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Application Guidance Notes: Technical Information from STAMFORD | AvK

AGN 030 – Service and Maintenance

DESCRIPTION

Suitable service and maintenance are vital to the reliable operation of the alternator and the safety of anyone coming into contact with the alternator. The alternator should be inspected between scheduled maintenance, in line with inspection procedures and schedules provided by the manufacturer to identify any potential failure modes, signs of misuse or excessive wear and tear.

An alternator specific Owner's Manual (also known as Installation, Service and Maintenance Manual) is supplied with every alternator. The manuals are also published on the www.stamford-avk.com website. Each manual includes a Section on Service and Maintenance.

The service activities are intended to maximise the life of the alternator but shall not vary, extend or change the terms of the manufacturer's standard warranty or the customer's obligation in that warranty.

Each service interval is a guide only, developed on the basis that the alternator was installed and is operated in accordance with the manufacturer's guidelines. If the alternator is located and/or operated in adverse or unusual environmental conditions, the service intervals may need to be more frequent. The alternator should be continually monitored between services to identify any potential failure modes, signs of misuse or excessive wear and tear.

Recommended Service Schedule

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

Service level documents referred to in the recommended service schedules can be purchased directly from STAMFORD |AvK Customer Service Department, by telephone on +44 1780 484732 or by email: service-engineers@cumminsgeneratortechnologies.com.

STAMFORD Alternators

The recommended service schedule for STAMFORD alternators can be found in Section 7 of the manual, with the following breakdown of sub-sections:

Recommended Service Schedule
Bearings
Controls
Cooling System
Coupling
Rectifier System
Temperature Sensors
Windings.

AvK Alternators

The recommended service schedule for AvK alternators can be found in Section 10 of the manual, with the following breakdown of sub-sections:

Preventive Servicing
Safety Precautions
Recommended Service Schedule
Servicing – General Structure
Vibration
Servicing the Bearings and the Lubrication System
Generators with Bearing Insulation
Service Windings
Servicing the Generators Cooler
Repairs, Dismantling and Reassembly.

Importance of Alternator Maintenance

The maintenance programme is developed to meet the needs of different alternator designs. There are three types of maintenance strategies;

- Reactive maintenance
    - Failure or abnormal operation
- Preventive time based maintenance
    - Time based maintenance.
    - Based on manufacturer’s experience.
- Predictive / condition based maintenance
    - Maintenance based on actual measurements.

A regular preventive maintenance schedule will ensure peak performance, maximize alternator life, maximized reliability and minimize breakdowns.

INSTALLATION CONSIDERATIONS

The alternator must be installed in an accessible location with easy access to the main terminal box, bearing cap, air filter, louvers (inlet and outlet) and NDE/DE end brackets. The mentioned access points provide easy access to internal alternator components as shown in Figure 1. This will allow the execution of periodic inspections, local maintenance and removal of the alternator for external services.

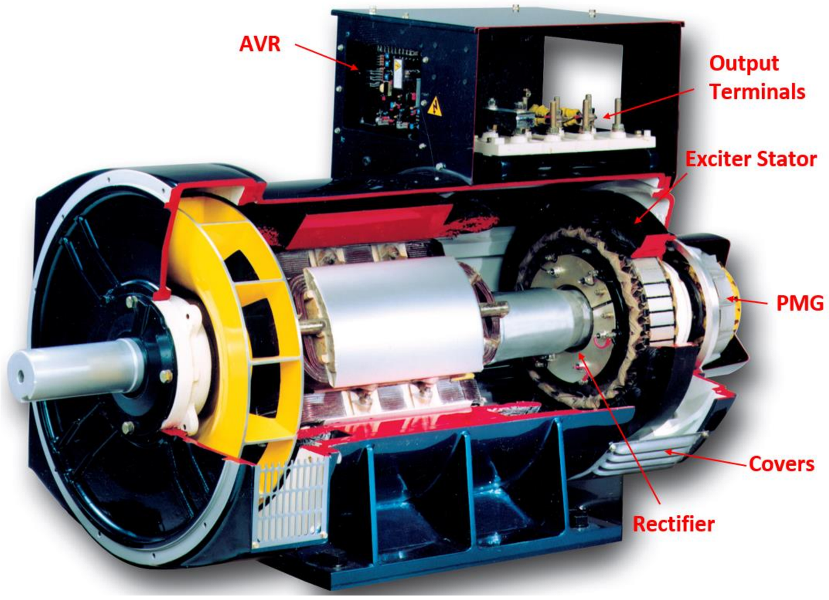

Figure 1: Internal alternator components that require periodic maintenance.

Alternators Lifting

Different alternator designs must be lifted by hooks or shackles attached to the lifting points (lugs or eyes). Chains of sufficient length, and a spreader bar if necessary must be used when lifting the alternators so as not to damage the terminal box, alternator parts and prevent the rotor from failing out on 1 bearing alternators as shown in Figure 2. When lifting entire Generating Set, the installation engineer must use specially designed Generating Set lifting points, and not alternator lifting lugs.

