

Draft 2

TCO Certified, Generation 11 for all-in-one PCs



TCO Certified –driving sustainable development in IT products

Sustainability in the IT sector is not about solving several separate issues; it's about tackling a myriad of small and large interconnected challenges and creating a system that works to drive steady and continuous environmental and social improvement.

More than 30 years of consistent effort and support from key stakeholders have resulted in a strong track record of success in reducing the climate impact of electronics and factories being more responsible. Using our framework enables a more structured and systematic approach to achieving a sustainable, circular business model. Going forward, our goals are ambitious, and we have a long-term roadmap that provides transparency for implementing sustainable IT.

About TCO Certified

TCO Certified is the global sustainability certification that drives progress in four key areas: climate, substances, circularity, and supply chain. The criteria are science-based and developed through an open, international process that involves various stakeholders. To address sustainability challenges and technological developments, a new generation of the certification is released every three years.

Accredited independent verification organizations ensure compliance with all criteria, both before and after certification, for the full validity period of the certificate. Certificates are valid worldwide and require no local adaptation.

TCO Certified is a third-party certification, independent of both industry and buyers. It complies with ISO 14024 Type I ecolabel requirements and has been approved through the GENICES peer-review process of the Global Ecolabelling Network.

How to apply for certification

TCO Development is the organization behind TCO Certified. It typically takes three to five weeks to receive the certificate from us, once compliance with all criteria is independently verified. You can find guidance to apply for the certification at industry.tcocertified.com/guidance/step-by-step-guide/

Need help?

Our certification team is always here to help. Feel free to email us at certification@tcodevelopment.com.

Our approved, independent verifiers around the world are also available and can explain the criteria and certification process in your local language. Contact details are available at industry.tcocertified.com/guidance/approved-verifiers.

About this document

This is TCO Certified, generation 11, for all-in-one PCs, released in 2027. An all-in-one PC is defined as a stationary computer and display in a single unit. The definition includes stationary thin clients. The criteria cover the product, its stand, external power supply and external cables as it is delivered to the end user. Any other peripherals that are shipped with the product are not covered by TCO Certified. For displays that are not light emitting or have less than 8-bit RGB color (i.e reflective, E-ink, etc), some visual ergonomics criteria are not applicable.

The criteria include:

Mandate: A description of the requirements that need to be fulfilled, and how conformity is verified.

Definitions: Explanations of important terms relevant to the criterion.

References: References to sources.

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 to maintain the criteria levels until the next generation is launched, which typically happens after three years. Several editions of the criteria document may be released during a generation. These editions are considered updates within the same generation and may include improved precision in mandates, test methods and clarifications.

To ensure predictability for certificate holders and applicants, criteria levels are not raised within a generation. This means that products certified according to an earlier edition of the same generation are not required to meet stricter criteria levels introduced after certification.

Table of contents

1 Product and sustainability information	8
1.1 Information to end users	9
1.1.1 Mandate	9
1.1.2 Clarifications	10
1.2 Product specification	12
1.2.1 Mandate	12
1.2.2 Clarifications	13
1.3 Digital Product Passport	14
1.3.1 Mandate	14
1.3.2 Clarifications	15
2 Climate	20
2.1 Renewable energy	21
2.1.1 Mandate	22
2.1.2 Clarifications	23
2.2 Annualized PCF	29
2.2.1 Mandate	30
2.2.2 Clarifications	30
2.3 Energy efficiency	33
2.3.1 Mandate	33
2.3.2 Clarifications	34
2.4 Energy management system	37
2.4.1 Mandate	37
2.4.2 Clarifications	38
2.5 Carbon offsets	40
2.5.1 Mandate	40
2.5.2 Clarifications	42
3 Substances	45
3.1 Process chemicals management	46
3.1.1 Mandate	46
3.1.2 Clarifications	47
3.2 Restricted product substances	50
3.2.1 Mandate	51
3.2.2 Clarification	51
3.3 Accepted product substances	54
3.3.1 Mandate	54
3.3.2 Clarification	55
4 Circularity	57
4.1 Product warranty	58
4.1.1 Mandate	58
4.1.2 Clarification	59

4.2 Security and functionality software updates	61
4.2.1 Mandate	61
4.2.2 Clarifications	62
4.3 Post-consumer recycled content	64
4.3.1 Mandate	64
4.3.2 Clarifications	65
4.4 Product packaging	67
4.4.1 Mandate	67
4.4.2 Clarification	68
4.5 E-waste management	69
4.5.1 Mandate	69
4.5.2 Clarification	70
4.6 Electrical safety	73
4.6.1 Mandate	73
4.6.2 Clarification	73
4.7 Replaceable components	74
4.7.1 Mandate	74
4.7.2 Clarifications	75
4.8 Standardized connectors	77
4.8.1 Mandate	77
4.8.2 Clarifications	78
4.9 Secure data removal	79
4.9.1 Mandate	79
4.9.2 Clarification	80
4.10 Standardized external power supply compatibility	81
4.10.1 Mandate	81
4.10.2 Clarification	82
4.11 Color gamut	83
4.11.1 Mandate	83
4.11.2 Clarification	83
4.12 Color uniformity	86
4.12.1 Mandate	86
4.12.2 Clarification	86
4.13 Color grayscale linearity	89
4.13.1 Mandate	89
4.13.2 Clarification	90
4.14 Correlated color temperature	92
4.14.1 Mandate	92
4.14.2 Clarification	93
4.15 Color uniformity – angular dependence	95
4.15.1 Mandate	95
4.15.2 Clarification	95

4.16 Display resolution	99
4.16.1 Mandate	99
4.16.2 Clarification	99
4.17 Luminance contrast – characters	101
4.17.1 Mandate	101
4.17.2 Clarification	101
4.18 Luminance uniformity – angular-dependence	105
4.18.1 Mandate	105
4.18.2 Clarification	105
4.19 Grayscale gamma curve	110
4.19.1 Mandate	110
4.19.2 Clarification	111
4.20 Luminance uniformity	113
4.20.1 Mandate	113
4.20.2 Clarification	113
4.21 Luminance contrast – angular dependence	116
4.21.1 Mandate	116
4.21.2 Clarification	116
4.22 Luminance level	118
4.22.1 Mandate	118
4.22.2 Clarification	118
4.23 Black level	121
4.23.1 Mandate	121
4.23.2 Clarification	121
5 Supply chain	123
5.1 Supply chain responsibility	124
5.1.1 Mandate	125
5.1.2 Clarification	126
5.2 Supply chain transparency	135
5.2.1 Mandate	135
5.2.2 Clarification	136
5.3 Anti-bribery management system	138
5.3.1 Mandate	138
5.3.2 Clarification	139
5.4 Responsible mineral sourcing	140
5.4.1 Mandate	140
5.4.2 Clarifications	141
5.5 Environmental management system	145
5.5.1 Mandate	145
5.5.2 Clarification	145
5.6 Water management	147
5.6.1 Mandate	147

Draft

1 Product and sustainability information

Purpose and focus

The product and sustainability information area criteria are intended to make certified products easier to identify, compare and use in procurement systems, sustainability reporting and lifecycle information systems. The criteria focus on reliable product identification, independently verified sustainability information, and stable access to product data connected to certified products.

How the information system works

The product and sustainability information area is built around a verified information chain. Criteria on information to end users are intended to make certification visible and help purchasers and users understand what TCO Certified means for a certified product. Criteria on product specification are intended to connect certificates to clearly identified product models and configurations, so that certified products can be found and used more reliably in procurement systems, marketplaces and reporting. Criteria on digital product passports are intended to provide stable access to defined product and lifecycle information that can support servicing, longer product use, material recovery and transparency.

What this enables

Transparency is the core mechanism in this area. By collecting independently verified information and making relevant data accessible where the criteria require or allow it, the area supports more credible product claims and reduces the risk of misleading or unsupported sustainability information.

Together, these criteria help make sustainability information more reliable, usable and credible. Purchasers get clearer information for product selection, procurement follow-up and reporting, brands are encouraged to provide structured and verifiable product data, and independent verifiers get defined evidence points for checking that certified products are correctly identified and that required product information is available and consistent.

1.1 Information to end users

Purpose

Purchasers and end users need to identify certified products and understand what certification means for a specific product. Clear product marking and accessible information make verified sustainability claims easier to find, compare and distinguish from unsupported claims.

This criterion makes certification visible on the product, packaging and brand owner website. It also provides a common location for public statements required in TCO Certified, supporting transparency and easier verification of certified product claims.

Applicability

All product categories.

1.1.1 Mandate

- A. The product must be labeled with the TCO Certified logo.
- B. The retail packaging must be labeled with the TCO Certified logo.
- C. "TCO Certified" must be mentioned on the brand owner's website(s) where the specific certified product is marketed and or sold.
- D. The brand owner website must have a, "Certified Product Commitment Page" containing:
 1. Information about TCO Certified
 - Descriptive text,
 - TCO Certified logo,
 - Link to the TCO Certified website.
 2. Public statements as required in the following criteria:
 - Carbon offsets.
 - Product warranty.
 - Replaceable components
 - Security and functionality software updates.

Submit the following to an approved verifier:

Necessary documentation describing and proving how:

- Documentation showing how the product will be labeled with the TCO Certified logo.
- Documentation showing how the retail packaging will be labeled with the TCO Certified logo.
- Description of where and how TCO Certified is mentioned on the brand owner's website.
- A link to the page on the brand owner website dedicated to TCO Certified.

The following is submitted to TCO Development:

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

1.1.2 Clarifications

Logo colors and quality



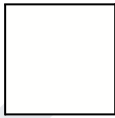
The TCO Certified logo must be reproduced using the designs, as shown by the originals published and available for download on:

<https://industry.tcocertified.com/documents/logos-and-images/>

Accepted Colors and Contrast ratios of the logo

The TCO Certified logo shall either use the colors defined in the table below or be monochrome in grayscale. The logo shall be clearly legible and distinguishable from the product surface. The contrast ratio between the logo and its background shall be at least 3:1, measured according to an established contrast calculation method.

Color definitions

Color	Sample	HEX	RGB	CMYK
Blue		#002169	R: 0 G: 33 B: 105	C: 100% M: 93% Y: 27% K: 24%
Green		#007934	R: 0 G: 121 B: 52	C: 96% M: 27% Y: 100% K: 15%
White		#FFFFFFE	R: 255 G: 255 B: 255	C: 0% M: 0% Y: 0% K: 0%

Products certified according to TCO Certified Edge

The TCO Certified Edge logo may be used as an alternative to the TCO Certified logo if the product has a valid TCO Certified Edge certificate.

Rack mounted products

Products designed to be installed in a rack (a supporting framework to hold hardware modules, such as servers, data storage products and network equipment) are excluded from A and B.

A. Labeling of the product

The product must be labeled with the TCO Certified logo in one of the following alternatives:

Alternative 1: Physical labeling, logo on product:

The TCO Certified logo must be placed on the product with a permanent label. The minimum acceptable size of the logo is 16x10mm, and the minimum acceptable distance to other graphical elements is 2.5 mm. If there are technical factors that prevent the minimum logo

size to be used, it is acceptable to use a smaller logo size as long as the logo remains clearly readable.

The logo must be placed on the outer casing of the product so that it is visible to the end user when the product is in its intended operational state. If the product is designed to be portable, it is acceptable to place the logo on the bottom side of the outer casing.

Logo for Headsets and the General product category.

If a headset or a product included in the general product category has no viable surface to place the logo, the product does not need to be labeled with the TCO Certified logo.

Alternative 2: Electronic labeling during the startup of the product:

During the system start-up sequence the TCO Certified logo must be displayed on the screen for a minimum of 0,5 seconds and cover at least 1% of the screen and not be smaller than 16x10mm.

Electronic labeling for smartphones

In addition to the alternatives above, smartphones are also accepted to have the text "TCO Certified" in the about section in the smartphones Operative system.

B.Labeling of the product packaging

Minimum size of logo on product packaging

The retail packaging of the product must be labeled with the TCO Certified logo. The minimum acceptable size of the logo is 16x10mm, and the minimum acceptable distance to other graphical elements is 2.5 mm.

Bulk packaging

Labeling of the product packaging is not required on bulk packaging. Packaging solutions that contain more than one individual product are considered bulk packaging solutions.

D. Information page about TCO Certified on the brand owner's website.

The brand owner website must have a dedicated TCO Certified page with Information about TCO Certified that includes a descriptive text, an image of the TCO Certified logo and a link to the TCO Certified website.

A boilerplate descriptive text about TCO Certified for use on the website can be provided by TCO Development upon request.

The page also needs to contain all public statements as required in TCO Certified, including but not limited to:

- *Carbon offset.*
- *Product warranty.*
- *Replaceable components*
- *Security and functionality software updates.*

Public statements

See each individual criteria for specifications and requirements for the public statements that are required to be published on the information page about TCO Certified on the brand owner website.

An example of how the statements can be formulated can be provided by TCO Development upon request.

1.2 Product specification

Purpose

Purchasers and end users need to identify certified products and understand what certification means for a specific product. Clear product marking and accessible information make verified sustainability claims easier to find, compare and distinguish from unsupported claims.

This criterion makes certification visible on the product, packaging and brand owner website. It also provides a common location for public statements required by TCO Certified, supporting transparency and easier verification of certified product claims.

Definitions

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

Sales name: The name that will be used to market the product.

Build-to-stock: Configurations of a product that have been pre-defined before an order for the configuration have been placed by a customer. These are not linked to a specific order but rather based on sales projections or anticipated customer demand. In this criterion, the term build-to-stock is considered to be interchangeable with make-to-stock, Pre-Built, ready-to-ship.

Applicability

All product categories.

1.2.1 Mandate

A. Product codes

The brand owner must provide one or more types of unambiguous product identification codes that are machine readable and openly accessible for every configuration of the certified product. For build-to-stock configurations and all certified products sold by others than the brand owner, at least all Global Trade Item Numbers (GTIN) must be submitted.

B. Product names

The brand owner must provide all sales names and model names for products covered by the certificate.

C. Product specification

The product must be specified with a technical specification containing product attributes and images of the product.

Submit the following to an approved verifier:

- A copy of the marking label, for the product and all external power supplies.
- A product specification to identify the certified product is reported in TCO Certified Portal.

The following is submitted to TCO Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
- GTINs assigned for the product, using the UPI template

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

- Product specification

1.2.2 Clarifications

Submission of product codes

For build-to-stock configurations, it is required to submit GTINs for all configurations no more than 3 months after the certification date.

Use the UPI template to submit all GTIN numbers for the product model. If more GTINs are created after the initial GTIN submission, they need to be submitted in the TCO Certified Portal.

GTINs must be provided for:

- All certified products sold by parties other than the brand owner, whether build-to-stock or configured-to-order.
- All certified build-to-stock products sold by the brand owner.
- It is not necessary to create or submit GTINs for configure-to-order products sold exclusively by the brand owner.

Product specification and marking label

Testing of a physical sample is required for several criteria in TCO Certified such as the CB certification, energy efficiency, etc. During this testing the conformity of the product specification and marking label is ensured. However, some of the testing may already have been done and a test report from a laboratory accredited according to ISO17025 may already be available. In the case no additional physical testing is needed no physical sample needs to be provided to the approved verifier.

