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Environmental Engineering (EE); Method for environmental performance scoring of smartphones

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Foreword

This final draft ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE), and is now submitted for the ETSI Membership Approval Procedure.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

In 2019, ITU-T Study Group 5 Question 7 (Q7) published Recommendation ITU-T L.1015 [i.1] "Criteria for evaluation of the environmental impact of mobile phones". Recommendation ITU-T L.1015 contains many relevant indicators related to the environmental impacts of mobile phones, but no standardised scoring methodology. Additional documents of relevance produced by Q7 include scoring methods for environmental health and safety performance of true wireless stereo headphones (Recommendation ITU-T L.1016 [i.3]) and circularity performance scoring for ICT goods (Recommendation ITU-T L.1023 [i.2] in 2020 and just recently an update in 2023).

ETSI TC EE Working Group M-ICT "Environmental matters associated with Mobile ICT Devices" is dedicated exactly to the intended scope and purpose of these kinds of scoring methods.

European and international markets are in need of a standardized scoring method for the environmental performance of smartphones which goes beyond just reparability criteria and can provide a more robust foundation for non-LCA based Green Claims. Features of such a method include:

- Additional indicators to differentiate best performing products that reach beyond regulatory requirements.
- Definition of weightings to combine all indicators into a single score.

Environmental impact calculations for smartphones - e.g. using Life Cycle Assessment (LCA) - are made in different ways and therefore absolute numbers (e.g. kg CO2e) calculated in different ways cannot currently be compared. Still, the ability to use LCA is very important in order to identify and reduce the environmental impact footprint of individual products.

The present document was developed jointly by the European Telecommunications Standards Institute Technical Committee Environmental Engineering (ETSI TC EE) and ITU-T Study Group 5. It is published as Recommendation ITU-T L.1017 [i.15] and ETSI ES 204 079 (the present document), which are technically equivalent, by ITU and ETSI, respectively.

1 Scope

The objective of the present document is to provide a standardized method to assess the environmental performance of smartphones. A method to arrive at an aggregate score reflecting the overall environmental performance is defined which takes into account material efficiency and Life Cycle Assessment (LCA) aspects. The following attributes of a smartphone are evaluated:

- Durability.
- Reparability, reusability and upgradeability.
- Recyclability and recoverability.
- Use of hazardous or restricted substances.
- Use of recycled materials.
- Packaging and Accessories.
- Environmental impacts.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] IEC 60529 :1989+AMD1:1999+AMD2:2013 CSV Consolidated version: "Degrees of protection provided by enclosures (IP Code)".

[2] IEC 60068-2-31:2008: "Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens".

[3] IEC 61960-3:2017: "Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications - Part 3: Prismatic and cylindrical lithium secondary cells and batteries made from them".

[4] EN ISO 6769:2022: "Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys" (produced by CEN).

[5] EN 45554:2020: "Material efficiency aspects for products in scope of Ecodesign legislation" (produced by CEN).

[6] EN 45557:2020: "General method for assessing the proportion of recycled material content in energy-related products" (produced by CEN).

[7] ISO 14040: "Environmental management -- Life cycle assessment -- Principles and framework".

[8] ETSI ES 203 199 (02-2015): "Environmental Engineering (EE); Methodology for environmental Life Cycle Assessment (LCA) of Information and Communication Technology (ICT) goods, networks and services".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references,only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Recommendation ITU-T L.1015 (2019): "Criteria for evaluation of the environmental impact of mobile phones".

[i.2] Recommendation ITU-T L.1023 (2023): "Assessment method for circularity performance scoring".

[i.3] Recommendation ITU-T L.1016 (2022): "Method for evaluation of the environmental health and safety performance of true wireless stereo headphones".

[i.4] Commission Regulation (EU) 2023/1670 of 16 June 2023 laying down ecodesign requirements for smartphones, mobile phones other than smartphones, cordless phones and slate tablets pursuant to Directive 2009/125/EC of the European Parliament and of the Council and amending Commission Regulation (EU) 2023/826.

[i.5] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE).

[i.6] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

[i.7] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

[i.8] Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC.

[i.9] Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC.

[i.10] Globally harmonized system of classification and labelling of chemicals (GHS) - United Nations.

[i.11] IEC 61249-2-21:2003: "Materials for printed boards and other interconnecting structures - Part 2-21: Reinforced base materials, clad and unclad - Non-halogenated epoxide woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad".

[i.12] Compatibility of polymers for recycling are described in Pahl, G., Beitz, W., Engineering design: A systematic Approach. Great Britain: Springer-Verlag London Limited, 1996.

[i.13] 2019/771/EU: "Directive (EU) 2019/771 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the sale of goods, amending Regulation (EU) 2017/2394 and Directive 2009/22/EC, and repealing Directive 1999/44/EC".

[i.14] NIST Special Publication 800-88: " Guidelines for Media Sanitization".

