भारतीय मानक
Indian Standard

IS 16584 : 2017
IEC/TR 62635 : 2012

निर्माताओं और पुनर्नवीनीकर्ताओं द्वारा इलेक्ट्रिकल और इलेक्ट्रॉनिक उपकरणों की जीवन अवधि की सूचना और पुनर्नवीनीकरण दर की गणना के लिए दिशा निर्देश

Guidelines for End-of-Life Information Provided by Manufacturers and Recyclers and for Recyclability Rate Calculation of Electrical and Electronic Equipment

ICS 13.020.30; 31.020

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NATIONAL FOREWORD

This Indian Standard which is identical with IEC/TR 62635 : 2012 'Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Standardization of Environmental Aspects of Electrical and Electronics Products Sectional Committee and approval of the Electrotechnical Division Council.

The text of IEC Technical report has been approved as suitable for publication as an Indian Standard without deviations. Certain terminology and conventions, are however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' or 'TR' appears referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

The technical committee has reviewed the provisions of the following International Standard referred in this adopted standard and has decided that it is acceptable for use in conjunction with this standard:

International Standard	*Title*
IEC 62474	Material declaration for products of and for the electrotechnical industry

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding of numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GUIDELINES FOR END-OF-LIFE INFORMATION PROVIDED BY MANUFACTURERS AND RECYCLERS AND FOR RECYCLABILITY RATE CALCULATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT

1 Scope

IEC/TR 62635, which is a technical report, provides a methodology for information exchange involving EEE manufacturers and recyclers, and for calculating the recyclability and recoverability rates to

- provide information to recyclers to enable appropriate and optimized EoL treatment operations,
- provide sufficient information to characterize activities at EoL treatment facilities in order to enable manufacturers to implement effective ECD,
- evaluate the recyclability and recoverability rates based on product attributes and reflecting real end-of-life practices.

Furthermore this technical report includes:

- criteria to describe EoL treatment scenarios;
- criteria to determine product parts that might require removal before material separation and related information to be provided by manufacturers (location and material composition);
- a format for information describing EoL scenarios and the results of EoL treatment activities;
- a method for calculating the recyclability and recoverability rate of EEE. The calculation is limited to EoL treatment and does not cover collection. The recyclability rate is expressed as a percentage of the mass of the product that can be recycled or reused, whereas the recoverability rate in addition includes a portion derived from energy recovery. This techncial report can be applied to all electrical and electronic equipment;
- some example data corresponding to identified scenarios provided in Annex D.

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.

IEC 62474, *Material declaration for products of and for the electrotechnical industry*

3 Terms and definitions

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

NOTE The following definitions are harmonized with the glossary of terms currently under development by TC 111 as future IEC/TR 62542 [3].

3.1
disposal
any operation which is not recovery even where this operation has a reclamation of substances or energy secondary consequences

3.2
end-of-life
EoL
life cycle stage of a product starting when it is removed from its intended use-stage

[SOURCE: IEC 62075:2008 [4], definition 3.4, modified]

3.3
end-of-life treatment
any operation after a waste has been handed over to a facility for product and product part reuse, material recycling, energy recovery and residue disposal

3.4
end-of-life treatment scenario
description of an end-of-life treatment process and corresponding recycling rates of product parts and materials

3.5
energy recovery
production of useful energy through direct and controlled combustion or other processing of waste

Note 1 to entry: Waste incinerators producing hot water, steam and/or electricity are a common form of energy recovery.

3.6
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

3.7
material recovery
material-processing operations including mechanical recycling, feedstock (chemical) recycling and organic recycling, but excluding energy recovery

[SOURCE: ISO 15270:2008 [5]]

3.8
material separation
operation to separate materials, including mechanical, chemical or thermal process (e.g. shredding, smelting, sorting , etc.) other than dismantling

Note 1 to entry: Reuse in the context of this technical report does not include second-hand sales.

3.9
recovery
any operation by which waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfill a particular function, or waste being prepared to fulfill that function, in the plant or in the wider economy

3.10
recovery rate
ratio of recovered products, product parts or materials mass to waste product mass reprocessed

3.11
recoverability
ability of a waste product to be recovered, based on actual practices

3.12
recoverability rate
ratio of recoverable products, product parts, materials mass to total waste product mass reprocessed

3.13
recyclability
ability of waste product to be recycled, based on actual practices

3.14
recyclability rate
ratio of recyclable product mass to total product mass

3.15
recycler
organization with the facility to carry out recycling and/or recovery operations

3.16
recycling
any operation by which waste products are reprocessed into products, product parts, materials or substances whether for the original or other purposes

Note 1 to entry: It includes the reuse, the reprocessing of material but does not include the energy recovery and reprocessing into materials that are to be used as fuels or for back-filling operations.

3.17
recycling rate
ratio of recycled products, product parts or materials mass to waste product mass reprocessed

Note 1 to entry: A recycling rate is obtained by computing data obtained from recycling operations.

3.18

reuse
operation by which a product, or a part thereof, having reached the end of one use-stage is used again for the same purpose for which it was conceived

3.19
total product mass
waste product mass reference which is inputted to the end-of-life treatment process

Note 1 to entry: Total product mass is used for recyclability/recoverability rate calculation.

