

Standard ECMA-341

3rd Edition / June 2008

**Environmental Design
Considerations for ICT
& CE Products**

Standard

Standard
ECMA-341

3rd Edition / June 2008

**Environmental Design
Considerations for ICT & CE
Products**

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 low 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 other stakeholders in **environmental aspects** and effects of **products** is increasing.

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

The process of integrating **environmental aspects** into **product** design and development has to be continuous and flexible, promoting creativity and maximizing innovation and opportunities for environmental improvement. Environmental issues should 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. This provides a better understanding of how their decisions will affect **environmental aspects** controlled by others – for example, at the raw-material and **parts** acquisition or **end of life** stages.

The purpose of this document is to help **designers** of **products** in the field of audio/video, information technology and communication technology to appropriately manage related environmental issues within the design process.

History

The basic work on this sector specific environmental conscious design standard started in Ecma TC38 in 2002 where experts from a group of ICT and CE companies developed the basic concept considering engineering best practices as well as market and regulatory environmental **product** requirements as well as later the first edition of IEC Guide 114 (2005). The main motivation has been to develop a practical help for designers to identify the relevant aspects for an environmental conscious design.

The result of that work was ECMA-341. In 2005, IEC TC108 PT62075 developed IEC 62075 based on ECMA-341 2nd edition from Ecma TC38 and drafts of the to be published horizontal standard IEC 62430. IEC published the first edition of IEC 62075 in 2008.

This edition of ECMA-341 aims to align IEC 62075 and ECMA-341 again and to serve as the base for further revisions.

This Ecma Standard has been adopted by the General Assembly of June 2008.

Table of contents

1	Scope	1
2	Conformance	1
3	Normative references	1
4	Terms and definitions	2
4.1	chemical emissions	2
4.2	consumable	2
4.3	designer	2
4.4	end of life	2
4.5	energy efficiency	2
4.6	environment	2
4.7	environmental aspect	2
4.8	environmental impact	3
4.9	environmental management system	3
4.10	hazardous substances and preparations	3
4.11	life cycle	3
4.12	manufacturer	3
4.13	module	3
4.14	organization	3
4.15	part	3
4.16	preparations	3
4.17	product	3
4.18	recycling	3
4.19	renewable material	4
4.20	reuse	4
4.21	skilled person	4
4.22	substance	4
4.23	upgrading	4
4.24	use stage	4
5	Life cycle thinking (LCT) aspects	4
6	Design requirements and recommendations	5
6.1	General considerations	5

6.2	Material efficiency	5
6.3	Energy efficiency	5
6.3.1	General	5
6.3.2	Energy modes and related energy efficiency measures	6
6.3.3	Operational modes	6
6.3.4	Energy saving modes	7
6.3.5	Off modes	8
6.3.6	No load mode	8
6.3.7	General energy efficiency measures	8
6.4	Consumables and batteries	9
6.4.1	Consumables	9
6.4.2	Batteries	9
6.5	Emissions	10
6.5.1	Chemical emissions	10
6.5.2	Noise emissions	10
6.6	Product lifetime	10
6.7	End of life	11
6.8	Hazardous substances and preparations	12
6.9	Product packaging	12

Annex A (informative) Design guidance and design for environment checklist 13

A.1	Life cycle thinking aspects	13
A.1.1	The organization has a management system such as an environmental management system in place covering environmental product design aspects.	13
A.1.2	The designer has followed those policies/programs.	13
A.1.3	It has been checked that any emphasis on a single stage of the life cycle of a product does not negatively alter the environmental impacts in other stages.	13
A.1.4	The designer has checked with the relevant departments within the organization, which of the following aspects are considered in the environmental policy or programs of the organization:	13
A.2	General considerations	14
A.2.1	The designer has identified in cooperation with the responsible departments within the company the latest environmentally related legal and market requirements applicable to the product.	14
A.2.2	The significant adverse/beneficial environmental impacts of the product during its life have been identified and analyzed in order to respectively reduce/increase them by alternative design solutions.	14
A.2.3	Experiences from the subsequent manufacturing, sales, product usage, maintenance and disposal stages have been considered.	14
A.2.4	A benchmarking with the environmental performance of competitor models has been carried out.	14
A.2.5	All applicable environmental product information to be made available is provided in an environmental product declaration (for example ECMA-370).	14
A.2.6	Certain product environmental characteristics are available.	14
A.3	Material efficiency	15

A.3.1	The variety of materials used in the product has been reduced.	15
A.3.2	The amount of material used in the product has been reduced.	15
A.3.3	The product contains materials that are considered to have less adverse or more beneficial environmental impact.	15
A.3.4	The product contains recycled materials (see 6.2).	15
A.3.5	The product uses renewable materials.	15
A.4	Energy efficiency	15
A.4.1	Energy modes and related energy efficiency measures.	15
A.4.2	Operational modes	16
A.4.3	Energy saving modes	16
A.4.4	Off modes	16
A.4.5	No load modes	17
A.4.6	General energy efficiency measures	17
A.5	Consumables and batteries	18
A.5.1	Consumables	18
A.5.2	Batteries	19
A.6	Emissions	21
A.6.1	Chemical emissions	21
A.6.2	Noise Emissions	21
A.7	Product lifetime	22
A.7.1	The product contains common mechanical packages (such as covers and chassis) or common parts or components that are used for multiple models in the product family or in multiple generations of the same product.	22
A.7.2	The product contains standardised parts.	22
A.7.3	The product contains modular components.	22
A.7.4	The product contains reused components and/or parts.	22
A.7.5	The product contains parts targeted for reuse in maintenance and spare parts applications.	23
A.8	End of life	23
A.8.1	Separation of parts containing hazardous substances and preparations is possible.	23
A.8.2	Incompatible materials (including electronic modules) connected to case/housing parts or chassis are easily separable.	23
A.8.3	The product can be disassembled down to the module level using commonly available tools.	23
A.8.4	All plastic parts weighing 25 g or more and with a flat area of 200 mm ² or more are marked with the type of polymer, copolymer, polymer blends or alloys in conformance with ISO 11469.	23
A.8.5	The following design choices have been avoided.	23
A.8.6	The following aspects have been considered and their number and variety reduced.	23
A.8.7	The treatment information for the product includes guidance regarding the following aspects:	24
A.9	Hazardous substances and preparations	24
A.9.1	Content in products (refer to Annex D for regulation examples)	24
A.10	Packaging	24
A.10.1	The variety of packaging materials used has been reduced.	24

A.10.2	The amount of packaging materials used has been reduced.	24
A.10.3	The used packaging materials are considered to have lower environmental impact.	25
A.10.4	The packaging was manufactured using recycled materials.	25
A.10.5	The packaging was manufactured using renewable materials.	25
A.10.6	The packaging complies with the applicable international, regional and national regulations.	25
A.10.7	The packaging materials have an appropriate marking.	25
Annex B (informative) Bibliography		27
Annex C (informative) Polymers compatibility guide		29
Annex D (informative) Examples of regulations		31
D.1	Government environmental agency URLs	31
D.2	Example of regulations for energy efficiency	32
D.3	Examples of regulations for batteries	32
D.4	Example of regulations for hazardous substances and preparations	32
D.5	Example of regulations for end of life treatment	32
D.6	Examples of regulations for product packaging	32

1 Scope

This Standard applies to all audio/video, information and communication technology equipment marketed as final products, hereafter referred to as **products**.

