Generator Technologies

Edition 7

generating

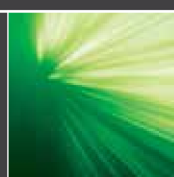
insight

Generating Life Edition

AMBATOVY

30 STAMFORD P7 alternators power super mine

Edition 7:



Foreword

Welcome to the 7th edition of Generating Insight.

The theme of this issue is 'Life Expectancy'…….. focusing on some of the important design considerations and factors that influence the longevity of an alternator.

In the current economic environment, price is a major factor, however it is not the only consideration during the process of selecting an alternator. Our customers ask for reliable, durable products that will last for many years and therefore design life is frequently being included within many specifications. The main areas of focus being the insulation system and the bearings.

Although it is very difficult to predict life, as it is greatly dependent upon the operating conditions, imposed external stresses and the environment, some guidance can be provided. Cummins Generator technologies use the highest quality materials within the manufacture of alternators to optimise life expectancy. The combination of design calculations and experimental validation provide a model that can be used to predict life expectancy. This enables customers to have the confidence that if operated within the application and operating conditions, the alternator should provide years of reliable service.

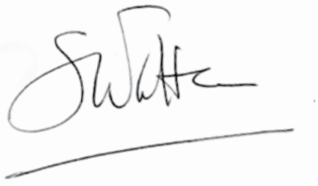
This publication focuses on the design life of two main components:

- **Bearings** - what should be considered when designing and selecting the bearing components in order to meet the design life requirements
- **Insulation system** - highlighting what determines the life expectancy of an insulation system and the impact of operating at different temperatures

Also we discuss accelerated testing as predicted design life calculations need to be validated.

As time to market is of key importance, accelerated testing is carried out to reduce overall test time and associated costs. Finally we touch on relevant codes and standards associated with design life and how the environment and operating conditions can impact the overall life of the alternator.

I hope you find the articles interesting and if you would like to discuss any in further detail please call any of our regional Application Engineering teams within Cummins Generator Technologies who would be more than happy to help.



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Editorial

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Generating Insight is the Cummins Generator Technologies magazine focusing on topics relevant to our products, our customers and our industry.

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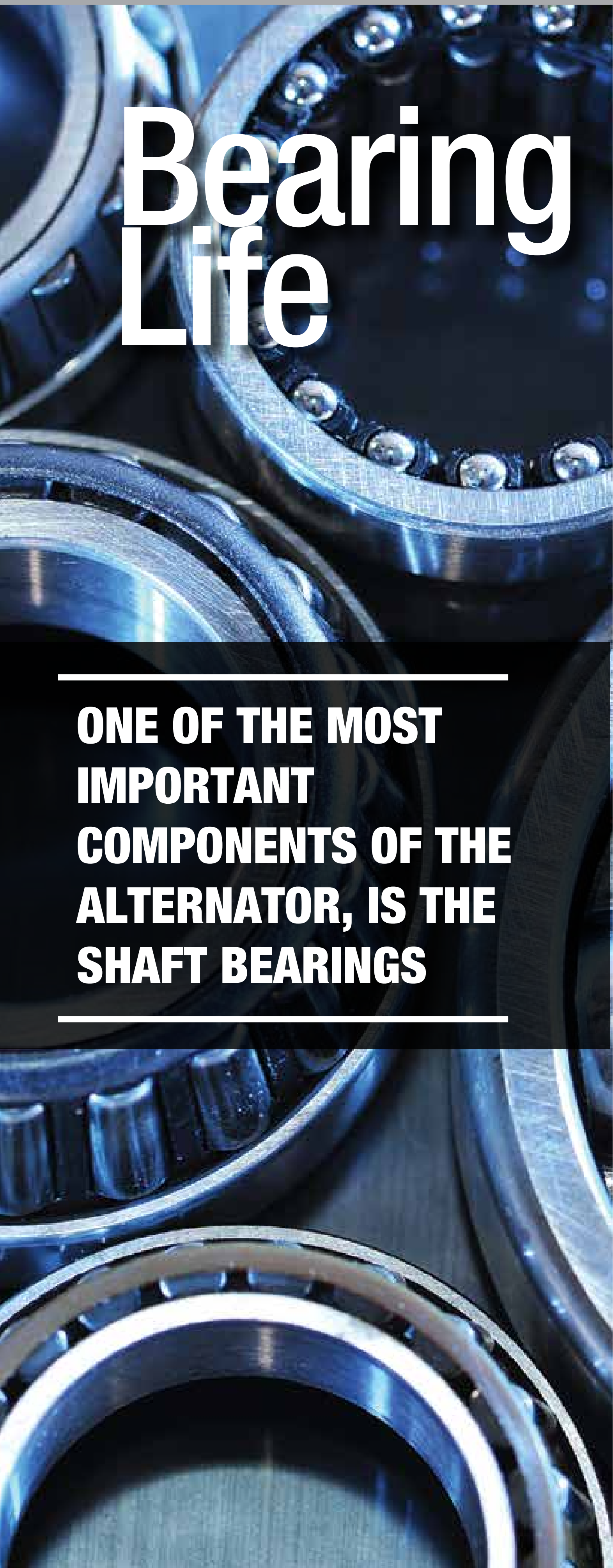
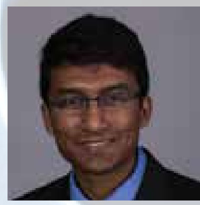


Bearing Life

ONE OF THE MOST IMPORTANT COMPONENTS OF THE ALTERNATOR, IS THE SHAFT BEARINGS



by Abinhav Patrick Tobin

Cummins Generator Technologies has a proven track record of manufacturing and supplying superior alternators for numerous applications in a variety of environments. The company constantly strives to improve many aspects of the design, and in particular, the life of the products and their constituent components, in order to meet our customers' continually evolving requirements.

