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Environmental management systems — Guidelines for incorporating material circulation in design and development

Systèmes de management environnemental — Lignes directrices pour intégrer la circularité des matériaux dans la conception et le développement

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 207, *Environmental management*, Subcommittee SC 1, *Environmental management systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 Background

One of the major challenges that we all face in achieving sustainable development is the efficient use of resources and reuse of these resources repeatedly without diminishing their value, usability, etc. Internationally, the United Nations Environment Programme International Resource Panel (UNEP IRP) warns that, at the current pace of production and consumption, 140 billion tons of natural resources will be consumed in 2050, which is twice the amount consumed in 2005. Such use of natural resources, which does not consider material circulation, has already resulted in unstable resource supplies and serious adverse environmental impacts[34].

The UN adopted 17 sustainable development goals (SDGs) in 2015 and set specific targets for each of them to be achieved over the next 15 years. SDG 9 ("build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"), SDG 12 ("ensure sustainable consumption and production patterns") and SDG 13 ("take urgent action to combat climate change and its impacts") are directly related to managing natural resources.

Emphasis on the transition from a linear to a circular economy in order to achieve sustainable development has been spearheaded by the European Union (EU)[33]. The concept of a circular economy encompasses a wide range of topics, from the full life cycle of products to business models. The general concept of a circular economy is closing the loop between different life cycles through the application of designs that allow for the enhancement of recycling and reuse for the more efficient use of raw materials and products, limiting (or eliminating) waste. One of the methods to consider for supporting the transition to a circular economy is implementing a design that facilitates the material circulation of products and their constituent parts (see Annex A).

Considering that products are largely composed of raw materials, the material circulation of products plays an important role in the sustainable use of resources. The widely held perception is that strategy/planning for the material circulation of products and their constituent parts should precede their design and development.

Material circulation can be understood as an approach integrated within design and development by which products, parts or materials can be continually reprocessed into the same or similar products in order to achieve material efficiency and (ultimately) the environmental objectives of the organization. In order to be of benefit to the organization and to ensure that the organization achieves its material efficiency objectives, it is intended that the improvement of material circulation be carried out as an integral part of the business operations of the organization. Material circulation can potentially have implications for all functions of an organization.

This document provides guidelines for strategies on material circulation to achieve material efficiency, i.e. minimize the use of materials, by maximizing the lifetime of products through improved design, with increased opportunities for repair, upgrade, reuse, remanufacturing and recycling by an organization.

A material circulation improvement process takes place within an organization's design and development, and it is there where the knowledge required in carrying out and managing material circulation is to be found. However, when it is intended that material circulation be carried out under the umbrella of an environmental management system (EMS), then the person responsible for the EMS is expected to have an understanding of what this process is, and how it is going to be managed and controlled. In this way, the integrity of the EMS is not jeopardized, and the material efficiency and other environmental objectives for the products can be achieved.

Incorporation of material efficiency within an EMS requires knowledge related to the following:

a) assessment of the material circulation of products in the organization;

b) identification of appropriate material circulation strategies to improve the material circulation of products and their constituent parts, and to support the achievement of the material efficiency objectives of the organization;

c) the design and development process, and an understanding of the material circulation improvement processes and how they are managed within an EMS.

0.2 Relationship with other standards

ISO 14001 is a core standard that provides the organization with a framework for establishing an EMS. There are four key elements to support users of ISO 14001. One of them is related to "policy and organizational elements" such as those related to sustainable use of resources, and further exemplified in complementary standards: ISO 14006 on ecodesign and this document (i.e. ISO 14009) on material circulation.

ISO 14006 provides guidelines to assist organizations in establishing a systematic and structured approach to the incorporation and implementation of ecodesign within an EMS such as that described in ISO 14001.

IEC 62430, on the other hand, describes principles, specifies requirements and provides guidance for organizations intending to integrate environmental aspects into design and development in order to minimize the adverse environmental impacts of products. IEC 62430 can be incorporated into an existing management system, as indicated in ISO 14006.

