



SLOVENSKI STANDARD SIST EN 45552:2020

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Splošna metoda za oceno trajnosti izdelkov, povezanih z energijo

General method for the assessment of the durability of energy-related products

Allgemeines Verfahren zur Bewertung der Lebensdauer energieverbrauchsrelevanter Produkte

Méthode générale pour l'évaluation de la durabilité des produits liés à l'énergie

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EUROPEAN STANDARD

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English version

General method for the assessment of the durability of energy-related products

Méthode générale pour l'évaluation de la durabilité
des produits liés à l'énergie

Allgemeines Verfahren zur Bewertung der
Funktionsbeständigkeit energieverbrauchsrelevanter
Produkte

This European Standard was approved by CEN on 13 February 2020.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN and CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EN 45552:2020 (E)**European foreword**

This document (EN 45552:2020) has been prepared by Technical Committee CEN-CENELEC/JTC 10 “Energy-related products – Material Efficiency Aspects for Ecodesign”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2020, and conflicting national standards shall be withdrawn at the latest by September 2020.

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

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive (2009/125/EC).

The dual logo CEN-CENELEC standardization deliverables, in the numerical range of 45550 – 45559, have been developed under standardization request M/543 of the European Commission and are intended to potentially apply to any product within the scope of the energy-related products (ErP) Directive (2009/125/EC).

Topics covered in the above standardization request are linked to the following material efficiency aspects:

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- a) Extending product lifetime; [SIST EN 45552:2020](https://standards.iteh.ai/catalog/standards/sist/0701dc5f-3540-4023-abb8-02aad3c642ac/sist-en-45552-2020)
 - b) Ability to re-use components or recycle materials from products at end-of-life; <https://standards.iteh.ai/catalog/standards/sist/0701dc5f-3540-4023-abb8-02aad3c642ac/sist-en-45552-2020>
 - c) Use of re-used components and/or recycled materials in products

These standards are general in nature and describe or define fundamental principles, concepts, terminology or technical characteristics. They can be cited together with other product-specific or product-group standards, e.g. developed by product technical committees.

This document is intended to be used by technical committees when producing horizontal, generic, and product, or product-group, standards.

NOTE CEN/CENELEC/JTC 10 is a joint TC, and uses either CEN or CENELEC foreword templates, as appropriate. The template for the current document is correct at the time of publication.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

As energy-related products (ErP) can often not be completely recycled, and the benefits associated with material recovery cannot fully compensate the energy (and material) demand of the whole production chain, each disposed ErP also means losses in energy and materials. Therefore, increasing the durability of ErPs can contribute to a reduction in the quantity of raw materials used and energy required for the production/disposal of ErPs and consequently reduces adverse environmental impacts.

When considering durability, the trade-off between longer lifetime (reducing impacts related to the manufacturing and disposal of the product) and reduced environmental impacts of new products (compared to worse/decreasing energy efficiency of older products) needs to be considered. In addition, consumer behaviour and advances in technology have to be taken into account. Considerations such as these are addressed in the preparatory studies commissioned under Directive 2009/125/EC. Whilst such aspects establish a relevant context for this standard, they are not addressed in this document.

This document covers a general method for the assessment of the reliability and the durability of ErPs. Reliability represents the assessment of a probability of duration from first use to first failure or in-between failures. Durability is the whole expected time for this same period and not a probability. To cover other material efficiency aspects of a product, the generic standards on “General methods for the assessment of the ability to repair, reuse and upgrade energy-related products – EN 45554:2020”, “General method for assessing the ability of an energy-related product to be remanufactured – EN 45553:-”¹, or equivalent standards can be taken into consideration.

This document describes a general assessment method that is intended to be adapted for application at a product or product-group level, in order to assess the reliability/the durability of ErPs.

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¹ Under preparation. Stage at time of publication: FprEN 45553:2020.

EN 45552:2020 (E)**1 Scope**

This document defines a framework comprising of parameters and methods for assessing the reliability and durability of ErPs. It is intended to be used in the preparation of product or product-group standardization deliverables.

NOTE 1 This document has been developed under standardization request M/543 of the European Commission to support Directive 2009/125/EC.

NOTE 2 Throughout this document, reference to 'user of this document' refers to those members of technical committees that are developing horizontal, generic, and product, or product-group standards. This document is not intended to be applied to generate product-specific information.

NOTE 3 Product-group, as used in this document, is an umbrella term used to refer to a group of products with similar properties and primary function(s).

