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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



111/817/CD

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SECRETARIAT:

Italy

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OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 13,TC 14,TC 17,TC 22,TC 23,TC 26,TC 27,TC 29,TC 32,TC 33,TC 34,TC 40,TC 46,TC 48,TC 59,TC 61,TC 62,TC 64,TC 65,TC 66,TC 72,TC 79,TC 82,TC 85,TC 88,TC 96,TC 100,TC 103,TC 108,TC 110,TC 121,TC 124

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Environment

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TITLE:

Assessment of material recoverability rate of products

NOTE FROM TC/SC OFFICERS:

Title change according to 111/797/Q (and 111/815/RQ) from Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment to Assessment of material recoverability rate of products

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Assessment of material recoverability rate of products

FOREWORD

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International Standard IEC 62635 has been prepared by IEC technical committee 111: Environmental standardization for electrical and electronic products and systems.

This edition cancels and replaces the technical report published in 2012.

This edition includes the following significant technical changes with respect to the previous technical specification:

- Introducing a default reference EoL treatment scenario
- Examples of Treatment scenarios updated and adapted to the state of the art
- Implementation of the content of EN 45555
- The IEC 62635 focuses on material recycling
- Formula for CRMs added

144 The text of this International Standard is based on the following documents:

FDIS	Report on voting
xxx	xxx

145
146 Full information on the voting for its approval can be found in the report on voting indicated in
147 the above table.

148 The language used for the development of this International Standard is English.

149 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
150 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
151 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
152 described in greater detail at www.iec.ch/standardsdev/publications.

153 The committee has decided that the contents of this document will remain unchanged until the
154 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
155 specific document. At this date, the document will be

- 156 • reconfirmed,
157 • withdrawn,
158 • replaced by a revised edition, or
159 • amended.

160

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161

162
163

Introduction

164 Electrical and electronic equipment (EEE) have become a defining and ubiquitous feature of
165 modern life, raising living standards of the global population. As a counter-effect, they are
166 becoming one of the fastest growing waste streams globally

167 NOTE: the amount of e-waste exceeded 57 million tons in 2021 (WEEE Forum, Read [here](#)).
168

169 Waste electrical and electronic equipment (e-waste) contains a complex mixture of materials,
170 some of which are hazardous, able to cause major environmental and health problems if the
171 discarded devices are not managed properly. Modern electronics also contain rare and
172 expensive resources, such as critical raw materials (CRMs). These can be recycled and re-
173 used if the waste is effectively managed. Improving the collection, treatment and recovery of
174 electrical and electronic equipment at the end of their life can increase resource efficiency and
175 support the shift to a circular economy.

176

177 To determine the ability to recover a product or its parts and materials at end-of-life, the
178 concepts of “recoverability” and “recoverability rates” are introduced. In order to effectively
179 improve the ability to recover products, parts and material at their end-of-life, it is necessary to
180 already consider a given end-of-life treatment scenario during the design and development
181 phase. In order to ensure that a given recoverability potential materializes into actual recovery
182 rates it is important to ensure that the actual treatment technologies employed at product EoL
183 are state of the art and capable to recover CRMs.

184

185 This standard provides a comprehensive framework for assessing the recoverability of materials
186 used in EEE, in particular critical and environmentally relevant raw materials which today are
187 often lost in landfills. It is a way to catch up in the global race for the supply of metals and
188 minerals and to implement environment, social and governance principles by an organization.

189 This standard provides the calculation rules based on the understanding that the material
190 recovery rate is defined as the data provided by the recycler. The product material recoverability
191 rate is the result of the calculation performed by the manufacturer.

192 The general method presented in this document takes into account the availability and efficiency
193 of state-of-the-art recycling and recovery processes to predict the recyclability or recoverability
194 rates of products already at the design phase. The focus is therefore on the ability to recover
195 or recycle the product itself rather than the recycling or recovery processes.

196 The standard can be used to assess a products material recoverability independently of where
197 it will be recycled using a default recovery scenario presented in Annex D. This option is
198 intended to assess products material recoverability early in the design process where the final
199 fate of a product might not be known, to compare the evolution of a product design overtime or
200 to compare different product designs against each other based on a common baseline.