3.20
waste
any material or object which the holder discards or intends or is required to discard

4 End-of-life treatment process principles

In general, EoL treatment needs to comply with applicable regulations, observe relevant industry practices and allow efficient recycling and recovery, while at the same time addressing safety and environmental concerns.

Figure 1 provides a synthesis of the main definition covering end-of-life treatment

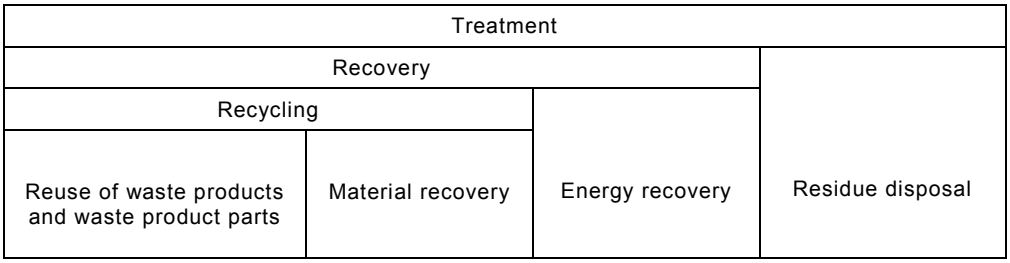

Figure 1 – Framework of the main definition covering end-of-life treatment

EoL treatment generally presents four phases:

a) **pre-treatment**: pre-treatment usually includes operations to mitigate hazards and dismantling parts for selective treatment. Parts are dismantled when there is a possibility for reuse, or they require selective treatment (e.g. regulations applicable to the recycling facility or contractual agreement), where this would allow a better end-of-life treatment efficiency;

b) **material separation**: several techniques may be used, such as mechanical separation (e.g. shredding), chemical separation or thermal separation (smelting), with appropriate sorting processes;

c) **energy recovery**: after these operations, the remaining and unsorted material may then be considered for energy recovery;

d) **disposal**: residues are then disposed in appropriate landfills.

The generic steps of EoL treatment used in this technical report are described in Figure 2, with each part or material flow having its own recycling rate. It is noted that the generic treatment process described in Figure 2 is one of many potential scenarios, while it is intended to be as generic as possible. Actual recycling processes may add additional processes, include or exclude portions of the generic process presented here.

