



BSI Standards Publication

Electrical insulating materials — Determination of the effects of ionizing radiation

Part 5: Procedures for assessment of ageing in service

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National foreword

This British Standard is the UK implementation of EN IEC 60544-5:2022. It is identical to IEC 60544-5:2022. It supersedes BS EN 60544-5:2012, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/112, Evaluation and qualification of electrical insulating materials and systems.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

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

Elektroisolerstoffe - Bestimmung der Wirkung ionisierender Strahlung - Teil 5: Bewertungsverfahren für die Alterung während des Einsatzes

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

The text of document 112/523/CDV, future edition 3 of IEC 60544-5, prepared by IEC/TC 112 "Evaluation and qualification of electrical insulating materials and systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60544-5:2022.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023-04-22
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2025-07-22

This document supersedes EN 60544-5:2012 and all of its amendments and corrigenda (if any).

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Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC/IEEE 62582 (series) NOTE Harmonized as EN IEC/IEEE 62582 (series)

IEC 62465 NOTE Harmonized as EN IEC 62465

IEC/IEEE 60780-323 NOTE Harmonized as EN 60780-323

IEC 60544-4 NOTE Harmonized as EN 60544-4

IEC 60544-1 NOTE Harmonized as EN 60544-1

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(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60544-2	-	Electrical insulating materials - Determination of the effects of ionizing radiation on insulating materials - Part 2: Procedures for irradiation and test	EN 60544-2	-
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	-	-



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

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CONTENTS

FOREWORD	4
INTRODUCTION	6
1 Scope	7
2 Normative references	7
3 Terms, definitions and abbreviated terms	7
3.1 Terms and definitions	7
3.2 Abbreviated terms	7
4 Background	8
4.1 General	8
4.2 Diffusion-limited oxidation (DLO)	8
4.3 Dose rate effects (DRE)	9
4.4 Accelerated radiation ageing	9
4.5 Accelerated thermal ageing	9
5 Approaches to ageing assessment	10
6 Identifying components of concern	10
6.1 General	10
6.2 Priorities for ageing management	10
6.3 Environmental monitoring	10
6.4 Localized severe environments	11
6.5 Worst case components	11
7 Condition monitoring techniques	11
7.1 General	11
7.2 Establishing correlation curves for CM methods	11
7.3 CM methods	12
7.4 Using CM for short-term troubleshooting	12
7.5 Using CM for long-term degradation assessment	14
8 Predictive modelling	15
9 Sample deposit	16
9.1 General	16
9.2 Requirements of a deposit	16
9.3 Pre-ageing samples for a deposit	16
9.4 Installation of a sample deposit	17
9.5 Testing of samples from the deposit	17
9.6 Determination of sampling intervals	17
9.7 Real time aged materials	18
Annex A (informative) Example of a CM correlation curve	19
Annex B (informative) Use of a deposit	20
B.1 Typical sample in a deposit	20
B.2 Typical testing schedule for a deposit	20
Bibliography	21
Figure 1 – Development of ageing data on changes in tensile elongation and a condition indicator (e.g. indenter modulus) – Schematic representation	13
Figure 2 – Correlation curve derived from data in Figure 1 – Schematic representation	14
Figure 3 – Estimation of elongation from a correlation curve	15

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Figure 4 – Modification of sampling interval dependent on values of the CM indicator – Schematic representation	18
Figure A.1 – Correlation curve for indenter modulus against tensile elongation for a CSPE cable jacket material [24].....	19

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 5: Procedures for assessment of ageing in service

FOREWORD

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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.

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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.

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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 323TM-1974² [5] and IEEE Std 383TM-1974² [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.

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.

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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