ISO 14051 provides guidance on a methodology [material flow cost accounting (MFCA)] that can be used for quantifying material flows in a production process or an organization. ISO 14052 has extended this concept by providing guidance on using this methodology for quantifying material flows in a supply chain. The MFCA methodology can easily be adapted and used for quantifying material flows in a product life cycle. Although this methodology could be used for quantification of material flows in a product life cycle, it is not addressed in this document.

In Europe, standards on material efficiency assessment methods (the EN 4555X group of standards) [22] to [30] have been developed to support future ecodesign requirements on, among other things, durability, reparability and recyclability of energy-related products. These standards are directly linked to this document.

ISO 14001 requires an organization to identify environmental aspects and the corresponding environmental impacts, taking a life cycle perspective into account. This involves considering aspects and impacts in each stage of the product life cycle, including design and development. ISO 9001 is focused on quality management systems, including design and development, but does not cover environmental impacts. ISO 14006 is focused on a management system to implement environmental conscious design by an organization. IEC 62430 assists with the incorporation processes to implement environmental conscious design by an organization. Lastly, the European EN 4555X group of standards focus on assessment methods related to material efficiency and material circulation, but they do not cover environmental and business management frameworks, as described in this document.

Figure 1 illustrates how ecodesign and material circulation in ISO 14006 and this document can support an EMS as described in ISO 14001.

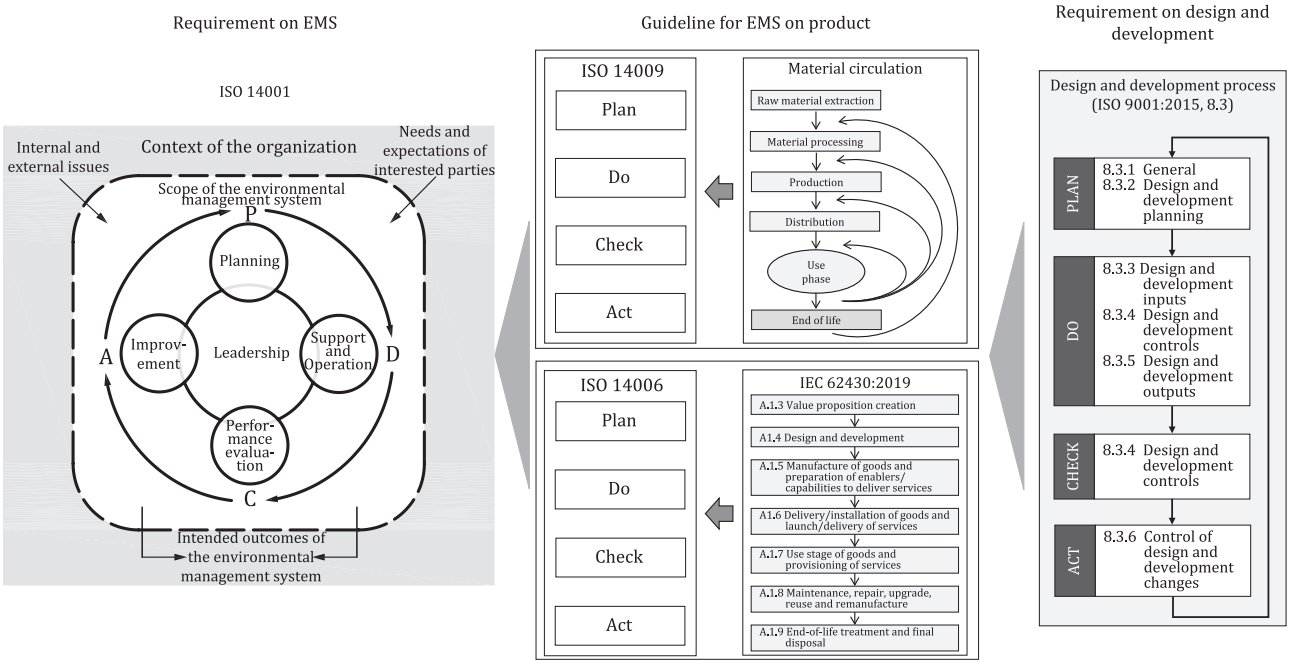

Figure 1 — Relationship between ISO 14001, ISO 14006 and this document

0.3 Overview

This document provides guidelines related to ISO 14001, a management system standard (MSS), and uses an identical structure. It places priority on the clauses of ISO 14001 for planning (Clause 6) and operation (Clause 8):

