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# **GENERAL PRODUCT APPLICATIONS AND CONDITIONS OF USE DOCUMENT (PACU 097) FOR PRESTOLITE ALTERNATORS**

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## **1. INTRODUCTION**

- 1.1. This document is intended to provide general application advice (including safety aspects) for the range of Prestolite alternators.
- 1.2. Individual products may have an additional PACU to cover specific requirements supplementary to this document. Products may also have outline drawings, circuit diagrams and technical service bulletins. This information can be obtained from Prestolite Electric or from our website [www.prestolite.com](http://www.prestolite.com).
- 1.3. It is important to contact a representative of the Applications or Sales departments of Prestolite Electric Ltd before specifying a product.
- 1.4. Products must be installed in accordance with the requirements of the relevant outline (installation) drawing.
- 1.5. Prestolite electrical equipment, including starters and alternators, is designed for use on approved applications on bus, coach, heavy commercial vehicle (exceeding 3.5 Tonnes UW), industrial, agricultural and marine engines. Use for aviation is specifically excluded.

## **2. GENERAL PRODUCT INFORMATION**

- 2.1. The rated performance is shown on the relevant drawing and/or performance curve.
- 2.2. In general, an alternator should be operated with a battery connected to its main terminals. Use without a battery is specifically excluded unless agreed by Prestolite Electric during the installation sign off. It is, however, normally permissible to run the alternator within its speed range without a battery connected, (or any connections at all for that matter) for the short period of time necessary for production engine testing. Should the alternator cut-in the voltage may be up to 1V above the nominal voltage when operating in this condition.  
  
Some alternators are designed for batteryless systems and in order to avoid system damage these alternators should not be connected to the vehicle battery. Details and recommendations for these systems can be obtained from Prestolite Electric.
- 2.3. The output is self limiting and the machine will not be damaged in the short term by an electrical load exceeding its rated value, but prolonged use at speeds where the rated output is exceeded will lead to battery discharge. It is essential that careful evaluation is carried out to ensure that a good load balance has been obtained. Poor load balance will result in the alternator running at maximum output for a high proportion of the duty cycle with consequential reduction in the long term life and durability of the alternator and also the system batteries. Poor load balance may also reduce the performance and / or life of other system components. The responsibility for the choice of drive ratio and the type of alternator will rest with the system designer, and Prestolite Electric can not be held responsible for undercharged batteries resulting from poor load balance.
- 2.4. To achieve the expected / predicted operating life it is essential that the machine must not be used in applications where the following parameters are exceeded.
  - 2.4.1. Maximum speed quoted in the specifications.
  - 2.4.2. Temperature range quoted in the specifications.

- 2.4.3. It is strongly recommended that all installations should provide a clean, cool, dry environment as this will increase machine life. This will also improve battery charging performance as the regulator temperature coefficient will ensure that the alternator output voltage is more closely matched to the battery requirement.
- 2.5. Prestolite alternators are of ventilated design and not recommended for use on under floor applications where it could be subjected to water or salt spray. However, the machine if occasionally subjected to a moderate water splash, will not suffer damage. If the machine is mounted low on an engine in an open compartment, then protection should be considered.
- 2.6. Prestolite alternators incorporate an electronic regulator to control the output voltage to a nominal value quoted in the specification, subject to limitations of speed, load and temperature. Under no circumstances should an external supply be connected / disconnected during alternator operation. Failure to observe this may result in unfavourable operating characteristics due to a conflict in regulator set points.
- 2.7. Some alternators have an AC output derived from the stator. The frequency relationship may be 6 or 8 pulses per revolution of the alternator shaft and may be electronically buffered or taken directly from a phase tap. Thus the frequency and source impedance of the AC out should be checked to ensure compatibility with the application. Where the signal is taken directly from a phase consideration should be given to fusing the cable close to the alternator.
- 2.8. In the rare event of regulator short circuit failure then the machine will attempt to deliver maximum rated current irrespective of battery demand. This will lead to the battery voltage rising above the normal maximum value. Some regulators have additional protection circuitry to provide a warning output or shut the machine down entirely should this situation arise.
- 2.9. Some alternators have rectifier diodes of the Avalanche (Zener) type and these limit the maximum voltage generated under load dump conditions. If the battery or a large inductive load is disconnected during operation then the resultant transient voltages (if large enough) will be clamped by reverse conduction of direction within the rectifier diodes for a short period of time. This prevents excessive voltage appearing on the machine terminals. The warning lamp may flash during operation under this condition when the machine recovers. If your system requires this protection then please ensure that you select an alternator with avalanche diodes.
- 2.10. The regulation voltage is affected by the temperature coefficient of the regulator. This is normally a negative parameter in the range  $-5\text{mV/K}$  to  $-15\text{mV/K}$  and has the effect of reducing the battery charging voltage as the regulator temperature increases. This assists in matching the alternator voltage to the battery temperature characteristic. The exact value is regulator dependent and may be obtained from Prestolite. The selected parameter must be correctly matched to the battery type and operating conditions to avoid under or overcharge conditions.