[i.15] Recommendation ITU-T L.1017: "Method for environmental performance scoring of smartphones".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

environmental aspect: element of an organization's activities or solutions that determines the environmental impact

NOTE: The Durability, 3RU and Use of hazardous and restricted substances outlined in this Recommendation are examples of environmental aspects.

environmental assessment: evaluation and interpretation of results and impacts from an environmental measurement

environmental indicator: metric used to measure one or more environmental aspects

NOTE: The D_n, $3RU_n$ and HR_n outlined in this Recommendation (e.g. D1) are examples of environmental indicators.

environmental measurement: process to help determine the environmental performance through collection, calculation or compilation of data or information

environmental performance: degree to which a set of environmental aspects align with the principles for a circular economy and low environmental impact

NOTE: The Environmental Performance Scores obtained by the framework outlined in this Recommendation are examples of environmental performance.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

BAT	Battery
BC	Back Cover
BUT	mechanical Button
DA	Display Assembly
EC	External Charging port
EIE	Environment Impact Evaluation
FFC	Front Facing Camera
FM	Folding Mechanism
FSC	Forest Stewardship Council®
IPxx	Ingress Protection
LCA	Life Cycle Assessment
MIC	Microphone
PA	Packaging and Accessories
PEFC	Programme for the Endorsement of Forest Certification schemes
RCM	Recycled Materials
RFC	Rear Facing Camera
RoHs	Restriction of Hazardous substances
RR	Recyclability and Recoverability
RRU	Repairability, Reusability, Upgradeability
SPK	Speaker
TS	Total environment performance Score

4 Methodology

The environmental performance of smartphones can be evaluated by addressing material efficiency and through consideration of life cycle assessment of environmental impacts.

The environmental performance of smartphones in terms of material efficiency can be evaluated by analysing three impact groups: durability (clause 6.1), repairability, reusability, upgradeability (clause 6.2) and material impacts (clause 6.3). The material impacts impact group consists of five aspects:

i) recyclability and recoverability;

ii) use of hazardous or restricted substances;

iii) use of recycled materials;

iv) packaging and accessories; and

v) environmental impact.

The total environmental performance score is calculated as follows:

$$TS_x = \frac{\mathrm{D+RRU+M}}{3} \quad (1)$$

where:

- *TS* = Total Environmental Performance Score
- *x* = Smartphone model
- *D* = Aggregated score for the aspect Durability (see clause 6.1)
- RRU = Aggregated Score for the aspect Repairability, Reusability, Upgradeability (see clause 6.2)
- M = Aggregated Score for the aspect Material impacts (see clause 6.3)

The aggregated score for Durability is calculated as an average of the maximum possible durability indicators as follows:

$$D = \frac{\sum_i D_i}{5i} \quad (2)$$

where:

- *D* = Aggregated score for the aspect Durability (see clause 6.1)
- D_i = Score for Durability indicator *i*
- *i* = number of included Durability indicators

The aggregated score for Repairability, Reusability, Upgradeability is calculated an average of the maximum possible indicators as follows:

$$RRU = \frac{\sum_i RRU_i}{5i} \quad (3)$$

where:

- *RRU* = Aggregated score for the aspect Repairability, Reusability, Upgradeability (see clause 6.2)
- RRU_i = Score for Repairability, Reusability, Upgradeability indicator *i*
- *i* = number of included Repairability, Reusability, Upgradeability indicators

The aggregated score for Material impacts is calculated as an average of the maximum possible indicators as follows:

$$M = \frac{\sum_i RR_i + \sum_i HR_i + \sum_i RCM_i + \sum_i PA_i + \sum_i EIEC_i}{5i} \quad (4)$$

where:

- M = Aggregated score for the aspect Material impact (see clause 6.3)
- RR_i = Score for Recyclability and Recoverability indicator i (see clause 6.3.1)
- HR_i = Score for Hazardous and Restricted substances indicator i (see clause 6.3.2)
- RCM_i = Score for Recycled Materials indicator i (see clause 6.3.3)
- PA_i = Score for Packaging and Accessories indicator i (see clause 6.3.4)
- EIE_i = Score for Environmental Impact indicator i (see clause 6.3.5)
- i = number of included Material impacts indicators

5 Conformance with regulations

To help users of the present document with designing new smartphones, indicators based on legal requirements in the EU are listed in Table A.1 in Annex A.

NOTE: At the time of writing, the Level 1 of the respective indicators in the following clauses match the EU minimum regulatory requirements as displayed in Annex A.

6 Material efficiency and environmental impact aspects

6.1 Durability

Table 1 lists the requirements for the evaluation of the Durability aspect (D) of smartphones.