201 The standard can also be used to assess a product material recoverability in relation to a
202 specific EoL treatment scenario for a given country or region. Annex E provides examples a
203 selection of specific scenarios for this purpose.

204 Based on the end-of-life treatment scenario chosen, it is assumed that the assessment of the
205 material recoverability of a product as a whole may be valid for a certain period of time in a
206 given geographical area. Therefore, the standard provides organizations with

- 207 • sufficient information to characterize activities at end-of-life treatment facilities in order
208 to enable them to implement effective environmentally conscious design and,
- 209 • sufficient information for the product designers (having to ensure the design for
210 recycling) about what will happen later-on, in the recycling process

211 This standard will also help the transparency and resilience of the whole supply and end-of-
212 life value chain. It will promote sustainable practices by enabling manufacturers, with the
213 support of end-of-life management stakeholders, to evaluate the potential for products and parts
214 recovery and, most specially, material recycling at the end of a product's life cycle. It also allows
215 for the meaningful interactions between EoL treatment operators and suppliers of materials,
216 parts and products with organizations that use the secondary raw materials.

217

218 By applying this standard, organisations can enhance their environmental performance,
219 contribute to waste and pollution reduction and so contribute to a circular economy.

220

221

222

223 **1 Scope**

224 IEC 62635 provides a method to calculate the material recoverability rate of electrotechnical
225 products based on end-of-life (EoL) treatment scenarios. This document sets up criteria and a
226 format to describe the EoL treatment scenarios. Additionally, the method is applied for
227 calculation of material recoverability rates of critical and environmentally relevant materials.

228

229 Furthermore, this standard also addresses:

- 230 • Provision of product information from manufacturers to EoL treatment operators to improve
231 material recovery rates
- 232 • Provision for end-of-life treatment information to build EoL treatment scenarios
- 233 • Provision of a default reference EoL treatment scenario
- 234 • Examples of EoL treatment scenarios and the corresponding material recovery rates are
235 provided.

236 **2 Normative references**

237 The following documents, in whole or in part, are normatively referenced in this document and
238 are indispensable for its application. For dated references, only the edition cited applies. For
239 undated references, the latest edition of the referenced document (including any amendments)
240 applies.

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

242 IEC 82474, *Material declaration - Part 1: General requirements*

243 **3 Terms and definitions**

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

245 **3.1**246 **alternate material recovery**

247 alternate material recycling

248 controlled processing of waste producing useful material of a different type compared to the
249 initial material

250 EXAMPLE: Slag; Thermoset that is shredded and used as filler in other materials.

251 [SOURCE: IEC/CDV 60050-193: IEV 193-04-09]

252 **3.2**253 **critical raw material**

254 CRM

255 material which, according to a defined classification methodology, is economically
256 important, and has a high-risk associated with its supply

257 Note 1 to entry: As the classification methodology is country or region specific, the CRMs list will be also country or
258 region specific.

259 [SOURCE: IEC/CDV 60050-193:2024, IEV 193-03-13]

260 **3.3**261 **depollution**

262 Process of removing pollutant(s)

263 **3.4**264 **pollutant**

265 substance which either alone or in combination with other substances or through its products
266 of degradation or emissions can have a harmful effect on human health or the environment.
267 [SOURCE: ISO 16000-32:2014, 3.7]

268 3.5

269 **disassembly**

270 process whereby a product is taken apart in such a way that it could subsequently be
271 reassembled and made operational

272 [SOURCE: IEC 60050-904:2014, IEV 904-04-01, modified — In the definition the term 'an item'
273 was replaced by 'a product' and note 1 to entry was removed]

274 3.6

275 **dismantling**

276 process whereby a product is taken apart in such a way that it is not intended to be reassembled
277 and made operational

278 Note 1 to entry: After dismantling some parts can be reused.

279 [SOURCE: ISO14009:2020, 3.2.16, modified — Part of the definition 'although the product (and
280 the parts not intended to be reused) can no longer be' was replaced by 'it is not intended to be'
281 and 'some parts can be reused' was moved to a note to entry]