One of the most important components of the alternator, is the shaft bearings. It is responsible for facilitating the location and rotation of the rotor within the stator, and because of this, it is considered to be a critical component, whose functional behaviour must be clearly understood. Of primary importance is the life of the bearing and the factors that affect it. This article reviews some of the major factors that Cummins Generator Technologies take into account when considering the bearing life of grease lubricated rolling element bearings.

The applications that STAMFORD and AvK alternators go into, can be broadly classified into two main categories, industrial and marine. Depending on the type of application and its environment, the bearings could be subjected to different types of loads, vibrations, contamination etc. that would affect the life of the bearings.

To accommodate these variations in operating parameters, several types of rolling element bearings are offered:-

1. Open deep grooved ball bearing
2. Sealed deep grooved ball bearing
3. Electrically insulated deep groove ball bearing – ring coated – hybrid
4. Anti-creep deep groove ball bearing
5. Cylindrical roller bearing
6. Electrically insulated cylindrical roller bearing – ring coated
7. Spherical roller bearing
8. Carb bearing

Factors affecting bearing life

There are many factors that impact bearing life, but the major ones are:-

1. Load on the bearing
2. Type and quantity of grease in the bearing arrangement
3. Type, quantity and size of contamination in the bearing

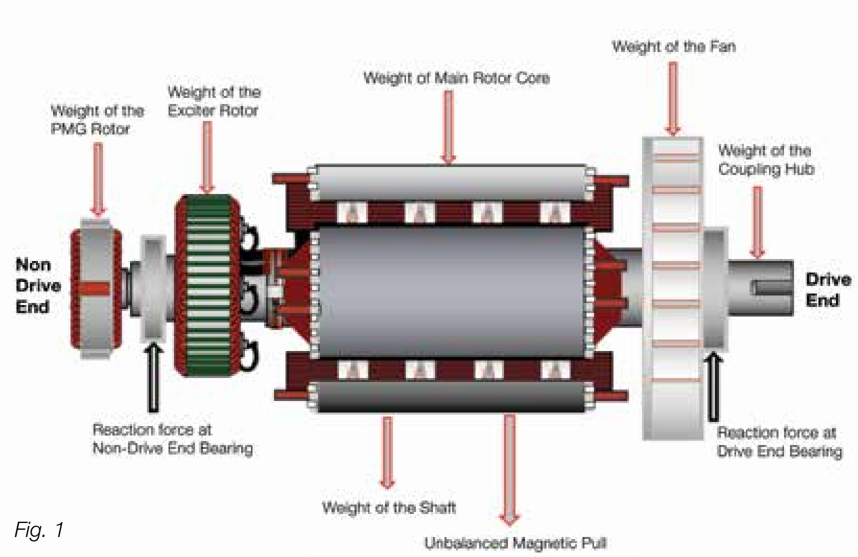


Fig. 1

Cummins Generator Technologies uses ISO 281:2007(E) (Rolling Bearings – Dynamic load ratings and rating life) to take into account, load, and contamination and grease condition when determining bearing life. In order to gain some insight into the nature of these three factors, the following brief review is given:-

Types of loads

When determining bearing life, the applied static and dynamic loads that the alternator bearings might have to sustain whilst in service, are taken into account. The two types of load are briefly explained below.

Static loads

One type of static load on the bearings is due to the combined weights of all components comprising the alternator rotor. Typical components seen on the rotor are: shaft, coupling hub, fan, main rotor core, exciter rotor core and PMG rotor (Fig.1). The mass of these components is subjected to gravitational acceleration, which results in what we commonly call "weight". This weight is seen as a load at the bearings. Another type of static load on the bearings is due to unbalanced magnetic pull (UMP). UMP is a magnetic force caused by asymmetry of the rotor / stator air gap. This UMP force is again seen at the bearings.

Dynamic loads

These loads are due to the mass of the Rotor being accelerated by non-gravitational forces. The dynamic loads experienced by the rotor can be generated from within the Alternator e.g. out-of-balance Rotor, or from sources that depend upon the type of application / environment.

Industrial Applications

In typical Industrial applications the general environment is stationary and the alternator is subjected to accelerating forces associated with the generating sets vibratory motion. This motion is driven by the engine's dynamic behavior, which is transmitted to the rotor via the alternator's connections to the engine and the generating sets sub-structure. The magnitudes of the forces impressed on the rotor depend upon the mass of the rotor, design/assembly of the generating set, dynamic behaviour of the engine. These forces must be taken into account when determining bearing life (Fig. 2).

Marine Applications

In typical marine applications the general environment is in motion, thus the alternator is subjected to accelerating forces associated with both the dynamic environment and the generating sets vibratory motion. Alternators sold into marine applications must be able to accommodate certain specific ship motions as specified by the various marine authorities (Lloyds: ABS: DNV etc.). These motions will generate dynamic bearing loads which must be accounted for when determining bearing life.

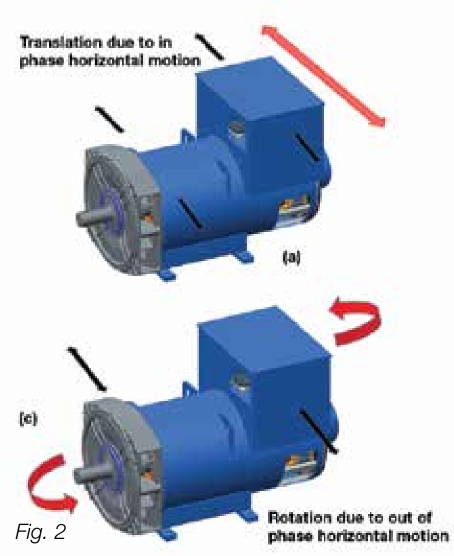


Fig. 2

Marine authorities typically specify a certain set of angles for both static and dynamic inclinations that the alternator must accommodate. The American Bureau of Shipping states certain angles of inclinations for emergency power installations on vessels which are depicted in figure 3.