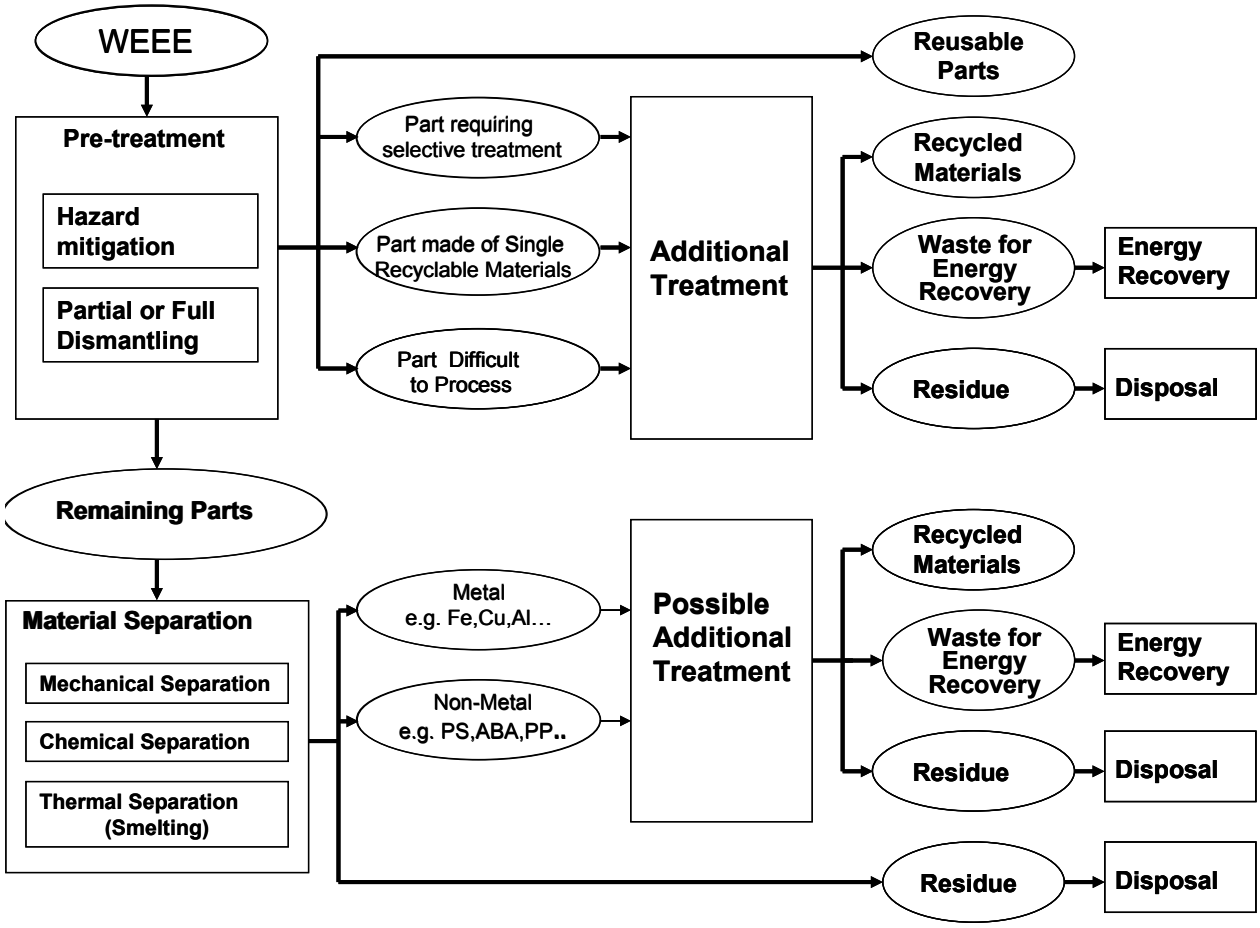

Figure 2 – End-of-life treatment generic scheme

The provision of product information may be helpful to recyclers when implementing treatment that respects environmental and safety requirements and optimizes parts and material recovery. Criteria to describe these parts are based on their characteristics and existence of dedicated EoL processing channels. These criteria are detailed in 5.4 along with related information to document the characteristics of the parts.

The provision of EoL treatment information, including recycling rates of the different materials, allows a recyclability and recoverability rate calculation which is based on the principle of Figure 2 and EoL treatment scenario which describes the processes at a recycling facility. Thus, it enables improvements in product design with regards to recyclability aspects. Feedback information exchange is essential when setting up a dedicated EoL channel. Criteria for treatment process identification are given in 6.2 and related information that describes the treatment processes is given in 6.4

5 Provision of product information

5.1 General

Provision of product information provides a method for manufacturers or other product suppliers to make EoL product information available to relevant stakeholders. Information can be provided on paper or in electronic form. Where a direct information transfer cannot be guaranteed, an electronic form can be made available on a website.

Details of information are given in 5.2 to 5.4.

The format given in Annex B should be used preferably for information from the manufacturer. Sketches, drawings or pictures are recommended to ease the interpretation.

5.2 Product identification

Product identification should contain:

a) manufacturer identification and contact details;

b) name, model or type of product;

c) total product mass – when relevant, the manufacturer should indicate which accessories or consumables are included in the mass. Dimensions may also be indicated;

d) date of information release – it is recommended to include a revision history;

e) product characteristics that may lead to special transportation requirements.

5.3 Indentification of potential hazards

Manufacturers should provide information which identifies the sources of potential hazards to recycling or recovery personnel. Examples include but are not limited to batteries, power capacitors, springs, high pressure fluids or gasses.

5.4 Parts identification for dismantling

5.4.1 General

The manufacturer should provide the identification of parts that may not be readily identified by recyclers and for which dismantling is recommended, so that recyclers can perform optimized EoL operations in compliance with regulations local to the recycling facility or required by contractual agreement.

This information is also used to calculate recyclability and recoverability rates of the product as described in Clause 7.

Guidelines for defining these parts for dismantling and based on EoL current practices are given in 5.4.2 to 5.4.4. It is assumed that further part dismantling would not improve EoL treatment safety or efficiency and that remaining parts can be processed as a whole in any mechanical, chemical, thermal or other means to separate recyclable materials.

For each part that requires removal, the following information should be declared based on the need of recyclers:

- identification of the part;
- purpose for dismantling;
- location;
- part mass.

It is recommended to provide information concerning the dismantling procedure (dismantling steps, tool(s), etc).

For the remaining parts, a material content description should be provided according to IEC 62474, the material declaration standard, using the relevant material classes.

This product description is also used in the recyclability and recoverability rates calculation as described in Clause 7.

5.4.2 Condition for part reuse

Reuse of parts often gives maximum environmental benefits. When a stable reuse system is in place and a market exists, reuse becomes economically viable. If such a system exists,

manufacturers should identify it in product documents or on websites so recyclers not directly in the system can direct parts accordingly.

A manufacturer is entitled to identify parts as reusable in a scenario for recovery rate calculations when the following two conditions are fulfilled:

a) it is possible to separate the part from the product while maintaining the part or component's functional integrity. In practice, this implies the product design allows accessibility and that binding systems are reversible;
b) the manufacturer can provide evidence that a commercial reuse and refurbishment system has been established for that part that takes into consideration regulation and market expectations. This can take the form of contracts with commercial partners, availability of refurbished parts in the marketplace or other evidence that there is an established system.

5.4.3 Condition for parts that required selective treatment to mitigate environmental hazards (de-pollution)

Manufacturers should provide information which identifies parts that present potential hazards to the environment. For these parts, there are generally legal requirements that impose dismantling and separate treatment. If needed, manufacturers should indicate which operations should be carried out before further product dismantling and treatment. This will assist recyclers to take the appropriate measures to prevent potential hazards or, at a minimum, mitigate it before further dismantling or material separation operations.

A few examples are the removal of

– batteries by EU WEEE and implementing legislation for each country,
– polychlorinated biphenyls (PCB) often contained within old capacitors – see Council Directive 96/59/EC [6]
– refrigerants as required by international agreements and implemented by individual countries (see USA Clean Air Act as an example).

Annex A provides a list of product parts and materials that potentially should be dismantled. This list is dependent on the jurisdiction in which the recycling facility resides.

