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Guidance on material efficiency considerations in environmentally conscious design of electrical and electronic products

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National foreword

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TECHNICAL REPORT

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Guidance on material efficiency considerations in environmentally conscious design of electrical and electronic products

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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GUIDANCE ON MATERIAL EFFICIENCY CONSIDERATIONS IN ENVIRONMENTALLY CONSCIOUS DESIGN OF ELECTRICAL AND ELECTRONIC PRODUCTS

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IEC TR 62824, which is a Technical Report, has been prepared by IEC technical committee 111: Environmental standardization for electrical and electronic products and systems.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
111/391/DTR	111/411/RVC

Full information on the voting for the approval of this Technical Report 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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

The natural resources of our planet are being depleted by the rapid growth of industry including the production and use of electrical and electronic products. Materials are consumed both directly and indirectly and lead to other environmental impacts, such as climate change. As a consequence, there are an increasing number of policies and regulations being considered or enacted at regional or national level to promote sustainable production while minimizing environmental impacts. To meet these challenges, this Technical Report provides information on how material efficiency considerations can be integrated into the environmentally conscious design (ECD).

Material efficiency relates to the efficient use of materials over a product's lifetime, including its fabrication, distribution, use and disposal. Within this document, the following material aspects are considered: material type, material quantity, material substitutability, use of renewable material, material recyclability, material recoverability, and durability of product.

This document is intended to support ECD, but focuses on the efficient use of material within products. Its aim is to facilitate the use of materials in an optimal way and thereby promote the sustainability of natural resources.

GUIDANCE ON MATERIAL EFFICIENCY CONSIDERATIONS IN ENVIRONMENTALLY CONSCIOUS DESIGN OF ELECTRICAL AND ELECTRONIC PRODUCTS

1 Scope

IEC 62824 which is a Technical Report provides information on selection and efficient use of materials in electrical and electronic products. Environmentally conscious design (ECD) can then proceed in such a way that aspects, including material type, material quantity, material substitutability, renewable material, material recyclability, material recoverability, and durability of product are taken into account during the design phase.

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.

None.

3 Terms and definitions

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

3.1
environmentally conscious design
ECD
systematic approach which takes into account environmental aspects in the design and development process with the aim to reduce adverse environmental impacts

[SOURCE: IEC 62430:2009, 3.6]

3.2
material
substance or mixture within a product or product part

[SOURCE: IEC 62474:2012, 3.4]

3.3
material efficiency
comparative indicator of material used for a product to provide a particular function

Note 1 to entry: Material efficiency can be assessed by considering aspects such as: material type, material quantity, material substitutability, use of renewable material, material recyclability, material recoverability, and durability of product.

Note 2 to entry: Material efficiency is a constituent of resource efficiency. Resource efficiency includes all aspects of material efficiency and, in addition, the use of energy, water, air, land, etc.

3.4
material recoverability
property of a product's design that determines the ease with which a particular material can be separated from other materials at the end of life stage

Note 1 to entry: Separation includes mechanical, chemical or thermal processes.

Note 2 to entry: This definition is specific to product design.

3.5
material recyclability
ability of waste materials to be processed for the original purpose or for other purposes, excluding energy recovery

[SOURCE: IEC 62542:2013, 6.9, modified — word “material” has been added to the term]

3.6
material substitutability
ability of a material to be substituted in a product with another material

Note 1 to entry: Material substitutability does not only depend on the material, but also on the product. Depending on how the material is used and which of its characteristics are exploited, the same material may be substitutable or not.

3.7
mixture
preparation
mixture or solution composed of two or more substances in which they do not react

Note 1 to entry: An alloy is treated as a mixture.

Note 2 to entry: Definition is taken from the Globally Harmonized System of Classification and Labelling of Chemicals (GHS): 2015, Chapter 1.2, Definitions and Abbreviations.

[SOURCE: IEC 62474:2012, 3.6, modified — Note 2 to entry has been added]

3.8
durability
ability to perform as required, under given conditions of use and maintenance, until the end of useful life

[SOURCE: IEC 60050-192:2015, 192-01-21]

3.9
substance
chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition

Note 1 to entry: Definition is taken from the Globally Harmonized System of Classification and Labelling of Chemicals (GHS): 2015, Chapter 1.2, Definitions and Abbreviations.

[SOURCE: IEC 62474:2012, 3.13, modified — Note 1 to entry has been added]

3.10
renewable material
material, the source of which is replenished and will not become depleted at the rate of use

4 Relationship between material efficiency and ECD

ECD standards in general cover all environmental aspects of a product’s life cycle.

Integration of material efficiency considerations to the ECD process can be achieved by implementing the following:

- at the phase “analysis of regulatory and stakeholders’ environmental requirements”, requirements relevant to material efficiency, if any, should be identified and analysed;
- at the phase “identification and evaluation of environmental aspects and corresponding impacts”, the relevant material aspects should be identified and, where possible, evaluated;
- at the phase “design and development”, the considerations of material aspects such as material type, material quantity, material substitutability, use of renewable material, material recyclability, material recoverability, and durability of product, if relevant, should be applied.