282 3.7

283 **end of life**

284 end-of-life

285 EoL

286 end of last use

287 end-of-last-use

288 life cycle stage of a product starting when it is removed from its use stage until the product is
289 either disposed of or is given a new life under a new identity

290 [SOURCE: IEC/CDV 60050-193:2024, IEV 193-05-06, modified — Note 1 and Note 2 to entry
291 have been removed]

292 3.8

293 **end-of-life treatment**

294 operations covering all activities starting when end-of-life products are disposed, and waste is
295 handed over for recovery and/or final disposal

296 Note 1 to entry: End-of-life treatment includes collection and logistics.

297 [SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-02, modified — Note 1 to entry has been
298 removed]

299 3.9

300 **end-of-life treatment scenario**

301 end-of-life treatment scenario

302 EoL treatment scenario

303 description of an end-of-life treatment process and corresponding recycling rates of product
304 parts and materials

305 3.10

306 **energy recovery**

307 production of useful energy through direct and controlled combustion or other processing of
308 waste

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

311 [SOURCE: IEC 60050-904:2014, IEV 904-04-03]

312 3.11

313 **final disposal**

314 treatment that does not lead to the recovery of product, parts, materials or energy

315 [SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-24, modified — Note 1 to entry has been
316 removed]

317 **3.12**

318 **manufacturer**

319 natural or legal entity with responsibility for the design, manufacture, packaging and labelling
320 of a product before it is placed on the market under his own name, regardless of whether these
321 operations are carried out by that entity itself or on his behalf by a third party

322 [SOURCE: ISO 7396-2:2007, 3.20, modified — In the definition the term 'person' was replaced
323 by 'entity', 'himself' was replaced by 'itself', and 'device' was replaced by 'product']

324 **3.13**

325 **material recovery**

326 material recycling

327 recycling

328 controlled processing of waste to produce material of the same or similar type as the initial
329 material

330 EXAMPLE: An ABS compound that is shredded and then recovered in ABS compound; An Aluminum-alloy that will
331 be recovered in Aluminum-alloy.

332 Note 1 to entry: Polymer materials are of the same type if they have the same base polymer such as PE, PP, ABS.
333 Metal materials of the same type share the same base metal (Aluminum-alloy).

334 Note 2 to entry: There can be variation in the performance of the recovered material compared to the initial one.

335 Note 3 to entry: Recycling can be sometimes referred to as upcycling (useful material with the same or higher
336 performance than the initial material) or downcycling (useful material with lower performance than the initial material).

337 [SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-06, modified — Note 1 and 2 to entry have
338 been removed]

339 **3.14**

340 **material recovery rate**

341 material recycling rate

342 mass ratio of recycled material recovered from waste

$$343 \quad MRR = \frac{m_{(rm)}}{m_{(w)}} \quad (1)$$

344 Note 1 to entry: Material recovery rate measures the proportion of materials recovered by a recycler from waste
345 (e.g. large volume of mixed products, stream of specific products)

346 Note 2 to entry: Formula (1) expresses material recovery rate. Variables are defined as follows:

347

348 MRR: material recovery rate

349 $m_{(rm)}$: mass of the recovered materials, excluding alternate materials.

350 $m_{(w)}$: total mass of the waste (inflow in a certain period)

351

352 [SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-07 modified — numbering of formula
353 changed]

354 **3.15**

355 **material separation**

356 operation to separate materials, including mechanical, chemical or thermal process other than
357 dismantling

358 EXAMPLE: Smelting, sorting, etc.

359 **3.16**

360 **products and parts recovery**

361 controlled process whereby products or parts are recovered from waste and are brought back
362 to use for the same or different purpose

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-04]

3.17
product material recoverability rate
product material recyclability rate

ratio of mass of the predicted recyclable material to the mass of the complete product

$$PMRR = \frac{m_{(rm)}}{m_{(p)}}$$

(2)

Note 1 to entry: Product material recoverability rate measures the recovery of material from specific products predicted at design stage based on an end-of-life treatment scenario.
Note 2 to entry: Formula (2) expresses product material recoverability rate. Variables are defined as below:

- PMRR: product material recoverability rate
- $m_{(rm)}$: mass of the total predicted recyclable materials of the product
- $m_{(p)}$: total mass of the product

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-08 modified — numbering of formula changed]

3.18
recovery
controlled process by which products, parts or materials are recovered from waste, or by which waste is used to produce energy

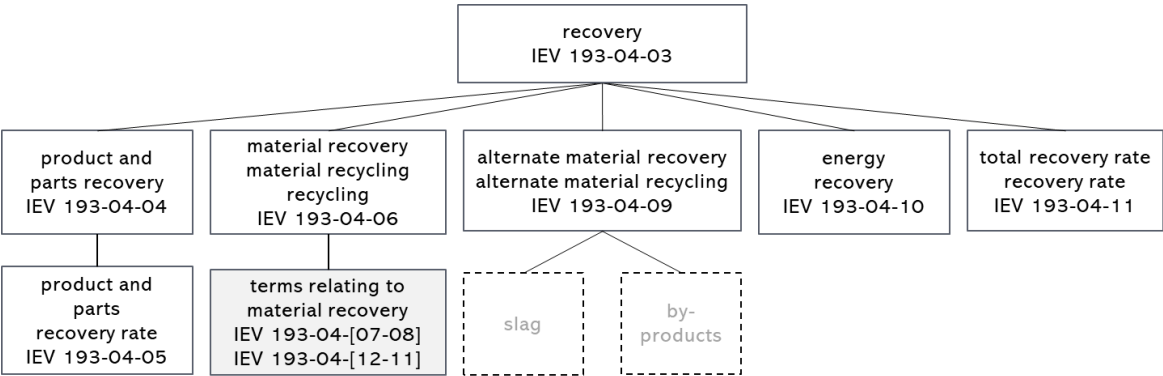


Figure 1 — Concepts relating to recovery

Note 1 to entry: Recovery is an operation by which value is regained from waste.
Note 2 to entry: Figure 1 shows the concept recovery and other related concepts. Concepts for the terms slag and by-products are not provided.

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-03, modified — Note 3 to entry has been deleted, Numbering of Figure changed]

3.19
products and parts recovery

controlled process whereby products or parts are recovered from waste and are brought back to use for the same or different purpose

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-04]

3.20
recoverability
ability of a waste product or part to be recovered, based on actual EoL management practices

3.21**total recovery rate**

recovery rate

mass ratio of energy, products, parts, and materials, including alternate materials, recovered from waste

$$TRR = \frac{m_{(rpp)} + m_{(rm)} + m_{(ram)} + m_{(im)}}{m_{(w)}} \quad (3)$$

Note 1 to entry: Recovered energy is expressed in terms of mass of the material incinerated to produce it.

Note 2 to entry: Formula (3) expresses total recovery rate. Variables are defined as below:

TRR:	total recovery rate
$m_{(rpp)}$:	mass of recovered products and parts
$m_{(rm)}$:	mass of recovered materials
$m_{(ram)}$:	mass of recovered alternate materials
$m_{(im)}$:	mass of incinerated materials for energy recovery
$m_{(w)}$:	total mass of waste (inflow) in a certain period

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-11 modified — numbering of formula changed]

3.22 recycled material

recovered material

secondary material

useful material that has been reprocessed from waste

Note 1 to entry: Recycled material can be pre- or post-consumer.

Note 2 to entry: Recycled material refers to the sum of the various fractions of materials recovered from waste like metals, plastics, etc.

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-03-10, modified — Note 3 to entry has been deleted]

3.23**reuse**

operation by which a product or part having reached the end of use is used again

Note 1 to entry: Reuse for another purpose is called repurpose.

Note 2 to entry: Normal, regular or sporadic use is not considered as reuse.

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-06-01, modified — Note 3 to entry has been deleted]

3.24**total product mass**

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.