### **3. ELECTRICAL INSTALLATION**

- 3.1. The output cable(s) must be rated to carry the maximum output current between the alternator and the battery. The total voltage drop in both positive and negative cables (including connectors) must not exceed the recommended volt drop at maximum output. Typically this would be 0.5V for 12V systems and 1V for 24V systems.
- 3.2. All cables should be supported to avoid failure due to vibration and should be securely connected to the alternator. Prestolite Electric recommendations for terminal tightening should be adhered to and the customer should check that this is suitable for the installation. Where cable conduits are used these should be looped adjacent to the alternator and a hole positioned at the lowest point to ensure water drainage.
- 3.3. It is good practice to fit a battery isolation switch in line between alternator and battery. This enables the alternator to be disconnected from the battery during repairs, servicing and if there is a fault condition. The switch should be suitably rated for the application. If a switch is not fitted then alternative arrangements must be made to ensure safe working.
- 3.4. Main connections should be made to the terminals as specified on the outline drawing. On earth return machines that have a negative terminal it is recommended to connect to this negative terminal rather use the connection from the mounting bolts into the engine.
- 3.5. The alternator may have a D+, WL or L connection. A lamp may or may not be required for excitation of the alternator. It should be noted that the L terminal may be driven by a low-side switch with no pull up. In this case only resistive loads to B+ should be connected to the terminal. Inductive loads such as relay coils must not be connected to the L terminal. The Outline drawing should always be consulted for the precise details of the correct connection schemes and Prestolite Electric Applications department consulted if required.
- 3.6. A warning lamp or relay auxiliary load can be connected to trio-equipped machines or regulators that incorporate a high-side/low-side D+/L driver.
- 3.7. In the case of trio-equipped machines, a warning light (with a minimum rating specified by Prestolite Electric) or an equivalent resistor must be connected to the alternator to provide initial excitation current from the battery (normally 100mA minimum at 22V or 200mA at 11V). This is necessary to ensure correct excitation of the machine. The warning light has the advantage of indicating failure of the charging system. Normally the warning light will be illuminated when the ignition switch is on and the alternator stationary. As the alternator speed is increased the warning light will go out when the cut in speed is reached. A charging system fault is indicated by one of the following:
  - 3.7.1. The warning light is not illuminated with the stationary alternator.
  - 3.7.2. The warning light does not extinguish at cut in speed.
  - 3.7.3. The warning light subsequently illuminates during operation.
- 3.8. Prestolite alternators normally incorporate one or more capacitors for radio frequency suppression. However, responsibility for the system EMC design and compliance with relevant EMC regulations is the responsibility of the system or vehicle integrator. Prestolite Electric will provide information and assistance as required.

- 3.9. Load share and parallel charging or multiple alternator applications. Certain products within the Prestolite range are not designed for parallel operation and connection in this configuration may result in unfavourable operating characteristics. Good practice in multiple alternator applications is to use alternators of exactly the same design and operate them at the same speed and temperature with the same circuitry. This includes having similar lead lengths and volt drops in the circuit. Applications using dissimilar products and manufacturers are particularly prone to sharing problems. It is important to notify Prestolite Applications department if parallel operation is required so that the correct advice, product & integration is given. See also 2.6.
- 3.10. When using Prestolite products to retrofit onto existing vehicles, it is important to check that there is no legacy equipment or circuitry that could cause adverse effects.

