

Draft 42

TCO Certified

Generation 10, for tablets



Draft 2

TCO Certified – driving sustainable development in IT products

Established in 1992, TCO Certified is a global sustainability certification for IT products. The organization behind TCO Certified is TCO Development. Certificates are valid worldwide and can be used as proof in all countries, without the need for local adaptation. TCO Certified is available with both general and product-specific criteria for several product categories: displays, notebooks, tablets, smartphones, desktops, all-in-one PCs, projectors, headsets, servers, network equipment and data storage. TCO Certified is also available with only the general criteria for any IT product after consultation with TCO Development.

Comprehensive criteria with a life cycle perspective

Certified products must meet comprehensive environmental and social criteria throughout the life cycle. The criteria are science-based and developed in an open process with TCO Development's international network of stakeholders, which includes users, buyers, industry, NGOs, researchers and subject matter experts. To address the most pressing sustainability challenges and stay current with the latest technology developments, a new generation of TCO Certified is released every three years.

A third-party certification, independently verified

TCO Certified is a third-party certification, independent of the IT industry and buyers. It meets the requirements in ISO 14024 Ecolabel Type 1 and has been approved by the [Global Ecolabelling Network](#) as part of the GENICES peer review process. Independent verification organizations, accredited to ISO 17025, verify that products conform with all criteria in TCO Certified. Verification is done both before and after certification, throughout the full validity period of the certificates.

How to apply for certification

At tcocertified.com, you'll find a guide that explains the certification process and lists what you need to do to apply for certification of your products. Compliance with all criteria in TCO Certified is independently verified. It generally takes three to five weeks to receive the certificate, once all documents and the product sample are delivered to the verification organization.

Need help?

Need help getting started? Or, would you like us to explain the certification process in more detail? Our certification team is always here to help. Email us on certification@tcodevelopment.com. Our approved, independent verifiers around the world are also at your disposal, and are able to explain the criteria and certification process in your local language. Contact details are available at tcocertified.com.

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About this document

This is TCO Certified, generation 10, for tablets, released in XXX 2024. Other common names for a tablet is tablet computer or slate computer. A tablet is defined as a portable computer with a display size > 7", that is primarily for battery mode usage and has a touch screen interface. This means that connection to mains via an adapter is considered to be mainly for battery charging purposes and the onscreen virtual keyboard or a digital pen is in place of a physical keyboard. However, external keyboards are available for tablets, some of which function as docks for the devices. If a detachable keyboard docking station is supplied together with the tablet for the intention of the product being converted to a notebook computer, then the product must be tested according to TCO Certified, generation 10, for notebooks. All external cables and external power supplies are considered a part of the tablet.

Available for 12 product categories

~~TCO Certified is available for 12 product categories and they all have the same generation number: generation 10. A majority of the criteria are the same for all product categories.~~

The criteria include:

Mandate: A description of the requirements that needs to be fulfilled, and how conformity is verified. Forms and signatures for application are available in chapter 11 of this document.

Definitions: Explanations of important terms relevant to the criterion.

References: References to sources, presented in chapter 10.

Clarifications: Further details and explanations of the mandate.

Compliance with criteria is independently verified

Compliance with the criteria is verified by verification organizations (verifiers) independent of both the certification body (TCO Development), the applicant and the brand owner. Each criterion includes a description of the proof that must be submitted to the verifier, and to TCO Development together with the application form. This may be a test report or a verification report:

1. A test report presents the results from tests conducted by a test facility accredited to ISO 17025, and is issued by that same facility.
2. A verification report is issued by a verifier approved by TCO Development and includes a summary and a result (pass or fail) based on either:
 - a test report issued by the same test facility,
 - a test report issued by a different test facility, or
 - certificates or other proof from the company or brand owner applying for the certificate.

Editions of TCO Certified

When we publish a new generation of TCO Certified, our ambition is always to maintain criteria levels until the next generation of TCO Certified is launched, which typically happens after three years. Several editions of the criteria document may be released, but will be considered only as updates within the ninth generation, with improved precision of the mandates, test methods and clarifications. To ensure that all currently certified products comply with the new edition of the criteria document, the criteria levels are never raised within a generation.

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1 Product and sustainability information

- The IT industry is complex and finding reliable data about products and manufacturing conditions can be a challenge.
- The lack of verified product claims can lead to unfair competition between brands as well as greenwash.
- Accurate and comparable information helps both brands and purchasers make informed decisions and measure their sustainability progress.

Transparency improves decision-making

To drive sustainable development in the complex IT industry, accurate and comparable information about products and manufacturing conditions is needed. Transparency around this type of data also helps purchasing organizations make more informed product choices, and measure and report the true sustainability impact of the certified models they actually buy. Another positive effect of giving purchasers and industry access to verified product claims is that it helps IT brands compare their sustainability performance with peers, and reduces the risk of unfair competition and greenwash.

Our approach: Providing access to independently verified sustainability data

To increase transparency around certified products, [Sustainability Performance Indicators \(SPIs\) are included data is collected](#) in TCO Certified. ~~SPIs make~~[This data makes](#) it possible to ~~identify those products that are best in class from a~~[measure and report on the](#) sustainability perspective and ~~exceed the requirements~~[impact of TCO Certified using IT products](#). To ensure accurate reporting, gathered data is verified by independent experts. [In those cases where collected data may be published in a non-anonymous format towards purchasers or other stakeholders, this is explicitly written in the criterion mandate under the headline "The following is submitted to TCO Development and may be published"](#).

Criteria in chapter 1 focus on:

- ~~• Requiring that sustainability data is reported and independently verified.~~
- [• Improving product identification of certified product models.](#)
- Helping end users find information on TCO Certified, and what the certification includes.
- Making sure that the product specification of certified products is correct.

1.1 Information to end users

Background

End users must clearly be able to identify which products are certified and what sustainability features the product fulfills.

Applicability

All product categories.

References

The license agreement between TCO Development and the applicant/brand owner.

1.1.1 Mandate

- a. The information document for end users must be written in English or in the local language of the country where the product is to be sold. It must accompany the product in at least one of the following ways:
 1. As a separate digital document found together with the product in the packaging.
 2. Included in a digital user manual.
 3. As a separate digital document that is hosted on the brand owner's website. In this case a direct link to the document must be included in the digital user manual mentioned above.
 4. [As a link to the digital document, on the product page that is redirected to when scanning the data carrier as specified in criterion 1.3 Unique product identifier.](#)
- b. The product and its retail packaging must be labeled with the TCO Certified logo. See clarifications for details.
- c. "TCO Certified" must be mentioned on the brand owner's website(s) where the specific certified product is marketed and or sold.

Submit the following to an approved verifier:

A completed and signed product form (chapter 11.3).

Submit the following together with the application to TCO Development:

A copy of the verification report(s) from a verifier approved by TCO Development.

1.1.2 Clarification

Products that are designed to be installed in a rack (supporting framework to hold hardware modules, typically servers, data storage products and networking equipment) are excluded from “1.1.1 b - labeling of the product and packaging”.

1.1.1 A - information document for end users

No editorial changes to the information document for end users are accepted without consent from TCO Development. The information document for end users is available at tcocertified.com.

If the applicant is separate from the brand owner, the applicant must ensure that the brand owner agrees to fulfill their part of this requirement.

If the information document to end users is included as a link or page in the digital user manual, it must be found in a separate chapter with the headlined “TCO Certified” that is visible in the table of contents.

1.1.1 B - labeling of the product and packaging

The TCO Certified logo must be displayed in one of the following ways:

Alternative A

On a permanent or temporary label. Temporary labels must be affixed to the product with an adhesive or cling-type application. The packaging material that is supposed to be removed in order to get the full functionality of a product (such as a screen protector) is defined as packaging material and not the product in this mandate and thus may not be the place for the product logo.

- a. The logo must be visible on the top or front of the product. (The front of the product is defined as the surface seen when viewing the product from the front and may include the stand. The top is defined as the surface that is seen from the top and the back is the surface that is seen from the back.)
- b. The minimum size of the logo is 16mm in width and 10mm in height.
- c. If the logo is to be placed alongside other logos or graphic elements, a minimum of 2,5mm padding must be used on all sides of the TCO Certified logo.

Exception

If the top and front of the product don't have a contiguous and coplanar area (area used for display or touch input are excluded) which is at least 16mm in width or 10mm in height, then the logo may be placed on the back side of the product.

or

Alternative B

Via electronic labeling displayed on the screen or digital product picture in one of the below ways:

- a. During the startup of the product:

The logo must cover at least 1% of the screen. The logo must be legible and be in color, black, or white; must appear at system start-up, and must be displayed for a minimum of 0,5 seconds.

- b. Via a shortcut on the desktop screen of the product. The shortcut must be in the form of the TCO Certified logo in color and clicking it should link to “the information document for end users” available at tcocertified.com.

~~TCO Certified logo as a part of~~

- c. If the product picture does not have a electronic display and do not have a continuous coplanar area (area used for display or touch input are excluded) which is at least 16mm in width or 10mm in height and without other logos or markings:

~~The TCO Certified logo is following must be~~ shown on the first page that is redirected to when scanning the data carrier as specified in criterion 1.3 Unique product picture where identifier without further clicks (scrolling is accepted)

- Full name of certification, including generation
- Certificate number of the product is marketed on the brand owners web site. In the product specification on this page, TCO Certified is also listed with a, that is a link to the “information to end user document” which is the document required under mandate 1.1 point 1. product page in TCO Certified Product finder
- An image of the TCO Certified logo

TCO Development will consider alternative proposals for electronic labeling on a case-by-case basis.

The retail packaging of the product must be labeled with the TCO Certified logo:

- a. The minimum size of the logo must be 16mm in width and 10mm in height.

- b. If the logo is to be placed alongside other logos or graphic elements, a minimum of 2,5mm padding must be used on all sides of the TCO Certified logo.

The certificate owner and brand owner must also conform with all the other logo rules on color, design, marketing, etc., that are specified in the TCO Certified license agreement appendix 2. The following two paragraphs (§2.2 and §2.5 in appendix 2 of the license agreement) are replaced by the rules listed above if a conflict occurs.

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1.1.1 C - Mention of TCO Certified on the brand owner website

- The inclusion of “TCO Certified” only needs to be represented as TEXT - i.e. a link to a specific page is not necessary.
- Instead of mentioning “TCO Certified” directly on the brand owners website(s), the brand owner can fulfill this requirement by including “TCO Certified” as TEXT in a product specific PDF file if it is accessible from the brand owner's website(s) where the specific certified product is marketed and or sold.

To fulfill this mandate the brand owner must submit a description on where and how the inclusion of “TCO Certified” as TEXT can be found for certified products. The description must include a general example of where the TEXT “TCO Certified” will be represented. The description must be submitted to the verification organization. If the location where TCO Certified will be mentioned as TEXT is changed, a new description must be submitted.

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1.2 Product specification

Background

It is important to ensure that each product to be certified is described accurately in the test report and certificate. Therefore, a physical sample of each product to be certified must be sent to an approved verifier, that examines it carefully to ensure that product marking and physical aspects conform with the reported information from the applicant or brand owner.

[Product weight is an indication of the amount of potential e-waste at end-of-life. By decreasing the product weight, e-waste can be reduced.](#)

Definition

The marking label is a label with the product's electrical rating (voltage, frequency, current), the manufacturer's name, trademark or identification mark, and the manufacturer's model or type reference according to IEC 62368-1 clause 4.1.15.

Applicability

All product categories.

References

1.1.

1.2.1 Mandate

- ~~A product specification of the worst case product configuration~~
- A marking label must be provided for the product.
- The total weight of the heaviest product configuration including the power supply and cables (without packaging) in kg must be reported.

Submit the following to an approved verifier:

- A copy of the marking label, for the product and all external power supplies.
- [A product specification of the heaviest configuration.](#)
- A completed and signed product form (chapter 11.3).

~~Submit The following together with the application~~ **is submitted to TCO**

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The total weight of the ~~worst case~~heaviest product configuration ~~and the~~including power supply and cables (without packaging) in kg ~~must be reported in TCO-Certified Portal.~~
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1.2.2 Clarification

The template must be completed with the requested information about the product. A type key that includes an asterisk (*) for unidentified characters, if any, in the model name and for other identification names must be submitted to the verifier. Only two * may be used in the model type key and each * must include two or more options.

Worst case configuration

There might be several configurations of a product covered by the same certificate. It is necessary that the verification of compliance cover all these configurations. Therefore, the independent verifier must determine the most likely worst-case configuration for compliance with each criterion in TCO Certified. This configuration is must be specified in the test reports under each criterion. ~~It is considered that all other configurations covered by the certificate will pass TCO certified as long as the~~ where worst case configuration pass:is used.

Sustainability performance indicator(s):

~~Product weight is an indication of the amount of potential e-waste at end-of-life. By decreasing the product weight, e-waste can be reduced. The product weight (in kg) of the~~ The worst-case configuration ~~(heaviest) of the product including any power supply but excluding packaging must be reported by the~~ must be available for purchase. It must be defined through a unique brand owner:

~~1.3 Sustainability performance indicators - To be revised in draft 2~~

Background

Sustainability is a long term goal and therefore code, a responsible way to work with sustainability is through a long term strategy. Improvements must often be phased in gradually and requires planning and preparation. The sustainability performance indicators will measure the development of products and brand owners, enabling new criteria levels in future generations of TCO Certified to be challenging but yet reasonable, and ensure that the most relevant parts of the product life cycle is covered.

The sustainability performance indicators also measure the sustainability benefits that the certified products create, and track this over time. A purchasing organization can use the sustainability performance indicators in sustainability reporting and, for example, implement climate compensation unique product identifier, or other sustainability related measures connected to the sustainability impact of the product.

Applicability

Tablets.

1.3.1 Mandate

- ~~All sustainability performance indicators must be evaluated.~~

Submit the following to an approved verifier:

- ~~A completed and signed product form (chapter 11.3)~~

Submit the following together with the application to TCO Development:

- ~~A copy of a verification report from a verifier approved by TCO Development.~~
- ~~All sustainability performance indicators must be reported in TCO Certified Portal.~~

1.3.2 Clarification

New applications

A verification report for the sustainability performance indicators must be issued by an approved verifier and the results must be reported to TCO Certified Portal.

Reassessments

Changes made to the product or its manufacturing may affect the sustainability performance indicators. The applicant can choose to do a re-assessment or not. To do a re-assessment, the necessary documentation (and in some cases the product) must be sent to a verifier that issues a verification report for the sustainability performance indicators and report the new data to TCO Certified Portal.

Quoting sustainability performance indicators in the marketing of a product

The following guidelines apply to all communications about sustainability performance indicators. Quoting or referring to the sustainability performance indicators in conjunction with the brand name TCO Certified is not allowed unless a written agreement to do so is made with TCO Development.

“Worst case” reporting

If the verifier has conducted a “worst case” testing and accepts a number of similar configurations of the product in the issued verification report based on these tests, the sustainability performance indicators may also be the same for all accepted configurations and thus represented by the worst case a list of configuration:

1.3.3 Sustainability Performance Indicators (SPI) list

The sustainability performance indicators choices that are collected through the SAQ, submissions to TCO Development, or during the application process. All sustainability performance indicators must be evaluated. The results will be used to benchmark the performance of products within available at the time of purchase. *If there are several versions of the same component (e.g. due to different aspects of the certification and to provide purchasers with information on sustainability benefits of certified products-*

All SPIs marked with “X”

are collected annually either through the SAQ or together with annual submissions.
(X = Always collected during annual reporting)

All SPIs marked with “Y”

are collected by the verification organization during application and product testing.
(Y = Always collected during product testing/verification/application process)

All SPIs marked with “Z”

are considered beyond the scope of mandates in TCO Certified and are therefore not required for compliance with TCO Certified. Products will receive the lowest classification if no data is provided for the evaluation. By submitting the additional data, the product will always receive a

better classification than if no data is submitted. It is possible to submit and re-evaluate these SPIs at any time the product is certified.

(Z = Additional information by the applicant/brand owner is needed)

The following is a summary of all the sustainability performance indicators collected.

SPI's described under product specification

- ~~Y~~ 1.2 The total weight of the product and power supply (without packaging)

SPI's described under socially responsible manufacturing criteria (Chapter 2)

- ~~X~~ 2.2 (SAQ 1.1) Level of brand owner communication of CoC in the supply chain
- ~~X~~ 2.2 (SAQ 2.1) The level of the supply chain identified
- ~~X~~ 2.2 (SAQ 2.2) The level of transparency for final assembly factories and smelters
- ~~X~~ 2.2 (SAQ 2.2) The percentage of publicly listed factories for certified products.
- ~~X~~ 2.2 (SAQ 3.1) The level of brand owner due diligence on *suppliers not owned* and *the buyer cannot influence which version they get, then the worst-case version of the component must be reported.*
- ~~X~~ 2.2 (SAQ 3.2) The level of brand owner audits and follow up on suppliers not owned
- ~~X~~ 2.2 (SAQ 4.1) Level of brand owner Initiatives to avoid child labour
- ~~X~~ 2.2 (SAQ 4.2) Level of brand owner remediation process for child labour
- ~~X~~ 2.2 (SAQ 5.1) Level of brand owner requirement on excessive temporary contracts
- ~~X~~ 2.2 (SAQ 5.2) Level of brand owner engagement in living wage programs
- ~~X~~ 2.2 (SAQ 6.1) Level of brand owner process to avoid excessive overtime
- ~~X~~ 2.2 (SAQ 7.1) The level of factories with trade union or worker representatives
- ~~X~~ 2.2 (SAQ 7.2) Level of brand owner involvement with union or worker representatives
- ~~X~~ 2.2 (SAQ 7.3) Level of brand owner work to counter union discrimination
- ~~X~~ 2.2 (SAQ 8.1) Level of brand owner work to improve management and worker dialogue

SPI's described under environmental responsible manufacturing criteria (Chapter 3)

- ~~X~~ 3.2 The energy efficiency indicators for each final assembly factory
- ~~Y~~ 3.4 Percentage of post-consumer recycled plastics by weight versus the total weight of all plastics (Class A-G):
- ~~Y~~ 3.4 Percentage of identified post-consumer recycled materials by weight versus the product weight (Class A-G):
- ~~Z~~ 3.5 Classification of PCF method (Class A-E)
- ~~Z~~ 3.5 Classification on availability of PCF (Class A-D)

SPI's described under user health and safety criteria (Chapter 4)

- ~~Y 4.2~~ The sound power level (LWA_d) in operating and Idling mode

SPI's described under product performance criteria (Chapter 5)

- ~~Y 5.1~~ Energy efficiency
- ~~Y 5.2~~ The pixel density
- ~~Y 5.3~~ The default CCT difference $\Delta u'v'$ compared to D65
- ~~Y 5.4~~ The minimum color triangle area
- ~~Y 5.5~~ The color uniformity
- ~~Y 5.6~~ The color uniformity—angular dependence
- ~~Y 5.7~~ The largest $\Delta u'v'$ measurement of color grayscale linearity
- ~~Y 5.8~~ The maximum and minimum (if applicable) luminance level
- ~~Y 5.9~~ The luminance variation
- ~~Y 5.11~~ The luminance contrast
- ~~Y 5.12~~ The luminance contrast—angular dependence

SPI's described under product lifetime extension criteria (Chapter 6)

- ~~Y 6.1~~ Classification of warranty period (Class A-G)
- ~~Z 6.1~~ Classification of extended warranty availability (Class A-G)
- ~~Z 6.1~~ Classification of public repair policy (A-G)
- ~~Y 6.2~~ Classification of fasteners and connectors (Class A-C)
- ~~Y 6.2~~ Classification of necessary tools for repair/upgrade, (Class A-D)
- ~~Y 6.2~~ Classification of availability of spare parts by target group (Class A-E)
- ~~Y 6.2~~ Classification of availability of spare parts by duration of availability (Class A-D)
- ~~Y 6.2~~ Classification of availability of comprehensive information (Class A-C)
- ~~Y 6.4~~ Product durability maximum drop height
- ~~Y 6.5~~ Remaining state of charge after 300 cycles (%)
- ~~Y 6.5~~ The optimum battery performance for an office user in years
- ~~Y 6.6~~ Toolless battery replacement (Class A-B)
- ~~Y 6.7~~ Battery protection software as default setting (A-B)
- ~~Z 6.7~~ Peak performance capability (Class A-C)
- ~~Z 6.7~~ Classification on intelligent charging software (Class A-C)
- ~~Y 6.8~~ Classification of Media sanitization solution (Class A-B)
- ~~Y 6.8~~ Classification of Compliance with EN 45554:2020 (Class A-B)
- ~~Y 6.9~~ Classification of lifetime extension of chargers (Class A-C)
- ~~Y 6.9~~ Classification of type of standardized external power supply distributed with the product (Class A-B)

SPI's described under material recovery criteria (Chapter 8)

- ~~Z 8.2 Membership in multi-stakeholder initiatives working towards solving the problems connected to e-waste (Class A-C)~~
- ~~X 8.2 Use of internationally accredited reuse and recycling facilities (Class A-D)~~
- ~~Z 8.2 Ratio of compensated versus manufactured products (Class A-G)~~

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1.3 Unique product identifier

Background

The criteria ensure that certified products are labeled with a data carrier connected to a unique product identifier. This facilitates circular value chains, enabling efficient and reliable identification of more sustainable products in the marketplace and preparing the product for upcoming EU directives on digital product passports.

Applicability

All product categories.

Definitions

GTIN: Global Trade Item Number

Unique product identifier: A unique string of characters for the identification of products that also enables a web link to the [digital](#) product passport.

Digital product passport: a set of data specific to a product accessible via electronic means through a data carrier.

Data carrier: a two-dimensional symbol or other automatic identification data capture medium that can be read by a device.

Serial number: [Any alphanumeric string that functions as a persistent and unique identifier for an individual item.](#)

1.43.1 Mandate

Part 1:

The certified product must have a Data carrier containing a Unique product identifier ~~compatible with the~~ [As specified in](#) GS1 digital link ~~standard~~ [standard](#) or equivalent.

Part 2:

When the data carrier is scanned by a device, it must redirect to a [website displaying](#) unit-specific [website product information](#).

Submit the following to an approved verifier:

- [Physical Sample of product equipped with data carrier. Or documentation showing that the product will be marked in the same way as a previously assessed and approved product.](#)
- [Sample URL \(as encoded in the data carrier\)](#)
- [Sample URL for the website displaying unit-specific product information.](#)
- [GTINs assigned for the product, using the UPI template](#)

- A completed and signed product form (chapter 11.3).

Submit ~~The following together with the application is submitted~~ to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The GTINs assigned with the product, either by range or specific id's.
-

1.43.2 Clarification

Process

Part 1:

1. ~~Submit documentation describing how the product will be physically marked with the data carrier. See Data carrier specifications below for details.~~
2. ~~Submit the range of GTINs assigned for the product.~~
3. ~~Submit URL domain, including subdomain name that will be used in the data carriers.~~

Part 2:

1. ~~Show proof that the scanning of the data carrier with a device leads to a unit specific website by submitting a sample data carrier connected to a product specific web address as specified in part 1.3~~

Note: ~~The first time a brand applies for a TCO Certified Generation 10 certificate, A period of 12 months to fulfill part 2 of the mandate is available~~ may be granted to implement functionality so that the scanning of the data carrier leads to a unit-specific website.

Unique product identifier specifications

The Unique Product Identity must be encoded into the data carrier according to GS1 digital link URI syntax standard. The minimum required information to include is:

1. Global Trade Identification Number(GTIN) as provided for in standard ISO/IEC 15459-6
2. Product serial number

Example URL: <https://id.brand.com/01/09506001343376/21/4EEE2F4654CA424>

Description of example URL: https://subdomain.domain_name.com/gtin/serialnumber



See Section 5 in [GS1 Digital Link Standard: URI Syntax](#) for more Examples of GS1 Digital Link URIs. It is recommended, but not mandatory, to use the best practices guide from GS1 [GS1 Digital Link: Best practices for creating your QR Code powered by GS1](#)

Data carrier specifications

Accepted types of data carriers:

[Qr-code or data matrix](#)

[To ensure data carrier quality, the following standards must be followed:](#)

[If data carrier is a QR-code: ISO/IEC 18004:2015](#)

[If data carrier is a data matrix: ISO/IEC 16022:2006](#)

Placement of data carrier on the product

- A. The data carrier must be placed on the outer casing or on the marking plate.
- B. The data carrier must be placed on a flat surface on the product..
- C. The data carrier must be accessible without using tools.
- D. The brand owner submits documentation or a sample that shows how the product will be marked with the data carrier to an approved verifier.

Encoded Information:

[QR codes must be based on ISO/IEC 18004:2015](#)

Data matrix must be based on ISO/IEC 16022:2006 Products made up of multiple detachable parts:

[The data carrier should be attached to at least one of the parts.](#)

Data carrier on product packaging.

[It is not required to label the product packaging with an additional copy of the data carrier with the unique product identifier, but it is allowed.](#)

Data carrier Size

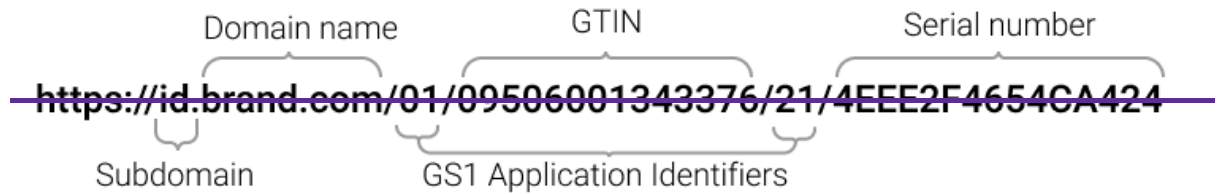
Use *Section 5.12.3 GS1 symbol specification* in [GS1 General Specifications](#) as a guide to select an appropriate label size to encode the Digital link URL domain name and product serial number.

URI and product identifier specifications:

It is recommended, but not mandatory, to use the best practices guide from GS1

Description of URL: `https://subdomain.domain_name.com/gtin/serialnumber`

Example URL: `https://id.brand.com/01/09506001343376/21/4EEE2F4654CA424EA3E9D3ED`



See Section 5 in [for more Examples of GS1 Digital Link URIs.](#)

Draft ✓

2 Socially responsible manufacturing

- Poor working conditions are common throughout the IT product supply chain.
- Child labor, forced labor, excessive overtime and hazardous substances are a risk to workers' health and lives.
- To drive social responsibility, a structured system for continuous improvements is needed, along with strict monitoring to ensure problems are resolved.

Social risk is present throughout the supply chain

Much of IT product manufacturing is carried out in low-wage countries where the labor market lacks clear regulation, and the protection of workers is insufficient. Poor working conditions occur throughout the supply chain. Sustainability risks include child labor, forced labor, and hazardous chemicals used in manufacturing. Excessive overtime leaves a worker with little to no time over for rest, recreation, family or further education. The mineral industry is connected to armed conflicts and human rights abuses, severe health problems for workers, and environmental degradation. As in many industries, the risk of bribery is also present. This must be counteracted as it hinders development, erodes justice, undermines human rights and interferes with the fair and efficient operation of markets.

Our approach: driving worker safety, human rights and closing non-conformities

Driving social responsibility throughout the complex IT product supply chain requires a clear and systematic approach. TCO Certified includes a framework that encourages proactive work and helps brand owners structure their work with sustainability. Corrective action plans must be developed and implemented within a set timeframe. To drive change where it's needed the most, monitoring of high-risk factories is intensified.

Criteria in chapter 2 focus on:

- Ensuring safer working conditions by requiring that the code of conduct is implemented throughout the supply chain.
- Guiding the industry to more sustainable practices with a structured system for continuous improvement.
- Requiring transparency about which suppliers are being used to increase accountability.
- Taking the next step in combating corruption in the supply chain by requiring compliance with the more ambitious anti-bribery standard ISO 37001.
- Continuing independent verification of due diligence all the way to the source of the minerals, to ensure that minerals are sourced responsibly.

- Requiring that all cleaning process chemicals are assessed by an independent toxicologist and benchmarked as a safer alternative before being used in the manufacture of certified products. The same principle applies also to flame retardants and plasticizers, covered in chapter 7.

Draft 2

Definitions ~~Chapter 2~~

3TG: tin, tungsten, tantalum, gold.

Anti-bribery management system: A system designed to help organizations ~~instill~~instil an anti-bribery culture and implement appropriate controls to detect and address bribery.

Brand owner: The company or organization owning or controlling the brand name of the product.

Bribery: Giving or receiving an unearned reward to influence someone's behavior.

Business licence: A business licence covers an independent work unit, which means it has its own ~~separated~~separate production areas, operation and management system, including but not limited to recruitment, working hours system, wage and benefit system, factory rules, etc. and all employees that under contract are dedicated to that factory.

Cleaning solvents: Chemicals and chemical mixtures used to remove contaminants, unwanted materials, and/or manufacture process residues (e.g. lubricants, adhesives, solder flux residues, plastic residue, and mold releases). Examples of process chemicals used for cleaning include: solvents, aqueous detergent solutions, stencil/ink removers, adhesive removers, solvent vapor degreaser solutions, ultrasonic parts cleaner solutions, photo-resist strippers, and solder~~_~~defluxing solutions.

Conflict-affected and high-risk areas: Areas in a state of armed conflict, fragile post-conflict areas, ~~as well as~~and areas witnessing weak or non-existing governance and security, such as failed states. In these areas, there are often widespread and systematic violations of international law, including human rights abuses.

Corrective action plan (CAP): A list of actions ~~that~~ the brand owner is responsible for implementing within a set timeframe; to address a specific problem.

Corruption: Gaining an advantage through illegitimate means. Bribery, abuse of power, extortion, fraud, deception, collusion, cartels, embezzlement and money laundering are all forms of corruption.

CPA: Clean Production Action. Developers of GreenScreen® for Safer Chemicals.

Final assembly factory: A final assembly factory is where the final assembly of the certified product ~~is taking~~takes place and is defined as the whole operation covered by a business license.

If the final assembly of the product is divided over more than one factory, all are considered final assembly factories.

Licensed GreenScreen Profilers: Toxicology firms licensed by CPA to provide GreenScreen assessment services for a fee to clients.