Although this Standard does not explicitly apply to individual components and subassemblies to be incorporated into final **products**, component **manufacturers** also need to consider this Standard, to enable **manufacturers** using such components to meet the requirements herein.

Only the intended use of **products** as defined by the **manufacturer** is within the scope of this Standard.

This Standard specifies requirements and recommendations for the design of environmentally sound **products** regarding

- **life cycle** thinking aspects,
- material efficiency,
- **energy efficiency**,
- **consumables** and batteries,
- chemical and noise emissions,
- extension of **product** lifetime,
- **end of life**,
- **hazardous substances/preparations, and**
- **product** packaging.

This Standard covers only criteria directly related to the environmental performance of the **product**. Criteria such as safety, ergonomics and electromagnetic compatibility (EMC) are outside the scope of this Standard and are covered by other standards.

2 Conformance

Conformant applications of this Ecma Standard:

- meet all of the applicable "shall" statements in Clauses **5** and **6**; and
- complete a design checklist for the product (or for a given family of products).

3 Normative references

The following referenced documents are indispensable for the application of this document. The latest edition of the referenced document (including any amendments) applies.

- ECMA-74 Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment (ISO 7779)
- ECMA-109 Declared Noise Emission Values of Information Technology and Telecommunications Equipment (ISO 9296)
- ISO 3741 Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms
- ISO 3744 Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane
- ISO 3745 Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for anechoic and hemi-anechoic rooms

- ISO 7779 Acoustics – Measurement of airborne noise emitted by information technology and telecommunications equipment
- ISO 9296 Acoustics – Declared noise emission values of computer and business equipment
- ISO 11201 Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Engineering method in an essentially free field over a reflecting plane
- ISO 11469 Plastics – Generic identification and marking of plastics products

4 Terms and definitions

For the purpose of this Standard the following terms and definitions apply.

4.1 chemical emissions

chemical **substances** and particulate matter emitted from a **product** into the air

4.2 consumable

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

[IEC Guide 114]

NOTE

*Consumables include, for example, printer cartridges and photographic film, and not **parts** required for repairs or **product** upgrades.*

4.3 designer

persons responsible for the design and development of a **product** under the supervision of the **manufacturer**

NOTE

See [4.12](#) for context with manufacturer.

4.4 end of life

life cycle stage of a **product** starting when it is removed from a **use stage**

4.5 energy efficiency

rational use of energy to achieve an intended application performance

More technically, it is the minimum quantity of energy required to deliver a functional output from a device.

NOTE

A more precise definition is not applicable in this context as the output performance largely depends on the specific device.

EXAMPLE

*For power supplies the **energy efficiency** is defined as the percentage of output power per input power.*

4.6 environment

surroundings in which an **organization** operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation

[ISO 14001:2004, definition 3.5]

4.7 environmental aspect

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

[ISO 14001: 2004, definition 3.6]

NOTE

A significant **environmental aspect** is one that has or can have a significant **environmental impact** (ISO 14001:2004, definition 3.7).

4.8 environmental impact

any change to the **environment** whether adverse or beneficial, wholly or partially resulting from an **organization's environmental aspects**

[ISO 14001:2004, definition 3.7]

4.9 environmental management system

part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedure, processes, and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy

[ISO 14001:2004, definition 3.8, modified]

4.10 hazardous substances and preparations

substance or **preparation** that can adversely impact the **environment** with immediate or retarded effect

[IEC Guide 109:2003, definition 3.6, modified]

4.11 life cycle

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

[ISO 14040:2006, definition 3.1]

4.12 manufacturer

organization responsible for the design, development and manufacture of a **product** in view of its being placed on the market, regardless of whether these operations are carried out by that **organization** itself or on its behalf

4.13 module

assembly of **parts** of a **product** with a function in itself (for example, a power supply) including those separately put on the market as a **product**

4.14 organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration

[ISO 14001:2004, definition 3.16]

4.15 part

any piece or object of, or included with, a **product**

4.16 preparations

mixtures or solutions composed of two or more **substances**

EXAMPLE

Tin is a **substance** and solder is a preparation (an alloy) that may contain tin.

4.17 product

audio/video, information and communication technology equipment

4.18 recycling

reprocessing of **products, modules** or **parts** thereof for **reuse** or other purposes during their **end of life** stage

4.19 renewable material

organic material not based upon fossil carbon sources

4.20 reuse

recycling of **products**, **modules** or **parts** by entering in a subsequent **product use stage**

4.21 skilled person

person with relevant education or experience to enable him or her to avoid dangers and to reduce the likelihood of risks that may be created by the equipment

[IEV 826-18-01, modified]

4.22 substance

matter with an individual molecular identity

4.23 upgrading

process to enhance the functionality or capacity of a **product**

4.24 use stage

period of the **product's** life from placing it into service until it enters its **end of life** stage

5 Life cycle thinking (LCT) aspects

Within the limits of the **designer's** responsibility, the **designer** shall consider life cycle thinking (LCT). LCT means integration of the **environmental impact** caused by a **product** throughout all **life cycle** stages as early as possible in the **product** design and development process when opportunities exist to make decisions to improve the environmental performance of the **product**.

Basic considerations require that:

- a goal to minimize the overall adverse environmental impact be defined by the **manufacturer/organization**;
- the significant **environmental aspects** of the **product** be identified and
- trade-offs associated with both environmental aspects and life cycle stages shall be considered.

Balanced compromises associated with both **environmental aspects** and the **life cycle** stages shall be considered. Any decision should be balanced with technical features and economic viability and shall not compromise health and safety.

NOTE

*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**. The **life cycle** of any **product** includes the extraction and processing of raw materials, manufacturing, transportation, use and **end of life** management (including **reuse**, **recycling** and final disposal). Each of these **life cycle** stages consumes resources and generates **environmental impacts** in air, water or soil.*

*It is not the **designer's** sole responsibility to deal with attributes not directly dependent on the **product** design. First, the **designer** should ensure that **products** comply with all relevant regulations governing **product** design. Then, the **designer** should take into account the **environmental impact** of the **product** throughout its life to identify the significant impacts that can be reduced by alternative design solutions.*

*General **environmental aspects** of **life cycle** stages such as extraction/processing of raw materials, manufacturing and transportation should be considered within existing environmental and procurement policies and guidelines of the **organization**. **Designers** should follow the design relevant aspects of those policies and guidelines.*

*Any emphasis on a single stage of a **product's life cycle** may alter another stage and therefore the overall **environmental impact**. The **designer's** responsibility is limited by the possibilities within the requested functionalities and market requirements. Balanced compromises will occur in optimizing **environmental impact** across the **product life cycle**.*

6 Design requirements and recommendations

6.1 General considerations

The following requirements have been compiled for use when designing and developing **products** as defined in the scope of this Standard, as far as they can be practically influenced by the **designer**.

The **designer**

- shall identify the latest environmental related legal and market requirements (from customers, government, environmental groups, industrial associations, etc.);
- should do benchmarking addressing the comparison of **energy efficiency**, material efficiency, and the use of hazardous substances or preparations;
- should gather and evaluate experience from the subsequent manufacturing, sales, **product** usage, maintenance and disposal stages,

to continually improve the process of environmentally conscious **product** design.

