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Irish Standard
I.S. EN 60544-5:2012

Electrical insulating materials -
Determination of the effects of ionizing
radiation -- Part 5: Procedures for
assessment of ageing in service (IEC
60544-5:2011 (EQV))

I.S. EN 60544-5:2012

Incorporating amendments/corrigenda issued since publication:

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April 2012

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Supersedes EN 60544-5:2003

English version

**Electrical insulating materials -
Determination of the effects of ionizing radiation -
Part 5: Procedures for assessment of ageing in service
(IEC 60544-5:2011)**

Matériaux isolants -
Détermination des effets des
rayonnements ionisants -
Partie 5: Procédures pour l'estimation du
vieillessement en service
(CEI 60544-5:2011)

Elektroisolierstoffe -
Bestimmung der Wirkung ionisierender
Strahlung -
Teil 5: Bewertungsverfahren für die
Alterung während des Einsatzes
(IEC 60544-5:2011)

This European Standard was approved by CENELEC on 2012-01-18. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

I.S. EN 60544-5:2012

EN 60544-5:2012

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Foreword

The text of document 112/171/CDV, future edition 2 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 60544-5:2012.

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) 2012-10-18
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2015-01-18

This document supersedes EN 60544-5:2003.

EN 60544-5:2012 constitutes an editorial revision to align it with standards recently developed by SC 45A as well as with other parts in the EN 60544 series.

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

Endorsement notice

The text of the International Standard IEC 60544-5:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60544-4 NOTE Harmonized as EN 60544-4.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60544-1	-	Electrical insulating materials - Determination of the effects of ionizing radiation - Part 1: Radiation interaction and dosimetry	EN 60544-1	-
IEC 60544-2	-	Guide for determining the effects of ionizing radiation on insulating materials - Part 2: Procedures for irradiation and test	-	-
IEC 60780	-	Nuclear power plants - Electrical equipment of the safety system - Qualification	-	-
IEC/TR 61244-1	-	Determination of long-term radiation ageing in polymers - Part 1: Techniques for monitoring diffusion-limited oxidation	-	-
IEC/TR 61244-2	-	Determination of long-term radiation ageing in polymers - Part 2: Procedures for predicting ageing at low dose rates	-	-

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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

- 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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International Standard IEC 60544-5 has been prepared IEC technical committee TC 112: Evaluation and qualification of electrical insulating materials and systems.

This second edition cancels and replaces the first edition, published in 2003, and constitutes an editorial revision to align it with standards recently developed by SC 45A as well as with other parts in the IEC 60544 series.

The text of this standard is based on the following documents:

CDV	Report on voting
112/171/CDV	112/191/RVC

Full information on the voting for the approval of this standard 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.

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 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 [1–4]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 selection of components, including those based on polymeric materials. These initial qualification procedures, such as IEEE-323 [5] and IEEE-383 [6], were originally written before there was sufficient understanding of ageing mechanisms. Most of the methods discussed in this part of IEC 60544 are therefore used to supplement the initial qualification process.

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

Part 1 (Radiation interaction and dosimetry) constitutes an introduction dealing very broadly with the problems involved in evaluating radiation effects. It also provides guidance to 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.

Part 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.

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

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

¹ Figures in square brackets refer to the bibliography.

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

Part 5: Procedures for assessment of ageing in service

1 Scope and object

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 standard is aimed at providing methods for the assessment of ageing in service. The approaches discussed in the following clauses 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, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60544-1, *Electrical insulating materials – Determination of the effects of ionizing radiation – Part 1: Radiation interaction and dosimetry*

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

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

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

IEC 60780, *Nuclear power plants – Electrical equipment of the safety system – Qualification*

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