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## Assessment method for circular scoring

Recommendation ITU-T L.1023

ITU-T L-SERIES RECOMMENDATIONS

**ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT**

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# Recommendation ITU-T L.1023

## Assessment method for circular scoring


### Summary

Recommendation ITU-T L.1023 outlines an assessment method for circularity scoring of information and communication technology (ICT) goods.

The assessment method consists of three steps:

1) Setting the relevance and applicability (R) of each criterion for circular product design (CCPD) for the ICT goods at hand,

2) Assess the margin of improvement (MI) of each criterion,

3) Calculate the circularity score (score) from 0 to 100% for the ICT good at hand for all three circular design guideline groups (CDGGs). This includes:

   – Using a predefined value matrix to identify the % score from 0 to 100 for each combination of R×MI.

   – Average the included criteria for the ICT good at hand separately for all three groups: product durability, ability to recycle, repair, reuse, and upgrade from equipment and manufacturer level.



### History

| Edition | Recommendation | Approval | Study Group | Unique ID* |
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### Keywords

Circularity score, criteria, ICT goods, product durability, recycling, repair, reuse, upgrade.


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## Assessment method for circular scoring

### 1 Scope

Realization of the circular economy requires incorporating elements in product design that support the reduction of material use, reuse, recycling and recovery of products, product parts, components and materials to circulate them in the value chain for as long as possible. This Recommendation contains a three-step methodology to identify an information and communication technology (ICT) good's circularity in three dimensions via three circular design guideline groups (CDGGs): first the ICT good durability, second the ICT good ability to be recycled, repaired, reused and upgraded, and third the manufacturers ability to recycle, repair, reuse and upgrade the ICT good put into the market. The three guideline groups are then divided into criteria for circular product design. These criteria are then assessed at four levels, both from how well circularity has been achieved, the margin of improvement, and the relevance and applicability of each criterion for the ICT good at hand. The margin of improvement (MI) score and relevance score are then combined and translated into a score for each criterion. The average of applicable criteria in each guideline group are calculated as the total circularity score for each guideline group.

No weighting of the guideline groups is included.

### 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.1015] Recommendation ITU-T L.1015 (2019), *Criteria for evaluation of the environmental impact of mobile phones.* https://www.itu.int/rec/T-REC-L.1015-201905-I

[ITU-T L.1020] Recommendation ITU-T L.1020 (2018), *Circular economy: Guide for operators and suppliers on approaches to migrate towards circular ICT goods and networks*. https://www.itu.int/rec/T-REC-L.1020-201801-I

[ITU-T L.1021] Recommendation ITU-T L.1021 (2018), *Extended producer responsibility – Guidelines for sustainable e-waste management*. https://www.itu.int/rec/T-REC-L.1021-201804-P

[ITU-T L.1022] Recommendation ITU-T L.1022 (2019), *Circular economy: Definitions and concepts for material efficiency for information and communication technology*. https://www.itu.int/rec/T-REC-L.1022-201910-I

### 3 Definitions

#### 3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

**3.1.1 ICT goods** [b-ITU-T L.1410]: Tangible goods deriving from or making use of technologies devoted to or concerned with:

– the acquisition, storage, manipulation (including transformation), management, movement, control, display, switching, interchange, transmission or reception of a diversity of data;

– the development and use of the hardware, software, and procedures associated with this delivery; and

– the representation, transfer, interpretation, and processing of data among persons, places, and machines, noting that the meaning assigned to the data is preserved during these operations.

NOTE – [b-ETSI TS 103 199] used the word "equipment" instead.

**3.1.2 component** [b-ETSI TR 103 679]: Part of a product that cannot be taken apart without destruction or impairment of its intended use.

**3.1.3 product part** [b-ETSI TR 103 679]: Sub-unit of a product.

NOTE – HDD is an example of a product part within a computer.

**3.1.4 upgrade** [b-EN 45554]: Process of enhancing the functionality, performance, capacity or aesthetics of a product.

**3.1.5 reliability** [b-EN 45552]: Probability that a product functions as required under given conditions, including maintenance, for a given duration without limiting event.

**3.1.6 refurbishment** [b-EN 45553]: Functional and/or aesthetic restoration of an energy-related product.

**3.1.7 material** [b-ETSI TR 103 679]: Substance or mixture of substances within a product or product part.

**3.1.8 substance** [b-ETSI TR 103 679]: Chemical element and its compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the declarable substance or changing its composition.

**3.1.9 product** [b-ETSI TR 103 679]: Good or service.

## 3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

**3.2.1 circular economy:** An economy closing the loop between different life cycles through design and corporate actions/practices that enable recycling and reuse in order to use raw materials, goods and waste in a more efficient way. The circular economy concept distinguishes between technical and biological cycles, the circular economy is a continuous, positive development cycle. It preserves and enhances natural capital, optimises resource yields, and minimizes system risks by managing finite stocks and renewable flows, while reducing waste streams.

NOTE – Definition adapted from [ITU-T L.1022] and [ITU-T L.1020].

**3.2.2 priority part**: A part having a high likelihood of needing repair, replacement or upgrading.

# 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CS Circularity Score

CDGG Circular Design Guideline Group

CCPD Criterion for Circular Product Design

CE Circular Economy

| | |
|---|---|
| CRM | Critical Raw Material |
| DfD | Design for Disassembly |
| DfR | Design for Recycling |
| DfRe | Design for Remanufacturing |
| DfX | Design for X |
| EEE | Electrical and Electronic Equipment |
| HDD | Hard Disc Drive |
| ICT | Information and Communication Technology |
| LCA | Life Cycle Assessment |
| MI | Margin of Improvement |
| MR | Material Recycling |
| PD | Product Durability |
| R | Relevance |
| RFP | Request for Procurement |
| sEEE | Small household electrical and electronic equipment |
| 3RUe | Ability to Recycle, Reuse, Refurbish and Upgrade, equipment level |
| 3RUm | Ability to Recycle, Reuse, Refurbish and Upgrade, manufacturer level |

## 5 Conventions

Colours are used in the appendices of this Recommendation to graphically indicate circularity scores ranging from green (very good) to red (very bad).

## 6 Background

The principles of circular economy (CE) emphasize optimizing resource yields at all stages of a product's lifecycle [b-ITU-T L.Sup.28], [ITU-T L.1015], [ITU-T L.1021], [ITU-T L.1022].

CE ultimately aims to make products without causing or incentivizing additional extraction of Earth's resources. This means using recycled and renewable material, prioritizing efficient use of materials and recovery of wastes, designing products to be durable to maximize their useful life and finally, where necessary, contributing materials back to the market for making new products.

This requires incorporating elements in product design that support the reduction of material use, reuse, recycling, and recovery of products, product parts, components and materials to circulate them in the value chain for as long as possible. To achieve this objective, criteria for circular product design (CCPDs) that aim to reduce, reuse, recycle and recover should be considered, and corresponding design guidelines integrated from the early stages of product design.

To date, in ITU-T the standardization of implementation of CE principles has largely focused on waste management models, such as integrating extended producer responsibilities [ITU-T L.1021] into business practices, rather than evaluating criteria and proposing design guidelines to incorporate circular elements into product design. Multiple design for X (DfX) approaches exist including design for disassembly (DfD), design for recycling (DfR), and design for remanufacturing (DfRe).