Supporting documentation

Submission template available at: <https://industry.tcocertified.com/documents/>

References

1. IEC 62368-1 Audio/video, information and communication technology, Part 1 -Safety requirements

1.3 Digital Product Passport

Purpose

Reliable product identification and access to product information support a circular product lifecycle. Information on certification status, repair, spare parts, battery replacement, warranty and take-back can otherwise become difficult to find during use and at end-of-life.

By linking each unit or model to a stable URL-based information source, this criterion makes trustworthy lifecycle information easier to access over time. This supports servicing, longer product use, material recovery and transparency.

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.

Data carrier: A two-dimensional symbol or other automatic identification data capture medium that can be read by a device such as a QR-code or a Data matrix.

Serial number: Any alphanumeric string that functions as a persistent and unique identifier for an individual item.

PIP: Product information page, The website displaying information about the product specified in the information requirements clarifications.

Intended operational configuration: The state that the product is designed to be used in, for example, a display is intended to be mounted on a stand before being used.

Item: A single unit if a model.

Applicability

All product categories.

1.3.1 Mandate

- A. The product must be equipped with a data carrier according to EN18220.
- B. A URL based product identifier according to EN18219 must be encoded into the data carrier.
- C. The URL based identifier must provide access to product information, in accordance with data exchange method(s) as specified in EN18216
- D. The following product information needs to be displayed on the product information page(PIP) that is connected to the URL based product identifier:

Product identification

- a. Model name.
- b. GTIN.

- c. Serial number.

Certification information

- d. TCO Certified Logo.
- e. Link to the “Certified Product Commitment Page” specified in the *Information to end users* criterion.
- f. Certification status for the product, retrieved from the TCO Certified API.

Circularity information

- g. Repair manuals as required in criteria *Replaceable components*.
- h. Battery replacement instructions as required in criteria *Battery replaceability*.
- i. Warranty status and access to Warranty extension.
- j. Instructions for access to purchase spare parts as required in criteria *Replaceable components*.
- k. Information and/or access to accepted take-back schemes at the end of life.

Submit the following to an approved verifier:

- Documentation showing how the product will be marked with a data carrier.
- A Sample URL as encoded in the data carrier
- A working sample URL for the destination website.
- Documentation showing that the required information is displayed on the product information page.

The following is submitted to TCO Development:

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

1.3.2 Clarifications

Clarifications for A:

Accepted types of data carriers

QR code or a data matrix.

Data carrier quality and size

The data carrier must be of sufficient size and quality so that it can be scanned using a smartphone camera indoors under normal lighting conditions. To ensure acceptable data carrier quality, it is recommended to follow: ISO/IEC 18004:2015 if the data carrier is a QR-code and ISO/IEC 16022:2006 if the data carrier is a data matrix.

It is recommended to use Section 5.12.3 GS1 symbol specification in GS1 General Specifications as a guide to select an appropriate label size to encode the required information.

Accepted data carrier placement

The data carrier must be placed on the outer casing of the product so that it is visible to the end user when the product is in its intended operational configuration. If the product is designed to be portable, it is acceptable to place the logo on the bottom side of the outer casing.

Data carrier placement for products made up of multiple detachable parts

The data carrier should be attached to at least one of the parts. Such as true wireless earbuds with a charging case, or a tablet shipped with a detachable keyboard.

Data carrier placement for products with vesa-mounting

It is not accepted to place the data carrier where it is not visible when the product is in its main intended operational configuration. For example inside of the Vesa mounting point of a display. Some small form Desktops are equipped with vesa mounts that enable mounting the product for example on the backside of a display. If that is the case, it is acceptable to place the data carrier inside of the mounting area since this is not the product's main intended operational configuration.

Alternative to physical data carrier for smartphones and tablets

For Smartphones and Tablets it is allowed to have the product identifier as a link in the operating system instead of using a data carrier

Clarifications for B:

Level of Product Identification

The table below shows the lowest required level of identification in the product identifier that is encoded into the data carrier for each product category.

	Unit level	Model level
Displays	X	
All-in-one PCs	X	
Desktops	X	
Notebooks	X	
Tablets	X	
Smartphones	X	
Headsets		X
General		X

Product identification on Unit level:

The URL- based product identity encoded into the data carrier must be able to identify the product on the unit level. This means that it must at least contain the product serial number (any alphanumeric string that functions as a persistent and unique identifier for an individual item).

Product identification on Model level:

The URL- based product identity encoded into the data carrier must be able to identify the product on the model level. This means that it must at least contain an alphanumeric string that functions as a persistent and unique identifier for a product model.

Clarifications for D:

The following information needs to be displayed on the PIP:

Product identification.

Brand must prove that the identifier is on the required level by displaying:

	Unit level	Model level
Modelname	X	X
GTIN	X	X
Serial number	X	

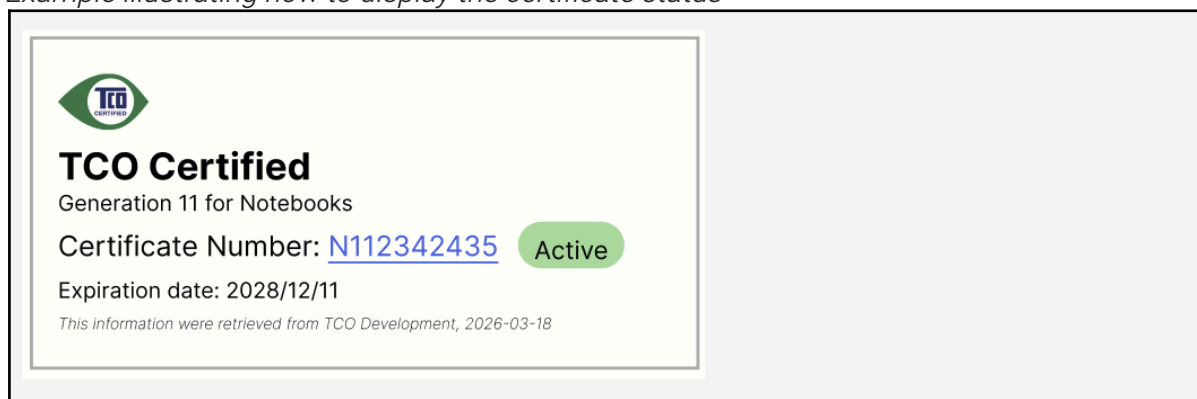
Configure-to-order products without GTINs

In the case that no GTIN is created for a configure-to-order product, it's allowed to instead display a full list of configuration choices on the PIP.

Certification information

The PIP must display a section informing the user about TCO Certified and the status of the certificate associated with the product. The certification status must be retrieved via API provided by TCO Certified.

Example illustrating how to display the certificate status



The URL query <https://data.tcocertified.com/GTIN> returns a JSON-LD file with certification status that needs to be displayed on the PIP.

(The exact data format might change until the final version of TCO Certified, generation 11)

The returned file contains the following data that needs to be displayed:

- Generation of TCO Certified that the product is certified according to.
- Image URL of the TCO Certified logo
- Certificate number
- Link to Product finder page for the certified product.
- Certificate status of the product
- Data retrieval date

Draft 2 note from TCO Development:

The important aspect that we want comments on is the general concept of displaying data retrieved from TCO Development. Technical details will be open for discussions.

In addition to displaying the data retrieved from TCO Certified, the section must also contain a link to the "Certified Product Commitment Page" as required in *the Information to end users* criterion.

Circularity information:

The following information that enables product lifetime extension needs to be displayed on the PIP:

- Repair manuals as required in the *Replaceable components* criterion
- Battery replacement instructions as required in the *Battery replaceability* criterion
- Warranty status and access to Warranty extension
- Instructions for access to purchase spare parts as required in the *Replaceable components* criterion.
- Information and/or access to accepted take-back schemes at the end of life.

General clarifications about the PIP

Duration of availability

The brand owner must publicly guarantee the availability of a website displaying the required information for at least 5 years after the end of placement of the product on the market (which is defined as the later date of either when the product was last marketed by the brand owner or when it was last manufactured).

Language selection

It is allowed to have a language selection pop-up. If a language selection is presented, a maximum of two subdirectories is allowed to be changed in the URL after a language has been selected. One for language, and one for region.

Accepted places on the page to display the required product information

The required product information needs to be visible directly when the page is loaded or in an expandable section or tab of the page that adheres to the following:

- The name of the tab/section clearly describes that clicking it will display the required data.
- Only one click is required to access the required data.
- The URL is not changed when clicking the tab.

Related resources

It is accepted to use links on the PIP to display required information content that is that is a file or a document. For example a PDF file containing a required service or repair manual.

2 Climate

Direction and focus

The climate area criteria are intended to move the IT industry toward lower product climate impact and support the TCO Certified roadmap vision for climate-neutral certified products. The criteria focus on climate impact from manufacturing, product use, and product lifetime.

How the criteria create change

The climate area is built around a reduction-first system that combines manufacturing energy, product lifetime, use-phase energy performance and accountability for remaining climate impact. Criteria on renewable electricity are intended to reduce the climate impact of manufacturing and increase demand for credible renewable electricity in the IT supply chain. Criteria on energy management are intended to strengthen systematic energy work at manufacturing sites and improve the data needed to identify future energy improvement opportunities. Criteria linked to supported product life and verified Scope 3 reductions are intended to reward real, verifiable climate impact reductions in manufacturing and make the climate benefit of longer product support visible to purchasers. Energy efficiency Criteria are intended to reduce electricity demand during use and limit unnecessary energy losses from power supplies. Criteria on carbon offsets are intended to take responsibility for part of the remaining Scope 3 climate impact through high-quality, independently verified carbon credits, while keeping offsets separate from direct reductions in the product life cycle.

What this enables

Together, these criteria help make climate-related progress measurable, comparable, and credible. Purchasers get clearer information about the climate-related performance of certified products, brands are encouraged to improve product design, supply-chain energy practices and product support, and independent verifiers get defined evidence points for checking climate-related Criteria consistently.

2.1 Renewable energy

Purpose

Electricity used in manufacturing usually accounts for a large share of the climate impact of IT products. This criterion is intended to increase the use of independently verified renewable electricity in the manufacturing of certified products.

Renewable electricity claims must be supported by REC cancellation statements, which help make claims traceable, independently verifiable and protected against double-counting.

Because claims may be made at different organizational levels, the criterion also clarifies how the reporting boundary is determined. This supports consistent reporting, credible verification and stronger market demand for renewable electricity in the IT supply chain.

Definitions

REC: Renewable Energy Certificate

Reporting entity: The entity making the renewable electricity claim. This may be:

- a factory OR
- a company within a defined region.

The reporting entity must be listed as beneficiary on the REC cancellation statement.

Reporting boundary: The buildings, facilities, and operations whose electricity consumption must be reported and included when calculating the renewable electricity share. The reporting boundary is determined by the information provided in the REC cancellation statement.

Renewable electricity share: The share of the reporting entity's electricity consumption that is covered by valid REC cancellations used to support the renewable electricity claim for the reporting period.

Applicability

All product categories.

2.1.1 Mandate

For each final assembly factory and each factory manufacturing display panels larger than 10 inches for the certified product, at least 30% renewable electricity share must be demonstrated through valid REC cancellation statements in accordance with this criterion.

Submit the following to an approved verifier:

For each factory covered by the mandate, the following must be submitted once a year:

- Documented proof of the total electricity consumption [MWh] for each factory.
- Documented proof of the renewable electricity share claimed for each factory.
 - The name of the reporting entity making the claim
 - REC cancellation statements listing that reporting entity as beneficiary
 - Documented proof of the total electricity consumption [MWh] of the reporting entity, if the reporting entity is broader than the individual factory.

If reporting is being done on brand owner's share of production at a factory, also submit:

- Documented proof of the brand owner's share of production at the factory, based on either:
 - The total number of units manufactured by the factory and the number of units manufactured for the brand owner
 - OR
 - The total revenue of the factory and the revenue for the brand owner's manufacturing at the factory.

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

- A copy of the verification report from a verifier approved by TCO Development.
- For each factory covered by the mandate, the following must be reported in the TCO Certified Portal once a year:
 - The total electricity used in each factory [MWh]
 - The renewable electricity share in each factory [%]

2.1.2 Clarifications

Reporting period

Reporting must be submitted by the brand owner no later than 31 August each year, including for one year after the certificate has expired.

The reporting must cover the previous calendar year, from 1 January to 31 December.

The production period of the RECs, meaning the period when the renewable electricity was generated, must fall within six months before and three months after the reporting period. REC cancellation statements used to support the renewable electricity claim for the reporting period must relate to RECs produced within that period.

Example:

Reporting submitted in 2025 must be received by 31 August 2025. It must cover electricity use from 1 January 2024 to 31 December 2024. The renewable electricity claim must be supported by REC cancellation statements for RECs produced between 1 July 2023 and 31 March 2025.

Calculating renewable electricity share

The renewable electricity share (RE%) shall be calculated as:

$$\text{RE\%} = Y / X \times 100$$

Where:

Y = total valid REC cancellations [MWh] used to support the renewable electricity claim for the reporting period.

X = total electricity consumption [MWh] of the same reporting entity during the same reporting period.

The REC cancellation statement determines which electricity use must be included in the calculation. The calculation must include all electricity used within the reporting boundary identified in the REC cancellation statement.

Proof of electricity consumption

Documented proof of electricity consumption must be based on independently verifiable documentation covering the full electricity use of the reporting entity during the reporting period.

Accepted proof:

- Regulatory energy audit documentation,
- ISO 50002 energy audit documentation,
- ISO 50001 certification audit evidence, including the certificate, certified scope, and audit report or summary confirming review of electricity data, or
- Other independent energy audits performed by accredited or legally authorised auditors.

The documentation must confirm that the reported electricity consumption:

- corresponds to the full electricity use within the reporting boundary identified in the REC cancellation statement, and

- covers the full reporting period.

Proof of renewable electricity claims

Claims of renewable electricity use must be verified by REC cancellation statements. Only electricity covered by REC cancellation statements is considered renewable in this criterion. The REC cancellation statement must identify the beneficiary and support the reporting boundary used for the renewable electricity claim.

- If a factory-level claim is made, the cancellation statement must clearly identify the factory.
- If a claim is made for a brand owner's share of production at a factory, the cancellation statement must clearly identify both the factory and the brand owner.

As an exception, if an accepted REC system does not allow the beneficiary field on the cancellation statement to specify the full reporting boundary beyond the business license or legal entity name, other fields on the cancellation statement, such as comments, purpose, or other free-text fields, may be used to clarify the reporting boundary.

This additional information must be included in the cancellation statement and allow the verifier to confirm the reporting boundary. The beneficiary and any additional boundary information must be specific enough to prevent the cancellation statement from being used for an unrelated reporting boundary.

The REC cancellation statement and the electricity consumption data must use the same reporting boundary. A broad company or regional cancellation statement can support a claim for that broad boundary, but does not by itself support a narrower factory or product claim. For TCO Certified, the cancellation statement must support the reporting boundary and electricity consumption used in the calculation. See "When RECs are retired for a larger entity" for cases where the beneficiary covers more than one factory.

Factory-level reporting

Factory-level reporting is encouraged in TCO Certified because it gives the clearest connection between the REC cancellation statement and the factory's electricity use.

If the factory business license is named as a beneficiary on the REC cancellation statement, only that factory's electricity use must be included in the calculation. This is the clearest and simplest reporting method.

Brand owner's share of production at a factory

The brand owner may instead report for its own share of production at a factory if:

- The factory does not meet the renewable electricity requirement,
OR
- The brand owner wants to claim a higher renewable electricity share than the factory as a whole.