The entire environmental performance of the **product** should be evaluated, while the considerations should give priority to those factors that can be substantially influenced through **product** design and are identified as major **environmental impacts** (for example, very often energy consumption). The evaluation should take into consideration the functions and normal usage of the **product** as well as the technical and economical feasibility.

As a minimum, the **designer** shall document decisions by some means, such as by maintaining a design checklist covering **environmental aspects** (an example for such a checklist is provided in Annex A).

This Standard requires certain **product** environmental characteristics to be made available in a form the **manufacturer** deems appropriate.

Further applicable information may be made available in an environmental product declaration (for example, ECMA-370).

6.2 Material efficiency

Material selection has an impact on the **environment**. When specifying materials, the **designer** should consider design alternatives that:

- reduce the variety of materials used;
- reduce the amount of material used and consequently the weight of the **product**;
- use materials that are considered to have lower adverse **environmental impact**;
- seek to use materials that can be easily **recycled**.

Material-related **end of life** aspects are covered in [6.7](#). For replacing materials containing **hazardous substances and preparations**, see [6.8](#).

6.3 Energy efficiency

6.3.1 General

To focus efforts on increasing energy efficiency, the **designer** shall be aware in which stage of the product **life cycle** the **product** will consume the most energy.

The intended use patterns of the **product**, including where relevant its typical system interactions, shall be considered. Where possible, the **organization** should strive for improving the overall system performance in respect to **energy efficiency**.

Energy consumption information shall be made available (see [6.3.5d](#) and [6.3.7](#)).

6.3.2 Energy modes and related energy efficiency measures

Energy mode definitions and applied terms vary depending on the **product** group. Therefore, rather than providing precise definitions of energy modes in this Standard, modes are described in generic terms as defined in 6.3.3 – 6.3.6 and illustrated in Figure 1. The intent is to balance the technical complexity with the simplicity needed for ease of communication and use.

NOTE

*Due to the high diversity of **products** covered by this Standard, examples are intended to clarify the energy modes and to guide the **designer**.*

The **designer** shall identify specific energy modes that apply to the **product** under development.

The **designer** shall consider **energy efficiency** measures for the identified energy modes (described in more detail in the following sections).

Designers shall also identify where energy is consumed with the **product** and take steps to reduce the overall energy consumption.

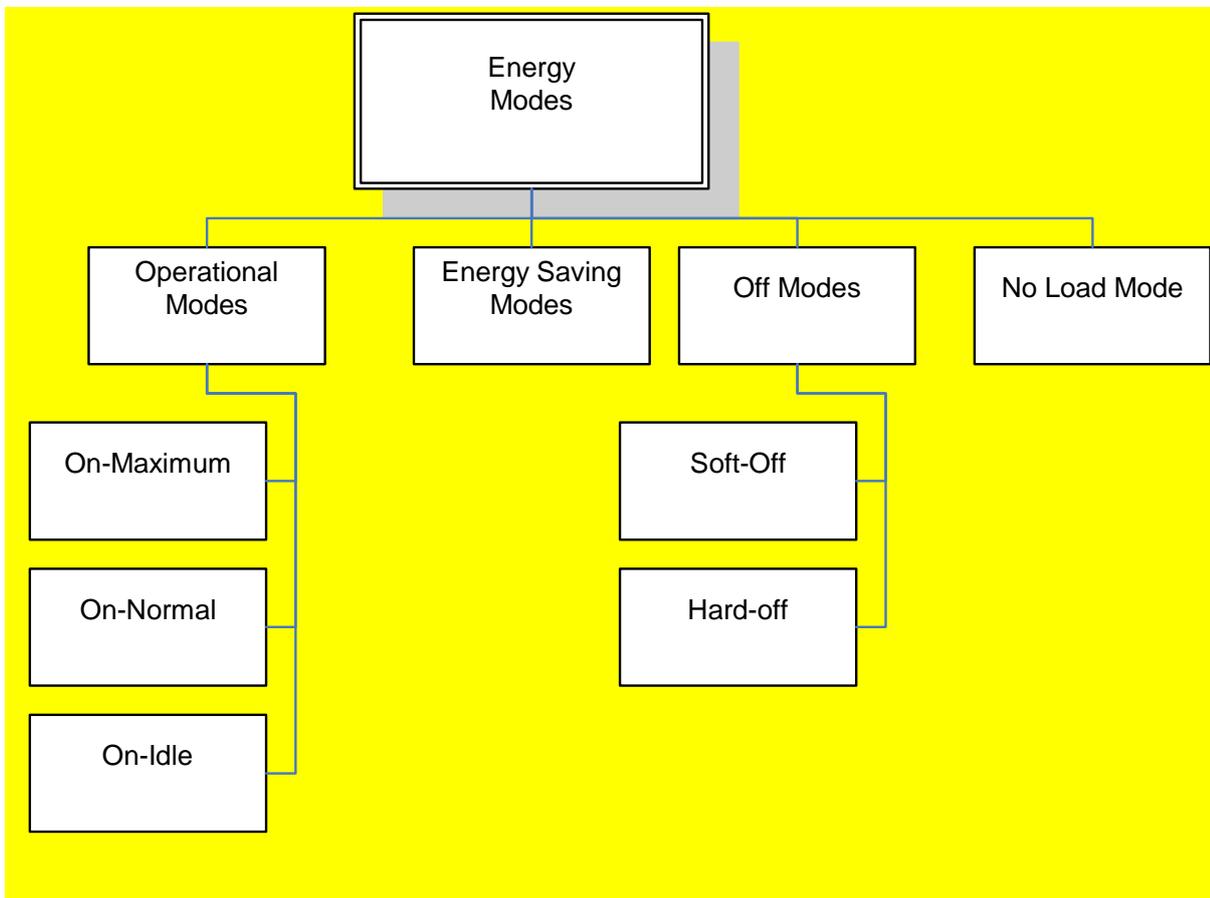


Figure 1 – Energy mode classification

6.3.3 Operational modes

Products perform their intended functions in the on-maximum, on-normal and on-idle operational modes.

- On-maximum: Operation with all options in use.

EXAMPLE 1

A television with maximum contrast, brightness and sound, or a personal computer with all slots and bays populated and operating.

- On-normal: Operation with default/standard configuration.

EXAMPLE 2

The factory setting of a computer display or a printer in active/run mode.

- On-idle: Operation with minimum system load by user and ready to operate without delay.

EXAMPLE 3

A personal computer running with no user initiated task consuming significant computing resources, or a printer in ready mode.

The **designer** shall consider:

- using low power components and/or design options as well as efficient power supply components to reduce the energy consumption in the on modes.

NOTE 1

*The reason for the above is that less efficient designs result in higher heat dissipation in the system, which leads to increased cooling requirements. By improving the **energy efficiency** of these designs in the on-mode, it may become possible to apply passive cooling thereby avoiding the use of fans and the resulting additional energy consumption.*

NOTE 2

Energy efficiency improvements typically reduce costs and noise and improve serviceability.

- identified modes (see [6.3.2](#)) when specifying the power supply. The AC-DC conversion efficiency should be high in the most used modes, for example, by applying voluntary programs and agreements as described in [6.3.7](#).

EXAMPLE 4

For typical personal computers in office use, the on-idle mode might represent a substantial percentage of the on-mode consumption and thus the conversion efficiency for this mode should be high. However, in many personal computers, the power supply loading is low in the on-idle mode, and hence often the conversion efficiency is low.

