# IEC 60544-5

Edition 3.0 2022-06

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

## Electrical insulating materials – Determination of the effects of ionizing radiation –
## Part 5: Procedures for assessment of ageing in service

## Matériaux isolants électriques – Détermination des effets des rayonnements ionisants –
## Partie 5: Procédures pour l'évaluation du vieillissement en service

IEC 60544-5:2022-06(en-fr)

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# ELECTRICAL INSULATING MATERIALS – DETERMINATION OF THE EFFECTS OF IONIZING RADIATION –

## Part 5: Procedures for assessment of ageing in service

## FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60544-5 has been prepared by IEC technical committee TC 112: Evaluation and qualification of electrical insulating materials and systems. It is an International Standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) added recent references in 7.4 showing that some electrical condition monitoring methods show promising correlations with ageing;
b) updated recommendations for implementation of a sample deposit in 9.2, installation of a sample deposit in 9.3 and testing of samples from the deposit in 9.4;
c) updated list of references.

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 112/523/CDV | 112/553/RVC |

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60544 series, published under the general title *Electrical insulating materials – Determination of the effects of ionizing radiation*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

# INTRODUCTION

Organic and polymeric materials provide a significant proportion of the insulation used in electrical systems. These materials are sensitive to the effects of irradiation and the response varies widely between different types. It is therefore important to be able to assess the degree of degradation of these insulating materials during their service lifetimes. This part of IEC 60544 provides recommended procedures for assessing ageing of insulating materials in service.

There are a number of approaches to the assessment of ageing of polymer-based components exposed to radiation environments [1], [2], [3], [4][1]. These are based on the better understanding of the factors affecting ageing degradation which has been developed over several decades. In nuclear power plants, qualification programmes are normally used for the selection of components, including those based on polymeric materials. These initial qualification procedures, such as IEEE Std 323™-1974[2] [5] and IEEE Std 383™-1974[2] [6], were originally written before there was sufficient understanding of ageing mechanisms. Most of the methods discussed in this document are therefore used to supplement the initial qualification process.

This document is the fifth in a series dealing with the effect of ionizing radiation on insulating materials.

IEC 60544-1 (Radiation interaction and dosimetry) constitutes an introduction dealing very broadly with the problems involved in evaluating radiation effects. It also provides guidance on dosimetry terminology, several methods of determining exposure and absorbed dose, and methods of calculating absorbed dose in any specific material from the dosimetry method applied.

IEC 60544-2 (Procedures for irradiation and test) describes procedures for maintaining seven different types of exposure conditions during irradiation. It also specifies the controls that should be maintained over these conditions so that when test results are reported, reliable comparisons of material performance can be made. In addition, it defines certain important irradiation conditions and test procedures to be used for property change determinations and corresponding end-point criteria.

IEC 60544-3 has been withdrawn and incorporated into the second edition of IEC 60544-2.

IEC 60544-4 (Classification system for service in radiation environments) provides a recommended classification system for categorizing the radiation endurance of insulation materials.

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[1] Numbers in square brackets refer to the Bibliography.

[2] IEEE Std 323-1974 and IEEE Std 383-1974 are now withdrawn and have been superseded by more recent revisions.

# ELECTRICAL INSULATING MATERIALS – DETERMINATION OF THE EFFECTS OF IONIZING RADIATION –

## Part 5: Procedures for assessment of ageing in service

## 1 Scope

This part of IEC 60544 covers ageing assessment methods which can be applied to components based on polymeric materials (e.g. cable insulation and jackets, elastomeric seals, polymeric coatings, gaiters) which are used in environments where they are exposed to radiation.

The object of this document is aimed at providing methods for the assessment of ageing in service. The approaches discussed in Clause 5 through Clause 9 cover ageing assessment programmes based on condition monitoring (CM), the use of sample deposits in severe environments and sampling of real-time aged components.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60544-2, *Electrical insulating materials – Determination of the effects of ionizing radiation on insulating materials – Part 2: Procedures for irradiation and test*

IEC TS 61244-1, *Determination of long-term radiation ageing in polymers – Part 1: Techniques for monitoring diffusion-limited oxidation*

IEC TS 61244-2, *Determination of long-term radiation ageing in polymers – Part 2: Procedures for predicting ageing at low dose rates*

## 3 Terms, definitions and abbreviated terms

### 3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

### 3.2 Abbreviated terms

BWR boiling water reactor

CBQ condition-based qualification

CM condition monitoring

CSPE chlorosulphonated polyethylene

DBE design basis event