In that case, the brand owner's share of the factory's electricity use is estimated in proportion to its share of:

- Production volume.

OR

- Revenue.

The selected method must be applied consistently for the same factory and reporting period.

When RECs are cancelled for a larger entity

If the beneficiary named on the REC cancellation statement is larger than one factory, for example, a company within a defined region, the renewable electricity share must be calculated using all the electricity used by that larger entity. It cannot be calculated using only the electricity used by one factory.

The factory may then claim the same renewable electricity share, but only if:

- The factory is fully owned by the company, AND
- The RECs are sourced and purchased in the same national electricity market as the factory.

Example:

- A REC of 50 MWh is issued to "IT Brand business in China".
- There is proof that the factory is owned by the IT brand in China.
- The total electricity use for "IT Brand business in China" is 100 MWh for 2025.
- The renewable electricity share is therefore $50 / 100 = 50\%$.
- The factory may then claim 50% renewable electricity.

Multiple factory manufacturing

If a product is manufactured at more than one factory, each factory covered by the mandate must comply individually. Averaging across factories is not allowed.

Renewable electricity sources

Accepted renewable electricity sources are:

- Wind
- Solar
- Geothermal
- Hydropower (Pumped hydro storage is accepted only if any grid-imported electricity used for pumping is specified in the submitted REC and deducted from the generated electricity.)
- Biomass - Accepted biomass sources are agricultural waste and residues, forest biomass, and biofuel plants.

Renewable energy certificates

REC registries track certificates from issuance to cancellation, reducing the risk of double-counting and enabling independent verification.

Renewable electricity may be purchased or self-generated, including on-site generation.

For self-generated renewable electricity, factories or brand owners may:

- Consume electricity directly from their own renewable generation and retain the RECs, or
- Export electricity to the grid and retain the RECs.

In both cases, the renewable electricity may only be claimed if the RECs are retained and cancelled for that claim.

Exception for new factories

This exception applies to factories that did not produce any TCO Certified product for any brand owner before 31 August in the application year. Brand owners using these factories must comply with the requirement from the following calendar year.

Exception for a high market price of RECs

When REC prices in a market exceed the thresholds set out below, part of the renewable electricity may be covered by RECs from neighbouring markets.

- If the market price of all accepted RECs in the relevant market is above 10 USD/MWh, up to 30% of the renewable electricity purchased may be covered by RECs from neighbouring markets.
- If the market price is above 30 USD/MWh, up to 70% of the renewable electricity purchased may be covered by RECs from neighbouring markets.

Use of this exception must be supported by documented market price evidence and assessed in accordance with the verification guidance.

Under this rule, RECs for factories in Taiwan may be sourced from China, Japan, the Philippines, South Korea, or Vietnam.

Accepted REC systems

Only RECs recognised by TCO Development as accepted REC systems are valid as proof of compliance. Additional countries or credible REC systems may be added after independent expert review and formal acceptance by TCO Development.

Country	Accepted REC systems
Brazil	I-REC
Canada	I-REC, REC (MRETS, NAR, ERCOT, WECC)

China	I-REC, GEC
Czech Republic	I-REC, EECS-GO
Egypt	I-REC
Hungary	I-REC, EECS-GO
India	I-REC, TIGR
Japan	I-REC, J-Credit, FIT-NFC
Malaysia	I-REC, TIGR
Mexico	I-REC
Poland	I-REC, National Guarantees of Origin
Portugal	I-REC, EECS-GO
Singapore	I-REC, TIGR
Taiwan	I-REC, T-REC, TIGR
Thailand	I-REC, TIGR
USA	I-REC, REC (MRETS, NAR, ERCOT, WECC)
Vietnam	I-REC, TIGR
South Korea	I-REC, Korean national REC system, TIGR

In Taiwan, CPPA may be accepted as an exception to the REC requirement.

Verification

Compliance with this criterion must be verified by a verifier approved by TCO Development in accordance with the *Climate verification guidelines*.

Verification must confirm:

- Authenticity of REC cancellation statements
- That the renewable electricity claim is supported by valid REC cancellation statements and uses the same reporting boundary as the electricity consumption data
- The reported electricity consumption used in the calculation
- A brand owner's share of production at a factory, if applicable

All verification must be based on independently verifiable documentation.

Supporting documentation

- Climate verification guidelines

available at: <https://industry.tcocertified.com/documents/>

References

- ISO – ISO 50001:2018 – Energy management systems – Requirements with guidance for use.
- ISO – ISO 50002-1:2025 – Energy audits – Part 1: General requirements with guidance for use.

Draft

2.2 Annualized PCF

Purpose

Manufacturing is typically the largest source of climate impact for IT products. Each time a product is replaced, new manufacturing emissions occur.

Product Carbon Footprints are useful for understanding where emissions occur, but they usually do not show how long a product can remain supported and in use. A product with a short supported life and a product with a long supported life may therefore appear similar, even though their annualized climate impact can be very different. PCFs can also vary by calculation method, scope, data sources and assumptions, so using them to rank products can be misleading even when the numbers appear precise.

This criterion shifts the focus from product-specific footprint comparisons to defined and verifiable climate reductions. It promotes longer supported product life, which spreads manufacturing emissions over more years, and verified Scope 3 reductions, which can reduce supply-chain emissions and scale better practices across the IT industry.

The annualized PCF makes the effect of longer product support and verified Scope 3 reductions visible to purchasers.

Definitions

Annualized PCF: The estimated climate impact per year during the period the product is supported.

The annualized PCF expresses a product's climate impact as the product category average Scope 3 value, reduced by any verified Scope 3 reductions, divided by the supported product life, with the product category average Scope 2 value added as an annual use-phase contribution. This provides a simple annualized metric that makes the effect of longer product support and verified Scope 3 reductions visible to purchasers.

Annualized PCF = ((Product category average Scope 3 – Verified Scope 3 reductions) / Supported product life) + Product category average Scope 2

Supported product life: The number of years after the end of placement of the product on the market during which the brand owner commits to providing the support needed for the product to maintain its intended functionality.

In TCO Certified generation 11, supported product life is determined as the shortest period among the following support elements, as defined in the Battery replaceability criterion, the Replaceable components criterion, and the Security and functionality software updates criterion:

- security and functionality software updates
- availability of critical spare parts
- availability of repair manuals
- availability of spare batteries, where applicable

Supported product life = min(security and functionality software updates period, critical spare parts availability period, repair manual availability period, spare battery availability period)

Product category average Scope 2 and 3: Category-level average emissions values that represent, for a given product category, the average Scope 2 emissions from product use and the average Scope 3 emissions from the supply chain.

Scope 3 reductions: Approved actions that lower a certified product's Scope 3 emissions can be claimed and applied as a reduction to the annualized PCF after meeting implementation and verification requirements.

CO₂e: Carbon dioxide equivalent is a common unit that expresses the climate impact of different greenhouse gases as the equivalent amount of carbon dioxide, based on their global warming potential

Applicability

This criterion applies to product categories for which TCO Development has defined a product category average Scope 2 and Scope 3 value. (Mandatory levels currently apply only to notebooks and displays.)

2.2.1 Mandate

- A. TCO Development estimates and publishes the annualized PCF in Product Finder for certified products in product categories for which TCO Development has defined a product category average Scope 2 and Scope 3 value.
- B. For notebooks and displays, the annualized PCF, calculated according to the methodology in TCO Certified, must meet the following levels:
 - Notebooks: lower than 45 kg CO₂e/year
 - Displays: lower than 72 kg CO₂e/year

Submit the following to an approved verifier:

- Documented proof of the implementation of any Scope 3 reduction activities.
- Documented proof of the supported product life, derived from the support periods verified through the *Battery replaceability*, *Replaceable components*, and *Security and functionality software updates* criteria.

The following 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 supported product life.
- The annualized PCF according to the definition in this criterion.
- Any approved Scope 3 reductions.

2.2.2 Clarifications

Scope 3 reductions

The list of accepted Scope 3 reductions and the associated reduction values are explained in "Scope 3 reductions" (see *Supporting documentation*). Brand owners may submit proposals for additional Scope 3 reduction activities to TCO Development for evaluation and possible inclusion in the list. To claim a reduction on the list, a brand owner must provide documented proof of the solution's implementation for the certified product. Approved Scope 3 reductions

may only be claimed where the implementation and verification conditions defined by TCO Development for that reduction activity are fulfilled.

Product category average Scope 2 and 3

The list of currently applicable product categories and the methodology of how the product category averages are developed are explained in “Product category average Scope 2 and 3” (see *Supporting documentation*).

Product category average annualized PCF

TCO Development also estimates and publishes a product category average annualized PCF for an average product in each category, using an EU average energy mix. This value is used as a baseline to show how each certified product compares with an average product in the same category, based on supported product life and any approved Scope 3 reductions.

$$Product\ category\ average\ PCF_{annualized} = \frac{Scope\ 3_{average}}{Product\ life_{average}} + Scope\ 2_{average}$$

$$Notebook\ average\ PCF_{annualized} = \frac{237}{4} + 6,5 = 66\ kg\ CO_2e/year$$

How to comply with the mandate

$$Product\ individual\ PCF_{annualized} = \frac{(Scope\ 3_{average} - Scope\ 3_{reductions})}{supported\ product\ life} + Scope\ 2_{average}$$

For notebooks and displays, the annualized PCF must be lower than the applicable threshold stated under Mandate. This is achieved by extending the supported product life, implementing Scope 3 reductions or a combination of both.

For illustrative examples of how the annualized PCF threshold may be met, see the *Scope 3 reductions* supporting document.

Product category	Product category average annualized PCF	TCO Certified mandate	Ways to comply with mandate
Notebooks	66 kg CO ₂ e/year	< 45 kg CO ₂ e/year	6 years SPL + 3% Scope 3 reductions, 7 years SPL + 0% Scope 3 reductions
Displays	100 kg CO ₂ e/year	< 72 kg CO ₂ e/year	6 years SPL + 2% Scope 3 reductions, 7 years SPL + 0% Scope 3 reductions

Supporting documentation

- Scope 3 reductions
- Product category average Scope 2 and 3
- Climate verification guidelines

available at: <https://industry.tcocertified.com/documents/>

Draft

2.3 Energy efficiency

Purpose

Electricity used to power IT products contributes to their climate impact. As the number of products in use increases, energy efficiency remains an important way to reduce electricity demand and related greenhouse gas emissions.

This criterion focuses on energy efficiency in the use phase. It helps purchasers rely on verified claims by requiring certified products to meet recognized requirements for energy efficiency, power consumption and power supply efficiency. Established test methods and accredited testing make energy performance more comparable and verifiable.

The criterion also addresses electricity losses in power supplies offered with certified products.

Applicability

All product categories covered by product-specific EU Ecodesign requirements.

2.3.1 Mandate

- A. All products must meet the energy efficiency, power consumption and, where applicable, power supply requirements in the applicable product-specific EU Ecodesign requirements.
- B. All external power supplies offered with the model must bear the Efficiency Level VI marking or higher in accordance with the International Efficiency Marking Protocol (IEMP).
- C. For products that require a non-USB-C power supply to operate, all external and internal power supplies offered with the model and rated above 240 W must achieve at least 90% efficiency at 50% load, measured according to the *Generalized Test Protocol for Calculating the Energy Efficiency of Internal AC-DC and DC-DC Power Supplies*, Revision 6.6, or a later revision shown to be technically equivalent.

Submit the following to an approved verifier:

- A copy of the test report(s) from a laboratory accredited according to ISO/IEC 17025.
- A copy of the marking label for each external power supply offered with the model.
- Proof of at least 90% efficiency for all power supplies covered by the $\geq 90\%$ requirement.

The following 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.
- A list of all power supplies offered with the model, including type (internal or external) and rated wattage.

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

- Measured energy values.
- Tested product configuration.

2.3.2 Clarifications

Applicable EU Ecodesign regulations

The product must be tested in accordance with the applicable product-specific EU Ecodesign implementing regulation. Relevant regulations include, where applicable:

- Commission Regulation (EU) 2019/2021 for electronic displays
- Commission Regulation (EU) 2019/424 for servers and data storage products
- Commission Regulation (EU) No 617/2013 for computers
- Commission Regulation (EU) 2023/826 for off-mode, standby-mode and networked-standby requirements where applicable

Where a regulation has been amended, the current consolidated version shall be used. The test report shall state which applicable implementing regulation the product has been tested against and found to comply with.

Testing only needs to cover the energy consumption and power supply efficiency requirements specified in the applicable EU Ecodesign regulation.

Measurement methods

For products tested according to Commission Regulation (EU) No 617/2013, power consumption in off mode, sleep mode, and idle mode must be measured in accordance with EN 62623:2013, as referenced in Commission Communication 2014/C 110/05 on transitional measurement methods.

Power supply efficiency for power supplies covered by the $\geq 90\%$ requirement must be measured according to the Generalized Test Protocol for Calculating the Energy Efficiency of Internal AC-DC and DC-DC Power Supplies, Revision 6.6, or a later revision shown to be technically equivalent.

Test reports and laboratory requirements

Testing may be carried out at any test facility accredited according to ISO/IEC 17025 for the relevant test methods. The test report must be verified by a verification organization approved by TCO Development.

Test reports from the 80 PLUS program may be accepted only if the 80 PLUS testing laboratory is accredited according to ISO/IEC 17025 for the relevant test method.

Unless otherwise specified by the applicable test method, all measurements must be performed at 230 V AC, 50 Hz, THD $\leq 2\%$.

Power supplies offered with the model

This includes power supplies included as standard, optional power supplies selectable at purchase, power supplies included in product configuration choices, and region-specific power supplies when offered with the same certified model. Replacement parts, service parts, and power supplies sold only separately after purchase are not included.

Tested configuration

For tested configurations, the following properties must be reported in the test report, where applicable:

- Brand
- Product name
- Model number
- Processor brand
- Processor model
- System memory (GB)
- Graphics configuration
- Operating system name
- Power supply unit

Portal reporting

For computer products, the measured idle (P_idle), sleep (P_sleep), and off-mode (P_off) power consumption values, annual total energy consumption (E TEC), and power supply efficiency, where applicable, must be submitted to the TCO Certified Portal together with the application.

For display products, the measured on-mode (P_measured_SDR), standby, and off-mode power consumption values, Standard Dynamic Range energy efficiency label (EEI Label SDR), and power supply efficiency, where applicable, must be submitted to the TCO Certified Portal together with the application.

Notebook products with idle-state power demand below 6 W

For notebook computer products with idle-state power demand below 6 W that are outside the scope of Commission Regulation (EU) No 617/2013, the product must meet and report the applicable off-mode, standby-mode and, where applicable, networked-standby requirements in Commission Regulation (EU) 2023/826.

Where Commission Regulation (EU) 2023/826 is used, the measured off-mode, standby-mode and, where applicable, networked-standby power consumption values must be submitted to the TCO Certified Portal.

Product market exception

For product models marketed and sold exclusively outside the EU market, compliance with the EU Ecodesign Directive is not required. Instead, the product must be tested in accordance with the latest active ENERGY STAR standard applicable to the relevant product category.

Supporting documentation

- Climate verification guidelines

Available at: <https://industry.tcocertified.com/documents/>

References

- European Union – Directive 2009/125/EC – Establishing a framework for the setting of ecodesign requirements for energy-related products.