It is important that the source of the requirement is communicated as well as the possible treatment required if such information is known to the manufacturer.

5.4.4 Condition for parts made of single recyclable materials

A manufacturer may choose to identify these parts based on recycler feedback. When a part of the product is made from a single recyclable material, dismantling of this part can be beneficial. A single part made from one material is well suited for end-of-life treatment without further processing. Recycling rates for this class of parts are typically high, see Annex D.

A manufacturer is entitled to identify parts as single recyclable in a scenario for recovery rate calculations when the following two conditions are fulfilled:

a) the size of the part and nature of material is such that there is an economical interest for dismantling. Due to the variety of end-of-life treatment practices, it is left to the manufacturer to identify components or parts that may lead to improved recovery;
b) there is a specific EoL channel for these materials with higher recycling rates compared to the results obtained after material separation.

The manufacturer should identify to the recycler these parts and the single recyclable material they are made of to facilitate effective recovery or recycling.

5.4.5 Condition for parts difficult to process

Some parts may require specific treatment to optimize end-of-life treatment operations. This may be due to the physical characteristics of the part that generally are too large for the capacity of a shredder or are incompatible with the material sorting process at a particular facility even after size reduction. Examples of parts that may require removal are castings, wire or cable and refrigerator motors. Metal parts that are difficult to process through size reduction and certain plastics are often included in this category.

The manufacturer should identify to the recycler such parts, provide dismantling instructions and use scenario feedback from recyclers when calculating the recyclability and recoverability rates.

6 Provision for end-of-life treatment information

6.1 General

Because of the wide variety of material separation methods, a recycler may wish to provide a manufacturer with detailed information on its process capability.

Clause 6 concerns information on the methods used by the recycler and facility specific requirements for processing of EEE for EoL treatment. It includes any process that sorts materials by density, electrical characteristics, magnetic, eddy current, spectrometry or other methods based on one or more material properties. This also includes separation by human pickers or sorters.

In particular, the recycler should bring suggestions regarding product design to the attention of the manufacturers for consideration during product design and in the calculation of the product recoverability and recyclability rates. In particular, a recycler should identify what parts need to be dismantled and recovered or recycled in specific channels. This is, for instance, when material, or a part, cannot be sorted out on line (e.g. plastics containing substances of concern) or presenting characteristics outside the treatment process capabilities, or presenting environmental or safety risks.

In general, information should be provided so that the extent of separation and disposition of parts and materials can be determined and used in the calculation of recyclability and recoverability rates.

Recyclers should identify critical issues affecting material separation such as difficulty to shred, material mixing incompatibility impairing recycling performances or dismantling costs. This aids the manufacturer in obtaining feedback on the practicality, feasibility and any issues with EoL treatment.

In addition, recyclers should indicate to manufacturers which product information is needed to optimize recycling and recovery processes, and to ensure adequate treatment.

Recyclers should also indicate to the manufacturers the materials, parts or components that are dismantled. For these instances, the recycling rate should be also indicated. The numbers reported should reflect the actual performance of the system employed by the recycler and not the theoretical capability of the equipment installed. They may vary according to the system employed by the recyclers at a given place.

The information from recyclers may be detailed when a particular product is treated in a dedicated stream. An average recycling rate may be given when the product is processed in a mixed stream, or when a generic EoL treatment process is referred to, as appropriate.

Recyclers may be required to obtain information from downstream recyclers or treatment providers.

Then, upon request, waste treatment information should be made available to the manufacturer of the products, as described in 6.2 to 6.4

A framework of information from recyclers is given in Annex C.

Information can be provided on paper or by electronic form.

6.2 End-of-life process identification

A lead page describing the contact data and a description of the EoL treatment process (general diagram and techniques, or generic EoL treatment process category) should be provided by the recycler.

It should contain:

- company name and address;
- contact name and email address;
- generic process diagram;
- covered product categories;
- date of release.

6.3 Measures for pollution prevention

Recyclers should provide the manufacturer with information on implementation of pollution prevention measures in compliance with legal and any specific requirements from the manufacturer.

In addition, recyclers should inform manufacturers of any difficulties they have experienced or they may face in pollution prevention.

6.4 EoL scenario information

6.4.1 General

The provision of information by recyclers about their process, in particular concerning dismantling operations and recycling or recovery rates achieved, assists manufacturers to assess the recyclability rates of their products and improve their designs with regards to EoL treatment. This ultimately has a greater environmental and societal benefit.

Elements of the EoL process to be documented are given in 6.4.2 to 6.4.6. It should be noted that this technical report covers the methodology to calculate recyclability and recoverability rate but does not stipulate that recyclers' proprietary information should be disclosed.

6.4.2 Reuse system documentation and data

The recycler should provide documentation that a commercial reuse and refurbishment system has been established for that part/component. Evidence of such a system can take the form of contracts with commercial partners, availability of refurbished parts in the marketplace, or other evidence that there is an established system. Documentation of the statistics on the rate of reuse of parts from EoL treatment should also be included either in the form of sales numbers as a percentage of incoming parts or third party industry wide surveys.

6.4.3 Recovery of single recyclable materials documentation and data

For product parts made of single recyclable materials, recycler specification should include:

- material description;

- minimum purity (acceptable contaminants);
- size and/or mass;
- material recycling rate and/or energy recovery rate when appropriate.

