STAMFORD | AvK ™

POWERING TOMORROW, TOGETHER

Application Guidance Notes: Technical Information from STAMFORD | AvK

AGN 014 – Marine Alternators

Cummins Generator Technologies have a policy of manufacturing all alternators using high quality materials and manufacturing procedures controlled by an ISO 9000 Quality System, to ensure that all alternators are inherently compliant with Marine Classifying Society requirements.

MARINE RATINGS

Marine Classifying Societies have independent policies for the rating of alternators for Marine applications. A common policy has been adopted to base the Marine ratings on an ambient temperature of 50°C, although some Marine Societies state an ambient condition of 45°C. It is therefore, within reason to increase the alternator's output rating by 3% when a specific Marine Society states an ambient temperature of 45°C.

For comparison, Table 1 shows the maximum ratings under temperature rise Classes for Industrial applications, with an ambient temperature set at 40°C, and Table 2 shows the maximum ratings under temperature rise Classes for Marine applications, with an ambient temperature set at 50°C.

Table 1 : maximum temperature rise (40 °C ambient) Industrial application			
Temperature rise class	Class B	Class F	Class H
Temp Rise °C	80	105	125

Table 2 : maximum temperature rise (50 °C ambient) Marine application			
Temperature rise class	Class B	Class F	Class H
Temp Rise °C	70	90	110

For ratings adjustments for other ambient conditions, refer to AGN012 Environmental Rating Factors.

A note of caution must be applied when considering the potential re-rating of Class H temperature rise Marine ratings, because it is often the case, that the limiting factor is not the thermal rating of the alternator but the short circuit current capability. Short circuit current capability also being a significant compliance factor with the Marine Classifying Societies.

The Marine Society requirements for short circuit current capability differs, just as we have with the two ambient temperatures of 45°C and 50°C.

Some STAMFORD alternators with a Class H insulation system are limited to the Class F temperature rise Marine rating, to achieve short circuit current capability. For further information, contact applications@cummins.com.

MARINE CLASSIFYING SOCIETIES

When Marine alternators are installed on a vessel, they must invariably meet the requirements of the Marine Classifying Society that governs the design of that vessel. We consider this to be a Classified Marine Application. There are applications where Marine alternators are used on-board small vessels or off-shore or close to the sea. These applications may not be governed by a Marine Classifying Society and so the alternators intended for use in these applications are categorised as unclassified.

Unclassified.

Any alternator manufactured by STAMFORD | AvK may be used for an Unclassified Marine application. It must be accepted, however; that the rating of the alternator must reflect the Marine industry limitations for temperature rise and higher operating ambient temperature. Furthermore, the need for an alternator to provide a sustained short circuit current - at a specified factor compared against the rated current - must be identified and then satisfied as being technically achievable by the incorporation of an appropriate excitation system.

Alternators that are to be supplied for an unclassified application or unspecified authority are tested to Design Documents for routine testing. The tests align with normal production tests and a Test Report may be issued on request to the Technical Centre Manager, through the order process.

Classified.

If, at the time of order, an alternator is specified to be compliant with a Marine Classifying Society's requirements, then the alternator will be manufactured against a code number that dictates the following actions:

1. The shaft steel material details are recorded and filed for trace-ability.

2. The Marine Society's authorised agent is allowed to inspect major components prior to final machine assembly.

3. Alternators that must be compliant with a specified, nominated, Marine Classifying Society are first subjected to normal production test, before being sent to the Technical Testing Facility, where an approved test procedure is used to conduct comprehensive testing. The Marine Society's Surveyor may choose to be present to witness the alternator testing. The appropriate Marine Authority's Surveyor witnesses the test procedure and certifies approval. Whether testing is witnessed or not, the test data is recorded and provided as a Test Report for performance and capability. If there is more than one alternator in a particular order, the practice is for Heat Run Testing to be carried out on one in four alternators, but the Cold Regulation Testing is conducted on all alternators.

Marine Classifying Society Requirements.

The following table lists the requirements for some of the Marine Societies. Further detail may be obtained by contacting applications@cummins.com.