Table 1: Durability indicators

No.	Indicator	Score				
		1	2	3	4	5
D1	Warranty for the smartphone and its components	2 years		3 years		> 3 years
D2	Dust protection	IP4x		IP5x		IP6x
D3	Water Protection	IPx4	IPx5	IPx6	IPx7	IPx8
D4	Drop resistance for non-foldable phones [number of drops]	45 < x ≤ 90	90 < x ≤ 180	180 < x ≤ 270	270 < x ≤ 300	x > 300
	Drop resistance for foldable phones [number of drops]	35 ≤ x in unextended state 15 ≤ x in fully extended state	70 ≤ x in unextended state 25 ≤ x in fully extended state	140 ≤ x in unextended state 35 ≤ x in fully extended state	210 ≤ x in unextended state 45 ≤ x in fully extended state	245 ≤ x in unextended state 55 ≤ x in fully extended state
D5	Battery life (full charge cycles)	800 = x cycles with remaining capacity ≥ 80 %		800 ≤ x < 1 000 cycles with remaining capacity ≥ 80 %	1 000 ≤ x < 1 200 cycles with remaining capacity ≥ 80 %	x ≥ 1 200 cycles with remaining capacity ≥ 80 %
D6	Scratch resistance (non-foldable displays)	Mohs level 4		Mohs level 5	Mohs level 6	Mohs level 7
D7	Number of full extension – fold cycles for foldable displays	X < 200 000 x	200 000 ≤ x < 265 000	265 000 ≤ x < 330 000	330 000 ≤ x < 400 000	x ≥ 400 000
D8	Period of availability of OS support (Provision of security updates, corrective updates or functionality updates to OS, at no cost from the date of end of placement on the market)	5 years		6 years		7 years

Additional explanation on indicators:

D1. Warranty includes the battery. It does not need to include other accessories such as headsets, battery chargers, etc. If the warranty differs between the smartphone and battery, the shorter is used for the assessment.

D2. IEC 60529 [1] is used for the assessment.

D3. IEC 60529 [1] is used for the assessment.

D4. IEC 60068-2-31 [2], Free fall repeated - Procedure 2.

D5. IEC 61960-3:2017 [3], Endurance in cycles, at a rate of 0,2 I_t A is used for the assessment.

D6. EN ISO 6769:2022 [4].

D7. There is no current standard testing methodology for this indicator. Manufacturers shall adopt a testing approach that is reproducible, providing consistent results under the same conditions, and repeatable, ensuring consistent outcomes across multiple trials. It shall be objective, minimizing human bias and error through standardized procedures.

6.2 Reparability, Reusability and Upgradeability

Table 2 lists the requirements for the evaluation of the Reparability, Reusability and Upgradeability (RRU) aspect of smartphones.

Table 2: Reparability, reusability and upgradability

No.	Indicators	Score				
		1	2	3	4	5
RRU1	Duration of availability of spare parts from the date of end of placement on the market (Spare parts may be equivalent, manufacturer-approved parts)	front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism, back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray and battery available for 7 years	back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray and battery = 8 years. front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism and battery = 7 years	front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism, back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray and battery available for 8 years	back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray and battery = 9 years, front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism and battery = 8 years	front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism, back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray and battery available for 9 years

No.	Indicators	Score				
		1	2	3	4	5
RRU2	Target group availability of spare parts See note 1	the back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray and battery and display assembly to end users, all other to professional repairers		the back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray, battery, display assembly, and charging port to end users, all other to professional repairers		front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism, parts list 2 and battery are available to end users
RRU3	Availability of repair, reuse and upgrade information for smartphone See note 2	Available only to independent operators at a reasonable price	Available to independent operators and end-users at a reasonable price	Available to independent operators at no cost	Available to independent operators at no cost and end users at a reasonable price	Available to independent operators and end users at no cost
RRU4	Use of standardized parts for front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism, back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray and battery	Professional repairers have non-discriminatory access to all software tools, procedures etc. needed to ensure the full functionality of the parts and of the device when a part is replaced.		Batteries are standardized parts that are available for purchase from more than one manufacturer. Digital files to enable the 3D printing of all plastic parts greater than 1 gram in weight are published for free-access online.		All replacement parts are accepted without the need for manufacturer authorization of any kind and with no degradation in functionality. Batteries and cameras are standardized parts that are openly available. Digital files for all plastic parts greater than 1 gram in weight are published for free-access online.
RRU5	Disassembly depth/sequence	See Table 3 below				
RRU6	Types of fasteners and accessibility	See Table 4 below				
RRU7	Type of tools needed for disassembly	See Table 5 below				
NOTE 1: Applicable if it does not conflict with manufacturers export control obligations. NOTE 2: Trade secrets are excepted. Applicable if it does not conflict with manufacturers export control obligations.						

The score for RRU5, RRU6 and RRU7 are aggregated and normalised scores. The 'Disassembly Depth' (SDD) RRU5, 'Fasteners (type)' (SF) RRU6 and 'Tools (type)' (ST) RRU7 scores are based on the aggregation of the following part level scores:

- BAT is the battery
- DA is the display assembly
- BC is the back cover or back cover assembly
- FFC is the front-facing camera assembly
- RFC is the rear-facing camera assembly
- EC is the external charging port
- BUT is the mechanical button
- MIC is the main microphone(s)
- SPK is the speaker
- FM is the hinge assembly or the mechanical display folding mechanism

If any of the parts listed above is present in a product more than once, only the one which delivers the lowest score shall be considered in the calculation of the 'Disassembly Depth' (SDD), 'Fasteners (type)' (SF) and 'Tools (type)' (ST) scores. If any part listed above is not present in the product, 5 points for RRU5, RRU6, RRU7 shall be used for that part.

