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# TECHNICAL REPORT

## Guide for the statistical analysis of ageing test data – Part 2: Validation of procedures for statistical analysis of censored normally distributed data

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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## Part 2: Validation of procedures for statistical analysis of censored normally distributed data

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IEC 60493-2 which is a technical report, has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

The text of this technical report is based on the following documents:

| Enquiry draft | Report on voting |
|---|---|
| 112/140/DTR | 112/145/RVC |

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This publication contains attached files in the form of a CD-ROM. These files are intended to be used as a complement and do not form an integral part of the standard.

A list of all parts of the IEC 60493 series, published under the general title *Guide for the statistical analysis of ageing test data,* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

# INTRODUCTION

Procedures for estimating ageing properties are described in specific test procedures, or are covered by the general documents on test procedures for ageing tests with a specific environmental stress (e.g. temperature, radiation, partial discharges).

In many cases, a certain property is determined as a function of time at different ageing stresses, and a time to failure based on a chosen end-point criterion is found at each ageing stress. A plot of time to failure versus ageing stress may be used to obtain an estimate of the time to failure for similar specimens exposed to a specified stress, or to obtain an estimate of the value of stress which will cause failure in a specified time.

The physical and chemical laws governing the ageing phenomena may often lead to the assumption that a linear relationship exists between the property examined and the ageing time at fixed ageing stresses, or between certain mathematical functions of property and ageing time, e.g. square root or logarithm.

The relationships between property values, ageing time, ageing and ageing exposure temperature are determined by mathematical procedures known as analysis of variance, analysis of covariance and regression analysis. In some cases, the property values cannot be determined because of time or property measurement limitations. Such data are referred to as “censored data”.

The mathematical procedures are well known and accepted as valid for complete (uncensored) data. This technical report describes the work done to validate the procedures for censored data.

# GUIDE FOR THE STATISTICAL ANALYSIS OF AGEING TEST DATA –

## Part 2: Validation of procedures for statistical analysis of censored normally distributed data

## 1 Scope

This part of IEC 60493 provides an account of the work done in designing and validating the statistical procedures for operations on censored groups of normally distributed data.

The relationship to similar operations on complete (uncensored) data is examined, and it is shown that “mixed” or wholly uncensored data groups may be analysed in the same way as wholly censored ones.

Attention is drawn to the effect of some variation of group size and extent of censoring, as well as the effect of non-uniform data group sizes.

## 2 Normative references

IEC 60216-3, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

IEC 60216-5, *Electrical insulating materials – Thermal endurance properties – Part 5: Determination of relative thermal endurance index (RTE) of an insulating material*

IEC 60216-6, *Electrical insulating materials – Thermal endurance properties – Part 6: Determination of thermal endurance indices (TI and RTE) of an insulating material using the fixed time frame method*

IEC 60493-1, *Guide for the statistical analysis of ageing test data. Part 1: Methods based on mean values of normally distributed test results*