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**Rubber and rubber products —
Determination of the sensitivity of test
methods**

*Caoutchouc et produits en caoutchouc — Évaluation de la sensibilité
des méthodes d'essai*



Reference number
ISO 19004:2004(E)

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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 19004 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analyses*.

This International Standard is based on ASTM D 6600-00, *Standard Practice for Evaluating Test Sensitivity for Rubber Test Methods*, copyright ASTM, used with permission of ASTM.

In this corrected version of ISO 19004:2004, the reference in the Bibliography to ASTM D 6600-00 has been transferred to Clause 1.

Introduction

Testing is conducted to make technical decisions on materials, processes and products. With the continued growth in the number of test methods available for determining physical and chemical properties of rubber and rubber products, a quantitative approach is needed to select test methods that have high quality or technical merit (or the method which has the highest). The procedures defined in this International Standard may be used for this purpose.

One index of technical merit frequently used in the past for test methods has been the precision of the method. The precision is usually expressed as some multiple of the test measurement standard deviation for a defined test domain. Although precision is a quantity required for test sensitivity, it is an incomplete description (only one-half of the necessary information) since it does not consider the discrimination power (sensitivity) of the method with respect to the property (or constituent) being determined.

Any attempt to determine the relative sensitivity of two different test methods on the basis of measurement standard deviation ratios or variance ratios, which give no information on the discrimination power of the methods, constitutes an invalid quantitative basis for determining the sensitivity. Coefficient of variation ratios (which are normalized with respect to the mean) may constitute a valid way of determining relative sensitivity, but only when the results obtained by the two test methods under comparison are directly proportional or reciprocally related to each other. If the relationship between two test methods is non-linear, or linear with a non-zero intercept, coefficient of variation ratios are not equivalent to the true test sensitivity as defined in this International Standard (see discussion in B.1.4 in Annex B).

This International Standard develops the terminology and concepts required to define and determine the sensitivity of a test method. Sufficient background information is presented to place the standard on a firm conceptual and mathematical foundation. This allows broad application of the standard across both chemical and physical test domains. The standard draws heavily on the approach and techniques given in references [1] and [2] in the Bibliography.

The text starts by giving definitions of a number of general terms and a brief review of the measurement process. This is followed by development of basic test sensitivity concepts. Two classes of test sensitivity (absolute and relative) are defined, as well as two categories:

- a) sensitivity determined over a limited measured-property range (category 1);
- b) sensitivity determined over an extended range (category 2).

For an extended property range, for either class, two types of test sensitivity may exist:

- 1) uniform or equal sensitivity across a range of property values (type 1);
- 2) non-uniform sensitivity, i.e. the sensitivity depends on the value of the property across the selected range (type 2).

Annex A is an important part of this document. It presents recommendations for using linear regression analysis for the determination of test sensitivity and recommendations for determining the precision of the test sensitivity determination.

Annex B is also an important adjunct to the document. It gives two examples of relative test sensitivity calculations:

- a) for a limited-range or “spot check” programme;
- b) for an extended-range test sensitivity programme in the case of a non-uniform test sensitivity.

Annex C gives background information on transforming the scales of plots, as is often needed for an extended-range sensitivity. It also gives the derivation of the absolute test sensitivity for a simple analytical chemical test.

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Rubber and rubber products — Determination of the sensitivity of test methods

1 Scope

This International Standard describes how test sensitivity can be determined for test methods used to measure typical physical and chemical properties of rubber and rubber products. It is also applicable to tests used to measure the properties of carbon black fillers.

Test sensitivity is defined as the ratio of the discrimination power of a test method for the fundamental property to be determined to the measurement error expressed as a standard deviation. It is frequently described as the “signal-to-noise ratio”.

This International Standard does not address the topic of sensitivity in the context of threshold (i.e. minimum) detection limits in the determination of very low or trace constituent levels.

This International Standard is based, with permission of ASTM, on ASTM D 6600-00, *Standard Practice for Evaluating Test Sensitivity for Rubber Test Methods*, copyright ASTM.

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/TR 9272, *Rubber and rubber products — Determination of precision for test method standards*

ISO 5725 (All parts), *Accuracy (trueness and precision) of measurement methods and results*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5725, together with the following, apply.

NOTE A number of specialized terms or definitions, not appearing in other International Standards, are required for this International Standard. They are defined in this clause in a systematic sequential order, from simple terms to complex terms; the simple terms may be used in the definition of the more complex terms. This approach generates the most succinct and unambiguous definitions. Some key concepts required for this International Standard are introduced and defined in other clauses of the standard. Their location in these other clauses puts them in a more appropriate context and makes understanding the concepts easier.

3.1 fundamental property

FP

inherent or basic property (or constituent) that a test method is intended to determine or assess

3.2 measured property

MP

property that a measuring instrument determines