SLOVENSKI STANDARD
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Metoda za doseganje krožnega oblikovanja izdelkov

Method to achieve circular designs of products

Methode zur Gestaltung von zirkulären Produkten

Méthode pour réaliser des conceptions circulaires de produits

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03.100.99	Drugi standardi v zvezi z organizacijo in vodenjem podjetja	Other standards related to company organization and management
13.020.60	Življenjski ciklusi izdelkov	Product life-cycles

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This draft European Standard is submitted to CENELEC members for enquiry. Deadline for CENELEC: 2023-11-24.

It has been drawn up by the Technical Committee CEN/CLC/JTC 10. If this draft becomes a European Standard, CEN and 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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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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European foreword

This document [CLC prEN 45560:2023] has been prepared by CEN/CLC/JTC 10 “Material efficiency aspects for products in scope of Ecodesign legislation”.

This document is currently submitted to the Enquiry.

The following dates are proposed:

• latest date by which the existence of this document has to be announced at national level	(doa)	dor + 6 months
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	dor + 12 months
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	dor + 36 months (to be confirmed or modified when voting)

CEN/CLC / JTC 10 has the objective to produce generic and horizontal CEN-CENELEC publications covering aspects such as assessment methods, design rules, dematerialization, digitalization and transfer of information on a variety of material efficiency topics, in particular (but not limited to):

a) Extending product lifetime;

b) Ability to reuse components or recycle materials[1] from products at end-of-life;

c) Use of reused components and/or recycled materials in products.

This document is intended to be used by organizations applying directly to products but can also be used by product technical committees when producing horizontal, generic, product-group, or product-specific standards. It can, therefore, be cited together with or product-group or product-specific standards, e.g. developed by product technical committees.

[1] Including coverage of the European Commission defined list of critical raw materials (CRM).

Introduction

0.1 Background

Climate change, biodiversity loss, resource depletion and the ever-increasing production of waste and pollution represent major challenges to society today. Circular economy, with its focus on material efficiency and the promise for longer lifetime of products, minimization of waste and closing the loops for materials is believed to be an important means to overcome these challenges. When transitioning into a circular economy, design plays a crucial role. It is stated that 80 % of a product's environmental impacts are determined at the design phase [1] and design choices can determine whether the efforts to become circular may succeed or not. Circular product design is a key element of developing and implementing circular business models and transitioning towards a circular economy.

In Europe, the Green Deal [2] launched in 2019 proposes a concerted strategy for a climate-neutral, resource-efficient and competitive economy. Scaling up the circular economy from front-runners to the mainstream economic players will make decisive contributions to achieving climate neutrality by 2050 and to decoupling economic growth from the use of natural resources by using these resources more effectively, while ensuring the long-term competitiveness of and within the EU. This standard, focusing on circular product design supports achieving the ambition stated in the European Circular Economy Action Plan (CEAP) [3].

Sustainable management and efficient use of natural resources is addressed by the UN's sustainable development goals (SDG). This document supports these goals, particularly SGD 12 to ensure sustainable consumption and production patterns.

The main purpose of this document is to develop a systematic way (method) to defining design rules and activities for the design and development of products such that they are made circular by design within a circular economy.

This document is intended for organizations designing and developing products that fall under the scope of the ecodesign legislation [4]. It focusses on optimizing material utilization and efficiency with strategies that enable narrowing (use less materials), slowing (extend product life, keep quality of products and materials as high as possible for as long as possible) and closing loops (remanufacture, recycling, and parts recovery).

0.2 Relation with other horizontal or generic standards

Although there are regulatory requirements for resource efficiency across most geographies, to date, the focus has been mostly on the energy efficiency of products. Recently standards focusing on the material efficiency became available, with the publication of the CEN-CLC/JTC10 EN 4555X-4556X group of standards. The JTC10 standards focus on the assessment of different aspects of material efficiency, such as durability of products (EN 45552), ability to be repaired, reused and upgraded (EN 45554), remanufacturability (EN 45553), proportion of reused components (EN 45556), recyclability and use of recycled contend (EN 45555 and EN 45557), and communication on the use of critical raw materials (CRMs) (EN 45558). These standards address how to assess ability (how easy or difficult it is) to e.g. repair, remanufacture or recycle a product. However, they do not provide guidance on what aspects to consider when designing a product. This document intends to fill in such a gap.

