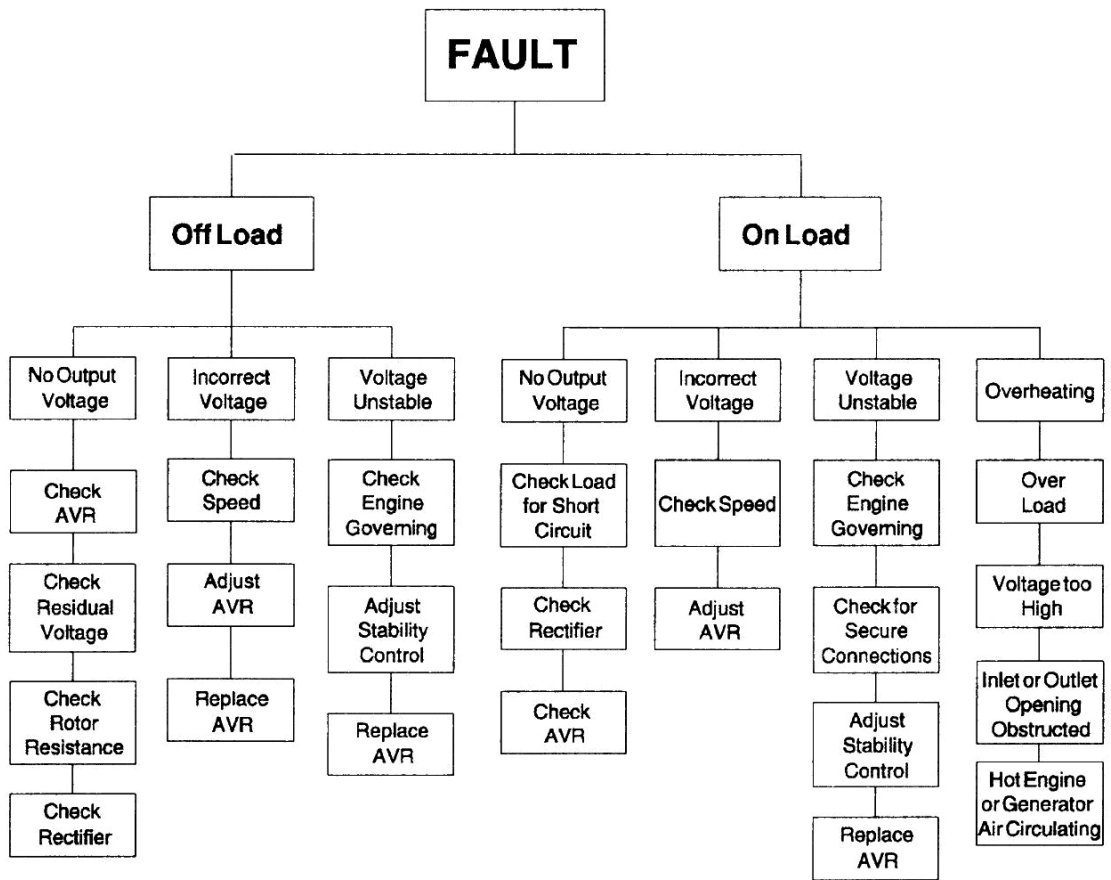
Before proceeding always check security of all connections, especially those to control equipment and / or AVR.

On SL models remove air intake cover and check condition of the sliprings, the freedom of movement of brushes, brush spring tension and amount of brushwear. Brushes should not be less than 8 mm long.

