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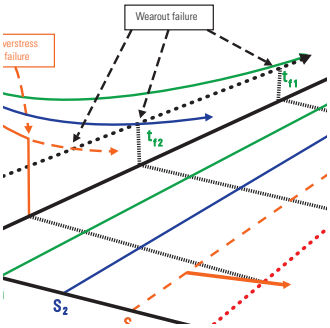

SPM-179 ACCELERATION FACTORS AND ACCELERATED LIFE TESTING

A guide based on practical experiences

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SPM

Reliability Management

SPM is an independent organisation consisting of about 60 company members in Scandinavia.

SPM initiates and finances unprejudiced investigations of common interest for its members – mainly in the field of reliability and testing of electronic components and materials.

Abstract

This report introduces the reader to the basic concepts of acceleration factors, acceleration models and accelerated life testing, as they apply to electromechanical products. It describes two widely used acceleration models: Arrhenius (temperature) and an Inverse Power Law (vibration and thermal cycling). Emphasis is put on wearout failure mechanisms and why knowledge of these is crucial for choosing the right model parameters. A number of practical examples and recommendations are given as well.

The report is intended for test and reliability engineers, familiar with environmental testing of electronics and mechanics.

The report is a result of gathering information from a number of sources, including engineers with many years of experience in testing of electronics and mechanics. The information and experiences gathered have been compiled to give the reader an adequate mixture of theory and practice.

It will be evident, that not all failure mechanisms can be addressed with accelerated life testing since they are not time dependent in the way that is assumed in the acceleration models commonly used. Rather, they depend on short term absolute stress level and should be addressed using relevant "overstress" test methods such as HALT.

The report concludes that acceleration modelling and accelerated life testing, when correctly applied, are valuable tools for product development and will provide understanding of product performance at different stress levels at the same time. This knowledge can further be used for derating and design optimisations. It is also stressed, that no single acceleration model can address all possible failure mechanisms of complex manufactured assemblies and products.

Preface

Background

Acceleration factors and models are often used to predict the "lifetime" of a given product, in a predefined use environment, based on the results of accelerated life testing. In many cases, however, the prediction obtained in the process is either meaningless or misleading and as a result, many companies hesitate to use this approach in product development. Very often, the reason for the unsatisfactory results is a lack of understanding about the possibilities and limitations of acceleration factors and accelerated life testing.

Even though several comprehensive books and articles on the subject exist, SPM members have asked for a simpler and more specific "tool" that includes just enough information to understand and use acceleration factors and models, primarily in relation to accelerated life testing of electromechanical products.

Due to the above, it has been the author's ambition to make a compilation of existing knowledge specifically addressing the subject, combined with practical examples and recommendations.

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Inspiration for the report has mainly been obtained from:

- Feedback from the SPM members in the project group and technical discussions with Lars Rimestad (Grundfos A/S) and Valter Loll (Loll - Consult).
- The author’s 12 years of practical experience from DELTA with testing of various customer products and consultancy on design improvements.

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Readers

The report is intended for test and reliability engineers, familiar with environmental testing of electronics and mechanics. Those already familiar with acceleration factors and models can proceed directly to chapters 3, 4 and 5.

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