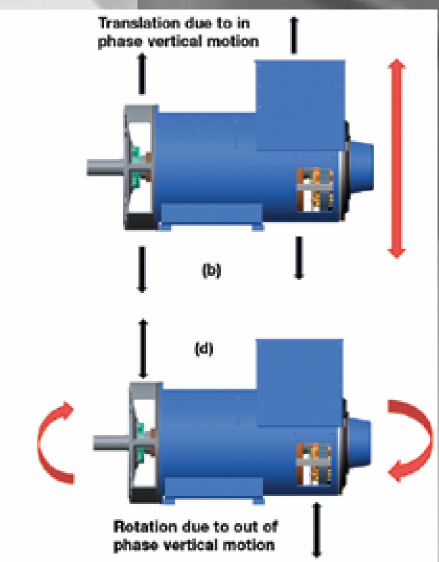
Contamination

When rolling element bearings are running under normal operating conditions, the distance between the moving and stationary parts inside the bearing, is extremely small. Any ingress of particulate contamination (small solid particles) into these small spaces from either the environment or from metallic wear inside the bearing, can result in permanent indentations (degradation of metallic surface) on the raceways, which in turn may lead to local stress raisers and metal fatigue. The particles can also cause damage to the rolling elements and cage if they get embedded in the cage pockets. Generally, contamination will decrease the bearing's useful operating life.

Another type of contamination is ingress of water. If water enters the bearing it can degrade the lubrication properties of the lubricant in the bearing and it can also cause corrosion of the metal surfaces. Both of these effects will result in reduced useful bearing life.

Grease

Grease is used to lubricate rolling element bearings. The type of grease used in a particular bearing is dependent upon many factors such as, type of bearing, rotational speed, environmental conditions, bearing load and application requirements etc. The oil in the grease forms a thin film between the bearing rolling elements, raceways and cage to reduce the frequency of metal to metal contact and hence increase the life of the bearing. A secondary function of grease is to dissipate heat generated inside the bearing. If heat is not removed from the bearing it may suffer thermal runaway, leading to premature bearing failure.



Another important aspect when it comes to grease, is the quantity of grease that a bearing requires. Too much grease can disrupt heat dissipation leading to high operating temperatures. The rolling elements (balls or rollers) begin to churn the grease which mechanically overworks the grease and breaks it down structurally. This then leads to inadequate lubrication of the bearing and premature bearing failure.

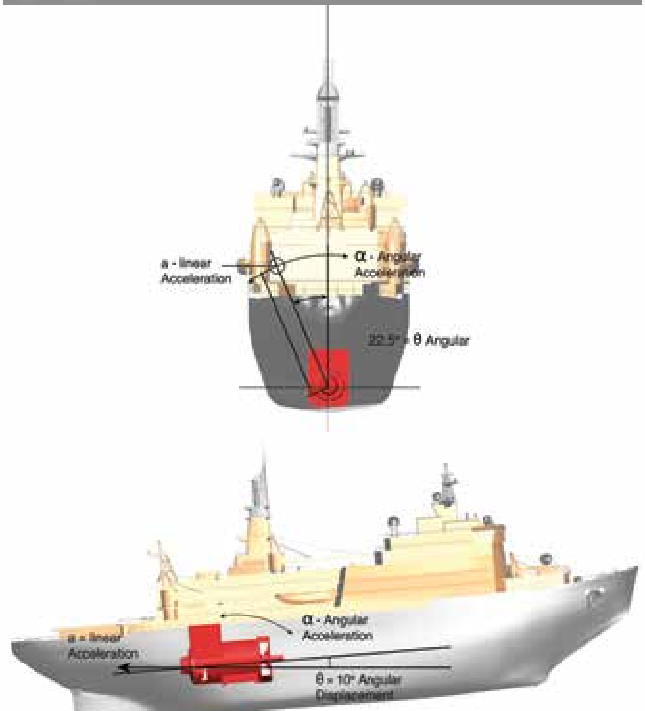
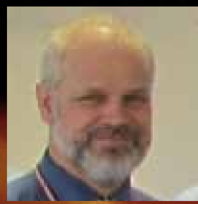


Fig. 3

All greases have a life expectancy. This life expectancy is influenced by temperature, speed, load, bearing arrangement and environmental conditions. Bearings operating at higher temperatures oxidize the lubricant quicker, which results in a reduced grease life, hence there is a need to carry out more frequent re-lubrication. Bearings that are used in applications where the environment is heavily contaminated (mining applications and marine) will require more frequent re-lubrication.

THE PARTICLES CAN ALSO CAUSE DAMAGE TO THE ROLLING ELEMENTS AND CAGE IF THEY GET EMBEDDED IN THE CAGE POCKETS

Alternator Life - Codes & Standards



by Jerry Dowdall

Cummins Generator Technologies products have an expectation from their customers that they are both reliable and durable: they expect it to deliver a lifetime of performance without any failure. However, it is rare for the customers to specify its time of life. So what is it that gives us a common understanding of expected product life? The Codes and Standards.

Codes and Standards fall into two categories:

- Codes - which ensure products are safe and fit for purpose. Usually these are written into law and must be complied with.
- Standards - where compliance is voluntary – but in order to sell product, ability to show compliancy with the standards becomes a market-based expectation. The standards are where the durability and life expectations are set.