Documentation should consist of a statement of results for the recovery/recycling process. The material recycler may need to consult with the purchaser of the material after removal/disassembly from the product to obtain the information on the actual recovered material rate. In that case, a statement from the final processor of the material stating the recycling and recovery rates should be included.

6.4.4 Requirements for part difficult to process

For product parts affecting material separation or requiring special EoL process, recycler specifications should include:

- product part description or characteristics;
- reason for requirement;
- materials recovered during processing of these parts;
- recycling rate and/or energy recovery rate when appropriate.

Documentation should consist of a statement of results from the final end-of-life treatment of the removed parts/components. The material recycler may need to consult with the purchaser of the material after removal/disassembly from the product to obtain the information on the actual recovered material rate. If that is the case, a statement from the final processor of the material stating the recycling and recovery rates should be included.

6.4.5 Material separation effectiveness documentation and data

Documentation should consist of the input and output statistics for the reporting facility using the reported process and products.

Documentation should include the input material mix or product, the recovered material streams and the recycling and recovery rates for each stream.

6.4.6 Disposal documentation and data

Recyclers supplying data for final disposal should have validated records from the processor that states the method and final disposal of the removed components. If specific material recovery rates are also being reported, evidence that the processor actually recovered materials at that rate should also be included.

7 Calculation method for recyclability and recoverability rate

7.1 General

There are two main elements which influence recycling rates and recovery rates of EEE in EoL treatment:

a) the design characteristics of the product such as the structure, material composition, size,weight, ability of part dismantling, etc. (see Clause 5).

b) the characteristics and performances of the EoL treatment process (see Clause 6).

Each series of EoL processes may be then described with a scenario that provides these characteristics for the system as a whole.

To calculate the recyclability rate and recoverability rate of EEE, the general principles are applied as below, based on the scheme in Figure 2:

(1) selection of an EoL treatment scenario:

Generally the manufacturer has limited control or influence over EoL treatment of a product. However, the designer may need to choose the end-of-life treatment scenario that will be used in the calculation.

(2) apply data corresponding to the selected scenario and relevant product information.

NOTE A generic EoL treatment scenario may be used for the estimation of EoL treatment and recovery rates when information on the specific EoL treatment scenarios is not available. Manufacturers can use also their own data for the calculation. Upon request, they should provide documentation of the recycling method and applicability to the product.

7.2 End-of-life treatment scenario selection

An EoL treatment scenario is a description of an EoL treatment process and the corresponding recycling rates and recovery rates of product parts and materials. This should reflect typical current EoL treatment practices.

These elements depend on the local infrastructure for EoL treatment, markets for recycled materials, and the type, technology and efficiency of an EoL treatment operation. These elements can vary significantly when the market value of recycled materials and EoL treatment infrastructure are changed.

The manufacturer can use representative data such as data from a public sources or industry association for the calculation of the recyclability rate for a specified region and product group, The selected scenario should be as far as possible appropriate for the category and market of the product studied.

An end-of-life treatment scenario should include following information:

- specific EoL treatment flow including dismantling;
- recycling and recovery rates of each product part and material.

Annex D shows examples of EoL treatment scenarios.These examples are from specific regions but can be used as representative data where appropriate.

7.3 Calculation of recyclability and recoverability rate

7.3.1 Variables and their symbols

Table 1 describes the symbols of the mass variables used in calculating the recyclability and recoverability rates.

Table 1 – Masses – Symbols and definitions

Symbol	Definition
$m_{(i)}$	Mass of i^{th} part
$RCR_{(i)}$	Recycling rate of the i^{th} part in the corresponding end-of-life treatment scenario
$RVR_{(i)}$	Recovery rate of the i^{th} part in the corresponding end-of-life treatment scenario
R_{cyc}	Recyclability rate
R_{cov}	Recoverability rate
m_{EEE}	Total product mass
NOTE All masses should be expressed in the same unit.	

7.3.2 Recyclability rate

Recyclability rate, R_{cyc}, of the product, as a percentage by mass (mass fraction in per cent), is calculated using the formula:

$$R_{cyc} = \frac{\text{Sum of recyclable masses of each parts}}{\text{Total product mass}} \times 100\ \%$$

$$= \frac{\sum (m_{(i)} \times RCR_{(i)})}{m_{EEE}} \times 100\ \%$$

7.3.3 Recoverability rate

Recoverability rate, R_{cov}, of the product, as a percentage by mass (mass fraction in percent), is calculated using the formula:

$$R_{cov} = \frac{\text{Sum of recoverable masses of each parts}}{\text{Total product mass}} \times 100\ \%$$

$$= \frac{\sum (m_{(i)} \times RVR_{(i)})}{m_{EEE}} \times 100\ \%$$

7.3.4 Calculation flow

Recyclability rate and recoverability rate can be conducted through the following calculation flow:

a) select a scenario for the calculation;

b) prepare data of the product specified; this would include a description of the parts and materials in terms of their masses;

NOTE For this purpose IEC 62474 may be used.

c) identify parts for dismantling, their mass and corresponding recycling rate and recovery rate by using EoL treatment scenario:
   - reusable product parts (see 5.4.2);
   - parts for selective treatment (see 5.4;3);
   - parts with single recyclable material and easy to dismantle (see 5.4.4);
   - parts difficult to process (see 5.4.5);

d) identify in the remaining parts the mass of recyclable materials through material separation (see 5.4.1);

e) select the corresponding recycling rate and recovery rate by using end-of-life treatment scenario (see 7.2);

f) calculate recyclability/recoverability rate of the product (see 7.3.2).

