FIDES, reliability assessment of electronics: a new approach to the lead-free process factor

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Abstract

The reliability control in airborne electronics products is essential due to safety and business reasons. As users do not have confidence in raw results provided by previous reliability prediction methodologies, FIDES has the objective to build up this confidence considering technology, process and use. After more than a decade of RoHS legislation and the beginning of the lead-free transition of airborne electronics, it is imperative to consider an appropriate lead-free process factor (Π_{LF}) in the reliability prediction. As shown in this work, aeronautical, military and medical industry have waivers that allow them to continue using lead to ensure reliability. Some industries apply components that have lead-free surface finishes with tin-lead soldering alloys. These mixtures, higher temperatures, different reflow times, and other factors introduce risks to the product reliability mainly when subjected to thermomechanical fatigue during long life cycle.

This work presents a new approach for the lead-free process factor (Π_{LF}) and new recommendations for the lead-free grade (LF_grade). An analysis was performed of the current recommendations for lead-free grade (LF_grade). Thirteen new recommendations and its respective weights were defined for the LF_grade, and the lead-free process factor (Π_{LF}) equation was simplified respecting the value range (from 1 to 2) proposed by FIDES; therefore, the lead-free process factor (Π_{LF}) can double the failure rate predicted (λ).

It is necessary to consider that currently there is a need to predict reliability applying an updated lead-free factor that identify and control the factors that presently influence the reliability are even more important objectives.

Key Words: Failure rate, FIDES, lead-free, Pb-free, pi-factors, reliability prediction

1 INTRODUCTION

Highly reliable products are important and strategic for the industry, especially for airborne electronic hardware (AEH). The reduced product development time and strategies to increase maturity and robustness are challenging; therefore, understanding reliability, choosing a methodology for prediction, identifying and controlling factors that influence the failure rate, identifying risks and mitigations of the lead-free assemblies; and considering all these initiatives in reliability prediction is imperative to assure high reliable products [1].

Empirical failure rate prediction models for electronic and electromechanical components emerged from the investigation of failures and efforts for their statistical description in military electronics applications. The United States Navy published the MIL-HDBK-217 in 1965 and stopped updating it in 1995. This Handbook is a standard widely accepted for decades also in industrial electronics and is still used today [2].

The RIAC-Handbook-217Plus model published in 2006 has been developed by the Reliability Information Analysis Center

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