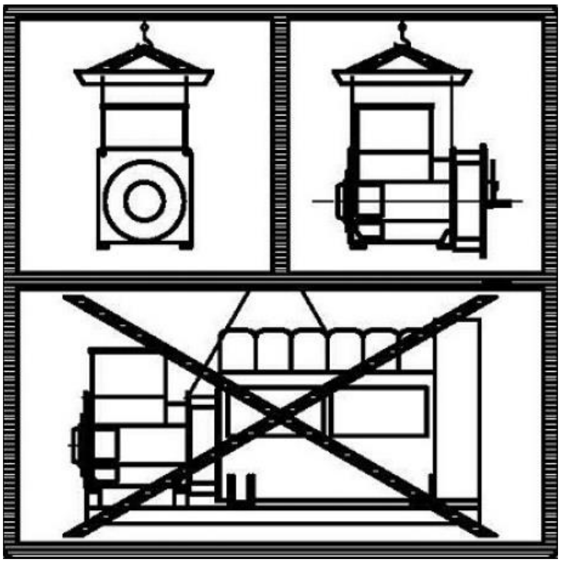

Figure 2: Showing an example of the right and wrong alternator lifting methods.

Mechanical Coupling

Installation engineers should follow the alternator manufacturer's integration instructions provided in the Owner's Manual. When coupling, the engineer should not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan as shown in Figure 3 as the fan is not designed to withstand such forces and will be damaged. The holes of the coupling discs should be aligned with the flywheel holes by cranking the engine. Additional forces should not be put on the bearings while assembling the coupling half as it will damage the bearings.

Figure 3: Alternator cooling fan vanes.

Safety

It is important to follow the alternator manufacturer’s general and local health and safety instructions. Incorrect installation, service or replacement of parts can result in severe equipment damage and personal injury. Only qualified individuals should perform electrical and mechanical component installations. Safety information signs are provided on the equipment to indicate hazards and emphasize instructions.

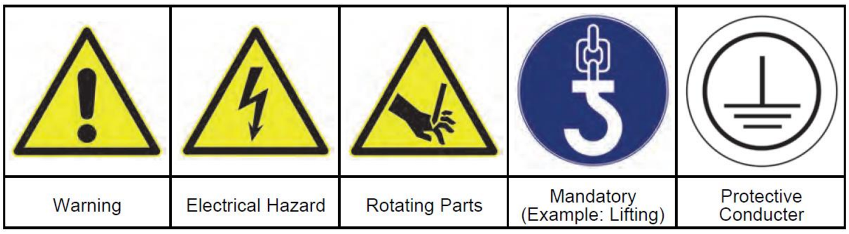

Figure 4: Examples of the safety signs provided on an alternator.

<u>Environmental Conditions</u>

Alternators installed in Generating Sets that are sited in arduous ambient environmental conditions may be susceptible to breakdown at their location site, if appropriate service and maintenance is not carried out. Ensuring reliable satisfactory service though, starts with careful consideration being given to the design of the ventilation systems that will be shared by both alternator and engine. Simplifying the considerations to just deciding to have a relatively simple canopy with large openings for the benefit of the engine and then considering the alternator satisfied by the fitting of low cost air filters will result in operating problems.

Decisions at the Generating Set design stage about the Canopy design and airflow control must include discussions with the alternator manufacturer to ensure that the appropriate optional extra air-filter / louver kit is nominated or the IP rating of the alternator is increased and that a bespoke maintenance regime is implemented for the complete Generating Set.

Refer to AGN072 – Environmental Conditions, for guidance on appropriate installation from the alternator manufacturer’s viewpoint.

Alternators in Coastal Locations

For example; an RTG Crane application is a quite unique situation. For reasons of making the alternator output characteristics suitable to power the Crane’s drive motor, combined with the duty cycle of the variable crane motor load, the alternator is usually operating with quite low winding temperatures. Whilst this low temperature situation would normally be considered to be beneficial, it does introduce a problem when the operating environment is a salt laden with a high humidity. The accepted winding temperature at which moisture is driven from the windings is some 95^{o}C and experience is showing that RTG applications do not achieve this.

So we have a winding contaminated by a salt laden atmosphere, combined with the dust and pollutants around a working dockside, plus RIC engined port vehicles adding exhaust by-products to this winding contamination problem. Add to this the humidity and moisture associated with local weather conditions, forming surface moisture on the alternator's outhang, a winding that is not getting hot enough to drive the moisture off and we have created a winding insulation system with much reduced 'barrier' capabilities.

The above considers the contaminants that weaken the winding insulation system. The following explains the additional electrical stresses associated with the Variable Speed Drive units used to power the various crane movements.

These VSD's are Non Linear Loads [NLL], with quite high levels of harmonic distortion. The resulting harmonic voltage distortion results in transient voltage conditions that may well be twice the peak value that the alternator would experience under normal linear load conditions.

These high transient voltage spikes stress the electrical insulation system, with which a clean uncontaminated winding insulation system can cope. But a contaminated winding will find such transient voltage spikes difficult to contain, followed inevitable by the breakdown of the insulation barrier and winding short circuit.