The present methodology incorporates some selected parameters of the CENELEC series of product material efficiency standards [b-CENELEC].

Moreover, the present methodology also differs from the product circularity indicator [b-PCI].

However, the methodology outlined in this Recommendation is not to be confused with methods which aim to measure circularity from a materials flow and organizational perspectives, such as those under development by the Ellen MacArthur Foundation [b-EMF] or the World Business Council for Sustainable Business [b-WBCSD].

While not all criteria described in this Recommendation might work for all ICT good categories, they are applicable to improve ICT good circularity if they are applied at the early stage of product design.

Therefore, this Recommendation is intended to be a guideline and methodology for designers of ICT goods and systems to align product design to the most relevant criteria and incorporate design guidelines. This use of this Recommendation can result in increased circularity of ICT goods.

## 7 The methodology

The methodology contains a three-step approach to support product designers in determining the most relevant criteria to be incorporated in their product design. Bovea and Pérez-Belis [b-Bovea] proposed which existing DfX guidelines are most relevant in product design from a circular economy perspective for small household electrical and electronic equipment (EEE). [b-AndraeVaija] proposed a new method based for ICT goods inspired by [b-Bovea]. These DfX guidelines proposed by [b-Bovea] and used for ICT goods by [b-AndraeVaija], are then reorganized and adopted further to the specificities of ICT goods based on CE principles as shown in Table 1, adapted from Table I in [b-AndraeVaija]. Additional criteria have been added and several have been removed compared to the original lists [b-Bovea], [b-AndraeVaija] in order to align with metrics included in the CENELEC product material efficiency standards [b-CENELEC] and EPEAT [b-EPEAT] and to reflect the variety of products in the ICT industry.

Noticeably, the far-left column of Table 1 – Groups – contains a list of circular principles that put all the criteria into different groups. The description of each *g*roup is as follows:

1) Product durability (PD): It includes criteria related to promoting the life span and durability of products by adapting their design and studying the possibility of upgrading software to a new version and service support by ensuring the product can be used for as long as possible by the first user or subsequent users.

2) Ability to recycle, repair, reuse, upgrade (3RUe) – equipment level: It includes criteria related to the product's structure and access to its priority parts for repair, connecting systems to facilitate disassembly and reassembly, spare parts, diagnostic and information availability. It relates to:
   – Possibilities to refurbish the ICT good;
   – Possibilities to reuse product parts and components within the ICT good (after first use) in refurbishment of similar or other ICT goods;
   – Facilitate the identification, separation and recycling of materials. Addresses separate collection of products for better recycling and development of designated recycling technologies.

3) Ability to recycle, repair, reuse, upgrade (3RUm) – manufacturer level:

   It includes criteria related to the manufacturer ability (on company level) to facilitate recycling, repair, reuse and upgrade. These requirements are not directly connected to the equipment, but to the infrastructure and support to be developed or supported by the manufacturer. It relates to:
   – Availability of service support in terms of information, infrastructure and spare parts.

In summary, each group contains a set of criteria that directly address the group's topic. Each criterion is also assigned to a code with the group's initials followed by a numerical number.

The proposed method is in principle unlimited regarding the number of groups and criteria. For example, new criteria for scratch resistance for example for metals, glass, etc. can be added and margin of improvement (MI*)* levels defined. Also new groups can be added accordingly. Appendix III contains an example of a potential new criterion for 3RUe.

**Table 1 – Circular design guidelines groups and criteria for circular product design of relevance for circular ICT**

| Group | Code | Criteria |
|---|---|---|
| Product durability | PD1 | Software and data support |
| | PD2 | Scratch resistance |
| | PD3 | Maintenance support |
| | PD4 | Robustness |
| | PD5 | Battery for portable ICT goods |
| | PD6 | Data security |
| Ability to recycle, repair, reuse, upgrade – equipment level | 3RUe1 | Fasteners and connectors |
| | 3RUe2 | Diagnostic support |
| | 3RUe3 | Material recycling compatibility |
| | 3RUe4 | Disassembly depth |
| | 3RUe5 | Recycled/renewable plastics |
| | 3RUe6 | Material identification |
| | 3RUe7 | Hazardous substances |
| | 3RUe8 | Critical raw materials |
| | 3RUe9 | Packaging recycling |
| Ability to recycle, repair, reuse, upgrade – manufacturer level | 3RUm1 | Service offered by manufacturer |
| | 3RUm2 | Spare parts distribution |
| | 3RUm3 | Spare parts availability |
| | 3RUm4 | Disassembly information |
| | 3RUm5 | Collection and recycling programmes |
| | 3RUm6 | Environmental footprint assessment knowledge available to improve the equipment material efficiency |

The proposed methodology involves three main steps that shall be followed:

1) The first step is to estimate the relevance (R) of each criterion to the ICT good or ICT system (e.g., mobile site) at hand based on relevance characteristic such as customer relevance or life cycle assessment (LCA) calculation.

2) The second step involves determining the margin of improvement (MI) of each criterion based on the degree to which the criterion is met. (See Table 4 for guidance on how to determine MI for each criterion) for the ICT good category.

NOTE – The order of steps 1 and 2 is somewhat flexible. The determination of MI can be done separately from the one for R. For example, for request for procurement (RFP) it works well if the telco operators determine the R and the manufacturers determine the MI.

3) The third step involves calculating the circularly score (score) for each group of the product at hand.

Through the third step it will be possible to determine the criteria most critical for improving the ICT good circularity.

The following clauses give a detailed description of each step. Appendix I reports example applications of the assessment methodology.

### 7.1 Step 1 – Estimate the relevance (R) of each guideline to the product at hand

The level of relevance (R*)* might appear somewhat ambiguous as there are many criteria/viewpoints which can be used to determine relevance. However, if the viewpoint is clearly set, defining R is not difficult.

R evaluates the degree of relevance of each criterion for a product category according to its function, life span, durability, performance, etc. R is defined based on four grades (see Table 2) and the option to set R to 0 when a criterion is not applicable to the product under investigation. The R of a criterion is considered *HIGH* when the significance (i.e., to the customer, to the cost, to the environment, the LCA score, etc.) of incorporating the aspects included in that group is essential when taking into account the tasks, life span, durability, performance, etc. features that characterize the product category to which the product belongs. Conversely, the R of the criterion is considered *LOW*. *Very HIGH* and *Very LOW* are the highest and lowest R grades, respectively.

In summary, R for each criterion given in Table 1 can be identified in a number of ways. One way is to assess R based on customer preferences (See examples in Appendix I.).