The standard EN/IEC 62430 assists organizations to incorporate environmentally conscious design (ECD) processes into their product design and development process. ISO 14009 [5] provides guidelines to organizations on how to incorporate circular product design strategies in the design and development within their environment management system. ISO 14006 [6] provides guidelines to assist organizations in establishing a systematic and structured approach to the incorporation and implementation of ecodesign within an environment management system, such as described in ISO 14001 [7]. Assessments of environmental impacts including aspects of material circularity are considered in documents such as EN 50693 [8], EN 15804 [9], and ISO 14040 [10].

The IEC 62309 [11] contains guidance and requirements for declaring reused parts. IEC 60300 series include general guidance on dependability, availability, reliability and maintainability, and IEC 62402 [12] includes obsolescence management.

International standards currently under development by ISO/TC 323 on circular economy are ISO/CDV 59004 on terminology, principles and guidance for implementation [13], ISO/CDV 59010 providing guidance on the

transition of business models and value networks [14], ISO/CDV 50020 on measuring and assessing circularity [15], and ISO/CD 59040 proposing a product circularity data sheet [16].

In the design rules for circular economy, all domains such as environmental, social, economic and technical are considered. As part of this holistic approach, value management is addressed in EN 12973 [17] and EN 16271 [18].

To avoid duplication as much as possible, this document references the above listed standards (sometimes normatively).

1 Scope

This document proposes a method to define circular products design rules. It details principles, requirements and guidance associated with the proposed method. This document:

- specifies requirements and guidance for integrating circularity into the design and development process of products by an organization.
- supports organizations to develop product design rules to fulfil their chosen circular categories (e.g. the circular business models chosen by the organization or the legislation requirements).

Having the life cycle thinking as a core principle, this document provides guidance on how to reduce environmental impacts, and how to deal with challenges such as trade-offs during circular product design, without compromising functions and safety.

This document focusses on material efficiency. It is not a management system standard.

This document can be applied when no product-specific or product group standard exist. Where such documents are developed, this document can be used as reference to ensure consistency and harmonization across the different product areas and supply chains or networks.

2 Normative references

The following documents are referred to in the text in such a way that some or all 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/IEC 62430:2019, *Environmentally conscious design (ECD) - Principles, requirements and guidance*

EN 45552:2020, *General method for the assessment of the durability of energy-related products*

EN 45553:2020, *General method for the assessment of the ability to remanufacture energy-related products*

EN 45554:2020, *General methods for the assessment of the ability to repair, reuse and upgrade energy-related products*

EN 45556, *General method for assessing the proportion of reused components in energy-related products*[2]

IEC 63333, *General method for assessing the proportion of reused components in products*[3]

EN 45557, *General method for assessing the proportion of recycled material content in energy-related products*

EN 45558, *General method to declare the use of critical raw materials in energy-related products*

3 Terms, definitions and abbreviated terms

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:

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

[2] Stage at the time of publication of this document is CD.
[3] Stage at the time of publication of this document is FDIS.

3.1 Terms and definitions relating to circular product design

3.1.1
circular economy
economic system that contributes to sustainable development whereby value of products, materials and other resources is kept as high as possible for as long as possible, keeping the resources in a circular flow and minimizing waste, harmful emissions and pollution

Note 1 to entry: Circular economy makes use of a systemic approach.

Note 2 to entry: A circular economy protects and supports regeneration of natural systems.

3.1.2
circular categories
subjects chosen by an organization to design products that are aligned with the principles of a circular economy

Note 1 to entry: The principles for a circular economy include [19]: (i) eliminate waste and pollution; (ii) circulate products and materials at their highest value; (iii) regenerate nature.

Note 2 to entry: For the purpose of this document, circular categories mainly cover material efficiency aspects.

3.1.3
circular goals
goals aligned with the principles of a circular economy

Note 1 to entry: The principles for a circular economy include [19]: (i) eliminate waste and pollution; (ii) circulate products and materials at their highest value; (iii) regenerate nature.

Note 2 to entry: For the purpose of this document, circular product design focusses on material efficiency aspects.