NOTE 3

Another reason for a low loading and therefore reduced power supply efficiency is the inherent extendibility of a system such as a personal computer. As such, the designer should balance extendibility vs. energy consumption.

- the true specification needs for the **product**. For example, over specifying the rating of the power supply can lead to an energy inefficient design.
- the effect of the operating **environment** specification provided to users and installers. For example, over specifying the maximum allowed ambient (room) operating temperature for large telecom, server or storage units can lead to energy inefficiencies in the room cooling systems.

6.3.4 Energy saving modes

Energy saving modes, often denoted as low power, sleep, deep sleep or stand-by, are states in which the equipment is connected to an electrical supply and is ready to resume an operational mode, within a user acceptable timeframe, through the use of remote control or another signal. In complex systems, various energy save modes may be present.

EXAMPLE 1

Sleep [stand-by/suspend to RAM (random access memory) mode for computers], stand-by-active high mode (set-top-box exchanging data with an external source but not providing picture or sound to the television), stand-by-active low mode (DVD-recorder programmed for recording but not recording/providing picture or sound to the television), stand-by-passive (television not providing picture or sound, but can be switched into operational mode by the remote control).

The **designer** shall:

- consider practical design options to automatically switch from on mode to energy save modes. The energy save mode settings should be adjustable by the user and designed in a way that it is likely to be adjusted if necessary to an alternative or custom setting, more suitable to their typical use. Other innovative solutions shall be considered;

EXAMPLE 2

A computer monitor may activate sleep mode when the user is detected to have left the viewing area or after a specified period of inactivity of manual input devices such as keyboard and mouse.

- consider the effect of the time to resume on the user acceptance to use the energy save modes;

EXAMPLE 3

The delay time for the first copy/print to start from energy save mode on a copier/printer.

- consider design options to reduce the energy consumption in the energy save modes by also applying similar methods as described in [6.3.3](#);
- inform the user of the higher energy consumption if the energy save mode is disabled.

6.3.5 Off modes

While connected to an electrical supply, **products** consume the least power in the following off modes:

- Soft-off: The equipment is switched off by the device itself or initiated by the user via remote control or command.

EXAMPLE 1

Printer in auto-off mode or computer after shutdown was completed.

- Hard-off: The off-power state in which the device uses zero watt (minimum energy consumption might occur due to line filters). The equipment is manually switched off with the main power switch [see c) and d) below].

EXAMPLE 2

Monitors, televisions and laser printers switched off at the primary side of the power supply and thus consuming no energy.

The **designer** shall

- a) consider design options to automatically switch from energy save mode to an off mode where practical,
- b) consider design options to reduce the energy consumption in the soft off modes to lowest values (minimum energy consumption might occur due to line filters),
- c) consider a main power switch. If applicable, the main power switch should be placed on the **product** such that the user can easily reach and use it,
- d) prepare energy consumption data (energy level in watthours) for a state a user would consider hard off but for which a power level of zero watt is not achievable and inform the user through documentation or other means.

6.3.6 No load mode

No load mode is the mode in which external power supplies or chargers are connected to an electrical supply, but are not connected to electrical or electronic equipment for which they have been designed.

Example

A mobile phone charger is plugged in, but the phone is not connected.

The **designer** shall consider design options that reduce energy consumption of no load mode to the lowest value.

6.3.7 General energy efficiency measures

All available energy saving features shall be documented during the design process.

Information on the **product's** energy consumption and, where applicable, its related energy modes shall be made available to the user.

Designers shall consider the requirements of international programmes, applicable for the **product** category, aimed to increase **energy efficiency**.

EXAMPLE 1

*The Energy Star international programme has made a number of **product** specifications and memoranda of understanding, available here: <http://www.energystar.gov>.*

Designers should consider other agreements as applicable aimed to improve **energy efficiency**.

The effects of the improved design decisions compared to previous similar designs should be quantified and communicated to **product** marketing departments in order to enable them to promote **products** with lower adverse total **environmental impact** through lower energy consumption.

The designer should enable the most **energy efficient** on modes and transitions to energy saving mode as the default modes with performance taken into consideration after transitions to energy saving modes as the default mode. If this is not reasonably achievable, the user shall be made aware of this and instructions on proper use of available energy saving controls and/or settings shall be provided to users. Instructions may be included in **product** user documentation in either printed or electronic form.

EXAMPLE 2

*A user should be made aware that enabling the wake-up on Local Area Network features prevents the **product** from entering the soft-off energy saving mode.*

If the **product** applies software and/or firmware, the **designer** shall be aware of the relevance of those for the overall **energy efficiency** of a system. The **designer** should balance the flexibility of software running on multipurpose devices and the **energy efficiency** of special purpose hardware.

6.4 Consumables and batteries

6.4.1 Consumables

For **consumables**, **designers** shall also consider the guidance specified in [6.7](#).

Products should be designed such that the use of **consumables** can be optimized relative to the functionality of the **product**. **Designers** should consider:

- functions to reduce or save the use of **consumables**;
- ease of replacement and maintenance of **consumables**.

The **manufacturer** shall provide users with information on the proper use of **consumables** relative to the functionality of the **product** and, where appropriate, **end of life** management of the **consumables**.

6.4.2 Batteries

Batteries shall comply with all applicable restrictions such as on **hazardous substances and preparations** (see [6.8](#)), design requirements on equipment containing batteries and, to the extent possible, all international labelling requirements.

Batteries with reduced **environmental impact** shall be considered. When materials with adverse **environmental impact** cannot be avoided (for example, mercury in button cells), the material and its justification shall be documented during the design process.

Batteries shall be easily identifiable and removable, either by users or **skilled persons**, except where the battery life span exceeds that of the **product**. In case the life span of the battery exceeds that of a **product**, batteries shall be removable for **end of life** treatment.

Product documentation shall give advice for the safe removal of the battery by either users or **skilled persons**. Information on batteries in the **product** shall be made available. This information shall include details on the types of the batteries and their locations, as well as proper procedures for safe removal and handling of the batteries, including information on **end of life** management/proper battery disposal.

Designs that prolong the durability of batteries shall be considered.

6.5 Emissions

6.5.1 Chemical emissions

Products shall be designed such that **chemical emissions** with adverse **environmental impact** during use are reduced wherever possible.

For **products** that use an electrostatic process, emission rates determined according to ISO/IEC 28360 should be made available.

6.5.2 Noise emissions

The designer shall consider techniques to reduce noise emissions.

NOTE

Reduced noise emissions improve energy efficiency.

In particular, noise emissions shall be evaluated according to ISO 7779, for **products** covered by ISO 7779 (or [ECMA-74](#)).

For **products** under the scope of this Standard and not covered by a **product** specific international standard noise test code, such as ISO 7779 (or ECMA-74), noise emissions do not have to be evaluated.

If noise emissions are evaluated for **products** under the scope of this Standard but not covered by either ISO 7779/ECMA-74 or another **product**-specific international standard noise test code, the basic sound power standards, ISO 3741, ISO 3744 or ISO 3745, and the basic emission sound pressure standard, ISO 11201, shall be used. The test conditions used should be recorded.

The resulting sound power levels and, where applicable, emitted sound pressure levels (including emission sound pressure measurement distance if not covered by ISO 7779/ECMA-74) shall be declared according to ISO 9296 (or ECMA-109) and should be documented according to available eco-declaration standards (such as ECMA-370). The levels shall be made available in the **product** information.