**Table 2 – Description of levels of relevance (R) of guidelines**

| Code | Grade of R | ***Description*** when taking into account the functions, life span, durability, performance, etc. of the product category. |
|---|---|---|
| R4 | Very HIGH {4} | The positive effect (for customer, environment etc.) of the criterion at hand will be *VERY HIGH*.<br>NOTE – For example, gateways could have R=4 for 3RUe1 as easily removable and reusable fasteners enable a cost-effective refurbishing business model giving a positive economic and green benefit. |
| R3 | HIGH {3} | The positive effect (for customer, environment, etc.) of incorporating the guidelines for the criterion at hand will be *HIGH.* |
| R2 | LOW {2} | The positive effect (for customer, environment, etc.) of incorporating the guidelines for the criterion at hand will be *LOW.*<br>NOTE – For example, gateways could have R=2 for 3RUm4 as disassembly information is not essential for end user. |
| R1 | Very LOW {1} | The positive effect (for customer, environment, etc.) of incorporating the guidelines for the criterion at hand will be *Very LOW.*<br>NOTE – For example, keyboards could have R=1 for PD6 as these devices usually do not store data that is considered to be private and needs secure data deletion. |

**Table 2 – Description of levels of relevance (R) of guidelines**

| | | |
|---|---|---|
| R0 | Not applicable {0} | The criterion is not applicable to the product at hand.<br>NOTE – A zero rating will result in the category not being included. This can be useful when the category cannot be applied, e.g., PD5 (Battery for portable goods) is not applicable to stationary products or products without batteries. |

R will be closely linked to the type of ICT good and the business model.

### 7.2 Step 2 – Evaluation of the margin of improvement (MI) for a product design

This step is to evaluate the margin of improvement (MI) of a specific criterion found in Table 1 for a product design.

MI evaluates the level of compliance of the criteria. It assesses to what extent a product design has incorporated circular design into the product.

MI is defined based on four grades (Table 3). If a certain criterion is not met, the MI of that product design will be *very High*, and grade 4 will be assigned. Conversely, if a product design fully meets the criterion, the MI will be *very Low*, and grade 1 will be assigned. The lower the MI, the higher possibility of a better score.

**Table 3 – Description of MI levels for each criterion**

| Code | Grade of MI | Description |
|---|---|---|
| MI4 | Very HIGH {4} | The criterion is not met in the product design. The MI of that aspect will be Very HIGH. |
| MI3 | HIGH {3} | The criterion is slightly met in the product design. The MI of that aspect will be HIGH. |
| MI2 | LOW {2} | The criterion is fairly met in the product design. The MI of that aspect will be LOW. |
| MI1 | Very LOW {1} | The criterion is fully met in the product design. The MI of that aspect will be VERY LOW. |

Table 4 gives guidance for identification and setting of MI levels. The values in the column "Scoring system (1-4) examples" are to be considered as examples that are only valid for a certain type of product (e.g., disassembly depth for home network gateways for 3RUe4 in Table I.2). Each MI level shall refer to entities which are verifiable and/or measurable.

**Table 4 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| Product durability | PD1: Software and data support | Availability of software and firmware updates & | MI = 1 – Software and firmware updates and upgrades availability can be categorized as long-term (class A, i.e., for a duration of time that reflects the expected maximum useful life of the product, cf. [b-EN 45554]). |

**Table 4 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| | | upgrades | MI = 2 – Software and firmware updates and upgrades availability can be categorized as mid-term (class B, i.e., for a duration of time that reflects the expected average useful life of the product, cf. [b-EN 45554]). |
| | | | MI = 3 – Software and firmware updates and upgrades availability can be categorized as short-term availability (class C, i.e., available during a period of two years after the time of sale of the product, cf. [b-EN 45554]). |
| | | | MI = 4 – No information on duration of availability (class D, cf. [b-EN 45554]) is provided on software and firmware updates and upgrades availability. |
| | PD2: Scratch resistance | Resistance of housing parts subject to be scratched | MI = 1 – Plastic scratch resistance equal or greater than 2H regarding [b-ASTM D3363 – 05]. |
| | | | MI = 2 – Plastic scratch resistance equal or greater than H regarding [b-ASTM D3363 – 05]. |
| | | | MI = 3 – Plastic scratch resistance equal or greater than HB regarding [b-ASTM D3363 – 05]. |
| | | | MI = 4 – Plastic scratch resistance lower or equal to B regarding [b-ASTM D3363 – 05]. |
| | PD3: Maintenance support | Availability of consumables, wear-out parts expected to be replaced periodically<br>Availability of maintenance infrastructure | MI = 1 – Consumables and wear-out parts expected to be replaced periodically can be categorized as publicly available (class A in [b-EN 45554]) or as available to independent maintenance service providers (class B in [b-EN 45554]). |
| | | | MI = 2 – Consumables and wear-out parts expected to be replaced periodically can be categorized as available to manufacturer-authorized maintenance service providers (class C in [b-EN 45554]). |
| | | | MI = 3 – Consumables and wear-out parts expected to be replaced periodically can be categorized as available to the manufacturer only (class D in [b-EN 45554]). |
| | | | MI = 4 – Consumables and wear-out parts expected to be replaced periodically can be categorized as not available (class E in [b-EN 45554]). No maintenance infrastructure are offered by manufacturer. |
| | PD4: Robustness | **Examples of standard which can be considered.** NEMA Rating for Enclosures or IP Class according to [b-IEC 60529]. Drop test according to [b-IEC 60068-2-31] or [b-MIL-STD-810G] Method 516.7. Temperature endurance test according to [b-IEC 60068-2-1] Cold/Heat or [b-MIL-STD-810G] Method 501.6 and 502.6. | To be assessed depending on selected standards and type of equipment.<br>NOTE – See Gateway example Table I.3.<br><br>For most of these standards, the MI level is either 1 or 4 as they are pass/fail standards.<br><br>NEMA rating for enclosures or IP classes need to be judged depending on the assessed product as not all products need the highest levels of ingress protection. |

**Table 4 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| | | [b-ITU-T K.21] Recommendation (last version) for 'Enhanced' levels.<br>[b-IEC 61960-3] Electrical test acceptance criteria.<br>Battery protection software.<br>Earthquake testing according to GR-3108-CORE. | |
| | PD5: Battery for portable ICT goods | Battery longevity for portable ICT goods.<br>[b-IEC 62620] may be applicable to measure capacity. | MI = 1 for Li: Battery pack is chargeable to >80% of its original design capacity after 300 cycles. |
| | | | MI = 2 for Li: Battery pack is chargeable to >70% of its original design capacity after 300 cycles. |
| | | | MI = 3 for Li: Battery pack is chargeable to >60% of its original design capacity after 300 cycles. |
| | | | MI = 4 for Li: Battery pack is chargeable to <60% of its original design capacity after 300 cycles. |
| | PD6: Data security | Data management: Personal data to be deleted without compromising the functionality of the device.<br>NOTE – The classification can be undertaken in alignment with [b-EN 45554] | MI = 1 – Personal data can be erased, and password can be reset by user. Features are built-in and easily accessible.<br>Note – *MI*=1 can be selected also when no personal data is stored on the device assessed. |
| | | | MI = 2 – Personal data can be erased, or password can be reset with external software, freely available solutions. |
| | | | MI = 3 – Erasure of personal data and password reset is possible on request using services of the manufacturer. |
| | | | MI = 4 – Neither the personal data nor password can be manipulated by the user. |
| Ability to Recycle, Repair, Reuse, upgrade – equipment level | 3RUe1: Fasteners and connectors | Fasteners, connectors and tools used to disassemble parts that are likely to need replacement during the expected lifetime of the product are reusable/removable per [b-EN 45554] | MI = 1 – Fasteners and connectors can be categorized as reusable (class A, i.e., an original fastening system that can be completely re-used, or any elements of the fastening system that cannot be re-used are supplied with the new part for a repair, re-use or upgrade process, cf. [b-EN 45554]) and using no tools, basic tools or product specific tools (classes A-C as defined in [b-EN 45554]). |
| | | | MI = 2 – Fasteners and connectors can be categorized as removable (class B, i.e., an original fastening system that is not reusable, but can be removed without causing damage or leaving residue which precludes reassembly (in case of repair or upgrade) or re-use of the removed part (in case of re-use) for a repair, re-use or upgrade process, cf. [b-EN 45554]) and using no tools, basic tools or product specific tools (classes A-C as defined in [b-EN 45554]). |
| | | | MI = 3 – Fasteners and connectors can be categorized as removable or reusable using proprietary tools. |
| | | | MI = 4 – Fasteners and connectors can be categorized as neither removable nor reusable (class C, i.e., an original fastening system which is neither removable |