Next-tier major suppliers: Suppliers to the final assembly factory of parts and packing materials for the certified product. ~~Major suppliers are determined by the auditee~~

~~management system (annual spending, critical component, more than once purchase...) that has been verified by an accepted auditor.~~

Process chemical inventory: A record ~~kept by~~ the factory keeps showing the process chemicals used ~~in the to~~ manufacture ~~of~~ certified products.

Process chemicals: Chemicals (individual chemicals or mixtures) used during the manufacture of a product and/or to ~~carry out maintenance of/maintain~~ related production equipment. Process chemicals are not intentionally fully incorporated into the product.

Cleaning agents, lubricants and additives are examples of process chemicals.

Refining: A process that increases the grade or purity of a metal.

Responsible Minerals Assurance Process (RMAP): Independent third-party assessment of smelter and refiner management systems; and sourcing practices; to validate conformance with RMAP standards.

Responsible minerals initiative (RMI): Member initiative for ~~the implementation of/implementing~~ minerals supply chain due diligence.

Smelting: The process of applying heat to ore in order to extract a base metal.

SMT: Surface-mount technology is a method in which the electrical components are mounted directly onto the surface of a printed circuit board (PCB). An electrical component mounted in this manner is ~~referred to as~~ called a surface-mount device (SMD).

Draft

2.1 Supply chain responsibility

Background

Social responsibility is a continuing challenge throughout the IT supply chain. From raw materials extraction to final assembly, working hours, health and safety and forced labor are examples of industry-wide issues. However, for those who want to drive greater social responsibility, a major issue is the complexity of the IT product supply chain. It includes many suppliers that are spread all over the world.

The most basic aspect of social responsibility in the supply chains is to define who holds the responsibility. After this is done, the level of conformity and the implementation in the supply chains need to be defined. Finally, to make sure that problems are solved and improvements are made, independent verification and follow-up is crucial. Continued monitoring is essential, even after closure. TCO Certified offers a structured platform to guide industry progress:

- The responsibility for correcting non-conformities is placed on the brand owner, which is at the top of the product value chain.
- Define minimum standards of the brand owner code of conduct covering the manufacturing of the certified product.
- We provide a control system to ensure that the brand owner takes ~~the~~ responsibility in the ~~final assembly factories and~~ supply chains of the certified product; and works in a structured way in accordance with the code of conduct.
- By including a system of consequences for continued non-conformities, we ~~create an incentive for~~ incentivise the brand owner to work proactively.

Applicability

All product categories.

References

2.1, 2.2, 2.3

2.1.1 Mandate

By signing this mandate, the brand owner agrees to (1.) the Commitment and agrees to conduct (2) the Structured work. Additionally, TCO Development requires that the brand owner shows (3) Proof of the commitment and the structured work by allowing inspections in the ~~final assembly factories and the~~ supply chains of the certified product, ~~by~~ sharing audit reports and CAPs, and ~~by~~ providing other documented proof described below.

1. Commitment

- The brand owner must have a public code of conduct for the manufacture of certified products, ~~that is~~ considered consistent with the following principles and rights at work:
 - ILO's fundamental conventions: 29, 87*, 98*, 100, 105, 111, 138, 155, 182 and 187.
 - The UN Convention on the Rights of the Child, Article 32.
 - All applicable local and national health and safety and labor laws effective in the country of manufacture, and a maximum 60-hour workweek including overtime*.

*See clarifications; 1 and 2

2. Structured work

- The brand owner must register ~~at each~~ final assembly ~~factories~~ factory and ~~display panel factories~~ each factory manufacturing display panels >10" for the product model(s) that the application covers to TCO Certified Portal and supervise the implementation of the code of conduct at these factories.
- The brand owner must ensure all registered ~~final assembly factories and display panel~~ factories have identified and ~~communicated~~ communicated the code of conduct to their next tier suppliers of parts for certified products.

3. Proof

- The brand owner code of conduct and communication process must be annually verified during the annual review process.
- Accepted initial audit reports, closure audit reports and corrective action plans for each registered ~~final assembly factory and display panel~~ factory must be uploaded to TCO Certified Portal.
- The supply chain identification template (SCIT) must be submitted. The template must be uploaded to TCO Certified Portal for ~~each only the~~ registered final assembly factory. An updated SCIT may be required to be resubmitted at any time.
Data on the following suppliers for the following parts ~~for the final assembled product~~ must be included in the SCIT:
 - Product housing: Enclosure (chassis) including stand: Parts >0.5 grams.
 - Printed circuit board: ~~Main board (mother board)~~ Mainboard (motherboard) and power board.
 - External cables: Power and peripheral connecting cables.
 - Processors and memory: CPU, GPU, chipset, DRAM, RAM, SSD and HDD.
 - Battery: Remote power source of the product.
 - Power supplies: internal and external.
 - Display panel (all sizes).

- TCO Development may also require seeing audit reports and corrective action plans from factories further up the supply chains of the certified product; to ensure that corrective actions have been successfully implemented.
- TCO Development additionally requires that supporting documentation be verified by an independent verifier; approved by TCO Development.
- TCO Development may commission random factory audits (spot checks) at any [of the factories registered to TCO Certified Portal](#).

Submit the following to an approved verifier:

Once a year at the Senior Management Representative annual review:

- The brand owner's public code of conduct communicated to the supply chains of the certified product. The code of conduct must be considered consistent with this mandate.
- Supporting Information on the routines of how management and workers in [the final assembly factories and display panel factories each registered factory](#) are informed about the code of conduct.
- A completed and signed brand owner form covering the certified product. (Chapter 11.1.)

For each application:

- A copy of the factory list in the CB certificate with the names and addresses of all final assembly factories manufacturing the certified product model. If any of these factories are not registered to TCO Certified Accepted Factory List, ~~then~~ the brand owner must submit the factory identification template to register the [final assembly factory to the list](#) or prove that the factory is not manufacturing the certified product model.
- [A photo of the display panel marking label.](#)
- Check that the brand name is listed as compliant; without missed due dates, ~~in the SRM table in on~~ TCO Certified Portal. Any missed due dates will mean a certification application cannot proceed until the required documentation is submitted [and the due date is extended or marked compliant](#).

For each final assembly factory and [display panel](#) factory manufacturing [display panels >10" for](#) the certified product:

- The most recent independent initial audit report, corrective action plan for each non-conformity and closure audit report must be uploaded to TCO Certified Portal. The audit interval is determined by the risk category of the factory. The risk category is set by the verifier according to the process described under: **Audit report and factory risk categorization**.

- The supply chain identification template (SCIT) must be completed and submitted to TCO Certified Portal [for each registered final assembly factory](#).

Submit ~~The following, together with the application is submitted~~ to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A copy of an English version of the public code of conduct must be uploaded to TCO Certified Portal.
- An independent audit, and a corrective action plan for each non-conformity, must be reported to TCO Certified Portal, at an interval determined by the risk category of the [registered](#) factory, for ~~all final assembly factories~~[the certified product](#).

The following is submitted to TCO Development and ~~display panel may be published:~~

- The status (YES/NO), if all factories manufacturing the certified ~~product~~[products are category 3, is automatically collected](#).

2.1.2 Clarification

General clarifications

The mandate is a social performance mandate, and criteria are based on ~~ILO's~~[ILO's](#) (International Labour Organization) fundamental conventions and local legislation. The mandate requires that the brand owner comply with the minimum standards for code of conduct, inspection and corrective action engagement, regarding the supply chain of the certified product.

* Convention 87 and 98: Collective bargaining and freedom of association: All workers must have the right to form, join and organize trade unions of their choice and to have them bargain collectively on their behalf with employers. In situations where this is restricted under law, employers must allow workers to freely and democratically elect their own representative(s) for the purpose of defending the rights and interests of workers.

* Local labor law: The limit and enforcement of local law regarding working hours ~~differs~~[differ](#) tremendously ~~across the world~~[globally](#). To harmonize with other initiatives and to find a reasonable level for the industry, the criteria in TCO Certified sets a maximum 60 hour workweek, including overtime, as a global requirement regardless of the local law.

* 60 hour working week: This criterion sets a global limit for weekly working hours that includes overtime based on ILO convention 1 (56 hours per work week including overtime). An additional four hours per workweek is given to harmonize with SAI and RBA. Therefore,

workweeks, including overtime, are not to exceed ~~a total of~~ 60 hours, and ~~that~~ workers must receive at least 1 day off every 7 consecutive days.

TCO Certified has established thresholds for non-compliance with ~~regards to~~ working hours. For factories up to 15000 employees, the following is applicable;

- Minor non-compliance: up to 2% of the total workforce working between 60 and 72 hours per week
- Major non-compliance: 2% - 15% of the total workforce working between 60 and 72 hours per week
- Priority non-compliance: More than 15% of the total workforce working between 60 and 72 hours per week or any percentage of the workforce working above 72 hours per week.

The verification process

Proof documentation must be submitted to an independent verifier approved by TCO Development. It is the verifier's responsibility to request any additional documents necessary for the review. The verifier will evaluate the information received from the brand owner according to the principles described below (1-5).

1. The code of conduct:

The brand owner must have their code of conduct covering the supply chains of the certified product reviewed annually by an approved verifier. If the code of conduct has not changed since the previous annual review, ~~then~~ the brand owner does not have to submit it again. ~~In this instance,~~ The Senior Management Representative (SMR) for supply chain responsibility must report this to an approved verifier. The approved verifier carries out the verification ~~is carried out~~ during the annual review process ~~by the approved verifier~~.

- The code of conduct must be ~~considered~~ consistent with all parts under **1. CommitmentCommitment.**
- The contents of the code of conduct must have been adopted by the brand owner's board and addressed by management.
- The code of conduct must cover the manufacturing of the certified product.

2. Information about the code of conduct:

The brand owner must annually submit a description of how management and workers at all ~~final assembly factories and display panel~~ registered factories manufacturing certified products are informed about all parts of the code of conduct. Proof of training classes or other means of worker training and how the factory measures the effectiveness of the worker training must be submitted for review. The training must be held specifically for the purpose

of training and not just part of a regular business review meeting. If there are no changes to the communication routine since the previous annual review, then the brand owner does not have to submit it again. In this instance, the SMR must report this to an approved verifier. The approved verifier carries out the verification ~~is carried out~~ during the annual review process ~~by the approved verifier.~~

Accepted proof of compliance. All parts must be fulfilled:

- Annual training on all parts of the code of conduct for management and workers or worker representatives at ~~final assembly factories and display panel~~ registered factories of the certified product.
- Training is through: workshops, e-~~learnings~~ learning, or online training programs.
- There is a questionnaire (self-assessment) process to assess management and worker understanding ~~of,~~ and conformity with, the code of conduct.

3. **The brand owner form**

A completed and signed brand owner form covering the certified product (Chapter 11.1.) to confirm that one or all products that are included in the application to TCO Development ~~complies~~ comply with this criterion.

4. **Factory registration on TCO Certified Portal**

For each certified product, ~~at each~~ final assembly ~~factories~~ factory and ~~display panel~~ factories ~~each factory~~ manufacturing display panels >10" for the certified product must be identified. ~~Also, suppliers for materials and components of the certified product must be identified using the supply chain identification template (SCIT) provided by TCO Development.~~ registered to TCO Certified Portal.

The approved verifier will ensure that ~~final assembly factories and display panel~~ factories are listed on TCO Certified Accepted Factory List ~~and that a completed SCIT is submitted to TCO Certified Portal before the due date stated on the portal.~~

- ~~Final assembly factories and display panel factories of the certified product must be~~ Factories are registered to TCO Certified Portal Accepted Factory List using the factory identification template.
- ~~The SCIT must be submitted for each final assembly factory for the certified product.~~
- ~~Each time a final assembly factory or~~ It is not necessary to submit a SCIT for the display panel factories.
- Each time a factory is removed, added or updated in any way, ~~it is~~ the brand ~~owner's~~ responsibility to owner must ensure that this information is updated on TCO Certified Portal by submitting the factory identification template to an approved verifier. The template is downloaded from tcocertified.com.

5. Independent social audit reports

The brand owner must ensure that TCO Certified Portal is continuously updated with the most recent independent initial audit report; and corrective action plans for all non-conformities ~~that were found during this~~the audit; from all ~~final assembly factories and display panel~~registered factories manufacturing the certified product.

Brand owners or applicants/manufacturers must submit audit reports and corrective action plans to an approved verifier for upload to TCO Certified Portal.

Factory audit intervals are determined by the risk category of the factory.

1. Independent audits must be conducted by organizations accredited to ISO 17021 and carried out by SA8000 or RBA lead auditors ~~that~~who are APSCA certified. The lead auditor's APSCA membership number must appear in the audit report ~~and be in good standing status on the public APSCA member website~~.
2. ~~Types of~~ Accepted audits ~~are~~:
 - a. SA8000,
 - b. RBA VAP,
 - c. Other audit types, if ~~they are~~ independently verified to be of equal quality to one of the accepted audits (a or b). This includes auditor qualification, audit process (e.g. triangulation of non-conformities), reporting and CAP. Verification will be conducted by an approved verifier before an alternative audit is accepted as proof.

Defining the factory risk category and audit intervals

~~Final assembly factories and display panel factories~~A factory new to TCO Certified Portal must be independently audited using an accepted audit type. Any SA8000 certificate or RBA recognition diploma must be submitted with the initial audit report. ~~Based on the latest audit results,~~A factory is assigned a category 1, 2 or 3. ~~Category 1 is higher based on the risk; category 2 is medium risk and category 3 is the lower risk choice categorization procedure below.~~

A

~~Brand owners~~ new factory to TCO Certified Portal ~~will automatically be categorized as risk category 1. (See below: "Audit report and factory risk categorization"). These factories can receive a maximum of 18 months from the registration date to achieve category 2 or 3. Other factories that have achieved category 2 or 3 on TCO Certified Portal have up to the audit renewal due date to retain or improve their risk category level. It is not accepted for factories to return to risk category 1 and receive 18 months.~~

~~Brand owners that are new to TCO Certified, or apply~~applying for certification to a new product category ~~will need to~~must undergo ~~an additional a~~ risk assessment ~~in order~~. This is for TCO Development to ~~be sure factory audit~~ assess the likelihood of fulfilling the requirements ~~will be fulfilled~~ within the given time. If the brand owner or factory is considered a higher risk for receiving an extended time ~~toward fulfilling the initial audit requirements,~~ then (for example: a history of non-compliance), an audit report and a corrective action plan must be submitted before the factory can be registered to TCO Certified Portal.

Lower risk countries

Some countries are considered as lower risk of social non-conformities by the SA8000 Country Risk Assessments Process, which is based on World Governance Indicators (WGI). These countries include but are not limited to: EU countries, USA and Japan. Country risk level is a factor that is considered when setting category levels 2 and 3.

TCO Certified Accepted Factory List

All brand owners, applicants and verifiers who have access to TCO Certified Portal will have access to see TCO Certified Accepted Factory List of final assembly registered factories ~~and display panel factories.~~ This list includes information such as the risk category, ~~a list of~~ audit non-conformities and due dates for submitting supporting documentation. ~~This is an advantage for those factories that work proactively with sustainability issues, closing non-conformities and monitoring continued conformity. These factories will be considered a better choice to do business with than risk category 1 factories.~~ The Access to information for factories ~~which are~~ directly owned by a brand owner; is limited to that brand owner.

Audit report and factory Risk categorization procedure.

Initial audits are required at regular intervals. The audit interval is based on the factory risk category.

- An **initial audit** ~~is covering~~covers the ~~full scope of the~~whole factory and this criterion.
- A **closure audit** covers at least the open non-conformities from the latest initial audit.
- An initial audit is more comprehensive and is accepted as a closure audit.
- Audits older than 12 months are not accepted.

Initial risk categorization

- Risk category 1 is given to all new factories entering TCO Certified Portal, TCO Certified Accepted Factory List. Factories cannot continue as category 1 for more than 18 months or return to category 1; once they have been category 2 or 3.

Risk category 1 (higher risk choice).

Initial audit

- Only risk category 1 factories receive up to 18 months to achieve risk category 2 or 3. Only initial audits less than 12 months old from the date the factory is [activated/registered](#) on TCO Certified Portal are accepted. Any priority and major non-conformities to TCO Certified must be independently verified closed with a closure audit within the time period specified in the table below. The due date for achieving category 2 or 3 appears on TCO Certified Portal for each active factory.

Audit status on initial factory registration date	Priority and/or Major non-compliances	Months to achieve category 2 or 3
Without an initial or closure audit.	Unknown	18 months to conduct an initial and closure audit
With an initial audit report less than 6 months old	Yes	12 months to conduct a closure audit
With an initial audit report less than 12 months old	Yes	6 months to conduct a closure audit

Corrective action plan

- For each non-conformity to the mandate commitment, a corrective action plan must be uploaded to TCO Certified Portal. It must include closure deadlines; set by the audit program, [for the completion of to complete](#) each corrective action.

Closure audit

- If there are major or priority non-conformities in the initial audit, a closure audit must be submitted within the remaining time (see table above). The due date for the closure audit appears on TCO Certified Portal. [For minor non-conformities](#), The corrective action plan must be completed [for minor non-conformities](#), but it is not necessary to submit the closure audit.

Re-categorization

- When all non-conformities other than minor are closed, the factory will be categorized as risk category 2. If the factory is also placed in a lower-risk country; or [if it is](#) certified according to SA8000, it will be categorized as 3 instead of 2.

Final assistance

- If the factory has been categorized as a risk category 1 for 18 months, then the factory management may receive final assistance toward conformity through TCO Certified Active Monitoring Program. If the brand owner or factory decides ~~to not~~ to commit to the program, the factory will be removed from TCO Certified Accepted Factory List, and the factory will no longer be allowed to manufacture products certified to TCO Certified.

Risk category 2 (moderate risk choice).

Initial audit

- For risk category 2, the factory must be audited every 24 months. A new initial audit report must be uploaded to TCO Certified Portal during the ~~24-months-month~~ audit period, and all major and priority findings must be ~~confirmed~~ independently verified closed within this time. The due date for submitting audit proof to retain a place on TCO Certified Accepted Factory List is shown on TCO Certified Portal.

Corrective action plan

- For each non-conformity to the mandate in TCO Certified, a corrective action plan must be uploaded to TCO Certified Portal. It must include closure deadlines; set by the audit program, ~~for the completion of~~ to complete each corrective action.

Closure audit

- If there are major or priority non-conformities, a closure audit must also be uploaded to TCO Certified Portal during the ~~24-months-month~~ audit period. If the factory only has minor non-conformities, the corrective action plan must be completed, but it is not necessary to upload the closure audit to TCO Certified Portal. The closure of minor non-conformities will be verified in the next initial audit.

The initial audit should be conducted at least 6 months before the factory audit due date on TCO Certified Portal; to give time for a closure audit (if one is necessary).

Failure to retain category 2

- Failure of the factory to retain category 2 within the due date will cause it to be flagged on TCO Certified Portal, which means no certification applications for products manufactured at the factory are approved until the remaining non-compliances are closed. Additional time to close remaining non-compliances may be applied ~~for~~ following a risk assessment of the reasons behind the failure to close the non-compliances on time and the closure time plan submitted by the factory. If the brand owner or factory decides ~~to not~~ to commit to retaining category 2, the factory will be

removed from TCO Certified Accepted Factory List, and the factory will no longer be allowed to manufacture products certified to TCO Certified.

Risk category 3 (lower risk choice).

Initial audit

- For risk category 3, the factory must be audited every 36 months. A new initial audit must be uploaded to [the](#) TCO Certified Portal during the ~~36-months-month~~ audit period, and all major and priority findings must be ~~confirmed~~[independently verified](#) closed within this time. The due date for submitting audit proof to retain a place on TCO Certified Accepted Factory List is shown on TCO Certified Portal.

Corrective action plan

- For each non-conformity to the mandate in TCO Certified, a corrective action plan must be uploaded to TCO Certified Portal. It must include closure deadlines; set by the audit program, ~~for the completion of~~ [to complete](#) each corrective action.
 - If the factory is SA8000 certified, then the non-conformities are solved ~~in accordance with~~ [following](#) the SA8000 certification procedure.

Closure audit

- If there are major or priority non-conformities, a closure audit must also be uploaded to TCO Certified Portal during the ~~36-months-month~~ audit period. If the factory only has minor non-conformities, the corrective action plan must be completed, but ~~it is not necessary to upload~~ [uploading](#) the closure audit to TCO Certified Portal [is not required](#). The closure of minor non-conformities will be verified in the next initial audit.
 - A valid SA8000 certificate is considered proof that major and priority non-conformities are ~~being~~ monitored ~~during regular intervals~~ [regularly](#) by SAAS-accredited verifiers; and that issues are being solved.

The initial audit should be conducted at least 6 months before the factory audit due date on TCO Certified Portal; to give time for a closure audit (if one is necessary).

Additional clarifications that are valid for all risk categories

- If the audit program and lead auditor accepts an offsite closure audit it will also be accepted in TCO Certified.
- If proven conditions change, such as when non-conformities are found during a spot check, the risk categorization will be re-assessed.
- A major non-compliance given to a control point in the audit report for the only reason that working hours do not meet the stricter local legislated levels than the 60 hour workweek permitted in TCO Certified; may have this rating altered to compliance on TCO Certified Portal on condition that the 60 hour working week requirement is met.

- Closure of priority findings within the CAP deadline will be monitored ~~in particular~~ by TCO Development through the spot check program.

On-site factory inspection initiated by TCO Development (spot checks).

TCO Development reserves the right to require full audit reports and conduct or commission on-site inspections at ~~final assembly~~ factories ~~and display panel factories~~ registered on TCO Certified Portal as manufacturing the certified product; to ~~verify that the brand owner is fulfilling the~~ monitor continued compliance to obligations in this criterion. The planning of social audits will be done in cooperation with the Senior Management Representatives appointed by the brand owner, accepted social auditors and factory management. Factory audits are announced up to two weeks in advance.

Social audits initiated by TCO Development will be realized on a judgment sample basis, in each case decided upon ~~and financed~~ by TCO Development. ~~Results from the audits~~ Audit results will be shared with the audited factory management and all the brand owners listed ~~as~~ using the audited factory. ~~This is in order to create a combined~~ combine the effort ~~toward implementing the corrective action plan. For TCO Development, the spot checks and all other uploaded reports contain valuable information on social performance, making it possible to translate~~ close any non-conformities into metrics and then measure improvements through ~~code of conduct and audit methodology~~ compliance.

Spot check audits are financed by TCO Development. If priority non-conformities are found and further investigations are necessary, the ~~cost for this must be covered by the~~ license holder must cover this cost.

The verifier approved for supply chain responsibility

Only an independent verifier approved by TCO Development has the authority to approve the following:

For each brand owner:

- Code of conduct.
- Communication of the code of conduct.
- Supporting documentation.
- Conduct reviews with a senior management representative.

Other assessments

- Review evidence that could prove that another audit protocol can be considered “equal quality to other approved audit protocols”. This includes but is not limited to; auditor qualification, audit process, reporting and corrective action plan.

The list of approved verifiers is found at tccertified.com.

Draft 2

2.2 Supply chain transparency

Background

Supply chain transparency includes two vital parts: a) the extent to which information about a company and its sourcing locations is made public to end-users and stakeholders and b) the company's process of taking action through supply chain visibility; to manage it effectively.

Companies struggle to achieve supply chain transparency since they lack a solid process and structure to manage risks and monitor behavior in their extended supplier network. Without visibility into their supply chains, brand owners create a blind spot where damage to reputation can emerge.

Transparency toward an independent party provides a company not only with the possibility to measure its own performance in key areas against ~~their~~ peers; but also a way to share and gain knowledge about solutions. Supply chain transparency requires a solid management system, where improvements are achieved by acting on responses to shared information.

Applicability

All product categories.

2.2.1 Mandate

The brand owner must appoint a Senior Management Representative (SMR) for supply chain responsibility for the certified product, who reports directly to senior management.

Irrespective of other duties, this person must have the authority to ensure that the certified product meets the supply chain criteria in TCO Certified.

The SMR has access to TCO Certified Portal and must ~~make sure~~ ensure that the due dates for submitting supporting documentation are complied with.

The SMR is responsible for the brand owner annual review process being completed with an approved verifier, and the report is uploaded to TCO Certified Portal before the annual due date.

Submit the following to an approved verifier:

Once a year at the Senior Management Representative interview:

- A completed annual review report.
- A completed and signed brand owner form covering all certified products and brand names used (chapter 11.1)

~~Submit The following together with the application is submitted~~ to TCO

Development:

- The report from the annual review must be uploaded to TCO Certified Portal.

- A copy of a verification report from a verifier approved by TCO Development.
- ~~The report from the annual review.~~

The following is submitted to TCO Development and may be published:

- The status (Yes/No & link to public list), if all final assembly factories manufacturing the certified product are listed publicly by the brand owner.
-

Draft 2

2.2.2 Clarifications

General clarifications

The aim of the mandate is to create transparency between TCO Development and senior management at the brand owner company of the certified product.

Senior Management Representative (SMR) details

The required details of the SMR must appear in TCO Certified Portal, and the SMR must be available for dialogue in English with TCO Development and verifiers throughout the validity of all the brand owner's certificates.

If the appointed SMR is changed, then details of the new SMR must be updated in TCO Certified Portal. TCO Development must be informed immediately.

The SMR must ensure that TCO Certified Portal is up to date, covering the following:

- Name, title, telephone number and email address of the SMR.
- A valid annual review report.

SMR and annual review

The annual review must be done with one of the verifiers approved by TCO Development. It is booked and paid for by the SMR company. The purpose is to ensure that the appointed person has the necessary authority and that the company ~~is working~~works in a structured way to implement the ~~brand owner's code of conduct and anti-bribery system~~points covered in the annual review questionnaire.

If the brand owner has more than one brand name registered, the review must cover each ~~of the brands names~~brand name respectively and ensure that all requirements in TCO Certified are fulfilled. The verifier must ensure that it is intuitive for anyone searching for the required information on each ~~of the brand names websites~~name's website where to find the information. In some cases, this means that it must be publicly stated who owns the brand name or that links are provided to the documents on the brand ~~owners~~owner's website.

As part of the annual review process, all questions must be answered and submitted to the verifier ~~prior to~~before the interview. During the part of the review questionnaire that covers the section on social performance, the SMR will be required to explain ~~in more detail~~ the brand owner's work toward a socially responsible supply chain of the certified product and provide supporting documentation where needed. It is recommended that SMRs involve colleagues in the meeting who can provide the necessary expertise in the areas covered by the questions. The interview part of the review process will likely be an online meeting. ~~If for some reason~~ it is not possible to have an online meeting or ~~if~~ the interview does not obtain an acceptable quality due to language difficulties, then the verifier may require a face ~~to face~~interview to

face interview. TCO Development has the right to participate in the interview with the SMR. In this case, TCO Development will cover its own expenses.

The final report from the annual review is then uploaded to TCO Certified Portal by the verifier. TCO Development have

The annual review questionnaire is revised every third year, following the right launch of a new generation of TCO Certified.

An evaluation is made based on the review results regarding the voluntary public disclosure of final assembly factories. There is no mandatory level, but this information may be shared with purchasers.

The link to participate the brand's publicly disclosed factories (if available) is taken from the review results and entered into TCO Certified Portal. After the report is uploaded, the verifier cross-checks the publicly disclosed factories at the interview with the SMR. In this case TCO Development will cover their own expenses-provided link against the final assembly factories used by the brand to manufacture certified products in TCO Certified Portal.

To count a final assembly factory as publicly listed, it must be made public on the brand owner website and state that the brand owner has a business relationship with those factories. The factory information must show at least the supplier name, factory full address and type of products manufactured at the factory.

About the ~~social performance~~ annual review questionnaire and result benchmarking

The annual review ~~social performance section~~ questionnaire is ~~a set an independent assessment~~ of questions aimed at gaining transparency into the brand owner's risk management ~~in of~~ the supply chain of the certified product ~~as and is~~ part of TCO Development's capacity-building work with brand owners.

The SMR is responsible for answering all questions and providing supporting documentation where needed. Answers are verified and ~~color~~ the level of achievement is benchmarked by the verifier ~~for easy reference: invested (green), involved (yellow) or interested (red)...~~

~~There is no minimum graded level required to be fulfilled, since the questions are~~ For the annual SMR interview questionnaire is intended to gather information on the actual level of social commitment, identify capacity-building possibilities, share solutions, and assist in ~~the development of~~ developing future generations of TCO-certified criteria. Feedback to the brand owner is given in the form of a report and table ~~that shows~~ showing the brand owner's final grading (after the interview) ~~in comparison~~ compared to other certifying brand owners (all brand names are kept anonymous). This helps the brand owner identify areas for improvement and measure their progress within the industry.

Result data will also be used to risk assess factories of the certified product for the spot-check program. In this program, TCO Development orders annual factory audits according to the code of conduct by independent auditors at a number of final assembly factories where certified products are manufactured.

The annual review questionnaire and guidelines for the annual review process are public and available for download at tcocertified.com:

Clarification of sustainability performance indicator(s)

One or more “sustainability performance indicators” (chapter 1.3) are collected for this criterion. There is no mandatory level for these indicators but they must be verified and reported according to the description below:

- **Public factory list**

The percentage of final assembly factories manufacturing certified products which are publically listed on the brand owners website must be reported in TCO Certified Portal, annually. (0% may be reported if the number is unknown):

In order to count a final assembly factory as publicly listed it must be made public on the brand owner website under a heading “Supply Chain” or similar. The factory information must show at least the supplier name, factory full address and type of products produced at the factory. Additional information on whether the supplier has produced a GRI based sustainability report is optional.

2.3 Anti-bribery management system

Background

Bribery is a widespread phenomenon. It raises serious moral, economic and political concerns, undermines good governance, hinders development and distorts competition. It erodes justice, undermines human rights, and ~~is an obstacle to the relief of~~[hinders](#) poverty ~~relief~~. It also increases the cost of doing business, introduces uncertainties ~~into~~[in](#) commercial transactions, increases the cost of goods and services, diminishes the quality of products and services, which may lead to loss of life and property, destroys trust in institutions and interferes with the fair and efficient operation of markets.