NOTE 1

*The additional noise from cooling systems is a frequent issue for audio and video systems and computers in home or silent office **environments**.*

NOTE 2

*The declared A-weighted sound power level $L_{WA,d}$, according to ISO 9296, is a statistical maximum value to account for **product** variation and lab-to-lab variations, and $L_{WA,d}$ is typically about 0,3 bels – 0,4 bels (3 dB – 4 dB) greater than the arithmetic average of A-weighted sound power level $L_{WA,r}$, measured according to ISO 7779, ISO 3741, ISO 3744 or ISO 3745. ISO 9296 (or ECMA-109) specifies how to determine and verify $L_{WA,d}$.*

6.6 Product lifetime

Where technically and economically feasible, **products** shall be designed to have a prolonged useful life and be easy to **upgrade** and repair. However, **designers** shall consider the balanced compromise of using up to date and efficient technology and prolonging the life of inefficient **products**. **Designers** shall consider incorporating the following features:

- use of common mechanical packages (such as covers and chassis) or common **parts** or components that are used for multiple models in the **product** family or in multiple generations of the same **product**, allowing for the **reuse** of common **parts**;
- use of standardised **parts** that may be more easily replaced or repaired;
- use of **modules**;
- **reuse** of **modules**, **parts** and **products**, whenever applicable. **Parts**, which may be targeted for **reuse** (for example, in maintenance and spare **parts** applications) should be identified.

To encourage the optimisation of a **product's** useful life, information on available options for **upgrading**, expanding and repair of **products** shall be made available if appropriate.

NOTE 1

*Specifics on design for upgradeability may need to be identified based on **product** categories, and/or initial cost of a **product**. There are categories of **products** for which upgradeability features may not be applicable, for example, single use cameras and pocket calculators.*

NOTE 2

Some of the guidelines provided in this subclause will aid serviceability.

6.7 End of life

Product design shall facilitate **reuse, recycling** and proper disposal at **end of life**.

The following design principles, where appropriate for the expected **end of life** processes, shall be applied:

- easy and safe separation of **parts** containing **hazardous substances and preparations** shall be possible (see [6.8](#));
- materials (including electronic **modules**) connected to case/housing **parts** or chassis intended for different **end of life** treatment shall be easily separable;
- disassembly down to the **module** level (for example, power supply, disk drive, circuit board) shall be possible using commonly available tools and all such **modules** shall be easily accessible;
- mark type of polymer, copolymer, polymer blends or alloys of plastic **parts**, including additives weighing 25 g or more and with a flat area of 200 mm² or more, in conformance with ISO 11469.

NOTE 1

Safety and performance considerations may override some of the requirements mentioned above.

NOTE 2

*There are categories of **products** for which dismantling may not be practical at **end of life**.*

Considering the expected **end of life** processing, **designers** should:

- Limit the number of polymers used in the **product**. Combinations of non-compatible materials which are not readily separated from each other shall be avoided, since this can compromise effective recycling. The compatibility guideline in Annex B should be used in selecting polymers when combinations of materials are intended to be used which could not easily be separated from each other. Advice on whether particular combinations of materials are readily compatible for the purposes of recycling can be obtained from polymer suppliers, specialized plastics recyclers or **manufacturers** who compound plastics;
- use labels and other identification marks made from the same material as the body of the products or a compatible material, where possible;

NOTE

There may be specific, for example safety requirements for labels.

- design for ease of disassembly;
- avoid the use of:
 - non-recyclable composites;
 - coatings and surface finishes on plastic **parts**;
 - adhesive backed stickers or foams on plastic **parts**; if stickers are required, they should be separable;
 - metal inserts in plastic **parts** (unless easily removable with common tools);
- reduce the number and variety of:
 - welds and glued joints;
 - connections (for example, fasteners and screws);

- steps necessary to remove targeted substances, preparations or parts in a treatment process;
- tools required for disassembly or extraction;
- position changes that have to be made by the dismantler.

Designers shall be aware of **product end of life** regulations to ensure legal compliance for products sold in targeted countries. **Designers** should prepare **end of life** treatment information that includes:

- identification of potentially valuable and/or re-usable **parts**;
- identification of **parts** containing **hazardous substances and preparations** and the location of such **parts**;
- special handling and disposal precautions.

6.8 Hazardous substances and preparations

Reducing and/or eliminating **hazardous substances and preparations** shall be considered as one of the priorities in the design of **products**. **Designers** shall be aware of (international, regional and national) prohibitions on the use of **hazardous substances and preparations** to ensure legal compliance for **products** sold in targeted countries. Consult Annex C for a list of examples of such regulations.

Designers shall attempt to reduce the use of **substances** that require special handling or disposal during the **product recycling** process.

Appropriate information on **parts** requiring special handling or disposal shall be made available to **product** users and **recyclers**.

When **hazardous substances and preparations** other than those that are restricted cannot be avoided, they shall be identified and an indication as to why they cannot be avoided shall be recorded during the design process.

6.9 Product packaging

Packaging material selection and its design has an impact on the **environment**. When specifying materials and designing packaging, the **designer** should consider design alternatives that:

- reduce the amount of material used and consequently the weight and size of the package;
- use materials that are considered to have lower adverse **environmental impact**;
- use **recycled** materials;
- use **renewable/recyclable** (considering available **recycling** technologies) materials.

As a minimum requirement the **designer** shall ensure compliance to international, regional and national regulations, concerning:

- **restrictions on** hazardous substances and preparations;
- recyclability, **such as** reuse or recycling;
- **appropriate marking (material content) of packaging materials**.

Annex A (informative)

Design guidance and design for environment checklist

The design checklist is intended solely for use of the **designer**. It is not intended to document environmental features for end users or to be used by end users to compare **products**.

This annex provides guidance in the form of an example checklist, that may be used to evaluate and record the requirements and recommendations according to this Standard during the design and/or redesign process. This is a generic checklist and not every item on the checklist is applicable to every **product** and/or **product** group.

It is recognised that there is a wide range of **products** covered under the scope of this Standard. For this reason it is not possible to provide a unique checklist for every type of **product** or family (group) of **products**. **Designers** should generate a design checklist based on the design requirements of this Standard and through other reference material and technical reports that will accurately reflect their specific **product** or family of **products**.

A.1 Life cycle thinking aspects

A.1.1 The organization has a management system such as an environmental management system in place covering environmental product design aspects.

ISO 14001 Other, please list:

No

A.1.2 The designer has followed those policies/programs.

Yes

No

A.1.3 It has been checked that any emphasis on a single stage of the life cycle of a product does not negatively alter the environmental impacts in other stages.

Yes, describe briefly

No – Please explain why:

A.1.4 The designer has checked with the relevant departments within the organization, which of the following aspects are considered in the environmental policy or programs of the organization:

Extraction/processing of raw materials

Procurement

Manufacturing

Transportation/distribution

Product design

Packaging

Use

Recycling, reuse and final disposal

A.2 General considerations

A.2.1 The designer has identified in cooperation with the responsible departments within the company the latest environmentally related legal and market requirements applicable to the product.

- () Yes
- () No

A.2.2 The significant adverse/beneficial environmental impacts of the product during its life have been identified and analyzed in order to respectively reduce/increase them by alternative design solutions.

- () Yes, describe briefly
- () No

A.2.3 Experiences from the subsequent manufacturing, sales, product usage, maintenance and disposal stages have been considered.

