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**Metallic materials — Fatigue testing —  
Statistical planning and analysis of data**

*Matériaux métalliques — Essais de fatigue — Programmation et  
analyse statistique de données*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12107 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 5, *Fatigue testing*.

This second edition cancels and replaces the first edition (ISO 12107:2003), which has been technically revised.

## Introduction

It is known that the results of fatigue tests display significant variations even when the test is controlled very accurately. In part, these variations are attributable to non-uniformity of test specimens. Examples of such non-uniformity include slight differences in chemical composition, heat treatment, surface finish, etc. The remaining part is related to the stochastic process of fatigue failure itself that is intrinsic to metallic engineering materials.

Adequate quantification of this inherent variation is necessary to evaluate the fatigue property of a material for the design of machines and structures. It is also necessary for test laboratories to compare materials in fatigue behaviour, including its variation. Statistical methods are necessary to perform these tasks. This International Standard includes a full methodology for application of the Bastenaire model as well as other more sophisticated relationships. It also addresses the analysis of runout (censored) data.



# Metallic materials — Fatigue testing — Statistical planning and analysis of data

## 1 Scope

### 1.1 Objectives

This International Standard presents methods for the experimental planning of fatigue testing and the statistical analysis of the resulting data. The purpose is to determine the fatigue properties of metallic materials with both a high degree of confidence and a practical number of specimens.

### 1.2 Fatigue properties to be analysed

This International Standard provides a method for the analysis of fatigue life properties at a variety of stress levels using a relationship that can linearly approximate the material's response in appropriate coordinates.

Specifically, it addresses

- a) the fatigue life for a given stress, and
- b) the fatigue strength for a given fatigue life.

The term “stress” in this International Standard can be replaced by “strain”, as the methods described are also valid for the analysis of life properties as a function of strain. Fatigue strength in the case of strain-controlled tests is considered in terms of strain, as it is ordinarily understood in terms of stress in stress-controlled tests.

### 1.3 Limit of application

This International Standard is limited to the analysis of fatigue data for materials exhibiting homogeneous behaviour due to a single mechanism of fatigue failure. This refers to the statistical properties of test results that are closely related to material behaviour under the test conditions.

In fact, specimens of a given material tested under different conditions may reveal variations in failure mechanisms. For ordinary cases, the statistical property of resulting data represents one failure mechanism and may permit direct analysis. Conversely, situations are encountered where the statistical behaviour is not homogeneous. It is necessary for all such cases to be modelled by two or more individual distributions.

An example of such behaviour is often observed when failure can initiate from either a surface or internal site at the same level of stress. Under these conditions, the data will have mixed statistical characteristics corresponding to the different mechanisms of failure. These types of results are not considered in this International Standard because a much higher complexity of analysis is required.

Finally, for the  $S-N$  case (discussed in Clause 8), this International Standard addresses only complete data. Runouts of censored data are not addressed.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3534 (all parts), *Statistics — Vocabulary and symbols*