7.4 Recyclability and recoverability rate communication

When a manufacturer communicates information of recyclability or recoverability rate, he should provide identification of the product reference and of the EoL scenario used.

The manufacturer should make available the corresponding product information as described in Clause 5 and the EoL scenario information as described in Clause 6.

Annex A
(informative)

Indicative list of materials or parts to be identified for selective treatment

In order to ensure that waste treatment does not harm people's health or the environment, in particular water, air or soil, wildlife and flora, it is required usually by regulation to take apart and direct some components or product parts into specific treatment channels.

The following indicative list gives items commonly covered by legislation:

– parts containing polychlorinated biphenyls (PCB);
– batteries;
– printed circuit boards if larger than 10 cm^2;
– toner cartridges, liquid and pasty, as well as color toner;
– plastic containing regulated flame retardants;
– parts containing asbestos;
– cathode ray tubes (CRTs);
– chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or hydrofluorocarbons (HFC), fluid hydrocarbons (HC);
– gas discharge lamps;
– liquid crystal displays (together with their casing where appropriate) of a surface greater than 100 cm^2 and all those back-lighted with gas discharge lamps;
– external electric cables;
– components containing refractory ceramic fibres;
– components containing radioactive substances;
– electrolyte capacitors containing substances of concern (height $>$ 25 mm, diameter $>$ 25 mm or proportionately similar volume).

Annex B
(informative)

Example format for manufacturer product end-of-life information

B.1 Example

Producer/ manufacturer identification (5.2)	Name company:	
	Website link	
	Address / email:	

Product identification (5.2)	Name of product, product family, model, etc :	
	Reference	

Sketches, drawings or pictures of product/ product family

Indication of size (dimension or mass)

Information for end-of-life treatment	**Items:**	**Location**
Potential hazards identification (5.3)		
Reusable parts (5.4.2)		
Selective treatment (5.4.3)		
Single recyclable material parts (5.4.4)		
Parts difficult to process (5.4.5)		

Sketches, drawings or pictures to identify and locate parts and material listed

Document reference number	Date of publication:

Annex C
(informative)

Framework of information from recyclers

C.1 General

When a manufacturer refers to a specific EoL channel (e.g. for reuse of single material part), it should provide documentation that a commercial reuse or EoL treatment system has been established for that part. This information should be based upon recyclers' declarations.

At a minimum, a communication of information about treatment of these parts should contain the following: part description, commercial reuse or EoL treatment system, commercial partners, percentage of part effectively reused or material effectively recycled.

Documentation of the statistics on the rate of reuse of parts should be in the form of sales numbers as a percentage of incoming parts for end-of-life treatment or third party industry wide surveys. Only the fraction of the parts actually resold should be counted as having been recycled by reuse.

NOTE In some national EoL treatment cases, 100 % of the part mass should be reported as recycled content, regardless of the actual reused portion.

C.2 Recycler information

Company name:		Date:	
Company address:			
Contact name:		Contact Email:	

C.3 Process description

Process diagram – Treatment methods – Products covered

C.4 Process capability for material separation

C.4.1 Product parts affecting treatment capabilities or requiring specific treatment

Product part description	Reason for restriction	Restriction criteria	Materials recycled/recovered	Recycling/recovery rate

C.4.2 Single material product parts

Material description	Minimum durity (acceptable contaminants)	Size restrictions	Materials recycled/ recovered	Recycling/recovery rate

C.4.3 Material separation effectiveness

Product or material mix	Recovered material	Recovery rate

C.5 Pollution prevention

Annex D
(informative)

Examples of treatment scenarios

D.1 General

Each region, nation or enterprise may conduct the calculation for some specific purposes, as necessary, according to the data available internally. In many cases, the data itself are deemed to be a certain level of proprietary particularly for the enterprises and cannot be disclosed. Annex D provides scenario recycling and recovery rates that correspond to some current practices. For each scenario, the scope of operations is covered, the date of the survey, and the source of information, etc. is given.

Scenarios can be used for the calculation of recyclability and recoverability rates of a product using the calculation method stipulated in this technical report. Therefore, it is suggested that a person who conducts the calculation according to this technical report always takes into account the appropriateness of the data available and whether or not it should be used for the purpose of this report.

The recycling industry is a continually evolving industry; hence, it is recommended to use the most recent and appropriate scenarios when calculating recyclability or recoverability rates.

D.2 Example 1: KEA scenario for large household appliances

The data in the following tables come from a study by the Korea Electronics Association (KEA) in which practices of the two end-of-life treatment centres[2] and one plastic recycling company[3] for large household appliance in Korea are investigated. The result of the study was established as a standard of KEA, namely KEA CE-3500 [7].

D.2.1 Process description

Dismantled before shredding:

– parts which require selective treatment;
– product parts with single recyclable material and easy to dismantle;
– product parts difficult to process (shredding).

Separation after shredding:

NOTE The process below should be harmonized with Figure 2.

– magnetic separation of ferrous metals;
– eddy current separation of metals;
– water and salt water separation of plastics.

