JEDEC
STANDARD

LOGNORMAL ANALYSIS OF UNCENSORED DATA AND OF SINGLY RIGHT-CENSORED DATA UTILIZING THE PERSSON AND ROOTZEN METHOD

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Contents

Foreword

This standard is intended for use by those involved with reliability, lifetime estimation or failure data analysis. This standard enables the user to estimate the parameters of a two parameter lognormal distribution from complete or singly right-censored independent failure data. The methods described were chosen because they can be easily done with a calculator or spreadsheet and are as accurate as more complex iterative techniques for the cases described.

Interferences or issues that can complicate and/or invalidate the analysis are discussed. One section discusses analysis of failure data where all units from within the sample have a known failure time. Another section discusses analysis of failure data for the case where the life experiment was stopped and the failure times for the surviving unis are not known. Graphical presentation is discussed and sample calculations are presented in several annexes.

Introduction

Analysis of reliability experiments depends extensively on failure statistics and commonly used failure distribution is the normal distribution after natural logarithms of the failure times have been calculated. Lognormal distributions and the associated statistics are used by analysts working in semiconductor reliability to interpret and communicate results from failure experiments. Unfortunately, many individuals who lack a sufficient background in statistical methods are using the techniques; errors in usage and interpretation are abundant.

This document was written to provide a very basic set of tools for determining the parameters of the lognormal distribution for cases where sophisticated tools or expertise do not exist. The techniques handle a majority of the experimental cases experienced by contributors. The step-by-step standard and annexes are intended to instruct and to help ensure proper analysis.

STANDARD FOR LOGNORMAL ANALYSIS OF UNCENSORED DATA AND OF SINGLY RIGHT-CENSORED DATA UTILIZING THE PERSSON AND ROOTZEN METHOD

(From JEDEC Board Ballot JCB-17-28, formulated under the cognizance of the JC-14.2 Committee on Wafer-Level Reliability)

1 Scope

1.1 Intent

This standard enables the user to estimate the parameters of a two-parameter lognormal distribution from complete or singly right-censored independent data samples.
Specifically, this standard is intended for analyzing failure-time (t_f) data obtained from a stress test of a sample of units when the natural logarithm of the failure-time (ln t_f) follow a normal distribution.
This standard is not intended to describe techniques used to determine how well the failure data fits a lognormal distribution. However, if points lie along a straight line for plots generated in section 8 the lognormal distribution estimators will describe the points along the line.

1.2 Results

The results of the analysis provide bias-corrected sample estimates for the median time-to-failure (t_{50}), mean of the ln t_f values (ln t_{50}), and the standard deviation (σ) of the ln t_f value of the lognormal distribution. Additionally, confidence intervals are provided for complete data samples (no censoring). These are all obtained from the failure time values (t_f)

1.3 Complete data case

This standard may be used to analyze complete data where the failure-time data for the entire sample population is known and used. The analysis uses the most efficient estimators for obtaining estimates of the two primary parameters (t_{50}, σ) of the distribution.

1.4 Right-censored case

This standard may be used to analyze singly right-censored (Type II censored) data where the test has been stopped before all the parts have failed. The analysis uses the Persson and Rootzen Estimators [1] corrected for bias [2, 3]. These estimators can be calculated with a hand calculator and are as accurate as more complex estimators.