— Clauses 4, 5, and 7 cover aspects related to an EMS;

— the establishment of material circulation strategies for products is considered in Clause 6;

— creating material circulation solutions, design considerations for material circulation, and ensuring operational planning and control are provided in Clause 8.

Additionally, this document contains the following annexes to assist users in understanding material circulation:

— Annex A shows the relationship between the circular economy and material circulation;

— Annex B provides examples and an explanation of interested parties;

— Annex C illustrates material flow in material circulation and the link with material efficiency;

— Annex D provides a case study on the redesign of existing products.

Environmental management systems — Guidelines for incorporating material circulation in design and development

1 Scope

This document gives guidelines for assisting organizations in establishing, documenting, implementing, maintaining and continually improving material circulation in their design and development in a systematic manner, using an environmental management system (EMS) framework.

These guidelines are intended to be used by those organizations that implement an EMS in accordance with ISO 14001. The guidelines can also help in integrating material circulation strategies in design and development when using other management systems. The guidelines can be applied to any organization regardless of its size or activity.

This document provides guidelines for design strategies on material circulation to achieve the material efficiency objectives of an organization, by focusing on the following aspects:

— type and quantity of materials in products;

— product lifetime extension;

— recovery of products, parts and materials.

In design and development, many aspects are considered, such as safety, energy efficiency, performance and cost. Although important, they are not addressed in this document.

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 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 http://www.electropedia.org/

3.1 Terms related to organization and leadership

3.1.1
management system
set of interrelated or interacting elements of an *organization* (3.1.5) to establish policies and *objectives* (3.2.21) and *processes* (3.3.3) to achieve those objectives

Note 1 to entry: A management system can address a single discipline or several disciplines (e.g. quality, *environment* (3.1.3), occupational health and safety, energy, financial management).

Note 2 to entry: The system elements include the organization's structure, roles and responsibilities, planning and operation, performance evaluation and improvement.

Note 3 to entry: The scope of a management system can include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations.

[SOURCE: ISO 14001:2015, 3.1.1]

3.1.2
environmental management system
EMS
part of the *management system* (3.1.1) used to manage *environmental aspects* (3.2.19), fulfil *compliance obligations* (3.2.33) and address *risks and opportunities* (3.2.34)

[SOURCE: ISO 14001:2015, 3.1.2]

3.1.3
environment
surroundings in which an *organization* (3.1.5) operates, including air, water, land, natural resources, flora, fauna, humans and their interrelationships

Note 1 to entry: Surroundings can extend from within an organization to the local, regional and global system.

Note 2 to entry: Surroundings can be described in terms of biodiversity, ecosystems, climate or other characteristics.

[SOURCE: ISO 14001:2015, 3.2.1]

3.1.4
environmental policy
intentions and direction of an *organization* (3.1.5) related to *environmental performance* (3.4.11), as formally expressed by its *top management* (3.1.6)

[SOURCE: ISO 14001:2015, 3.1.3]

3.1.5
organization
person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its *objectives* (3.2.21)

Note 1 to entry: The concept of organization includes, but is not limited to sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private.

[SOURCE: ISO 14001:2015, 3.1.4]

3.1.6
top management
person or group of people who directs and controls an *organization* (3.1.5) at the highest level

Note 1 to entry: Top management has the power to delegate authority and provide resources within the organization.