- () Yes
- () No

A.2.4 A benchmarking with the environmental performance of competitor models has been carried out.

- () Yes
- () No

A.2.5 All applicable environmental product information to be made available is provided in an environmental product declaration (for example ECMA-370).

- () Yes
- () No

A.2.6 Certain product environmental characteristics are available.

- () Yes, list sources
 - [] Product specification document
 - [] Manufacturer environmental product declaration
 - [] Product user manual (hard copy)
 - [] Product user manual (soft copy)
 - [] Product labels or packaging
 - [] Product packaging insert
 - [] Internet. Provide URL:
 - [] Other. Describe:
- () No

A.3 Material efficiency

A.3.1 The variety of materials used in the product has been reduced.

Yes, describe briefly

No

A.3.2 The amount of material used in the product has been reduced.

Yes, describe briefly

No

A.3.3 The product contains materials that are considered to have less adverse or more beneficial environmental impact.

Yes, describe briefly

No

A.3.4 The product contains recycled materials (see 6.2).

Yes

No

A.3.5 The product uses renewable materials.

Yes describe briefly

No

A.4 Energy efficiency

A.4.1 Energy modes and related energy efficiency measures.

Energy consumption information is made available in an environmental product declaration, at (URL):

A.4.1.1 Ease of use as related to the selection and operation of energy saving features was considered and implemented.

Yes, considered and implemented; describe briefly:

Yes, considered but not implemented; specify reason(s):

Not applicable

No

A.4.1.2 List specific energy modes that apply to the product:

.....

A.4.1.3 Detail significant energy consumption modules and plans to reduce their energy consumption:

.....

A.4.2 Operational modes

A.4.2.1 Note actions taken to use low power components and design options.

.....
.....

A.4.2.2 Note actions taken to improve the energy efficiency of power supply components.

.....
.....

A.4.2.3 Note actions taken to ensure the AC-DC conversion efficiency is highest in the most used energy mode.

.....
.....

A.4.2.4 Note actions taken to ensure overspecification of items such as the power supply has not taken place.

.....
.....

A.4.2.5 Detail analysis undertaken to ensure operating characteristics, such as room temperature, have not been overspecified.

.....
.....

A.4.3 Energy saving modes

A.4.3.1 Note design actions taken to automatically switch from on mode to energy save modes.

.....
.....

A.4.3.2 Note design actions taken to reduce the time taken for the product to switch from energy save mode to active mode.

.....
.....

A.4.3.3 List actions taken to reduce energy consumption in energy save mode similar to those taken in A.4.3.2 above.

.....
.....

A.4.4 Off modes

A.4.4.1 Note design options taken to automatically switch from energy save mode to off mode.

.....
.....

A.4.4.2 Note design options taken to reduce energy consumption in soft-off mode.

.....

A.4.4.3 Note options considered in the placing of the power switch to make it more user accessible.

.....

A.4.4.4 In hard-off mode, is the energy consumed zero watthours?

- () Yes
- () No. If no, what actions have been taken to inform the user of this?

.....

A.4.5 No load modes

List design options taken to reduce the energy consumption of the no load mode to the lowest possible.

.....

A.4.6 General energy efficiency measures

A.4.6.1 List any energy saving features of this product here that have not been noted elsewhere.

.....

A.4.6.2 Information on energy consumption in all relevant energy modes has been made available to product users.

- () Yes, list sources
 - [] Environmental product declaration
 - [] Product specification document
 - [] Product user manual (hard copy)
 - [] Product user manual (soft copy)
 - [] Product labels or packaging
 - [] Product packaging insert
 - [] Internet. Provide URL
 - [] Other. Describe.

- () Not applicable
- () No

A.4.6.3 Applicable voluntary agreements aimed at improving energy efficiency of products were considered and recommendations met.

- () Yes, considered and recommendations met;
 describe briefly:
- () Yes, considered but recommendations not met;
 specify reason(s):

() Not applicable

() No

A.4.6.4 The product is compliant to the requirements of the international ENERGY STAR® program.

() Yes, according version

() Not applicable

() No; give reason(s) for non-compliance.

.....

A.4.6.5 The effects of improved energy design features have been quantified and communicated to marketing.

() Yes

() No/Not applicable

A.4.6.6 Default setting is set to the most energy efficient on modes and/or transitions to energy save mode.

() Yes

() No

A.4.6.7 Information on proper use of available energy saving controls and/or settings is available to product users.

() Yes, list sources

[] Product user manual (hard copy)

[] Product user manual (soft copy)

[] Product or packaging labels

[] Product packaging insert

[] Internet. Provide URL.

[] Other. Describe.

() Not applicable

() No

A.5 Consumables and batteries

A.5.1 Consumables

A.5.1.1 The avoidance of hazardous substances and preparations in consumables has been considered.

() Yes

() Not applicable (no consumables)

() No

A.5.1.2 The product has been designed such that the use of consumables associated with the product can be optimised relative to the functionality of the product.

() Yes

() Not applicable (no consumables)

() No

A.5.1.3 Information on the proper use of consumables associated with the product has been provided to the user.

- Yes, list sources (all that apply):
 - Environmental product declaration
 - Product user manual (hard copy)
 - Product user manual (soft copy)
 - Product service manual
 - Internet. Provide URL.
 - Other. Describe.
- Not applicable (no consumables)
- No

A.5.2 Batteries

A.5.2.1 All batteries in the product comply with applicable restrictions on hazardous substances and preparations contained in relevant national, regional and international legislation.

- Yes
- Not applicable (no batteries)
- No, rationale:

A.5.2.2 All batteries in the product are labelled according to requirements of relevant regional, national or international legislation.

- Yes
- Not applicable (no batteries)
- No

A.5.2.3 Consideration has been given to batteries with reduced environmental impact.

- Yes; specify type of batteries considered (check all that apply).
 - Li-Ion
 - Li-Polymer
 - NiMH
 - Other; describe
- Not applicable (no batteries)
- No; specify reason(s).....

A.5.2.4 The product has batteries containing materials regarded as detrimental to the environment that cannot be avoided.

- No
- Not applicable (no batteries)
- Yes
 - Identify batteries
.....
 - Where reported
.....

Reason(s) why material(s) cannot be avoided

.....

A.5.2.5 All batteries and assemblies containing those batteries are easily identifiable and removable.

Yes

Not applicable (no batteries)

No; specify reason(s):

Batteries are not intended to be removed until the end of life, or the product needs a continuous power supply.

Other

A.5.2.6 Information on proper procedures for removal and safe handling of batteries is available in product user documentation.

Yes, list sources

Environmental product declaration

Product user manual (hard copy)

Product user manual (soft copy)

Product service manual

Product labels

Internet. Provide URL

Other: describe.

Not applicable (no batteries)

No; give reason(s)

.....

A.5.2.7 For NOT easily removable batteries: Advice on service outlets for exchange of non-removable batteries (during product life) is provided in the product documentation.

Yes

Not applicable (no batteries)

No

A.5.2.8 Information on battery type and location is available in the appropriate product documentation.

Yes

Type of battery

Location

Not applicable (no non-removable batteries)

No

A.5.2.9 Battery management features that help to prolong battery life have been considered and implemented.

Yes, considered and implemented

Yes, considered but not implemented

Not applicable (no batteries)

() No; give reason(s)

A.6 Emissions

A.6.1 Chemical emissions

A.6.1.1 Product has been designed such that chemical emissions are reduced wherever possible.