3.25**waste**

material or object which the holder decides, or is required, to dispose of

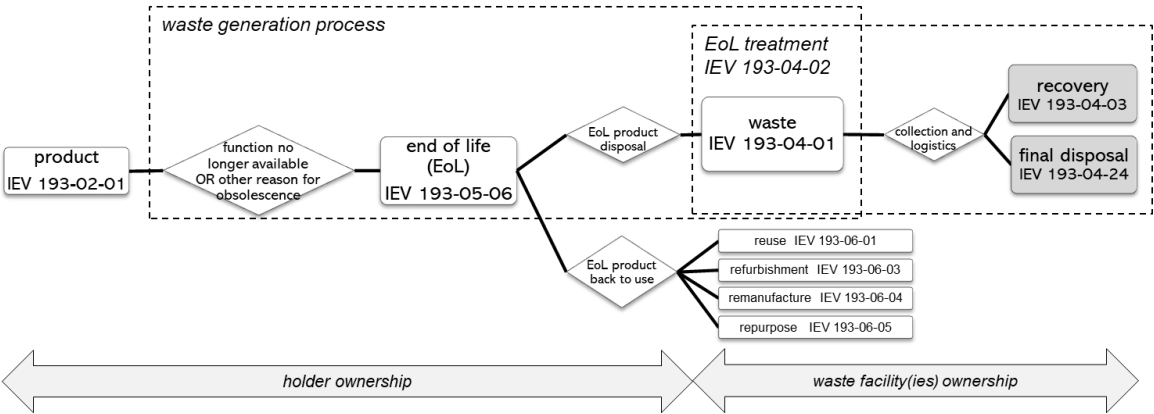


Figure 2 — Diagram of waste generation process

Note 1 to entry: Triggers for the decision or need to dispose of include:

- function no longer available,
- change in the needs by the user (e.g. no longer fashionable),
- interoperability loss,
- product no longer repairable or serviceable due to loss or unavailability of spare parts, consumables or technical information.

Note 2 to entry: Figure 2 shows the steps associated with the waste generation process and the link with end-of-life treatment.

[SOURCE: IEC/CDV 60050-193:2024, IEV 193-04-01 modified - Numbering of Figure changed]

3.26

ECD

Environmental Conscious design

systematic approach which considers environmental aspects in the design and development with the aim to reduce adverse environmental impacts throughout the life cycle of a product

Note 1 to entry: Other terminology used worldwide with the same meaning includes ecodesign, design for environment (DFE), green design and environmentally sustainable design.

Note 2 to entry: This note applies to the French language only.

[SOURCE: IEC 62430:2019, 3.1.1]

4 End-of-life treatment scenario

4.1 General considerations

An EoL treatment scenario is a description of the combination and sequence of processes and steps required for the EoL treatment of a product. It also includes the corresponding recycling rates of product parts and materials.

The EoL treatment scenario can be used to assess a product's material recoverability as described in Clause 9. This document provides a default reference EoL treatment scenario for a general material recoverability assessment (Annex D). It also specifies requirements and guidance for establishing a specific EoL treatment scenario (clause 5). The specific EoL treatment scenario can be for assessing the material recoverability based on the recycling processes used in a specific region or for specific product categories. Examples of specific EoL treatment scenarios are included in Annex E.

The default reference EoL treatment scenario can be used independently of where the product will be recycled. It is intended to facilitate the assessment of product recoverability early in the design process where the final fate of a product might not be known, to compare the evolution of a product design over time or to compare different product designs against each other based on a common baseline.

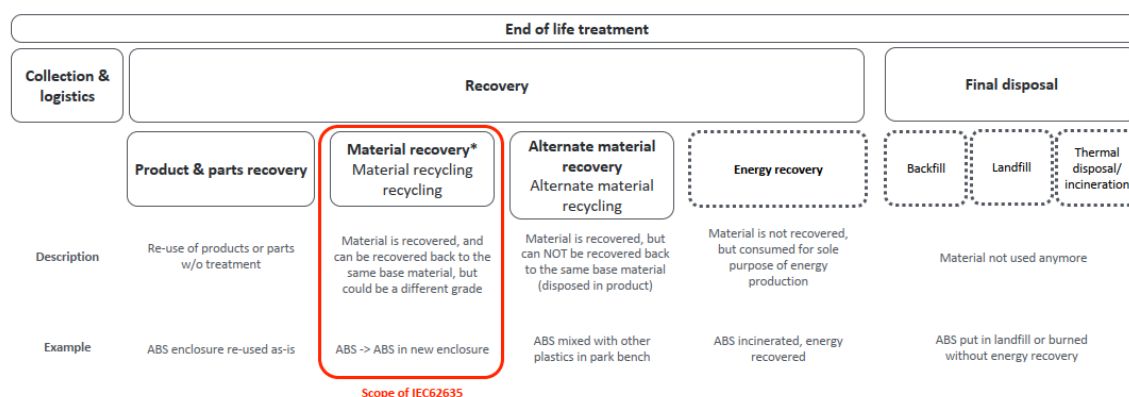
Depending on the objective of assessing the products' material recovery rate, the assessment shall be based on either:

- the default reference EoL treatment scenario presented in Annex D
- one of the examples of specific EoL treatment scenarios presented in Annex E or
- a custom EoL treatment scenario that meets the requirements specified in clause 5.

Depending on the objective of assessing the products' material recovery rate, the assessment shall be based on either the default reference EoL treatment scenario presented in Annex D or one of the examples of specific EoL treatment scenarios presented in Annex E or a custom EoL treatment scenario that meets the requirements specified in clause 5.

NOTE 1 The same reference EoL treatment scenario is applicable for the assessment of a product or its constituent parts or materials. Losses outside of the reference EoL treatment scenario, e.g. collection, storage, transport, are not considered.

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.



*can be expressed as Material recovery rate per IEC 62635

Figure 3 – Framework of the main definition covering end-of-life treatment

502

503 EoL treatment is generally implemented in five phases:

- 504 a) **pre-treatment**: pre-treatment usually includes operations to mitigate hazards and
505 dismantling parts for selective treatment. Parts are dismantled when there is a possibility
506 for reuse, or they require selective treatment (e.g. regulations applicable to the recycling
507 facility or contractual agreement), where this would allow a better end-of-life treatment
508 efficiency;
- 509 b) **material separation**: several techniques may be used, such as mechanical separation (e.g.
510 shredding), chemical separation or thermal separation (smelting), combined with
511 appropriate sorting processes;
- 512 c) **End of EoL treatment**: is where the waste material has been reprocessed into products,
513 materials or substances whether for the original or other purpose. This is the same point
514 from which the amount of recovered material can be determined;
- 515 d) **energy recovery**: after these operations, the remaining and unsorted material may then be
516 considered for energy recovery;
- 517 e) **disposal**: residues are then disposed in appropriate landfills.

518

519 4.2 Specification of the Default Reference EoL treatment scenario

520 The default reference EoL treatment scenario is intended to assess products material
521 recoverability early in the design process where the final fate of a product might not be known,
522 to compare the evolution of a product overtime or to compare different product designs against
523 each other based on a common baseline.

524 This default reference EoL treatment scenario can also be used as a reference for creating a
525 specific or product category specific EoL treatment scenarios.

526 The generic steps for EoL treatment are illustrated in Figure 4. The main steps are dismantling,
527 pre-grinding, sorting and shredding.

528 The generic steps used to describe the default reference EoL treatment scenario used in this
529 standard are described in Figure 4, with each part or material flow having its own recycling rate.
530 It is noted that the generic treatment process described in Figure 4 is one of many potential
531 scenarios, while it is intended to be as generic as possible. Actual recycling processes may add
532 additional processes, include or exclude portions of the generic process presented here.

533 The provision of EoL treatment information, including recycling rates of the different materials,
534 allows a recyclability and recoverability rate calculation which is based on the flow shown in
535 Figure 4 and EoL treatment scenario which describes the processes at a recycling facility. Thus,
536 it enables improvements in product design with regards to recyclability aspects.