Organizations ~~have a responsibility to prevent~~[are responsible for preventing](#) all forms of corruption within their businesses and ~~their~~ supply chains. To do so, organizations must align their business policy, monitoring and enforcement mechanisms with internationally recognized best practices against all forms of bribery.

With TCO Certified, brand owners that apply for product certification are reviewed by an independent reviewer, who assesses the brand owner's anti-bribery management system; to ensure that it meets the requirements of ISO 37001.

Applicability

All product categories.

References

2.4.

2.3.1 Mandate

The brand owner must have internal processes and routines in place to prevent and respond to all forms of bribery, covering all business activities connected to the certified product. This includes ~~making sure~~[ensuring](#) that the supply chain of at least the certified product ~~proves full alignment~~[aligns](#) with the anti-bribery management system standard ISO 37001.

Submit the following to an approved verifier:

- A completed and signed brand owner form covering the certified product (chapter 11.1).
- An ISO 37001 certificate; or ~~a booked date for~~ the anti-bribery ~~questionnaire and follow up annual~~ review ~~with~~[report by](#) an approved verifier.

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
-

Draft 2

2.3.2 Clarification

The brand owner's anti-bribery management system covering all business activities connected to the certified product, including the supply chain, must be considered to be fully aligned with ISO 37001. If an ISO 37001 certificate is ~~not available~~unavailable as proof, the brand owner ~~has the option to~~can complete the questionnaire and take part in a follow-up verification review with an approved verifier. ~~A date for the review must be set before the verifier can issue a verification report to TCO Development.~~

A follow-up review of the brand owner anti-bribery management system will be in the form of a questionnaire and included in the first annual review with the assigned Senior Management Representative (SMR) for supply chain responsibility.

Each answer ~~of~~to the questionnaire will be graded using ~~a color~~. Green is aligned, yellow is ~~improvement necessary~~partial alignment and red is ~~not aligned~~no alignment. A completed ~~SAQ~~questionnaire and ~~required~~ supporting documentation must be submitted to the verifier ~~prior to~~before the review. These will be verified in the online review between the verifier and the brand owner SMR and any experts responsible for anti-bribery the SMR wishes to include.

Verification guidelines

- ~~Full-Alignment to ISO 37001 is considered to be~~without providing a valid certificate is when all answers are scored green (except 12.1) in the anti-bribery section of the annual review- ~~questionnaire. When all required points are aligned,~~ there is ~~then~~no need to include ~~the anti-bribery section as part of in the~~ following annual ~~review~~reviews unless requested by TCO Development.
- ~~Not in full alignment to ISO 37001 is considered to be~~If any point (except 12.1) is scored yellow or red. ~~In this case,~~ a corrective action plan must be made, and the point will be included in the following annual review and must ~~then~~be scored green.
- Only question 12.1 (covering independent verification ~~of the~~ anti-bribery management system) can be graded yellow or red; since this review in TCO Certified is considered an independent verification of the anti-bribery management system.

2.4 Responsible mineral sourcing

Background

Minerals such as tin, tantalum, tungsten, gold and cobalt are connected to armed conflicts and human rights abuses in the [world's](#) regions ~~of the world~~ where they are extracted. Unsafe mining methods also lead to severe health problems for workers; and environmental degradation in local communities. Since the mineral supply chain can include hundreds of suppliers, from mines and smelters or refiners to final production, ~~it is a challenge to~~ [makemaking](#) informed choices about mineral sourcing, from extraction to finished product, ~~is~~ [challenging](#).

TCO Certified drives more responsible mineral sourcing in all countries where the mining industry and trade are present. Suppliers must adopt a responsible approach to mineral sourcing, irrespective of where ~~in the world~~ they operate. TCO Certified goes beyond the current definition of conflict minerals and requires ~~that~~ brand owners ~~to~~ include cobalt ~~as part of~~ [in](#) their due diligence process. To drive widespread, positive impacts ~~at a faster rate~~, due diligence and risk reporting ~~is~~ [are](#) standardized, ~~with focus~~ [focusing](#) on long-term, continuous improvement.

Applicability

All product categories.

References

2.5, 2.6, 2.7, 2.8.

2.4.1 Mandate

The brand owner must:

- Have a supply chain policy for responsible ~~minerals~~ [mineral](#) sourcing; for the certified product that can be considered to cover at least 3TG and cobalt. The policy must be both public and communicated to the supply chain.
- ~~Have~~ [Conduct](#) a ~~process to identify~~ [reasonable](#) country of origin ~~and~~ [inquiry for](#) smelters or refiners (SORs) of at least 3TG and cobalt for the certified product that follows the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas process.
- Annually demonstrate that at least 70% of the total number of SORs for 3TG and cobalt in the supply chain of the certified product are conformant (certified) to an accepted independent third party due -diligence program.

- ~~Annually demonstrate that at least 10% of the total number identified 3TG and cobalt SORs, in the supply chain of the certified product, process only from scrap or recycled materials.~~
- Annually submit the completed ~~responsibly sourced minerals~~[responsible mineral sourcing](#) template ~~with all the information required in the template.~~

Submit the following to an approved verifier:

- The most recent version of the public responsibly sourced minerals policy and a description of how it is communicated to the supply chain of the certified product.
- A description of the brand owner's structured work on identifying risk areas in the supply chain of the certified product with supporting documentation.
- The ~~responsibly sourced minerals~~[responsible mineral sourcing](#) template ([a TCO Certified template](#)) and supporting documents must be completed and submitted to TCO Certified Portal before the brand owner annual due date stated in ~~the SRM table,~~[TCO Certified Portal](#) and cover the supply chains of the final assembly factories of the certified product registered by the brand owner on TCO Certified Accepted Factory List.
- A completed and signed brand owner form covering the certified product (chapter 11.1).

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A copy of the responsibly sourced minerals policy, in English. (Must be uploaded to TCO Certified Portal.)

2.4.2 Clarifications

Responsibly sourced minerals policy

The responsibly sourced minerals policy is an essential statement by the brand owner. It must reflect the brand owner's commitment toward responsible sourcing of minerals and the expectations that their raw material suppliers adhere to the policy.

Verification guidelines:

The verifier must ~~be able to~~ verify that the responsibly sourced minerals policy can be considered to cover at least 3TG and cobalt for all the certified products, ~~that it~~ [is public](#), and ~~also~~ that it is clear how the policy is communicated to suppliers.

- "Public" means that the policy is visible on the brand ~~owner~~[owner's](#) website; or is included in the brand owner's annual sustainability or responsible minerals report, ~~and~~

that it is ~~clearly~~ communicated that it covers all the brand names the brand owner has registered on the TCO Certified Portal.

- “Communicated” could be ~~as~~ part of a contract and/or ~~in~~ a written agreement with suppliers.

To verify the level of strictness, the policy must require at least the following:

- That suppliers uphold the policy.
- That suppliers neither directly nor indirectly finance armed groups in conflict-affected regions.
- That suppliers neither tolerate nor contribute to human rights abuses that include forced labor, child labor and environmental degradation.
- A commitment to supporting responsible sourcing from ~~these~~ regions ~~in which~~ where specific mining operations may present risk.
- ~~That~~ Suppliers work with the brand owner to identify SORs of 3TG and cobalt in the supply chain and report details using a ~~minerals reporting template, such as~~ conflict minerals reporting template (CMRT) or extended minerals reporting template (EMRT).
- That sourcing of 3TG and cobalt must be from SORs ~~that are~~ participating in third party audit programs aligned with OECD Due Diligence guidance and working toward certification.
- That action plans must be developed for SORs identified as not participating or certified to a third party audit program; to remove them from the supply chain or have them ~~become participants~~ participate in a program to obtain certification.

Structured work on identifying risk areas

The brand owner must carry out structured work to identify if at least 3TG and cobalt are present anywhere in the supply chain of the certified product, with the goal to identify the SORs. The verification of the structured work is carried out as part of the brand owner annual review process.

Identifying risk areas is a process that helps map the chain of custody of risk minerals down to the SORs within the supply chain. This is commonly done by a minerals reporting template ~~such as a CMRT and EMRT~~ being systematically sent through the supply chain. This transfer of information facilitates the identification of high-risk SORs.

Verification guidelines:

The verifier has been provided with a description of how the brand owner identifies risk areas in ~~its~~ the supply chain of the certified product. The verifier can also require a copy of the

completed [minerals reporting](#) template as further evidence of compliance. See [below the examples below](#):

- Using an established minerals reporting template as part of the brand owner's due diligence process. As a random follow-up at the request of TCO Development, completed examples of the template are to be submitted to the verifier.
- A public list of SORs on the brand owner website ~~is considered verification~~ [verifies](#) that the brand owner has identified the list ~~through~~ using a minerals reporting template.

Audited smelters or refiners (SORs)

Brand owners are required to annually submit information ~~of~~ [on](#) the SORs identified as the source of 3TG and cobalt in the supply chain of the certified product. The required information identifies SORs that are conformant, active or otherwise registered through independent verification for their mineral sourcing due diligence process.

The brand owner must annually demonstrate the SORs that are conformant (certified) to an accepted responsible sourcing program (~~see below accepted programs~~) and those that [are considered to](#) process ~~only from~~ scrap or recycled materials. ~~Supporting information on the SOR recycling program is required as proof that the SOR processes only recycled/scrap materials.~~

Verification guidelines:

The verifier must annually be provided with the ~~responsibly sourced minerals~~ [responsible mineral sourcing](#) template (a TCO Certified template) with the required columns covering information on the SORs identified as the source of 3TG and cobalt in the supply chains of the certified products.

The template section, 'Audited facilities' requires information about which SORs are in the supply chain of the certified product. SORs must be ~~those that are~~ publicly registered as ~~conformant~~ [conformant](#) with [the](#) Responsible Minerals Assurance Process (RMAP) or ~~registered~~ on the European Union (EU) 'white list'. Registered ~~as being part of a program such~~ as 'active' or 'in-process' is not accepted as compliant. The verifier will compare the submitted information against the latest published list of conformant SORs using the comparison tool provided by TCO Development.

[Other third party](#)

[The brand owner can find their annual due date for submitting the responsible mineral sourcing template on TCO Certified Portal. The template is downloaded from \[tco certified.com\]\(#\) and must be submitted to the accepted verifier in time.](#)

[Audit program cross-recognition](#)

~~RMAP cross-recognised audit programs (if used) are accepted. These presently include the London Bullion Market Association (LBMA) and the Responsible Jewellery Council (RJC). Other programs must first be considered to independently verify the implementation of independent verification to access the OECD due diligence guidance implementation before they can be being accepted as an alternative. The brand owner must provide proof of program alignment to the accepted verifier before it can be added as an independent third party due for assessment.~~

~~Due diligence program accepted by TCO Development. If the SOR is entered as sourcing recycled or scrap 3TG or cobalt, documented proof supporting this fact must also be submitted.~~

~~The annual due date for submitting the responsibly sourced minerals template is found on TCO Certified Portal. The template is downloaded from teocertified.com.~~

More information:

- The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (“OECD due diligence guidance”), available at oecd.org. Brand owners require suppliers to disclose their sourcing origins of minerals by using a questionnaire template such as the Responsible Minerals Initiative (RMI), conflict minerals reporting template (CMRT) or similar in order to prevent the potential use of risk minerals.
- Member of the Responsible Minerals Initiative (RMI). Members contribute to a number of tools and resources, including the conflict minerals reporting template; supporting in-region sourcing schemes and the Responsible Minerals Assurance Process (RMAP).
- Responsible Minerals Assurance Process (RMAP) helps companies make informed choices about responsibly sourced minerals in their supply chains. Independent third-party audits of SOR management systems and sourcing practices are used to validate conformance with RMAP standards. The assessment employs a risk-based approach to validate SOR company-level management processes for responsible mineral procurement.

The RMAP standards are developed to meet the ~~requirements of the~~ OECD Due Diligence Guidance requirements, the Regulation (EU) 2017/821 of the European Parliament and the U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act.

- EU ‘white list’ is a proposed list of SORs. The regulation (EU) 2017/821 ~~works to promote~~ promotes the responsible sourcing of SORs of tin, tantalum, tungsten and gold, whether they are based inside the EU or not. This is because EU importers ~~will be required to~~ must identify the SORs in their supply chains and check whether they have

the correct due diligence practices ~~in place~~. Whenever EU importers find SOR practices ~~to be~~ insufficient or associated with risks, they ~~will have to~~ must manage and report on this.

To help companies, the European Commission is working to create a compliant list of global SORs which source responsibly.

Draft 2

2.5 Process chemicals management

Background

Scientific research shows that workers that/who come into contact with chemical substances used in the manufacture of IT products are more likely to suffer from cancer, reproductive damage, birth defects and other serious illnesses.

The use of chemicals such as benzene and n-hexane (industrial cleaning solvents), that/which have well-documented toxic human health effects, have been restricted in some parts of the world; but are often used by the manufacturing industry in developing countries where legislation is weaker, and workers are less protected. These chemicals need to be phased out of production; and not be replaced with equally hazardous substances.

To replace chemicals with safer alternatives, process chemicals and their suitable safer alternatives must be identified and independently assessed by an approved toxicologist. The Personal Protective Equipment (PPE), training and exposure monitoring provided to the workers who risk chemical exposure also needs/need to be reviewed and improved.

Applicability

All product categories.

References

2.9, 2.10

2.5.1 Mandate

Each final assembly factory and display panel factory manufacturing display panels >10" for the certified product:

- must have a structured health and safety management system in place that is independently certified to ISO 45001.
- must only use cleaning solvents; for product components and PCB process cleaning; that contain individual chemicals or formulations that appear on TCO Certified Accepted Substance List (ASL).
- must submit chemical inventory data covering at least cleaners, adhesives and lubricants.
- All substances of a mixture must be accounted for. Non-accepted substances must not exceed concentration levels of 0.1% by weight of the chemical product.

Submit the following to an approved verifier:

- A copy of the valid ISO 45001 certificate ~~for the final assembly factory and display panel factory manufacturing the certified product.~~
- An accepted process chemical data collection template ~~for each final assembly factory and display panel factory manufacturing the certified product.~~ The chemical data must at least cover the chemical formulations and ingredients ~~as~~ shown in the chemical safety data sheet and used on the production lines where certified products are manufactured. The template must be submitted before the factory is added to TCO Certified Portal.
- A completed and signed factory form (chapter 11.2).

~~Submit~~ The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
- For assessed substances, a copy of the assessment report issued by an approved licensed profiler independent of the accepted screened chemistry program. For GreenScreen certified formulations, a copy of the GreenScreen Certified certificate: is acceptable.
- The process chemical data template must be reported in TCO Certified Portal.

2.5.2 Clarification

The cleaning process chemicals that appear on TCO Certified Accepted Substance List are commonly used by production lines to clean display panels, product enclosures ~~and~~, printed circuit boards ~~(PCBs)~~, SMT machinery and tools.

The production lines manufacturing certified products must only use cleaners ~~that are~~ listed on the TCO Certified Accepted Substance List. To be included on the list, chemicals must be independently assessed; and receive a GreenScreen® benchmark score of 2, 3 or 4: Alternatively or ChemFORWARD hazard band A, B or C. For chemical formulations ~~that are~~, GreenScreen certified ~~(gold or platinum)~~ or gold set by a licensed GreenScreen Profiler ~~are~~ is accepted. ~~If a substance on ASL is set a non-accepted benchmark through reassessment, then the benchmark is removed from the ASL. Substances with a removed benchmark or certification receive a sunset date for when they will be removed from the list. Before the sunset date, the chemical may be used on production lines where products certified according to TCO Certified are made. This gives the supplier/s time to have an independent assessment of the chemical, or to replace it with an approved benchmarked or certified alternative from the list.~~

From the date when a factory is registered on TCO Certified Portal and TCO Certified Accepted Factory List, a 12-~~months-month~~ transition period to using only safer alternatives appearing on TCO Certified Accepted Substance List can be applied for. To keep the factory active on TCO Certified Portal, an updated process chemical data collection template must be re-submitted before the process chemical compliance due date on TCO Certified Portal.

Proof of health and safety management system conformity:

A valid ISO 45001 certificate must be uploaded to TCO Certified Portal for each registered factory that is in scope of this requirement. The certificate must be issued by a certification body that is accredited to issue the certification. Factories that do not yet have a certified health and safety management system according to ISO 45001, may apply to TCO Development for an extended ~~time~~ period of up to 24 months to complete certification. This ~~timeplan~~extended-time application template can be obtained from an accepted verifier. TCO Development has the right to deny the applicant an extended period ~~of time~~ if there is reason to believe the factory ~~will not be able to~~cannot achieve the ISO 45001 certification within the ~~extended time~~ period (for example, if other critical non-compliance issues are pending; or if the ~~timeplan is insufficient~~factory has a history of persistent audit non-compliance).

Process Chemical Data Collection Tool and Guidelines

An accepted Process Chemical Data Collection Tool must be completed and uploaded to TCO Certified Portal. The data must cover at least cleaning agents, adhesives and lubricants ~~being used~~ for the production of to produce the certified product. The Process Chemical Data Collection Tool can be downloaded from tcocertified.com/certification-documents.

Completing the Process Chemical Data Collection (PCDC) Tool

- The senior representative at the factory, whose responsibilities cover chemical management, must assist the applicant in ~~the completion of~~completing the accepted PCDC Tool.
- The areas that must be completed by the applicant are listed as 'required'.
- Listed chemical substances must show the CAS# number. ~~For proprietary reasons~~ The chemical supplier can directly submit this information to TCO Development: ~~if there are proprietary concerns~~. If a CAS# number is withheld, ~~then~~ the chemical ingredient is treated as a restricted substance, and the cleaning product must be replaced with an accepted alternative. ~~The~~An alternative is to have the formulation GreenScreen Certified and listed by trade name only.

- The information must cover at least all chemical types required under the mandate and ~~that are used for the~~to manufacture ~~of~~ certified products.
- Upon request, the process chemical inventory at the factory must also be submitted for independent verification purposes.
- The PCDC Tool must be updated at the request of TCO Development.
- TCO Development has the right to compile confidential information with CAS numbers. TCO Development reserves the right to publish such compiled, anonymous information, ~~but~~. Still, no information will be presented ~~in such a way~~so that the company or the products in question can be identified.

Exposure controls and personal protective equipment (PPE)

TCO Certified Accepted Substance List reduces the risk of worker exposure to highly hazardous chemicals. However, safer alternatives do not remove the responsibility of the factory management to provide personal protection equipment as described in the chemical's safety data sheet (SDS), ~~that~~which covers exposure controls and personal protection.

Verification of PPE (availability, training and use) is included in the ISO45001 standard and as part of the required factory audits- (see mandate 2.1).

3 Environmentally responsible manufacturing

- Large amounts of natural resources and energy are used to manufacture IT products.
- This consumption can lead to soil, water and air pollution, as well as large greenhouse gas emissions.
- To reduce environmental risk, the environmental impact must be measured and environmental and energy management systems need to be in place.

Major environmental risks in the IT industry

Several environmental hazards occur throughout the IT product life cycle. The manufacturing process is a large risk. Harmful substances that are not handled safely risk ending up in nature. Life cycle assessments confirm that a typical IT product consumes more energy during its manufacture than during its entire usable life, resulting in large greenhouse gas emissions which impacts our climate. Another risk is the extensive use of natural resources in manufacturing, leading to a high energy consumption and the loss of valuable, finite resources.

Our approach: measuring and incentivizing reduced environmental impact

With TCO Certified, the brand owner must have an environmental management system in place, and work systematically with continuous improvement in environmental performance. Gathering information on material reuse and energy efficiency in the assembly phase is important and creates incentives for reducing the product's carbon footprint.

Criteria in chapter 3 focus on:

- Lowering environmental risk and ensuring continual improvements by requiring that all final assembly factories are certified according to ISO 14001 and have an environmental management system in place.
- Putting the spotlight on energy efficiency in manufacturing through annual reporting.
- Lowering energy use in manufacturing by requiring compliance with ISO 50001.
- Gathering information about post-consumer recycled content and renewable materials to help buyers identify more circular products.
- Offering the brand owner an incentive to determine the product's carbon footprint through Product Carbon Footprint (PCF) analysis.

3.1 Environmental management system

Background

A certified environmental management system helps an organization work in a systematic way with environmental performance, and make continuous environmental improvements. To be efficient, an environmental management system must include independent, external reviews.

Definitions

See definitions chapter 2.0

Applicability

All product categories.

~~The company or companies that manufacture the product.~~

References

2.11

3.1.1 Mandate

- Each final assembly factory and each factory manufacturing display panels >10" for the certified product must have a structured environmental management system that is independently certified to ISO 14001.
- ~~• Each factory manufacturing display panels for the certified product must have a structured environmental management system that is independently certified to ISO 14001.~~

Submit the following to an approved verifier:

- A copy of a valid ISO 14001 certificate for each final assembly factory and each factory manufacturing panels >10" for the certified product.

~~Submit~~ The following together with the application is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
-

3.1.2 Clarification

The applicant must ensure that a valid ISO 14001 certificate is available on TCO Certified Portal at all times, for every final assembly factory, and display panel factory that are registered to TCO Certified Portal as manufacturing certified products.

The certificate(s) or an appendix to the certificate(s) must make it clear what the certification covers.

If necessary the applicant may ask for an extended time period of up to 12 months on behalf of a factory that is not yet certified, by presenting a time plan for achieving the ISO 14001 certification and signing an agreement. TCO Development has the right to deny the applicant an extended period of time if there is a substantial risk that the factory will not be able to achieve ISO 14001 certification within the extended time period.

The certificate must be issued by a certification body that is accredited by an accreditation body covered by the International Accreditation Forum, iaf.nu, Multilateral Arrangement on Environmental Management Systems.

Draft

3.2 Renewable energy

Background

While IT products become increasingly energy efficient in the use phase, there are still improvements to be made in the manufacturing phase. Life cycle assessments show that many IT products consume more energy during manufacturing than during the use phase. As we face the challenges posed by climate change, it has become increasingly important for companies to transition to renewable energy sources. By increasing the share of renewable electricity in the final assembly of certified products, the product carbon footprint and climate impact of the certified product are reduced. This also increases the demand for Renewable Energy Certificates (RECs), which increase the economic incentive to build new generators for renewable electricity in many regions where most electricity is generated from non-renewable sources.

Applicability

All product categories.

3.2.1 Mandate

For each final assembly factory that manufactures the certified product:

- ~~the total electricity used and the electricity procured and/or generated from renewable sources must be reported as “energy efficiency indicators” yearly.~~

At least 15% of the ~~total~~ electricity used in the final assembly of the certified product must be procured and/or generated from renewable sources. This ratio must be reported yearly.

Submit the following to an approved verifier:

- ~~A completed and signed factory form(s) (chapter 11.2)~~

Once a year, the brand owner must provide:

- Documented proof ~~that at least 15% of the total~~ ratio of renewable electricity used in the final assembly ~~factories manufacturing of~~ the certified product ~~was procured and/or generated from renewable sources the previous calendar year in each factory that is used.~~
- Submit Documented proof of the total electricity and the ratio of renewable electricity used in each final assembly factory of the certified product.

The following ~~together with the application~~ is submitted to TCO Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

- ~~The energy efficiency indicators~~ The ratio of renewable electricity used in the final assembly of certified products for the brand in each factory must be reported in TCO Certified Portal once a year.
 - The total electricity consumption and the ratio of renewable electricity use for each final assembly factory must be reported in TCO Certified Portal once a year.
-

Draft 2

3.2.2 Clarification

Reporting period

The Brand owner reporting period

The reporting by the brand owner must be submitted by 31 August each year. Each reporting covers period is the previous calendar year. The reporting applies until one year after the certificate has expired. Only electricity used, and generated and procured during the previous calendar year must be included in the report. Renewable electricity certificates may be procured up to three months after the reporting period as long as the applicable reporting period is specified on the REC (to avoid double counting).

Acceptable sources and conditions for procurement and generation

Acceptable sources for renewable electricity **Exception for new factories**

For factories where no TCO Certified Generation 10 product was certified (for any brand) before 31 August. The brand owners manufacturing of certified products at this factory must be in compliance the following calendar year. However, the brand owner must still report the renewable electricity share of their manufacturing (even if not in compliance), each 31 August.

The ratio of renewable electricity may be reported at the factory or product level.

Brand owners can choose if to report on the whole factory level, or, on the manufacturing of their certified products. Reporting on their own manufacturing is useful if they want to purchase additional RECs for their own manufacturing to achieve a higher share than the factory.

In this case the electricity used to manufacture certified products is estimated based on the allocation of manufacturing volume, which is a common principle used in, for example, the Greenhouse Gas Protocol. This means that the total electricity consumption of the factory is allocated to individual products based on units manufactured.

For each reporting period and final assembly factory, the brand owner must report the following:

If the ratio of renewable electricity used by the factory is $\geq 15\%$ reporting may be done only on the factory level and must include:

- Documented proof of the total electricity consumption of the factory (X)
- Any RECs designated to the factory (with the factory name and region) for the renewable electricity (Y) generated or purchased by the factory during this period.

Calculations:

- The ratio of renewable electricity by the factory and conditions for procurement in the assembly of certified products ($RF = (Y/X)$).

Draft 2

Otherwise, reporting must be more detailed and include:

- Documented proof of the total electricity consumption of the factory (X)
- Any RECs designated to the factory (with the factory name) for the renewable electricity generated or purchased by the factory during this period (Y).
- Documented proof of the total number of units of any kind manufactured (Z) and the number of certified units manufactured for the brand owner (W) during the period.
- Any RECs (S) designated to the factory and brand owner (with the factory name and brand name) specifically for the manufacturing of certified products.

Calculations:

- The estimated electricity used to manufacture certified products ($E = X/Z*W$)
- The ratio of renewable electricity by the factory ($RF = Y/X$).
- The ratio of renewable electricity by the brand owners manufacturing ($RC = S/E$)
- The ratio of renewable electricity in the assembly of certified products ($RT = RF+ RC$)

Exception for a high market price of RECs

If the market price of all allowed RECs in the market in question is above 10 USD / Mwh the applicant is allowed to source allowed I-REC accounting for 30% of the renewable electricity purchased from markets with neighboring borders.

If the market price of all allowed RECs in the market in question is above 30 USD / Mwh, the applicant is allowed to source allowed I-RECs accounting for 70% of the renewable electricity purchased from markets with neighboring borders.

Renewable electricity must be generated from:

- Wind,
- Solar,
- Geothermal,
- Hydropower (pumped hydro storage is not accepted)
- Biomass (agriculture waste and residues, forest biomass, biofuels plants)

Renewable energy certificates (RECs)

Renewable electricity can be purchased or generated. Factories can own their own projects. Projects might be on-site or off-site, on the grid, or entirely off-grid. The generation must be issued with renewable energy certificates (RECs). Factories can consume directly from their projects or retain the RECs, and claim the use of renewable electricity. They can also sell electricity to the grid, retain the RECs, and claim the use of renewable electricity.

Both for self-generation and market-purchased RECs the attributes (and certificates) must be sourced and purchased from within the same national region as the factory using the electricity. Also, the renewable electricity production facility for which the certificates are

issued must be within the same national region. The national region constitutes a “market” for the purpose of transacting and claiming attributes. (see exception to this above).

A REC must be recognized on the list below to be accepted as proof of compliance. Credible systems may be added to the list after independent review and acceptance from TCO Development.

Country	Accepted REC
Brazil	I-REC
Canada	REC, I-REC
China	I-REC, GEC
Czech Republic	EECS-GO
Egypt	I-REC
Hungary	EECS-GO
India	I-REC, Indian national EAC system
Japan	J-Credit, FIT-NFC, GEC
Malaysia	I-REC
Mexico	I-REC
Poland	National Guarantees of Origin
Portugal	EECS-GO
Singapore	I-REC
Taiwan	T-REC, I-REC, CPPA
Thailand	I-REC
USA	REC, I-REC
Vietnam	I-REC
South Korea	Korean national EAC system

Verification guidelines of factory data

- Documented proof of the total electricity consumption consists of all electricity contracts and bills (The total number is added to the Accepted Factory List and only needs to be verified once per factory and year).
- Proof of the total number of units manufactured and the number of certified units manufactured for the brand owner (W) during the period must be a copy of a document or digital system that can be verified during an onsite audit. (The total number is added to the Accepted Factory List and only needs to be verified once per factory, brand name and year).

Draft 2

Verification of Renewable Energy Certificates (RECs)

The brand owner must present proof that renewable energy certificates are exclusively owned by, have been permanently retained by or retired on behalf of the specific factory or by the brand manufacturing at the specific factory. This means that RECs designated to the factory must have the factory name on it, and RECs designated to the brands manufacturing at the factory must have both the factory name, and brand name on it (to avoid double counting).

Energy Attribute Certificates are part of tracking systems in which certificates are electronically serialized and issued to generators with accounts on the system. There they are traded and ultimately permanently retired when they are used to support a claim.

For more information on how to verify the authenticity of the REC with each certificate body such as the below listed, a guideline can be found here:

<https://tcocertified.com/industry/certification-documents/ef>

Simplified verification process of RECs:

1. The authenticity of the REC is verified with each certificate body.
2. The reporting period is within the 12+3-month window.
3. The amount of renewable electricity represented by the certificate.
4. The certificate ownership is to the specific factory (and brand owner) in question.
- 4-5. The certificate is retired (not for sale) when making a claim about renewable energy will, where possible, be harmonized with international standards and be added in draft 2.

3.3 Energy management system

Background

A certified energy management system helps an organization work in a systematic way with energy performance and make continuous improvements at both company and product levels. To be efficient, an energy management system must include independent, external reviews.

Definitions

~~Final assembly factory: Factory where the final assembly of the certified product takes place. See definitions chapter 2.0~~

Applicability

All product categories

3.3.1 Mandate

- Each final assembly factory and each factory manufacturing display panels >10" for the certified product must have a structured energy management system ~~that is~~ independently certified to ISO 50001.

~~Each factory manufacturing display panels for the certified product must have a structured energy management system that is independently certified to ISO 50001.~~

Submit the following to an approved verifier:

- A copy of a valid ISO 50001 certificate for each final assembly factory and each factory manufacturing panels >10" for the certified product.