**Table 4 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| | | | nor reusable, as defined as in MI = 1 and MI = 2, for a repair, re-use or upgrade process, cf. [b-EN 45554]). |
| | 3RUe2: Diagnostic support | Diagnostic support classification by necessary interface | MI = 1 – Interface can be categorized as an intuitive interface (Class A) – cf. [b-EN 45554]. |
| | | | MI = 2 – Interface can be categorized as a coded interface with public reference table (Class B) or as a publicly available hardware / software interface (Class C) – cf. [b-EN 45554]. |
| | | | MI = 3 – Interface can be categorized as a proprietary interface (Class D) – cf. [b-EN 45554]. |
| | | | MI = 4 – Diagnostic is not possible with any type of interface (Class E) – cf. [b-EN 45554]. |
| | 3RUe3: Material recycling compatibilit y | Materials compatibility for joint recycling | MI = 1 – All of the following requirements shall be fulfilled;<br>1) plastic parts >25g do not contain metal inlets or fasteners that are moulded, heat or ultrasonically inserted or glued-in and cannot be separated by breaking off from the plastic part or with commonly available tools.<br>2) Plastic parts >100g do not have an adhesive, coating, paint or finish that is not compatible with recycled. Note – Plastic parts with >25% post-consumer recycled content and printed-circuit boards are exempt. Requirement does not apply to parts where such measures are required for safety, legal or technical requirements.<br>3) Plastic parts >25g are comprised of a single resin or combination of resins compatible for recycling and are separable by hand or with commonly available tools from other plastic parts >25g and not compatible for joint recycling.<br>NOTE – Printed circuit boards, wires and cables, connectors, electronic, optical, acoustic, ESD and EMI components are excluded. |
| | | | MI = 2 – Two of the requirements specified for MI = 1 are fulfilled. |
| | | | MI = 3 – One of the requirements specified for MI = 1 is fulfilled. |
| | | | MI = 4 – None of the requirements specified for MI = 1 is fulfilled. |
| | 3RUe4: Disassembl y depth | Number of steps necessary to reach the priority parts | To be assessed depending on selected standards and type of equipment.<br>NOTE – See Appendix I for an example. |
| | 3RUe5: Recycled/re newable plastics | Use of pre- or post-consumer recycled plastics<br>Note – Refers to plastics used in the ICT good itself. | MI = 1 – Total content of recycled and biobased plastics 75-100%. |
| | | | MI = 2 – Total content of recycled and biobased plastics 50-75%. |
| | | | MI = 3 – Total content of recycled and biobased plastics 25-50%. |
| | | | MI = 4 – Total content of recycled and biobased plastics 0-25%. |
| | 3RUe6: Material identificatio n | Materials identification according to ISO 11469. | MI = 1 – Markings to identify base materials as per [b-ISO 11469], [b-ISO 1043-1] (plastics), [b-ISO 1629] (rubbers) [b-ISO 18064] (thermoplastic elastomers), as well as fillers and reinforcing materials (ISO 1043-2), plasticizers (ISO 1043-3) and flame retardants (ISO 1043-4) |
| | | | MI = 2 – Markings to identify base materials as per [b-ISO 11469], [b-ISO 1043-1] (plastics), [b-ISO 1629] (rubbers) and [b-ISO 18064] (thermoplastic elastomers) |
| | | | MI = 3 – Markings to identify plastics as per [b-ISO 11469] and [b-ISO 1043-1]. |
| | | | MI = 4 – No markings to identify materials on any part. |

**Table 4 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| | 3RUe7: Hazardous substances | Reduction of bromine and chlorine | MI = 1 – Each plastic part in the product exceeding 0.5 g shall not contain greater than 1000ppm chlorine or greater than 1000 ppm bromine at the homogeneous level [b-IEEE 1680.1]. Test methods such as IEC 62321-3-1 and 62321-3-2 are recommended. [b-IEEE 1680.1].<br>NOTE – Parts which exceed 25% post-consumer recycled content may contain a maximum of 5000 ppm chlorine and a maximum of 5000 ppm bromine [b-IEEE 1680.1]. Power cords – in jurisdictions where PVC-free power cords have not been approved by safety agencies for use in the product – are exempted. [b-IEEE 1680.1]. |
| | | | MI = 2 – Each plastic part in the product exceeding 25g shall not contain greater than 1000ppm chlorine or greater than 1000ppm bromine at the homogeneous level. [b-IEEE 1680.1].<br>NOTE – Parts which exceed 25% post-consumer recycled content may contain a maximum of 5000 ppm chlorine and a maximum of 5000 ppm bromine. [b-[IEEE 1680.1]. Printed circuit boards, cables and wiring, fans and electronic components are excluded. [b-IEEE 1680.1]. |
| | | | MI = 3 – Parts exceed the concentrations of 1000ppm chlorine or 1000ppm bromine, but the manufacturer has carried out a hazard assessment and no viable alternative substances have been identified. [b-IEEE 1680.1].<br>Note – Notes as for MI = 1 and MI = 2 apply here as well. |
| | | | MI = 4 – The bromine and chlorine based substances content is unknown. |
| | 3RUe8: Critical Raw Materials | Declaration of Critical Raw Materials Content.<br>NOTE – CRMs are different for each region. Examples of defined CRM include L.1100 and the list of CRM for the EU [b-EU-CRM]. Each product has to choose the appropriate CRM list. | MI = 1 – Based on the CRM content assessment, design efforts have been carried out to substitute CRM and the results have been published. |
| | | | MI = 2 – An assessment according to EN 45558 has been carried out on all of the CRMs present in the product. |
| | | | MI = 3 – Indicative weight range assessment of at least two CRMs present in the product.<br>Note – Example for servers in Table I.7. |
| | | | MI = 4 – The CRM content is unknown. |
| | 3RUe9: Packaging recycling | Material recycling aspects included in the packaging | MI = 1 – All the aspects of material efficiency are considered for the packaging, by fulfilling all of the following four requirements:<br>1) Elimination of elemental chlorine as a bleaching agent used to bleach virgin or recovered fibres subsequently used in product packaging,<br>2) Elimination of the use of expanded polystyrene in product packaging,<br>3) Packaging is designed in a way that it allows reuse or recovery in alignment with [b-EN 13429] and [b-EN 13430],<br>4) Sum of the concentrations of intentionally added lead, cadmium, mercury and hexavalent chromium present in any packaging component (e.g., wrapping, box, cover, pallet, metal clips etc.) shall not exceed 100 ppm by weight. |
| | | | MI = 2 – Two or three of the requirements for MI = 1 for packaging material efficiency are fulfilled. |
| | | | MI = 3 – One of the requirements for MI = 1 for packaging material recycling is fulfilled. |
| | | | MI = 4 – None of the requirements for MI = 1 for packaging material recycling is fulfilled. |