8.2 BL Model - Fault Finding Guide



8.3 SL Model - Fault Finding Guide



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9 Parts Identification

9.1 BL105 Alternator - Single Bearing

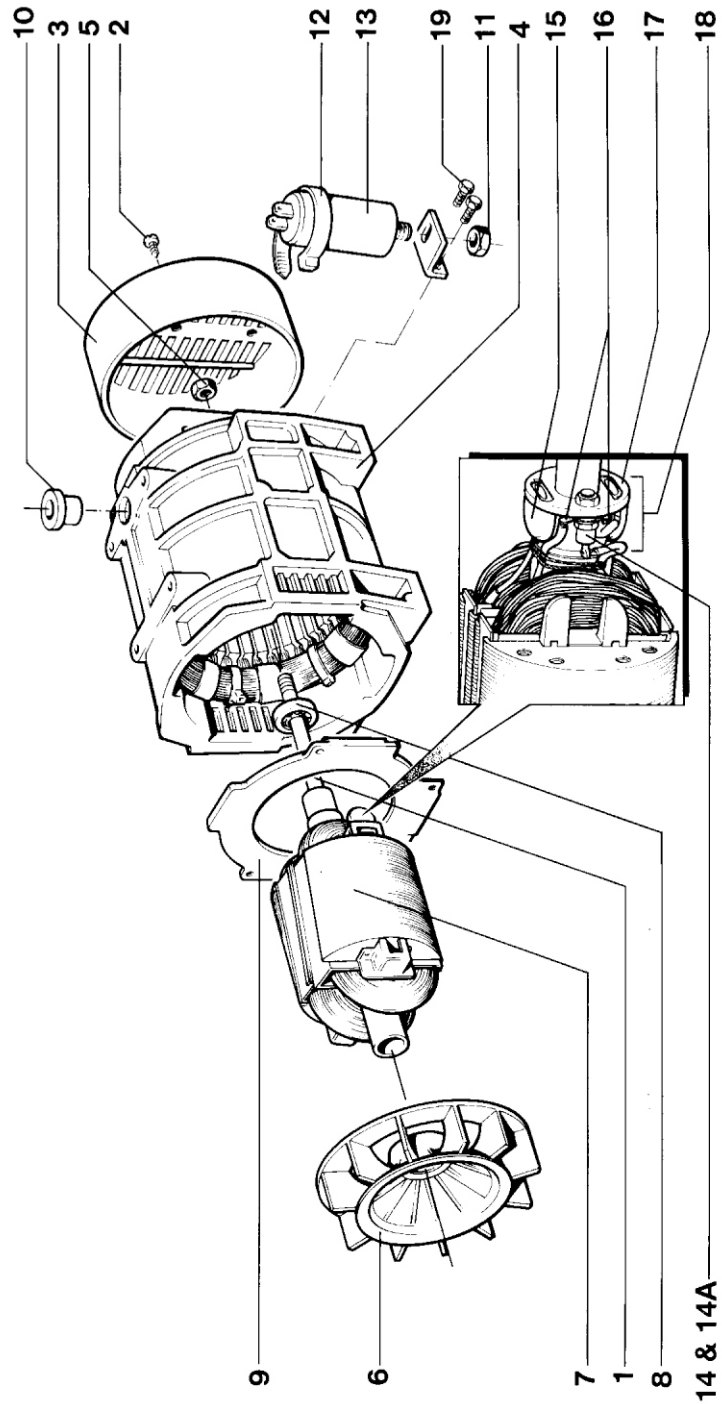


TABLE 3. BL105 ALTERNATOR - SINGLE BEARING

Plate Ref	Description	Part Numbers
1	SHAFT SECURING STUD	Various
2	END COVER FIXING SCREWS	005-04053
3	END COVER (PLASTIC)	14-116 / 1
3	END COVER (STEEL)	240-20344
4	STATOR FRAME ASSEMBLY	Various
5	SHAFT SECURING NUT	018-001
6	FAN	240-10213
7	WOUND ROTOR ASSEMBLY	Various
8	BEARING	014-040
9	AIR BAFFLE	240-10127
10	INSULATING BUSH	016-016
11	CAPACITOR FIXING NUT	With Capacitor
12	CAPACITOR SUPPORT BRACKET	240-10120
13	CAPACITOR (40uf)	009-093
14	DIODE (Forward) 800v	002-022
14a	DIODE (Reverse) 800v	002-023
14b	DIODE (Single Diode Type) 1200v	073-50042
15	VARISTOR	073-08160
16	SOLDER TAG	020-131
17	DIODE / VARISTOR CARRIER HUB	20-205 / 1
18	DIODE / VARISTOR HUB ASSEMBLY (2 Diode Type)	B105Z-11001
18a	DIODE / VARISTOR HUB ASSEMBLY (1Diode Type)	240-10335
18b	DIODE / VARISTOR HUB ASSEMBLY (PCB Type)	240-10336
19	CAPACITOR BRACKET FIXING SCREW	005-04084