When it comes to STAMFORD and AvK alternators, there are three principle standards that they refer to:

- IEC 60034: Rotating electrical machines
- NEMA MG-1: Motors and alternators
- UL-1446: Systems of insulating materials

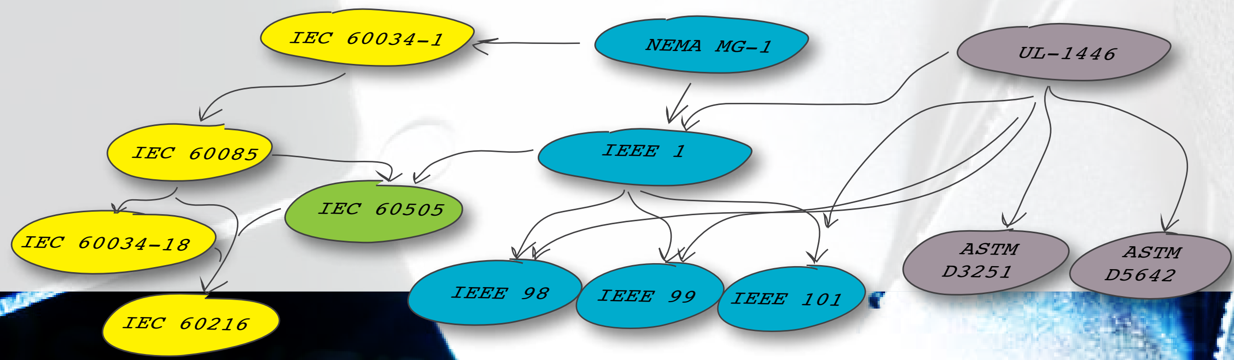
These standards define the methods and limitations of operation of electrical machines in order to deliver a certain lifetime, if operated in ideal conditions.There is a strong linkage between these standards and the standards they refer to. The diagram below shows the high-level relationships, but there are additional standards involved that define how the life of an insulation system and hence the life of a machine is defined.

The standards state that one of the principle ageing factors is – which translates as the relationship between the temperature that the insulation system sees, and how long it will last. This relationship is expressed as the thermal endurance graph, and requires the Temperature Index (TI) and halving Interval (HIC) of an insulation system to be defined.

The main standards relate to a number of other standards, of which IEC 60085: Electrical insulation — thermal evaluation and designation is the main reference to define how an insulation system is to be tested.

The aim of the IEC 60085 is to define the thermal life and limits of an electrical insulation system, which requires thermal ageing tests. The standards lay out how insulation systems can be tested to find the thermal life, or how the life can be determined from experience. The work to determine these values for a new insulation system is both extensive and time-consuming, which is why we rarely change our insulation systems.

Having defined how the insulation systems are to be tested, IEC 60085 also defines the thermal operating limits electrical machine, which is known as the temperature classes, class B, F and H. By operating the electrical machine within these, the standards define what life should be expected if the electrical machine is operated within the stated temperature class:



THERMAL EFFECTS ON THE INSULATION SYSTEM ARE ONE OF THE MAJOR FACTORS INFLUENCING THE LIFE OF ELECTRICAL MACHINES

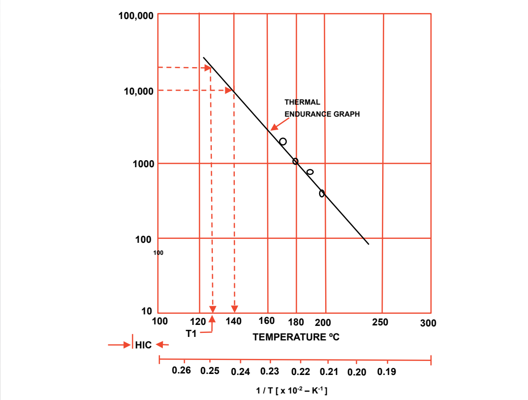


Figure A.1 – Thermal endurance graph, TI and HIC

Table 1 ± Thermal Class Assignment

ATE or RTE °C		Thermal class °C	Letter designation[a]
≥90	<105	90	Y
≥105	<120	105	A
≥120	<130	120	E
≥130	<155	130	B
≥155	<180	155	F
≥180	<200	180	H
≥200	<220	200	N
≥220	<250	220	R
≥250 b	<275	250	-

a If desired, the letter designation may be added in parentheses, e.g. Class 180 (H). Where space is a factor, such as on a nameplate, the product TC may elect to use only the letter designation.

b Designations of thermal classes over 250 shall increase by increments of 25 and be designated accordingly.

(table reproduced from IEC 60085-2008)

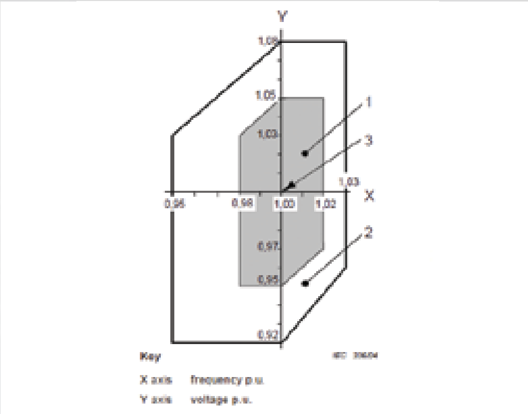


Figure 11: Voltage and frequency limits for generators (reproduced from IEC 60034-1:2010)

This is repeated in IEEE – 1, so the standards are consistent in the declaration of their declaration of thermal class.

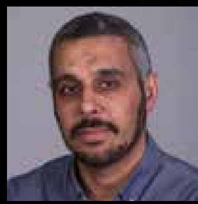
The standards also define the voltage and frequency limits that machines can be subjected to and still be expected to perform correctly because when a machine is operated at or beyond these limits, the machine will see temperature rises beyond that allowed by the thermal class which will reduce the overall life of the insulation system. IEC 60034 defines these voltage and frequency limits.

Conclusion:

By declaring that our machines comply with IEC 60034, NEMA MG-1 and UL-1446 we are saying that the insulation systems of our alternators comply with the requirements of these standards, and will deliver a life as defined by the standards when operated in ideal conditions.

In reality, there are other factors that will affect the overall life of our machines, but the standards agree that thermal effects on the insulation system are the major factors influencing the life of electrical machines.