**Table 4 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| Ability to Recycle, Repair, Reuse, upgrade – manufacturer level | 3RUm1: Service offered by manufacturer | Duration of Repair, Reuse, upgrade services | MI = 1 – RRU service availability can be categorized as long-term (class A, i.e., a repair, re-use or upgrade service, which the manufacturer offers for a duration of time that reflects the expected durability of the product, cf. [b-EN 45554]).<br>NOTE – Expected durability is the time a customer (the user of the ICT good) can expect the product to last (in its generation) before the next generation is entering the market. |
| | | | MI = 2 – RRU service availability can be categorized as mid-term (class B, i.e., a repair, re-use or upgrade service, which the manufacturer offers for a duration of time that reflects the expected durability of the product, cf. [b-EN 45554]).<br>NOTE – Expected average durability includes warranty returns and other early failures and is therefore lower than expected durability. |
| | | | MI = 3 – RRU service availability can be categorized as short-term (class C, i.e., a repair, re-use or upgrade service, which the manufacturer offers for two years after the time of sale of the product, cf. [b-EN 45554]). |
| | | | MI = 4 – No RRU service availability is offered. |
| | 3RUm2: Spare parts distribution | Availability of spare parts to different categories of persons/ organisations | MI = 1 – Spare parts are publicly available or available to independent repair service providers (Class A and Class B, as defined in [b-EN 45554]). |
| | | | MI = 2 – Spare parts are available to manufacturer-authorized repair service providers or available to the manufacturer only (Class C and Class D, as defined in [b-EN 45554]) in all the markets where the product is sold by the manufacturer. |
| | | | MI = 3 – Spare parts are available to manufacturer-authorized repair service providers or available to the manufacturer only (Class C and Class D, as defined in [b-EN 45554]) in limited markets where the product is sold by the manufacturer. |
| | | | MI = 4 – Spare parts are not available (Class E, as defined in [b-EN 45554]). |
| | 3RUm3: Spare parts availability | Duration of spare parts availability | MI = 1 – Spare parts availability can be categorized as long-term (class A, i.e., a repair, re-use or upgrade process, for which the required spare part(s) is/are available for a duration of time that reflects the expected durability of the product category, cf. [b-EN 45554]) |
| | | | MI = 2 – Spare parts availability can be categorized as mid-term (class B, i.e., repair, re-use or upgrade process, for which the required spare part(s) is/are available for a duration of time that reflects the expected average durability of the product, cf. [b-EN 45554])<br>Note – Average durability is lower than expected durability as the average takes into account the failure rate while the expected durability refers to the duration of the generation. |
| | | | MI = 3 – Spare parts availability can be categorized as short-term (class C, i.e., repair, re-use or upgrade process, for which the required spare part(s) is/are available during a period of two years after the time of sale of the product, cf. [b-EN 45554]) |
| | | | MI = 4 – No information on duration of availability is provided for spare parts (class D, i.e., repair, re-use or upgrade process, for which the required spare part(s) is/are available at the time of sale, but for which the duration of availability cannot be determined, cf. [b-EN 45554]). |
| | 3RUm4: Disassembly | Classification of information availability by | MI = 1 – Information is publicly available (class A, i.e., repair, re-use or upgrade process, for which the relevant information is available to all interested parties, cf. [b-EN 45554]). |

**Table 4 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| | information | comprehensiveness | MI = 2 – Information is available to independent repair service providers (class B, i.e., repair, re-use or upgrade process for which the relevant information is available to any self-employed professional, as well as any legally established organization, providing repair services, cf. [b-EN 45554]). |
| | | | MI = 3 – Information is available to manufacturer-authorized repair service providers (class C, i.e., repair, re-use or upgrade process, for which the relevant information is available to service providers authorized by the product manufacturer to offer repair services, cf. [b-EN 45554]). |
| | | | MI = 4 – Information is available to the manufacturer only (class D, i.e., repair, re-use or upgrade process, for which the relevant information is available to the product manufacturer, cf. [b-EN 45554]). |
| | 3RUm5: Collection and recycling programmes | Participation of designated collection programs | MI = 1 – A designated collection program for refurbish, remanufacturing, repair and a designated selective, recycling program for specific parts of ICT goods (e.g., specific recycling process able to recover Germanium from optical fibre, Tantalum from Tantalum capacitors or Indium from LCD/OLED displays, etc.). |
| | | | MI = 2 – A designated collection program for refurbish, remanufacturing, repair and a designated recycling program exist for specific ICT goods (e.g., IT and telecommunications equipment for European WEEE handled by smelters to recovers precious metals). |
| | | | MI = 3 – A designated collection or a designated recycling program exist. |
| | | | MI = 4 – Neither designated collection nor designated recycling program exist. |
| | 3RUm6: Environmental footprint assessment knowledge publicly available | Knowledge on the equipment environmental footprint | MI = 1 – An [b-ISO 14040] / [b-ISO 14044] or [b-ITU-T L.1410] compliant life cycle assessment (LCA) has been carried out on the ICT good and the results have been published. |
| | | | MI = 2 – A simplified environmental footprint assessment (e.g., screening LCA, environmental footprint assessment on one environmental indicator such as carbon footprint, etc.) has been carried out on the ICT good and the results have been published. |
| | | | MI = 3 – An environmental footprint assessment on a similar type of ICT good has been studied and the results have been published. |
| | | | MI = 4 – Neither an environmental footprint assessment have been done on the ICT good, nor an environmental footprint assessment on a similar type of equipment have been published. |

## 7.3 Step 3 – Calculating the circularity score (Score) of the product

To identify the criteria that are most important to be incorporated into a product design, it is necessary to calculate the circularity score (score).

The values assigned to and used to calculate the score of an ICT good, which would allow designers to identify which groups listed in Table 1 are most important to be incorporated, more so than others in their product design in order to improve its circularity.

Once the R and MI values are decided following steps 1 and 2, it will be possible to calculate the score of an ICT good for each group using (1):

$$Score = R \times MI \quad (1)$$

For instance, if a product does not at all meet a criterion, then its MI is very high (Table 3). Therefore, a numerical value of 4 is assigned. If this criterion is very relevant, or belongs to a group that is very relevant for this product category/type, then the numerical value of 4 (Table 2) is assigned to R. In this case, the theoretical score for this product is 4(*R*) × 4(*MI*) = 16.