#### **4. MECHANICAL INSTALLATION**

- 4.1. The alternator should be mounted where, in the event of bracket failure, it cannot affect the safe operation of the vehicle by the rupture of hydraulic or electrical connections, or interfere with the steering mechanism. Mounting brackets should be of a sufficiently robust nature and the mounting bolts should be of an adequate size and tightened to specification. All bracket designs must be approved by Prestolite Electric.
- 4.2. When the engine is running the fan and pulley assembly constitute a safety hazard to a person performing work in the engine compartment. The alternator should therefore be sited so as to minimise the risk of the hands or clothing of an operator coming into contact with any rotating component or belt.
- 4.3. The alternator should be sited where it will not be exposed to contamination e.g. by spillage of fuel, oil, brake fluid, antifreeze, battery acid or kerosene.
- 4.4. The alternator should be mounted on the engine in a cool position where the flow of air through the unit will be unobstructed and where there will be no risk of damage due to radiant heat from the exhaust system. The side of the engine opposite to the exhaust outlet is therefore preferred. If exhaust side mounting is unavoidable, heat shields or ducts should be used. See also operating temperature range, paragraph 2.4.2.
- 4.5. If piped air is used then the intake grill should be suitably located to ensure a clean, cool supply. The pipe length should be as short as possible and have a drain at the lowest point. If flexible piping is used it should be fire retardant and self supporting. The intake grill must be designed to allow ease of inspection and cleaning.
- 4.6. Bearing life is a function of pulley overhang, radial pulley load, drive ratio and speed. Having regard to these factors, the bearing life should be calculated for all installations to ensure that the design life is adequate. Prestolite Electric will not normally approve an installation if the B10 bearing life is less than 20000 hours or 800000 km. Over-tensioning of the drive belt will reduce bearing life. Bearing life can also be reduced by belt oscillations caused by other auxiliaries on the belt run and even torsional oscillations due to engine firing pulses.
- 4.7. The pulley should be fitted to the shaft such that it abuts the centre of the fan. It is essential that the shaft nut is tightened to the specified torque. Serious damage to the machine can occur if this nut is not tightened to the specified torque. Customer service instructions must emphasise the importance of this torque specification and the correct assembly of all associated nuts & washers.

- 4.8. Instructions on the outline drawing referring to mechanical handling, torque specifications and tightening procedures should be strictly adhered to.
- 4.9. Brush life (when applicable) will vary according to operating cycle. In order to minimise radio frequency emissions, brush replacement should be planned at regular intervals.

## **5. APPLICATION SIGN OFF**

As part of the application or installation sign-off procedure it is expected that a Prestolite Electric Applications Engineer will inspect the completed installation and any relevant circuit diagrams, drawings and calculations. Particular attention will be paid to the following:

Alternator Mounting	Alternator Drive Ratio	Electrical Connections
Operating Duty	Environmental conditions and piping	
Electrical loading	Ambient, Engine compartment and air inlet temperatures	
Ease of removal and refitting		

In some cases it may be necessary to make vehicle measurements. Warranty will be withheld if Prestolite Electric application department does not approve the installation or if the installation changes from the standard that has been signed off.

## **6 SERVICE PRECAUTIONS**

- 6.1 The cable(s) are live at all times while the battery is connected. Before any form of maintenance or inspection is attempted the battery must be disconnected.
- 6.2 Connections must not be made or broken in the presence of a flammable vapour. Hydrogen & Oxygen gas from a battery under charge can cause a fire and /or an explosion.
- 6.3 The alternator must not be operated in the presence of a flammable vapour.
- 6.4 When the alternator is rotating, the fan and pulley constitute a safety hazard. No maintenance work or inspection should be attempted when the engine is running.
- 6.5 The alternator or battery leads must not be disconnected when the engine is running.
- 6.6 Refitting:

Reversed battery connections will result in a high fault current damaging the rectifier, causing severe arcing and overheating the cable. It is therefore essential to ensure correct polarity.
- 6.7 Jump Starting:

The use of an external battery connected in parallel with the installed battery for emergency starting purposes is permitted providing:

  - 6.7.1 The external battery is the same nominal voltage as the installed battery.
  - 6.7.2 The correct polarity is maintained; reversed connection will result in dangerously high circulating current and fire risk. Refer to 6.2 and 6.6.
  - 6.7.3 The installed battery is not disconnected.
- 6.8 The alternator contains an electronic regulator and therefore special care is necessary. In particular:
  - 6.8.1 The alternator regulator terminals should not be 'flashed'.

- 6.8.2 Use of high voltage test equipment (i.e. Meggers) must only be used as detailed in the Prestolite Service Manuals or Technical Service Bulletins.
- 6.8.3 Welding and other high voltage processes should not be performed on the vehicle when the alternator is connected.

## **7 MAINTENANCE**

- 7.1 Prestolite Electric will not be responsible for any damage if maintenance instructions specified in the workshop manual, PACU or outline drawing are not strictly observed.
- 7.2 When replacement parts are required, it is essential that only genuine Prestolite Electric specified components are used.
- 7.3 All terminals, mounting bolts and pulley nuts should be regularly checked for tightness.
- 7.4 The air passages in the machine including the rectifier fins should be regularly checked to ensure they are clear. When fitted this should include the pipe and filter.
- 7.5 The relevant Prestolite Electric Service Manual or Technical Service Bulletins cover workshop procedures for stripping, assembling and testing the alternator.
- 7.6 Drive belts must be tensioned as per engine manufacturer's specification.

## **8 OPERATOR AND SERVICE INSTRUCTIONS**

- 8.1 In order to ensure that the driver / operator is aware of the function of the system it is important that the following sections of this PACU should be included in the operator's instructions.
- 8.2 3.5 Warning light connections and operation.
- 8.3 The relevant paragraphs of sections 3 to 7 should be included in the vehicle / equipment service manual.