INSULATION CLASSES AND LIFE EXPECTANCY



by Jawad Al-Tayie

This article explains the meaning of thermal classes and temperature rises and provides an overview of the half-life expectancy of an insulation system.

Thermal/Insulation Classes

The definition of thermal classes as specified by the IEC 60085-2008 and by the IEEE Std1-2001 are summarised in table 1. Thermal class refers to the designation that is equal to the numerical value of the recommended maximum continuous total temperature in degrees Celsius (°C).

Classification of insulation system according to NEMA MG1 where insulation systems are divided into four classes according to the thermal endurance of the system for temperature rating purposes. These classes have been established in accordance with IEEE Std1.

Temperature rises are classified as temperature rises by resistance and temperature rises by ETD (Embedded Temperature Detector).

IEC 60085 Thermal Classes		IEEE std.1 Thermal Classes	
H	180°C	H	180°C
F	155°C	F	155°C
B	130°C	B	130°C
E	120°C	E	N/A
A	105°C	A	105°C

Table.1: Thermal classes assignment

Rises by resistance are established by measuring temperature at cold and after thermal stability conditions. Temperature rises by resistance state the maximum temperature rise (Delta T) as specified by IEC60034-1 table.7 and NEMA MG1 part 32 table.32-3 and based on 40°C ambient temperature.

The maximum temperature rises by ETD are specified by IEC60034-1 and NEMA MG1 part 32 and based on 40°C ambient temperature.

If the total operating temperature is raised by 10°C then the thermal life expectancy of the insulation system is reduced by 50%

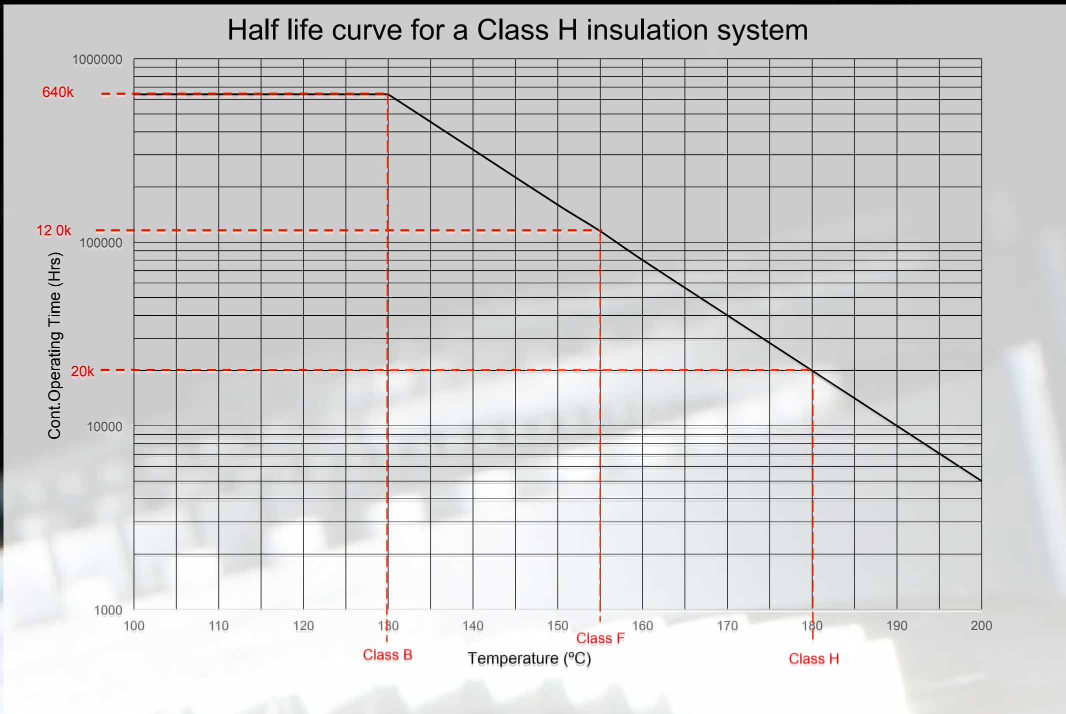


Figure 1: Insulation half-life of class H insulation system verses temperature

Half-life graph of class H insulation system

Underwriters Laboratories (UL) have established operating temperatures and associated life expectancy levels for all the electrical insulation materials available and grouped these materials into the various classes familiar to all those involved with electrical machines and equipment.

UL used Arrhenius Equation to model the relation between time and temperature. Arrhenius equation which describes the temperature dependence on the velocity coefficient of chemical reaction can be used to model the relationship between system test life and temperature. The Arrhenius equation was simplified by taking the natural logarithms to plot the relation between time and temperature.

The half-life curve of class H insulation system as described by the UL standard is illustrated in figure 1.

- To operate class H insulation system at its maximum operating temperature of 180ºC, the design life expectancy of the insulation system is 20kHrs.
- To operate class H insulation system at 155ºC, the design life expectancy is 120kHrs.
- To operate class H insulation system at 130ºC, the design life expectancy is 640kHrs.
- Similarly, to operate class F insulation system at its maximum operating temperature of 155ºC, the design life expectancy of the insulation system is 20kHrs.
- To operate class F insulation system at 130ºC, the design life expectancy is 120kHrs.
- To summarize, operating class H insulation system at 155°C will give similar life to operating class F insulation class at 1300C. Operating class H insulation system at 1800C will be similar to operating class F insulation system at 155°C.