In another instance, if a product has slightly met a criterion, then its MI is high (Table 3). Therefore, a numerical value of 3 is assigned. If this criterion belongs to a group that is not at all relevant for this product category/type, then its R is very low and the numerical value of 1 (Table 2) is assigned. In this case, the theoretical score for this product is 1(*R*) × 3(*MI*) = 3.

However, the present method aims to reward circularly designed ICT goods with high % values and less circularly designed ICT goods with low % values.

NOTE – 0% is the worst score and 100% the best possible score.

This requires some development of the scoring as described in Appendix II and [b-AndraeVaija] – compared to the baseline method [b-Bovea].

Figure 1 shows the translation of R and MI combinations to values between 0% and 100%.

| | | R | | | |
|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** |
| **MI** | **1** | 55 | 75 | 90 | 100 |
| | **2** | 50 | 60 | 70 | 80 |
| | **3** | 40 | 35 | 30 | 15 |
| | **4** | 25 | 20 | 10 | 0 |

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**Figure 1 – Matrix with values for *MI* and *R* combinations**

With the score determined, it will then be possible to identify the criteria for improving a product's circularity. For instance, if the score of ICT good A is 0% in the PD category (i.e., Very High *MI* = 4 and Very High *R* = 4), it means that it is very urgent to redesign the product by improving the criteria (incorporating the corresponding guidelines) from the PD group found in Table 1. Conversely, if the score of ICT good A is 100% in the 3RUe group (i.e., Very Low *MI* and Very High *R*), it means that no urgent action is needed to improve the product design from an 3RUe standpoint.

In addition, at this stage it is possible to review the list of criteria applied to the ICT good. Indeed, some of them might not be relevant (*R* = 0), due to the ICT good design or business model, whereas some might be missing in order to describe the effort needed to improve its circularity. For example, for an ICT good that will undergo a refurbishment process during its lifespan it could be interesting to consider the scratch resistance (PD2) of the housing parts, as they might be reused as spare parts. This exercise is carried out on a gateway (see Table I.4).

The scale used by the score assessment method represents the level of circularity for a particular product design (including manufacturer services) and the urgency to incorporate different criteria. They are graded differently depending on the average *Score* at *Group* level.

These average total scores on group level are obtained by calculating the average of the scores for the criteria contained in the group.

For instance, the PD contains six criteria. Again, PD1, PD2,…PD6 are obtained by finding the scores between 0 and 100 for each R×MI combination in Figure 1. Thus, the average score for PD is equal to: $\frac{PD1+PD2+PD3+PD4+PD5+PD6}{6}$. Non-relevant criteria shall be removed from the average calculation. For example, if *PD6* is not relevant, the average score for PD is equal to: $\frac{PD1+PD2+PD3+PD4+PD5}{5}$.

The scores obtained by the assessment method in the present document provides designers a clue of a product's circularity performance, allowing them to improve the criteria and groups that have the lowest scores.

Table 5 shows how e.g., a designer or system engineer may interpret the score for each group.

**Table 5 – The level of urgency of score for each group**

| Circularity score in % | Urgency level explanation |
|---|---|
| 81-100 | Does not require any urgent actions |
| 61-80 | Does not require very urgent actions |
| 41-60 | Efforts should be made to improve, but not so urgent |
| 21-40 | It is urgent to improve |
| 0-20 | It is very urgent to improve |

Appendix I illustrates an application of the present methodology to one ICT good.

# Appendix I

## Examples of application of the methodology

(This appendix does not form an integral part of this Recommendation.)

### I.1 Gateway example

The following example applies the present three-step method to an ICT good – a gateway (Tables I.1 to I.6).

The scoring will be done according to the list of 21 criteria from Table 4 in the main body of the Recommendation. The groups and criteria are also displayed in Table I.1.

**Table I.1 – Empty table with the 21 criteria distributed in the three groups**

| Equipment: Gateway Gen Z | | | |
|---|---|---|---|
| **Circular Design Guidelines Group (CDGG)** | **Criteria** | **Relevance (R)** | **Margin of improvement (MI)** |
| Product durability | PD1: Software and data support | | |
| | PD2: Scratch resistance | | |
| | PD3: Maintenance support | | |
| | PD4: Robustness | | |
| | PD5: Battery for portable ICT goods | | |
| | PD6: Data security | | |
| Ability to recycle, repair, reuse, upgrade - equipment level | 3RUe1: Fasteners and connectors | | |
| | 3RUe2: Diagnostic support | | |
| | 3RUe3: Material recycling compatibility | | |
| | 3RUe4: Disassembly depth | | |
| | 3RUe5: Recycled/renewable plastics | | |
| | 3RUe6: Material identification | | |
| | 3RUe7: Hazardous substances | | |
| | 3RUe8: Critical raw materials | | |
| | 3RUe9: Packaging recycling | | |
| Ability to recycle, repair, reuse, upgrade - manufacturer level | 3RUm1: Service offered by manufacturer | | |
| | 3RUm2: Spare parts distribution | | |
| | 3RUm3: Spare parts availability | | |
| | 3RUm4: Disassembly information | | |
| | 3RUm5: Collection and recycling programmes | | |
| | 3RUm6: Environmental footprint assessment knowledge publicly available | | |

For each criterion the scoring is determined as follows:

– **Scoring for R**:

The type of equipment (i.e., a gateway), its business model (equipment rent to customers and recovered by the operator to be refurbished, sometimes several times during its lifespan), the results of life cycle assessments (LCAs) on this type of equipment and the economic aspects (for example total cost of ownership) have been taken into account to assess the values for *R*.

For instance, all gateways will be refurbished several times during their lifecycle, thus it is critical to be able to disassemble them quickly. Thus *R* = 4 (most relevant) for the criterion 3RUe4 regarding disassembly depth.

In contrast, as the operator owns the equipment and the customers have to return the equipment to the operator at the end of their subscription, the availability of spare parts to customers is not really relevant. The operator is in charge of all the repair and refurbishment operations, which are carried out by the equipment manufacturer or third party companies. Thus *R* = 1 (least relevant) for the criterion 3RUm2 regarding spare parts distribution.

As the equipment does not contain any battery (be it primary or secondary ones) the criterion PD5 regarding battery longevity is irrelevant. Thus, for this gateway, *R* = 0 for the criterion PD5. Hence, this criterion will no longer be mentioned in the following tables.

– Scoring for MI:

The scoring for MI is done according to the performance levels defined in the Table 4 of the Recommendation. However, for some of them the performance levels have to be defined at equipment type level, as the levels are very different from one equipment type to another.

For instance, Table I.2 shows the four levels of MI for the criterion 3RUe4 regarding **d**isassembly depth.