Note 2 to entry: If the scope of the *management system* (3.1.1) covers only part of an organization, then top management refers to those who direct and control that part of the organization.

[SOURCE: ISO 14001:2015, 3.1.5]

3.1.7
interested party
person or *organization* (3.1.5) that can affect, be affected by, or perceive itself to be affected by a decision or activity

EXAMPLE Customers, communities, suppliers, regulators, non-governmental organizations, investors and employees.

Note 1 to entry: To "perceive itself to be affected" means the perception has been made known to the organization.

[SOURCE: ISO 14001:2015, 3.1.6]

3.1.8
circular economy
economy that is restorative and regenerative by design, and which aims to keep *products* (3.2.5), components and *materials* (3.2.7) at their highest utility and value at all times, distinguishing between technical and biological cycles

[SOURCE: ISO 20400:2017, 3.1]

3.2 Terms related to planning

3.2.1
design and development
process (3.3.3) that transforms *requirements* (3.2.32) into a *product* (3.2.5)

Note 1 to entry: Design and development usually follow a series of steps, e.g. starting with an initial idea, transforming that into a formal specification, through to the creation of a new product, its possible *redesign* (3.2.2) and consideration of end-of-life.

Note 2 to entry: Design and development can include taking a product idea from planning to product provision and review of the product. It can include considerations on business strategies, marketing, research methods and design aspects that are used. It includes improvements or modifications of existing products.

[SOURCE: IEC 62430:2019, 3.1]

3.2.2
redesign
design of a *product* (3.2.5) based on an existing product design to improve targeted characteristics of the product

Note 1 to entry: Examples of targeted characteristics include reducing the use of *raw materials* (3.2.11), enhancing the *recycled content* (3.2.23), reducing the use of hazardous substances, energy saving, improving *material* (3.2.7) recyclability, etc.

3.2.3
ecodesign
systematic approach that considers *environmental aspects* (3.2.19) in *design and development* (3.2.1) with the aim to reduce adverse *environmental impacts* (3.2.20) throughout the *life cycle* (3.2.17) of a *product* (3.2.5)

Note 1 to entry: Other terminology used worldwide includes "environmentally conscious design (ECD)", "design for environment (DfE)", "green design" and "environmentally sustainable design".

[SOURCE: ISO 14006:2020, 3.2.2]

3.2.4
circular readiness
potential of the *product* (3.2.5) and its constituent *parts* (3.2.6) for *material circulation* (3.2.12)

3.2.5
product
any goods or service

[SOURCE: ISO 14050:2020, 3.5.12]

3.2.6
part
hardware, firmware or software constituent of a *product* (3.2.5)

[SOURCE: EN 45554:2020, 3.1.1]

3.2.7
material
substance or mixture of substances within a *product* (3.2.5) or product *part* (3.2.6)

[SOURCE: IEC 62474:2018, 3.15]

3.2.8
pre-consumer material
material (3.2.7) diverted from the waste stream during a manufacturing *process* (3.3.3)

Note 1 to entry: Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

[SOURCE: ISO 14021:2016, 7.8.1.1 a) 1), modified — Part of the text has been moved to Note 1 to entry.]

3.2.9
post-consumer material
material (3.2.7) generated by households or by commercial, industrial and institutional facilities in their role as end-users of the *product* (3.2.5) that can no longer be used for its intended purpose

Note 1 to entry: This includes returns of material from the distribution chain.

[SOURCE: ISO 14021:2016, 7.8.1.1 a) 2), modified — Part of the text has been moved to Note 1 to entry.]

3.2.10
recycled material

material (3.2.7) that has been reprocessed from recovered (reclaimed) material by means of a manufacturing *process* (3.3.3) and made into a final *product* (3.2.5) or into a component for incorporation into a product

Note 1 to entry: Recovered material could be from *pre-consumer material* (3.2.8) or *post-consumer material* (3.2.9).

Note 2 to entry: “Recovered material” and “reclaimed material” are treated as synonyms.