~~Submit~~ The following together with the application is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development

3.3.2 Clarification

The applicant must ensure that a valid ISO 50001 certificate is available on TCO Certified Portal at all times for every final assembly factory and each factory manufacturing panels >10" for the certified product. The certificate(s) or an appendix to the certificate(s) must make it clear/clarify what the certification covers.

Factories that do not yet have a certified energy management system according to ISO 50001, may apply to TCO Development for an extended ~~time~~-period of ~~18~~24 months to complete certification by annually submitting an extension application on the ~~status of the~~ certification ~~status~~. This application and status template can be obtained from TCO Development. TCO Development has the right to deny the applicant an extended period ~~of time~~ if there is a substantial risk that the factory will not be able to achieve ISO 50001 certification within the extended ~~time~~-period. The certificate must be issued by a certification body ~~that is~~ accredited by an accreditation body covered by the International Accreditation Forum, iaf.nu, Multilateral Arrangement on Energy Management Systems

Draft 2

3.4 Post-consumer recycled content

Background

Use of recycled materials lowers the environmental impact. The manufacturing of recycled plastics, if 100% recycled content is achieved, can reduce ~~the~~ energy consumption by up to 60 percent, compared to virgin plastics. Less raw materials are required to produce recycled plastics, which can lead to a reduced carbon footprint. Every metric ton of recycled plastic produced can result in up to 1-3 metric tons of carbon dioxide savings, compared to virgin plastics.

The long-term goal is that all materials in certified products are circulated and renewable where technically possible.

Definition

PCR – Post-consumer recycled: Post-consumer recycled materials are derived from used consumer products, often packaging, bottles, and durable goods including IT products. (I.e. aluminum cans, PET bottles). This does not include PCM material.

PCM - “Pre-consumer Material”: Material or by-products generated during the manufacturing of a product but before the product reaches the end-use consumer.

Applicability

All product categories.

3.4.1 Mandate

The following information for the worst-case configuration (lowest PCR content ratio of PCR plastics and materials) of the certified product (including any external power supply) must be reported:

- Percentage of post-consumer recycled plastics by weight versus the total weight of all plastics.
- Percentage of identified post-consumer recycled materials (plastic and non-plastic) by weight versus the product weight.

Submit the following to an approved verifier:

- The completed post-consumer recycled content template
- Supporting documentation for all parts claiming PCR content.
- A completed and signed product form (chapter 11.3).
- ~~Documentation on PCR content of all parts with a weight above 0.5g~~

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

Draft 2

3.4.2 Clarification

- Only Supporting documentation for all parts claiming PCR content.

The following is submitted to TCO Development and may be published:

- The total product weight (including external power supply) and configuration
- The weight of all plastics in the product.
- The weight of all post-consumer recycled content where the weight is confirmed by documented proof from the material vendor as described below may be reported. plastics and other identified post-consumer recycled material in the product.

Additional configurations that achieve a higher PCR content may also be presented if the applicant submits the required documentation. The specification of the configuration(s) achieving a higher percentage of PCR materials must be specified, either through component configuration or through model identification such as GTIN or manufactured model identification number.

3.4.2 Clarification

The worst-case configuration (lowest PCR content by weight of total product weight) that is available for purchase must be defined and stated in the verification report. It must be defined through a unique brand owner code, a unique product identifier, or a list of configuration choices that are available at the time of purchase. *If there are several versions of the same component (e.g. due to different suppliers) and the buyer cannot influence which version they get, then the worst-case version of the component must be reported.*

All plastic parts with a weight above 0.5 grams must be accounted for in the Post-consumer recycled content & packaging template. Parts that are non-plastic and without PCR content do not need to be listed individually.

Document proof from the material vendor must be provided for an independent third party covering each part containing post-consumer recycled material must be provided if it is to be included in the PCR percentage.

If no proof exists, then 0% must be reported. TCO Development has the right to require a full bill of material.

Exceptions plastics

Optical components and display panels, electronic components, cables, connectors, PCBs, insulating mylar sheets, hard sheets for insulation, soft sheets for heat dissipation, elastomer feet, sponge materials, and labels may be excluded. This means that the weight of these items is not included when calculating the total weight of the plastic in the product in this requirement. [The total product weight for the worst case configuration is calculated including these parts.](#)

The following information must be submitted to an approved verifier

For each plastic part with a weight above 0.5g, the following must be reported:

- Name of part/part ID
- Material manufacturer name
- [Identification marking of PCR material](#)
- [Weight of part \(grams\)](#)
- ~~[Post-consumer recycled content in weight \(grams\)](#)~~
- ~~[For identified non-plastic](#)~~ [Weight of plastics in part](#)
- [Weight of post-consumer recycled content \(grams\)](#)

[For other identified post-consumer recycled content:](#)

- Name of part/part ID
- Material manufacturer name
- ~~[Weight \(grams\)](#)~~
- Type of material
- [Weight of part \(grams\)](#)
- [Weight of post-consumer recycled content in weight \(grams\)](#)

A PCR

[The post-consumer recycled content](#) template is available at tcocertified.com/certification-documents and may be used to provide this information. Similar templates covering the same information ~~is~~[are](#) acceptable.

Clarification of sustainability performance indicator(s)

One or more “sustainability performance indicators” (chapter 1.3) are collected for this criterion. There is no mandatory level for these indicators but they must be verified and reported according to the description below.

The performance indicators collected for this criterion are:

- Percentage of post consumer recycled plastics by weight versus the total weight of all plastics.
- Percentage of identified post consumer recycled materials (plastic and non plastic) by weight versus the product weight

Draft 2

3.5 Product carbon footprint

Background

Product Carbon Footprint (PCF) is one of the most established ways ~~for~~of determining the climate impact of a product. PCFs cover the whole life cycle of a product, from the raw material extraction to the recycling or disposal phase. Using product carbon footprints enables an overall picture in order to work on reductions and measures in the right places.

~~The accuracy of PCFs can vary enormously based on the methodology and type of source data used. As it is very time-consuming and costly to make accurate PCFs the majority of PCFs are based on very general source data. This results in large uncertainties making product comparisons useless.~~

Definitions

Primary data: ~~This term refers to data from specific processes within the supply chain of the user of the PCF method. Such data may take the form of activity data, or foreground elementary flows (life cycle inventory). Primary data are site specific, company specific (if multiple sites for the same product), or supply chain specific. Primary data may be obtained through meter readings, purchase records, utility bills, engineering models, direct monitoring, material/product balances, stoichiometry, or other methods for obtaining data from specific processes in the value chain of the user of the PCF method.~~

Foreground system processes: ~~This term refers to those processes in the product life cycle for which direct access to information is available. For example, the producer's site and other processes operated by the producer or its contractors (e.g. goods transport, head-office services, etc.) belong to the foreground processes~~

Applicability

All product categories.

3.5.1 Mandate

A PCF must exist for ~~every~~each certified product, and ~~the classification of the PCFs~~its availability must be ~~conducted~~evaluated by an approved verifier.

Submit the following to an approved verifier:

- Necessary documentation for the evaluation of PCF availability
- A completed and signed product form (11.3).

~~Submit~~ **The following together with the application is submitted to TCO**

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

The classification following is submitted to TCO Development and may be published:

- Type of the PCF availability must be reported in TCO Certified Portal.
- Instructions on how to retrieve the PCF.

3.5.2 Clarification

The PCF for the product is estimated based on product type data using either ISO 14040, ISO 14044, ISO 14067, ISO 14025, IEC TR 62921, PAS 2050, the WRI GHG Protocol Product Life Cycle Accounting and Reporting Standard, PAIA-tool, INEMI Eco-Impact Estimator or equivalent PCF standard.

For product models which that can be configured, the typical product configuration must be used. The typical product configuration is defined as PCF for the product configuration which is expected to be manufactured in must at least be based on the largest number product model family.

PCF Requirements

The product carbon footprint result must include the following:

1. Inputs used in the assessment (at a minimum, lifetime of the product, amount of electricity consumed in the use phase by the product per year, and significant product model elements/parameters).
2. Total life cycle carbon footprint and carbon footprint of the product's life cycle stages (at a minimum, manufacturing, use, transport, and end-of-life).
3. Explanation of uncertainty addressed either through a statistical assessment or through a disclaimer statement.

Availability (~~Class A-D~~)

The availability of PCF increases the transparency of PCF methods used and enables future revisions.

Class-A

Publicly available

- The results of the PCF as defined in the PCF Requirements are publicly available and can be downloaded free of charge.
- A link to the download location is uploaded to TCO Certified Portal

Class-B

Available on-demand

- The results of the PCF as defined in the PCF Requirements are available on-demand from the brand owner.
- Instructions on how to retrieve the PCF is provided.

Verification guideline

~~For Class A:~~ In order to determine if a PCF can be considered as publicly available, the verifier must:

1. Confirm that the PCF is available for download free of charge on the brand owners PCF repository
or
2. Confirm a public statement on the brand ~~owners~~owner's website, that at least all TCO Certified products will have the results of the PCF available online during product availability.

Draft 2

3.6 Product carbon footprint reductions

Background

Research conducted by IT sustainability research and consulting ~~organisation~~[organization](#) PX3, on 707 unique IT product models from 42 manufacturers shows that many manufacturers report no PCF value at all for several of their products. And for products that report PCF values, different manufacturers have chosen different methods to make the calculations. Add to this the complexity ~~in~~[of](#) the supply chain. This means that comparisons of PCF between products are more or less meaningless, and to draw correct conclusions from the comparisons and make sustainability-focused purchasing strategies based on these values meaningless also, and ~~possible~~[possibly](#) even misleading.

One way to overcome this, until all manufacturers publish comparable and verified PCF values, is to look at average scope 3 calculations for different product types and instead focus on activities reducing ~~the annual footprint such as increasing the years of usage to lower the yearly~~[product](#) carbon footprint. ~~And to also take further actions to actually reduce emissions. TCO Certified has joined forces with PX3 on this approach.~~

In order to incentivize reductions of the carbon footprint, a list of [accepted](#) best practice solutions ~~resulting in a significant reduction of the product carbon footprint~~ is included in TCO Certified and expanded over time. The implementation of any solution on this list is then verified [on a product level](#) by independent experts and [presented on the certificate may be published by TCO Development](#) as an estimated reduction of the Px3 value representing the ~~product~~[product's](#) carbon footprint.

Applicability

All product categories.

3.6.1 Mandate

~~Any claimed solutions from the list of approved best practice solutions to reduce the embodied PCF as well as the total~~ [A comparable product carbon footprint value must be estimated reduction of the PCF](#) for the certified product [must be verified by an independent expert and presented on the certificate according to the Px3 methodology with any implemented reductions subtracted.](#)

Submit the following to an approved verifier:

- Documented proof of the implementation of ~~the~~[any](#) claimed PCF reduction solution covering the manufacturing of the certified product.

- ~~• A completed and signed product form (11.3).~~

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
- All verified PCF reduction solutions, the period when the reduction is valid, and the total estimated reduction of the PCF must be reported in TCO Certified Portal.

The following is submitted to TCO Development and may be published:

- All verified PCF reduction solutions implemented and the total estimated reduction of the PCF.
-

3.6.2 Clarification

The Px3 values estimated for certified products make comparisons between products possible. This enables sustainability-focused purchasing strategies. For products where no reduction solution has been implemented, the default Px3 value (without any reduction) will be used for the certified product.

Claiming a reduction of the Px3 value

To claim a best practice solution on the list, a brand owner must provide documented proof of implementation of the solution covering the production of the certified product.

Adding new best practices to the list

Other solutions may be added as they get ~~approved~~accepted by TCO Development. A description of the solution is then sent to an approved independent expert who will determine if the solution fulfills the requirements or not. To qualify for the list of best practices, the investigation must show that the proposed best practice solution:

- contributes to a measurable reduction of the total PCF that can be estimated as a reduction of the Px3 value.
- is possible to verify in a credible way
- is not already industry standard but instead pushes the majority of brand owners to improve their supply chains.
- ~~• can be estimated into a reduction of the Px3 value~~
- is formulated so that it is not limited to a certain brand owner or proprietary technology.

All the supporting documentation and the conclusion from the expert are then sent to TCO Development, who will decide to update the list of best practices solutions.

Px3 value and list of approved best practice solutions to reduce the PCF

The following Px3 value is the average product carbon footprint estimation that will be presented when no reduction solutions have been implemented. The list of best practice solutions that are approved to use accepted and will result in a reduction of the estimated PX3 value in the TCO Certified Product Finder can be found at: <https://tcocertified.com/industry/certification-documents/>

- ~~To be expanded in draft 2...~~

Draft 2

4 User health and safety

- A poorly designed IT product may cause discomfort and cause injury and health problems for the user.
- Fire hazard, electric shock and explosions are some of the risks associated with substandard products. They may also have a short lifespan which is negative from a sustainability perspective.
- A safe and ergonomically designed IT product supports productivity and can meet the user's needs longer.

Poor product design is a safety hazard

Product safety and functionality is fundamental to sustainability in the IT sector. Products that are uncomfortable or unsafe to use often have a short lifespan which leads to pollution, e-waste and high resource consumption. They may also cause health and safety problems for the user. Examples of identified safety hazards include product overheating and risk of fire, battery volatility which can lead to burning or explosion, and poor electrical safety design that may increase the risk of fire or electric shock.

Our approach: verifying product safety, protecting the user

An IT product must be safe to use and should provide the user with the necessary function and comfort for a long time. To be efficient, criteria for user health and safety aspects must be specific, and tailored to each product category.

Criteria in chapter 4 focus on:

- Requiring that products are safe to use and that the user's risk of injury is minimized.
- Making sure that any cases of burning, explosion and electric shock are prevented.
- Limiting specific risks through criteria adapted for each product category.

4.1 Electrical safety

Background

IT products must be safe to use. Electrical safety refers to the electrical design of the product. Electrical insulation and other arrangements must be in place to prevent the user from touching live components. Faulty or inadequate electrical insulation can also result in an electrical flashover that may cause a fire or an explosion.

Applicability

All products with built-in or external power supplies.

References

4.1.

4.1.1 Mandate

The product and external power supply/supplies must be certified according to [EN/IEC 62368-1](#) edition 2 or newer.

Submit the following to an approved verifier:

- A copy of a valid CB certificate ~~or a national certificate from a CB member (NCB)~~ for the product.

~~Submit~~ The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
-

4.1.2 Clarification

For products classified as medical equipment, IEC 60601-1 [version 3.2 or newer](#) can be used instead of [EN/IEC 62368-1](#).

4.2 Acoustic noise

Background

Acoustic noise from fans, disk drives, etc. can be disturbing to users. Therefore, IT products should be as silent as possible during use. To make it possible for the user to choose a product with a comfortable noise level and frequency characteristics, this information should be reported.

To provide comparable information about acoustic noise levels, the A-weighted sound power level (L_{WAd}) in operating and idling mode must be measured in accordance with ISO 7779:2018 and reported in accordance with ISO 9296 p.4.4.1 in bels (B). As these standards do not include any clear definition of operating and idling mode, the following definitions apply for these modes and for the reported sound values:

Definitions

Sound power level (L_w): Total emitted sound power from a sound source, given in bels (B) and with the reference 1 pW.

A-weighting: The measured linear sound level (sound pressure or sound power) weighted against the sensitivity of the human ear for different frequencies (A-curve).

Declared A-weighted sound power level (L_{WAd}): in bels (B). Defined in accordance with ISO 9296 3.2.5.

Operating mode(s): A condition in which the system must be operated, at a load equal to or higher than “~~operating mode~~ [Web browsing](#)” & “[Office productivity](#)” for personal computers and workstations defined in ECMA-74 20th edition (C.15.3). ~~The loading of the graphics card in operating mode is exempted as TCO Certified is mainly intended for business products where graphic intense operation is unusual.~~

Idling mode: A condition in which the system must be operated, at a load equal to or higher than “idling mode” for personal computers and workstations defined in ECMA-74 edition 20 (C.15.3).

Applicability

All notebook computers and tablets with integrated moving parts.

References

4.2-4.8

4.2.1 Mandate

1. The A-weighted sound power level (LWAd) must not exceed:

Operating mode: 3.9B

Idling mode: 3.5B

If the product does not emit prominent discrete tones according to procedures specified in ECMA 74 Annex D, a higher A-weighted sound power level (LWAd) is accepted but must not exceed:

Operating mode: 4.2B

Idling mode: 3.8B

2. The A-weighted sound power level for a product must be reported in the product data sheet and/or in any other product descriptions.

Submit the following to an approved verifier:

- A copy of the test report(s) from a laboratory accredited according to ISO 17025
- A completed and signed product form (chapter 11.3)

Submit The following together with the application is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The A-weighted sound power level must be reported in TCO Certified Portal.

4.2.2 Clarification

The acoustic noise test must only be carried out if the product has any internal moving mechanical parts. This noise measurement is to be carried out at any test facility accredited according to ISO 17025, but the test report must be verified by a verification organization approved by TCO Development, who must sign a verification document for noise, covering all configurations.

Prior to testing, the computer must have been switched on for 15 minutes.

Switch on the computer and begin recording elapsed time starting immediately after completing any log in activity necessary to fully boot the system. Once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed. Exactly 15 minutes after this, run the sample in accordance with ECMA-74 20th edition ([or a more recent version](#)) and start to accumulate test noise levels.

The required operating modes for testing are "Web browsing" & "Office productivity". The worst case value of these two modes should be reported.

The PC Mark "Web Browsing" test under "Essentials" may be used for the "Web browsing" operating mode.

The PC Mark "Writing" and "Spreadsheets" may be used for the "Office productivity" operating mode. If SYSMark is used, this mode it is called "Productivity"

For Chromebook systems, PCMark for Android can be used by choosing "Web Browsing 3.0" for "Web Browsing" and "Writing 3.0" together with "Data Manipulation 3.0" may be used for the "Office productivity" operating mode.

The noise measurements must follow ISO 7779:2018 or a more recent version fo the standard and must be reported according to ISO 9296:1988. (However, the principle for how the measurement uncertainty is handled must be the same as for all the other criteria in the certification. This means that no uncertainty must be added to the result presented in the report.)

In addition to reporting the measured A-weighted sound power level (L_{WA}) in Bels (B), the single measurement values of the 9 measurement positions and the mean value of these A-weighted sound pressure level (L_{pA}) in decibels (dB) must be included in the test report.

Overall uncertainty

The test must be performed in such a way that the total expanded uncertainty in the test result will be less than ± 2.5 dB.

Note

The uncertainties given are worst case limits. In many cases it will be possible to obtain better accuracy.

5 Product performance

- A low-performing product can reduce user productivity and satisfaction. It may therefore be discarded prematurely.
- High energy consumption can lead to large emissions of greenhouse gases, which contributes to the climate crisis.
- By taking both product performance and environmental factors into account, user productivity can improve and the device can be in use for a longer time.

Low product performance reduces productivity and is a sustainability risk

Product performance is essential for user satisfaction and productivity. Low-performing products are also problematic from a sustainability perspective — in many cases, these products have a shorter lifespan, which leads to pollution, e-waste and high resource consumption. Discarding products prematurely is often also more costly for the purchasing organization.

Our approach: balancing product performance with energy efficiency

Product performance, user satisfaction and the development of more circular IT products are interconnected. In order for IT products to be more sustainable, all these factors need to be prioritized. Balancing product performance with energy efficiency is also important to reduce the product's climate impact.

High-performance products can meet the user's needs for a longer period of time. This way, the product's service life can be extended, which is an extremely important factor in reducing resource consumption, reducing greenhouse gas emissions and the amount of e-waste produced. Using the product for a longer time is also often better from an economic perspective, and provides a lower total cost of ownership for the purchasing organization.

Criteria in chapter 5 focus on:

- Requiring that product performance is balanced with energy efficiency through specific criteria for each product category.

5.1 Energy efficiency

Background

The IT industry and people's IT usage are large sources of greenhouse gas emissions, which remain the leading factor in climate change. As the number of IT equipment in use grows, greenhouse gas emissions are also increasing. Reducing the problem requires a number of measures, of which energy-efficient products are one part.

This criterion focuses on energy efficiency in the use phase and helps purchasing organizations independently verify that the IT product they source meets the energy efficiency requirements of ENERGY STAR.

Applicability

Notebooks, tablets,

References

5.1.

5.1.1 Mandate

The energy consumption and power supply requirements in version 8 of the ENERGY STAR® program for computers must be fulfilled.

Submit the following to an approved verifier:

- A copy of the test report(s) from a laboratory accredited according to ISO 17025.

Submit The following together with the application is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The measured energy values and product configuration must be reported in TCO Certified Portal

5.1.2 Clarification

The product must be tested according to version 8 (or a more recent version) of the ENERGY STAR program for computers. Testing can be carried out at any test facility accredited according to ISO 17025, but the test report must be verified by a verification organization

approved by TCO Development. The minimum version of EnergyStar that all product configurations are able to meet will be presented on the certificate.

Testing only needs to cover the energy consumption requirements and the power supply requirements of that program. The product does not need to be ENERGY STAR certified to be approved for TCO Certified.

Measured energy consumption according to ENERGY STAR®[®], as well as Typical Energy Consumption (TEC) and the allowed maximum consumption (TEC_MAX) for each category (~~1-12, d1-d2~~1-12, D1-D2, 0-2 or ~~0-2~~Thin Clients) must be submitted to TCO Certified Portal, together with the application.

For each tested configuration, at least the following properties must be reported on the test report and in TCO Certified Portal:

- Processor brand
- Processor model
- System memory (GB)
- Integrated or dedicated GPU
- Operating system name

Clarification of sustainability performance indicator(s)

- In addition to the requirements in the mandate, "sustainability performance indicators" (chapter 1.3) must be reported. PSU if applicable

Exceptions and special requirements

All exceptions and special requirements, test methods etc. that are accepted by ENERGY STAR are also accepted by TCO Development.

Products that are covered by another ENERGY STAR product specification must be tested according to that specification.

Visual ergonomics

Good visual ergonomics is a very important aspect of quality that can also have a direct effect on the health, comfort and productivity of the user. Good ergonomics, such as a high quality display image, can also influence our productivity and extend the usable life of a product. In this way, ergonomic design can also offer sustainability benefits.

In developing criteria for visual ergonomics, the possible health effects of various parameters have been taken into account. Other features that characterise high quality displays have also been in focus when developing these criteria.

TCO Development used three main methodologies to determine suitable levels and test methods for the visual ergonomics criteria:

1. Acceptable visual levels, as determined by scientific research.
2. Statistics from tests carried out in accordance with TCO Development, ISO, MPR regulations and from specialized VDU tests.
3. Manufacturers' knowledge and experience, which is invaluable. Manufacturers, consumer groups and other organisations with interests in the visual ergonomics field have contributed a great deal of valuable information and ideas throughout the development process.

5.2 Display resolution

Background

Image quality is negatively affected by a low fill factor, visible “jaggies”, poor rendering of details etc. All of these parameters are related to the resolution of the display. For display resolution characteristics, it is important to take the viewing distance into account.

Definition

A pixel is the smallest addressable imaging element of the display panel capable of reproducing a full range of luminance and colors.

Applicability

Tablet computers.

References

5.4.

5.2.1 Mandate

The display panel should have a pixel density of at least 145 PPI.

Submit The following together with the application is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The pixel density must be reported in TCO Certified Portal.
-

5.2.2 Clarification

145 PPI gives a reasonable image quality at a viewing distance of 40cm, which can be regarded as a normal viewing distance to a tablet placed in your lap, based on anthropometric data.

Preparations for testing

No specific preparation of the product is needed.

Equipment

Calibrated ruler for the diagonal measurement. Product manual or similar information about the display resolution.

Test method

The maximum resolution and size of the display panel are found in the manual or in a similar information document from the manufacturer. Verify the diagonal distance in inches rounded to one decimal and calculate the PPI.

Test evaluation

The pixel density (PPI, pixels per inch) should be calculated as following:

$$PPI = \frac{\sqrt{\text{horizontal pixels}^2 + \text{vertical pixels}^2}}{\text{the diagonal of the panel in inches}}$$

Overall uncertainty

Measurement uncertainty in diagonal measurement is $\leq \pm 2\text{mm}$. Product data information is sufficient.

See 9.1.9

5.3 Correlated color temperature

Background

Physical measurements of color stimuli can only give an indication of the color appearance in a practical situation. The color of the frame, the spectral composition of the lighting, the color of various areas in the visual field, and the complexity of brightness variations in the visual field all influence the color appearance of an tablet display image.

It is important to be able to set a color temperature that represents average daylight. It will be intuitive to most users to have their document background and photo editing in this color temperature as this is a light source that users will be exposed to daily. Average atmospheric filtered daylight has a correlated color temperature of approximately 6500K and is reproduced by a number of standards ex. D65, sRGB, ITU rec 709 which are widely used in photo and video editing.

Definition

The correlated color temperature is a measure of the perceived screen color expressed in Kelvin (K).

Applicability

Non monochromatic tablet computers with backlit or light emitting pixels.

References

5.4, 5.15-5.18, 5.21, 5.23-5.29, 5.30, 5.31.

5.3.1 Mandate

The product default preset correlated color temperature may have any name but must have a color difference $\Delta u'v' \leq 0.02$ when compared to CIE u' and v' chromaticity coordinates for D65.

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
- The measured values must be reported in TCO Certified Portal.

5.3.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- A TCO Certified default test image, as shown in figure 9.1.7, must be used for this measurement.

Equipment

Spectro-radiometer capable of presenting CIE u' and v' chromaticity coordinates with at least three decimals.

Test method

The spectral properties at the center of the measurement area must be measured with a spectroradiometer. The spectral data must then be processed, which is normally done directly in the instrument's microprocessor, to give chromaticity coordinates. In this case, the CIE coordinates u' and v' are needed for the test evaluation and are often presented directly by the spectro-radiometer used.

Test evaluation

CIE $u'v'$ chromaticity coordinates for D65.

u'	v'
0,1979	0,4683
u'	v'
0,1979	0,4683

If the spectro-radiometer used only can produce CIE 1931 x and y chromaticity coordinates, these can be transformed to u' and v' chromaticity coordinates by using the formulae in the CIE Publication 15.2 (reference 5.17). The relevant CIE material – conversion formulae and tabulated data for u'_{cct} and v'_{cct} – can also be found on the TCO Certified website: tcocertified.com.

The resulting color difference calculation must be presented to 3 decimal places.

Overall uncertainty

$\leq \pm 0.003$ in u' and v' .

See 9.1.9

5.4 Color gamut

Background

Accurate color rendering is important when realistic color images or color presentations are presented on the tablet display. Poor color rendering can lead to poor readability and misinterpretation.

Applicability

Non monochromatic tablet computers with backlit or light emitting pixels.

References

5.15-5.18, 5.21, 5.23-27, 5.29-5.33

5.4.1 Mandate

The minimum color triangle must have the following coordinates:						
	Red		Green		Blue	
Coordinate	u'	v'	u'	v'	u'	v'
Requirement	≥ 0.375	≥ 0.503	≤ 0.160	≥ 0.548	≥ 0.135	≤ 0.305

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
 - The measured values must be reported in TCO Certified Portal.
-

5.4.2 Clarification

The u' and v' chromaticity coordinates of the primary colors red (R), green (G) and blue (B) of the screen must aim at values given in international IEC, EBU and ITU standards. The u' and v' chromaticity coordinates of the primary colors R, G and B form a triangle in the CIE 1976 uniform chromaticity scale diagram. The larger the area of the triangle, the wider the range of colors the screen is capable of presenting.

The color characteristics of a tablet display are based on the visual appearance of the tablet display primary color stimuli, the R, G, B-stimuli.

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- A TCO Certified default test image, as shown in figure 9.1.7, must be used for this measurement.
- The measurement area must have each of the following RGB settings: (255, 0, 0) for red, (0, 255, 0) for green, (0, 0, 255) for blue.

Equipment

Spectro-radiometer with a capacity to present u' and v' coordinates to at least 3 decimal points.

Test method

The instrument must be directed orthogonally towards the different test square centers at the measurement distance described in 9.2.5. Measure the chromaticity coordinates at the center of the measurement area for each color setting specified above or alternatively, the larger measurement area image (80% of the active screen area) described in 9.1.7 may be used for these measurements. Change the color of the area for each measurement.

Test evaluation

The recorded chromaticity coordinates u' and v' for the red, green and blue squares must be reported.

The u' and v' must be presented to 3 decimal places.

Overall uncertainty

$\leq \pm 0.003$ in u' and v' for red and green.

$\leq \pm 0.007$ in u' and v' for blue.

See 9.1.9.

Draft 2

5.5 Color uniformity

Background

The human visual system is very sensitive to changes in color hue in white and gray areas. White and gray color hues also serve as reference colors on the screen, that affect how all other colors are perceived. Patches of color variation on an active white or gray screen may reduce the contrast, be disturbing and affect readability, color rendering and color differentiation.

Definition

The color uniformity of a display is the capability to maintain the same color on any part of the screen.

Applicability

Non monochromatic tablet computers with backlit or light emitting pixels.

References

5.4, 5.14, 5.16-5.19, 5.20, 5.21.

5.5.1 Mandate

The maximum color deviation between measured active areas on the screen that are intended to maintain the same color must be $\Delta u'v' \leq 0.012$.

Submit The following ~~together with the application~~ is submitted to TCO

Development:

1. A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
2. The measured value must be reported to TCO Certified Portal.

5.5.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- The entire active area of the screen must be white and the display color setting must be RGB 255, 255, 255.

Equipment

Spectroradiometer with a capacity to present u' and v' coordinates with at least 3 decimals.

Test method

The color uniformity must be measured orthogonally to the tablet screen plane at 9 points. The 4 corner positions (1, 3, 7 and 9) are measured 1° from the edges of the screen as shown in *luminance uniformity 1*. The 4 side positions (2, 4, 6 and 8) are measured on the middle of the side 1° from the edge. These measurement points have a $1/2^\circ$ margin to the edges if the measurement area of the instrument is 1° (see figure *luminance uniformity 1*). Finally the center position (5) is measured.

The color uniformity must also be evaluated visually by the technician in order to find those areas where the color varies the most except from the 9 default positions. If a significant difference within the 1° from the edge area is found these measuring points must also be measured and used to evaluate the color uniformity.