**Table I.2 – Scoring example of criterion 3RUe4**

| | | |
|---|---|---|
| 3Rue4: Disassembly depth | Number of steps necessary to reach priority parts | MI = 1 – All the priority parts for repair operations are accessible after one or two disassembly steps |
| | | MI = 2 – All the priority parts for repair operations are accessible after three or four disassembly steps |
| | | MI = 3 – All the priority parts for repair operations are accessible after five or six disassembly steps |
| | | MI = 4 – All the priority parts for repair operations are accessible after more than six disassembly steps |

For the gateway studied in this example the priority part for repair operation is the printed circuit board assembly. In order to be able to reach it, three operations have to be carried out:

– 1/ remove screws which fasten the top enclosure to the bottom enclosure;

– 2/ remove the top enclosure;

– 3/ remove the printed circuit board assembly which is fastened with two snap-fits (i.e., clips) on the bottom enclosure.

According to Table I.2, this performance level is equal to MI = 2.

The four levels of MI for PD4 regarding robustness are shown in Table I.3.

**Table I.3 – Scoring example of criterion PD4**

| | | |
|---|---|---|
| PD4: Robustness | – Wear and damage resistance [b-MIL-STD-810H]<br>– NEMA ratings for enclosures<br>– IP Class<br>– [b-IEC 60068-2-31] free fall standard<br>– [b-ITU-T K.21] (last version) for "Enhanced" levels | MI = 1 – The product's design features better characteristics than the average ones for its product type for NEMA and IP Class. When applicable, it is also compliant with [b-MIL-STD-810H], [b-IEC 60068-2-31] and Recommendation ITU-T K..21 (last version) for "Enhanced" levels. |
| | | MI = 2 – The product's design features average characteristics for NEMA and IP Class regarding the product type. It does not comply with [b-MIL-STD-810H], [b-IEC 60068-2-31] or [b-ITU-T K.21] (last version) for "Enhanced" levels. |
| | | MI = 3 – The product's design features worse characteristics than the average ones for its product type for NEMA and IP Class. It does not comply with [b-MIL-STD-810H], [b-IEC 60068-2-31] or [b-ITU-T K.21] (last version) for "Enhanced" levels. |
| | | MI = 4 – The product's design features lowest possible NEMA or IP Class. It does not comply with [b-MIL-STD-810H], [b-IEC 60068-2-31] or [b-ITU-T K.21] (last version) for "Enhanced" levels. |

For the studied gateway the NEMA and IP class are average for the product type and it does comply with [b-ITU-T K.21] for "enhanced" level. Thus, according to Table I.3, the performance level is equal to MI = 2.

Other criteria are calculated likewise to obtain the remaining R×MI pairs (Table I.4).

**Table I.4 – All applicable R and MI values for the gateway example**

| Equipment: Gateway Gen Z | | | |
|---|---|---|---|
| **Circular Design Guidelines Group (CDGG)** | **Criteria** | **Relevance (R)** | **Margin of improvement (MI)** |
| Product Durability | PD1: Software and data support | 4 | 1 |
| | PD2: Scratch resistance | 4 | 2 |
| | PD3: Maintenance support | 2 | 2 |
| | PD4: Robustness | 3 | 2 |
| | PD6: Data security | 2 | 2 |
| Ability to Recycle, Repair, Reuse, Upgrade - equipment level | 3RUe1: Fasteners and connectors | 3 | 1 |
| | 3RUe2: Diagnostic support | 4 | 3 |
| | 3RUe3: Material recycling compatibility | 3 | 1 |
| | 3RUe4: Disassembly depth | 4 | 2 |
| | 3RUe5: Recycled/renewable plastics | 2 | 1 |
| | 3RUe6: Material identification | 2 | 3 |
| | 3RUe7: Hazardous substances | 3 | 2 |

**Table I.4 – All applicable R and MI values for the gateway example**

| Equipment: Gateway Gen Z | | | |
|---|---|---|---|
| **Circular Design Guidelines Group (CDGG)** | **Criteria** | **Relevance (R)** | **Margin of improvement (MI)** |
| | 3RUe8: Critical raw materials | 2 | 4 |
| | 3RUe9: Packaging recycling | 2 | 2 |
| Ability to recycle, repair, reuse, upgrade - manufacturer level | 3RUm1: Service offered by manufacturer | 4 | 1 |
| | 3RUm2: Spare parts distribution | 1 | 2 |
| | 3RUm3: Spare parts availability | 4 | 1 |
| | 3RUm4: Disassembly information | 1 | 3 |
| | 3RUm5: Collection and recycling programmes | 2 | 2 |
| | 3RUm6: Environmental footprint assessment knowledge publicly available | 3 | 3 |

Note that the criterion PD5: Battery is no longer mentioned in this table as this criterion is irrelevant for the studied product (R = 0).

The score of each criterion is then calculated according to its *R* and *MI* results, combined with the matrix presented in Figure 1 (*Score* matrix with values for *MI* and *R* combinations). For instance, for the criterion 3RUe4 regarding **d**isassembly depth according to the assessment carried out previously the results are R = 4 (most relevant) and MI = 2. According to Figure 1 this combination of R and MI gives a score of 80.

The same process is applied to identify the scores of the other criteria, according to their R and MI results displayed in Table I.4. Table I.5 shows the results of these efforts.

**Table I.5 – Scores for all criteria**

| Equipment: Gateway Gen Z | |
|---|---|
| **Circularity score** | **Criteria** |
| 100 | PD1: Software and data support |
| 80 | PD2: Scratch resistance |
| 60 | PD3: Maintenance support |
| 70 | PD4: Robustness |
| 60 | PD6: Data security |
| 90 | 3RUe1: Fasteners and connectors |
| 15 | 3RUe2: Diagnostic support |
| 90 | 3RUe3: Material recycling compatibility |
| 80 | 3RUe4: Disassembly depth |
| 75 | 3RUe5: Recycled/renewable plastics |
| 60 | 3RUe6: Material identification |
| 70 | 3RUe7: Hazardous substances |
| 20 | 3RUe8: Critical raw materials |
| 60 | 3RUe9: Packaging recycling |
| 100 | 3RUm1: Service offered by manufacturer |

**Table I.5 – Scores for all criteria**

| Equipment: Gateway Gen Z | |
|---|---|
| **Circularity score** | **Criteria** |
| 50 | 3RUm2: Spare parts distribution |
| 100 | 3RUm3: Spare parts availability |
| 40 | 3RUm4: Disassembly information |
| 60 | 3RUm5: Collection and recycling programmes |
| 30 | 3RUm6: Environmental footprint assessment knowledge publicly available |

The next step is to calculate the score at group level. These scores are obtained by calculating the average of the score for the criteria contained in the group.

For instance, the product durability group contains 6 criteria, but only 5 are relevant for the studied equipment. According to Table I.5 their scores are:

– PD1: 100

– PD2: 80

– PD3: 60

– PD4: 70

– PD6: 60

Thus, the score for product durability is equal to: $\frac{100+80+60+70+60}{5} = 74$

NOTE – The criterion PD5 on battery longevity is not taken into account in the calculation.

Likewise, the scores for the other groups are calculated. Table I.6 shows the result.

**Table I.6 – Circularity score results for all groups**

| Equipment: Gateway Gen Z | |
|---|---|
| **Circularity score** | **Circular Design Guidelines Group (CDGG)** |
| 74 | Product durability |
| 62 | Ability to recycle, repair, reuse, upgrade – equipment level |
| 63 | Ability to recycle, repair, reuse, upgrade – manufacturer level |

A radar type chart can finally be used for a better graphical representation and help in understanding which group should be improved and the ones that already have good scores. Figure I.1 shows the results for the gateway studied in this appendix.