RRU5: The 'Disassembly Depth' (SDD) score shall be calculated as follows:

a) for non-foldable smartphones the following formula shall be used:

SDD = (DDBAT×0,30) + (DDDA×0,30) + (DDBC×0,10) + (DDFFC×0,05) + (DDRFC×0,05) + (DDEC×0,05) + (DDBUT×0,05) + (DDMIC×0,05) + (DDSPK ×0,05)

b) for foldable smartphones, the following formula shall be used:

SDD = (DDBAT×0,25) + (DDDA×0,25) + (DDBC×0,09) + (DDFFC×0,04) + (DDRFC×0,04) + (DDEC×0,04) + (DDBUT×0,04) + (DDMIC×0,04) + (DDSPK ×0,04) + (DDFM×0,17).

where DDXX is the Dissembly score of part XX.

Table 3: Disassembly

No.	Indicators	Score				
		1	2	3	4	5
RRU5	Battery and back cover, Display assembly, front-facing camera assembly, rear-facing camera assembly, external charging port, mechanical button, main microphone(s), speaker, hinge assembly or the mechanical display folding mechanism	20 ≥ x > 15 steps	15 ≥ x > 10 steps	10 ≥ x > 5 steps	5 ≥ x > 2 steps	x ≤ 2 steps

Step in table 3 means an operation that finishes with the removal of a part (or bundle) or with a change of tool; any placement of a part away from its initial location, even if that entails partial disconnection or unplugging, shall also be considered as removal.

RRU6: The 'Fasteners (type)' (SF) score is calculated as follows:

a) for non-foldable smartphones, the following formula shall be used: SF = (FBAT×0,30) + (FDA×0,30) + (FBC×0,10) + (FFFC×0,05) + (FRFC×0,05) + (FEC×0,05) + (FBUT×0,05) + (FMIC×0,05) + (FSPK×0,05)

b) for foldable smartphones, the following formula shall be used: SF = (FBAT×0,25) + (FDA×0,25) + (FBC×0,09) + (FFFC×0,04) + (FRFC×0,04) + (FEC×0,04) + (FBUT×0,04) + (FMIC×0,04) + (FSPK×0,04) + (FFM×0,17)

where FXX is the Fastener score of part XX.

Different parts can have different fastener scorings. The fastener scoring in the table below should be applied to each part separately and aggregated for a total score. The assessment of the type of fasteners is based on the disassembly process to remove the specified part, starting from the previous priority part in disassembly sequence already removed. In case different types of fasteners are encountered in the disassembly of a priority part, the worst score shall be considered.

Table 4: Fasteners

No.	Part	Score				
		1	2	3	4	5
RRU6	Battery, back cover, display assembly, front-facing camera assembly, rear-facing camera assembly, external charging port, mechanical button, main microphone(s), speaker, hinge assembly or the mechanical display folding mechanism	All fasteners are at least removable	All fasteners are at least resupplied. Some require heating or cooling to be removed	All fasteners are at least resupplied and require no heating or cooling to be removed	All fasteners are reusable and require no heating or cooling to be removed	All fasteners are reusable retained fasteners and require no heating or cooling to be removed

'reusable retained fastener' means a fastener that remains attached/retained within the relevant assembly of the product even when unfastened and can be completely reused for the same purpose in the reassembly, without any damage either to the product or to the fastener that would make their multiple reuse impossible. For example, snap fits, friction fits, compression fits, screw-based captive fasteners and clips can be considered reusable retained fasteners if they can endure at least 10 assembly-disassembly cycles. For snap fits, friction fits and compression fits disengagement is either via sheer pulling force in the direction of the assembly, or there is marking that clearly indicates how the snap fit can be disengaged. In the case of damage to a screw-based captive fastener, it shall be possible to remove the captive fasteners from the part they are affixed to by a different procedure or higher force compared to the process for routine disassembly.

'reusable fastener' means a fastener that can be completely reused for the same purpose in the reassembly, without any damage either to the product or to the fastener that would make their multiple reuse impossible.

'resupplied fastener' means a removable fastener that is supplied at no additional cost with the spare part which it is intended to connect or fix; adhesives shall be considered resupplied fasteners if they are supplied with the spare part in a quantity that is sufficient for the reassembly, at no additional cost.

'removable fastener' means a fastener that is not a reusable fastener, but whose removal does not damage the product, or leave residue, which precludes reassembly.

RRU7:

The 'Tools (type)' (ST) score shall be calculated as follows:

a) for non-foldable smartphones the following formula shall be used:

   i) ST = (TBAT×0,30) + (TSCR×0,30) + (TBC×0,10) + (TFFC×0,05) + (TRFC×0,05) + (TEC×0,05) + (TBUT×0,05) + (TMIC×0,05) + (TSPK×0,05)

   ii) for foldable smartphones the following formula shall be used:

b) ST = (TBAT×0,25) + (TSCR×0,25) + (TBC×0,09) + (TFFC×0,04) + (TRFC×0,04) + (TEC×0,04) + (TBUT×0,04) + (TMIC×0,04) + (TSPK×0,04) + (TFM×0,17)

where TXX is the Tool score of part XX.