The conditions for color measurement in the corner positions and the distribution of other measurement points are illustrated in figure *luminance uniformity 1*.

Test evaluation

$\Delta u'v'$ according to the CIE (1976) uniform chromaticity scale diagram must be calculated for each measured position using the formula

$$\Delta u'v' = \sqrt{(u'_A - u'_B)^2 + (v'_A - v'_B)^2}$$

where A and B are the two points found to have the largest color difference between them.

The largest difference in $u'v'$ value must be reported.

The result must be presented to 3 decimal places.

(The evaluation procedure is exemplified below)

- Make a table of color chromaticity values for each measured position

Measurement position no.	u'	v'
1	0.190	0.447
2	0.186	0.441
3	0.186	0.437
-	-	-
n-1	0.185	0.434
n	0.186	0.432
Largest difference	0.005 in this example	0.015 in this example

- The largest u' difference, $\Delta u'$, is 0.005 (between 0.190 and 0.185) at measurement positions 1 and n-1.
- The largest v' difference, $\Delta v'$, is 0.015 (between 0.447 and 0.432) at measurement positions 1 and n.
- Since $\Delta v'$ (= 0.015) is much larger than $\Delta u'$ (= 0.005), the $\Delta v'$ value must be used for the calculation of $\Delta u'v'$.
- The corresponding two pairs of u' and v' to be used for the calculation are thus the values found at position 1 and position n and thus become the values used for points A and B such that $u'_1 = u'_A = 0.190$ and $v'_1 = v'_A = 0.447$ for point A in this example and $u'_n = u'_B = 0.186$ and $v'_n = v'_B = 0.432$ for point B in this example.

Hence $\Delta u'v' = \sqrt{0.000016 + 0.000225} = 0.01552$, which must be reported as 0.016.

Overall uncertainty

$\leq \pm 0.003$ in u' and v' .

See 9.1.9

Draft 2

5.6 Color uniformity – angular dependence

Background

The human visual system is very sensitive to changes in color hue in white and grey areas. White and gray color hues also serve as reference colors on the screen, that affect how all other colors are perceived. Patches of color variation on an active white or gray screen may reduce the contrast, be disturbing and affect readability, color rendering and color differentiation.

Definition

The white color uniformity – angular dependence of a display is the capability of the display to maintain constant white color over the screen surface depending of the direction from which the screen is viewed.

Applicability

Non monochromatic tablet computers with backlit or light emitting pixels.

References

5.4, 5.14, 5.16-5.21.

5.6.1 Mandate

In landscape mode, the $\Delta u'v'$ between areas on the left side and the right side of the screen when it is positioned at $+30^\circ$ and at -30° horizontally to the screen normal (rotated around the vertical axis through the center of the screen) must be ≤ 0.024 .

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
- The measured value must be reported in TCO Certified Portal.

5.6.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- The screen background must be RGB 102,102,102.
- Chromaticity coordinates u' and v' must be measured at three different positions on the screen as shown in figure *color uniformity - angular dependence 1*. Each measurement position must consist of white RGB 255, 255, 255 areas with a size that is 4% of the active screen size.
- The spectro-radiometer must be positioned and directed orthogonally to the screen center-point as described in 9.2.5.

Draft 2

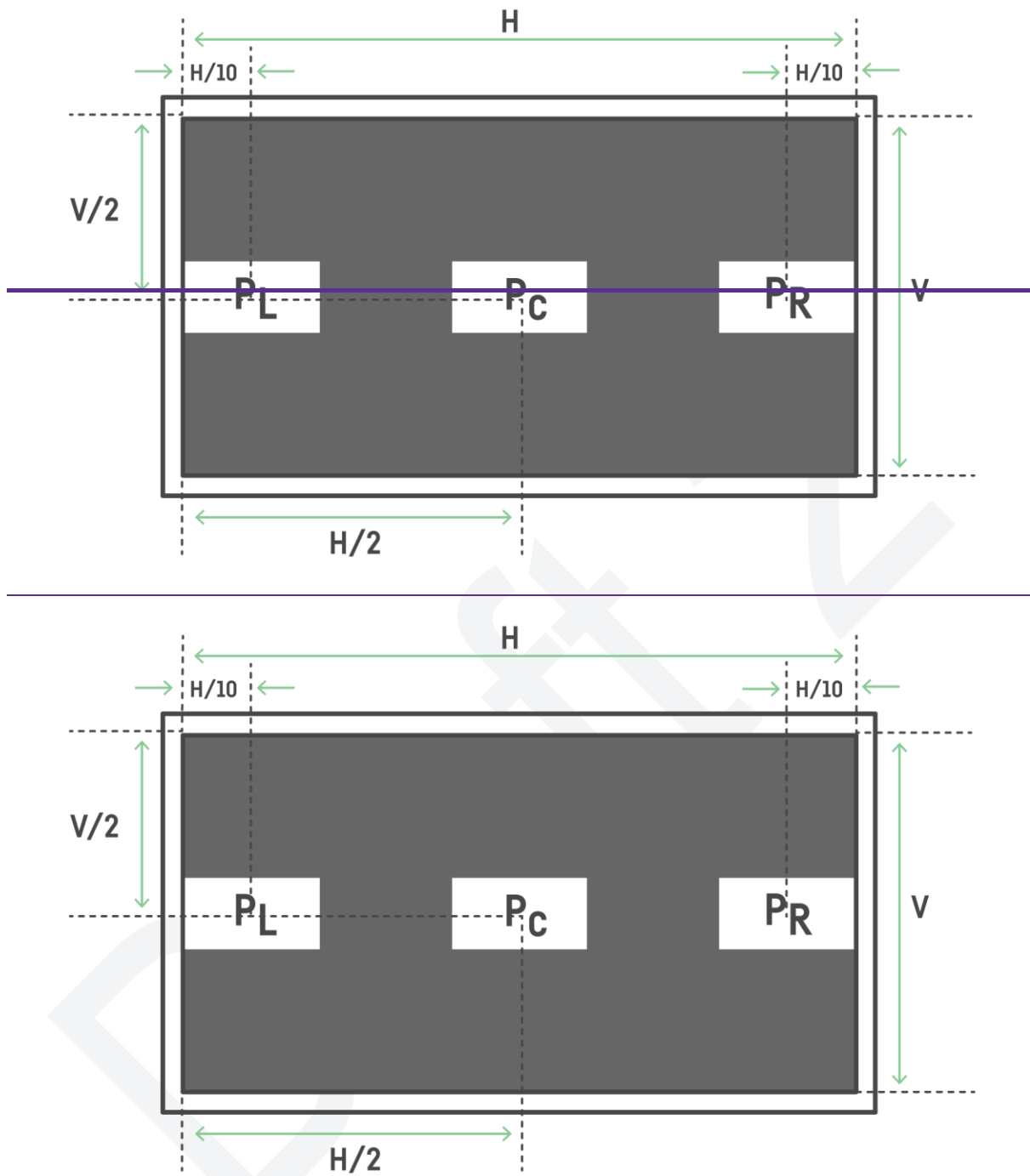


Figure *color uniformity - angular dependence 1*. Measurement positions for color uniformity-angular dependence.

Equipment

Spectro-radiometer with a capacity to present u' and v' coordinates with at least 3 decimals.

Test method

- The spectro-radiometer must always be directed towards a measurement point and rotated around a fixed vertical axis, (or horizontal axis for the tilt measurement) through the focal point of the front lens with a distance as described in 9.2.5.
- The spectro-radiometer must be turned towards positions P_L and P_R and focused. The colour co-ordinates at positions P_L and P_R (u'_{PL/0}, v'_{PL/0} and u'_{PR/0}, v'_{PR/0} respectively) must be recorded.
- The screen must then be rotated +30° around a vertical axis through the screen centre-point and the chromaticity coordinates at positions P_L, P_R, (u'_{PL/+30}, v'_{PL/+30} and u'_{PR/+30}, v'_{PR/+30} respectively) must be recorded.
- The screen must finally be rotated -30° around a vertical axis through the screen centre-point and the chromaticity coordinates at positions P_L, P_R, (u'_{PL/-30}, v'_{PL/-30} and u'_{PR/-30}, v'_{PR/-30} respectively) must be recorded.
- Pivot screens must only be measured in the normal landscape mode.

Test evaluation

Δu'v' according to the CIE (1976) uniform chromaticity scale diagram must be calculated for each measured position using the formula

$$\Delta u'v' = \sqrt{(u'_A - u'_B)^2 + (v'_A - v'_B)^2}$$

where A and B are the two points found to have the largest color difference between them.

The largest difference in u'v' value must be reported.

The result must be presented to 3 decimal places.

(The evaluation procedure is exemplified below)

- Make a table of chromaticity values for each measurement position and calculate Δu'v' for +30° for and -30°.

Measurement position no.	Example value u'	Example value v'
PL /+30	0.190	0.447
PR /+30	0.187	0.442
Difference at +30°	0.003	0.005
Δu'v' at +30°	0.0059	
Measurement position no.	Example value u'	Example value v'
PL /-30	0.182	0.436
PR /-30	0.189	0.432

Difference at -30°	0.007	0.004
$\Delta u' v'$ at -30°	0.0081	
Largest difference $\Delta u' v'$	0.0081 in this example	

The largest calculated $\Delta u' v'$ difference is 0.0081 when the screen is rotated -30°. The test value to be reported is this value, reported to 3 decimal places, thus 0.008.

Overall uncertainty

$\leq \pm 10\%$ in luminance.

$\leq \pm 0.003$ units for u' and v' .

$\leq \pm 0.3^\circ$ in rotation angle.

See 9.1.9

Draft 2

5.7 Color grayscale linearity

Background

A well-tuned color grayscale is the basis for good color rendering on the screen. This is measured via steps in a grayscale on the screen. To enable correct color interpretation, each grayscale step should have similar color hues. To avoid confusion for the user, only the luminance should vary.

Definition

Color grayscale linearity is the capability of the screen to maintain the same u',v' coordinates of a grayscale pattern at all grayscale levels. Only the luminance should change from one grayscale step to the next.

Applicability

Non monochromatic tablet computers with backlit or light emitting pixels.

References

5.4, 5.14, 5.16-5.21.

5.7.1 Mandate

The $\Delta u'v' \leq$ the maximum allowed difference for each step according to table *color grayscale linearity 1*.

Table *color grayscale linearity 1*

Greyscale	Maximum $\Delta u'v'$ difference					
	255	225	195	165	135	105
255	0					
225	0,045	0				
195	0,045	0,045	0			
165	0,050	0,050	0,050	0		
135	0,055	0,055	0,050	0,050	0	
105	0,055	0,055	0,055	0,055	0,050	0

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
 - The largest $\Delta u'v'$ measurement must be reported in TCO Certified Portal.
-

Draft 2

5.7.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- A TCO Certified default test image, as shown in figure 9.1.7, must be used for this measurement.
- The measurement area must have a size that is 4% of the active screen size and have the following RGB settings: R=G=B= 255, 225, 195, 165, 135, 105, 75, 45.

Equipment

Spectroradiometer with a capacity to present u' and v' coordinates with at least 3 decimals.

Test method

The instrument must be directed orthogonally towards the different measurement areas centers at the measurement distance described in 9.2.5. Measure the chromaticity coordinates at the center of the measuring area for each grayscale step specified above. Change the grayscale of the area for each measurement.

Test evaluation

The evaluation procedure is exemplified below:

- A spreadsheet is available on [tcocertified.com](https://www.tcocertified.com), which will calculate the $\Delta u' v'$ differences between all the grayscale levels according to the equation:

$$\Delta u' v' = \sqrt{(u'_A - u'_B)^2 + (v'_A - v'_B)^2}$$

- Fill in the chromaticity values of u' and v' for each measured grayscale step into the corresponding cells of the spreadsheet.
- The table *color grayscale linearity 1* contains colored cells indicating difference requirements. The principle is that the darker the grayscale, the more difficult it is to see a color difference.
- Examples on how to use the table: By using the column 255 (grayscale 255) and go down to line 165 (grayscale 165) you find that the maximum allowed color difference $\Delta u' v'$ is 0.050 (orange cell). For the grayscales 225 and 105 the maximum allowed difference is 0.055 (blue cell).

Overall uncertainty

$\leq \pm 10\%$ in luminance.

$\leq \pm 0.003$ units for u' and v' .

See 9.1.9

Draft 2

5.8 Luminance level

Background

Poor screen luminance can lead to low contrast, poor readability and color discrimination, which may cause misinterpretations and eye strain. Therefore, it is important that the luminance levels can be set both high and low enough, with respect to the ambient lighting.

Definition

Luminance being emitted from a particular area is a measure of the luminous intensity per unit area of light travelling in a given direction and falls within a given solid angle.

The unit of luminance is candela per square meter (cd/m^2)

Applicability

Tablet computers with backlit or light emitting pixels.

References

5.3- 5.8.

5.8.1 Mandate

The maximum luminance must be $\geq 200 \text{ cd}/\text{m}^2$.

Submit ~~The following together with the application is submitted~~ to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
 - The maximum luminance must be reported in TCO Certified Portal
-

5.8.2 Clarification

Preparation of the tablet computer for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- The product must be unplugged from mains before testing.
- The TCO Certified default test image with an 18-step grayscale as shown in Figure *Luminance level 1* must be used for luminance level measurement.

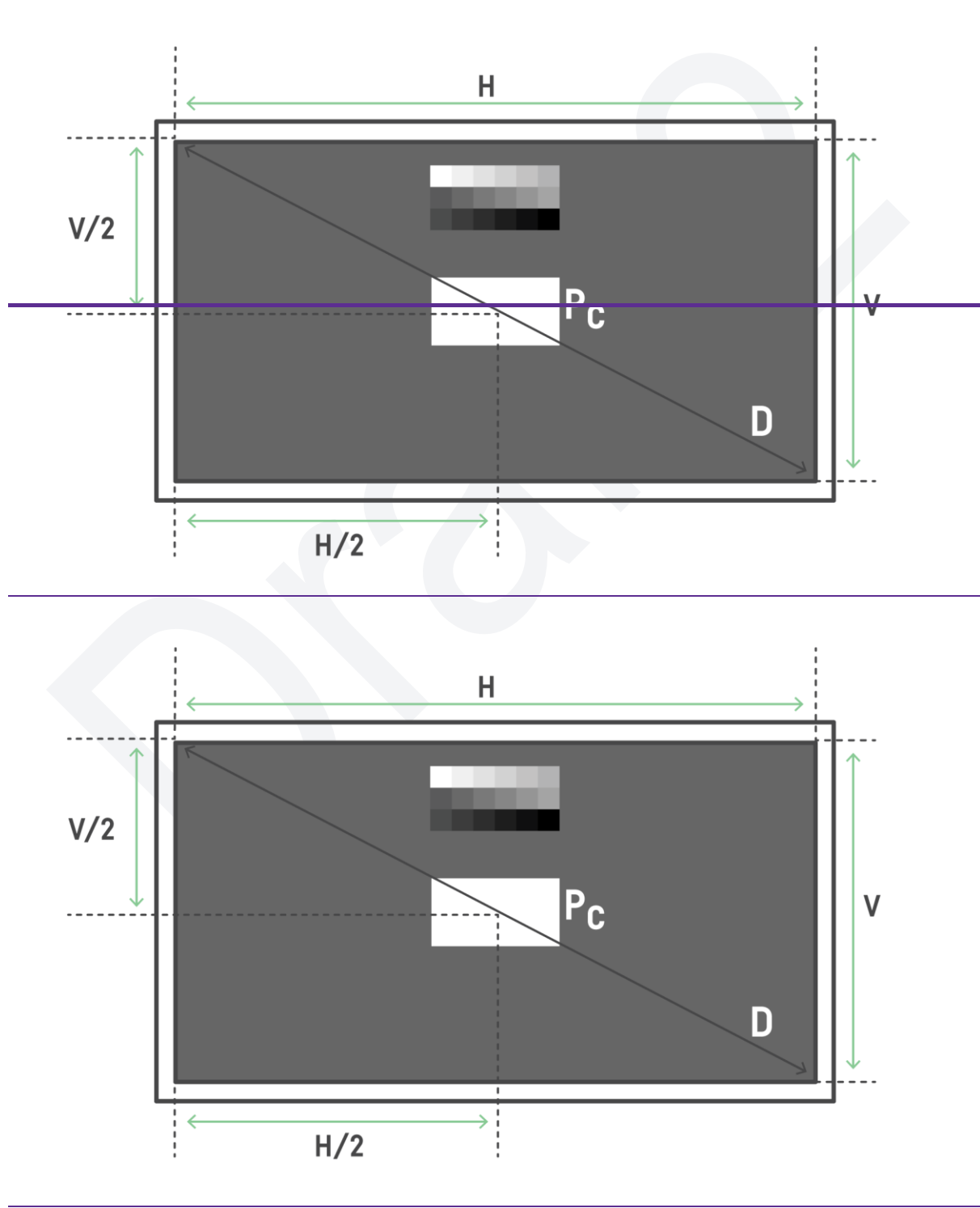


Figure *Luminance level 1*. The TCO Certified default test image with the 18-step grayscale inserted.

- The measurement position P_C must be at the center of a the measurement area without line borders, having an RGB setting of 255, 255, 255, and positioned at the center of the screen. The background must be RGB 102,102,102.

The following evaluation must be carried out orthogonally to the screen surface

- To achieve the maximum luminance proceed as follows:
Use the TCO Certified default test image with an 18-step grey scale pattern presented on the screen. From the default setting, adjust the controls for the display to achieve as high luminance as possible with an acceptable image quality. The image quality is considered acceptable when at least 15 of the 18 grayscale steps are visible. At this maximum luminance, test that the display has a luminance ≥ 200 cd/m².
- When this test is completed, the display must be adjusted back to the test luminance setting as described under 9.1.7 for all remaining Visual Ergonomic tests. Allow the display to stabilize before other test measurements are made.

Draft

Equipment

Luminance meter or spectroradiometer.

Test method

The luminance at the center of the white measurement area must be measured with the luminance meter directed orthogonally to the measurement area as described in 9.2.5. For the battery mode measurement, the battery must be fully charged. Disconnect the power supply and wait five minutes to have the screen stabilized before the measurement of the luminance is performed. Re-connect the power supply after the Battery mode test is completed.

Test evaluation

The measured luminance is the required value. The luminance must be reported with no decimal places.

The measured Luminance, Contrast and Brightness settings must be noted in the test report. The preset CCT in default setting must also be noted.

Overall uncertainty

$\leq \pm 10\%$ in luminance.

See 9.1.9

Draft 2

5.9 Luminance uniformity

Background

When poor luminance uniformity is visible, it can locally affect the contrast and consequently the readability of information on the display. The areas of deviating luminance can have different sizes and cause varying contour sharpness.

Definition

Luminance uniformity is the capacity of the tablet display to maintain the same luminance level over the whole active screen area. The luminance uniformity is defined as the ratio of maximum to minimum luminance within the fully active screen area.

Applicability

Tablet computers with backlit or light emitting pixels.

References

5.3-5.7, 5.9-5.12.

5.9.1 Mandate

Luminance variation across the active screen, $L_{\max} : L_{\min}$ must be ≤ 1.50 .

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
- The Luminance variation must be reported in TCO Certified Portal

5.9.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- The entire active area of the screen must be white and the display color setting must be RGB 255, 255, 255.

Equipment

Luminance meter or spectroradiometer.

Test method

The luminance must be measured orthogonally to the tablet screen plane at 9 points. The 4 corner positions (1, 3, 7 and 9) are measured 1° from the edges of the screen as shown in figure *luminance uniformity 1*. The 4 side positions (2, 4, 6 and 8) are measured on the middle of the side 1° from the edge. Finally the center position (5) is measured. This means that all measurement points have 1/2° marginal to the edges if the measurement area of the instrument is 1°.

The luminance uniformity must also be evaluated visually by the technician in order to find any dark or bright areas except from the 9 default positions. If a significantly bright or dark area is found these measuring points must also be measured and used to evaluate the luminance uniformity.

The conditions for luminance measurement in the corner positions and the distribution of other measurement points are illustrated in figure *luminance uniformity 1*.

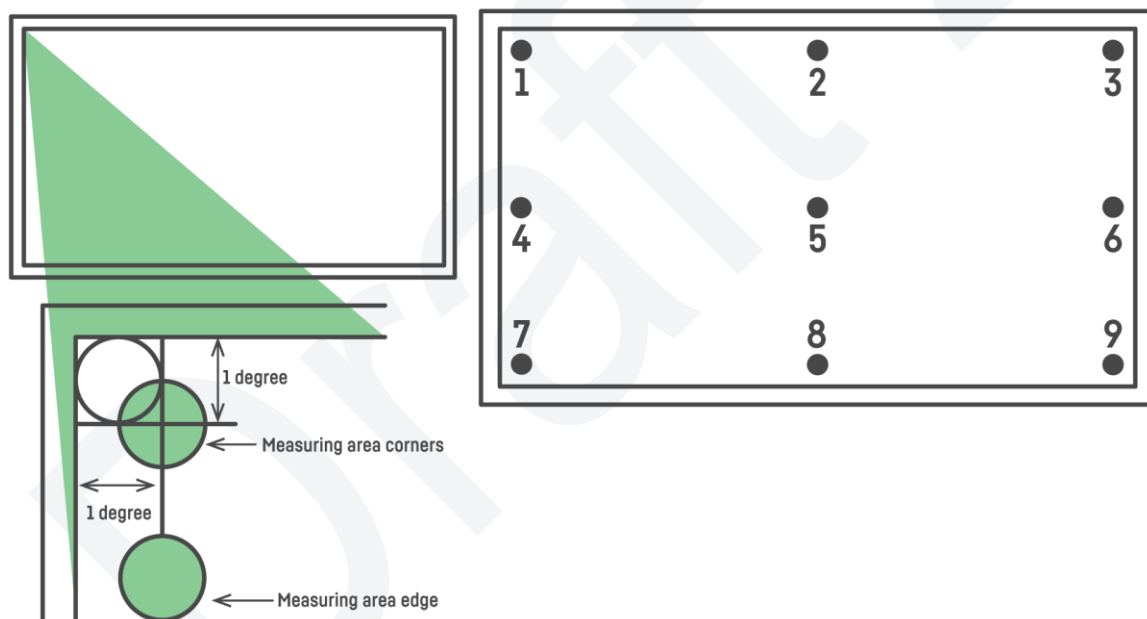


Figure *luminance uniformity 1*. Measurement positions for the measurement of luminance and color uniformity.

Test evaluation

The luminance uniformity must be reported as the ratio between the highest and the lowest measured luminance values. The result must be presented to 2 decimal places.

Overall uncertainty

≤ ± 10 % in luminance.

≤ ± 0.1 unit in luminance uniformity.

See 9.1.9

Draft 2

5.10 Luminance uniformity - angular-dependence

Background

The luminance of a tablet display is angular-dependent, i.e. screen luminance decreases when the display is viewed slightly from the side, either horizontally or vertically. This can have a negative effect on contrast and can affect the readability of the display.

Definition

Luminance uniformity – angular dependence, is the capacity of the tablet display to maintain a certain luminance level independently of the viewing direction. The angular-dependent luminance uniformity is defined as the ratio of maximum luminance to minimum luminance in the specified measurement areas.

Applicability

Tablet computers with backlit or light emitting pixels.

References

5.3, 5.7, 5.9-5.12.

5.10.1 Mandate

1. In landscape mode, when the screen is rotated around the vertical axis through the center of the screen the mean value of the L_{\max} to L_{\min} ratios at $\pm 30^\circ$ must be ≤ 3.00 .
2. In landscape mode, when the screen is rotated around the horizontal axis through the centre of the screen the mean value of the L_{\max} to L_{\min} ratios at $\pm 30^\circ$ must be ≤ 3.00 .

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.

5.10.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- Luminance values must be measured at five different positions on the screen as shown in figure *luminance uniformity - angular-dependence* 1. Each measurement position must consist of white RGB 255, 255, 255 measurement areas (4% of the active screen size) without line borders.

- The background must be RGB 102,102,102.
- The luminance meter must be positioned and directed orthogonally to the screen center-point as described in 9.2.5.

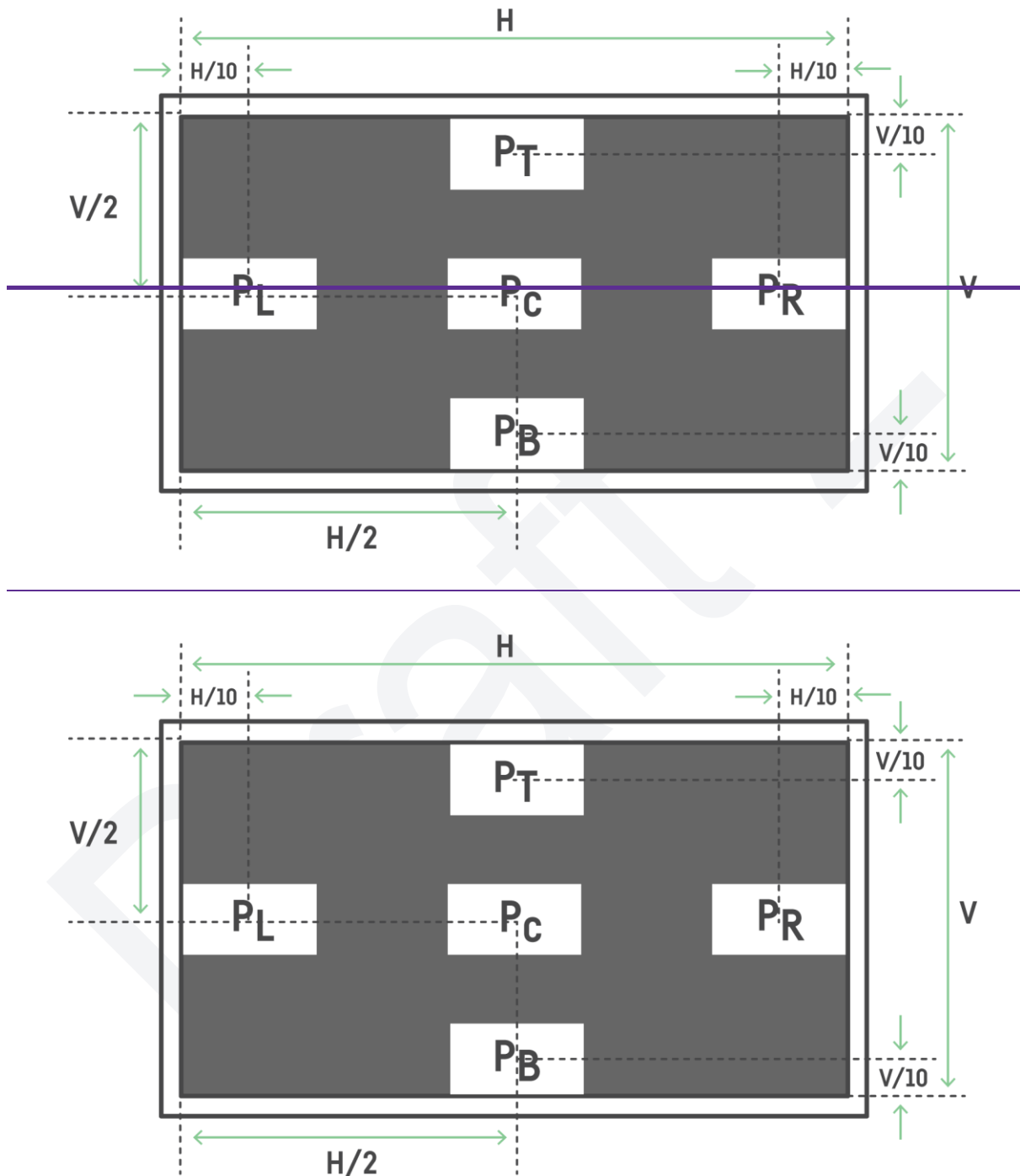


Figure: *luminance uniformity - angular-dependence 1*. Measurement positions for luminance uniformity - angular dependence.

Equipment

Luminance meter.

Test method

1. The luminance meter must always be directed towards a measurement point and rotated around a fixed vertical axis (or horizontal axis for the tilt measurements) through the focal point of its front lens at the distance described in 9.2.5.
2. In landscape mode the display must be rotated +30 degrees around a vertical axis through the display center-point and the luminance at positions P_L and P_R ($L_{PL/+30/0}$ and $L_{PR/+30/0}$ respectively) must be recorded. See figure *luminance uniformity - angular-dependence 2*.
3. In landscape mode the display must then be rotated -30 degrees around the vertical axis through the screen center-point and the luminance at positions P_L and P_R ($L_{PL/-30/0}$ and $L_{PR/-30/0}$ respectively) must be recorded. See figure *luminance uniformity - angular-dependence 2*.
4. In landscape mode the display must then be tilted +30 degrees backwards around a horizontal axis through the display center-point and the luminance at positions P_T and P_B ($L_{PT/0/+30}$ and $L_{PB/0/+30}$ respectively) must be measured. The result must be recorded. See figure *luminance uniformity - angular-dependence 3*.
5. In landscape mode the display must then be tilted -30 degrees around a horizontal axis through the display center-point and the luminance at positions P_T and P_B ($L_{PT/0/-30}$ and $L_{PB/0/-30}$ respectively) must be measured. The result must be recorded. See figure *luminance uniformity - angular-dependence 3*.
6. The measurements to be carried out are summarised in table *luminance uniformity - angular-dependence 4*. The step numbers in the step column are the test method paragraphs.

Table *luminance uniformity - angular-dependence 4*.