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2 Yeungnam recycling centre in Chilseo, Korea, and Capital area recycling centre in Yongin, Korea.

3 CN-Technology Korea Co. in Hwaseong, Korea.

D.2.2 Recycling and recovery rate data of the example 1 scenario

Table D.1 – Recycling and recovery rate of product parts which require selective treatment

NOTE All abbreviations should be followed by their fully spelt out term.

Part or material	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
Power cable	25	90
Capacitor (containing polychlorinated biphenyls)	50	90
Switch (Hg)	50	90
Backlighting lamps (Hg)	80	90
Batteries (internal)	0	0
PCB (printed circuit board assembly)	10	90
BFR (brominated flame retardant) plastics	0	90
Asbestos	0	0
CRT (cathode-ray tube)	80	80
CFC (chlorofluorocarbon) - R11, R12	80	80
HCFC (hydrochlorofluorocarbon) - R141b	80	80
HFC (hydrofluorocarbon) - R134a	80	80
HC (hydrocarbon) - R600a	0	0
Fluorescent tubes	95	95
Gas discharge lamps (excludes fluorescent tubes)	70	70
LCD (liquid crystal display)	0	0
Refractory ceramic fibres	0	0
Radioactive substances	0	0
Electrolyte capacitors	0	0

Table D.2 – Recycling and recovery rate of product parts with a single recyclable material

Material	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
ABS (acrylonitrile butadiene styrene)	90	90
PP (polypropylene)	90	90
HIPS (high impact polystyrene)	90	90
GPPS (general purpose polystyrene)	98	98
SAN (styrene acrylonitrile)	98	98
PC (polycarbonate)	90	90
Steel (general)	95	95
Stainless steel (magnetic)	95	95
Stainless steel (non-magnetic)	95	95
Aluminum	95	95
Copper	98	98
Nickel pure	95	95
Zinc die casting	95	95
Magnesium	95	95
EP (EPOXY resin)	0	90
PF (phenol formaldehyde resin)	0	90
PUR (polyurethane foam)	0	90
Glass (door panel)	0	0
Glass (shelf)	0	0

Table D.3 – Recycling and recovery rate of product parts difficult to process

Part name	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
Compressors	90	90
AC motor	90	90
Resin motor	0	0
Clutch	90	90
Evaporator	90	90
Transformer (MWO: microwave oven transformer)	90	90
cement weight balance	0	0
steel weight balance	95	95

Table D.4 – Recycling and recovery rate of product parts which go to separation process

Material name	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
ABS	70	90
ABS (GF: glass fibre-reinforced)	0	90
EPS (expandable polystyrene)	0	90
PA (polyamide)	70	90
PC (polycarbonate)	70	90
PC/ABS	70	90
PC/PBT	70	90
PC-G (glass reinforced)	0	90
PE_HD (high density)	70	90
PE_LD (low density)	70	90
PMMA (polymethyl methacrylate)	70	90
PET (polyethylene terephalate)	70	90
PET blended	0	90
PUR (soft foamed plastic)	0	90
POM (polyoxymethylene, polyacetal)	70	90
PP (Polypropylene)	70	90
PP-T (talcum reinforced)	0	90
PS (polystyrene resin)	70	90
HIPS	70	90
GPPS	78	98
MIPS	0	90
PVC	0	90
SAN (styrene acrylonitrile plastic)	78	98
PBT(polybutylene terephthalate)	70	90
PBT+PC	70	90
EP (epoxy resin)	0	90
PF (phenol formaldehyde resin)	0	90
PUR(polyurethane foam)	0	90
Steel (general)	93	93
Stainless steel (magnetic)	93	93
Stainless steel (non-magnetic)	60	60
Aluminum	90	90
Copper	93	93
Rubber (general)	0	90

D.3 Example 2: European scenario for large household appliances, small household appliances, IT and telecommunications equipment, consumer equipment

D.3.1 General

The data in the following tables were produced by G-SCOP Laboratory, the University of Grenoble (France) for a study [8] led by the consulting company CODDE together with five EEE manufacturers [9] and funded by the French EPA ADEME. The tables have been computed after the collection, the analysis and the homogenization of data coming from technical reports and scientific articles from various sources (scientific journal and conferences, industrial associations, national EPA). Values have also been checked when analysing practices at several WEEE treatment centers representative for Europe. Methodology and values have been published elsewhere [10, 11, 12]

D.3.2 Process description

All losses of processes presented in Figure 2 (until the production of recycled material) have been considered.

Dismantled before shredding:

– parts which require selective treatment;
– product parts with single recyclable material (metal and polymer) easy to dismantle;
– product parts difficult to process through shredding.

Separation after shredding:

NOTE The process below should be harmonized with Figure 2.

– magnetic separation of ferrous metals;
– eddy current separation of metals;
– gravimetric separation of plastics.

Energy recovery of polymers:

– Energy recovery of polymers arising from WEEE is not widely developed in most European countries; therefore, it is assumed that only a low fraction of the flows of polymers going to disposal is orientated to energy recovery.

Representativeness of data:

– Geographic: Europe
– Temporal: values are typical form forerunners WEEE treatment centers of the period 2005 – 2008; only recovery routes with proven economic viability (in 2005 – 2008) have been considered i.e. at least two industrial plants using the technologies are in operation in Europe; it is believed that they are representative of the average situation in Europe until 2013.