- European Union – Commission Regulation (EU) 2019/2021 – Ecodesign requirements for electronic displays.
- European Union – Commission Regulation (EU) 2019/424 – Ecodesign requirements for servers and data storage products.
- European Union – Commission Regulation (EU) No 617/2013 – Ecodesign requirements for computers and computer servers.
- European Union – Commission Communication 2014/C 110/05 – Transitional methods of measurement and calculation for implementing Directive 2009/125/EC.
- European Union – Commission Regulation (EU) 2023/826 – Ecodesign requirements for off mode, standby mode and networked standby energy consumption.
- European Committee for Electrotechnical Standardization – EN 62623:2013 – Desktop and notebook computers – Measurement of energy consumption.
- International Efficiency Marking Protocol – External Power Supply International Efficiency Marking Protocol.
- ENERGY STAR – Product specifications for applicable product categories.
- EPRI / CLEARResult – Generalized Test Protocol for Calculating the Energy Efficiency of Internal AC-DC and DC-DC Power Supplies.
- ISO/IEC – ISO/IEC 17025 – General requirements for the competence of testing and calibration laboratories.

2.4 Energy management system

Purpose

Energy management systems help organizations work systematically with energy performance and continuous improvement. This criterion strengthens energy management in the manufacturing of certified products by requiring covered manufacturing sites to have an independently certified ISO 50001 energy management system.

Independent certification confirms that the factory has a structured process for reviewing energy use, identifying significant energy uses and improving energy performance over time.

The criterion also requires reporting of the factory's most significant energy uses. This helps identify where energy is used in manufacturing and where future improvements may have the greatest effect. Over time, this can support better data, better prioritization and stronger climate requirements for supply-chain energy hotspots.

Definitions

ISO 50001: An international standard for energy management systems, used to improve energy performance, energy use, and energy consumption.

Significant Energy Use (SEU): An energy use identified as significant by the organization through its ISO 50001 energy review.

Applicability

All product categories

2.4.1 Mandate

Each final assembly factory, display panel factory for panels larger than 10 inches, and PCB mainboard fabricator for the certified product must:

- A. Have an energy management system that is independently certified to ISO 50001; and
- B. Submit the three identified Significant Energy Uses (SEUs) with the highest estimated annual energy consumption, as determined in the factory's ISO 50001 energy review.

Submit the following to an approved verifier:

For each required factory for the certified product:

- Evidence that a valid ISO 50001 certificate and the completed SEU data collection template have been uploaded to the TCO Certified Portal, or proof that an extension has been approved for the required factory.

The following is submitted to TCO Development:

- A copy of a verification report from a verifier approved by TCO Development
- Completed SEU data collection templates

2.4.2 Clarifications

ISO 50001 certificate scope and validity

A valid ISO 50001 certificate must be available in the TCO Certified Portal for every required factory, unless an extension has been approved. The certificate, or an appendix to the certificate, must state what the certification covers. The ISO 50001 certification must cover the entire operation included in the factory's business license.

Certificates must be issued by an independent certification body accredited for energy management systems certification by an accreditation body covered by the International Accreditation Forum (IAF) Multilateral Recognition Arrangement.

Extended period exception

An applicant may request an extension of up to 18 months for a required factory that is not ISO 50001 certified at the date of application. The request must include a detailed time plan for achieving certification and be accompanied by a signed agreement.

If an extension is approved, the ISO 50001 certificate requirement and the SEU submission requirement do not apply to that factory during the approved extension period. The factory must submit SEU information once it has obtained ISO 50001 certification and completed an ISO 50001 energy review. TCO Development reserves the right to deny an extension if there is a significant risk that the factory will be unable to achieve ISO 50001 certification within the requested period.

Reporting SEUs

The SEU information shall be submitted by the brand owner no later than 31 August each year. The submission shall be based on the latest available ISO 50001 energy review for each required factory with a valid ISO 50001 certificate. If no updated energy review has been conducted since the previous submission, the factory shall confirm that the previously submitted SEUs remain valid.

The factory's SEU determination shall follow its ISO 50001 process and documented significance criteria, such as energy consumption, improvement potential, and impact on overall energy performance.

In the TCO Certified SEU data collection template, factories must report:

- The three identified SEUs with the highest estimated annual energy consumption.
- The energy type used by each of these SEUs (e.g., electricity, natural gas, steam).
- The estimated annual energy consumption in kWh/year or as a percentage of total factory energy use for each.
- Any opportunities for energy performance improvement for the three listed SEUs, as identified in the ISO 50001 energy review.

If exact annual consumption or percentage data are not available for an SEU, factories may provide the best available estimates used internally for SEU determination. Estimates may be based on sub-metering, engineering calculations, or proportional allocation methods.

Supporting documentation

- SEU data collection template

available at: <https://industry.tcocertified.com/documents/>

References

- ISO – ISO 50001:2018 – Energy management systems – Requirements with guidance for use.
- International Accreditation Forum – IAF Multilateral Recognition Arrangement.

Draft

2.5 Carbon offsets

Purpose

TCO Certified prioritizes reducing climate impact in the product life cycle. Carbon offsets can finance projects that reduce or remove emissions outside the product value chain, but they do not reduce the on-site or supply-chain emissions generated during manufacturing. Carbon offsets are therefore not counted in the annualized Product Carbon Footprint calculation in TCO Certified.

This criterion requires brand owners to use high-quality, independently verified carbon credits to offset part of the remaining Scope 3 climate impact for certified products. Any carbon offset claim under TCO Certified must use accepted carbon credits aligned with international best practice, be retired in a way that reduces double-counting risk, and be communicated through clear and verifiable claims.

Definitions

Carbon offset: The use of retired carbon credits to compensate for a defined amount of greenhouse gas emissions outside the product value chain.

Carbon credit: A tradable unit representing one metric tonne of CO₂e reduced or removed by a carbon offset project and issued by a carbon-crediting program.

Retirement: The permanent cancellation of a carbon credit in a registry so that it cannot be used or claimed again.

Applicability

All product categories where a Product category average Scope 3 has been defined by TCO Development.

2.5.1 Mandate

For each certified product manufactured during the reporting year in a product category where a Product category average Scope 3 has been defined, the brand owner must offset at least 10% of the applicable Product category average Scope 3 through carbon credits.

For TCO Certified generation 11, this corresponds to:

- 24 kg CO₂e for each certified notebook manufactured
- 30 kg CO₂e for each certified desktop manufactured
- 33 kg CO₂e for each certified display manufactured
- 12 kg CO₂e for each certified tablet manufactured
- 37 kg CO₂e for each certified all-in-one PC manufactured

Submit the following to an approved verifier:

- A link to a public statement published on the Certified Product Commitment Page, as required by the *Information to end users* criterion, showing compliance with the mandate by describing the brand owner's carbon offset commitment for certified products.

For each applicable product category, the following must be submitted once a year:

- The number of certified products manufactured during the previous calendar year.
- The calculated carbon offset amount required under this criterion.
- Proof that the required amount is covered by accepted carbon credits retired for TCO Certified products manufactured during the previous calendar year.

The following 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 carbon offset amount for each certified product manufactured, expressed in kg CO₂e.
- A link to the public carbon offset statement.

Draft

2.5.2 Clarifications

Product category average Scope 3

Product category average Scope 3 values are developed by TCO Development using Scope 3 data from public PCFs in each product category. The values may be updated periodically to reflect products currently available on the market. The list of applicable product categories and the methodology used to develop the averages are explained in *Product category average Scope 2 and 3* (see *Supporting documentation*).

Accepted carbon credits

Any carbon offset claim must be supported by accepted carbon credits under this criterion. The credits must be retired in a public registry in a way that supports independent verification and reduces the risk of double-counting.

Accepted carbon credits are credits that meet at least one of the following routes:

- Integrity Council for the Voluntary Carbon Market (ICVCM) Core Carbon Principles (CCP)-labelled credits
- Credits from a carbon offset project rated BBB or above by Sylvera.

For ICVCM CCP-labelled credits, the submitter must provide a dated record from the official registry of the issuing carbon-crediting program, or another official issuance document from that program, showing that the submitted carbon credits carry the CCP label.

For credits submitted under the Sylvera route, the submitter must provide a dated screenshot, PDF, report, or other record from Sylvera showing that the project from which the submitted carbon credits originate is rated BBB or above.

In both cases, the submitted evidence must contain sufficient information to match the carbon credits to the project they originate from and to any required retirement record.

TCO Certified generation 11 draft 2 note:

Draft 1 required CCP-labelled credits only. Feedback indicated that this could create a bottleneck because the current market availability of CCP-labelled credits is limited. Draft 2, therefore, adds an alternative route for credits from projects rated BBB or higher by Sylvera.

The purpose of this change is to keep the objective unchanged: quality control and verifiability through established external systems, while reducing the risk that the criterion becomes difficult to apply in practice. Feedback is welcome on whether other established approaches could achieve this objective with strong quality assurance, clear third-party evidence, and low administrative burden for both brands and verifiers.

Public statement

The carbon offset must be declared in kg CO₂e per certified product. The public statement must not state or imply that carbon offsets reduce the product carbon footprint or reduce the manufacturing emissions of the certified product. For more information on public statement requirements, see *Information to end users* criterion.

Annual carbon offset reporting

Reporting must be submitted by the brand owner no later than 31 August each year, including for one year after the certificate has expired. The reporting must cover certified products manufactured during the previous calendar year, from 1 January to 31 December.

The annual carbon offset report must include:

- The number of certified products manufactured during the previous calendar year for each applicable product category.
- The carbon offset amount allocated to certified products manufactured during the previous calendar year, by product category, expressed in kg CO₂e.
- Proof of retirement of carbon credits in public registries, with a clear designation linking the retired credits to TCO Certified products manufactured during the previous calendar year.
- Evidence showing that the carbon credits used meet one of the accepted carbon credit routes under this criterion.

Carbon credits should preferably be retired with a designation that clearly identifies the TCO Certified product claim, the brand owner, and the previous calendar year covered by the claim.

Example:

“Retired for TCO Certified products of Brand X manufactured during 2025.”

If the retirement record only names a broader entity, such as a company or corporate group, it must also include a purpose, note, or other official registry information that clearly links the retired credits to TCO Certified products manufactured during the previous calendar year. A broad company name alone is not sufficient to support a TCO Certified product claim.

Credits retired for a broad enterprise can support a broad enterprise-level claim, but they do not by themselves prove allocation to TCO Certified products. The retirement record must therefore support the TCO Certified product claim, reporting year, and offset quantity used for compliance.

The claim boundary may be identified in any official registry field or retirement certificate, such as the beneficiary, purpose, note, remarks, or retirement reason. If the registry does not allow this, official written confirmation from the registry or carbon-crediting program may be used. Internal allocation records alone are not sufficient.

Calculation example

If 20,000 certified notebooks are manufactured during the reporting year, the brand owner must provide documented proof of retired carbon credits allocated to certified notebooks covering at least 480,000 kg CO₂e.

Verification

Compliance shall be verified by a verifier approved by TCO Development, in accordance with the *Climate verification guidelines*.

Supporting documentation

- Climate verification guidelines
- Product category average Scope 2 and 3
-

available at: <https://industry.tcocertified.com/documents/>

References

- Integrity Council for the Voluntary Carbon Market – Core Carbon Principles.
- Sylvera – Carbon Credit Ratings & Quality Assessment.

Draft

3 Substances

Direction and focus

The substances area criteria are intended to move the IT industry toward safer chemical choices and support the TCO Certified roadmap vision of safer substances in certified products, packaging and manufacturing. The criteria focus on reducing hazardous substances in products and manufacturing, increasing knowledge about chemical hazards, and making safer alternatives easier to identify and use.

How the criteria create change

The substances area is built around a risk-based safer-substitution system: restricting known hazardous substances, treating unassessed alternatives as a risk, and making independently assessed safer alternatives visible. Criteria on restricted substances are intended to reduce the use of known hazardous substances in certified products, packaging and product parts where the criteria apply. Criteria on accepted substances are intended to prevent regrettable substitution by treating substances as risks until they have been independently assessed and accepted as safer alternatives. Criteria on process chemicals are intended to reduce worker exposure to hazardous chemicals in manufacturing and expand the same safer-substitution logic to selected process chemicals used in manufacturing.

Transparency is a core mechanism in this area. By collecting chemical information and making accepted substances publicly visible, the criteria help build shared knowledge about safer alternatives and make it easier for safer choices to become normal practice. This also supports circularity by reducing hazardous content that can limit responsible recycling and material reuse.

What this enables

Together, these criteria help make chemical risk management more preventive, transparent and credible. Purchasers get clearer information that certified products follow a structured approach to safer substances, brands are encouraged to phase out hazardous substances and select independently assessed alternatives, and independent verifiers get defined evidence points for checking substance restrictions, accepted substances and process chemical Criteria consistently.

3.1 Process chemicals management

Purpose

Scientific research shows that workers 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), which have well-documented toxic human health effects, has been restricted in some parts of the world but is 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, the process chemicals and their suitable alternatives must be identified and independently assessed by an approved toxicologist. The Personal Protective Equipment (PPE), training, and exposure monitoring provided to workers at risk of chemical exposure also need to be reviewed and improved.

Definitions

Process Chemicals: Chemicals (individual chemicals or mixtures) used during the manufacture and/or finishing of a product and/or maintenance of related production equipment that are not intentionally fully incorporated into the product. Examples of process chemicals include cleaning agents, solvents, lubricants, photochemicals, plating agents, refrigerants, hydraulic fluids, adhesives, inks and coatings, etc.

Cleaning products: Chemicals and chemical mixtures used to remove contaminants, unwanted materials and/or process residues (e.g., lubricants, adhesives, solder flux residues, plastic residue, mold release residue, etc) from display assemblies, product housings, printed circuit boards, SMT machinery, and production tools. Fluxes and mold release agents are not considered cleaning products

Adhesives: Chemical products used during manufacturing for temporary bonding, masking, or processing purposes that are not intentionally fully incorporated into the final product. These may include adhesives used for positioning, protection, or processing steps and are removed, consumed, or not intended to remain in the finished product.

Applicability

All product categories.

3.1.1 Mandate

1. Each final assembly factory, display panel assembly factory (panels >10"), and PCB mainboard fabricator that is involved in the manufacture of the certified product and registered in TCO Certified Portal must:
 - Have a valid ISO 45001 certificate.
 - Use only cleaning products listed on TCO Certified Accepted Substance List
 - Submit chemical inventory data covering at least cleaning products, adhesives and lubricants.
2. Each final assembly factory involved in the manufacture of the certified product and registered in TCO Certified Portal must use only adhesives listed on TCO Certified

Accepted Substance List.

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:

For each required factory for the certified product:

- A valid ISO 45001 certificate must be uploaded to TCO Certified Portal before the stated due date.
- An accepted process chemical template (PCT) must be provided before the factory can be added to TCO Certified Portal.

The following 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 template must be reported in TCO Certified Portal.

3.1.2 Clarifications

ISO 45001 certification

The applicant must ensure that a valid ISO 45001 certificate is available in TCO Certified Portal for each required factory type.

The certificate must clearly state the scope of the certification and be understood to cover the entire operation under the factory business license.

Certificates must be issued by a certification body accredited by an accreditation body that is a signatory to the International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA).

Due date for compliance

The applicant may apply for an extension of up to 18 months for a factory that is not yet ISO 45001 certified. The application must be submitted to the approved verifier at the time the factory is registered in TCO Certified Portal.

The application template is obtained from the approved verifier.

TCO Development reserves the right to deny an extension if there is a significant risk that ISO 45001 certification will not be achieved within the extended time allowance.