3.1.4
circular product
product aligned with the principles of a circular economy

Note 1 to entry: The principles for a circular economy include [19]: (i) eliminate waste and pollution; (ii) circulate products and materials at their highest value; (iii) regenerate nature.

Note 2 to entry: For the purpose of this document, circular product focus on material efficiency aspects.

3.1.5
circular product attribute
what needs to be addressed to align a product with the principles of a circular economy

Note 1 to entry: The principles for a circular economy include [19]: (i) eliminate waste and pollution; (ii) circulate products and materials at their highest value; (iii) regenerate nature.

Note 2 to entry: For the purpose of this document, circular product attributes focus on material efficiency aspects.

3.1.6
circular product design
circular design of product(s)
process of creating products that are aligned with the principles of a circular economy

Note 1 to entry: The principles for a circular economy include [19]: (i) eliminate waste and pollution; (ii) circulate products and materials at their highest value; and (iii) regenerate nature.

Note 2 to entry: The concept can be also applied to existing products through redesign.

Note 3 to entry: For the purpose of this document, circular product design focuses on material efficiency aspects.

3.1.7
circularity
<of a product or part>
intentional design for multiple cycles

Note 1 to entry: Products designed for circularity are actively cycled in their intended cycling pathways.

3.1.8
function
effect of a product or one of its constituents

[SOURCE: EN 16271:2012, 3.8]

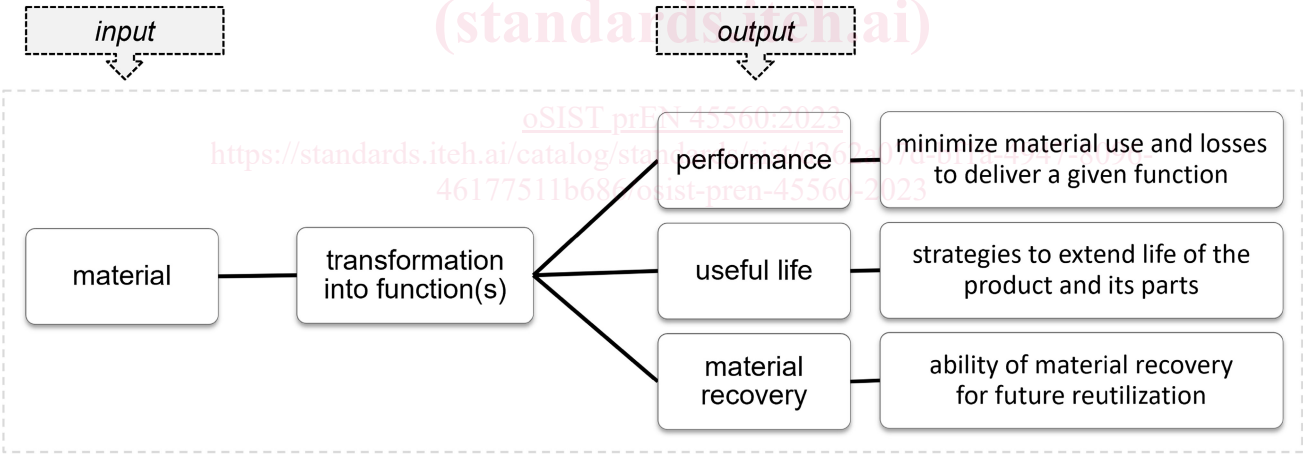
3.1.9
functionality
ability to deliver functions

3.1.10
material efficiency
relationship of an output of performance, useful life, and material recovery versus an input of material

Note 1 to entry: Material efficiency can be expressed as a ratio or other quantitative relationship.

Note 2 to entry: Material efficiency concept diagram is given below:

[SOURCE: IEC 60050-193:2023[3]]



3.1.11
performance
effectiveness with which an intended function is carried out

[IEC 61226:2020, 3.16 – modified — Examples were removed]

3.1.12
value
gains from satisfying needs and expectations, in relation to the resources used

EXAMPLE: Revenues, savings, productivity, sustainability, satisfaction, empowerment, engagement, experience, trust.

Note 1 to entry: Value is relative to, and determined by the perception of, the organization and interested parties.