D.3.3 Recycling and recovery rate data of the end of the example 2 scenario

Table D.5 – Recycling and recovery rate of product parts which require selective treatment

NOTE All abbreviations should be followed by their fully spelt out term.

Part or material	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
Cable (high current)	33	33
Cable (low current)	24	24
Battery (lead-acid)	60	60
Battery (Ni-Cd) (2 type: portable (<1 kg); non-portable (>1 kg))	70	70
Other battery	45	45
PWB (printed wiring board with components) – Poor	14	57
PWB (printed wiring board with components) – Intermediate	17	60
PWB (printed wiring board with components) – Rich	18	61
CRT (cathode ray tube)	90	90

Table D.6– Recycling and recovery rate of product parts with a single recyclable material

Material	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
ABS (acrylonitrile butadiene styrene)	94	95
ABS with any additives	94	95
PP (polypropylene)	94	95
PP+EPDM	94	95
PP-GF (polypropylene + glass fibre)	94	95
PP with natural fibres (e.g. hemp)	0	97
PP with any other additives	94	95
HIPS (high impact polystyrene)	94	95
HIPS with any additives	94	95
PE (polypropylene copolymer)	94	95
SAN (styrene acrylonitrile) with and without additives	94	95
PC (polycarbonate) with and without additives	94	95
ABS-PC with and without additives	94	95
PA (polyamide) with and without additives	94	95
PA-6 with and without additives	94	95
Other polymers	0	5
Steel (general)	95	95
Aluminum	95	95
Copper	95	95
Other metal	95	95

Table D.7 – Recycling and recovery rate of product parts difficult to process

Part name	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
AC motor	85	85
Heatsink	93	93
Cable (optical)	0	0
Bulb	0	0

Table D.8 – Recycling and recovery rate of product parts which go to separation process

Material name	Recycling rate $RCR_{(i)}$	Recovery rate $RVR_{(i)}$
ABS	74	75
ABS with any additive	0	5
PA with or without additive	0	5
PA6 with or without additive	0	5
PC with or without additive	0	5
PC-ABS with or without additive	0	5
HDPE with or without additive (high density polyethylene)	0	5
PP (polypropylene)	90	91
PP+EPDM (ethylene propylene diene monomer)	90	91
PP-GF (glass fibre)	90	91
PP with any other additives	0	5
P/E	90	91
HIPS	83	84
HIPS with any additive	0	5
SAN with or without additive	0	5
Other polymer with our without any additives	0	5
Steel (general)	94	94
Aluminum	91	91
Copper	85	85
Other metal	70	70

Annex E
(informative)

Example of recyclability rate calculation

This example shows a recyclability rate calculation for a refrigerator based on the scenario "KEA scenario for large household appliance".

Table E.1 – Recyclability rate calculation table

Brand name:		**KEA-Ref**		**Recycling scenario**		**KEA large home appliance**	
Model (type/variant):		**Ref-541**		**Total weight** m_{EEE}		**98 271 g**	
	Name of part	**Mass** g	**Material**	**Recycling rate** %	**Recyclable mass** g	**Recovery rate** %	**Recoverable mass** g
Reusable parts	–				–		–
Parts for selective treatment	PCB Main	417	PCB	10	42	90	375
	PCB F AS	80	PCB	10	8	90	72
	…	0			…		…
Parts with single recyclable material	CASE VEGETB A	1 840	PS	90	1 656	90	1 656
	CASE VEGETB B	1 740	PS	90	1 566	90	1 566
	POCKET R S	880	PS	90	792	90	792
	POCKET R M	694	PS	90	625	90	625
	COVER DISPNS BOX	217	ABS	90	195	90	195
	Cover M/PCB BOX	360	PP	90	324	90	324
	GASKET F DR AS	840	PVC	90	756	90	756
	GASKET R DR AS	900	PVC	90	810	90	810
	…	0			…		…
Parts difficult to process	COMPRESSOR	10 870	Comp.	90	9 783	90	9 783
	GEARED MOTR	2 665	Motor	90	2 399	90	2 399
	MOTOR R FAN AS	359	Motor	90	323	90	323
	…	0			…		…
Metal separation	PLATE DV AS	1021	Steel	93	950	93	950
	PLATE CAB	12 273	Steel	93	11 414	93	11 414
	EVAPORATOR AS	1100	Aluminium	90	990	90	990
	…	0			…		…
Non-metal separation	DECO HNDLE T	43	ABS	70	30	90	39
	LINER F	9 345	ABS	70	6 541	90	8 411
	LINER R	10 340	ABS	70	7 238	90	9 306
	BASE CAB	2 070	PP	70	1 449	90	1 863
	…	1919	…		…		…
Sum					$\sum(m_{(i)} \times RCR_{(i)})$ =74,035		$\sum(m_{(i)} \times RVR_{(i)})$ =80,452
	Recyclability rate: R_{rcy}	$\frac{\sum(m_{(i)} \times RCR_{(i)})}{m_{EEE}} \times 100\,\% = 75{,}3\,\%$					
	Recoverability rate: R_{rcv}	$\frac{\sum(m_{(i)} \times RVR_{(i)})}{m_{EEE}} \times 100\,\% = 81{,}9\,\%$					

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