Changing a product’s design in relation to material efficiency can impact other environmental aspects and therefore the ECD process needs to be reconsidered in its entirety.

Figure 1 illustrates how material aspects could be integrated into the ECD process. The middle and right parts in Figure 1 provide an overview of the ECD process. The left part gives examples of various material aspects that are considered during an implementation of the ECD process.

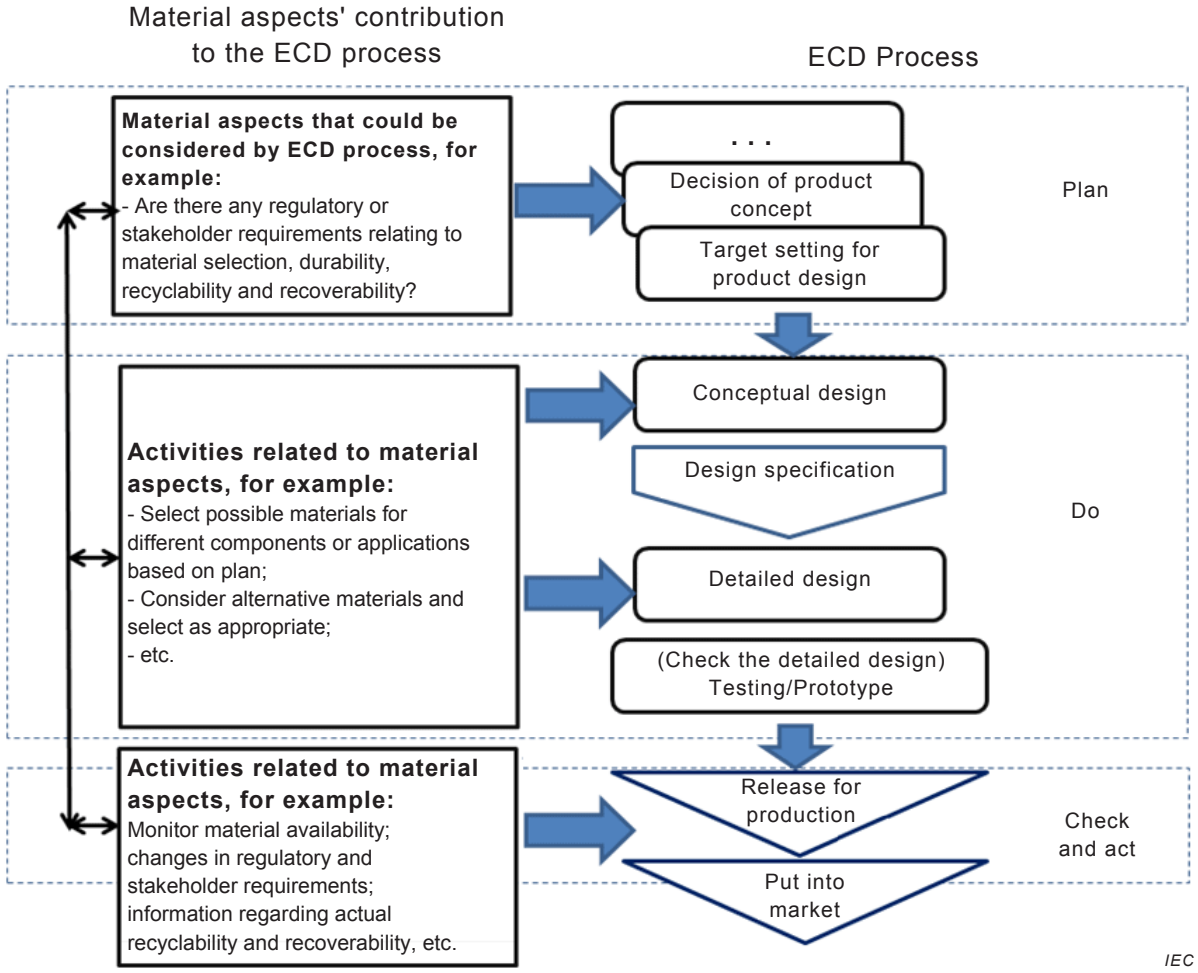

Figure 1 – Illustration on integration of material aspects into the ECD process

5 Material aspects for material efficiency

5.1 Material type and material quantity

5.1.1 General

Material declaration according to IEC 62474 can provide a source of information about type and quantity of materials used in a product.

NOTE Material declaration might be available only for materials containing substances subject to a reporting obligation.

5.1.2 Material type

Material type is described by the physical and chemical properties of the material.

The type of material affects the environmental impacts because of:

- the material's physical or chemical properties;
- the processes including extraction, manufacturing, storing, transportation, recycling and disposal.