Nom	Company	Temp rise Ambient temperature class H	Temp rise Ambient temperature class F	Short Circuit current	Transient voltage drop	Overload	Temperature Detector	Space heaters	Regulation	Shaft conformity certificate	Factory setting	Spare parts
ABS	American Bureau of shipping	115°/50°	95/50	300% 2 sec	NS	50% 2mn	P ≥ 500 kVA	≥ 455 kg	+/- 4%	NS except propulsion	P ≥ 100 kW	
BV	Bureau Veritas	110°/50°	90°/50°	300% 2 sec P≥ 50 kW	15% 0.6 Pn P.F = 0.4	50% 15 sec	Required in AUT + propulsion	Required in AUT + propulsion	+/- 2.5%	P ≥ 500 kW	S	NS
CGSS	Coast Guard steam ship TP 127	115°/50°	95°/45°	300% 2 sec	15% 0.6 Pn P.F = 0.4	NS	P ≥ 500 kVA	≥ 455 kg	+/- 2.5%	P ≥ 375 kW	NS	
DNV	Det Norske Veritas	110°/45°	95°/45°	300% 1 sec	15% 0.6 Pn P.F = 0.4	50% 2 mn	NS	R	+/- 2.5%	P ≥ 100 kW	P ≥ 100 kW	D
GL	Germanischer Lloyd's	120°/45°	100°/45°	300% 1 sec P≥ 50 kVA	15% 0.6 Pn P.F = 0.4	50% 2 mn	NS	P ≥ 500 kVA	+/- 2.5%	NS except propulsion	NS	BRGS D
KRS	Korea Register of Shipping	115°/50°	90°/45°	300% 2 sec	NS	50% P.F = 0.8 15 sec	NS	R	+/- 2.5%		P ≥ 100 kW	
LRS	Lloyds Register of shipping	110°/45°	90°/45°	300% 2 sec	NS	50% P.F = 0.8 15 sec	NS	R	+/- 2.5%	P ≥ 100 kW	P ≥ 100 kW	
NKK	Nippon Kaiji Kyokai	120°/45°	95°/45°	300% 2 sec	NS	50% 2mn	P ≥ 500 kVA			P ≥ 375 kW	P ≥ 100 kW	
PRS	Polish Register of shipping	120°/45°	95°/45°	NS	15% 0.6 Pn P.F = 0.4	50% 2mn Un – 10% P.F = 0.6	NS	R	+/- 2.5%	NS		BRGS AVR D
RINA	Registro Italiano Navale	115°/45°	90°/50°	300% 2 sec P≥ 50 kVA	15% 0.6 Pn P ≥ 50 kVA.= 0.4 P.F	50% P.F = 0.6 15 sec	Required in AUT	Required in AUT	+/- 2.5%	Approval of shaft on plan if P ≥ 250 kW	S	
RMRS	Russian Maritime Register of shipping	120°/45°	95°/45°	NS	15% 0.6 Pn P.F = 0.4	15% 0.6 Pn P.F = 0.4	NS	R	+/- 2.5%	NS	S	

SOLAS (Safety Of Life At Sea).

The International Convention for the Safety of Life at Sea (SOLAS) is an international maritime treaty which requires Signatory flag states to ensure that ships flagged by them comply with minimum safety standards in construction, equipment and operation. Alternators

intended for use on vessels must be compliant to SOLAS regulations in the alternator's design and build standard. The Marine design of alternators manufactured by Cummins Generator Technologies are inherently compliant to SOLAS regulations.

MARINE FIRE EXTINGUISHING SPRINKLER SYSTEMS

Introduction.

Special requirements for IP23 marine alternators for use in supplying fire extinguishing sprinkler systems was published by the DNV Marine Classifying Society; SOLAS Ch.II-2, reg.7.7, reference IMO MSC/Circ.913. Further testing was carried out against SOLAS Ch.II-2, reference IMO MSC/Circ.1387 by combined Marine Classifying Societies.

The expectation is that the ship, or offshore platform, will be fitted with a fire control sprinkler system and once activated this will operate in all zones for a period long enough to establish the true location and source of the fire. Then the sprinkler system in 'safe' areas will be stopped. The expected time required to identify the source of the fire and so cease sprinkling in safe areas, is expected to be up to 20minutes.