- () Yes
- () Not applicable
- () No

A.6.1.2 For a product based on the electrostatic process, chemical emissions [ozone and VOC (volatile organic compound)] and dust emissions have been evaluated.

- () Yes
- () Not applicable (**product** is not based on electrostatic process)
- () No

A.6.1.3 For a product based on the electrostatic process, emission rates have been determined in accordance with ISO/IEC 28360.

- () Yes
- () Not applicable (**product** does not consume supplies)
- () No

A.6.2 Noise Emissions

A.6.2.1 Noise emissions have been measured and evaluated according to ISO 7779 (equivalent to an earlier edition of ECMA-74).

- () Yes
- () No
- () Other – describe
- () Not applicable

A.6.2.2 For products outside the scope of ISO 7779, one of the sound power standards, ISO 3741, ISO 3744 or ISO 3745, and the emission sound pressure level standard ISO 11201 have been used to measure and evaluate noise emissions.

- () Yes
- () No
- () Not applicable

A.6.2.3 For all products under the scope of this Standard, declared A-weighted sound power level L_{WAd} and declared A-weighted sound pressure level L_{pAm} are determined and declared in accordance to ISO 9296 (equivalent to ECMA-109).

- () Yes
- () No
- () Not applicable

NOTE

The declared A-weighted sound power level L_{WAd} , according to ISO 9296, is a statistical maximum value to account for **sound power variations between products** and lab-to-lab measured sound power level variations, and L_{WAd} is typically

about 0,3 – 0,4 bels (3 dB – 4 dB) greater than the average A-weighted sound power level L_{WA} , measured according to ISO 7779, ISO 3741, ISO 3744 or ISO 3745. ISO 9296 (or ECMA-109) specifies how to determine and verify L_{WAd} .

A.6.2.4 Declared noise emission values according to ISO 9296 (ECMA-109) are available in the appropriate product documentation.

- Yes
- No
- Not applicable

A.6.2.5 For the declared sound pressure level L_{pAm} values, whether the value is for the operator position or bystander positions is indicated in the appropriate product documentation with the declared levels. Furthermore, if L_{pAm} is measured for the operator position, then the documentation shall indicate whether the unit is table top or floor standing. For products not covered by ISO 7779, the distance used to measure L_{pAm} shall be indicated.

- Yes
- No
- Not applicable

NOTE
The usage of a particular product determines which positions are appropriate. For example, for a personal computer the operator position is always the defined sound pressure level position; similarly for a server, bystander positions are the defined positions.

A.7 Product lifetime

A.7.1 The product contains common mechanical packages (such as covers and chassis) or common parts or components that are used for multiple models in the product family or in multiple generations of the same product.

- Yes, describe.
- Not applicable
- No

A.7.2 The product contains standardised parts.

- Yes, list
- No
- Not applicable

A.7.3 The product contains modular components.

- Yes, list
- Not applicable
- No

A.7.4 The product contains reused components and/or parts.

- Yes, list
- Not applicable
- No

A.7.5 The product contains parts targeted for reuse in maintenance and spare parts applications.

- Yes, list
- Not applicable
- No

A.8 End of life

A.8.1 Separation of parts containing hazardous substances and preparations is possible.

- Yes
- No
- Not applicable

A.8.2 Incompatible materials (including electronic modules) connected to case/housing parts or chassis are easily separable.

- Yes
- No
- Not applicable

A.8.3 The product can be disassembled down to the module level using commonly available tools.

- Yes
- No, list all special tools required for disassembly.

.....

A.8.4 All plastic parts weighing 25 g or more and with a flat area of 200 mm² or more are marked with the type of polymer, copolymer, polymer blends or alloys in conformance with ISO 11469.

- Yes
- No
- Not applicable

A.8.5 The following design choices have been avoided.

- Incompatible non-recyclable composites and coatings on major plastic parts
- Coatings and surface finishes on plastic parts that are difficult to recycle without downgrading
- Adhesive backed stickers or foams on plastic parts; if stickers are required they should be separable
- Metal inserts in plastic parts, which are not easily removable with common tools

A.8.6 The following aspects have been considered and their number and variety reduced.

- Welds and adhesives
- Connections (for example, fasteners and screws)
- Steps necessary for disassembly
- Tools required for disassembly
- Position changes that have to be made by the dismantler

A.8.7 The treatment information for the product includes guidance regarding the following aspects:

- Identification of potentially valuable and/or reusable parts
- Identification of parts containing hazardous substances and preparations
- Special handling and disposal precautions
- Plan for the disassembly of the product into major modules or subassemblies

A.9 Hazardous substances and preparations

A.9.1 Content in products (refer to Annex D for regulation examples)

A.9.1.1 The product complies with the applicable international, regional and national prohibitions on the use of certain hazardous substances and preparations.

- Yes, list
- Not applicable
- No

A.9.1.2 Use of substances that require special handling or disposal during the recycling process has been reduced or eliminated.

- Yes, eliminated
- Yes, reduced; list
- Not applicable
- No

A.9.1.3 Appropriate information on parts requiring special handling or disposal has been made available to users and recyclers.

- Yes
- No
- Not applicable

A.9.1.4 Hazardous substances other than those restricted are used in this product.

- Yes – List the substances and give rationale for their use
.....
.....
.....
.....
- No

A.10 Packaging

A.10.1 The variety of packaging materials used has been reduced.

- Yes, describe briefly
- No

A.10.2 The amount of packaging materials used has been reduced.

- Yes, describe briefly

No

A.10.3 The used packaging materials are considered to have lower environmental impact.

Yes, describe briefly

No

A.10.4 The packaging was manufactured using recycled materials.

Yes

No

A.10.5 The packaging was manufactured using renewable materials.

Yes describe briefly

No

A.10.6 The packaging complies with the applicable international, regional and national regulations.

Yes, list

No

A.10.7 The packaging materials have an appropriate marking.

Yes, list applied standard

.....

No

Annex B (informative)

Bibliography

- [1] IEC 60050-826:2004, International Electrotechnical Vocabulary – Part 826: Electrical installations
- [2] IEC 60065, Audio, video and similar electronic apparatus – Safety requirements
- [3] IEC 60950-1, Information technology equipment – Safety – Part 1: General requirements
- [4] IEC 62368, Audio/video, information and communication technology equipment – Safety requirements (under development)¹
- [5] EN 13427, Packaging – Requirements for the use of European Standards in the field of packaging and packaging waste
- [6] ECMA-74, Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment
- [7] ECMA-109, Measurement of High-Frequency Noise Emitted by Information Technology and Telecommunications Equipment
- [8] ECMA-341, Environmental design considerations for electronic products
- [9] ECMA-370:2006, TED – THE ECO DECLARATION
- [10] SAECHTLING, H. Kunststoffaschenbuch, Carl Hanser Verlag, München, 1998 (27 edition)
- [11] IEC Guide 109:2003, Environmental aspects – Inclusion in electrotechnical product standards
- [12] IEC Guide 114, Environmentally conscious design – Integrating environmental aspects into design and development of electrotechnical products
- [13] ISO 14001:2004, Environmental management systems - Requirements with guidance for use
- [14] ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework
- [15] ISO 14050, Environmental management – Vocabulary
- [16] ISO/TR 14062, Environmental management – Integrating environmental aspects into product design and development

¹) In preparation.