Only the tools that are need in order to replace the respective part are considered in the assessment. Proprietary tools, commercially available tools and commonly available tools are specified in EN 45554:2020 [5].

Table 5: Tools

No.	Tools	Score				
		1	2	3	4	5
RRU7	Battery, back cover, display assembly, front-facing camera assembly, rear-facing camera assembly, external charging port, mechanical button, main microphone(s), speaker, hinge assembly or the mechanical display folding mechanism	Feasible with commercially available tools	Feasible with set of tools that is supplied with the product	Feasible with set of tools that is supplied with spare part	Feasible with basic tools	Tools not needed

6.3 Material impacts

6.3.1 Recyclability and Recoverability

Table 6 lists the requirements for the evaluation of Recyclability and Recoverability (RR) aspect of smartphones.

Table 6: Recyclability and Recoverability

No.	Indicator	Score				
		1	2	3	4	5
RR1	Polymer compatibility in all plastics containing parts (for recycling)	Incompatible polymers used in the same plastic part can be separated		Polymers used in the same plastic part are compatible polymers for recycling		Same polymer is used in all plastic parts

Additional explanation on indicators:

RR1. Only plastic containing parts with plastic content above 1 % of total product mass are considered.

NOTE 1: Compatibility of polymers for recycling are described in Pahl, G., Beitz, W., Engineering design: A systematic Approach. Great Britain: Springer-Verlag London Limited, 1996 [i.12].

NOTE 2: Recyclability rate is not covered as an indicator for the time being as there is no standardisation work in ETSI currently ongoing at the time the present document has been drafted.

6.3.2 Use of hazardous and restricted substances

Table 7 lists the requirements for the evaluation of the use of hazardous and restricted substances (HR) aspect of smartphones.

Table 7: Use of hazardous and restricted substances

No.	Indicator	Score				
		1	2	3	4	5
HR1	Hazardous and restricted substances in scope of RoHs, REACh and battery directives.	Plastic parts are halogen free according to IEC 61249-2-21 [i.11]. Product fulfills EU RoHS [i.6], REACh, and Battery directive requirements in all markets.	Plastic parts and cables/wires and printed circuit boards are halogen free according to IEC 61249-2-21 [i.11]. Product fulfills EU RoHS, REACh, and Battery directive requirements in all markets.	Full product is halogen free according to IEC 61249-2-21 [i.11]. Product fulfills EU REACh, and Battery directive requirements in all markets. Product exceeds exemptions of Annex III RoHS Directive [i.6] by date (at least 1 year in advance of the expiring date) or by lower content (at least 20 % lower than the allowed concentration.	Full product is halogen free according to IEC 61249-2-21 [i.11]. Product fulfills EU Battery directive requirements in all markets. Product exceeds exemptions of Annex III RoHS Directive [i.6] by date (at least 1 year in advance of the expiring date) or by lower content (at least 20 % lower than the allowed concentration. Product does not contain substances of Annex XVII of REACh Regulation above 0,1 % of mass percentage of each part above 0,1 % of total product mass.	Full product is halogen free according to IEC 61249-2-21 [i.11]. No exempted application in Annex III of RoHS Directive used. Product does not contain substances of Annex XVII of REACh Regulation [i.7] above 0,1 % of mass percentage of each part above 0,1 % of total product mass. Product does not contain substances with a hazard statement in Part 3 of the GHS [i.10] System above 0,1 % of mass percentage of each part above 0,1 % of total product mass.
NOTE: The intention to limit the assessment of hazardous and restricted substances to parts above 0,1 % of total product mass is to exclude components that are very small, e.g. capacitors and resistors.						

6.3.3 Use of recycled materials

Table 8 lists the requirements for the evaluation of the use of Recycled Materials (RCM) aspect of smartphones.

Table 8: Use of recycled materials

No.	Indicator	Score				
		1	2	3	4	5
RCM1	Content of recycled material in plastic parts by weight	0 < x < 20 %	20 ≤ x < 35 %	35 ≤ x < 65 %	65 ≤ x < 80 %	80 % ≤ x
RCM2	Content of recycled Au in parts containing Au by weight	0 < x < 20 %	20 ≤ x < 35 %	35 ≤ x < 65 %	65 ≤ x < 80 %	80 % ≤ x
RCM3	Content of recycled Al in parts containing Al by weight	0 < x < 20 %	20 ≤ x < 35 %	35 ≤ x < 65 %	65 ≤ x < 80 %	80 % ≤ x
RCM4	Content of recycled Cu in parts containing Cu by weight	0 < x < 20 %	20 ≤ x < 35 %	35 ≤ x < 65 %	65 ≤ x < 80 %	80 % ≤ x

Recycled content is determined in accordance with EN 45557 [6]. Accessories are not considered in the assessment of recycled materials.