5.1.3 Material quantity

Generally, by reducing the quantity of a given material, the environmental impact of the product in relation to that material is reduced. However, other aspects such as the way in which materials are incorporated in the product could affect the respective materials' recyclability and recoverability.

NOTE The reduction of material quantity could affect product safety, quality, performance, etc.

EXAMPLE For electromagnetic compatibility (EMC) reasons, a conductive screen can be provided as part of a product's enclosure. This could be achieved by applying a metalized coating to a plastic case or by using separate plastic and metal parts. If a metalized coating is used, much less metal is required, but it will be very difficult to separate the plastic and metalized coating. In this case, using two parts will result in more material usage and that could improve material recoverability.

When considering material quantity, the following can be taken into account:

- The quantity of material used in the product;

NOTE The reduction of material quantity in a product could also negatively affect its recyclability rate

- The quantity of material consumed for manufacturing the product depends on the manufacturing process for example, casting, lathing, forming, extruding. The choice of process depends on the material physical properties and the product design. A certain amount of material is wasted during every manufacturing processing (e.g. chip formation during the process of cutting materials by mechanical means, using tools such as saws, lathes and milling).

5.2 Material substitutability

Manufacturers frequently seek to have alternative suppliers as part of their contingency plans. It is expected that processes for a robust design would ensure that alternative materials and alternative suppliers are considered. These activities will lead to different materials being selected and consequential changes in environmental impacts.

NOTE Material substitution could affect quality, safety, performance, marketability, etc.

The following are examples of factors that can trigger the need to substitute a material used in a given product:

- regulatory changes in various regions/nations can affect the availability or the use of that specific material;

- new manufacturing processes can emerge, making use of an alternative material possible, or making use of the original material impractical;
- the organization seeks to manufacture in a new region/nation where the original material is unavailable;
- innovative way of using materials in products.

When considering material substitutability, the following can be taken into account:

- designing the product or the process in order to allow the use of an alternative material, for example substituting a non-renewable material with a renewable material;
- seeking to specify an alternative for non-renewable material that has a lower environmental impact;
- using a material that, in application, provides a durability better than or equal to the original material;
- assignment of a higher level of importance to the environmental impact of the material, as compared to other prioritization factors;
- avoiding over specifying material requirements such as material type and/or composition;
- using a new technology to produce the part which has environmental benefits (e.g. it uses less energy).

5.3 Renewable material

Renewable materials could be considered as an alternative material but, since they have different properties, design changes might be required (e.g. changing the dimension of a part).

NOTE Use of renewable materials can have a positive or negative environmental impact. For example, the production of a renewable material can involve increased water consumption, eutrophication and/or land-use.

5.4 Material recyclability and material recoverability

5.4.1 General

Some regional regulations have already introduced product or material recycling requirements.

From the recycling perspective, it is generally advantageous to minimize the number of different materials in the product.

5.4.2 Material recyclability

Material recyclability is a function of the material itself and treatment processes that convert waste streams into recycled materials.

Calculation of product recyclability rate is described in IEC TR 62635.

When considering material recyclability, the following can be taken into account.

- A part made from a single recyclable material is generally well suited for end of life treatment. However, this may not be true for all cases, for example, there are many types of plastic of the same generic type (e.g. ABS), but there are many formulations of that generic type which can reduce or prevent its recycling.

NOTE Using a single material might not always be optimal if that single material has a high environmental impact.

- Material recyclability can vary from one geographic location to another for example depending upon the recycling technologies available.
- Local legislations may require certain materials to be recycled.

- Ensure that products are designed to achieve the integration of (plastic) materials (for using similar physicality) and avoid the addition of a substance that impairs the recyclability.

5.4.3 Material recoverability

Material recoverability is a function of how materials are used in a product and the separation processes that create discrete streams during the waste treatment processes or enable materials to be recovered so that the material can be used again.

When considering material recoverability, the following can be taken into account:

- ensure that products are designed so that specific parts (e.g. printed circuit board assembly, and compact secondary batteries) can be easily removed using commonly available tools;
- ensure that different materials used together can be easily separated using tools and techniques available at local recycling facilities;
- local legislations may require certain materials to be recovered, possibly because of their value (e.g. rare earth materials) or possibly because of their hazardous nature (e.g. mercury);
- generally, recoverability of a material can be increased if the part using the material can be separated by mechanical process.

5.5 Durability of product

The durability of a product will depend on many factors including the materials chosen and the way they are incorporated into the product (e.g. the forces applied to the materials, the temperature they operate at). Hence, care should be taken when selecting materials to ensure that they are compatible with the expected lifetime of the product when used in application.

When considering durability of product, the following can be taken into account:

- alignment of the projected lifetime of each part and component with the expected lifetime of the product could prevent the product from being disposed prematurely due to minor faults;

NOTE If the above mentioned equalization of the projected lifetime of each part and component is impossible, the ease of repairing the product or reusing the part could be considered.

- the external surfaces of the parts should be resistant to the level of abrasion, fouling and corrosion expected in the intended application, since that will influence the lifespan of the material.

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