Annex C (informative)

Polymers compatibility guide

Designers should verify identified compatibilities and recheck them with the polymer vendors, see Table C.1 for examples. The listed polymers have many different characteristics depending on the used additives that need a thorough analysis of the suggested compatibility on the material level, especially when they are not marked to be compatible. Therefore, further analysis may be necessary.

Abbreviations used in the table:

ABS	Acrylonitrile-butadiene-styrene
ASA	Acrylonitrile-styrene-acrylate
PA	Polyamide
PBT	Poly (butylene terephthalate)
PC	Polycarbonate
PE	Polyethylene
PET	Poly (ethylene terephthalate)
PMMA	Poly (methyl methacrylate)
POM	Poly (oxymethylene)
PP	Polypropylene
PPE	Poly (phenylene ether)
PS	Polystyrene
PVC	Poly (vinyl chloride)
SAN	Styrene-acrylonitrile
TPU	Thermoplastic polyurethane

NOTE

In Table C.1, the proposed or identified thermoplastics do not take into account all the compounds and reinforcements, charges and other protection substances or technical features improvements

Legend for the table C.1

+	Good compatibility over a wide range of mixtures
□	Limited compatibility for small excess component amounts
■	Incompatible

Table C.1 – Example of compatibility of various thermoplastics²

		Excess component																		
		ABS	ASA	PA	PBT	PBT+PC	PC	PC+ABS	PC+PBT	PE	PET	PMMA	POM	PP	PPE	PPE+PS	PS	PVC	SAN	TPU
Mixture component	ABS	+	+	@	+	+	+	+	+	@	@	+	@	@	@	@	@	+	+	+
	ASA	+	+	@	+	+	+	+	+	@	@	+	@	@	@	@	@	+	+	+
	PA	@	@	+	@	@				@	@	@	@	@		@	@		@	+
	PBT	+	+	@	+	+	+	+	+	@	@	@	@	@	@	@	@		+	@
	PBT+PC	+	+	@	+	+	+	+	+	@	@	@		@	@	@	@		+	+
	PC	+	+		+	+	+	+	+	@	+	+		@	@	@	@		+	@
	PC+ABS	+	+	@	+	+	+	+	+	@	+	+	@	@	@	@	@		+	+
	PC+PBT	+	+		+	+	+	+	+	@	+	+	@	@	@	@	@		+	+
	PE			@			@			+				+		@		@		@
	PET	+	+	@	+	+	+	+	+	@	+	@	@	@	@	@	@	@	@	@
	PMMA	+	+	@			+	+	+	@	@	+	@	@	@	@	@	@	@	@
	POM	@	@	@	@	@				@	@		+	@	@	@	@	@	@	@
	PP			@						@				+		@		@		@
	PPE	@	@	@	@	@	@	@	@	@	@	@	@	@	+	+	+		@	@
	PPE+PS	@	@	+	@	@	@	@	@	@	@	@	@	@	+	+	+		@	@
	PS	@	@	@	@	@	@	@	@	@	@	@	@	@	@	+	+	@	@	@
	PVC	+	+							@		+	+	@		@	@	+	+	+
	SAN	+	+	@	+	+	+	+	+	@	@	+	@	@	@	@	@	+	+	@
	TPU	+	+	+		+	+	+	+	@	+	+	+	@	@	@	@	+	+	+

²) Table C.1 was adapted from Table 5.3, page 632 of H. Saechtling, *Kunststoffaschenbuch*, Carl Hanser Verlag, München, 1998 (27th edition).

Annex D (informative)

Examples of regulations

D.1 Government environmental agency URLs

Many regulations exist which relate to aspects of environmentally conscious design. This annex is an incomplete list of URLs (see Table D.1) where designers may find some regional regulations. Clauses D.1 - D.6 point to further legislation as a reference and example. The reader is encouraged to verify the latest status of any amendments that may exist to the mentioned regulations.

NOTE

Since regional regulations are emerging and being modified on a constant basis, this Standard cannot provide more complete and accurate information.

Table D.1 – Government environmental agency URLs

Region	URL
Argentina	http://www.msal.gov.ar (in Spanish)
Australia	http://www.deh.gov.au
Brazil	http://www.mma.gov.br/port/CONAMA (in Portuguese)
Canada	http://www.ec.gc.ca
China	http://english.sepa.gov.cn/
Chile	http://www.conama.cl (in Spanish)
Columbia	http://www.minambiente.gov.co (in Spanish)
Costa Rica	http://www.minae.go.cr/ (in Spanish)
European Union (EU)	http://eur-lex.europa.eu
Hong Kong	http://www.info.gov.hk/epd
Japan	http://www.env.go.jp/en/
Malaysia	http://www.doe.gov.my/
Mexico	http://www.conae.gob.mx/ (in Spanish)
Singapore	http://www.mewr.gov.sg
South Korea	http://www.me.go.kr/ (see English entry)
Taiwan	http://www.epa.gov.tw/english/
USA	http://www.epa.gov

D.2 Example of regulations for energy efficiency

- Energy Using Products (EuP) Directive (2005/32/EC) is a framework for setting the rules for eco-design in the EU, and will cover electrical and electronic devices and heating equipment.

NOTE

There are also voluntary requirements for energy efficiency, such as US EPA Energy Star. These should not be confused with regulatory requirements, but may also be considered in product design.

D.3 Examples of regulations for batteries

- EU Directive 91/157/EEC defines for example limits on heavy metal content related to mercury, cadmium and lead and the types of batteries covered. Detailed requirements for marking are contained in Directive 93/86/EEC.
- USA Mercury-Containing and Rechargeable Battery Management Act. Pub. L. No. 104-142. (1996) which was intended to facilitate the recycling or proper disposal of rechargeable batteries.

D.4 Example of regulations for hazardous substances and preparations

- Lead, cadmium, mercury, hexavalent chromium, PBDE and PBB as defined in Directive [2002/95/EC] (commonly named RoHS directive) and its amendments.
- Asbestos [US TSCA and NESHAP, EU 76/769/EEC]
- Ozone Depleting Substances (according to Montreal Protocol): Chlorofluorocarbons (CFC), Hydrobromofluorocarbons (HBFC), Hydrochlorofluorocarbons (HCFC), Halons, carbontetrachloride, 1,1,1-trichloroethane, bromochloromethane [EU: Regulation (EC) No. 2037/2000, 2038/2000, 2039/2000];
- Nickel for articles coming into direct and prolonged contact with skin [EU 76/769/EEC]

D.5 Example of regulations for end of life treatment

- EU Directive 2002/96/EC commonly named WEEE directive [2002/96/EC]

D.6 Examples of regulations for product packaging

- EU - EU Directive 94/62/EEC requiring that the sum of the concentrations of lead, cadmium, mercury, chromium-VI does not exceed 100 ppm by weight. For **products** placed on the market in the European Union the packaging essential requirements as defined in the standards [EN 13427 – EN 13432] shall be applied.
- South Korea - 'Act on the Promotion of Saving and Recycling Resources' covers the labelling and **recycling** of **product** packaging.
- USA – California's Rigid Plastic Packaging Container ("RPPC") Law requires packaging to meet one of four **reuse, recycling** or reduction criteria. California's Toxics in Packaging Prevention Act (A.B. 455) prohibits packaging which contains intentionally introduced cadmium, hexavalent chromium, lead, or mercury.