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Environmentally conscious design - Integrating environmental aspects into design and development of electrotechnical products

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Environmentally conscious design – Integrating environmental aspects into design and development of electrotechnical products

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTALLY CONSCIOUS DESIGN – INTEGRATING ENVIRONMENTAL ASPECTS INTO DESIGN AND DEVELOPMENT OF ELECTROTECHNICAL PRODUCTS

FOREWORD

This first edition of IEC Guide 114 has been prepared in accordance with Annex A of Part 1 of the ISO/IEC Directives by the Advisory Committee on Environmental Aspects (ACEA).

The text of this guide is based on the following documents:

Approval document	Report on voting
C/1357/DV	C/1369/RV

Full information on the voting for the approval of this guide can be found in the report on voting indicated in the above table.

INTRODUCTION

Every product has an effect on the environment, which may occur at any or all stages of its life cycle – raw-material acquisition, manufacture, distribution, use, and disposal. These effects may range from slight to significant; they may be short-term or long-term; and they may occur at the local, regional or global level (or a combination thereof).

The interest of customers, users, developers and others in the environmental aspects and effects of products is increasing. The information provided by this document may also be of interest to external stakeholders who are not directly involved in the product design and development process.

Anticipating or identifying the environmental aspects of a product throughout its life cycle may be complex. The environmental aspects of a product must also be balanced against other factors, such as its intended use, performance, safety and health, cost, marketability, quality, and legal and regulatory requirements. It is important to consider its function within the context of the system where it will be used.

The process of integrating environmental aspects into product design and development must be continuous and flexible, promoting creativity and maximizing innovation and opportunities for environmental improvement. As a basis for this integration, environmental issues may be addressed in the policies and strategies of the organization involved.

Early identification and planning enable organizations to make effective decisions about environmental aspects that they control and to understand better how their decisions may affect environmental aspects controlled by others – for example, at the raw-material acquisition or end-of-life stages.

The widespread use of electrotechnical products has drawn increased attention to their effects on the environment. In many countries all over the world, this has resulted in the adoption of electrical and electronic equipment regulations affecting wastes, hazardous substances and energy efficiency.

The purpose of this document is to help designers of electrotechnical products appropriately to manage related environmental issues within the design process. Principles of integrating environmental aspects into product design and development have been described in ISO 14062. Though electrotechnical products have some specific features which have given rise to the present document, some aspects of ISO 14062 have been taken up in this document to make it capable of standing alone.

Subsequent sector-specific design documents may be developed to address specific sector needs not covered in this document.

ENVIRONMENTALLY CONSCIOUS DESIGN – INTEGRATING ENVIRONMENTAL ASPECTS INTO DESIGN AND DEVELOPMENT OF ELECTROTECHNICAL PRODUCTS

1 Scope

IEC Guide 114 describes concepts relating to the integration of environmental aspects into electrotechnical product design and development. It is intended for use by all those involved in the design and development of products, regardless of organization type, size, location and complexity, and for all types of electrical and electronic equipment, whether new or modified. It is written for those directly involved in the process of product development and for those responsible for the policy and decision-making process within the organization.

2 Reference documents

ISO 1043 (all parts), *Plastics – Symbols and abbreviated terms*

ISO 9000:2000, *Quality management systems – Fundamentals and vocabulary*

ISO 11469:2000, *Plastics – Generic identification and marking of plastics products*

ISO 14001:1996, *Environmental management systems – Specification with guidance for use*

ISO 14040:1997, *Environmental management – Life cycle assessment – Principles and framework*

ISO/TR 14062:2002, *Environmental management – Integrating environmental aspects into product design and development*

IEC Guide 109:2003, *Environmental aspects – Inclusion in electrotechnical product standards*

3 Terms and definitions

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

3.1
consumable
user-replaceable part or piece of equipment that manufacturers place on the market for direct sale for use in equipment

NOTE Examples of consumables include printer cartridges and photographic films.

