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INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Nuclear power plants – Instrumentation and control important to safety –
Electrical equipment condition monitoring methods –
Part 3: Elongation at break**

**Centrales nucléaires – Instrumentation et contrôle-commande importants pour
la sûreté – Méthodes de surveillance de l'état des matériels électriques –
Partie 3: Allongement à la rupture**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL IMPORTANT TO SAFETY – ELECTRICAL EQUIPMENT CONDITION MONITORING METHODS –

Part 3: Elongation at break

FOREWORD

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IEC/IEEE 62582-3 was prepared by subcommittee 45A: Instrumentation and control of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation, in cooperation with the Nuclear Power Engineering Committee of the Power & Energy Society of the IEEE¹, under the IEC/IEEE Dual Logo Agreement between IEC and IEEE. It is an International Standard.

This document is published as an IEC/IEEE Dual Logo standard.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

- a) Updated best practices relating to condition monitoring using the tensile elongation method.
- b) Updated bibliography, references and context.

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

Draft	Report on voting
45A/1524/FDIS	45A/1538/RVD

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 the rules given in the ISO/IEC Directives, Part 2, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications/.

A list of all parts of the IEC/IEEE 62582 series, under the general title *Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods*, 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, or
- revised.

¹ A list of IEEE participants can be found at the following URL: http://standards.ieee.org/downloads/62582-3/62582-3-2012/62582-3-2012_wg-participants.pdf.

INTRODUCTION

a) Technical background, main issues and organisation of the standard

This part of this IEC/IEEE standard specifically focuses on elongation at break methods for condition monitoring for the management of ageing of electrical equipment installed in nuclear power plants. The method is primarily suited to samples taken from equipment that are based on polymeric materials.

This part of IEC/IEEE 62582 is the third part of the IEC/IEEE 62582 series. It contains detailed descriptions of condition monitoring based on elongation at break measurements.

The IEC/IEEE 62582 series is issued with a joint logo which makes it applicable to management of ageing of electrical equipment qualified to IEEE as well as IEC Standards.

IEC/IEEE 60780-323 defined term condition-based qualification which is an adjunct to type testing. The qualified condition is established by condition indicator(s) prior to the start of accident conditions for which the equipment was demonstrated to meet the design requirements for the specified service conditions. IEC/IEEE 60780-323 defined condition indicator.

Significant research has been performed on condition monitoring techniques and the use of these techniques in equipment qualification as noted in NUREG/CR-6704, vol.2 (BNL-NUREG-52610), JNES-SS-0903, 2009 and IAEA-TECDOC 1825:2017.

It is intended that this IEC/IEEE standard be used by test laboratories, operators of nuclear power plants, systems evaluators and licensors.

b) Situation of the current standard in the structure of the IEC SC 45A standard series

Part 3 of IEC/IEEE 62582 is the third level IEC SC 45A document tackling the specific issue of application and performance of elongation at break measurements in management of ageing of electrical instrument and control equipment in nuclear power plants.

Part 3 of IEC/IEEE 62582 is to be read in association with Part 1 of IEC/IEEE 62582, which provides requirements for application of methods for condition monitoring of electrical equipment important to safety of nuclear power plants.

For more details on the structure of the IEC SC 45A standard series, see item d) of this introduction.

c) Recommendations and limitations regarding the application of this standard

It is important to note that this document establishes no additional functional requirements for safety systems.

d) Description of the structure of the IEC SC 45A standard series and relationships with other IEC documents and other bodies documents (IAEA, ISO)

The IEC SC 45A standard series comprises a hierarchy of four levels. The top-level documents of the IEC SC 45A standard series are IEC 61513 and IEC 63046.

IEC 61513 provides general requirements for instrumentation and control (I&C) systems and equipment that are used to perform functions important to safety in nuclear power plants (NPPs). IEC 63046 provides general requirements for electrical power systems of NPPs; it covers power supply systems including the supply systems of the I&C systems.

IEC 61513 and IEC 63046 are to be considered in conjunction and at the same level. IEC 61513 and IEC 63046 structure the IEC SC 45A standard series and shape a complete framework establishing general requirements for instrumentation, control and electrical power systems for nuclear power plants.