9.2 BL105 Alternator - Two Bearing

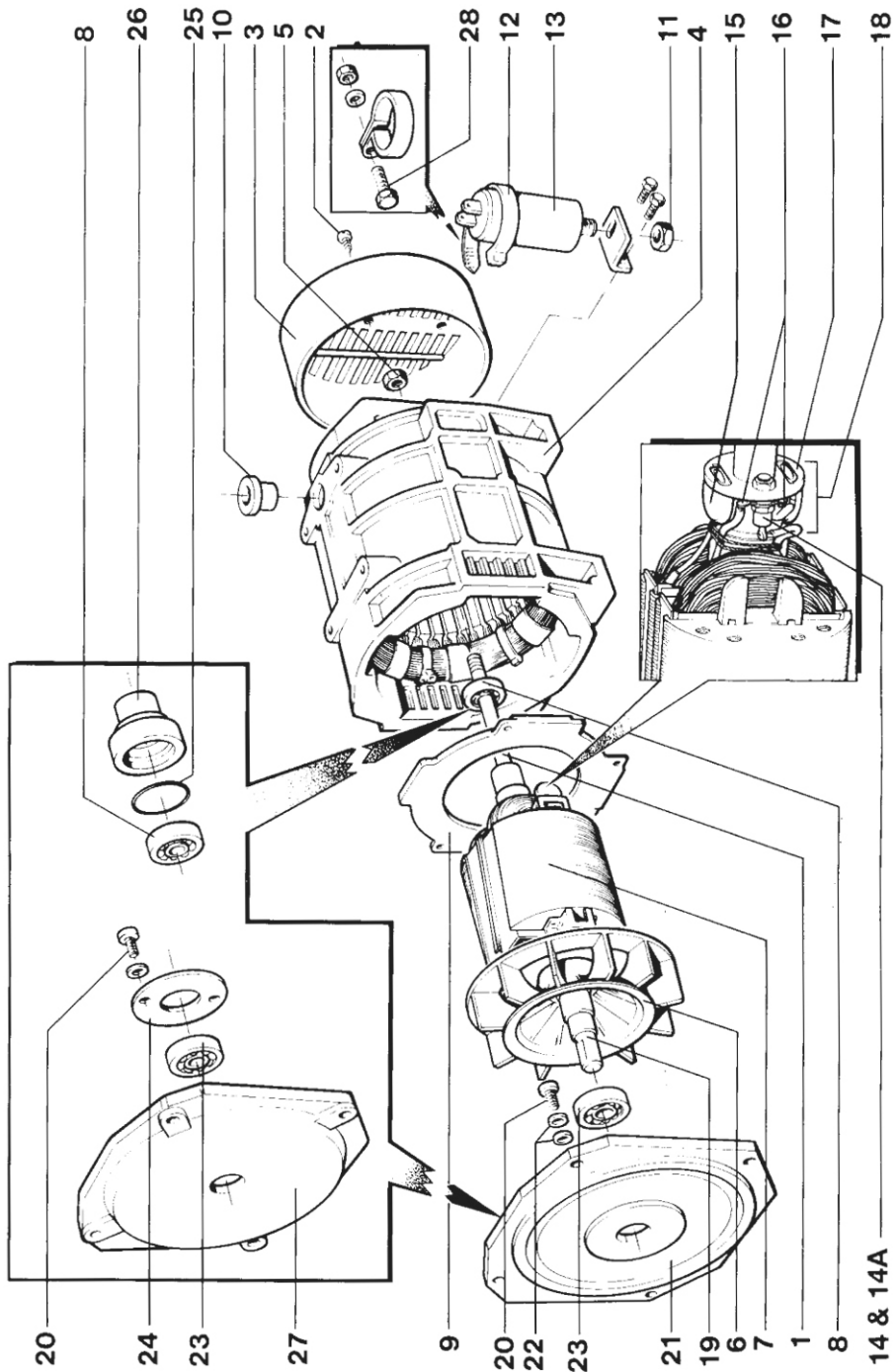


TABLE 4. BL105 ALTERNATOR - TWO BEARING

Plate Ref	Description	Part Numbers
1	SHAFT SECURING STUD*	240-20618 or 240-20624
2	END COVER FIXING SCREWS	005-04053
3	END COVER	14-116 / 1 or 240-20344
4	STATOR FRAME ASSEMBLY	Various