Process Chemical Template process

The latest version of the Process Chemical Template (PCT) must be submitted when a factory registers on TCO Certified Portal. Any alternative to the PCT provided by TCO Development must first be approved as an accepted alternative.

Any PCT submitted to verify compliance must be uploaded before the due date shown on TCO Certified Portal for each factory registered on TCO Certified Portal.

The chemical data reported in the PCT must, at a minimum, cover the chemical formulations and ingredients listed in the applicable chemical safety data sheets and used on the production lines where certified products are manufactured.

The PCT must, at a minimum, include data for cleaners, adhesives, and lubricants used in the manufacture of certified products. If any process chemical is added to the PCT but is not used on the relevant production lines of certified products, this must be clearly stated in the PCT. The most recent version of the PCT is available on the supporting documents webpage at tco-certified.com.

TCO Certified Accepted Substance List

Accepted cleaners and adhesives can be found on TCO Certified Accepted Substance List. To be included on the list, substances must be independently assessed and achieve a GreenScreen® benchmark score of 2, 3, or 4, or a ChemFORWARD hazard band of A, B, or C. For chemical mixtures (formulations), GreenScreen Certified™ Platinum or Gold, issued by a licensed GreenScreen Profiler, is also accepted.

For more information on how to add a substance to TCO Certified Accepted Substance List, visit: <https://industry.tco-certified.com/guidance/accepted-substance-list/how-it-works/>

Due date for compliance

From the date a factory is registered on TCO Certified Portal, the applicant may apply for an extension of up to 18 months to comply with the requirement that cleaners and, where applicable, adhesives used on production lines for certified products appear on TCO Certified Accepted Substance List.

For a factory to retain an active status on TCO Certified Portal, an updated Process Chemical Template must be submitted before the PCT due date on TCO Certified Portal.

Completing and submitting the Process Chemical Template (PCT)

- The senior factory representative responsible for chemical management must support the applicant in completing the PCT.
- All sections marked as “required” in the template must be completed.
- Substance ingredients must include a unique identifier called a CAS number. If a CAS number is withheld for any reason, the ingredient must be treated as a restricted substance until it is proven to be safer. Substances listed by trade name (formulations without a CAS number entered) are accepted if they are GreenScreen Certified™
- The information provided must cover all process chemical types required under the mandate and used in the manufacture of certified products.
- Upon request, the factory’s complete process chemical inventory must be submitted for independent verification.
- The PCT must be updated upon TCO Development’s request.

Use of submitted chemical information

TCO Development may compile submitted chemical information, including CAS numbers, for internal analysis.

TCO Development reserves the right to publish aggregated and anonymized data derived from this information. Published data will not enable the identification of individual companies, factories, or products.

Exposure controls and Personal Protective Equipment (PPE)

TCO Certified Accepted Substance List reduces the risk of worker exposure to highly hazardous chemicals by promoting the use of safer alternatives. However, the use of safer alternatives does not absolve factory management of its responsibility to provide appropriate training and personal protective equipment (PPE) as specified in the chemical safety data sheet, including requirements related to exposure controls and personal protection.

Verification of PPE availability, worker training, and correct use is covered by ISO 45001 and included in the required factory audits.

Supporting documentation

<https://industry.tcocertified.com/documents/>

References

<https://www.iso.org/iso-45001-occupational-health-and-safety.html>

<http://www.centerforsustainabilitysolutions.org/clean-electronics/>

Draft

3.2 Restricted product substances

Purpose

Electronic products contain substances that pose risks to both human health and the environment throughout their life cycle. Hazardous substances such as heavy metals (cadmium, mercury, lead, hexavalent chromium) and halogenated compounds (including brominated and chlorinated substances) are well documented as toxic, persistent, and bio-accumulative. Workers may be exposed during manufacturing, and harmful emissions can occur at end-of-life through uncontrolled recycling or incineration, leading to the release of dioxins, furans, and other toxins.

To reduce these impacts, TCO Certified criteria go beyond existing legislation such as the EU RoHS Directive (2011/65/EU), for example, by prohibiting mercury in lamps and by more comprehensively addressing halogenated materials. Phasing out halogenated substances, including PVC, is a key step toward safer, more sustainable products. PVC is the most common halogen-containing plastic in electronics, and its use raises additional concerns due to additives such as plasticizers and stabilizers.

Safer alternatives are increasingly adopted for cables, housings, and other components. Materials such as thermoplastic elastomers (TPE) and thermoplastic polyurethane (TPU) are free from halogens and associated additives while maintaining performance and durability. Transitioning to these alternatives supports safer working conditions, less hazardous products and improved recyclability at end-of-life.

Definitions

An electronic component is considered an individual part or a combination of parts that together perform a specific function and are designed to be directly mounted on or attached to a printed circuit board (PCB). Internal and external power supplies are not included in the definition.

Product housing refers to the enclosure or protective casing of the product that protects internal components and safeguards users from hazards associated with electrical components. This includes protective enclosures as defined in applicable product safety standards, intended to protect against electrical shock, high temperatures, fire, mechanical hazards (e.g. the fan), and radiation (e.g., an internal laser).

A printed circuit board (PCB) is a board consisting of insulating laminate material with conductive pathways that provide electrical interconnections between electronic components. PCB laminate refers to the base insulating material of a PCB before electronic components are mounted.

A power board, or power PCB, regulates the power supply to the device, converting alternating current to direct current.

External cables are supplied with the product for powering it or connecting it to external peripherals (e.g., USB, HDMI, DisplayPort). External cables permanently attached to a peripheral delivered with the product are not included in the requirements.

Applicability

All product categories.

3.2.1 Mandate

The product must not contain the following substances:

1. Heavy metals

Cadmium, mercury, lead and hexavalent chromium.

2. Halogens

PBB, PBDE and HBCDD.

3. Plasticizers

DEHP, BBP, DBP and DIBP.

4. External cables

External cables supplied with the product must be free from polyvinyl chloride (PVC).

5. Halogenated flame retardants, plasticizers and stabilizers

Halogenated flame retardants, plasticizers and stabilizers must not be used in the following parts weighing more than 0.5 grams:

- Product housing
- Printed circuit board laminates
- Cables and wires

6. Testing for bromine and chlorine in the power supply PCB

The largest PCB by area in the internal or external power supply unit must be tested for total bromine and chlorine content, as specified in the clarifications.

Scope, exemptions and maximum concentration values are specified in the clarifications for each restriction.

Submit the following to an approved verifier:

- Test report(s) from a laboratory accredited according to ISO 17025 covering the largest PCB in the power supply.
- A report on the worst-case concentrations by weight in homogeneous materials, and worst-case concentrations in batteries where applicable, shall be reported using the Restricted Substance Template. The report may cover multiple products.

The following is submitted to TCO Development:

- Test report(s) from an ISO 17025 accredited laboratory
- Verification report(s) from a verifier approved by TCO Development.

3.2.2 Clarification

1. Heavy metals

Applies to the entire product.

Exemptions follow EU Directive 2011/65/EU (RoHS) and supporting documents, with the exception that mercury in lamps is not permitted.

Maximum concentration values in homogeneous materials are 0.01% for cadmium, 0.1% for mercury, 0.1% for lead, and 0.1% for hexavalent chromium.

For batteries, maximum concentration values according to Regulation (EU) 2023/1542: 0.0005% mercury, 0.002% cadmium, and 0.004% lead.

Halogens: PBB, PBDE (including decaBDE) and HBCDD.

Applies to the entire product.

Maximum concentration value: 0.1% by weight per restricted substance in homogeneous materials.

2. Plasticizers: DEHP, BBP, DBP, and DIBP.

Applies to the entire product.

Maximum concentration value: 0.1% by weight per restricted substance in homogeneous materials.

3. External cables free from polyvinyl chloride (PVC)

Applies to all external power and peripheral cables supplied with the product. PVC must not be intentionally added.

Maximum concentration value: 0.1% by weight per restricted substance in homogeneous materials.

Exception handling.

PVC-free external cables are the default requirement. An exception may be granted for a specific cable type and market, if PVC-free alternatives are not legally permitted for use, sale, or import due to regulatory or safety approval requirements in that market.

For this exception, the applicant must provide:

- Documented proof of the regulatory or certification constraint.
- Evidence of active engagement with authorities or certification bodies to enable PVC-free approval.
- Confirmation that the transition to PVC-free cables will occur as soon as permitted.

Acceptable evidence may include:

- Written confirmation from certification bodies or authorities.
- Documented communication with regulators or market surveillance authorities.
- Submission records or reference numbers for safety approval applications.

Exceptions are limited to the minimum necessary scope.

Applying for a transitional extended period

Applicants may request authorization for an extended period to complete the transition to PVC-free materials. The applicant must submit a risk assessment questionnaire to TCO Development for approval explaining:

- The reason for the extension request,
- Information on the used substance and the potential substitute/s,
- A timeline for completing the substitution.

If the extension period expires without conformity, the verifier must notify TCO Development to determine appropriate actions, which may include suspending the certificate.

4. Halogenated flame retardants, plasticizers and stabilizers

Applies to all the following weighing more than 0.5 grams

- Product housing parts
 - Includes the stand and external power supply housing
 - Includes the power supply socket/inlet
- Printed circuit boards,
- Cables and wires.
 - External cables supplied with the product
 - Internal detachable power or data cables,
 - Cables permanently attached to electronic components (e.g., fans, speakers).

Exempted:

- Electronic components and PCB laminates sealed inside electronic components.

Maximum concentration value: 0.1% by weight per restricted substance in homogeneous materials. Fluoroorganic additives used to modify dripping behavior or processing properties are exempted up to 0.5% by weight in homogeneous materials.

5. Testing for bromine and chlorine in the power supply PCB

The largest PCB by area in the internal or external power supply unit must be tested in its final state, including laminates but excluding attached electronic components

Accepted test methods:

- IEC 62321-3-1:2013
- IEC 62321-3-2:2020
- EN 14582

Testing must be conducted by an ISO 17025 accredited laboratory.

If the same PCB is used across multiple products, a single test report may be used, provided traceability between the tested sample and the product is verified.

If total bromine or chlorine exceeds 0.1%, additional investigation and testing are required to demonstrate compliance with the restriction on halogenated substances.

If the concentration is below 0.1%, no further testing is required.

References

1. Regulation 2023/1542 concerning batteries and waste batteries
2. EU Directive 2011/65/EU restriction of EEE hazardous substances.
3. Regulation concerning Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), EC 1907/2006

3.3 Accepted product substances

Purpose

Hazardous non-halogenated substances are problematic in the manufacturing and material recovery phases, where workers and the environment can be exposed, leading to human health and environmental risks. This criterion 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.

Both methods align with international standards and regulations that assess chemicals' human health and environmental risks. 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 are independent toxicology firms licensed or qualified by Clean Production Action or ChemFORWARD to provide assessment services to stakeholders for a fee.

TCO Certified Accepted Substance List is a public list of independently assessed safer alternatives considering toxicity and functionality.

Applicability

All product categories.

3.3.1 Mandate

All the following parts weighing more than 0.5 g must only contain intentionally added non-halogenated flame retardants, plasticizers and stabilizers listed on TCO Certified Accepted Substance List:

- Product housing parts
- Printed circuit board laminates
- Cable and wires

Exempted:

- Electronic components, PCB laminates sealed inside electronic components.

All substances in a formulation must be accounted for. Substances that do not appear on TCO Certified Accepted Substance List must not exceed a concentration of 0.1% by weight in the additive formulation.

Submit the following to an approved verifier:

- If a substance is to be added to TCO Certified Accepted Substance List, the applicant must first provide a copy or database access to the certified hazard assessment report conducted by an accepted licensed GreenScreen profiler or qualified ChemFORWARD assessor.

The following is submitted to TCO Development:

- Verification report(s) from a verifier approved by TCO Development.
- A copy or database access to the certified hazard assessment report conducted by an accepted licensed GreenScreen profiler or qualified ChemFORWARD assessor.

3.3.2 Clarification

Applies to all the following weighing more than 0.5 grams

- Product housing parts
 - Includes the stand and external power supply housing
 - Includes the power supply socket/inlet
- Printed circuit board (PCB) laminates,
- Cables and wires.
 - External cables supplied with the product
 - Internal detachable power or data cables,
 - Cables permanently attached to internal electronic components (e.g. fans, speakers).

TCO Certified Accepted Substance List

Non-halogenated alternatives may be used once they:

- Receive an accepted hazard assessment score
- Appear on TCO Certified Accepted Substance List.

Accepted assessments include:

- GreenScreen Benchmark 2, 3 or 4 assigned by a licensed GreenScreen Profiler.
- ChemFORWARD Hazard Band A, B or C assigned by a qualified ChemFORWARD assessor.

GreenScreen Benchmark U may be accepted only if the hazard assessment report states that the worst-case data-gaps scenario results in Benchmark 2 or higher.

TCO Development must have access to the relevant hazard assessment report before a substance can be added to the list.

TCO Certified Accepted Substance List is dynamic, meaning it can be updated as new substances are assessed. Substances may also be reassessed based on new scientific information.

TCO Development may require manufacturers to disclose details of substances used in randomly selected products. To verify that the obligations under this mandate are fulfilled, CAS number disclosure and laboratory assessments of selected parts will be conducted to assess the completeness, quality, and validity of the benchmark score.

Conformity procedure

When the applicant confirms that all substances relevant to this mandate appear on TCO Certified Accepted Substance List, and the documentation is verified as complete, the verifier may issue the verification report. An extended period may be authorized to fulfil this requirement (see “Applying for an extended period” below).

For more information on how to add a substance to TCO Certified Accepted Substance List, visit:

<https://industry.tcocertified.com/guidance/accepted-substance-list/how-it-works/>

Applying for an extended period.

Applicants may request authorization for an extended period to complete hazard assessments or substitute substances for one appearing on TCO Certified Accepted Substance List.

The applicant must submit a risk assessment questionnaire to TCO Development explaining:

- The reason for the extension request,
- Information on the used substance and the potential substitute/s,
- A timeline for completing the hazard assessment or substitution.

If an extension is not granted, only substances appearing on TCO Certified Accepted Substance List may be used before a verification report can be issued

If the extension period expires without conformity, the verifier must notify TCO Development to determine appropriate actions, which may include suspending the certificate.

References

1. <https://www.greenscreenchemicals.org/>
2. <https://www.chemforward.org/>
3. <https://pharos.habitablefuture.org/>

4 Circularity

Direction and focus

The circularity area criteria are intended to move the IT industry toward longer product use and support the TCO Certified roadmap vision of circular flows for certified products, components and materials, with less waste and reduced need for virgin material extraction. The criteria focus on making longer product use more practical, supporting repair and reuse, increasing demand for recovered materials, and strengthening responsible end-of-life flows.

How the criteria create change

The circularity area is built around two connected flows: keeping products in use for longer, and keeping materials in circulation when products can no longer be used as complete products. Across these flows, the criteria prioritize keeping products, components and materials at their highest practical value for as long as possible.

Criteria on warranty, durability, software support, repairability, replaceable components and batteries are intended to support longer product use and make repair more practical. Criteria on secure data removal are intended to make reuse by a second owner more practical. Criteria on standardized connectors and charging compatibility are intended to reduce dependence on product-specific chargers, cables and accessories where the criteria apply.

Criteria on post-consumer recycled content, packaging and e-waste management are intended to strengthen circular material flows by increasing demand for recovered materials, improving recyclability and supporting more responsible take-back and processing.