3.2
design and development
set of processes that transform requirements into specified characteristics or into the specification of a product, process or system

NOTE 1 The terms "design" and "development" are sometimes used synonymously and sometimes used to define different stages of the overall process of turning an idea into a product.

[ISO 9000:2000, definition 3.4.4]

NOTE 2 Product development is the process of taking a product idea from planning to market launch and reviewing the product, in which business strategies, marketing considerations, research methods and design aspects are used to take a product to a point of practical use. It includes improvements or modifications to existing products or processes.

3.3
design specification
specification which describes how to meet the functional requirements that are set by the performance specification

3.4
environment
surroundings in which a product operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation

NOTE Surroundings in this context extend from within a product to the global system.

[ISO 14001:1996, definition 3.2]

3.5
environmental aspect
element of an organization's activities, products or services that can interact with the environment

NOTE A significant environmental aspect is an environmental aspect that has or can have a significant environmental impact

[ISO 14001:1996, definition 3.3]

3.6
environmental impact
any change to the environment, whether adverse or beneficial, wholly or partly resulting from an organization's activities, products or services

[ISO 14001:1996, definition 3.4]

3.7
field replaceable unit
part, component or subassembly that is easily removed (mechanically disjointed) using ordinary tools

NOTE "Easily removed" consists of using ordinary tools to perform such functions as screwing or disconnecting, and only without irreversibly destroying the unit.

3.8
life cycle
consecutive and interlinked stages of a product system, from raw-material acquisition or generation of natural resources to the final disposal

[ISO 14040:1997, definition 3.8]

3.9
life cycle assessment (LCA)
compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle

[ISO 14040:1997, definition 3.9]

3.10
performance specification
specification, based on the requirement specification, which defines the functional requirements, the context in which the product must operate, and interface and interchangeability characteristics

NOTE It does not state the methods for achieving the required results.

3.11
process
set of interrelated or interacting activities which transform inputs into outputs

NOTE 1 Inputs to a process are generally outputs of other processes.

NOTE 2 Processes in an organization are generally planned and carried out under controlled conditions to add value.

[ISO 9000:2000, definition 3.4.1]

3.12
product system
collection of materially and energetically connected unit processes which performs one or more defined functions

[ISO 14040:1997, definition 3.15]

3.13
requirement specification
specification of the requirements that the product has to fulfil; describes which user groups are aimed at and what basic functions the product should have

4 Strategic considerations

4.1 Goal and potential benefits

The goal of integrating environmental aspects into product design and development is the reduction of adverse environmental impacts of the product throughout its entire life cycle. In striving towards this goal, multiple benefits can be achieved for the organization, its competitiveness, its customers and other stakeholders. Potential benefits may include

- lower costs by optimizing the use of materials and energy, more efficient processes, reduced waste disposal;
- stimulation of innovation and creativity;
- increase in knowledge about the product, thus facilitating further improvements;
- reduction of risks, such as avoiding non-compliance to regulations or risks of increased costs for end-of-life treatment due to hazardous substances.

4.2 Organizational considerations

The existing policies, strategies and structure of an organization usually take account of their socio-economic context (for example, new regulations on wastes and on substances) and of their stakeholders (customers, competitors, suppliers, etc.). It is important to consider this context, because it may have economic and environmental implications for the organization and can provide valuable guidelines for the integration of environmental aspects into product design and development.

4.3 Product-related considerations

Integration of environmental aspects into product design and development should consider the following product-related issues:

- early integration, i.e. address the environmental aspects early in the design and development process;
- product life cycle, i.e. analyse from raw-material acquisition to end of life (see Figure 1);
- functionality, i.e. how well the product suits the purpose for which it is intended in terms of usability, useful lifetime, reliability, appearance, etc.;

- multi-criteria, i.e. consideration of all relevant environmental impacts and aspects;
- consideration of trade-offs in the process of seeking optimal solutions.

These issues are discussed in more detail in 4.3.2.

4.3.1 General considerations on product-related environmental aspects and impacts

This clause gives a global overview of product-related environmental aspects and impacts, basic issues and strategic environmental objectives.