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.

EN 12973:2000, *Value management*

EN 45559, *Methods for providing information relating to material efficiency aspects of energy-related products*

EN 62308:2006, *Equipment reliability - Reliability assessment methods*

EN 62506:2013, *Methods for product accelerated testing*

EN 60812, *Analysis techniques for system reliability - Procedure for failure mode and effects analysis (FMEA)*

3 Terms and definitions

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

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>

Note 1 to entry: See CLC/prTR 45550 for additional definitions.

3.1 General definitions**3.1.1 Terms related to reliability and durability****3.1.1.1 durability**

< of a part or a product >

ability to function as required, under defined conditions of use, maintenance and repair, until a limiting state is reached

Note 1 to entry: The degree to which maintenance and repair are within the scope of durability will vary by product or product-group.

Note 2 to entry: The user of this document has to define the criteria for the transition from limiting state to end-of-life (EoL). For more information see Figure D.1.

Note 3 to entry: Durability can be expressed in units appropriate to the part or product concerned, e.g. calendar time, operating cycles, distance run, etc. The units should always be clearly stated.

3.1.1.2

reliability

probability that a product functions as required under given conditions, including maintenance, for a given duration without limiting event

Note 1 to entry: The intended function(s) and given conditions are described in the information for use provided with the product.

Note 2 to entry: Duration can be expressed in units appropriate to the part or product concerned, e.g. calendar time, operating cycles, distance run, etc. The units should always be clearly stated.

3.1.1.3

limiting event

occurrence which results in a primary or secondary function no longer being delivered

Note 1 to entry: Examples of limiting events are failure, wear-out failure or deviation of any analogue signal.

3.1.1.4

limiting state

condition after one or more limiting event(s)

Note 1 to entry: A limiting state can be changed to a functional state by maintenance or repair of the ErP.

Note 2 to entry: A limiting state can change to EoL-status if maintenance or repair is no longer viable due to socio-economic or technical reasons.

3.1.1.5

wear-out failure

failure due to cumulative deterioration caused by the stresses imposed in normal use

Note 1 to entry: The probability of occurrence of a wear-out failure typically increases with the accumulated operating time, number of operations, and/or stress applications.

Note 2 to entry: In some instances, it can be difficult to distinguish between wear-out and ageing phenomena.

[SOURCE: IEV 192-03-15]

3.1.2 Terms related to functions

3.1.2.1

primary function

function fulfilling the intended use

Note 1 to entry: There can be more than one primary function.

EN 45552:2020 (E)**3.1.2.2****secondary function**

function that enables, supplements or enhances the primary function(s)

[SOURCE: EN 62542:2017; 5.14]

3.1.2.3**tertiary function**

function other than a primary or a secondary function

[SOURCE: EN 62542:2017; 5.16, modified examples deleted]

3.1.2.4**functional analysis**

process that describes the functions of a product and their relationships, which are systematically characterized, classified and evaluated

3.1.3 Activities related to use**3.1.3.1****normal use**

use of a product, including its transport and storage, or a process, in accordance with the provided information for use or, in the absence of such, in accordance with generally understood patterns of usage

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Note 1 to entry: Normal use should not be confused with intended use. While both include the concept of use as intended by the manufacturer, intended use focuses on the purpose while normal use incorporates not only the purpose, but transport and storage as well.

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[SOURCE: IEC 871-04-22]

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3.1.3.2**intended use**

use in accordance with information provided with a product or system, or, in absence of such information, by generally understood patterns of usage

Note 1 to entry: Intended use should not be confused with normal use. While both include the concept of use as intended by the manufacturer, intended use focuses on the purpose while normal use incorporates not only the purpose, but transport and storage as well.

[SOURCE: ISO/IEC Guide 51:2014; 3.6, modified Note 1 to entry added]

3.1.3.3**normal operating conditions**

characteristic in operation which may affect performance of the product during intended use

Note 1 to entry: Examples of operating conditions are modified environmental conditions when the product operates (self-heating, condensation), characteristics of the power supply, duty cycle, load factor, vibration due to operation.

Note 2 to entry: Given normal operating conditions and defined operating conditions of use, maintenance and repair, refer to a specified subset of normal operating conditions which are used for the assessments.