What this enables

Together, these criteria help make circularity more practical, measurable and credible. Purchasers get clearer information about how certified products support longer use, repair and responsible end-of-life handling. Brands are encouraged to design and support products for repair, reuse and material recovery. Independent verifiers get defined evidence points for checking that product lifetime, repairability, material and end-of-life Criteria are fulfilled consistently.

4.1 Product warranty

Purpose

A long product lifetime depends on products being designed and manufactured for durability and reliable use. Warranty requirements give brand owners an economic incentive to improve quality control, address weaknesses and design products that remain functional for longer. This supports circularity by encouraging products that are less likely to be replaced early because of material or manufacturing defects.

Definitions

Warranty: Manufacturer or brand owner's commercial guarantee of durability for the certified product, covering material or manufacturing defects. For the purpose of TCO Certified, repair or replacement under the warranty must be carried out in accordance with Article 14 of Directive (EU) 2019/771, including "free of charge" as defined in Article 2(14) in all markets where the certified product is sold.

MSRP: Manufacturer's suggested retail price.

Applicability

All product categories.

4.1.1 Mandate

- In all markets where the product is sold the brand owner must offer a 5-year minimum available warranty, where at least 1 year must be included free of charge. (For peripherals as defined in the clarification, this is instead a 3-year available warranty where at least 1 year must be included free of charge.)
- The same warranty conditions must apply during the included warranty period and any purchased extended warranty period.
- Each year of warranty, which is not included free of charge, must be offered for a maximum of 10% of the MSRP of the product and must be available for purchase together with the product.
- For notebooks at least one replacement of the main battery must be provided free of charge within the user-selected warranty period (1-5 years) if the battery has degraded to $\leq 60\%$ State of Health (SoH) and is not "easily replaceable" (as defined in "Battery replaceability" mandate).

Submit the following to an approved verifier:

- A link to a public statement published on the Certified Product Commitment Page as required in the "Information to end users" criterion, showing compliance with the mandate.

The following 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 minimum included warranty in years
- The minimum purchasable extended warranty in years
- The maximum cost (in % of product's MSRP) per year for the extended warranty
- The free battery replacement coverage (notebooks)

- A link to a the public statement published on the Certified Product Commitment Page as required in the “Information to end users” criterion

4.1.2 Clarification

Peripherals

Within TCO Certified, certain product categories are classified as peripherals. These are typically lower-cost, less technically complex products. Peripherals are defined in the guiding document “Peripherals definition”

At the release of this document, the following product categories are defined as peripherals:

- Headsets
- IP phones
- Keyboards
- Mice
- Webcams (not video conferencing systems)
- USB hubs / docks
- Powerbanks
- Chargers.

As new product categories are included in TCO Certified, they will be evaluated if they are considered peripheral or not.

Public statement

The brand owner must provide a link to a public statement in English covering the certified product, where the brand owner commits to the minimum warranty on any market where the product is sold according to the mandate.

- The statement must either be published on, or linked from the “Certified Product Commitment Page” required in the “Information to end users” criterion.
- The brand owner must ensure that the public statement remains accessible during the validity period of the certificate. If the URL changes, the brand owner must provide an updated link.
- The supporting document “Public statement template” is an example of the minimum content of the commitment needed for compliance.
- If the product is only sold in a non-English-speaking market, the statement may be non-English as long as the verifier can translate and confirm that the statement fulfills the minimum requirements and can translate it into English.
- If product components have different warranty periods, or if different warranty periods are offered in different regions, the worst-case scenario for the product (least number of years) must be used in the statement.
- The statement must include information on how to purchase an extended warranty, for example, directly from the brand owner's webshops or through a retailer.
- The statement must mention that one replacement of the main battery is included in the warranty if it reaches 60% SoH within the warranty period for notebooks with batteries requiring tools to replace.
- The statement must show the minimum free and purchasable extended warranty period in years.

- The statement must confirm that the same warranty conditions apply during the included warranty period and any purchased extended warranty period.

Cost for extended warranty

If several years can be purchased at the same time, all available lengths of the plan must fulfill the criterion.

Example: MSRP = 1000 EUR, 10% gives a maximum warranty cost of 100 EUR/year.

2-year warranty can cost maximum 100 EUR.

3-year warranty can cost maximum 200 EUR.

5-year warranty can cost maximum 400 EUR.

Note

A pre-installed battery information and protection software that can determine if the main battery has degraded to $\leq 60\%$ State of Health (SoH) is mandatory in TCO Certified under the “battery information and protection software” criterion.

Supporting documentation

1. Public statement template

available at: <https://industry.tcocertified.com/documents/>

4.2 Security and functionality software updates

Purpose

Devices may become obsolete or vulnerable when software updates are no longer provided, putting user data at risk and shortening the useful life of the device. Therefore, TCO Certified intends to address the following challenges:

- **Consumer Protection:** Consistent security updates minimize risks from cyber threats and unauthorized data access.
- **Device Longevity:** By ensuring security and corrective updates, products can maintain original functionality for longer, delivering better value to users and reducing electronic waste.
- **Brand owner accountability:** A defined support period helps ensure that brand owners take responsibility for software support and post-sale maintenance.

Definitions

Security update: A software or firmware update, including security patches, if relevant for a given device, whose main purpose is to provide enhanced security for the device.

Corrective update: A software or firmware update, including corrective patches, whose purpose is to provide corrections to bugs, or malfunctions in the operating system.

End of placement on the market: The later date of either when the product was marketed by the brand owner or when it was last manufactured.

Core functionality : Core functionality means that all hardware components and interfaces included at first delivery must remain functional at their original level and be maintained to address known security threats, including those identified after first delivery.

Applicability

All product categories

4.2.1 Mandate

- The brand owner must make a public statement to ensure the availability of free-of-charge security and corrective software and firmware updates necessary to retain core functionality of the product for at least 6 years after the end of placement of the product on the market. For peripherals, (as defined in the clarification), this is instead 5-years.
- For notebooks, desktops and All-In-One PCs, the brand owner must ensure that the product can install and boot at least one alternative, locally installed, Linux based or equivalent Operating System, and that firmware, drivers are available to maintain core functionality for this OS for at least 6 years after the end of placement of the product on the market.

Submit the following to an approved verifier:

Documented proof of compliance with the mandate, including at least:

- A link to a public statement published on the Certified Product Commitment Page as required in *Information to end user* criterion, showing compliance with the mandate.

- The number of years after the end of placement of the product on the market covered by the brand owner's public commitment to provide free-of-charge security and corrective software updates

The following 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:

- A link to a public statement where the brand ensures the availability of free-of-charge security and corrective software updates for the certified product for the required support period.
- The number of years after the end of placement of the product on the market covered by the brand owner's public commitment to provide free-of-charge security and corrective software updates.

4.2.2 Clarifications

Third party operating systems

For some product categories, brand owners rely on third party operating systems (OS), including systems provided by e.g. Microsoft or Google. When a product uses such an OS, the brand owner cannot know, and take responsibility for, if software support will be offered by the third party for the entire mandated period. Therefore an alternative OS must be possible to use.

Alternative operating system

If the software update support expires for the pre-installed OS, the product must not be technically restricted to the preinstalled operating system in a way that prevents installation, booting or continued use of a supported alternative operating system. Where Secure Boot or similar boot integrity mechanisms are used, the product must allow a documented method to disable Secure Boot, enroll user provided keys, or otherwise boot the supported alternative operating system.

Support may be demonstrated through mainline Linux kernel support, support in a maintained Linux distribution, publicly available drivers, or a documented commitment to provide upstream support.

Firmware updates necessary for security or continued operation must be available through a documented method that does not depend on an operating system that is no longer maintained. Examples include LVFS, fwupd, UEFI update, bootable update image, or an equivalent method accepted by the verifier.

Core functionality

Core functionality means that all hardware components and hardware interfaces included in the certified product at first delivery to the end user must remain functional at least to the same functional level as at first delivery.

This includes at least, where applicable, processor operation, graphics, internal and external display functionality, internal storage, wired and wireless networking, keyboard, pointing device, touchscreen, webcam, microphone, speakers, audio input and output, battery charging, power management, sleep and wake functionality, docking functionality, expansion ports, external connection ports, firmware update mechanisms, and security related hardware functionality needed for continued operation.

Public statement on the information page

The public statement must explain how the free-of-charge security and corrective software updates will be provided. The statement must either be on, or linked from the “Information web page” specified in mandate 1.1 D in TCO Certified. The brand owner must ensure that the public statement remains accessible during the validity period of the certificate. If the URL changes, the brand owner must provide an updated link.

Peripherals

Within TCO Certified, certain product categories are classified as peripherals. These are typically lower-cost, less technically complex products. Peripherals are defined in the guiding document “Peripherals definition”

At the release of this document, the following product categories are defined as peripherals:

- Headsets
- IP phones
- Keyboards
- Mice
- Webcams (not video conferencing systems)
- USB hubs / docks
- Powerbanks
- Chargers.

As new product categories are included in TCO Certified, they will be evaluated if they are considered to be a peripheral or not.

Supporting documentation

1. Public statement template

available at: <https://industry.tcocertified.com/documents/>

4.3 Post-consumer recycled content

Purpose

Requiring post-consumer recycled content creates predictable demand to put materials back into productive use, reducing dependence on virgin resources, and creating demand that strengthens the collection, sorting, and recycling infrastructure needed for circular material flows over time.

Definitions

PCR materials: Post-consumer recycled materials, materials derived from used consumer products. For example, metals and plastics.

PCR material content ratio: The weight of PCR materials in the product divided by the total product weight. Expressed as a percentage.

Applicability

All product categories.

4.3.1 Mandate

All product configurations must contain at least 5% PCR materials by weight of the product.

Submit the following to an approved verifier:

- The completed PCR material template
- Documented proof for all parts claiming PCR content.
- The total weight of the heaviest product configuration, including the power supply and cables (without packaging), in kg.

The following is submitted to TCO Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
- Documented proof for all parts claiming PCR content.

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

- The weight of all plastics in the product.
- The weight of all post-consumer recycled plastics in the product
- The weight of identified non-plastic post-consumer recycled material in the product.
- The total weight of the heaviest product configuration, including the power supply and cables (without packaging) in kg.

4.3.2 Clarifications

The PCR content requirement applies to all material types in the product; including metals and plastics etc. Post Industrial Recycled content (PIR) can not be used to claim PCR content. Ocean bound plastics (OBP) may not be used to claim PCR plastic content

This criterion is based on the principle that only verifiable and traceable post-consumer recycled (PCR) material can be credited toward compliance. Claims of PCR content must therefore be supported by part-level documentation from independent third parties, regardless of prevailing industry practices or existing recycled-content certifications. Materials or components for which PCR content cannot be reliably traced and documented are not eligible to be included in the PCR calculation. The difficulty of traceability, or the absence of PCR-specific documentation in current supply chains, does not exempt materials or product categories from the requirement; rather, it defines the boundary between what can and cannot be counted. This approach is intended to ensure credibility, comparability, and a clear demand signal for post-consumer material recovery.

Example calculation for mix of materials

Lithium cobalt dioxide (LiCoO_2) contains 5.6% cobalt by weight. The cobalt content is sourced entirely from post-consumer recycled (100%PCR) material, with 0% pre-consumer recycled (PIR) and 0% post-industrial content (PIC).

For a component consisting of 100% Lithium cobalt dioxide with a total weight of 50 g, the amount of post-consumer recycled cobalt is calculated as follows:
 $50 \text{ g} \times 5.6\% = 2.8 \text{ g}$.

Therefore, 2.8 g of post-consumer recycled material can be reported in the PCR template.

Tested Configuration

- The assessment must be done on the product configuration with the lowest PCR material content ratio available for purchase.
- The tested configuration must be specified with a list of configuration choices and a product code.
- It is optional to report a second configuration representing the best case PCR content ratio by submitting a separate submission of the PCR material template. Doing so will result in a range being presented for the product on TCO Certified Product Finder.

Filling in the template

The PCR material template is available at tcocertified.com/certification-documents

- Plastic parts weighing less than 0.5g may be excluded from the PCR material template.
- Non-plastic parts without PCR content do not need to be listed individually.
- The following components are exempted when calculating the total weight of plastics in the product: Optical components, 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.

- If an external power supply is shipped with the product, it must be included in the template.

Documented proof

Documented proof from 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.

TCO Development reserves the right to require a full bill of materials.

Reporting of the total weight of the heaviest product configuration.

In addition to reporting the total weight of the heaviest product configuration, including the power supply and cables (without packaging) in kg, it is optional to report a second configuration representing the product configuration with the lowest total weight of the product, including the power supply and cables (without packaging) in kg. Doing so will result in a range being presented for the product on TCO Certified Product Finder.

Draft

4.4 Product packaging

Purpose

To promote packaging materials that are recyclable and, at the same time, pose a lower environmental risk if they are not properly managed after use. By phasing out plastics and encouraging alternatives such as corrugated paper. The criterion supports packaging solutions that are easier to recycle and less harmful if they end up outside controlled waste streams.

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.

- 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 the material can be recycled instead of becoming waste.
- Even for packaging materials that can be separated into single materials, only a small percentage 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.

Definition

Packaging: According to the 94/62/EC definition of sales packaging or primary packaging, i. e. packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase

Applicability

All product categories.

4.4.1 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.
- For packaging solutions that are comprised of $\geq 10\%$ plastic, by weight of all packaging materials, the following must be fulfilled:
 - $\geq 50\%$ of the total plastic packaging must be composed of post-consumer recycled plastics, by weight.

Hazardous substances in packaging

- Any intentionally added flame retardants, plasticizers, and stabilizers used in the packaging must appear on TCO Certified Accepted Substance List.
- Non-recycled 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:

- Completed post-consumer recycled content template - packaging section.

- Document proof from the material vendor must be provided for each part containing post-consumer recycled plastics.
- Restricted substance template

The following 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:

- Total weight of all packaging materials
- Total weight of all plastic content in the packaging solution
- Total weight of post-consumer recycled plastic materials

4.4.2 Clarification

Packaging solutions that contain more than one individual product are not covered by the mandate, such as bulk packaging solutions.

Documented proof from 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. TCO Development reserves the right to require a full bill of materials.

The following information must be submitted to an approved verifier

For each packaging part weighing more than 0.5g, the following must be reported in the “postconsumer recycled content & packaging template”, packaging tab:

- Material Type
- Weight of part
- Weight of plastics in part
- Weight of PCR plastic content
- PCR material manufacturer name
- PCR material identifier

Supporting documentation

1. Post-consumer recycled content & packaging template available at: <https://industry.tcocertified.com/documents/>

4.5 E-waste management

Purpose

E-waste is one of the fastest-growing waste streams globally, and large amounts are still exported to countries with limited capacity to manage it safely. This often leads to informal handling, pollution, health risks, and the loss of valuable materials. While the Basel Convention restricts hazardous e-waste movements, enforcement and national regulations vary widely. Many countries lack effective e-waste legislation, EPR systems, or clear collection and recycling targets. To address these gaps, brand owners must ensure responsible take-back and processing of their products, improving traceability and resource recovery where formal systems are missing. This criterion drives safer, more consistent global e-waste management.

Definitions

EPR (Extended Producer Responsibility): A policy approach where producers are financially and/or physically responsible for managing products at end-of-use.