Note 2 to entry: Value can be financial or non-financial.

Note 3 to entry: Value can be created, realized, acquired, redistributed, shared, lost, or destroyed.

Note 4 to entry: The value of an entity is generally determined in terms of the amount of other entities for which it can be exchanged.

Note 5 to entry: The word “value” sometimes refers to a (numerical) unit of data, e.g. the output from measurement and “values” sometimes refers to principles or standards of behaviour, e.g. included in the concept of culture. When “value” is used in these senses, it should always be used with some form of qualifier, e.g. “numerical value” or the meaning should be obvious from the context.

Note 6 to entry: When a process is inefficient, the amount of resources used can exceed the amount of resources required.

Note 7 to entry: The diagram below illustrates the general concept of value assessment

$$\text{value} \propto \frac{satisfaction\ of\ the\ needs}{\text{consumption of resources}}$$

[SOURCE: ISO 56000:2020, 3.7.6, modified — Note 6 and 7 to entry have been added]

3.2 Terms and definitions relating to environment

3.2.1
environment
surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelationships

[SOURCE: ISO 14050:2020, 3.2.2]

3.2.2
environmental aspect
element of an organization’s activities or products that interacts or can interact with the environment

[SOURCE: ISO 14050:2020, 3.2.20]

3.2.3
environmental impact
change to the environment, whether adverse or beneficial, including possible consequences, wholly or partially resulting from an organization’s environmental aspects

[SOURCE: ISO 14050:2020, 3.2.22]

3.2.4
environmentally conscious design
ECD
systematic approach which considers environmental aspects in the design and development with the aim to reduce adverse environmental impacts throughout the life cycle of a product

Note 1 to entry: Other terminology used worldwide with the same meaning includes ecodesign, design for environment (DFE), green design and environmentally sustainable design.

Note 2 to entry: This note applies to the French language only.

[SOURCE: IEC 62430:2019, 3.1.1]

3.3 Terms and definitions relating to product and resource

3.3.1
component
constituent of a product which cannot be fragmented without losing its particular function

[SOURCE: IEC 60050-151:2001/AMD3:2019 (IEV-151-11-21), modified — “part of a device” was replaced by “of a product, and “physically divided into smaller parts” was replaced by “fragmented”]

3.3.2
material
(physical) matter composed of one or more substances

[SOURCE: ISO/IEC/CDV 82474-1:2023,[4] 3.1.7]

3.3.3
part
constituent of a product

EXAMPLE: Hardware or other physical matter, software, firmware, liquid, gas, etc.

Note to entry: A part can be an assembly, sub-assembly or a component.

3.3.4
product
goods, service, or combination thereof

Note 1 to entry: For the purpose of this document, the following are excluded: food, feed, medicinal products for human use, veterinary medicinal products, living plants, animals and microorganisms, products of human origin, products of plants and animals relating directly to their future reproduction.

[SOURCE: ISO 14050:2020, 3.5.12, modified — in the definition the term “any” has been removed, and the term “or combination thereof” has been added and Note 1 to entry has been added]

3.3.5
resources
anything that is required to satisfy the needs

Note 1 to entry: Resource can be physical, financial, intellectual, and social. Resource can also include skills and time.

[SOURCE: EN 1325:2014, 2.1.9, modified — The plural of the term was removed, in the definition the term ‘everything’ was replaced by ‘anything’, the two Notes to entry were removed and a new Note to entry was included]

3.4 Terms and definitions relating to recycling

3.4.1
recovery
operation that gives value to end-of-life products, parts or materials which otherwise would be disposed

Note 1 to entry: Recovery can result in products, parts, materials and/or energy.

3.4.2
recycled content
proportion, by mass, of recycled material in a product or part

[4] Stage at the publication of this document is CDV.

Note 1 to entry: The proportion is often expressed as a percentage of mass.