[SOURCE: ISO 14021:2016, 7.8.1.1 b), modified — Notes 1 and 2 to entry have been added.]

3.2.11
raw material
primary or secondary *material* (3.2.7) that is used to produce a *product* (3.2.5)

Note 1 to entry: Secondary material includes *recycled material* (3.2.10).

Note 2 to entry: Primary raw material is a material which has never been processed into any form of end-use product.

[SOURCE: ISO 14040:2006, 3.15, modified —Note 2 to entry has been added.]

3.2.12
material circulation
closed-loop approach where *products* (3.2.5) or their constituent *parts* (3.2.6) are reprocessed and brought back to use for the same or other purpose

Note 1 to entry: The term “constituent parts” refers to sub-assemblies, parts or *materials* (3.2.7) used to fabricate a product.

Note 2 to entry: Reprocessing involves the restoration or modification of the functionality of the product or its constituent parts, and may consist of repairing, rework, replacement of worn parts, and/or *upgrade* (3.2.27) of software, firmware and/or hardware as well as materials recycling. Reprocessing includes all phases of the *life cycle* (3.2.17) of a product from, for example, *repair* (3.2.26), *reuse* (3.2.28) and *remanufacturing* (3.2.29), up to *recycling* (3.3.6). It excludes disposal.

Note 3 to entry: Material circulation could improve *material efficiency* (3.2.13).

3.2.13
material efficiency
minimization of the use of (natural) resources by maximizing the lifetime of *products* (3.2.5) through optimized *material circulation* (3.2.12) strategies

3.2.14
critical raw material
CRM
materials (3.2.7) that, according to a defined classification methodology, are economically important and have a high-risk associated with their supply

[SOURCE: EN 45558:2019, 3.1.1, modified —Note 1 to entry has been deleted.]

3.2.15
disassembly
process (3.3.3) whereby a *product* (3.2.5) is taken apart in such a way that it could subsequently be reassembled and made operational

[SOURCE: IEC 62542:2013, 6.1]

3.2.16
dismantling
process (3.3.3) whereby a *product* (3.2.5) is taken apart in such a way that some *parts* (3.2.6) can be *reused* (3.2.28), although the product (and the parts not intended to be reused) can no longer be reassembled and made operational

3.2.17
life cycle
consecutive and interlinked stages of a *product* (3.2.5) (or service) system, from *raw material* (3.2.11) acquisition or generation from natural resources to final disposal

Note 1 to entry: The *life cycle stages* (3.2.18) include acquisition of raw materials, design, production, transportation/delivery, use, end-of-life treatment and final disposal.

[SOURCE: ISO 14001:2015, 3.3.3]

3.2.18
life cycle stage
element of a *life cycle* (3.2.17)

[SOURCE: ISO 14006:2020, 3.2.5, modified — Note 1 to entry has been deleted.]

3.2.19
environmental aspect
element of an *organization's* (3.1.5) activities or *products* (3.2.5) or services that interacts or can interact with the *environment* (3.1.3)

Note 1 to entry: An environmental aspect can cause (an) *environmental impact(s)* (3.2.20). A significant environmental aspect is one that has or can have one or more significant environmental impact(s).

Note 2 to entry: Significant environmental aspects are determined by the organization applying one or more criteria.

Note 3 to entry: Activities of the organization are those related to the *design and development* (3.2.1).

[SOURCE: ISO 14001:2015, 3.2.2, modified — Note 3 to entry has been added.]

3.2.20
environmental impact
change to the *environment* (3.1.3), whether adverse or beneficial, wholly or partially resulting from an *organization's* (3.1.5) *environmental aspects* (3.2.19)

[SOURCE: ISO 14001:2015, 3.2.4]

3.2.21
objective
result to be achieved

Note 1 to entry: An objective can be strategic, tactical, or operational.

Note 2 to entry: An objective can be expressed in other ways, e.g. as an intended outcome, a purpose, an operational criterion, as an *environmental objective* (3.2.22), or by the use of other words with similar meaning (e.g. aim, goal, or target).