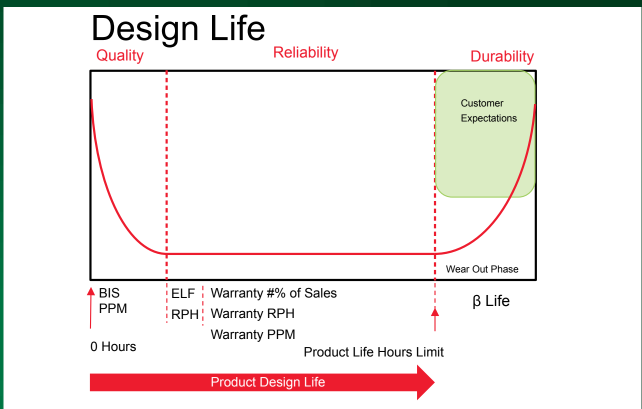
The meaning of the half-life phrase is that after a period of 20kHrs continuously operating at 180ºC (or at 155°C for class F insulation system), the insulations ultimate electrical strength which can be correlated to the dielectric resistance, will have degraded to approximately half of its original value when it was new. It does not mean that it will fail after 20kHrs.

The half-life curves indicate that if an alternator total operating temperature is reduced by 10°C then the thermal life expectancy of the insulation system is approximately increased by 200% (doubled). Conversely, if the total operating temperature is raised by 10°C then the thermal life expectancy of the insulation system is reduced by 50% (halved).

In practice other external factors such as applied load, voltage spikes due to connected load or environmental conditions, contaminations, maintenance practices, all can have an influence on the insulation life and therefore understanding and limiting these factors will help to improve the life of the insulation and alternator.

ACCELERATED Life Testing

by Robin Jackson



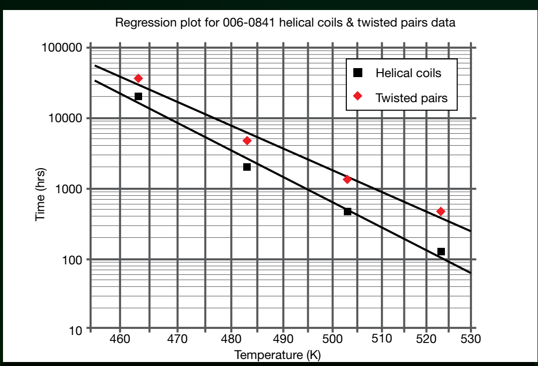
In the quest for developing products that interact effectively to the design intent, with other components, sub systems and systems, delivering reliability and durability, we go to great lengths to assess product viability.

A typical design life curve depicts early life failure, reliability and durability zones, with a clear target and expectation of reaching wear-out distributions during the durability period.

We constantly try to find methods of assessing capability and risk, so the purpose of testing, computer modeling such as finite element analysis, multi physics engineering analysis, probability studies, Failure Modes Affects Analysis (FMEA), Fault tree analysis, (FTA) are to generate and evaluate information on that designed capability, so that data informed decisions can be made.

The problem with testing is that cost of normal life stress exposure testing over extended time is a luxury that can be rarely afforded, as businesses strive to be first to market, bringing innovation which provides that competitive edge and attracts customers to the product.

In terms of testing of components, there are literally endless opportunities to develop assessment of features, properties and interactions. However, multiple feature interactions



Thermal stress - copper wire coating capability curves

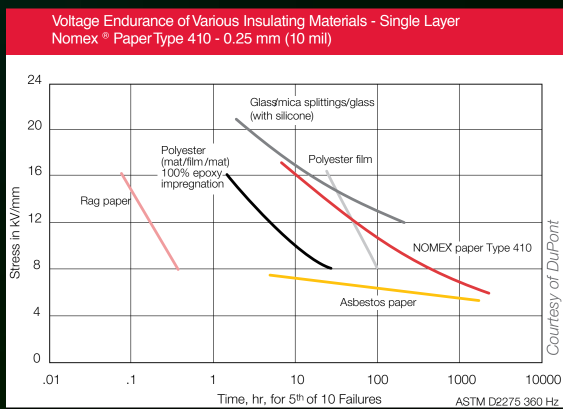
rarely exhibit linearity, especially when considering complex materials and compounds often used in electrical machine design. The ability to isolate one feature, property or interaction, apply the appropriate stress, and develop a solution that is both predictable and repeatable, whilst maintaining all other features, is sometime difficult (and expensive) to manage.

If we consider designing a product for 40,000 hours life expectancy, to prove reliability we would need to test 24/7 for approximately 4.5 years. As you can appreciate this is impractical and cost prohibitive.

In an effort to reduce longevity of normal life stress testing and speed strong data based decision making, accelerated life test methods have been developed for component life tests with components operated at high or extended stresses and failure data observed.

While high stress testing can be performed for the sole purpose of seeing where and how failures occur and using that information to improve component designs, such as selection of alternate material strength properties or to make better component feature selections, accelerated life testing can be utilised for the following two purposes:

- To study how failure is accelerated by stress and fit an acceleration model to data from multiple stress cells running in parallel.
- To obtain enough failure data at high stress to accurately project (extrapolate) what the component life at use will be.
- Both provide models on which model or range assessment can be reliably made, without the need to repeat testing infinitely!



Electrical stress curves

Example of Bearing Accelerated Life test

Thermal Stress, Inter-coil connections endurance test

Of course insulation systems are important part of the validation requirements for rotating electrical machines, and Cummins Generator Technologies carry out a range of accelerated life evaluation on other systems, sub systems and components, for example in considering our design application of bearing assemblies

Test planning and operation for a (multiple) stress cell life test experiment usually consists of the following:

- Picking several combinations of the relevant stresses (the stresses that accelerate the failure mechanism under investigation). Each combination is a "stress cell". Note that we plan for only one mechanism of failure at a time. Failures on test due to any other mechanism will be considered censored run times.
- Making sure stress levels used are not too high - to the point where new failure mechanisms that would never occur at use stress are introduced. Picking a maximum allowable stress level requires experience and/or good engineering judgment.
- Placing random samples of components in each stress cell and running the components in each cell for fixed (but possibly different) lengths of time.
- Gathering the failure data from each cell and using the data to fit an acceleration model and a life distribution model and using these models to project reliability at use stress conditions.