Products may have a range of environmental aspects (for example, emissions generated, resources consumed) that result in environmental impacts (for example, air, water and soil pollution, climate change).

The environmental impacts of a product are largely determined by the material and energy inputs and outputs generated at all stages of its life cycle (see Figure 1). Environmental impacts can be greatly influenced by the actions of organizations and individuals using the product.

Inputs generally fall into two broad categories: material and energy.

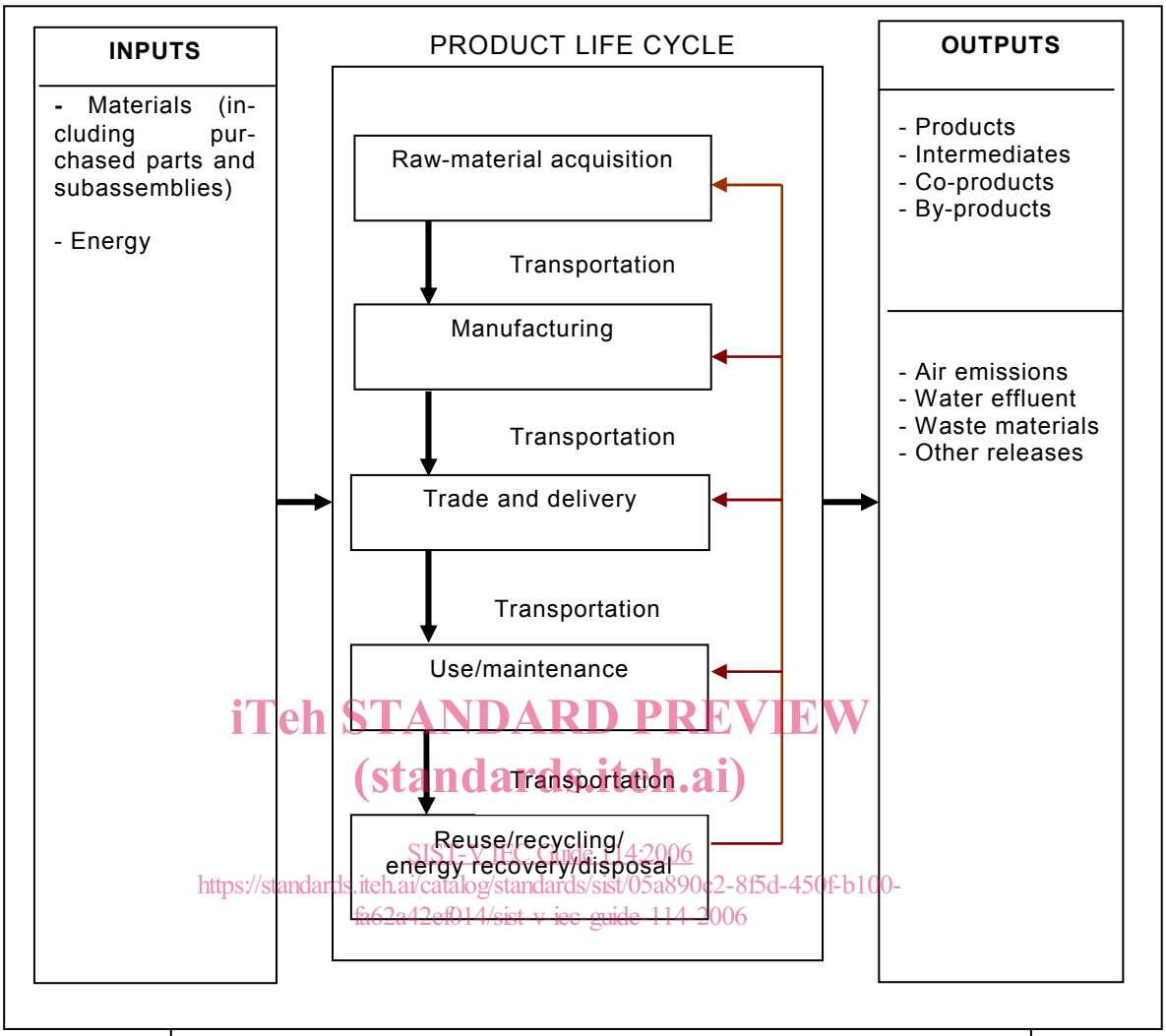
- Material inputs are associated with a variety of environmental aspects; for example, use of resources, exposure of humans and ecological systems to contaminants, emissions to air, water and soil and the generation of waste materials and their accumulation.
- Energy inputs are required at most stages of the life cycle of a product. Energy sources include fossil and biomass fuels, waste materials, nuclear, hydropower, geothermal, solar and wind energy. Each type of energy source has identifiable environmental aspects.