The decision to have the new alternator fitted with IP44 inlet louvers will ensure that whilst the alternator is running, the inlet cooling air is being filtered and moisture droplets are being removed by the Premaberg filter system.

However, the IP44 filter assembly is not really addressing all the problems of the location being in a coastal, salt laden atmosphere. The problem with salt is that it will form a moisture absorbing film of contamination on the alternator's winding. When the alternator is working and the windings are hot, the moisture is driven off the windings surface and the insulation resistance - IR - will be high enough to ensure that no insulation breakdown or surface tracking occurs. However; as soon as the Generating Set is stopped, the alternator's local environment becomes extremely humid, it is at this point the hygroscopic layer of salt that has formed on the windings will absorb moisture and this will result in the windings IR value being reduced to a low level and so, an inability to insulate/isolate phase to phase and phase to earth. Therefore, when the Generating Set is next started and the alternator excites to the normal working voltage - electrical pressure - there is a real risk that an insulation failure will occur as a result of insulation breakdown initiated by surface tracking.

The ideal solution is to filter the salt from Generating Set cooling air. But the practicalities must include control of the humidity level of the alternator's environment and this involves far more than the fitting of an alternator anti-condensation heater.

The most successful schemes involve a fan heater blowing several kW's of hot air around the Generating Set 'chamber' to keep the humidity RH% as low as possible. Obviously, this needs an electrical power supply when the Generating Set is not running and so may well not be an easy option.

There may be a way of running-on the Generating Set after its programmed service duty. This would be in a way devised to keep hot dry air circulating whilst the whole Generating Set area temperature is gradually reduced to stop the sudden increase in RH% that occurs around Generating Sets when they are stopped and left trapped in their 'sweat box' canopies.

It could be that Generating Set's are operating in parallel, or a Generating Set is operating in parallel with a mains supply. This then suggests an option to introduce some Generating Set environment control, because it would seem that there is always an electrical supply available.

We cannot rule out that the stresses associated with miss-paralleling, or the instability of the local mains supply e.g.; micro-interruptions, will damage insulation systems and promote failures. But if the site history is one of winding failures occurring at the point/moment of starting the Generating Set ready to put the unit back into service then, from experience, we would consider saline contamination is the prime culprit.

MAINTENANCE OF THE WINDING INSULATION SYSTEM

The only way to check on the condition of the winding insulation system, is by introducing a regular procedure to check the stator winding Insulation Resistance (IR) value and although not normal practice for a low voltage scheme, the Polarisation Index [PI] should be measured too, if the alternator is installed in any challenging environment. This check of IR and PI need only be carried out to the stator winding. The spinning of the rotor and the fact that it operates at low voltages means that it is not, as much, at risk.

Refer to AGN015 – Testing Winding Insulation Systems for details of IR and PI testing.

At the first sign that the IR and PI are low, the alternator stator winding must be cleaned.

The exciter field is another 'at risk' component and the fact that it operates with dc. means that it has a high risk factor due to its operation with fixed polarisation. If the exciter field insulation fails it will also take out the AVR.

Cleaning windings

If cleaning of the windings becomes necessary, then the preferred method is to completely strip the alternator to enable a thorough inspection and then a washing process, which will result in dirt removal by encouraging a washing-out of dirt by an action that will not result in the dirt being forced further into the winding assembly. The washing medium should be clean hot water applied from a directional nozzle at a pressure not exceeding 3bar.

At no point should the winding insulation be subjected to a jet of water pressure that is deforming the insulation materials.

For extremely oily contaminants, an alternative method is to use a hot pressure wash - not exceeding 3bar – with an added solvent based biodegradable cleaner of neutral pH. Note: 'Autosmart' and Aquawash' are trade names of such biodegradable cleaners.

Water-based Alkaline Detergents should not be used for cleaning as they contain 'wetting agents' that leave contaminants - in the form of salts - on the winding surfaces. These contaminants are hygroscopic and therefore readily absorb moisture, which will lower the insulation resistance and promote surface tracking.

Caution: Inappropriate or badly executed cleaning methods will leave contamination embedded in the winding crevices and this local contamination will promote degradation of the insulation system.

After the cleaning process, the windings must be slowly [over several hours] heated to at least 100degC in a thorough drying out procedure of perhaps twelve to twenty four hours. The insulation resistance [IR], phase to phase, and phase to earth, must be measured during this process.

Refer to the alternator's Owner's Manual (Installation, Service & Maintenance Manual) for the drying out procedures and the IR test procedure, including the values, in Mega-Ohms, that the winding must achieve before the winding IR can be said to be high enough for the wound assembly to be considered a serviceable unit.

Once the windings have been cleaned and the insulation resistance improved to what is considered to be a satisfactory level, the clean and dry windings should be treated with an appropriate 'over-coating' electrical anti-tracking resin / varnish. This treatment will offer protection from further immediate in-service recontamination of the winding surface. The chosen anti-tracking material should be of the same insulation thermal rating as the alternator's insulation system - Class 'F' or Class 'H'. Checks must also be made to ensure that the electrical anti-tracking resin / varnish will adhere to the windings original impregnation materials.

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