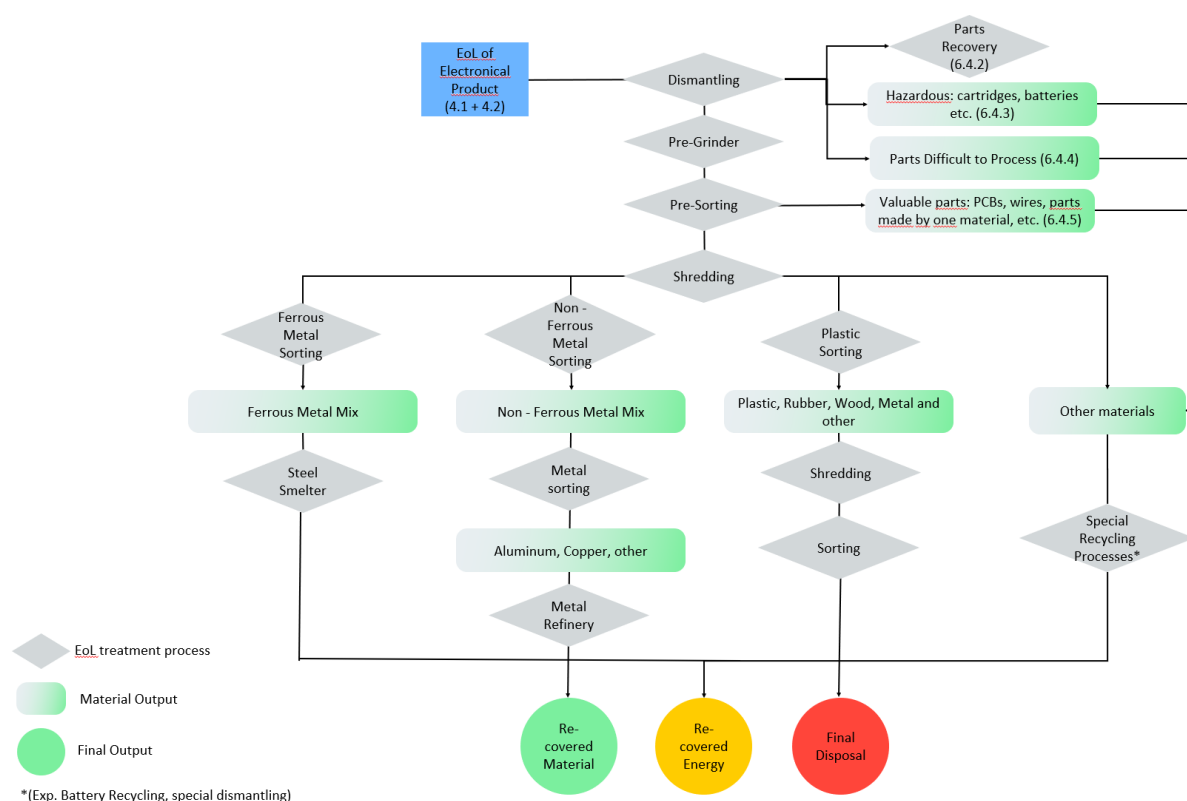


Figure 4 – Generic EoL treatment scenario

5 Specific EoL treatment scenarios

5.1 General

Compliance with national regulation or selling a product in one region only might require evaluating a products material recoverability in relation to a specific EoL treatment scenario for a given country or region. Annex E provides examples of specific scenarios for this purpose. Clause 5 provides criteria for developing more specific treatment scenarios.

Information exchange is essential when setting up or describing an EoL treatment scenario. Criteria for treatment process identification are given in 5.2 and related information that describes the treatment processes is given in 5.4.

5.2 Development of a specific EoL treatment scenario

Compliance with national regulation might require evaluating a products material recoverability in relation to a specific EoL treatment scenario for a given country or region. To calculate the material recoverability rate for a given group of products in a given region, the reference EOL treatment scenario shall be established.

A flow diagram of the specific EoL treatment scenario shall be developed. The flow diagram shall include all relevant treatment steps of the reference EoL treatment (can be the default reference EoL treatment scenario or a specific EoL treatment scenario) scenario in sequential order and specify from the starting point (waste product) all the outputs of each treatment step and their destination (e.g. material recovered, landfilled or input to another process).

The material recoverability rate shall indicate, as far as possible, the overall efficiency of the material recovery, taking into account the losses at each treatment step.

The default reference EoL treatment scenario shall be used to specify design related criteria affecting material recoverability according to the requirements in Clause 8, and to calculate the