Steps	Landscape mode	Screen rotation	Screen tilt	Measuring points			
				P_L	P_R	P_T	P_B
Step 2	Horizontal direction (turned around vertical axis)	+30°	0°	X	X		
Step 3	Horizontal direction (turned around vertical axis)	-30°	0°	X	X		
Step 4	Backwards tilt = (turned around the horizontal axis)	0°	+30°			X	X
Step 5	Forwards tilt = (turned around the horizontal axis)	0°	-30°			X	X

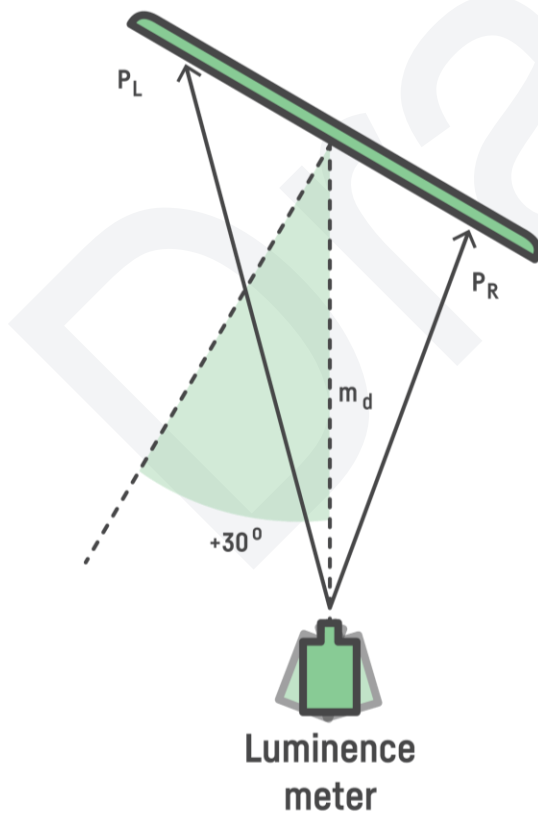
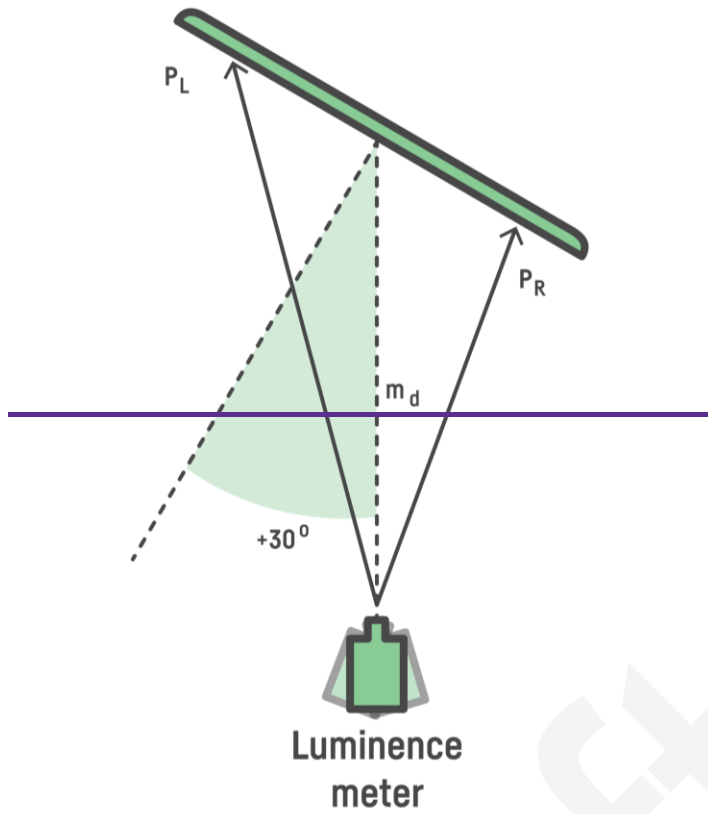


Figure *luminance uniformity - angular-dependence 2*. Top view of test set-up when the display is rotated ± 30 degrees. The + rotation is defined clockwise.

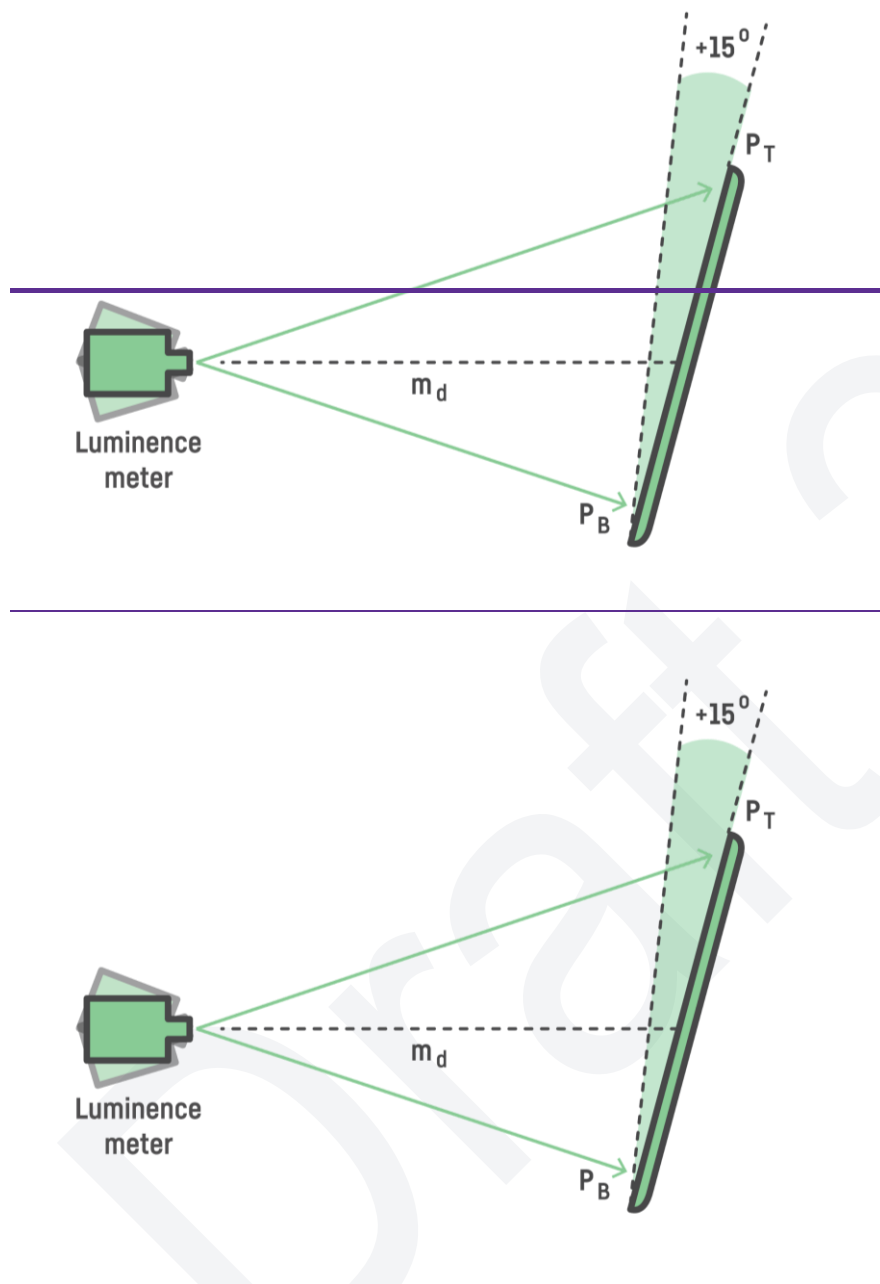


Figure *luminance uniformity - angular-dependence 3*. Side view of the test set-up when the display is tilted +15° backwards. The + tilt is defined backwards.

Test evaluation

- The luminance uniformity for angular dependence must be calculated as follows. In landscape mode, for the horizontal direction, (turned around the vertical axis) measurement presented in table *luminance uniformity - angular-dependence 4* (test step 2 and 3). A ratio between the two measured luminances must be calculated. This ratio, or its inverse if it has a higher value, must be reported as the requested L_{\max} to

L_{\min} luminance uniformity in **mandate 1**. The requirement is on the mean value of the two ratios $+30^\circ$ and -30° . The result must be presented to 2 decimal places.

- In landscape mode, for the vertical direction (turned around the horizontal axis). Tilt backwards and tilt forwards $\pm 30^\circ$ (test steps 4 and 5 above). A ratio between the two measured luminances must be calculated. This ratio, or its inverse if it has a higher value, must be reported as the requested L_{\max} to L_{\min} luminance uniformity in **mandate 2**. The requirement is on the mean value of the two ratios $+30^\circ$ and -30° . The result shall be presented to 2 decimal places.

Both **mandate 1** and **mandate 2** results shall be presented in the test report.

Overall uncertainty

$\leq \pm 10\%$ in luminance.

$\leq \pm 0.3^\circ$ in rotation angle.

$\leq \pm 0.1$ unit in luminance uniformity.

See 9.1.9

Draft 2

5.11 Luminance contrast – characters

Background

The degree of contrast is important for readability and for distinguishing one character from another.

Definition

Luminance contrast – characters is the capacity of the display to maintain a high luminance difference between a bright background and dark characters or parts of characters over the whole active area.

Luminance contrast – characters is expressed as the ratio of the L_{\max} to L_{\min} difference over the sum of L_{\max} and L_{\min} , in accordance with Michaelson's formula.

Applicability

Tablet computers with backlit or light emitting pixels.

References

5.4, 5.7, 5.9, 5.10, 5.11, 5.14, 5.22

5.11.1 Mandate

The luminance contrast must be ≥ 0.70 measured orthogonally to the screen.

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
 - The luminance contrast must be reported in TCO Certified Portal
-

5.11.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- A micro-photometer for luminance measurement must be aligned orthogonally to the display surface.
- The test images must be presented in a pixel matched way. One program that does this up to 8-bit color is Microsoft Paint.

Equipment

A micro-luminance meter such as an array photodetector capable of measuring luminance on structures ≤ 0.02 mm. Measurement requirements are given in clause 9.2.5.

Test method - New

This measurement is a modified version of the measurements in IDMS 7.2 and IDMS 7.8. By visual evaluation of the standard test measurement position the technician must search for and locate visual stripes, or patches, that clearly influence the contrast of characters or even parts of characters. Once the patches are visually identified as having significantly lower contrast they must be geometrically referenced from the upper left corner of the active image and the position must be reported in the test report. If no such position is found, the default test position is the center of the screen. If one position is found that does not fulfil the mandate, there is no need to make further measurements.

With an array or scanning light measuring device, obtain the luminance profile of the vertical black-pixel line and the corresponding white region. Obtain the net signal S as a function of distance with any background subtracted (this is the background inherent in the detector if a nonzero signal exists for no light input). A correction for veiling glare must be made. See the figure below for an illustration of the pixel configuration and data. 12 consecutive pixel rows on the display must be used for integration in vertical direction to get a one-dimensional intensity signal.

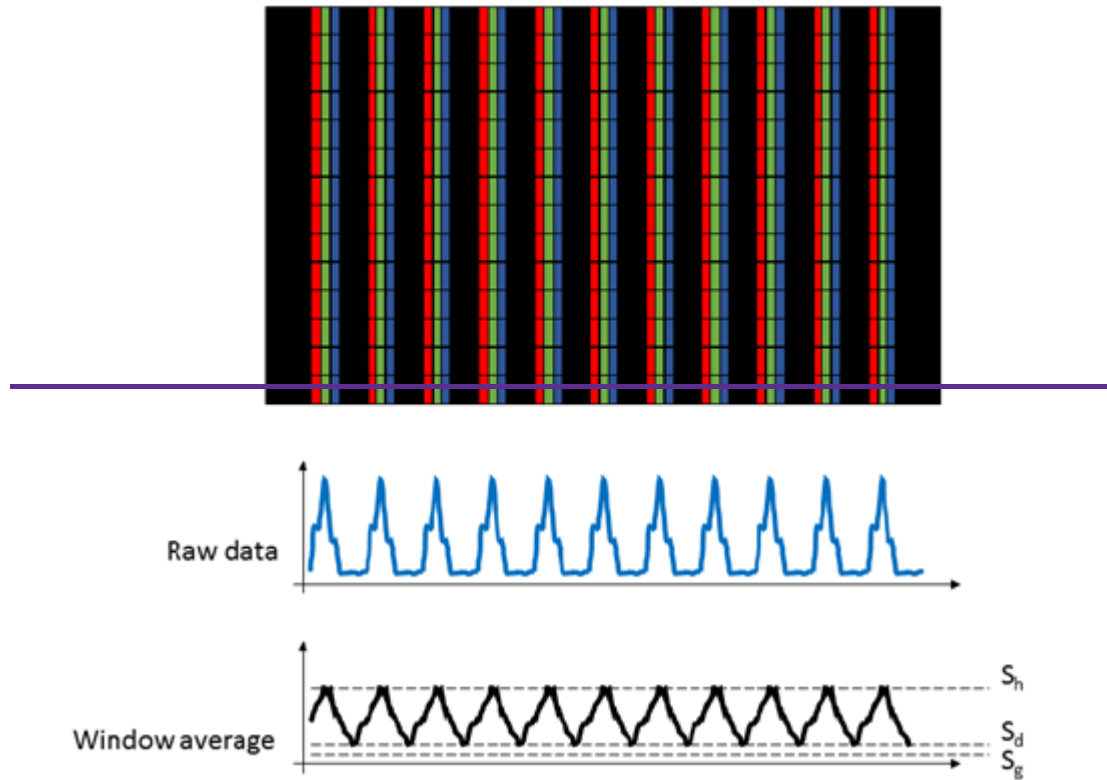
Here, the 1-1-1-1 patterns must be used, i.e. the 6-groups with the highest resolution. Inside each group, the pattern with the worst measured performance must be chosen.

Perform a running window average (moving box-car filter) of the luminance profile where the averaging window width is as close as possible to the pixel pitch as rendered by the light measuring device. There should be at least 10 or more detector pixels per display pixel. For example, if an array detector is used and with the magnification of the imaging lens there are 53.4 array pixels which cover the display pixel pitch, then the running average window width is 53 array pixels wide.

From the resulting modulation curve determine (1) the net intensity level of the vertical black line

$S_K = S_d - S_g$, where S_d is the minimum intensity level (dim) of the black line generated by the display, S_g is the ground level, and (2) the net intensity level of the white line $S_W = S_h - S_g$, where S_h is the maximum intensity level (high) of the white line generated by the display.

Compute the resolution contrast ratio as, $C = (S_W - S_K) / (S_W + S_K)$.



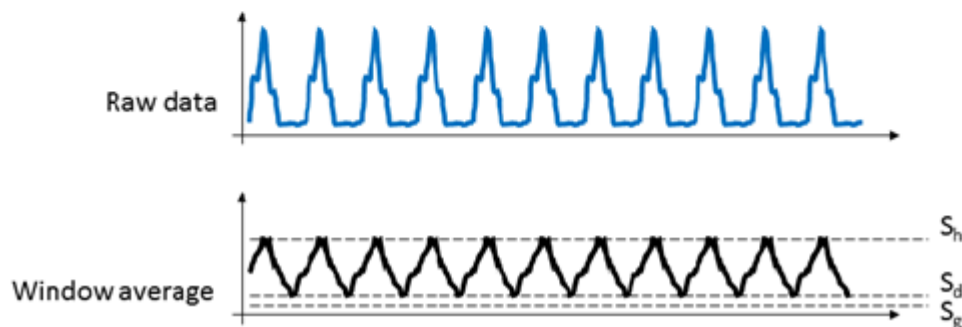
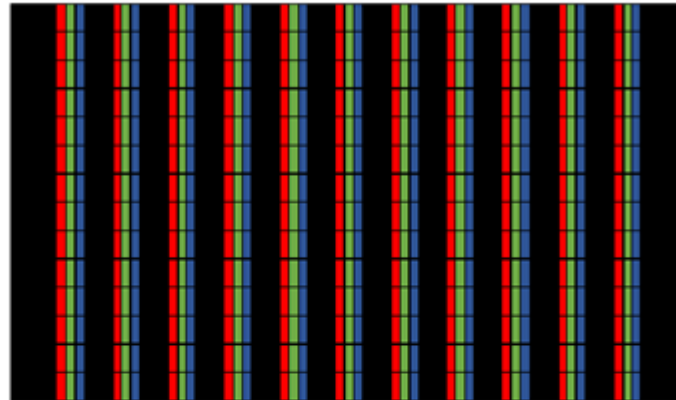


Figure *Luminance contrast - characters 1*: Measurement principle (from IDMS 7.2).

In summary:

$$S_K = S_d - S_g \quad (1)$$

$$S_W = S_h - S_g \quad (2)$$

$$C = (S_W - S_K) / (S_W + S_K)$$

Then perform the same operation but in vertical mode for the other set of grille patterns. Record the contrast values for both directions.

Test picture: "WGrille pattern" with the same resolution as the display.

Test evaluation

C must be ≥ 0.70 .

The lowest luminance contrast found must be reported.

The result must be presented to 2 decimal places.

Overall uncertainty

$\leq \pm 0.05$ in contrast.

The misalignment between the screen surface normal and the optical axis of the luminance meter must be $\leq 0.3^\circ$.

See 9.1.9

Draft 2

5.12 Luminance contrast – angular dependence

Background

For displays, the luminance and consequently the contrast of the display may be angular-dependent. The luminance variations can influence both the bright white and the dark areas of the screen, causing a change in contrast. This can have a negative effect on the readability of the display.

Definition

Luminance contrast – angular dependence, is the capability of the tablet display to maintain the same contrast regardless of the direction from which the screen is viewed. Luminance contrast – angular dependence, is expressed as the ratio of the L_{\max} to L_{\min} difference over the sum of L_{\max} and L_{\min} , in accordance with Michaelson's formula. It is measured at two different angles.

Applicability

Tablet computers with backlit or light emitting pixels.

References

5.4, 5.9, 5.12-5.15.

5.12.1 Mandate

In landscape mode, the luminance contrast-angular dependence must be ≥ 0.80 at $\pm 30^\circ$ horizontally from the viewing direction (rotated around the vertical axis through the center of the screen).

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s), and a copy of the verification report(s) from a verifier approved by TCO Development.
- The luminance contrast-angular dependence must be reported in TCO Certified Portal.

5.12.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- A TCO Certified default test image, as shown in figure 9.1.7, must be used for this measurement.
- The measurement area must have each of the following RGB settings: (RGB 255, 255, 255) and (RGB 0, 0, 0).

Equipment

Luminance meter or spectroradiometer.

Test method

- The luminance meter must be positioned and directed orthogonally to the screen center-point as described in 9.2.5.
- The tablet computer display must be rotated around a vertical axis through the screen front center, changing the azimuth angle to + 30°. The luminance of the white measurement area L_{W+30} and the luminance when the measurement area is black L_{K+30} at the center must be recorded.
- Finally the azimuth angle of the screen must be changed to -30° and the new measurements $L_{W/-30}$ and $L_{K/-30}$ taken.

Test evaluation

The luminance contrast values C_{+30} and C_{-30} must be calculated using the formula

$$C = \frac{L_W - L_K}{L_W + L_K}$$

Of C_{+30} and C_{-30} , only the lowest value must be reported as the luminance contrast.

Overall uncertainty

≤ ± 10% in luminance.

≤ ± 0.05 in contrast.

See 9.1.9

6 Product lifetime extension

- In our current, linear way of producing and consuming products we take virgin natural resources and make products from them which we then discard once we're done using them – often after a relatively short time.
- Linearity leads to the loss of valuable and scarce natural resources, pollution and extensive energy use that contributes to the climate crisis.
- Moving toward sustainable solutions means creating a system that is more regenerative, where products and materials are kept in their intended use longer.

Linearity undermines ecosystems and the economy

Today, the common approach to the IT product life cycle is linear. Virgin materials are extracted to make new products which are used and then discarded, often after a relatively short time. In a majority of cases, materials are not recycled, and turn to waste. This linear “take, make, use, dispose” model is not sustainable and largely inefficient from a resource perspective. It depletes the earth's natural resources, and creates enormous amounts of hazardous e-waste.

Our approach: driving the development of products that can live longer

The best way to begin taking a more circular approach to the production and consumption of IT products, is extending their usable life. For the IT industry, this means designing products that are durable, built to last, upgradeable and repairable, making them more attractive for reuse or secondary markets. Once a product has reached the end of its usable life, the materials should be possible to recycle and use again in new products.

Criteria in chapter 6 focus on:

- Extending product life by requiring that products are durable, repairable and that spare parts and repair manuals are available.
- Making sure batteries in mobile products live longer, are replaceable and easily can be charged in a way that protects the battery from premature degradation.
- Enabling reuse of cables and reducing e-waste through requirements of standardized connectors.
- Incentivizing the IT industry to produce longer-lasting products by requiring that a product warranty must be in place on all markets where the product is sold.
- Preventing data leakage and promoting safe reselling of products through secure data removal solutions.

6.1 Product warranty

Background

~~By extending product lifetime, natural resources are used more efficiently and the pollution to air, water and soil is reduced.~~ A precondition for an extended product lifetime is that the product is of high quality. A product warranty provides the brand owner with an economic incentive to design a durable product that lasts longer and to encourage users to keep their products longer before replacing them.

Definitions

Brand owner: The company or organization owning or controlling the brand name.

Brand name: The name or sign, including but not limited to a trademark or company name, used to identify, amongst users and customers, the manufacturer or seller of a product.

~~Product warranty: Is an agreement where the brand owner offers to repair or replace broken products at no charge.~~

Product warranty: Covers defects existing at the time of delivery and those appearing after delivery that are due to material or manufacturing faults. It does not cover damages due to misuse or accidents. (However, functionality defects resulting from normal wear and tear, such as battery degradation, fan and keyboard wear-down, etc. must be covered.)

MSRP: Manufacturer's suggested retail price

Applicability

All product categories.

6.1.1 Mandate

In all markets where the product is sold, the brand owner must:

- Offer ~~the possibility of~~ a 5-year minimum available warranty, where ~~a minimum of at least~~ 1 year must be included free of charge.
- Each year of warranty, which is not included free of charge, must be offered for a maximum of 15% of the ~~cost for~~ MSRP of the product and must be available for purchase together with the product.

~~The following must be reported and listed on the certificate:~~

- ~~The number of years of warranty, including extension.~~
- ~~The number of years of warranty free of charge~~
- ~~The maximum cost per year for an extended warranty~~

Submit the following to an approved verifier:

- [A link to a public statement in English covering the warranty of the certified product.](#)
- A completed and signed brand owner product form (chapter 11.4).

~~Submit~~ The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- [Minimum included product warranty in years](#)
 - [Minimum purchasable extended warranty in years](#)
 - [Minimum total available warranty in years \(free + extended\)](#)
 - [The maximum cost \(in % of product cost\) per year for the extended warranty](#)
 - [A link to a public commitment on warranty covering the certified product](#)
-

6.1.2 Clarification

The ~~verifier~~brand owner must ~~see documentation proving~~provide a link to a public statement in English covering the availability of the reported warranty for the certified product, where the brand owner commits to the minimum warranties on all markets~~any market~~ where the product is sold, as well as information on how to purchase an extended warranty, for example, directly from the brand owner's webshops or through a retailer.

If product components have different warranty periods, or if different warranty periods are offered in different regions, the worst-case scenario (least number of years) must be ~~reported.~~
The ~~documentation must prove that warranty not included free of charge cost a maximum of 15% of the product cost per year and is available for purchase together with~~used in the product~~statement.~~

Warranty period (Years)

~~This is~~ Link to a public commitment on warranty covering the certified product

The link must be functioning during the validity of the certificate. If the URL is changed, then it must first be approved by TCO certified and the new URL added to the certificate.

Minimum included product warranty

This is the minimum number of years ~~of~~(at least 1 year) of product warranty that is included for free and must be at least 1~~on all markets where the product is sold.~~

~~Total~~ Minimum purchasable extended warranty availability (Years)

This is the ~~total number~~ minimum optional extension of ~~years of the product~~ warranty that ~~must be available, offered~~ for purchase ~~together~~ with the product ~~including~~ on all markets.

Minimum total available warranty

This is the ~~years free~~ worst-case combination of ~~charge~~ “included product warranty” and ~~must be at least 5-~~ “purchasable extended warranty” on any market where the product is sold.

Maximum warranty cost per year (in % of product cost)

This is the maximum annual cost for the purchasable extended warranty, ~~for the years that are not included free of charge and~~ must not exceed 15% of the MSRP cost of the product.

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6.2 Replaceable components

Background

Extending the lifetime of IT products is the most effective way to reduce their environmental impact. Components that often break or become outdated may limit the total lifespan of the product and must be replaceable. ~~By making these critical replaceable components available and~~By providing the user with clear instructions on how to ~~exchange them,replace these critical components~~, IT-products can live longer.

Definitions

CPU: Central processing unit.

GPU: Graphics processing unit.

RAM: Random access memory.

Storage: Any computing hardware that is used for storing, porting, and extracting data files and objects, including temporary and permanent storage of information (SSD, HDD, RAM).

Display assembly: Main display panel.

All batteries: Defined as all batteries with one or more cells that are installed in the product.

System board: Also referred to as the motherboard.

Keyboard: Built-in keyboard.

External/Internal PSU: The power supply unit used to convert AC to low voltage DC power for the internal components of the product.

Critical, replaceable components: Components that are crucial for the functionality and have a high risk of failing during normal use. Components that are defined as critical, replaceable components (per product category) are listed in the clarifications section of this criterion.

Applicability

All product categories.

References

6.1, 6.2.

6.2.1 Mandate

- The brand owner must provide a service manual describing how to replace at least all critical replaceable components. The service manual must be available for anyone to read, free of charge.

Submit the following to an approved verifier:

- A completed and signed brand owner [product](#) form (chapter 11.4)
- A link to the service manual on the brand owner website or a pdf of the material that will be published there during the validity of the certificate

~~Submit~~ The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development, [including the link and instructions on how to locate the service manual.](#)
-

6.2.2 Clarification

Replaceable parts management

- The brand owner must provide a service manual including step-by-step instructions and component descriptions for the disassembly and assembly.
 - External PSU, charger, and AC Adapters are exempted from the disassembly instructions.
 - If instructions on how to replace all critical replaceable components (listed below) are included in the user manual, no additional service manual is needed to comply with the mandate 6.2.1.
- [Board diagrams must be available for professional repairers free of charge.](#)
- A critical, replaceable component must be possible to replace with an equivalent component. However, the replacement component does not have to be identical to the original component.
- Instructions on how to replace the critical components must be available online during the validity of the certificate.
- If a critical component is soldered, step-by-step instructions are not needed, however it must be stated that the component is soldered in the service- or user manual.
- For data center products (Servers, Storage products, Network equipment), if one or more critical replaceable component(s) are part of a controller canister or system

board, the controller canister or system board must be treated as the critical component.

- Headband cushions which are molded do not need to be replaceable. Headband cushions designed to be snapped/mounted (for eg, with adhesive) shall be replaceable.

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Critical replaceable components:

The critical replaceable components listed below must only be made available if they are included in the certified product.

Displays Connectivity cables Power cables External PSU System board/motherboard Display panel assembly	Tablets Battery Display Panel/display assembly External/internal PSU
All-in-one PCs CPU External/internal PSU Storage (SSD, HDD, ODD) System memory (RAM) System board/motherboard	Smartphones Battery Display Panel/display assembly Charger
Notebooks Battery Display Panel/display assembly Storage (SSD, HDD) System memory (RAM) External/internal PSU Keyboard System board/motherboard	Headsets Battery External/internal PSU Earloop Neckband Ear tips Ear cushions Microphone shield Headband
Desktops CPU GPU (PCIe) External/internal PSU Storage (SSD, HDD, ODD) System memory (RAM) System board/motherboard	Projectors The light source (except lasers) Filters External PSU

<p>Servers</p> <p>System boards(s) Storage (i.e. SSD, HDD) CPU RAM Network device PSU Fan module(s) Connectivity cables Rack rails Cable management arms</p>	<p>Storage products</p> <p>System board(s) Storage (i.e. SSD, HDD) Storage controller (i.e. RAID controllers) PSU Fan module(s) Batteries Connectivity cables Rack rails Cable management arms</p>
<p>Network equipment</p> <p>System board(s) Storage (i.e. SSD, HDD) PSU Fan module(s) Expansion module(s) I/O module(s) Connectivity cables Rack rails Cable management arms</p>	
<p><i>Component table</i></p>	

Component table

6.3 Standardized connectors

Background

By using one standardized interface (USB Type-C) for charging and data transfer, fewer cables need to be manufactured, and the ~~re-use~~reuse of chargers and data cables can increase. USB Type-C is also designed to be more robust and future-proof than the existing USB Type-A and Type-B. Therefore, using USB Type-C helps prevent problems with failing ports.

~~The connector can also enable features such as eGPU for notebooks that make it possible to upgrade the GPU performance with standalone graphics cards. This means that a user will be able to keep the same product for a longer time.~~

Definitions

USB Type-C: A 24-pin USB connector system with a horizontally symmetrical "reversible" connector: based on the "Universal Serial Bus Type-C Cable and Connector Specification".

Applicability

Notebooks, desktops, AIOs, smartphones, tablets

6.3.1 Mandate

The device must ~~carry be equipped with~~ at least one USB Type-C ~~connector that is~~receptacle compatible with USB 3.1 Gen 1 or faster and that remains accessible and operational at all times.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3)
- A product manual including an exploded diagram of the device illustrating the types of connectors used.

~~Submit~~ The following ~~together with the application~~is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

6.3.2 Clarification

Products with no connectors are exempted from this criterion.

Clarification of sustainability performance indicator(s)

One or more “sustainability performance indicators” (chapter 1.3) are collected for this criterion. There is no mandatory level for these indicators but they must be verified and reported according to the description below.

One cable solution for Notebooks

Utilizing a one cable Thunderbolt USB Type-C solution simplifies connections between a notebook and peripherals such as monitors, external drives, and power sources. This technology consolidates the need for separate data, display, and power cables into a single cable. Consequently, this approach not only reduces clutter but also promotes sustainability by diminishing electronic waste and cutting down on resource consumption linked to producing and transporting multiple cables.

Class A

All configurations of the products are equipped with at least one Thunderbolt 4 USB Type-C connector.

Class B

All configurations of the products are equipped with at least one Thunderbolt 3 USB Type-C connector.

Class C

Not all, or no configurations are equipped with Thunderbolt 3 or 4 USB Type-C connector.