As a rule, energy consumption of an electrotechnical product during the use stage is a very important factor for the determination of its environmental impacts. In many cases, it is the most important one.

Outputs generated during the life cycle of a product fall into several categories: the product itself, intermediates, co-products, by-products and other outputs as described below.

- Air emissions comprise releases of gases, vapours and particulate matter into the air.
- Water effluent discharges comprise discharges of substances to either surface or groundwater.
- Waste is generated during each stage of the life cycle of a product. Waste products can become inputs to other processes, or can be treated, recycled, used as energy sources, incinerated or land-filled.
- Other releases may include noise, electromagnetic fields, etc.

For design and development, it is useful to describe inputs and outputs in terms that are measurable and comparable.



IEC 746/05

Figure 1 – Inputs and outputs and examples of environmental impacts associated with the life cycle of a product

4.3.2 General considerations for integrating environmental aspects into product design

The integration of environmental aspects as early as possible into the product design and development process offers the flexibility to make changes and improvements to products. In contrast, postponing to later stages of the process may preclude the use of desirable environmental options, because all the major technical decisions have already been made.

A life-cycle approach is used to identify the relevant environmental aspects and impacts during the entire product life cycle, thus helping in defining design approaches. It is important to take into account all stages of the life cycle of a product, as shown in Figure 1, and to recognize how products can affect the environment at different stages.

Changing any single input (for example, altering a material used) or influencing a single output (for example, reducing specific emissions or making provisions for reducing hazardous wastes) may affect other inputs or outputs. Therefore, it is important to ensure that any emphasis on a single stage of the life cycle of a product does not unintentionally alter the environmental impacts at another stage, or result in additional impacts on other elements of the local, regional or global environment.

Considering a broad range of potential impacts and environmental criteria and exercising caution when excluding such criteria, help ensure that the reduction of one effect does not result in an increase in another impact.

When developing products, there is considerable value in thinking in terms of functionality (how well the product suits the purpose for which it is intended in terms of usability, useful life time, appearance, etc.) rather than in terms of a specific technical solution. It is, therefore, important to adopt a broad approach when searching for new options and to highlight the functionality required to fulfil customer or user demands and needs. Such thinking may lead to a service solution that has reduced environmental impacts when compared with traditional solutions only based on goods.

In addition to traditional design criteria (for example, performance, quality, cost), a variety of environmental criteria should be taken into account. This generally involves considering a range of different potential environmental impacts, as presented in Figure 1, through a multi-criteria concept.

The organization may recognize that different interested parties (scientific community, government, environmental groups, customers, etc.) may have varying perceptions of the importance of environmental issues. These different perceptions may have relevance for product design and development.

An integrated perspective of, and pragmatic approach to, the different life-cycle stages and environmental aspects can help ensure that adequate solutions are found for dealing with the trade-offs associated with most design decisions. There are three types of trade-offs:

- trade-offs between different environmental aspects; for example, optimizing a product for weight reduction might negatively affect its recyclability. The comparison of potential environmental impacts associated with each option can help decision-makers find the best solution;
- trade-offs between environmental, economic and social benefits. These can be tangible (for example, lower cost, waste reduction), intangible (for example, convenience) and emotional (for example, image). For example, making a product more robust increases the lifetime and, as a result, may benefit the environment by reducing long-term resource use and waste but may also increase initial costs. This may have social as well as economic effects;