6.3.4 Packaging and Accessories

Table 9 lists the requirements for the evaluation of Packaging and Accessories (PA) aspect of smartphones.

Table 9: Packaging and Accessories

No.	Indicator	Score				
		1	2	3	4	5
PA1	Quantity of plastic, and presence of recycled and sustainable content used in packaging	The only plastic elements used are i) cover foils and plastic bags for devices and accessories and/or ii) tape, adhesives, coatings, strappings, and stretch wraps critical to the performance of the packaging	The only plastic elements used are i) cover foils and plastic bags for devices and accessories and/or ii) tape, adhesives, coatings, strappings, and stretch wraps critical to the performance of the packaging. All have recycled content 80 % ≤ x	The only plastic elements used are tape, adhesives, coatings, strappings, and stretch wraps critical to the performance of the packaging All have recycled content 80 % ≤ x	The only plastic elements used are tape, adhesives, coatings, strappings, and stretch wraps critical to the performance of the packaging All have recycled content of at least 80 %. Any cardboard packaging materials are 80 % ≤ x certified by FSC/PEFC or similar	No plastic material used in packaging at all. Any cardboard packaging materials are at least 80 % certified by FSC/PEFC or similar
PA2	Charger / cable decoupling	Product options are available with or without charger. The default product option is either with cable included or with cable and charger included	Product options are available with or without charger. The default product option is with cable included but no charger. Charger is available as an optional extra at additional cost. Manufacturer provides power rating specifications for the cable and power supply	Only product option available is without charger. The default product option is with cable included. Charger is available as an optional extra at additional cost. Manufacturer provides power rating specifications for the cable and power supply	Only product option available is without charger. The default product option is without cable included. Cable and charger are available as an optional extra at additional cost. Manufacturer provides power rating specifications for the cable and power supply	Only product option available is without charger and without cable. Cable and charger are available as an optional extra at additional cost. Manufacturer provides power rating specifications for the cable and power supply

6.3.5 Environmental impact

Currently the environmental impact footprint calculations are done differently and absolute LCA scores cannot be compared. However, the integrated holistic impact evaluation capability aspect (EIE) of the individual smartphone manufacturer is essential. Table 10 based on Recommendation ITU-T L.1023 [i.2] indicator 3RUm6 - proposes indicators and scoring levels addressing this issue.

Table 10: Environmental impact footprint assessment knowledge and application

No.	Indicators	Scoring level				
		1	2	3	4	5
EIE1	Environmental impact footprint assessment knowledge and application.	A simplified environmental impact footprint assessment (e.g. screening LCA, environmental impact footprint assessment on one environmental indicator such as carbon footprint, etc.) has been carried out on the smartphone model and the results are made available on demand.	An b-ISO 14040 [7] or ETSI ES 203 199 [8] compliant Life Cycle Assessment (LCA) has been carried out on the smartphone model and the results are made available on demand.	An b-ISO 14040 [7] or ETSI ES 203 199 [8] compliant Life Cycle Assessment (LCA) has been carried out on the smartphone model and the results are made publicly available.	An b-ISO 14040 [7] or ETSI ES 203 199 [8] compliant Life Cycle Assessment (LCA) has been carried out on the smartphone model showing improved technical performance per product environmental impact between product at hand and previous corresponding product model. Results are 3rd party peer-reviewed and made available on demand.	An b-ISO 14040 [7] or ETSI ES 203 199 [8] compliant Life Cycle Assessment (LCA) has been carried out on the smartphone model showing improved technical performance per product environmental impact between product at hand and previous corresponding product model. Results are 3rd party peer-reviewed. Results are made publicly available.

7 Documentation

The assessment of the smartphone shall be documented.

The sub-scores for each individual indicator (clauses 6.1 to 6.3) as well as the overall score shall be documented. When using the present document for communication purposes, all sub-scores and the overall score shall be stated. (see Annex B).

Annex A (informative): Legal requirements in the EU

Table A.1 lists applicable legal requirements for smartphones in the European Union as well as the relevant standards to measure the respective requirement.

Table A.1 uses "parts list 1", "parts list 2" and "repair information", which include multiple items:

Parts list 1: front-facing camera assembly, rear-facing camera assembly, external audio connector(s), external charging port(s), mechanical button(s), main microphone(s), speaker(s), hinge assembly, mechanical display folding mechanism.

Parts list 2: the back cover or back cover assembly, display assembly, protective foil for foldable displays, charger, SIM tray and memory card tray.

Repair information includes:

i) the unequivocal product identification;

ii) disassembly map or exploded view;

iii) wiring and connection diagrams;

iv) electronic board diagrams;

v) list of necessary repair and test equipment;

vi) technical manual of step by step repair instructions;

vii) diagnostic fault and error information;

viii) component and diagnosis information;

ix) instructions for software and firmware;

x) information on how to access data records of reported failure incidents stored on the device;

xi) information on how to access professional repair.