6.4 Product durability

Background

The military standard MIL-STD-810H and the International Electrotechnical Commission IEC 60068-2 include a series of endurance tests such as low and extreme temperature and drop tests. Products that meet these requirements can last longer and be reused to a larger extent.

Definitions

MIL-STD-810H: Environmental Engineering Considerations and Laboratory Tests, a United States military standard for product durability.

IEC 60068-2: A collection of methods for environmental testing of electronic equipment and products.

Applicability

Notebooks, smartphones and tablets.

6.4.1 Mandate

The product must be tested according to the MIL-STD-810H or IEC 60068-2 test procedure with the modified storage / operational temperature interval and duration as well as the drop test height according to the table below. The results will be reported on the certificate.

Test	Test conditions	Required level
Drop test	Drop height	≥ 45 cm
High temperature	Storage temperature for ≥ 48 h	≥ 60 °C
	Operational temperature for ≥ 4 h	≥ 40 °C
Low temperature	Storage temperature for ≥ 48 h	≤ -30 °C
	Operational temperature for ≥ 4 h	≤ -20 °C

Submit the following to an approved verifier:

- A copy of the test report(s) from a laboratory accredited according to ISO 17025.

Submit The following ~~together with the application~~ submitted to TCO

Development:

- A copy of the verification report from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The drop height test, high- and low temperature test results must be reported in TCO Certified Portal.
-

Draft 2

6.4.2 Clarification

Assessment and verification

The applicant must provide test reports showing that the model has been tested and has met the functional performance requirements for durability. Testing must be carried out by a test facility accredited according to ISO 17025 and the test report must be verified by a verifier approved by TCO Development.

Products which have already been tested to the same or a stricter specification, will be accepted without the need to retest. The following methods are accepted.

For MIL-STD-810H the following methods apply

- Drop test: Method 516.8 - Shock (procedure IV)
- High temperature: Method 501.7 - Basic Hot (A2)
- Low temperature: Method 502.7 - Basic Cold (C1)

Unless it can be proved that the plastics or rubber material in the product is unaffected by the applied test-temperature (as mentioned in paragraph 5.19 Total High Temperature Exposure Duration and Method 502.6 - 2.3.2 Exposure Duration), the duration of the high temperature test (method 501.7 Basic Hot (A2)) and the low temperature test (Method 502.7 Basic Cold (C1)) must be at least 48h in storage and 4h in operation. [If a stricter testing is applied, such as Cold \(C2\) or Severe Cold \(C3\) then the duration must be at least 4h in storage and 4h in operation.](#)

For IEC 60068-2 the following methods apply

- Drop test: 60068-2-31:Ec
- High temperature: IEC 60068-2-2:B
- Low temperature: 60068-2-1:Ab/e.

Test evaluation

The product under test shall first be baseline tested for performance at 20 °C with a fully charged battery. All operation tests shall be started with a fully charged battery in the system. During the low temperature operational test, the product may be switched on at ≤ 0 °C.

After exposure to any of the three specified stress tests, the product should be able to:

1. Boot up and operate normally
 - Boot or resume should not exceed 50% greater time increase as a result of the test.
 - No noticeable operational faults when using standard software applications (Excel, Word etc).

- No major damage to the product that does not allow for standard usage, e.g.,- opening/closing of the notebook display, usage of any critical buttons, non-functional display.
2. Not create hazards to end user
- No case or display cracking or other sharp points created from failures that could injure a user.
 - No electrical component failures or access that could result in a user safety issue.

Draft 2

6.5 Battery longevity

Background

Short life cycles for IT products is a global problem connected to product design, user habits and end of life solutions. One important reason why portable IT products are discarded prematurely is that the battery loses its capacity over time and becomes too degraded to provide enough power for the product. The product experience could many times be improved by replacing the battery Instead of buying a new product.

Definitions

Main battery: Unit that incorporates one or more cells and which is ready for use. It incorporates adequate housing and a terminal arrangement and may have electronic control devices (IEC 61960).

State of Health (SoH): Current full charge capacity (in mAh), expressed as a percentage of the design capacity (rated capacity).

Rated capacity: The specified capacity by the manufacturer.

Applicability

~~Notebooks, headsets, tablets, smartphones and general~~ Battery-operated products

References

6.3-6.6

6.5.1 Mandate

- The main battery must be able to withstand a minimum of 300 charging cycles with at least 90% of the rated capacity according to IEC 61960-3:2017 or newer.
- ~~The battery must be tested for endurance in cycles, measurement of internal AC resistance, Measurement of the internal DC resistance from chapter 7 Electrical test in IEC 61960-3:2017 or newer.~~

Submit the following to an approved verifier:

- A copy of the test report(s) from a laboratory accredited according to ISO 17025.
- A completed and signed product form (chapter 11.3).

~~Submit~~ The following ~~together with the application~~ is submitted to TCO

Development:

- ~~A copy of a verification report from a verifier approved by TCO Development.~~
- The battery model name, ~~the amount~~ technology, rated capacity, rated voltage, rated power and the tested number of charging cycles ~~, the capacity left of rated capacity~~

after each cycle, internal AC and DC resistance before and after 300 charging cycles for all main batteries must be reported in TCO Certified Portal.

6.5.2 Clarification

- A copy of a verification report from a verifier approved by TCO Development.

The internal AC/DC resistance must be measured before following is submitted to TCO Development and after the endurance in may be published:

- The tested number of charging cycles test with at least 90% of the rated capacity remaining.

Draft 2

6.6 Battery replaceability

Background

Batteries are consumables, often with a shorter life than the product they are installed in. To extend the total lifespan of the product, main batteries must be replaceable, so that products can be repaired and reused. Another concern that makes replaceability important is that the explosive cells of Lithium-ion batteries may pose a fire risk when shredded in the recycling process, causing a hazardous situation for recyclers.

Definitions

Main battery: Unit that incorporates one or more cells and which is ready for use. It incorporates adequate housing and a terminal arrangement and may have electronic control devices (IEC 61960).

Reuse: Reuse is the second step in the waste hierarchy: waste prevention, reuse, recycling, recovery of energy and safe disposal.

Recycle: The purpose of recycling is to recover materials from waste, for use in the production of new products by upcycling or downcycling. Recycled materials can also be used as a component in new raw materials.

Earbuds: Earbuds rest on the concha – the opening outside the ear canal

Earphones: Earphones – also known as in-ear headphones – are inserted in the ear canal

Tools are defined under the criterion replaceable components

Applicability

[Notebooks, headsets, smartphones and tablets.](#)

[Battery-operated products.](#)

6.6.1 Mandate

- The battery must be replaceable by the end-user with the use of commercially available tools or tools provided free of charge with the product. No proprietary tools, thermal energy, or solvents must be necessary to replace the battery.
- The battery must be available for anyone to purchase
- The instructions on how to replace the battery must be available for anyone to read, free of charge online throughout the whole lifetime of the certificate.

Submit the following to an approved verifier:

- A link to instructions on the brand owner website or a pdf of the material that will be published there during the validity of the certificate
- A completed and signed product form (chapter 11.3)

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The toolless battery replacement evaluation must be submitted to TCO Certified Portal.
-

6.6.2 Clarifications

Headsets products defined as earbuds and earphones are exempted from the battery replaceability mandate. “Replacing the battery” means to disassemble the product (if needed), exchange the battery with a new one and assemble the product to its original state.

Clarification of sustainability performance indicator(s)

~~One or more “sustainability performance indicators” (chapter 1.3) are collected for this criterion. There is no mandatory level for these indicators but they must be verified and reported according to the description below.~~

Toolless battery replacement (Class A-B Yes/No)

- **Class A Yes:** The main battery is possible to replace by the user without tools.
- **Class B No:** The main battery is not possible to replace by the user without tools.

Verification: The verifier must check if the main battery is possible to replace by the user without tools.

6.7 Battery information and protection

Background

While extending the life of IT products is key to lowering its environmental impact, mobile IT products are often replaced because the battery has lost its capacity to deliver enough power which limits the functionality of the product. Each charging cycle will degenerate the battery and reduce the battery's capacity to hold a charge. To slow down the degradation of the battery, battery protection software that lowers the maximum battery charge level to at least 80% can extend the total lifetime of the battery. It is also important that the user understands how the performance of the product changes as the battery degrades. When the user has access to this information they are better equipped to make decisions on when it is time to replace the battery instead of changing the whole product.

Definitions

Charge cycle: One charge cycle is completed when the battery is charged from 0% to 100% and then discharged back down to 0%. This could be performed by partially charging-discharging the battery multiple times on different State of Charge (SoC) levels as long as the total amount of charge-discharge percentage is approximately equal to the nominal capacity.

State of Health (SoH): Current full charge capacity (in mAh), expressed as a percentage of the design capacity (rated capacity).

State of Charge (SoC): The remaining battery capacity expressed as a percentage of full-charge capacity (SBS-IF, 1998).

Applicability

Notebooks, smartphones, tablets.

6.7.1 Mandate

1. The brand owner must provide battery protection software that can lower the maximum battery charge level (SoC) to at least 80% or less. It must be pre-installed on the product.
2. The brand owner must provide software pre-installed that can determine and monitor the following, and display the data for the user:
 - State of Health
 - State of Charge
 - The number of full charge cycles that the battery has gone through. ~~(Not applicable if the battery is replaceable by the user without tools)~~

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3).

- Documentation showcasing how point 1 and 2 in the mandate is fulfilled.

Submit ~~The following together with the application~~ is submitted to TCO

Development:

A copy of the verification report(s) from a verifier approved by TCO Development.

6.7.2 Clarification

The brand owner must specify the name and version of the software(s).

Chrome OS products are excluded from point 1 in this mandate.

In part 2 of the mandate, The “State of Health” and “The number of full charge cycles that the battery has gone through” are not applicable if the battery is replaceable by the user without tools.

Draft

6.8 Secure data removal

Background

By reusing IT products, their usable life can be extended which is an effective way of reducing their environmental impact. However, fear of confidential data leakage often prevents companies and individuals from making their products available on the second-hand market. By providing software that wipes the storage of the device, the owner can more safely recirculate their product.

Definitions

Brand owner: The company or organization owning or controlling the brand name.

Brand name: The name or sign, including but not limited to a trademark or company name, used to identify, amongst users and customers, the manufacturer or seller of a product.

Media sanitization: refers to a process that renders access to target data on the media infeasible for a given level of effort.

~~NIST 800-88 Revision 1: Erasing a hard drive using the NIST 800-88 Revision 1 data sanitization method will prevent all software-based file recovery methods and hardware-based recovery methods from recovering data from the drive.~~

Applicability

Notebooks, network equipment, desktops, all-in-one PCs, servers, data storage products, smartphones and tablets.

Reference

6.7.

6.8.1 Mandate

The brand owner must provide a media sanitization solution, either by:

1. Pre-installing it on/in the product before it is shipped.
2. Providing the software for download on their webpage, free of charge.
3. Providing a direct link on their own webpage to an external webpage where the software is available for download, free of charge.
4. Providing a remote secure data removal service upon request, free of charge.
5. Providing an on-site secure data removal service upon request, free of charge.

The selected media sanitization solution above must conform with the ~~guidelines of NIST 800-88 Revision 1, for the level of "Clear" in accordance with the products storage~~

~~technology~~; method of “Clear” in IEEE P2883. Users must be able to use it at least once, free of charge.

OR

6. Pre-installed data encryption technologies that allow for erasure or removal of the encryption keys.

Submit the following to an approved verifier:

Instructions on how to use this functionality, the techniques used and the secure data deletion standard(s) it supports must be provided in the user manual and/or by a web link to the manufacturer’s webpage.

The following is submitted to TCO Development:

- A completed and signed product form (chapter 11.3).

Submit the following together with the application to TCO Development:

- A copy of the verification report from a verifier approved by TCO Development.

6.8.2 Clarification

~~We accept “enhanced secure erase” as an option for ATA SSDs to comply with the level of “Clear” in NIST 800-88 Revision 1.~~

Pre-installed data encryption technologies must have a security stronger or equal to: AES encryption algorithm in cipher block chaining (CBC) or XTS mode with a 128-bit or 256-bit key.

6.9 Standardized external power supply compatibility

Background

Today, cables and chargers are manufactured to many different standards, which makes them difficult to reuse. By using one standardized interface (USB Type-C) for wired charging and one standard (Qi) for wireless charging, fewer cables and chargers need to be manufactured and the re-use of chargers and data cables can increase.

Definitions

USB Type-C: A 24-pin USB connector system with a horizontally symmetrical "reversible" connector-[based on the "Universal Serial Bus Type-C Cable and Connector Specification"](#).

EPS: External Power Supply

Applicability

All products with rechargeable batteries and external power supplies ≤ 240 W.

6.9.1 Mandate

- A. The product must carry a USB Type_C standardized receptacle (port) for USB Power Delivery according to the standard EN/IEC 63002:2021 - Identification and communication interoperability method for external power supplies used with portable computing devices or newer.

OR

- B. The product must have a built-in wireless charging capability that complies with Qi Wireless Power Transfer System, Power Class 0 Specification version 1.2.4, or future revisions.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3).

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
-

6.9.2 Clarification

Interoperability guidelines for external power supplies are defined according to the IEC 63002:2021 or newer (Identification and communication interoperability method for external power supplies used with portable computing devices.)

Clarification of sustainability performance indicator(s)

One or more “sustainability performance indicators” (chapter 1.3) are collected for this criterion. There is no mandatory level for these indicators but they must be verified and reported according to the description below.

Type of standardized external power supply distributed with the product (Class A-B)

By using one standardized interface (USB Type C) for charging, fewer cables need to be manufactured and the re-use of chargers can increase. For product models with multiple EPS options, all EPS that may be delivered must be evaluated and the lowest classification will determine the classification for the SPI.

- **Class A: USB Type C EPS**

- The EPS that is distributed with the product complies with EN/IEC 63002:2021 and have a USB Type C connector which can charge the product

- **Class B: Non USB Type C EPS**

- The EPS that is distributed with the product does not support charging through a USB Type C connector.

For products delivered with a charging case, the case must fulfill the criterion.

6.10 Repairability index

Background

In order to make IT products more sustainable and avoid early disposal and E-waste, it is important that electronic devices they are designed for easy repair. Repairability is a measure of how effortlessly a product can be fixed, maintained, or enhanced. A high score on the repairability scale signifies that the product is designed for simple repairs, with easily accessible parts, clear guidelines, and a supply of replacement components. Conversely, a low score indicates that the device is difficult to repair, which could lead to early disposal and an increase in electronic waste.

The main objective of external verification of a repairability index provides stakeholders with a comprehensive assessment of a product's repairability is to encourage manufacturers to prioritize. It is our ambition to align with global standards and regulations when possible, such as the EU Lot 3 mandate on repairability in their design and manufacturing methods. By promoting a universal standard for repairability, the aim is to create a more environmentally friendly and responsible IT industry. This will lead us towards an era where repairability is a fundamental aspect of product conception and influences consumers' choices.

Definitions

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. Therefore this mandate may be revised when new EU regulations covering this come into force in the future.

Applicability

Smartphones, Tablets, Notebooks

6.10.1 Mandate

The below aspects must be evaluated and calculated into a repairability index.

- Disassembly depth for all listed parts
- Fasteners (type)
- Tools (type)
- Spare Parts information
- Repair Information
- ~~Software Updates~~Spare Parts (duration)

~~The calculated repairability index (classification) will be printed on the certificate and published on the Product Finder.~~

Submit the following to an approved verifier:

- A completed and signed ~~brand owner~~product form (chapter 11.43)
- ~~Provide~~Sufficient technical documentation to judge all aspects ~~in~~of the mandate

~~Submit~~ The following ~~together with the application~~is submitted to TCO

Development:

- Filled out Repairability score excel from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- The calculated repairability index ~~classification~~ submitted to TCO Certified Portal

6.10.2 Clarifications

The repairability index must be calculated according to EU COMMISSION DELEGATED REGULATION (EU) 2023/1669 of 16 June 2023 or a more recent version. Notebooks are treated as tablets except for the critical components which are listed in this mandate. TCO Development provides a downloadable excel on their website to simplify this calculation.

The Repairability Index is an aggregated and ~~normalised~~normalized score, as a calculated value derived from the following six scoring parameters ~~where:~~

- ~~SDD is the~~“Disassembly Depth”~~score.~~
- ~~SF is the~~“Fasteners (type)”~~score.~~
- ~~ST is the~~“Tools (type)”~~score.~~
- ~~SSP is the~~“Spare Parts”~~score.~~
- ~~SSU is the~~“Software Updates (duration)”~~score.~~
- ~~SRI is the~~“Repair Information”~~score.~~

~~The same scoring methodology shall apply to both smartphones and slate tablets. The Repairability Index (R) shall be calculated as follows:~~

~~●~~ $R = (SDD*0,25) + (SF*0,15) + (ST*0,15) + (SSP*0,15) + (SSU*0,15) + (SRI*0,15)$

The “Disassembly Depth” (~~SDD~~), “Fasteners (type)” (~~SF~~) and “Tools (type)” (~~ST~~) scores are based on the aggregation of the following priority part level scores parts:

Mobile phones and Tablets.

- ~~● BAT is the battery.~~
- DA is the Battery.
- 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 Speaker.
- Hinge assembly or the mechanical display folding mechanism.

Notebooks

- ~~● BAT is the battery.~~
- DA is the Battery (if multiple, consider deepest)
- Display assembly (if multiple, consider deepest)
- ~~● BC is the back cover or back cover assembly.~~
- STO is the Keyboard
- Storage (SSD,HDD) (if multiple, consider deepest)
- ~~SMR is the~~ System memory (RAM) (if multiple, consider deepest)
- ~~● PSU is the External/internal PSU~~
- ~~● BUT is the mechanical buttons~~
- SMB is the System board Ports (Vga, Hdmi, USB,)
- Back cover or its assembly
- Systemboard/motherboard
- ~~● FAN is the fans~~
- ~~● FM is the hinge assembly or the mechanical display folding mechanism.~~
- Fans

If any of the priority parts listed above is present in a product more than once, only the one which that delivers the lowest score shall be considered in the calculation of the “Disassembly Depth” (~~SDD~~), “Fasteners (type)” (~~SF~~) and “Tools (type)” (~~ST~~) scores. If a priority part is not present in the product, the highest point level for each score shall be considered for this part.

The “Disassembly Depth” (SDD) score shall be calculated as follows:

(a) if the hinge assembly or the mechanical display folding mechanism are not present in the product, 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) if the hinge assembly or the mechanical display folding mechanism are present, the following formula shall be used:

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

SDD For Notebooks:

$$SDD = (DDBAT*0,25) + (DDDA*0,25) + (DDBC*0,09) + (DDSTO*0,04) + (DDSMR*0,04) + (DDPSU*0,04) + (DDBUT*0,04) + (DDSMB*0,04) + (DDFAN*0,04) + (DDFM*0,17).$$

Disassembly Depth (DD) assessment at part level

The Disassembly Depth score (~~DD~~) for each priority part ~~(DDBAT, DDDA, DDBC, DDFFC, DDRFC, DDEC, DDBUT, DDMIC, DDSPK, DDFM)~~ shall be calculated based on the number of steps required to remove a part from a product, without damaging the product. The counting of the steps for each part starts from the product fully assembled, with the charger disconnected and any SIM card installed. Points ranging from 1 to 5 are assigned as follows:

- ~~DD~~ ≤ 2 steps = 5 pt.
- 5 steps ≥ ~~DD~~ > 2 steps = 4 pt.
- 10 steps ≥ ~~DD~~ > 5 steps = 3 pt.
- 15 steps ≥ ~~DD~~ > 10 steps = 2 pt.
- ~~DD~~ > 15 steps = 1 pt.

Definition of step: ‘step’ 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;

For the calculation of disassembly steps, the following rules shall apply:

- The disassembly depth count is completed when the target part is separated and individually accessible.
- Where multiple tools need to be used simultaneously, the use of each tool counts as a separate step.
- Operations related to cleaning, removing traces or heating are counted as steps.

- The disassembly depth shall be calculated on the basis of the repair and maintenance information, and of the description of the disassembly steps for each priority part given in the technical documentation;
- where remote notification or authorisation/authorization of serial numbers or parts pairing is necessary for the full functionality of the spare part and with the device, each of these actions is counted as five additional disassembly steps.

The “Fasteners (type)” (SF) score is calculated as follow:

~~(a) for smartphones or slate tablets, except foldable ones, 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 or foldable slate tablets, the following formula shall be used:~~

$$SF=(FBAT*0,25)+(FDA*0,25)+(FBC*0,09)+(FFFC*0,04)+(FRFC *0,04)+(FEC *0,04)+(FBUT*0,04)+(FMIC*0,04)+(FSPK*0,04)+(FFM*0,17)$$

- software preparation steps do not count as steps for disassembly. (for example, shut down the battery in bios before disassembly = 0 steps added).

Fasteners (type) (F) assessment at part level:

The “Fasteners (type)” scores (Fi) for each priority part i (FBAT, FDA, FBC, FFFC, FRFC, FEC, FBUT, FMIC, FSPK, FFM) are assigned according to the level of removability and reusability of the fasteners used in the device assembly. Points ranging from 1 to 5 are assigned as follows:

- Reusable Fasteners = 5 pt.
- Resupplied Fasteners = 3pt.
- Removable Fasteners =1 pt.
- Non removable fasteners = 0pt

The assessment of the type of fasteners is based on the disassembly process to remove the specific priority 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. The Fi scores shall be calculated on the basis of the repair and maintenance information, and of the description of the fasteners for each priority part given in the technical documentation. The “Tools (type)” (ST) score shall be calculated as follows:

~~(a) for smartphones or slate tablets, except foldable ones, the following formula~~

shall be used:

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

(b) for foldable smartphones or foldable slate tablets, the following formula shall be used:

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

Tools (type) (T) assessment at part level

The "Tools (type)" scores (T_i) for each priority part i (~~TBAT, TDA, TBC, TFFC, TRFC, TEC, TBUT, TMIC, TSPK and TFM~~) are assigned according to the complexity and availability of the tools needed for its replacement. Points ranging from 1 to 5 are assigned as follows:

- No tools = 5 pt;
- Basic tools = 4pt.
- A set of tools that is supplied (or offered to be supplied at no additional cost) with the spare part = 3 pt.
- A set of tools that is supplied (or offered to be supplied at no additional cost) with the product = 2 pt.
- Commercially available tools =1pt.

Tools Definitions:

basic tools - means a screwdriver for slotted heads, a screwdriver for cross recess screws, a screwdriver for hexalobular recess heads, a hexagon socket key, a combination wrench, combination pliers, combination pliers for wire stripping and terminal crimping, half round nose pliers, diagonal cutters, multigrip pliers, locking pliers, a prying lever, tweezers, magnifying glass, a spudger and a pick;

commercially available tool - means a tool that is available for purchase by the general public and is neither basic tools nor a proprietary tool;

The assessment of the type of tools is based on the disassembly process to remove the specific priority part, starting from the previous priority part in disassembly sequence already removed. Where different types of tools are needed for the disassembly of a priority part, the lowest score shall be considered. The T_i scores shall be calculated on the basis of the repair and maintenance information, and of the description of the tools for each priority part given in the technical documentation.

Spare parts score for smartphones and tablets shall be:

The "Spare Parts" (~~SSP~~) score shall be calculated at product level as follows:

- Spare parts for all priority parts are available to end users and professional repairers = 5 pt;
- Spare parts for display assembly, battery, back cover (or back cover assembly) and cameras are available to end users and professional repairers; spare parts for all other parts are available to professional repairers = 4 pt;
- Spare parts for display assembly, battery and back cover (or back cover assembly) are available to end users and professional repairers; spare parts for all other parts are available to professional repairers = 3 pt;
- Spare parts for display assembly and battery are available to end users and professional repairers; spare parts for all other parts are available to professional repairers = 2 pt;
- Spare parts for display assembly are available to end users and professional repairers; spare parts for all other parts are available to professional repairers = 1 pt;
- Spare parts for the hinge assembly, mechanical display folding mechanism are to be available only in case of foldable smartphones.

Spare parts score for Notebooks shall be:

- Battery and Display assembly to end users All other to professionals = 1pt
- Battery, Display assembly & Keyboard to end users; All other to professionals = 2pt
- Battery, Display assembly & Keyboard, Storage & Ram to end users; All other to professionals = 3pt
- Battery, Display assembly & Keyboard, Storage, Ram, Ports & Back cover to end users; All other to professionals = 4pt
- All parts = 5pt

Software updates (smartphones and tablets).

The 'Software Updates (duration)

The "Software Updates (duration)" (SSU) score shall be calculated at product level as follows:

— Minimum guaranteed availability of security updates, corrective updates and functionality updates to the operating system for at least 7 years = 5 pt.

— Minimum guaranteed availability of security updates, corrective updates and functionality updates to the operating system for 6 years = 3 pt.

— Minimum guaranteed availability of security updates, corrective updates and functionality updates to the operating system for 5 years = 1 pt.

The above durations refer to years from the date of end of placement on the market of the product model.

Spare parts (duration)

The "Spare parts (duration)" score shall be calculated through the different spare parts levels bundled as follows:

Level 1 (most critical components): Battery, Display assembly

Level 2: Keyboard, Storage, System memory (RAM)

Level 3 (least critical components): Ports, Back cover or its assembly, Systemboard/motherboard, Fans

- Level 1 and Level 2 = 10 yrs; Level 3 = 9 years 5pt
- Level 1 and Level 2 = 9 yrs; Level 3 = 8 years 4pt
- Level 1 and Level 2 = 8 years; Level 3 = 7 years 3pt
- All parts available for 7 years. 2pt
- Level 1, Keyboard, storage, ports/connect 7 years 1pt

The above durations refer to years from the date of end of placement on the market of the product model.

Repair Information

The Repair Information (SRI) score shall be calculated at product level as follows:

- Public availability of repair and maintenance information,
 - except electronic board diagrams, at no cost for end users and availability of repair and maintenance information,
 - including electronic board diagrams, at no cost for professional repairers= 5 pt.
- Availability of repair and maintenance information at no cost for professional repairers = 3 pt.
- Availability of repair and maintenance information with a reasonable and proportionate fee for professional repairers = 1 pt.
- A fee shall be considered reasonable if it does not discourage access by failing to take into account the extent to which the professional repairer uses the information.

Definition of repair and maintenance information according to COMMISSION REGULATION (EU) 2023/1670 of 16 June 2023:

The repair and maintenance information shall contain the level of detail needed to be able to replace all priority parts for smartphones, tablets and notebooks and shall at least include:

- the unequivocal product identification
- a disassembly map or exploded view;
- wiring and connection diagrams, as required for failure analysis;
- electronic board diagrams;
- a list of necessary repair and test equipment;
- technical manual of instructions for repair, including marking of the individual steps;
- diagnostic fault and error information (including manufacturer-specific codes, where applicable);
- component and diagnosis information (such as minimum and maximum theoretical values for measurements);
- instructions for software and firmware (including reset software);
- information on how to access data records of reported failure incidents stored on the device, where applicable, with the exception of personal identifiable information such as related to user behavior and location information;

The repairability index excel can be found at <https://tcocertified.com/industry/certification-documents/>

7 Reduction of hazardous substances

- Hazardous substances used in IT products ~~are a risk to~~ human health and the natural environment.
- Legislation is lagging and focuses on banning substances, but the substitutions can be just as hazardous; or even worse.
- TCO Certified drives transparency and knowledge-sharing, developing pathways to safer alternatives.

Hazardous substances – a risk to human health and the environment

No one knows how many chemicals are in use today. What we do know is that very few of these substances have been studied for their impact on humans and the environment.

Examples of potentially hazardous substances are plasticizers, flame retardants and stabilizers, often used in components, cables and other plastic parts. These substances risk leaking out in the natural environment, both in connection with manufacturing, and when products and their packaging are incinerated, placed in landfill or recycled in an improper way.

Keeping hazardous substances out of products is ~~also~~ important ~~also~~ from a circular perspective. Contaminated materials cannot be responsibly recycled and reused in new products; and risk therefore being incinerated or discarded, adding to the enormous e-waste problem.

Our approach: guiding the IT industry to safer alternatives

For a long time, TCO Certified has restricted the use of harmful substances with criteria that go beyond RoHS. However, simply banning substances isn't enough. A banned substance may be replaced with another that is equally harmful; or potentially even worse. Therefore, we need better information about substances before they are being used. With TCO Certified, a chemical is considered a high risk until it is proven to be otherwise. GreenScreen® for Safer Chemicals is used to identify a pathway to safer alternatives.

Criteria in chapter 7 focus on:

- Reducing or eliminating the use of hazardous substances in IT products and their packaging; beyond RoHS.
- Requiring that all flame retardants, plasticizers and stabilizers are assessed by an independent toxicologist and benchmarked as a safer alternative before being used in certified products. The same principle applies also to process chemicals, covered in chapter 2.

- Increasing transparency and making safer alternatives the mainstream choice by collecting all approved substances on the public and dynamic TCO Certified Accepted Substance List.

Draft 2

7.1 Heavy metals

Background

Electronic devices contain hazardous substances like heavy metals and brominated flame retardants. The effects of cadmium, mercury, lead and hexavalent chromium are well documented as substances hazardous both to human health and the environment. They may cause problems, both in the manufacturing phase where workers or the environment can be exposed, and at the material recovery, where uncontrolled recycling can cause the release of toxins such as dioxins and furans.

This criterion is harmonized with EU RoHS Directive (2011/65/EU), except that in TCO Certified, mercury is not allowed in lamps. As TCO Certified is a global certification, this also affects products sold outside the EU.

Applicability

All product categories.

References

7.1, 7.2.

7.1.1 Mandate

The product must not contain cadmium, mercury, lead and hexavalent chromium

Exemptions are according to EU Directive 2011/65/EU (RoHS) and the documents supporting the directive, except that mercury in lamps is not permitted.

The maximum concentration values tolerated by weight in homogeneous materials are 0.01% for cadmium, 0.1% for mercury, 0.1% for lead and 0.1% for hexavalent chromium according to EU RoHS Directive (2011/65/EU annex II) and the documents supporting the directive.

The limit value for batteries is 0.0005 % for mercury, 0.002 % for cadmium and 0.004 % lead per listed part, according to [EU Directive 2006/66/EC Regulation \(EU\) 2023/1542](#).