Reuse and Recycling Facility (RRF): A first-tier facility that processes collected products for reuse or material recovery, certified according to R2, e-Stewards, WEEELABEX, EN 50625, TS.LB.001 v1.1, or equivalent.

First-tier facility: A directly contracted or subcontracted facility that initially receives and processes collected e-waste.

Applicability

All product categories.

4.5.1 Mandate

- All certified products put on the market must be covered by product take-back systems.
- In countries without functional E-waste Management Systems, the brand owner must ensure that the combined total take-back volume of IT products is at least 5% of the combined total weight of certified products sold across these countries.
- At least 60% of all first-tier reuse and recycling processing facilities used by non-EPR systems are certified according to R2, e-Stewards, WEEELABEX, EN 50625, TS.LB.001 v1.1, or TCO Certified-approved equivalent.

Submit the following to an approved verifier:

Annually before 31 August:

- A filled-out TCO Certified E-waste management template covering the previous calendar year.
- Supporting documentation, including:

- Active contracts with take-back systems for countries without functional E-waste Management Systems.
- Evidence of total take-back volumes carried out in countries without functional E-waste Management Systems. (in the form of contracts with take-back systems).
- Valid certificates for all reuse and recycling facilities used by the take-back systems.

The following 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

4.5.2 Clarification

Reporting period

All reporting must be submitted by 31 August each year and must cover the previous calendar year. The obligation to report continues until one year after the certificate expires.

Countries with functional E-waste Management Systems

TCO Development defines a country to be without functional E-waste management systems if any of the following parameters in “The Global E-waste Monitor 2024” or later are not fulfilled:

- National e-waste legislation
- EPR for e-waste
- Collection targets
- Recycling targets

A complete list of countries and their respective status can be found on tco-certified.com.

Reporting and verification guideline

The brand owner must complete the TCO Certified E-waste Management Template. In this template, the brand must provide the following information:

1. Take-back Coverage

For every country that does not have a Functional E-waste Management System, and where the brand owner’s certified product sales represent more than 0.5% (the percentage should be rounded to the nearest whole percentage) of their global certified sales, the brand owner must ensure that at least one take-back system covers that country.

- The brand owner must provide a contract between the brand owner and each take-back system that confirms the agreed services.
- If the take-back system is owned by the brand owner, documentation must be provided showing how users are informed about how to deliver their E-waste in that country. (e.g. website with the take-back option/process)

2. Reuse- and recycling facilities

At least 60% of first-tier reuse and recycling facilities used in all countries without a Functional E-waste Management System must be certified according to R2, e-Stewards, WEEELABEX, EN 50625, TS.LB.001 v1.1, or TCO Certified-approved equivalent.

- For each facility, the brand owner must provide a contract between the first-tier reuse and recycling facilities and the take-back system.

3. Manufacturing Volumes

Per product category:

- Number of certified products manufactured during the reporting year.
- Total weight (kg) of these certified products.

To estimate the total weight of certified products, the following default weights must be used unless the brand owner can prove real product weights, in which case those may be used instead:

- Display and AIO PCs 6 kg
- Notebooks 2 kg
- Tablets 1 kg
- Smartphones 0.3 kg
- Desktops 9 kg
- Projectors 8 kg
- Headsets 0.3 kg
- Servers 20 kg
- Network Equipment 7 kg
- Data storage 40 kg
- Other categories (to be added if needed, contact TCO Development)

4. Take-Back Volumes

The brand owner must report the total weight of products collected during the reporting year, broken down by product category, for all countries without a Functional E-Waste Management System.

- This must be verified through a contract or service agreement with the take-back system that specifies the processed weight and the time period covered.

Verification and Reporting

If the verifier identifies discrepancies or incomplete data, the brand owner must provide clarifications or corrected submissions within 30 days of the verifier's request.

TCO Development has the right to require independent verification of sales volumes and reported take-back volumes.

Products collected through take-back

IT products collected through the take-back system do not need to be of the same brand name or product category as the reporting brand owner.

Supporting documentation

E-waste management template available at: <https://industry.tcocertified.com/documents/>

References

1. The Global E-waste Monitor 2024
https://www.itu.int/en/ITU-D/Environment/Documents/Publications/2025/d-gen-e_waste.01-2024-pdf-e.pdf

Draft

4.6 Electrical safety

Purpose

IT products must be safe to use. Compliance with electrical safety standards is important to protect users from hazards such as electrical shock, fire, mechanical or thermal injury.

Applicability

All products with built-in or external power supplies.

4.6.1 Mandate

The product and external power supply (s) must be certified to IEC 62368-1, Edition 3 or later.

Submit the following to an approved verifier:

- A copy of a valid CB certificate for the product.
- For each external power supply shipped with the product:
 - A copy of a valid CB certificate or a national certificate from a CB member (NCB) for the external power supply
 - The manufacturer and model name
 - The external power supply's protection classification

The following is submitted to TCO Development:

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

4.6.2 Clarification

For products classified as medical equipment, IEC 60601-1, Edition 3.2 or later, can be used instead of IEC 62368-1.

For certificate upgrades from TCO Certified, generation 10, IEC 62368-1, Edition 2 may be used.

References

IEC62368-1 Audio/video, information and communication technology, Part 1 -Safety requirements

4.7 Replaceable components

Purpose

Extending the lifetime of IT products is one of the most effective ways to reduce their environmental impact. Components that often break or become outdated may limit the total lifespan of the product and should be possible to replace. By providing the user with clear instructions on how to replace these critical components and how to access spareparts, 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 panel: Main display panel or display panel assembly.

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, the central printed circuit board (PCB) in a computer. It acts as the backbone that connects all vital internal components—such as the CPU, memory, and storage.

Keyboard: Built-in keyboard.

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

End of placement on the market: is defined as the later date of either when the product was marketed by the brand owner or when it was last manufactured.

Applicability

All product categories.

4.7.1 Mandate

The brand owner must publicly declare the following:

For at least 6 years after the end of placement of the product on the market, and for at least all critical components listed in TCO Certified for the product category, the brand owner ensure:

- the availability of free of charge repair manuals
- access to purchase spare parts

(for peripherals, this is instead at least 5-years)

Submit the following to an approved verifier:

- A link to the manual on the brand owner website and a copy of the material that will be published there during the validity of the certificate
- Documentation showing how end users can access or purchase the listed critical components.

The following 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 repair manual.
- A link to a public statement published on the Certified Product Commitment Page as required in the *Information to end users* criterion, showing compliance with the mandate.

4.7.2 Clarifications

Peripherals

Within TCO Certified, certain product categories are classified as peripherals. These are typically lower-cost, less technically complex products. Peripherals are defined in the guiding document “Classification of peripherals” available for download at <https://industry.tcocertified.com/documents/>.

Repair manuals

The repair instructions may be placed in a separate repair manual or may be part of the user manual. At least the following information must be available:

- The brand owner must provide a manual including step-by-step instructions and component descriptions for the disassembly and assembly of the product in order to replace all critical components.
- The listed critical components do not need to be disassembled themselves. (The instructions only need to describe how to replace them.)
- A critical 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 critical components must be available online.
- 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 repair manual.

Access to spare parts

- The brand owner must prove that they have a system in place that allows the end user to access spare parts of all the listed critical components for the product category. Either offering purchase of the components directly on the product information page. Or providing a registry of local authorized vendors of the components on that same page as required in the *Digital product passport* criterion.

Table of critical components per product category.

The table below lists critical components for each product category.

Only components that are present in the product are included; components not used in the product are exempt.

Draft 2 note from TCO Development: Please add your feedback about the added components highlighted in red in the table below.

	Fixed external cables	External/Internal PSU	System board	Display panel	Battery	CPU	Storage	RAM	GPU	Keyboard
Displays	X	X*	X	X						
All-in-one PCs	X	X	X	X		X	X	X	X	
Desktops	X	X	X			X	X	X	X	
Notebooks	X	X	X	X	X		X	X	X	X
Tablets	X	X	X	X	X		X	X	X	
Headsets	X	X			X					
Smartphones	X	X		X	X					
General	X	X			X		X			

*= Only external PSU for Displays.

Public statement on the information page

The public statement must explain how the replaceable components may be purchased. The statement must either be on, or linked from the "Information web page" specified in mandate 1.1 D in TCO Certified. The brand owner must ensure that the public statement remains accessible during the validity period of the certificate. If the URL changes, the brand owner must provide an updated link.

Supporting documentation

1. Public statement template

available at: <https://industry.tcocertified.com/documents/>

4.8 Standardized connectors

Purpose

By using one standardized interface (USB Type-C) for charging and data transfer, fewer cables need to be manufactured, and the 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.

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

All product categories.

4.8.1 Mandate

Notebooks, Desktops, AIOs

The device must be equipped with at least one USB Type-C receptacle compatible with Thunderbolt 4 or USB4 or later, and that remains accessible and operational at all times.

Smartphones, Tablets

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

General, Headsets

The device must be equipped with at least one USB Type-C receptacle compatible with USB 2.0 or faster and that remains accessible and operational at all times.

Displays

The device must be equipped with at least one USB Type-C receptacle compatible with DisplayPort or HDMI and that remains accessible and operational at all times.

Submit the following to an approved verifier:

- Documentation describing and proving how the mandate is fulfilled

The following is submitted to TCO Development:

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

4.8.2 Clarifications

Products with no connectors

If the product does not have any connectors, it is exempted from this criterion.

Accepted documentation for proving compliance

A product manual, including an exploded diagram of the device illustrating the types of connectors used in the product.

or

A technical specification document describing which specifications the USB Type-C connector can fulfill, together with a picture of the port.

Displays manufactured before 2028-01-01 do not need to fulfill this mandate.

Draft

4.9 Secure data removal

Purpose

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.

Applicability

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

4.9.1 Mandate

The brand owner must provide a free-of-charge media sanitization solution for the product, including instructions on how it is used.

Submit the following to an approved verifier:

Necessary documentation describing and proving how the mandate is fulfilled:

- How the media sanitization solution is distributed and that it conforms with “Clear” according to IEEE P2883.
- or
- Proof that approved data encryption technologies are pre-installed.

The following is submitted to TCO Development:

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

4.9.2 Clarification

The brand owner must provide a media sanitization solution for the product, in one of the following ways:

1. Pre-installing it on/in the product before it is shipped.
2. Providing a remote secure data removal service upon request, free of charge.
3. Providing an on-site secure data removal service upon request, free of charge.

The selected media sanitization solution above must conform with the method of "Clear" in IEEE P2883 or ISO/IEC 27040:2024. Users must be able to use it at least once, free of charge.

OR

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

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.

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.

4.10 Standardized external power supply compatibility

Purpose

Many products still use product-specific charging interfaces, cables, chargers or charging cases, which can make these accessories difficult to reuse across products. Standardized charging interfaces can reduce the need to manufacture dedicated chargers and cables, and increase the reuse of existing charging equipment.

For low-power products, a USB Type-C charging interface can provide sufficient interoperability. For products with higher charging power needs, USB Power Delivery and standardized EPS-device communication are needed to ensure reliable compatibility with external power supplies. Wireless charging can provide an alternative standardized charging method when it follows the Qi specification.

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.

4.10.1 Mandate

A. Low-power wired charging

Products with a maximum declared charging input power of 15 W or less must carry a USB Type-C receptacle for charging.

The product must be chargeable from a standard USB Type-C power source providing sufficient power, without vendor-specific restrictions.

B. USB-PD wired charging

Products with a maximum declared charging input power of more than 15 W and up to 240 W must carry a USB Type-C receptacle that:

1. supports USB Power Delivery according to USB-IF specifications version 3.0 or newer,
2. implements all mandatory identification and interoperability information sets defined in EN/IEC 63002:2021 or newer, and
3. allows charging from any USB-PD-compliant external power supply providing sufficient power, without vendor-specific restrictions.

C. Wireless charging

The product must have built-in wireless charging capability that complies with Qi Wireless Power Transfer System, Power Class 0 Specification version 1.2.4, or future revisions.

For products delivered with a charging case, the charging case must fulfill this criterion. If the case contains a wired charging interface, the applicable requirement in A or B must be fulfilled. If the case supports wireless charging, C must be fulfilled.

Submit the following to an approved verifier:

- Necessary documentation describing and proving how the mandate is fulfilled

The following is submitted to TCO Development:

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

4.10.2 Clarification

For products with a maximum declared charging input power of 15 W or less, USB Power Delivery and EN/IEC 63002 compliance are not required. These products must still be chargeable through USB Type-C from a standard USB Type-C power source providing sufficient power, without vendor-specific restrictions.

For products with a maximum declared charging input power of more than 15 W and up to 240 W, interoperability requirements for external power supplies follow EN/IEC 63002:2021 or newer, including all mandatory identification and communication information sets required for EPS–device compatibility.

For products delivered with a charging case, the charging case must fulfill this criterion. If the charging case contains a wired charging interface, the applicable wired charging requirement must be fulfilled based on the maximum declared charging input power of the charging case. If the charging case supports wireless charging, it must comply with the Qi requirements above.

4.11 Color gamut

Background

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

Definition

The color characteristics of a display are based on the visual appearance of the primary color stimuli of the display, the R, G, B-stimuli. The color gamut of a device or process is that portion of the color space that can be represented or reproduced.

Applicability

Non-monochromatic displays and all-in-one PCs with backlit or light emitting pixels.

4.11.1 Mandate

The following mandates must be met:

1. The minimum color triangle must be $\geq 29\%$.
2. The following tolerances to the sRGB coordinates:

Coordinate	Red		Green		Blue	
	u'	v'	u'	v'	u'	v'
Requirement	≥ 0.411	≥ 0.503	≤ 0.140	≥ 0.548	≥ 0.150	≤ 0.210

The following 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 values must be reported in TCO Certified Portal.

4.11.2 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 more saturated and the wider the range of colors the screen is capable of presenting if the same numbers of color bits are used. The relative color gamut calculation in this document is expressed as a percentage of the total CIE 1976 uniform chromaticity scale diagram. However, it is also important that the u' and v' for red, green and blue are accurate enough to present as true colors as possible.

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

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 test square centers at the measurement distance described in chapter 9. 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 chapter 9 may be used for these measurements. Change the color of the area for each measurement.

Reference color coordinates are based on sRGB: Red ($u' 0.451, v' 0.523$), Green ($u' 0.125, v' 0.563$), Blue ($u' 0.175, v' 0.158$) which corresponds to 33.3% of the total CIE 1976 uniform chromaticity scale diagram (100% sRGB and 87% Adobe RGB).

Test evaluation

Mandate 1

Calculate the color gamut using the equation below.

$$A (\%) = 256.1 \times |(u'R - u'B)(v'G - v'B) - (u'G - u'B)(v'R - v'B)|$$

The indexes R, G and B are short for Red, Green and Blue.