Plate Ref	Description	Part Numbers
5	SHAFT SECURING NUT*	018-001
6	FAN	240-10213
7	WOUND ROTOR ASSEMBLY	Various
8	BEARING — NON DRIVE END	014-040* / 014-041**
9	AIR BAFFLE	240-10127
10	INSULATING BUSH	016-016
11	CAPACITOR FIXING NUT	With Capacitor
12	CAPACITOR SUPPORT	240-10120
13	CAPACITOR (40uf)	009-093
14	DIODE	(See Single Bearing parts list)
15	VARISTOR	073-08160
16	SOLDER TAG	020-131
17	DIODE / VARISTOR CARRIER HUB	20-205 / 1
18	DIODE / VARISTOR HUB ASSEMBLY	(See Single Bearing parts list)
19	STUB SHAFT*	05-416 / 1 or 05-417 / 1
20	BEARING RETAINING SCREW	016-40717
21	D.E.BRACKET	Various
22	BEARING RETAINING WASHER*	501-016
23	BEARING — DRIVE END	014-003* / 014-042**
24	BEARING RETAINING WASHERS**	501-057
25	O' RING**	019-014
26	BEARING HOUSING**	240-10154
27	D.E.BRACKET**	Various

9.3 SL105 Alternator

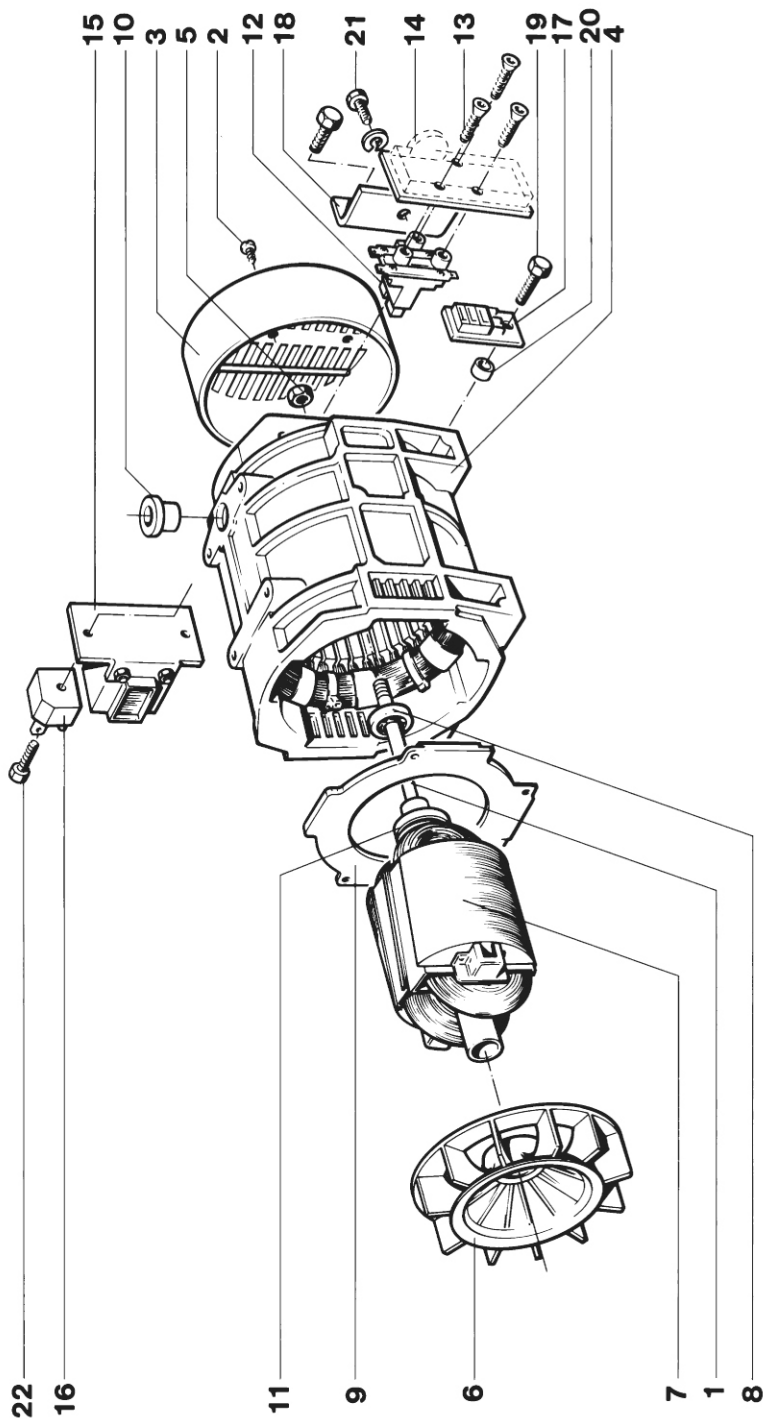


TABLE 5. SL105 ALTERNATOR

Plate Ref	Description	Part Numbers
1	SHAFT SECURING STUD	Various
2	END COVER FIXING SCREWS	005-04053
3	END COVER (PLASTIC)	14-116 / 1
3	END COVER (STEEL)	240-20344

Plate Ref	Description	Part Numbers
4	STATOR FRAME ASSEMBLY	Various
5	SHAFT SECURING NUT	018-001
6	FAN	240-10213
7	WOUND ROTOR ASSEMBLY	Various
8	BEARING	014-040
9	AIR BAFFLE	240-10127
10	INSULATING BUSH	016-016
11	SLIPRINGS	013-001
12	BRUSHBOX ASSEMBLY	011-008
13	AVR FIXING SCREWS	504-163
14	AUTOMATIC VOLTAGE REGULATOR (AVR)	036-245
15	CHOKER	240-20346
16	DIODE BRIDGE	002-058
17	RADIO INTERFERENCE SUPPRESSOR (RIS)	036-115
18	BRUSHBOX MOUNTING PLATE	240-10126
19	RIS FIXING SCREW	005-04076
20	RIS INSULATING SPACER	240-1 01 37
21	BRUSHBOX FIXING SCREW	016-40613
22	DIODE BRIDGE FIXING SCREW	005-04076

10 Service Parts and After Sales Service

10.1 Recommended Spares