Table A.1: Legal requirements in the EU

No.	Regulation	Indicator	EU Requirement	Applicable standard or regulation
	Durability			
1	Sale of goods (2019/771/EU [i.13])	Warranty period for the smartphone and its components	1 year	-
2	Ecodesign (2023/1670/EU [i.4])	Dust protection	IP4x	IEC 60529:1989/ AMD2:2013/ COR1:2019 [1]
3	Ecodesign (2023/1670/EU [i.4])	Water Protection	IPx3	IEC 60529:1989/ AMD2:2013/ COR1:2019 [1]
4	Ecodesign (2023/1670/EU [i.4])	Drop resistance	Number of drops: 45 ≤ x	IEC 60068-2-31 [2], Free fall repeated – Procedure 2
5	Ecodesign (2023/1670/EU [i.4])	Scratch resistance	Hardness level 4 (Mohs hardness scale)	EN ISO 6769:2022 [4]
6	Ecodesign (2023/1670/EU [i.4])	Battery life (full charge cycles)	800 cycles ≤ x with remaining capacity ≥ 80 %	IEC EN 61960-3:2017 [3]

No.	Regulation	Indicator	EU Requirement	Applicable standard or regulation
7	Ecodesign (2023/1670/EU [i.4])	Period of availability of OS support (Provision of security updates, corrective updates or functionality updates to OS at no cost from the date of end of placement on the market)	5 years ≤ x	-
	Repair, reuse & upgrade			
8	Ecodesign (2023/1670/EU [i.4])	Duration of availability of spare parts	7 years	-
9	Ecodesign (2023/1670/EU [i.4])	Target group availability of spare parts in parts list 1	Professional repairers	EN 45554:2020 [5]
10	Ecodesign (2023/1670/EU [i.4])	Target group availability of spare parts in parts list 2 and display assembly	Professional repairers and end users. See note 1.	EN 45554:2020 [5]
11	Ecodesign (2023/1670/EU [i.4])	Fasteners for parts included in parts list 1, parts list 2	removable, resupplied or reusable	EN 45554:2020 [5]
12	Ecodesign (2023/1670/EU [i.4])	Tools to replace parts in parts list 1	no tool, a tool or set of tools that is supplied with the product or spare part, or basic tools; or with commercially available tools	EN 45554:2020 [5]
13	Ecodesign (2023/1670/EU [i.4])	Tools to replace parts in parts list 2	no tool, a tool or set of tools that is supplied with the product or spare part, or basic tools	EN 45554:2020 [5]
14	Ecodesign (2023/1670/EU [i.4])	Environment / skills to replace parts in parts list 1	workshop environment by a generalist.	EN 45554:2020 [5]
15	Ecodesign (2023/1670/EU [i.4])	Environment / skills to replace parts in parts list 2	use environment by a layman	EN 45554:2020 [5]
16	Ecodesign (2023/1670/EU [i.4])	Availability of factory reset and data deletion functionality	Presence of a software function, that resets the device to its factory settings and erases securely by default all personal information	
17	Ecodesign (2023/1670/EU [i.4])	User information on secure data deletion of all user data	Manufacturer website, **or** in-box printed, **or** digitally in the device	Guidelines for Media Sanitization, NIST Special Publication 800-88 - Revision 1 [i.14]
18	Ecodesign (2023/1670/EU [i.4])	User information and tools to use for transfer of data from old to new smartphone	Manufacturer website, **or** in-box printed, **or** digitally in the device	

No.	Regulation	Indicator	EU Requirement	Applicable standard or regulation
19	Ecodesign (2023/1670/EU [i.4])	Spare part delivery time after having received the order	i) For 5 years after placement on market: 5 working days ≥ x ii) 6th to 7th years after placement on market: 10 working days ≥ x See note 2	
20	Ecodesign (2023/1670/EU [i.4])	Information on the price of spare parts	Provision (on the free access website of the manufacturer) of indicative pre-tax prices for spare parts, including the pre-tax price of fasteners and tools, if supplied with the spare part	
21	Ecodesign (2023/1670/EU[i.4])	User information on repair and maintenance	Provision of repair and maintenance information to professional repairers (unless that information is made publicly available at the manufacturer's free access website) See note 3	
22	Ecodesign (2023/1670/EU [i.4])	Batteries for smartphones with IP-rating below IP67 Target group availability of spare parts Fasteners Tools Environment Skills	end-users and professional repairers resupplied or reusable no tool, a tool or set of tools that is supplied with the product or spare part, or basic tools Use environment Layman	EN 45554:2020 [5]
23	Ecodesign (2023/1670/EU [i.4])	Batteries for smartphones: With IP rating at IP67 or above, Remaining capacity of at least 83 % of the rated capacity after 500 full charge cycles, and Remaining capacity of at least 80 % of the rated capacity after 1 000 full charge cycles:	Professional repairers Removable, resupplied or reusable no tool, a tool or set of tools that is supplied with the product or spare part, basic tools, or commercially available tools workshop environment generalist	EN 45554:2020 [5]