[SOURCE: ISO 14021:2016, 7.8.1.1 a), modified — “or packaging” has been replaced by “or part” and Note 1 to entry was included]

3.4.3
recycled material
recovered material
secondary material
material that has been reprocessed from end-of-life products, parts and material

3.4.4
recycling
recovery operation of any kind, by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes excluding energy recovery

Note 1 to entry: Recycling includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

[SOURCE: Directive 2008/98/EC, modified by moving the last sentence of the definition to the note 1 to entry]

3.4.5
waste
material or object which does not fulfil its function anymore, or for which the holder has no need, and the holder decides or is required to discard

Note 1 to entry: Triggers for the decision or need to discard include, for example: function no longer available, change in the needs by the user, interoperability with new system elements not supported, loss or unavailability of data or history information about the object (e.g. instruction for use not available; service info; info needed for refurbishment).

[SOURCE: IEC 60050-193:2023[3]]

3.5 Terms and definitions relating to durability

3.5.1
durability
<of a part or a product>
ability to function as required, under specified conditions of use, maintenance and repair, until the end-of-life is reached

Note 1 to entry: For the purpose of this document, the designer has to specify the criteria for the durability.

Note 2 to entry: The criteria is based on predictable aspects (e.g. technical aspects) so that the durability can be estimated.

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.

[SOURCE: EN 45552:2020 definition 3.1.1.1, modified — In the definition the term “defined” has been replaced by “specified” and the term “a limiting state” has been replaced by “the end-of-life”, notes 1 and 2 to were removed and new notes 1 and 2 were added]

3.5.2
end-of-life
EoL
end-of-final-use
life cycle stage of a product starting when it is finally removed from its intended use-phase

[SOURCE: IEC 60050-901:2013 (IEV 191-07-15)]

3.5.3
end-of-use
point in time when one user does not want to repair or maintain or does not want to use the product anymore

[SOURCE: IEC/CD 60050-193[3]]

3.5.4
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.

[SOURCE: EN 45552:2020, 3.1.1.2]

3.6 Terms and definitions relating to lifetime extension

3.6.1
disassembly
process whereby a product is taken apart in such a way that it could subsequently be reassembled and made operational

[SOURCE: IEC 60050-904:2014/AMD3:2019 (IEV 904-04-01), modified — “an item” has been replaced by “a product” and note 1 to entry has been deleted]

3.6.2
maintenance
process to retain a product in, or restore it to, a state in which it can perform as intended

[SOURCE: IEC 60050:2015 (IEV 192-06-01), modified — in the definition the term “combination of all technical and management actions intended” was replaced by “process”, the term “item” was replaced by “product” and the term “required” was replaced by “intended”, and the Note to entry has been deleted]

3.6.3
repair
process of returning a faulty product to a state where it can fulfil its intended use

[SOURCE: EN 45554:2020, modified — In the definition “condition” was replaced by “state”]

3.6.4
refurbishing
reconditioning
industrial process to return a used product or part to its original specifications

Note 1 to entry: Specifications include form, functionality, performance and safety aspects.

Note 2 to entry: The identity of the product or part shall be maintained (e.g. serial or type number).

3.6.5
remanufacturing
industrial process to create a product by combining different parts from used products and including, where necessary, new parts

Note 1 to entry: Remanufacturing also occurs when at least one change is made which influences the safety or original performance of an existing product.

Note 2 to entry: The product shall be given a new identity (e.g. serial or type number).

3.6.6
reuse
operation by which a product or part is used again

Note 1 to entry: when the product or part is reused for another purpose, it is also called repurpose.

3.6.7
upgrade
process to enhance the functionality, aesthetics, or performance of a product

Note 1 to entry: An upgrade to a product can involve addition or replacement of parts.

[SOURCE: IEC 60050-193[3]]

3.6.8
useful life
<of a product>
time interval from first use until the user requirements of the last user are no longer met due to social, economic, or technical reasons

Note 1 to entry: Concept not intended for measurement.

Note 2 to entry: Useful life can only be quantified retroactively.

Note 3 to entry: Social, economic, or technical reasons can result in parts obsolescence.

Note 4 to entry: Social aspects include trends in fashion.

3.7 Abbreviated terms

AI	Artificial intelligence
CEAP	European circular economy action plan
CE	Circular economy
CRM	Critical raw material
ECD	Environmentally conscious design
ESG	Environment, social and governance
GHG	Greenhouse gas
ICT	Information and communication technology
IP	Intellectual property
ME	Material efficiency
SDG	Sustainable development goal