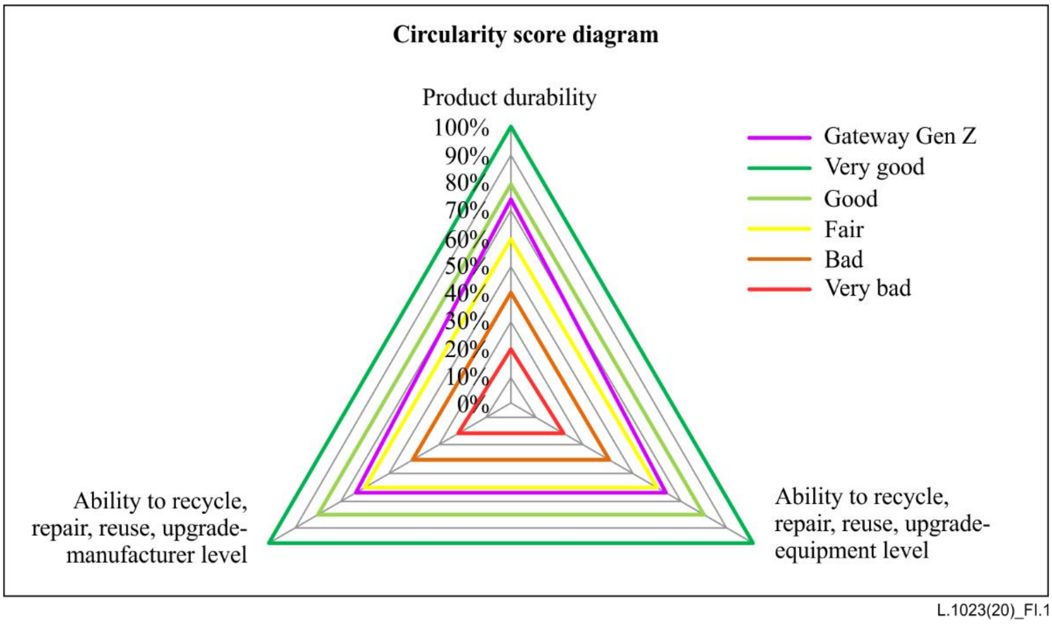


**Figure I.1 – Radar chart for the gateway according to group scores from Table I.6**

## I.2 Server example

Table I.7 shows another suggestion for 3Rue8 *MI* levels for servers.

**Table I.7 – Suggestion for 3Rue8 MI levels for CRMs in servers**

| | | |
|---|---|---|
| 3RUe8: Critical raw materials | Declaration of critical raw materials content | MI = 1 – Based on the CRM content assessment, design efforts have been carried out to substitute CRM. |
| | | MI = 2 – An assessment has been carried out on the CRM content (cf. EN 45558). |
| | | MI = 3 – Indicative weight range (less than 5 g, between 5 g and 25 g, above 25 g) at component level, of the at least two critical raw materials is available (cf. [b-EU 2019/424] for servers). |
| | | MI = 4 – The CRM content is unknown. |

# Appendix II

## Rationale for scoring tables

(This appendix does not form an integral part of this Recommendation.)

The first step of the approach is to fill a matrix of combinations with some pertinent values. To facilitate this process, 5 levels from A (the best score) to E (the worst score) are considered. Figure II.1 shows the completed matrix.

| | | R | | | |
|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** |
| **MI** | **1** | C | B | A | A |
| | **2** | C | B | B | A |
| | **3** | C | D | D | E |
| | **4** | D | D | E | E |

L.1023(20)_FII.1

**Figure II.1 – A to E matrix for MI and R**

The progression is linear from the lowest score to the highest (for example with the best scoring located in the top-left corner and the worst one in the bottom-right).

Then each level in a range of 20% is translated as followed:

– A = [100%; 80%]

– B = [80%; 60%]

– C = [60%; 40%]

– D = [40%; 20%]

– E = [20%; 0%]

Once again, the matrix is filled with appropriate score for each letter. (Figure II.2)

| | | R | | | |
|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** |
| **MI** | **1** | 55 | 75 | 90 | 100 |
| | **2** | 50 | 60 | 70 | 80 |
| | **3** | 40 | 35 | 30 | 15 |
| | **4** | 25 | 20 | 10 | 0 |

L.1023(20)_FII.2

**Figure II.2 – 0% to 100% matrix for *MI* and *R***

Then a formula is derived that combines MI and R to reach the % scores in Figure II.2. As the progression of the scores in Figure II.2 is not linear the resulting equation (II.1) allowing calculation of each cell score is rather complex.

$$Score\ for\ MI, R\ combination$$
$$= \left(\left(\frac{1}{3} \times \boldsymbol{MI}^3 - 2.5 \times \boldsymbol{MI}^2 + \frac{25}{6} \times \boldsymbol{MI}\right) \times \boldsymbol{R}^2 + \frac{45}{\boldsymbol{MI}} + 20.75\right) \times \frac{100}{97.75} \quad \text{(II.1)}$$
$$(expressed\ in\ \%)$$

By using equation (II.1) the Table *Scores* can be recalculated, as displayed in Figure II.3.

NOTE – If the range for R and MI is susceptible to be changed (e.g., someone wants to try a 1 to 5 range for both metrics) a new formula – to calculate the scores for the new combinations (e.g., [*R*=5; *MI*=5]) – is required.

In the current situation with fixed ranges for R and MI the scores in Figure II.2 could be considered directly.

| | | R | | | |
|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** |
| **MI** | **1** | 70 | 76 | 86 | 100 |
| | **2** | 45 | 48 | 53 | 60 |
| | **3** | 35 | 32 | 27 | 20 |
| | **4** | 30 | 24 | 14 | 0 |

L.1023(20)_FII.3

**Figure II.3 – 0% to 100% matrix for MI and R based on equation (II.1)**

# Appendix III

## Additional groups and criteria which may be relevant for certain ICT goods

(This appendix does not form an integral part of this Recommendation.)

Further groups and criteria examples may be developed which are only valid for a certain type of ICT good. Tools which is mentioned in [b-EN 45554] could be such an example outlined in Table III.1.

**Table III.1 – Guidance for identification of MI level for each criterion**

| Group | Criterion | Guidance for identification of MI level of any ICT good | Scoring system (1-4) examples (to be adjusted according to product) |
|---|---|---|---|
| 3RUe | 3RUeIII.1: Tools | Tools required for repair operations per [b-EN 45554] | MI = 1 – Repair operations are feasible with no tools, basic tools, tools supplied with the product or spare part and/or product specific tools (as defined in [b-EN 45554]). |
| | | | MI = 2 – Repair operations are feasible with other commercially available tools (as defined in [b-EN 45554]). |
| | | | MI = 3 – Repair operations are feasible with proprietary tools (as defined in [b-EN 45554]). |
| | | | MI = 4 – Repair operations are not feasible with any existing tool (as defined in [b-EN 45554]). |

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