No.	Regulation	Indicator	EU Requirement	Applicable standard or regulation
		• Target group availability of spare parts • Fasteners • Tools • Environment • Skills		
	Recyclability & recoverability			
24	Waste Electrical and Electronic Equipment (WEEE) (2012/19/EU [i.5])	System provided for smartphone disposal	Fulfills WEEE requirements	[i.5]
25	Waste Electrical and Electronic Equipment (WEEE) (2012/19/EU [i.5])	Information to recyclers on dismantling / WEEE directive	Information to recyclers via free access website of dismantling information to access any of the components referred to in article 15 of WEEE directive, including sequence of dismantling steps, and tools or technologies needed to access the targeted components.	[i.5]
26	Ecodesign (2023/1670/EU [i.4])	Plastic marking	Marking of plastic components heavier than 50 g	
27	Ecodesign (2023/1670/EU [i.4])	Recyclability rate	To be calculated as mass based recyclability rate, with the following reference end-of-life scenario: • Battery: Co, Li (Rcyc,Li 90 %) masses count towards recyclability rate • Mono-material parts removed when extracting the battery: Steel, Al, Mg, plastics or copper masses count towards recyclability rate • All other parts: Cu, Co, Sn (Rcyc,Sn 50 %), Ni (Rcyc,Ni 85 %), In (Rcyc,In 50 %), Au, Ag, PGM (Rcyc,PGM 95 %) masses count towards recyclability rate	EN 45555:2019 [5]

No.	Regulation	Indicator	EU Requirement	Applicable standard or regulation
	Use of hazardous and restricted substances			
28	Restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment (2011/65/EU [i.6])	RoHS Directive	Product fulfills EU RoHS Directive requirement in EU market	[i.6]
29	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), (1907/2006/EC [i.7])	Restricted substances in the product	Product fulfills EU REACh Regulation in EU market	[i.7]
30	batteries and waste batteries, (2023/1542/EU [i.8])	Restricted substances in the battery	Battery fulfills EU Battery Directive (or EU Battery Regulation) substance requirements in EU market	[i.8] and [i.9]
31		Prolonged Skin Contact (PSC) materials	A risk assessment has been performed of PSC materials to determine substances of concern that pose a risk of skin sensitization	
NOTE 1: Applicable if it does not conflict with manufacturers export obligations. NOTE 2: Requirement applicable for the EU, requirements for other regions will be determined in a later version of the present document. NOTE 3: Manufacturers are not obliged to divulge trade secrets.				

Annex B (informative): Scoring tables

Table B.1

Durability indicators		Score
D1	Warranty for the smartphone and its components	
D2	Dust protection	
D3	Water Protection	
D4	***Drop resistance for non-foldable phones [number of drops] OR***	
	Drop resistance for foldable phones [number of drops]	
D5	Battery life (full charge cycles)	
D6	***Scratch resistance (non-foldable displays)*** ***OR***	
	Number of full extension - fold cycles for foldable displays	
D7	Period of availability of OS support	
	Total Durability score	

Table B.2

Reparability indicators		Score
	Non part-weighted	
RRU1	Duration of availability of spare parts from the date of end of placement on the market	
RRU2	Target group availability of spare parts	
RRU3	Availability of repair, reuse and upgrade information for smartphone	
	Non part-weighted RRU score	

	Part-weighted	BAT	DA	BC	FFC	RFC	EC	BUT	MIC	SPK	FM×	Score
RRU4	Disassembly depth/sequence											
RRU5	Types of fasteners and accessibility											
RRU6	Type of tools needed for disassembly											
	Foldable weighting	25 %	25 %	9 %	4 %	4 %	4 %	4 %	4 %	4 %	17 %	
	Non-foldable weighting	30 %	30 %	10 %	5 %	5 %	5 %	5 %	5 %	5 %	N/A	
											Part-weighted RRU score	
											Total Reparability score (non part-weighted + part-weighted)	

Table B.3

Material impact indicators		Score
RR1	Polymer compatibility in all plastic containing parts (for recycling)	
HR1	Hazardous and restricted substances in scope of RoHs, REACh and battery directives.	
RCM1	Content of recycled material in plastic parts	
RCM2	Content of recycled gold in parts containing gold	
RCM3	Content of recycled aluminium in parts containing aluminium	
RCM4	Content of recycled copper in parts containing copper	
PA1	Quantity of plastic, and presence of recycled and sustainable content used in packaging	
PA2	Charger / cable decoupling	
EIE1	Environmental impact footprint assessment knowledge and application	
	Total Material impact score	

Annex C (informative): Scoring spreadsheet

Here follows a link to a scoring spreadsheet for the method outlined in the present document:

https://docbox.etsi.org/EE/Open/M-ICT4%20scoring%20calculations%20v1.0.xlsx

Annex D (informative): Bibliography

- ISO 14044: "Environmental management -- Life cycle assessment -- Requirements and guidelines".

History

Document history		
V1.1.0	July 2024	Membership Approval Procedure MV 20240923: 2024-07-25 to 2024-09-23