[SOURCE: ISO 14001:2015, 3.2.5, modified — The original Note 2 to entry has been deleted and the notes renumbered accordingly.]

3.2.22
environmental objective
objective (3.2.21) set by the *organization* (3.1.5) consistent with its *environmental policy* (3.1.4)

[SOURCE: ISO 14001:2015, 3.2.6]

3.2.23
recycled content
proportion, by mass, of *recycled material* (3.2.10) in a *product* (3.2.5)

[SOURCE: ISO 14021:2016, 7.8.1.1 a), modified — "or packaging" has been deleted from the end of the definition.]

3.2.24
durability
<of a part or a product> ability to function as required, under defined conditions of use, *maintenance* (3.2.25) and *repair* (3.2.26), 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* (3.2.5) or product group.

Note 2 to entry: Durability can be expressed in units appropriate to the *part* (3.2.6) or product concerned, e.g. calendar time, operating cycles, distance run, etc. The units should always be clearly stated.

[SOURCE: EN 45552:2020, 3.1.1.1, modified — Note 2 to entry has been deleted.]

3.2.25
maintenance
combination of all technical and management actions intended to retain an item in, or restore it to, a state in which it can perform as required

Note 1 to entry: Management is assumed to include supervision activities.

[SOURCE: IEV 192-06-01]

3.2.26
repair
process (3.3.3) of returning a faulty *product* (3.2.5) to a condition where it can fulfil its intended use

[SOURCE: EN 45554:2020, 3.1.4]

3.2.27
upgrade
process (3.3.3) of enhancing the functionality, *performance* (3.4.10), capacity or aesthetics of a *product* (3.2.5)

Note 1 to entry: Upgrade may involve changes to the software, firmware and/or hardware.

[SOURCE: EN 45554:2020, 3.1.5, modified — Note 2 to entry has been deleted.]

3.2.28
reuse
process (3.3.3) by which a *product* (3.2.5) or its *parts* (3.2.6), having reached the end of their first use, are used for the same purpose for which they were conceived

Note 1 to entry: Reuse after second or subsequent usage is also considered as reuse, but normal, regular or sporadic use is not considered as reuse.

[SOURCE: EN 45554:2020, 3.1.3]

3.2.29
remanufacturing
industrial *process* (3.3.3) which produces a *product* (3.2.5) from used products or used *parts* (3.2.6) where at least one change is made which influences the safety, original performance, purpose or type of the product

Note 1 to entry: The product created by the remanufacturing process may be considered a new product when placing on the market.

[SOURCE: EN 45553:2020, 3.1.1, modified — "Refer to the EU Blue Guide for additional information" has been deleted from Note 1 to entry and Note 2 to entry has been deleted.]

3.2.30
refurbishing
functional or aesthetical *maintenance* (3.2.25) or *repair* (3.2.26) of an item to restore it to its original, or *upgraded* (3.2.27) or other, predetermined form and functionality

[SOURCE: IEV 904-04-09]

3.2.31
recovery
any operation by which waste serving a useful purpose by replacing other *materials* (3.2.7) which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy

Note 1 to entry: Recovery operations include material recovery and energy recovery.

Note 2 to entry: In this document, only recovery of *products* (3.2.5), *parts* (3.2.6) and materials are considered.

[SOURCE: IEC TR 62635:2012, 3.9, modified — Note 1 and 2 to entry have been added.]

3.2.32
requirement
need or expectation that is stated, generally implied or obligatory

Note 1 to entry: "Generally implied" means that it is custom or common practice for the *organization* (3.1.5) and *interested parties* (3.1.7) that the need or expectation under consideration is implied.

Note 2 to entry: A specified requirement is one that is stated, for example in *documented information* (3.3.2).

Note 3 to entry: Requirements other than legal requirements become obligatory when the organization decides to comply with them.

[SOURCE: ISO 14001:2015, 3.2.8]