A word of warning, when you test components in a stress cell for a fixed length test, it is typical that some (or possibly many) of the components end the test without failing. This is the censoring problem, and it greatly complicates experimental design, which can be tough to manage in statistical science.

Where do we use accelerated life testing?

Commonly, electrical machines, which rely upon the properties of insulating materials to manage electrical charge stress, use Accelerated life testing, to predict insulation components or system life.

If we think about insulation materials, there are a number of factors which might be considered as accelerators in degrading the electrical insulation properties.

Let's take for example, coil winding insulation system components, such as Nomex™ insulation paper, manufactured by DuPont, or copper wire coatings, for example.

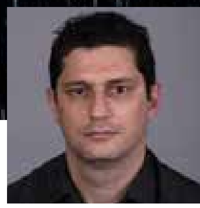
When combined into sub systems, or systems, evaluation of the combination of materials through accelerated life testing helps us understand material interactions to operational stress, for example environmental stress, or mechanical stress.

Ultimately, the accelerated life evaluation of the system enables life predictions to support design life evaluation and capability confirmation.

The Arrhenius Curve previously discussed in the Insulation Life article on page 7-8 is a representation of an insulation system evaluation of half-life, based on a sequence and combination of tests applied over time, accelerating stress factors, to develop failure assessed capability.

DESIGNING A PRODUCT FOR 40,000 HOURS LIFE EXPECTANCY WOULD REQUIRE TESTING 24/7 FOR APPROXIMATELY 4.5 YEARS

Environmental Impact



by Nikolaos Oikonomopoulos

Globalisation and the advancements in transportation and logistics has enabled us to address the growing demand by setting up ad-hoc power plants using reciprocating engine driven gensets; this has also meant that gensets are being used in harsher environmental conditions. It has therefore become critical for us to understand the impact of these environmental conditions on the alternator and design suitable protection mechanisms.

Environmental conditions impacting performance of an alternator:

Where the alternator is installed in the world (geography) and the application type (mining, marine, oil & gas) affect the type of environmental conditions the alternator is exposed to. Figure 1 shows the temperatures across different parts of the globe.

I. Dust/sand:

Contamination of the winding and the insulation by the dust can lead to deterioration of winding insulation system and can negatively impact insulation life. Combined with moderate to strong winds, dust/sand could erode the winding insulation leading to premature failure of windings or reduced thermal capacity of windings at the very least. Additionally, dust/ sand could block air-flow leading to elevated temperatures in the alternator windings.

II. Water / High Humidity

Water or high humidity in the air reduces the insulation resistance of the windings and diminishes the design life of the insulation system. Water / high humidity may also enter the connections used in electronic circuits damaging them. Salt water / water vapour is a conductor and could lead to accelerated breakdown of the insulation system.

III. Ambient Temperature:

The temperature rise in the alternator is highly sensitive to the temperature of the air entering the machine. Higher ambient temperature means higher thermal stress leading to winding insulation degradation (and diminished alternator life) due to high temperature in the windings. It is therefore very important to ensure that either the ambient temperature is controlled or the right alternator/rating selected for the ambient temperature.

IV. Altitude

Air at higher altitudes has a lower electrical breakdown resistance to voltage and electrical machines therefore require enhanced insulation capabilities to prevent breakdown. Clearance distances will also need to be considered depending on the altitude. Additionally, a de-rate dependent on the altitude is required to negate the effects of reduced cooling caused by thinner air.

V. Salt

Presence of salt may cause corrosion of the electrical parts such as rectifier and windings. This can result to degradation of the insulation resistance and increase of the contact resistance. Salt also corrodes metallic components like bearings, shaft limiting the mechanical strength and capability. Figure 2 shows the picture of an exciter of a machine exposed to salt mist. The corrosive effects of salt are clearly visible.

VI. Other factors

Vibration/shock or Chemicals could also have a significant negative impact on the alternator performance and life and are dependent on the application type – eg:- alternators used in mining, chemical industry standby.

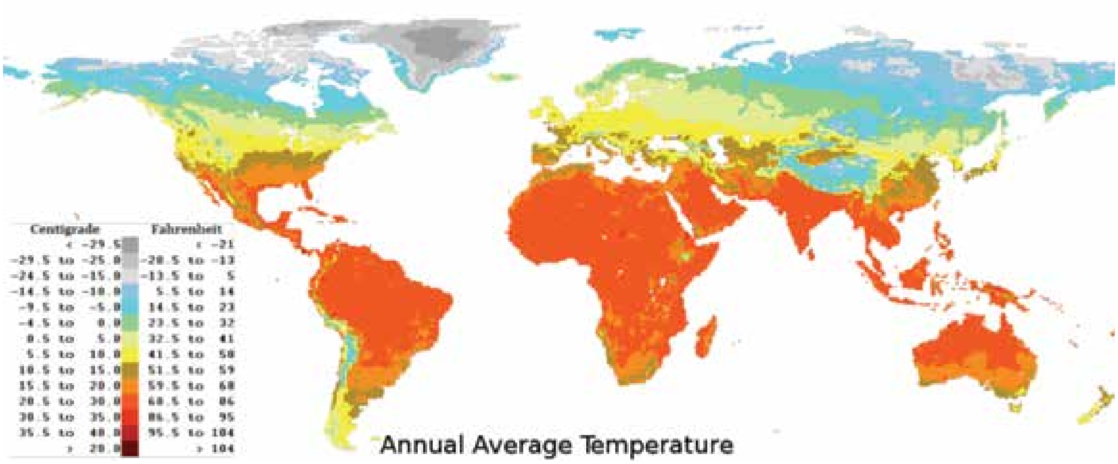


Figure 1: Annual Average Temperature across the globe

How alternators are typically protected from environmental conditions?