Service parts are conveniently packaged for easy identification.

We recommend the following for service and maintenance. In critical applications a set of these service spares should be held with the alternator.

TABLE 6. BL105 MODELS

	Description	Part No.	Quantity
1	Capacitor	009-093	1
2	NDE Bearing	014-040	1
3	NDE Bearing - R.V.A.	014-041	1
4	DE Bearing - 2 Bearing	014-003	1
5	DE Bearing - R.V.A.	014-042	1
6	Diode Varistor Assembly	B105Z-11001 or 240-10335 (Snubber) or 240-10336 (PCB)	1

NOTICE

R.V.A. refers to Road Vehicle Alternator.

TABLE 7. SL105 MODELS

	Description	Part No.	Quantity
1	AVR MD1C	036-245	1
2	Diode Bridge	002-058	1
3	NDE Bearing	014-040	1
4	DE Bearing - 2 Bearing	014-003	1
5	Brushbox (including brushes)	011-008	1
6	Carbon Brush with spring	010-026	2

When ordering spare parts the machine serial number and type should be quoted, together with the part description. The serial number is on the side of the alternator.

Orders and enquiries for parts should be addressed to:

Cummins Generator Technologies Mexico

Av. Circuito Mexico No. 185

Parque Industrial 3 Naciones

San Luis Potosi, SLP

C.P. 78395

Tel: +52 444 870 4400

Fax: +52 444 870 4471

10.2 After Sales Service

A full technical advice and on-site service facility is available from our Service Department in Oakham or through our Subsidiary Companies.

Call for quotation.

11 End of Life Disposal

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.

11.1 Recyclable material

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

The iron, steel and copper can now be recycled.

11.2 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.

11.3 Waste material

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

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