3.1.3.4**maintenance**

action carried out to retain a product in a condition where it is able to function as required

NOTE 1 to entry Examples of such actions include inspection, adjustments, cleaning, lubrication, testing, software update and replacement of a wear-out part. Such actions could be performed by users in accordance with instructions provided with the equipment (e.g. replacement or recharging of batteries); or the actions could be performed by service personnel in order to ensure that parts with a known time to failure are replaced in order to keep the product functioning.

3.1.3.5**repair**

process of restoring a faulty product to a condition where it can fulfil its intended use

3.1.4 Other terms**3.1.4.1****part**

hardware, firmware or software constituent of a product

[SOURCE: EN 45554:2020; 3.2]

3.1.4.2**normal environmental conditions**

characteristics of the environment in the immediate vicinity of the product during transport, storage, use, maintenance and repair, which may affect its performance during normal use

Note 1 to entry: Examples of environmental conditions are pressure, temperature, humidity, radiation, vibration.

<https://standards.iteh.ai/catalog/standards/sist/0701dc5f-3540-4023-abb8-02ad5c847ac/sist-en-45552-2020>

Note 2 to entry: Given normal environmental conditions and defined environmental conditions of transport, storage, use, maintenance and repair, refer to specified subsets of normal environmental conditions which are used for the assessments.

3.2 Abbreviations

AF	Acceleration Factor
ALT	Accelerated Life Test
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Fields
ErP	energy-related product
EoL	end-of-life
FAST	Function Analysis System Technique
FMEA	Failure Mode and Effects Analysis
FMECA	Failure Mode, Effects and Criticality Analysis
FTA	Fault Tree Analysis
HASA	Highly Accelerated Stress Audit
HALT	Highly Accelerated Life Test
HASS	Highly Accelerated Stress Screen

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LCD	Liquid Crystal Display
LED	Light Emitting Diode
MTBF	Mean Operating Time Between Failures
MTTF	Mean Operating Time To Failure
MTTFF	Mean Operating Time To First Failure
PCB	Printed Circuit Board
TTF	Time to Failure

4 Concept and process overview**4.1 Concept****4.1.1 General**

This subclause explains the concepts relevant to both reliability and durability. Reliability is defined in 3.1.1.2 and durability in 3.1.1.1. The relation between reliability and durability is also depicted in Figure D.1 of Annex D.

There are some key concepts to consider when addressing durability. Durability can be limited by the fatigue/ageing of a part, which can cause a limiting event. A limiting event occurs when a primary or secondary function is no longer delivered. This results in the product being in a limiting state.

There are also some key concepts to consider when addressing reliability. To assess reliability, the time at which a certain percentage of products has reached a limiting state is used (e.g. the time by which an accumulated X % of a population will fail (B), where X is expressed in orders of magnitude of 10 such as 0,1, 1, 10 for respectively B0,1, B1 or B10). However, other reliability assessments such as mean operating time to failure (MTTF), mean operating time to first failure (MTTFF) and mean operating time between failures (MTBF) are also used. The reliability assessment between the first use of the product and the first limiting event does not take repair into account. Whilst the reliability assessment between two consecutive limiting events takes into account the effects of a previous repair action, such cases are not covered in this document.

NOTE 1 MTTF, MTTFF and MTBF are measures of constant risk and therefore, they do not give the expected time to failure. In the case of a non-repairable product, MTTFF equals MTTF. For products with an exponential distribution of operating times to failure (i.e. a constant failure rate), MTTF is numerically equal to the reciprocal ($\frac{1}{\text{failure rate}}$) of the failure rate. Mean operating time between failures can only be applied to repairable products.

NOTE 2 Reliability and durability are defined in standardization and are relevant methods to estimate the technical lifetime of a product. Whilst "Minimum Lifetime" can be specified, this requires a wider consideration than reliability and durability assessment, as it could include additional aspects such as economic, social or regulatory requirements.

Durability can be expressed in units like calendar time, the number of operating cycles, distance, etc. Reliability can be expressed as a unit combined with a probability (see example below). The user of this document shall specify the most appropriate units for expressing reliability and durability.

EXAMPLE Durability could be 7 years for which a car is able to operate under defined environmental conditions and operating conditions (20 000 km/year). If the car is used under different operating conditions (28 000 km/year), the expected durability could be 5 years. This assumes that all parts are able to withstand the defined conditions. A car operates with a reliability $R(t_1, t_2) > 0,9$ (90 %) where t_1 and t_2 could be respectively 0 km and 100 000 km, under defined environmental and operating conditions.