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3).

~~Submit~~ The following ~~together with the application is submitted~~ to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.

Draft 2

7.2 Halogens

Background

Halogenated substances are often persistent and can bio-accumulate in living organisms. They are problematic from both a human health and environmental perspective throughout the product life cycle and should be phased out. Workers may be exposed during manufacturing. Substances risk leaking out into the natural environment at end of life. PVC is by far the most common halogen-containing plastic.

Definitions

An electronic component is considered an individual part or combination of parts that, when together, perform a design function(s-) and are typically directly attached to a printed circuit board. Internal and external power supplies are not included in the definition.

Product housing protects internal components and safeguards the user against injury from these electrical components. Product safety standards define these safeguards as different types of protective enclosures. These enclosures are added to safeguard against electrical shock, high temperatures, fire and mechanical (moving parts such as the fan), and radiation (such as any internal laser), whilst also protecting internal parts.

Printed circuit board (PCB) or printed wiring board (PWB) laminate is a printed board that provides point-to-point connections.

Power board or power PCB regulates the power leading to the device, converting alternating current to direct current

Polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) are restricted in the EU RoHS Directive (2011/65/EU) due to the hazardous properties of these substances.

Hexabromocyclododecane (HBCDD) has been identified as a substance of very high concern in accordance with EU REACH criteria due to PBT (persistent, bio-accumulative, toxic) properties.

External cables delivered with the product: Cables that provide power to the product and to cables that connect the product to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc).

Applicability

All product categories.

References

7.2, 7.3.

7.2.1 Mandate

1. Product housing parts above 0.5 grams, printed circuit board (PCB) laminates and external cables delivered with the certified product must not contain intentionally added (additive or reactive) halogenated flame retardant, plasticizer or vinyl polymer stabilizer substances.

Exempted are all other parts, such as electronic components and PCB laminates sealed inside electronic components.

2. The product must not contain PBB, PBDE and HBCDD. No parts of the product are exempted.
3. The largest PCB by area in the power supply unit (internal/external) must be tested for bromine and chlorine; (see clarification below).

Maximum concentration values tolerated for a non-accepted substance (including decaBDE) is 0.1% by weight of the material in homogeneous materials.

Fluoroorganic additives, used to modify the dripping behavior of plastics in fire conditions or to improve the processing behavior, are exempted provided that they do not exceed 0.5% by weight of the material in homogeneous materials.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3).
- A copy of the test report(s) from any laboratory accredited according to ISO 17025

Submit ~~The following together with the application~~ is submitted to TCO

Development:

- A copy of the test report(s) from any laboratory accredited according to ISO 17025 and a copy of the verification report(s) from a verifier approved by TCO Development.

7.2.2 Clarification

1. Applies to product housing parts above 0.5 grams. This includes the product stand and the housing of the external power supply. The internal or external power supply socket or inlet is included in the definition of product housing.

PCB laminates completely sealed within an electronic component are exempted.

External cables delivered with the product are considered cables ~~that are~~ provided to supply power to the product and ~~to~~ connect the product to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc).

See mandate for non-halogenated substances for the requirements on safer substitution.

2. Applies to the whole ~~of the~~ product, including components, parts and raw materials in all assemblies and sub-assemblies, such as batteries, paint, surface treatment, plastics, electronic components and printed wiring boards.

3. Applies to the testing for bromine and chlorine where the following is required:

The largest PCB by area in the power supply unit must be tested for bromine and chlorine. The PCB must be tested in its final state with PCB laminates included but does not need to be tested with electrical components attached. Testing must be conducted through either IEC IEC 62321-3-1:2013, 62321-3-2:2020 or EN14582 by an ISO 17025 accredited laboratory. If the same PCB is used in multiple products, a test report may be used for multiple products if traceability between the tested sample and the product is verified.

- If indications of bromine or chlorine >0.1% are discovered, the applicant must proceed with additional testing ~~in order~~ to prove compliance with this criterion.
- If the concentration of a detected substance is <0.1%, then no additional testing is needed.

7.3 Non-halogenated substances

Background

Hazardous non-halogenated substances are problematic in the manufacturing and material recovery phases where workers and the environment can be exposed, leading to ~~both~~ human health and environmental risks. ~~The purpose of~~ This criterion ~~is~~ aims to increase the knowledge of which non-halogenated substances are used in certified products, how hazardous they are to human health and the environment, and to drive a shift toward less hazardous alternatives.

This mandate uses the [chemical](#) hazard assessment and decision logic framework GreenScreen® for Safer Chemicals, developed by the non-profit organization Clean Production Action (CPA), ~~and the ChemFORWARD hazard banding system based on the Cradle to Cradle Material Health Assessment Methodology.~~

~~GreenScreen criteria are in line~~ Both methods align with international standards and regulations that assess ~~the chemicals'~~ human health and environmental risks ~~of chemicals.~~

These include the Regulation on the classification, labelling and packaging of substances and mixtures (CLP), ~~the~~ Globally Harmonized System of Classification and Labelling of Chemicals (GHS), OECD testing protocols, European REACH Regulation that includes RoHs, POPs, SVHCs and the U.S. EPA's Design for Environment (DfE) Alternatives Assessment.

Definitions

~~Licensed~~ GreenScreen Profilers: ~~and ChemFORWARD qualified assessors: Independent~~ toxicology firms licensed/~~qualified~~ by CPA/~~ChemFORWARD~~ to provide ~~GreenScreen~~ assessment services for a fee to clients.

TCO Certified Accepted Substance List: Public list of independently assessed safer available alternatives considering toxicity and functionality. ~~Go to:~~

~~Clean Production Action (CPA). Developers of GreenScreen® for Safer Chemicals:~~

~~An~~ electronic component is considered an individual part or combination of parts that, when together, perform a design function(s) and are typically directly attached to a printed circuit board. Internal and external power supplies are not included in the definition.

Product housing protects internal components and safeguards the user against injury from these electrical components. Product safety standards define these safeguards as different types of protective enclosures. These enclosures are added to safeguard against electrical shock, high temperatures, fire and mechanical (moving parts such as the fan), and radiation (such as any internal laser), whilst also protecting internal parts.

External cables delivered with the product: Cables that provide power to the product and ~~to~~ cables that connect the product to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc).

Applicability

All product categories.

References

7.4, 7.5, 7.6.

Draft 2

7.3.1 Mandate

Product housing parts above 0.5 grams, printed circuit board (PCB) laminates and external cables delivered with the certified product must only contain intentionally added (additive or reactive) non-halogenated flame retardants and vinyl polymer stabilizers that appear on TCO Certified Accepted Substance List.

All substances of a flame retardant and stabilizer mixture must be accounted for. Non-accepted substances must not exceed concentration levels of 0.1% by weight of the flame retardant and stabilizer.

Exempted are all other parts, such as electronic components and PCB laminates sealed inside electronic components.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3).

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A document copy or access to a database copy of the certified assessment report conducted and issued by a licensed GreenScreen Profiler.

7.3.2 Clarification

Applies to product housing parts above 0.5 grams. This includes the product stand and the housing of the external power supply. The internal or external power supply socket or inlet is included in the definition of product housing.

Only PCB laminates completely sealed within an electronic component are exempted.

External cables delivered with the product are considered cables ~~that are~~ provided to supply power to the product, and to connect the product to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc).

TCO Certified Accepted Substance List

Non-halogenated flame retardants can be used in certified products once they receive an accepted [GreenScreen benchmark](#) ~~or ChemFORWARD hazard band~~, and appear on the public TCO Certified Accepted Substance List. GreenScreen ~~benchmark score of benchmarks~~ 2, 3 or 4 assigned by a licensed GreenScreen profiler ~~or hazard bands A, B or C assigned by a qualified ChemFORWARD assessor~~ are accepted to appear on ~~the public~~ TCO Certified Accepted Substance List. ~~{A~~ [GreenScreen](#) benchmark U may only be accepted when the

“worst case scenario” for data gaps is considered ~~to be~~ a benchmark 2 or above. The list is dynamic, which allows new substances that have undergone a valid assessment to be added at any time. Accepted substances may be reassessed in light of new scientific findings.

~~If an accepted substance is reassessed and given a benchmark score lower than 2, TCO Development reserves the right to remove the substance from TCO Certified Accepted Substance List. Before a substance is removed from the list a sunset date (at least one year) is set and shown on the list. This is to give chemical and product manufacturers time to submit additional information to improve the benchmark score or to transfer to an alternative on the list. Product models that use a removed chemical but were certified before the sunset date are permitted to keep their TCO Certified certificate. Models certified after the sunset date may only contain flame retardants or plasticisers that are listed on TCO Certified Accepted Substance List.~~

~~Any spot checks by TCO Development will require manufacturers to disclose substance details being used in randomly chosen products. To verify that the obligations according to this mandate are fulfilled CASNR disclosure and laboratory assessments of selected parts will be conducted to assess the completeness, quality and validity of a benchmark score.~~

~~TCO Development and Clean Production Action (CPA) must have access to a copy of the GreenScreen and ChemFORWARD assessment report reports before the substance can be added to TCO Certified Accepted Substance List, available at.~~

Conformity procedure

- If all substances relevant to this mandate are confirmed by suppliers to be on TCO Certified Accepted Substance List, complete the product form 11.3 and submit it to an approved verifier. When the verifier considers all documentation ~~to be~~ compliant, they will issue an environmental verification to the applicant.
- If any substance relevant to this mandate does not yet appear on TCO Certified Accepted Substance List, then it must be added before approval can be given by a verifier. An extended time period to comply can be applied ~~for~~ here (see “Applying for an extended period...” below).
- Adding a TCO Development will require manufacturers to disclose substance to the details used in randomly chosen products. To verify that the obligations according to this mandate are fulfilled CASNR disclosure and laboratory assessments of selected parts will be conducted to assess the completeness, quality and validity of a benchmark score.

Get a substance assessed and added to TCO Certified Accepted Substance List:

- First, determine if the substance is restricted or already has a valid assessment available.
 - a. Contact TCO Development directly to see if we have any additional information on the substance. Reasons for the substance's absence can be that the substance has received benchmark 1, that no the substance is restricted.
- 4. Visit TCO Certified Potential Candidate List to see if a previous assessment has been conducted or that it has a benchmark score U (unspecified), due to a high number of data gaps.
 - b. If TCO Development requires completed and the substance to be benchmarked, we recommend that you profiler/assessor that completed it.
 - c. Visit the GreenScreen Assessment Registry or contact your suppliers and inform them that the ChemFORWARD to see if a valid assessment is available.
- If the substance will need needs an assessment by and depending on the chemical hazard assessment method chosen, a licensed GreenScreen profiler. The list of licensed profilers can be is found on the Clean Production Action website at, and a qualified ChemFORWARD assessor is found on the ChemFORWARD website.
- A draft report per substance (not per product) is Next, an extensive chemical hazard assessment will be assembled by the licensed profiler/assessor from the available information (literature search, structural similarity comparison, expert judgment-), covering human and environmental toxicology endpoints in accordance with GreenScreen or ChemFORWARD requirements
- It is the licensed The profiler that/assessor sets the benchmark score/hazard band per relevant substance, which is. The assessment report is then valid for at least up to five years.
- Benchmark Complete assessment reports must be submitted to TCO Development for final approval before a substance is added to TCO Certified Accepted Substance List. A copy must also be made available to CPA.
- When the final approval is complete, TCO Development will add the substance is added to the TCO Certified Accepted Substance List, showing it shows only the substance's name, CASRN, type, of additive, benchmark score/hazard band, date of the assessment and profiler/assessor company name.
- Once a substance is added to the list and the environmental verifier identifies them, then it, they will issue the environmental verification to the applicant (see above point 1: "If all flame retardants and plasticizers only include substances on.

A substance being removed from TCO Certified Accepted Substance List:

- When the validity of a GreenScreen/ChemFORWARD assessment (5 years) has expired and not been updated, TCO Development will consider that the substance is no longer being used on certified products. In this case, the procedure is as follows)-substance will be moved to TCO Certified Potential Candidate List.
- If a substance benchmark/hazard band has been degraded during the 5 year validity to a non-accepted benchmark/hazard band, it must be removed. The substance can continue to be used for up to 18 months from the degraded date. The removal date will be visible on TCO Certified Accepted Substance List.

Applying for an extended period-of time to substitute or add a substance to TCO Certified Accepted Substance List

Applicants signing the mandate ~~have the option to~~can seek an extended period-of time in order to complete assessments or substitute restricted substances. Upon request for an extension, the applicant ~~is required to~~must complete a risk assessment questionnaire and submit it to TCO Development. The risk assessment requires the applicant to clarify why an extension is necessary, provide information on the chemical and its substitute-in question, and include a timeline for completing the assessment and/or substitution-to be completed. If an extension application is not granted, the applicant ~~is required to~~must ensure that all used flame ~~retardants, plasticizers~~retardant, plasticizer or ~~stabilizers~~stabilizer formulations only include substances ~~that are~~ on TCO Certified Accepted Substance List before an environmental verification can be issued for the product model ~~by an environmental verifier.~~ If ~~the agreed an~~ extension due date is exceeded without conformity, ~~then the environmental~~ verifier must contact TCO Development and a course of action will be decided after discussing the issue with the applicant.

7.4 Plasticizers

Background

Plasticizers are increasingly associated with negative environmental and human health impacts. RoHs is a restricted substances list that, beginning in 2019, restricts the use of four phthalates. TCO Development is committed to ~~take~~[taking](#) a much broader approach by identifying and restricting not only these four, but all substances of high concern used in IT products. Our criteria are, therefore, designed to make sure that replacement substances are independently assessed as safer alternatives, and that transparency increases. The full list of safer alternatives is available on tcocertified.com.

This mandate uses the [chemical](#) hazard assessment and decision logic framework ~~called~~ GreenScreen® for Safer Chemicals, developed by the non-profit organization Clean Production Action (CPA), ~~and the ChemFORWARD hazard banding system based on the Cradle to Cradle~~ [Material Health Assessment Methodology](#).

GreenScreen criteria ~~are in line~~[align](#) with international standards and regulations that assess chemicals on their human health and environmental hazards. These include the Regulation on the classification, labelling and packaging of substances and mixtures (CLP), ~~the~~ Globally Harmonized System of Classification and Labelling of Chemicals (GHS), OECD testing protocols, European REACH Regulation that includes RoHs, POPs, SVHCs and the U.S. EPA's Design for Environment (DfE) Alternatives Assessment.

Definitions

Plasticizer: An additive to a polymer (plastic), to increase its flexibility, transparency, durability, or longevity.

Phthalates: The most common type of plasticizer in PVC cables.

~~Licensed profilers:~~ [GreenScreen Profilers and ChemFORWARD qualified assessors:](#) [Independent](#) toxicology firms licensed/[qualified](#) by CPA/[ChemFORWARD](#) to provide ~~GreenScreen~~ assessment services for a fee to clients.

TCO Certified Accepted Substance List: Public list of independently assessed safer available alternatives considering toxicity and functionality. ~~Available at:~~

~~Clean Production Action (CPA). Developers of GreenScreen® for Safer Chemicals;~~

Product housing is ~~considered~~ the external enclosure or casing that protects the [product's](#) internal parts ~~of the product~~. This includes the product stand.

[An](#) electronic component is considered an individual part or combination of parts that, when together, perform a design function(s) and are typically directly attached to a printed circuit board. Internal and external power supplies are not included in the definition.

External cables delivered with the product: Cables that provide power to the product and ~~to~~ connect the product to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc).

Applicability

All product categories.

References

7.4, 7.5, 7.6.

7.4.1 Mandate

- Product housing above 0.5 grams and cable and wire insulations must only contain intentionally added plasticizers that appear on TCO Certified Accepted Substance List. Exempted are connectors and wires sealed inside electronic components.
- The product must not contain Bis (2-ethylhexyl) phthalate (DEHP), Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP), and Diisobutyl phthalate (DIBP).
No parts of the product are exempted.

All substances of a plasticizer mixture must be accounted for. Non-accepted ingredients must not exceed concentration levels of 0.1% by weight of the plasticizer.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3).

~~Submit~~ The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A document copy or access to a database copy of the complete assessment report conducted and issued by an approved GreenScreen licensed profiler.

7.4.2 Clarification

The mandate applies to ~~the~~ product housing above 0.5 grams. There is no weight threshold for cable and wire insulations. This includes internal and external power supply housing and external cables. Only wires ~~that are enclosed inside~~ completely sealed within an electronic ~~components~~ component such as a HDD, SSD and ODD are exempted.

Examples of cables and wires ~~that are included~~include: Internal product cables that interconnect between components and are detachable at both ends, such as power, and data/signal cables. Cables permanently attached to electronic components, such as fans and speakers. External cables delivered with the product are considered cables ~~that are~~ provided to supply power to the product and ~~to~~ connect the product to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc).

TCO Development ~~and Clean Production Action (CPA)~~ must have access to a copy of the GreenScreen and ChemFORWARD assessment ~~report~~reports before the substance can be added to TCO Certified Accepted Substance List, ~~available at~~.

For more clarifications on adding substances to TCO Certified Accepted Substance List; ~~conformity procedure, rules for adding a substance and applying for an extended period of time for substances not on the list, refer to clarifications under the mandate~~accepted hazard assessment frameworks, see non-halogenated substances 7.3 clarifications.

Draft

7.5 Hazardous substances in product packaging

Background

The use of hazardous substances in packaging materials is problematic and should be minimized. It poses a risk to human health and the environment, not least because packaging materials have a short lifespan and generate large volumes of waste. Several hazardous substances are regulated in many countries, and the use of them should be phased out.

Applicability

All product categories.

References

7.7.

7.5.1 Mandate

The packaging material must not contain lead (Pb), cadmium (Cd), mercury (Hg) or hexavalent chromium (Cr6). Plastic packaging material must not contain organically bound halogens.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3).

Submit The following ~~together with the application~~ is submitted to TCO

Development:

- A copy of a verification report from a verifier approved by TCO Development.
-

7.5.2 Clarification

Limit values are according to Directive 94/62/EC on packaging and packaging waste.

8 Material Recovery

- More than 50 million metric tons of e-waste is generated every year and only a small amount is handled in a safe way.
- This leads to pollution, human health hazards and the loss of valuable finite resources.
- For a more sustainable life cycle, products and materials must be recovered and reused to a much larger extent.

Material waste – a multi-faceted sustainability issue

Today's unsustainable handling of e-waste leads to pollution, health hazards and the loss of valuable natural resources, such as copper, gold and rare earth metals. According to the United Nations University, electronic waste is the fastest growing waste stream in the world, with more than 50 million metric tons generated every year. It is estimated that only 20 percent of the waste is handled in a proper way. The rest is unaccounted for and risk being incinerated, placed on scrap heaps, or illegally exported to developing countries, often to destinations lacking effective legislation that regulates how e-waste should be managed. In these countries, products are manually disassembled, burned in the open air or dissolved in acid by local laborers including children, without adequate protective equipment – leading to severe health problems.

The packaging is also a sustainability issue. Packaging material has a short lifetime and generates large volumes of waste. Using several types of materials that are difficult to separate makes recycling a challenge.

Our approach: prevent e-waste and recover materials safely

The most important way of reducing e-waste is to use products longer. Read more about this in chapter 6. Once products have reached the end of their usable life, they must be collected for remanufacturing, refurbishing or recycling. Product packaging must be designed in a way that enables reuse and recycling.

Criteria in chapter 8 focus on:

- Saving natural resources and limiting hazardous waste by requiring that all packaging materials must be easily separable if not reusable.
- [Gathering information on which to increase the use of post-consumer recycled plastics in product packaging when it is not possible to substitute them with other non-plastic materials.](#)
- [Ensuring that brand owners actively participate in e-waste reduction through offering product take-back schemes in all sales countries and utilizing a significant portion of](#)

certified reuse and recycling facilities ~~are used today, to prepare for future criteria on material recovery.~~

Draft 2

8.1 Product packaging

Background

Packaging is a well-known environmental problem that is regulated in many countries worldwide. Packaging material has a short lifetime and generates large volumes of waste.

~~About~~ More than 50% of global waste ends up in landfills or open dumps.

- To reduce the waste generated by packaging materials, it shall be possible to separate them into single material types without the use of tools so that material can be recycled instead of becoming waste.
- ~~Plastics that degrades~~ Even for packaging materials that may be separated into single materials, little of the plastic is properly recycled. Plastics that degrade into microplastics should be prevented from entering landfills or waterways, as the incomplete degradation process leads to the accumulation of highly mobile microplastics in the environment. ~~For the packaging material that ends up as waste, the materials shall be biodegradable in nature so that they degrade with minimal harm to the environment.~~

Defintions

~~**Biodegradable materials:** Materials that are capable of undergoing physical, chemical, thermal or biological decomposition so that the materials are fully assimilated, leaving no residues in the natural environment within 1 year.~~

Definitions

Applicability

All product categories.

8.1.1 Mandate

- All parts of the packaging of the certified product weighing more than 25 grams must be possible to separate into single material types without the use of tools.
- ~~Products with a total weight, including the power supply and cables (without~~ For product packaging) ≤ 10 kg
- ~~Packaging material must consist solutions that are comprised of minimum 80% biodegradable materials~~ $\geq 20\%$ plastic, by weight of the worst case all packaging solution materials, the following must be fulfilled:
- ~~Products with a total weight, including the power supply and cables (without~~ $\geq 50\%$ of the total plastic packaging) > 10 kg

- ~~Packaging material must consist of minimum 50% biodegradable materials by weight~~be composed of the worst case packaging solution~~post-consumer recycled plastics, by weight.~~
- ~~or~~
- ~~Packaging material must consist of a minimum 90% postconsumer recycled content~~

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3)
- Completed post-consumer recycled content template - packaging section.

The following information must be ~~is~~ submitted with the application to TCO Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.

The following is submitted to TCO Development and may be published:

- Total weight of all packaging materials
- Total weight of all plastic content in the packaging solution
- Total weight of post-consumer recycled plastic materials
- Percentage of post-consumer recycled plastics

8.1.2 Clarification

~~Biodegradable refers to the ability of materials to break down and return to nature. In order~~
~~Packaging solutions that contain more than one individual product are not covered by the~~
~~mandate, such as bulk packaging solutions.~~

~~Document proof from the material vendor must be provided for packaging products or~~
~~materials to qualify as biodegradable, they must completely break down and decompose into~~
~~natural elements within a short time after disposal — typically a year or less.~~each part
~~containing post-consumer recycled plastics if it is to be included in the PCR percentage.~~
~~If no proof exists, then 0% must be reported.~~

The following information must be submitted to an approved verifier

For each packaging part ~~with a weight ≥ 25 grams~~weighing more than 0.5g, the following must be reported in the ~~PCR~~“postconsumer recycled content & packaging template”,
packaging tab:

- NameMaterial Type

- Weight of part or Part ID
- Weight of plastics in part
- Weight of PCR plastic content
- PCR material manufacturer name
- ~~Weight of part (grams)~~
- ~~Weight of biodegradable content~~
- Weight of PCR material identifier

- ~~The post-consumer recycled plastics~~

A PCR/content & packaging template is available at tcocertified.com/certification-documents

Draft 2

8.2 E-waste management—Revised

Background

Enormous amounts of e-waste is generated every year. It is one of the world's fastest growing waste streams, and much of it is exported to developing countries, burdening local communities with this global problem. Unsafe handling of e-waste causes pollution, human health hazards and the loss of valuable, finite resources. The Basel Convention governs the export of many types of electronic waste, however, it is not properly implemented in all countries. To help reduce the e-waste problem, manufacturers need to provide mechanisms to take back their products. This is consistent with the principle of individual producer responsibility, where each manufacturer is financially responsible for managing its own branded products at end-of-use. The purpose of this criterion is to influence the expansion of better electronic waste management practices to more countries.

Applicability

All product categories.

8.2.1 Mandate

~~By the end of August each year, the~~ The brand owner must ~~report annually complete the e-waste management template~~ and ~~fulfill the following for the previous calendar year globally for each~~ prove that:

In all countries where the certified product. ~~(This applies until one year after the certificate expires):~~

Part 1—Report

- ~~1.—The number of certified products that were manufactured~~
- ~~2.—All countries the certified products were is sold in~~
 - ~~a.—A selected subset that accounts for at least 50% of sold certified products.~~
- ~~The name of, the~~ brand owner offers product take-back system or extended producer responsibility schemes (EPRs) used for each country.
- ~~The name and address~~ At least 40% of the ~~all first-tier~~ reuse_ and recycling facilities processing the collected products together with the standards met ~~used~~ by the facilities (i.e. non-EPR take-back systems are certified according to R2, e-Stewards, WEEELABEX, EN50625, or equivalent).

And

Part 2—Fulfill

1. ~~All used take back systems in countries accounting for a minimum of 50% of total sales volume must be certified according to R2v3, e-stewards or WEEELABEX.~~
 - a. ~~Provide a list of at least one take back system per country,~~
 - b. ~~Provide a valid R2v3 or e-stewards certification per take back system.~~
 - c. ~~Provide a valid contract between the Brand owner certifying and the take back system provider.~~

Submit the following to an approved verifier:

- A completed and signed brand owner product form (chapter 11.4).
- Submit a filled-out TCO Certified E-waste management template covering the previous calendar year.

The following together with the application is submitted to TCO Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
- The e-waste management template must be uploaded annually in TCO Certified Portal

8.2.2 Clarification

Instead of Reporting period

The reporting manufacturing volumes must be submitted by 31 August each year. Each reporting period is the previous calendar year. The reporting applies until one year after the certificate has expired.

Reporting and verification guideline

The brand owner must complete the E-waste template. In this template the brand owner will provide the following information:

1. The number of certified products that were manufactured.
2. The take-back volume of products (in numbers) by the brand owner for each certified product, reporting may be done by combining product category. (take-back carried out by EPRs systems, which is mandatory/approved by local law/government are excluded)
 - a. The number of products processed for Reuse
 - b. The number of products processed for Recycling
3. The name and weblink to all used take-back systems (EPR and non-EPR).
- 4.4. All countries in which the certified products within each product category were sold together with one take-back system covering the country.

2.5. Reuse The name and address of all first-tier reuse- and recycling facilities that are used by government approved EPRs are excluded from point 4 in the mandate- non-EPR take-back systems to process the products.

a. The certificates held by the first-tier reuse- and recycling facilities used to process the products. (i.e. R2, e-Stewards, WEEELABEX, EN50625, or equivalent.)

The e-waste management template can be found at <https://tcocertified.com/certification-documents/>

Clarification The number of sustainability performance indicator(s)

One or more “sustainability performance indicators” (chapter 1.3) are collected for this criterion. There is no mandatory level for these indicators but they must be verified and reported according to the description below.

Ratio of compensated versus certified products that were manufactured products (Class A-G)

For can be reported per product category applicability, see the corresponding TCO Certified Edge, E waste compensation criteria document.

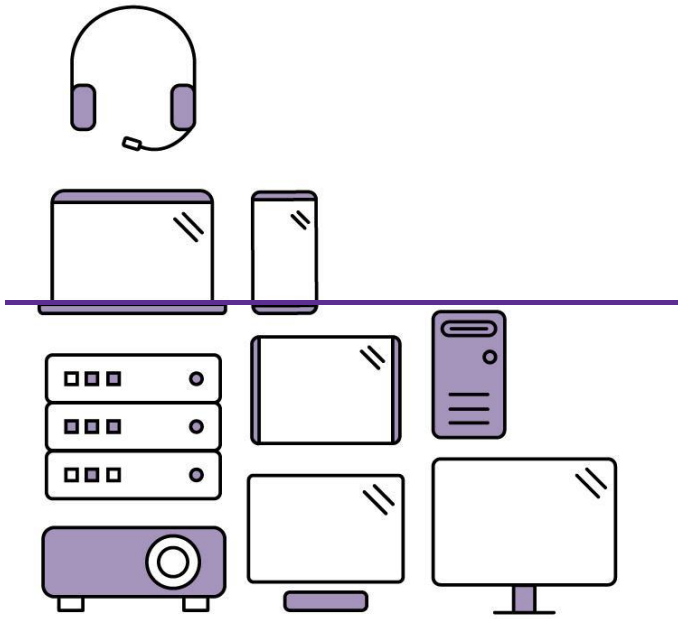
For this SPI, products have the possibility to be compliant with the model of TCO Certified Edge—E waste compensation without achieving the full 100% compensation threshold. The compensation must still follow the rules in TCO Certified Edge—E waste compensation:

- **Class A:** Fully compliant with TCO Certified Edge, E waste compensated. (100%)
- **Class B:** 75% or above
- **Class C:** 50% or above
- **Class D:** 25% or above
- **Class E:** 10% or above
- **Class F:** 1-10%
- **Class G:** 0% or no information provided.

Verification: The brand owner must provide a verification of conformity report from an approved verification organization which follows the TCO Certified Edge, E waste compensated rules.



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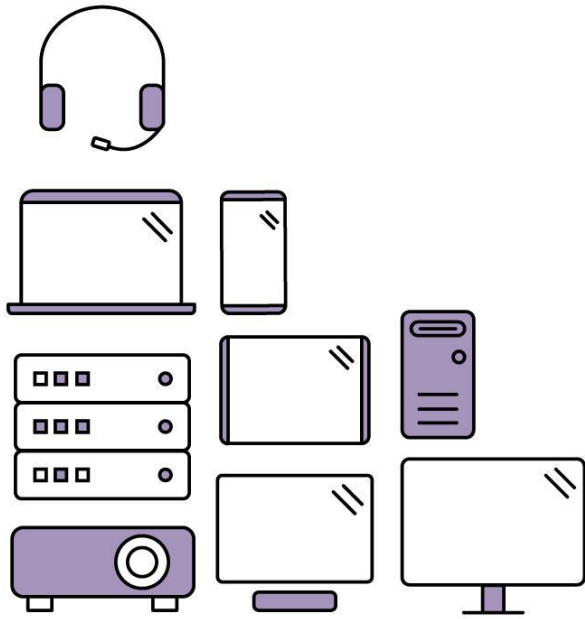
be handled by an EPR or by the Brand owner.

For Part 2 - Point 1 - The take-back can

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