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general requirements for specific topics, such as categorization of functions and classification of systems, qualification, separation, defence against common cause failure, control room design, electromagnetic compatibility, human factors engineering, cybersecurity, software and hardware aspects for programmable digital systems, coordination of safety and security requirements and management of ageing. The standards referenced directly at this second level should be considered together with IEC 61513 and IEC 63046 as a consistent document set.

At a third level, IEC SC 45A standards not directly referenced by IEC 61513 or by IEC 63046 are standards related to specific requirements for specific equipment, technical methods, or activities. Usually these documents, which make reference to second-level documents for general requirements, can be used on their own.

A fourth level extending the IEC SC 45 standard series, corresponds to the Technical Reports which are not normative.

The IEC SC 45A standards series consistently implements and details the safety and security principles and basic aspects provided in the relevant IAEA safety standards and in the relevant documents of the IAEA nuclear security series (NSS). In particular this includes the IAEA requirements SSR-2/1, establishing safety requirements related to the design of nuclear power plants (NPPs), the IAEA safety guide SSG-30 dealing with the safety classification of structures, systems and components in NPPs, the IAEA safety guide SSG-39 dealing with the design of instrumentation and control systems for NPPs, the IAEA safety guide SSG-34 dealing with the design of electrical power systems for NPPs, the IAEA safety guide SSG-51 dealing with human factors engineering in the design of NPPs and the implementing guide NSS42-G for computer security at nuclear facilities. The safety and security terminology and definitions used by the SC 45A standards are consistent with those used by the IAEA.

IEC 61513 and IEC 63046 have adopted a presentation format similar to the basic safety publication IEC 61508 with an overall life-cycle framework and a system life-cycle framework. Regarding nuclear safety, IEC 61513 and IEC 63046 provide the interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. In this framework, IEC 60830, IEC 62138 and IEC 62566 correspond to IEC 61508-3 for the nuclear application sector.

IEC 61513 and IEC 63046 refer to ISO 9001 as well as to IAEA GSR part 2 and IAEA GS-G-3.1 and IAEA GS-G-3.5 for topics related to quality assurance (QA).

At level 2, regarding nuclear security, IEC 62645 is the entry document for the IEC/SC 45A security standards. It builds upon the valid high level principles and main concepts of the generic security standards, in particular ISO/IEC 27001 and ISO/IEC 27002; it adapts them and coordinates them to fit the nuclear context and coordinates with the IEC 62443 series. At level 2, IEC 60964 is the entry document for the IEC/SC 45A control rooms standards, IEC 63351 is the entry document for the human factors engineering standards and IEC 62342 is the entry document for the ageing management standards.

NOTE 1 It is assumed that for the design of I&C systems in NPPs that implement conventional safety functions (e.g. to address worker safety, asset protection, chemical hazards, process energy hazards) international or national standards would be applied.

NOTE 2 IEC TR 64000 provides a more comprehensive description of the overall structure of the IEC SC 45A standards series and of its relationship with other standards bodies and standards.

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL IMPORTANT TO SAFETY – ELECTRICAL EQUIPMENT CONDITION MONITORING METHODS –

Part 3: Elongation at break

1 Scope

This part of IEC/IEEE 62582 contains methods for condition monitoring of organic and polymeric materials in instrumentation and control systems using tensile elongation techniques in the detail necessary to produce accurate and reproducible measurements. This document includes the requirements for selection of samples, the measurement system and conditions, and the reporting of the measurement results.

The different parts of IEC/IEEE 62582 are measurement standards, primarily for use in the management of ageing in initial qualification and after installation. IEC/IEEE 62582-1 includes requirements for the application of the other parts of IEC/IEEE 62582 and some elements which are common to all methods. Information on the role of condition monitoring in qualification of equipment important to safety is found in IEC/IEEE 60780-323.

This document is applicable to non-energised equipment.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia is available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEEE Standards Dictionary Online: available at <http://dictionary.ieee.org>

3.1 elongation

E
tensile strain, expressed as a percentage of the test length, produced in the piece by a tensile stress

[SOURCE: ISO 37:2017, 3.2]

3.2 elongation at break

E_b
tensile strain in the test length at the breaking point

[SOURCE: ISO 37:2017, 3.5]