Therefore, a great deal of equipment will be 'sprinkled-on' even though no fire exists in that area or zone. As that equipment may be a 'risk' as a source of fire, however; there must be a sprinkler nozzle(s) positioned above it. In the case of a Generating Set, hot engine surfaces, high pressure fuel rail, fuel supply and pipe work etc. are obvious sources of fire and so the Generating Set must have a sprinkler nozzle(s) positioned above it.

Systems.

Standard alternators manufactured by STAMFORD | AvK have been incorporated into Generating Sets that have been subjected to FWBLAFFS compliant, fresh water spray sprinkler systems.

FWBLAFFS systems are offered with different fundamental designs. The pressure at which they operate varies; the quantity of water they disperse varies, as does the nozzle technology for atomisation and percentage of 'fog' to heavy droplets.

It is most important that the characteristics of the FWBLAFFS compliant equipment is identified and compared with the characteristics of the types associated with successful tests of STAMFORD | Avk.

Successful Tests.

A FWBLAFFS system manufactured by York-Novenco, identified as XFlow, has been used for the successful testing of Generating Sets built by DEMP incorporating an HCM534 type alternator.

1. A FWBLAFFS system manufactured by Tyco and identified as System 913 – AM15 nozzles and Nippon Dry Chemical Vapour Fog system MS-A nozzles has been tested against a Norwegian built Generating Set that incorporated an HCM434 type alternator.

The above successful and certified tests were conducted at Aggreko, Egersud, Norway.

The above identified tests resulted in the following approval documents:

Germanischer Lloyds approved the HCM534 Alternators.

BV approved the HCM434 when tested with two different 'sprinkler/spray' systems, each operated at different pressures.

2. A Water Spray system matched by Shanghai Institute 704. SOLAS certified nozzle type HHSJ-9007. Tests carried out on a PM734B2 IP23 marine alternator.

The above successful and certified tests were conducted at Cummins Generator Technologies Wuxi, China.

The above identified tests resulted in the following an approval document signed and certified by the Marine Classifying Societies present; ABS, BV, CCS, DNV and GL.

Nozzle Technology.

The secret to survival of a standard build of alternator seems to be attributable to the special design of spray head nozzle and characteristics of the resulting Fog & Droplet combination.

The resulting characteristics of the sprayed atomised water is required to become a stationary 'fire-blanket' and not submerge the Generating Set in water droplets, or create a fog that readily follows the cooling air stream into the Generating Set, thereby soaking the alternator's windings and in turn reducing the windings Insulation Resistance [IR] values.

Conclusion.

Technical considerations conclude that all the Standard build of STAMFORD | Avk STAMFORD HCM4, S4L1M, HCM5, S5L1M, HCM6, S6L1M, PM7 and S7L1M alternators should successfully operate in conjunction with a FWBLAFFS system, using a controlled fresh water mist and droplet system, which is identified to have a nozzle technology and fresh water spray characteristics similar to the above identified types.

This judgement is based on the fact that these STAMFORD alternators have:

- Similar specification of electrical insulation materials and winding assembly manufacturing methods.
- Are fitted with a similar design of IP23 enclosure for the IC01 cooling system with similar air inlet vent air speeds.
- Have similar frame position location of air inlet and outlet vents as the successfully tested HCM434, HCM534 and PM734B2 alternators.

A FWBLAFFS system dispensing salt water would introduce a chemical contaminant that would rapidly degrade the insulation systems ability to resist moisture ingress, which in turn would rapidly reduce the IR values and so promote premature breakdown of phase to phase and phase to earth barriers, leading to winding burnout.

If, following a drenching in salt water, it was possible to immediately dismantle the alternator, wash away all traces of salt, then follow a controlled Drying-Out procedure, a restoration of good winding surface finish and achieving acceptably high PI and IR values, then the wound components would then be considered again as suitable for service.

This same salt neutralisation process of cleaning and restoration to a serviceable standard would need to be conducted on all the alternator components, including the rotating diode assembly, terminal assembly, bearing assemblies, and all frame, end bracket and adaptor location spigots and fixings.

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