1) IP and IC enclosures: - IP refers to ingress protection and IC refers to the cooling circuit arrangement used in the alternator according to IEC 60034-5 and IEC 60034-6 respectively. Ingress Protection or IP is a critical part of the alternator design and is used to protect the alternator from dust/solid particles and water ingress. The Ingress Protection or IP capability of the alternator can be used to protect the alternator from severe environmental conditions like chemicals, salt, dust, humidity, etc,… Figure 3 shows an image of theIP44 configuration offered by Cummins Generator Technologies on some designs of its products.

2) Varnish / Impregnation / Coating on Winding and / or metallic components of the alternator: Alternatively, the manufacturer may recommend the application of an additional coat / varnish / impregnation to protect the windings and metallic components from environmental conditions like salt, humidity, dust and chemicals.

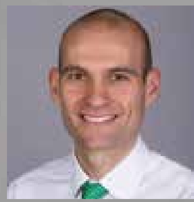
Cummins Generator Technologies has been involved in a variety of activities to understand these applications and develop key criteria that allow selection of the right alternators for these harsh applications. Our team of experienced engineers work with our customers to develop product solutions that target specific application condition requirements.

Figure 2: Effect of salt mist on an exciter

Figure 3: IP 44 PM7 awaiting factory tests

Counterfeit STAMFORD Alternators

Destroyed Following Seizure by Customs Officers



by Alex Wheldon

Earlier this year, Cummins Generator Technologies plans put in place to tackle the illegal trade of fake alternators struck a blow to counterfeiters when Customs Officers at the Port of Eilat in Israel seized 10 generator sets originating from United Arab Emirates and bound for Palestine. The generating sets all contained fake STAMFORD alternators which were decoupled from the sets and destroyed.

The illegal trade of fake alternators has been growing in recent years and affects all major alternator manufacturers. Cummins Generator Technologies takes a zero tolerance approach to counterfeiting of any kind and tracks down illegal counterfeiters.

The 10 fake STAMFORD HC5 alternators were discovered by Customs Officers who have been trained by Cummins to screen shipments passing through the seaport for possible counterfeits. Originating from Future Power International in Sharjah, the alternators looked similar to genuine STAMFORD alternators on the outside, but in reality fake STAMFORD alternators have sub-standard build quality, come with no warranty and can potentially cause irreparable damage to the generator engine.

Poor life expectancy

Past tests carried out by Cummins Generator Technologies on fake alternators have been so unsuccessful, the alternators have failed before we have been able to collect test data.

Authentic Cummins STAMFORD alternators are manufactured using premium materials, under controlled processes and by highly trained workforces. In addition, they undergo the most rigorous alternator testing in the industry. Time and again fake alternators fail to perform, leaving unsuspecting customers out of pocket and often without recourse.

For more information of Cummins Generator Technologies anti-counterfeiting efforts or to ensure authenticity of STAMFORD alternators, visit: genuine-stamford.com.

To report incidents of counterfeit or suspicious products, please email: report.counterfeit@cummins.com.

Customer in Focus

STAMFORD® alternators providing the power.....

Customer: Cummins South Africa

Where: Nickel-Cobalt mining and processing plant, Madagascar

Specified: 30 x STAMFORD P7 alternators for use in 1,250 kVA generator sets

Purpose: Delivering 37.5 MVA of reliable power to the site, operating 24/7 for the anticipated project life of 27 years

The largest capital project in the history of Madagascar, the Ambatovy Project, has deployed generator sets equipped with STAMFORD P7 alternators to help meet its requirement for prime power. They play an essential role as part of a $15 million combined mine and processing project that is set to make a substantial contribution to the country's future prosperity.

"In total, 30 generator sets using STAMFORD P7 alternators were installed at the site, and have since ensured the supply of power that is crucial to this project, which has the potential to sustainably boost the economy of Madagascar and the standard of living for its people," reports Nicola Morgan-Evans, General Manager for Commercial Power Systems at Cummins South Africa, an official STAMFORD | AvK distributor.

The Ambatovy Project represents the country's biggest capital spend to date. It is a large tonnage nickel and cobalt project with annual production capacity estimated at 60,000 tons of nickel, 5,600 tons of cobalt and approximately 190,000 tons of ammonium sulphate. The project has an estimated project life of 27 years, and is one of the world's biggest lateritic nickel mines.

The STAMFORD P7 alternators used on the project are from a range of modern and versatile alternators that have become a popular choice for applications requiring reliable power in harsh environments. Available from 910 to 2,750 kVA, the P7 range can be supplied in 4 pole or 6 pole, single or two bearing AVR controlled versions. Permanent Magnet Generator (PMG) technology is fitted as standard, and the range's 2/3 pitch windings avoid excessive neutral currents.

The generator sets into which the STAMFORD P7 alternators are fitted are actually a rental-spec design. However, thanks to the durability of their components and their ability to operate reliably in the harsh environmental conditions of the project, the customer felt confident in purchasing the generator sets outright. Support, service and a commitment to delivering and setting up in a short time frame were further key factors in the decision to purchase.

The 1,250 kVA generator sets, equipped with Cummins KTA50-G3 engines, provide 37.5 MVA of power and operate 24/7 from two plants, each supplying 18.75 MVA. Each plant is equipped

with 15 x C1250 D2R units for prime power, 15 x 0.4 kV/11 kV step-up transformers, two 20ft containerised MV cells including Digital Management Control system DMC300s and MV switchgear.

The Ambatovy project is already contributing greatly to the local economy – around 12,000 workers were hired directly and indirectly during the construction phase alone. A local development programme provides a human resources registration centre with occupational and technical training programmes for small to medium sized local companies. More than 200 public hearings were held to examine the project's social and environmental issues, which led to the adoption of environmental conservation models based on World Bank guidelines.

generating insight

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