Example: The following reading gives a gamut of $A = 31.65\%$

Red $u'/v' = 0,436/0,526$

Green $u'/v' = 0,132/0,572$

Blue $u'/v' = 0,181/0,158$

Mandate 2

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 chapter 9

References

1. ISO 13406-2 Ergonomic requirements for work with visual displays based on flat panels - Part 2: Ergonomic requirements for flat panel displays. International Organisation of Standardisation.
2. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 574-575.
3. ITU-R Recommendation BT.709-5: Parameter values for the HDTV standards for production and international programme exchange
4. E.B.U. Standard for chromaticity tolerances for studio monitors Tech. 3213-E August 1975.
5. SMPTE 170M-1999 Television - Composite Analogue Video Signal - NTSC for Studio Applications.
6. Hunt, R.W.G. Measuring colour. 3rd edition (1998), Kingsley-Upon-Thames: Fountain Press.
7. CIE Publication 15.2 (1986), Colorimetry, p. 11, p.27-28 and p. 53-54, table 1.3).
8. Roberts, A., Eng, B., (1995) "A method for the calculation of tolerances for display primary chromaticity coordinates" Research and development Department, Technical Resources, The British Broadcasting Corporation.
9. <http://www.w3.org/Graphics/Color/sRGB.html>
10. SMPTE RP 145-1994: SMPTE C Colour Monitor Colorimetry
11. IEC 61966-2-1 (1999-10) Multimedia systems and equipment - Colour measurement and management - Part 2-1: Colour management - Default RGB colour space – sRGB.
12. ITU-R Recommendation BT.470-6: Conventional television systems.
13. ISO TC130 WD 12646 p. 5 Section 4.7 Chromaticity and luminance of the white and black points and tracking.
14. www.srgb.com
15. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall.
16. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 12, Colour difference thresholds p. 279.
17. ISO 9241-8 Ergonomic requirements for office work with visual display terminals (VDTs) - Part 8: Requirements for displayed colours. International Organisation of Standardisation.

4.12 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 displays and all-in-one PCs with backlit or light emitting pixels.

4.12.1 Mandate

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

The following 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 values must be reported in TCO Certified Portal.

4.12.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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 display screen plane at nine points. The four 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* (section 5.9.2)). Finally, the center position (5) is measured.

In addition to the nine default positions, the color uniformity must also be evaluated visually by the technician in order to find areas where the color varies the most. 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 chapter 9

References

1. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
2. ISO 13406-2 Ergonomic requirements for work with visual displays based on flat panels - Part 2: Ergonomic requirements for flat panel displays. International Organisation of Standardisation.
3. Kokoschka S. (1986). Visibility aspects of VDUs in terms of contrast and luminance. Behaviour and information technology. vol.5, No. 4, pp 309-333.
4. Hunt, R.W.G. Measuring colour. 3rd edition (1998), Kingsley-Upon-Thames: Fountain Press.
5. CIE Publication 15.2 (1986), Colorimetry, p. 11, p.27-28 and p. 53-54, table 1.3).
6. Roberts, A., Eng, B., (1995) "A method for the calculation of tolerances for display primary chromaticity coordinates" Research and development Department, Technical Resources, The British Broadcasting Corporation.
7. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, pp 278-279.
8. Fairchild M. D. (1995), "Considering the surround in device-independent colour imaging". www.cis.rit.edu/people/faculty/fairchild/PDFs/Bart.pdf
9. ISO TC130 WD 12646 p. 5 Section 4.7 Chromaticity and luminance of the white and black points and tracking.
10. ISO 9241-8 Ergonomic requirements for office work with visual display terminals (VDTs) - Part 8: Requirements for displayed colours. International Organisation of Standardisation.

4.13 Color grayscale linearity

Background

A well-tuned color grayscale is the basis for good color rendering of the screen. This is measured by comparing 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 displays and all-in-one PCs with backlit or light emitting pixels..

4.13.1 Mandate

$\Delta u'v' \leq 0.020$ between 28 evenly distributed grayscale levels combinations.

Table *color grayscale linearity 1*

	Maximum $u'v'$ difference							
Grayscale	255	225	195	165	135	105	75	45
255	0							
225	0.020	0						
195	0.020	0.020	0					
165	0.020	0.020	0.020	0				
135	0.020	0.020	0.020	0.020	0			
105	0.020	0.020	0.020	0.020	0.020	0		
75	0.020	0.020	0.020	0.020	0.020	0.020	0	
45	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0

The following 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 largest $\Delta u'v'$ measurement must be reported in TCO Certified Portal.

4.13.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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 center of the measurement area, from the distance described in chapter 9. Measure the chromaticity coordinates at the center of the measurement area for each grayscale step specified above. Change the grayscale of the area for each measurement.

Test evaluation

A spreadsheet is available on tco certified.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.

Overall uncertainty

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

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

See chapter 9

References

1. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
2. Bilissi, E., Jacobson, R. E., and Attridge, G. G (2008): "Just noticeable gamma difference and acceptability of sRGB image display on a CRT monitor, Imaging Technology Research Group, University of Westminster, Harrow, UK, The Imaging Science Journal Vol 56, 189-200.
3. Kokoschka S. (1986). Visibility aspects of VDUs in terms of contrast and luminance. Behaviour and information technology. vol.5, No. 4, pp 309-333.

4. Hunt, R.W.G. Measuring colour. 3rd edition (1998), Kingsley-Upon-Thames: Fountain Press.
5. CIE Publication 15.2 (1986), Colorimetry, p. 11, p.27-28 and p. 53-54, table 1.3).
6. Roberts, A., Eng, B., (1995) "A method for the calculation of tolerances for display primary chromaticity coordinates" Research and development Department, Technical Resources, The British Broadcasting Corporation.
7. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, pp 278-279.
8. Fairchild M. D. (1995), "Considering the surround in device-independent colour imaging". www.cis.rit.edu/people/faculty/fairchild/PDFs/Bart.pdf

Draft

4.14 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 a 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 according to a number of standards such as D65, sRGB and 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 displays and all-in-one PCs with backlit or light emitting pixels.

4.14.1 Mandate

The product's default preset correlated color temperature may have any name but must have a color difference $\Delta u'v' \leq 0.012$ when compared to CIE u' and v' chromaticity coordinates for D65.

The following 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.
-

4.14.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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 centre 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

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 5.26). The relevant CIE material – conversion formulae and tabulated data for u'_{CCT} and v'_{CCT} – can also be found on 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 chapter 9

References

1. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
2. ISO 13406-2 Ergonomic requirements for work with visual displays based on flat panels - Part 2: Ergonomic requirements for flat panel displays. International Organisation of Standardisation.
3. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 567-569.

4. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 574-575.
5. ITU-R Recommendation BT.709-5: Parameter values for the HDTV standards for production and international programme exchange
6. E.B.U. Standard for chromaticity tolerances for studio monitors Tech. 3213-E August 1975.
7. SMPTE 170M-1999 Television - Composite Analogue Video Signal - NTSC for Studio Applications.
8. Hunt, R.W.G. Measuring colour. 3rd edition (1998), Kingsley-Upon-Thames: Fountain Press.
9. CIE Publication 15.2 (1986), Colorimetry, p. 11, p.27-28 and p. 53-54, table 1.3).
10. Roberts, A., Eng, B., (1995) "A method for the calculation of tolerances for display primary chromaticity coordinates" Research and development Department, Technical Resources, The British Broadcasting Corporation.
11. <http://www.w3.org/Graphics/Color/sRGB.html>
12. SMPTE RP 145-1994: SMPTE C Colour Monitor Colorimetry
13. IEC 61966-2-1 (1999-10) Multimedia systems and equipment - Colour measurement and management - Part 2-1: Colour management - Default RGB colour space – sRGB.
14. ITU-R Recommendation BT.470-6: Conventional television systems.
15. ISO TC130 WD 12646 p. 5 Section 4.7 Chromaticity and luminance of the white and black points and tracking.
16. ISO 3664:1999, Viewing conditions for graphic technology and photography, p. 5, 4.2.4 Surround and backing for reflection viewing, Note 1 p. 8.
17. Schenkman, B., and Kjell Dahl, L. (1999). Preferred colour temperature on a colour screen. Displays, 20, 73 - 81.
18. www.srgb.com
19. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall.
20. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 12, Colour difference thresholds p. 279.
21. ISO 9241-8 Ergonomic requirements for office work with visual display terminals (VDTs) - Part 8: Requirements for displayed colours. International Organisation of Standardisation.

4.15 Color uniformity – angular dependence

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. Angular-dependent color variations on an active white or gray screen may 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 displays and all-in-one PCs with backlit or light emitting pixels.

4.15.1 Mandate

In landscape mode, the $\Delta u'v'$ of white color 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 $\Delta u'v' \leq 0.024$.

The following 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.

4.15.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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*, below. 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 chapter 9.

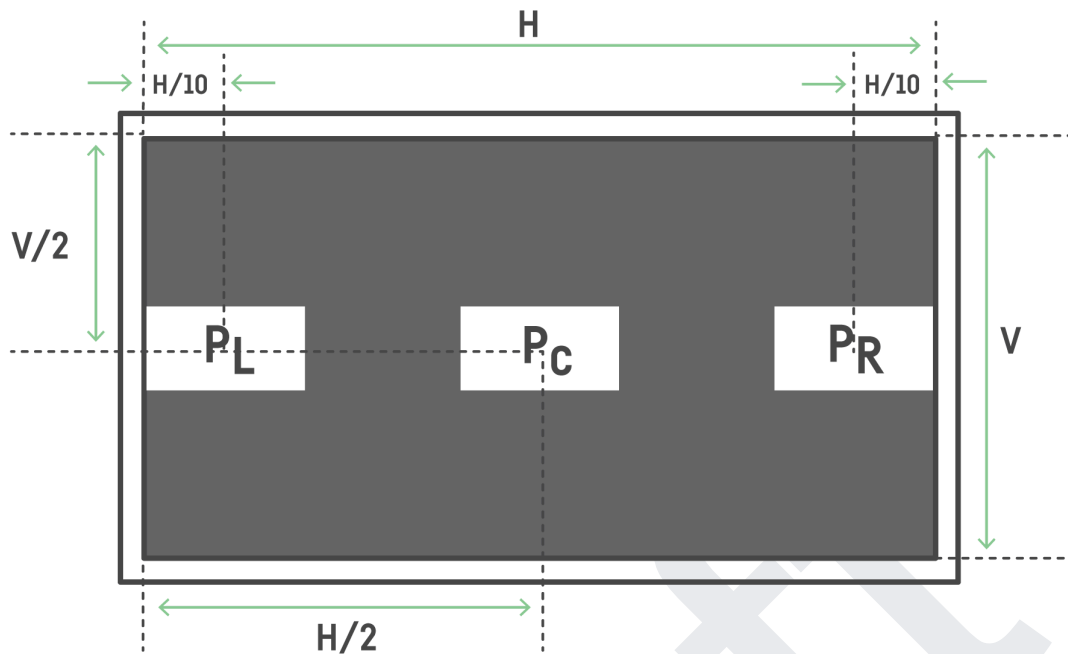


Figure *color uniformity - angular dependence 1*. Measurement positions for color uniformity-angular dependence.

Equipment

Spectroradiometer 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 from the distance described in chapter 9.
- The spectro-radiometer must be turned towards positions P_L and P_R and focused. The color coordinates at positions P_L and P_R ($u'_{P_L/0}$, $v'_{P_L/0}$ and $u'_{P_R/0}$, $v'_{P_R/0}$ respectively) must be recorded.
- The screen must then be rotated +30 degrees around a vertical axis through the screen's center-point and the chromaticity coordinates at positions P_L , P_R , ($u'_{P_L/+30}$, $v'_{P_L/+30}$ and $u'_{P_R/+30}$, $v'_{P_R/+30}$ respectively) must be recorded.
- The screen must finally be rotated -30 degrees around a vertical axis through the screen's center-point and the chromaticity coordinates at positions P_L , P_R , ($u'_{P_L/-30}$, $v'_{P_L/-30}$ and $u'_{P_R/-30}$, $v'_{P_R/-30}$ respectively) must be recorded.
- Pivot screens must only be measured in the usual landscape mode.

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 chromaticity values for each measurement position and calculate $\Delta u'v'$ 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
$\Delta u'v'$ 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 chapter 9

References

1. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
2. Kokoschka S. (1986). Visibility aspects of VDUs in terms of contrast and luminance. Behaviour and information technology. vol.5, No. 4, pp 309-333.
3. Hunt, R.W.G. Measuring colour. 3rd edition (1998), Kingsley-Upon-Thames: Fountain Press.
CIE Publication 15.2 (1986), Colorimetry, p. 11, p.27-28 and p. 53-54, table 1.3).

4. Roberts, A., Eng, B., (1995) "A method for the calculation of tolerances for display primary chromaticity coordinates" Research and development Department, Technical Resources, The British Broadcasting Corporation.
5. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, pp 278-279.
6. Fairchild M. D. (1995), "Considering the surround in device-independent colour imaging". www.cis.rit.edu/people/faculty/fairchild/PDFs/Bart.pdf
7. ISO TC130 WD 12646 p. 5 Section 4.7 Chromaticity and luminance of the white and black points and tracking.

Draft

4.16 Display resolution

Background

Image quality is negatively affected by a low fill factor, visible “jaggies” and poor rendering of details. All of these 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

Displays and all-in-one PCs.

4.16.1 Mandate

Display panels ≤60” must have a pixel density of at least 70 PPI and

Display panels >60” must have a resolution of at least 8.3 MP (4K)

Submit the following to an approved verifier:

- Product(s) for testing

The following is submitted to TCO Development:

- For each panel used in the product, the following must be reported in TCO Certified Portal:
 - Manufacturer
 - Model/type
 - Resolution
 - Panel type
- 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:

- For each panel used in the product, the following must be reported:
The pixel density, resolution, panel size, aspect ratio and panel type must be reported in TCO Certified Portal.

4.16.2 Clarification

70 PPI gives a reasonable image quality at a viewing distance of 80 cm, which can be regarded as a normal viewing distance to a display monitor on a desktop workspace, based

on anthropometric data. Very large displays (>60") are often those used in conference rooms or for multiple viewers. In these situations, the viewing distance is often more than 80cm, so 4k resolution should be enough in most cases.

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 can be 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 follows:

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

Overall uncertainty

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

See chapter 9

References

1. ISO 9241-3 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 3: Visual display requirements. International Organisation of Standardisation, 1992
2. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
3. ISO 13406-2 Ergonomic requirements for work with visual displays based on flat panels - Part 2: Ergonomic requirements for flat panel displays. International Organisation of Standardisation.

4.17 Luminance contrast – characters

Background

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

Definition

Luminance contrast – characters are 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 are 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

Displays and all-in-one PCs with backlit or light emitting pixels.

4.17.1 Mandate

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

The following 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

4.17.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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 section chapter 9.

Test method

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. If patches with significantly lower contrast are found, 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 fulfill 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 must be used for integration in the 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 ten 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 that 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 product, 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 product. Compute the resolution contrast ratio as, $C = (S_W - S_K) / (S_W + S_K)$.

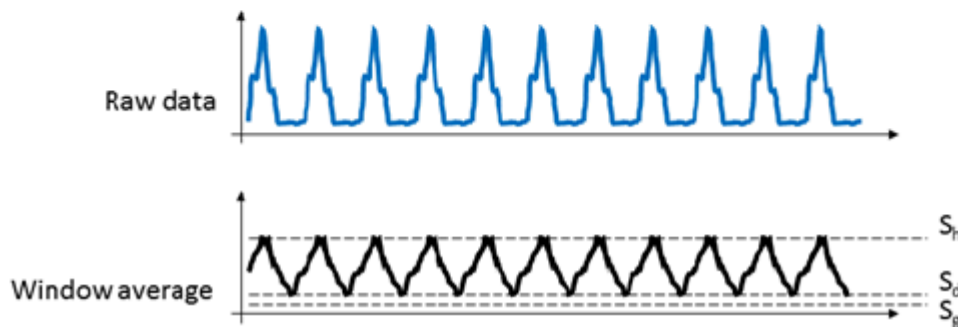
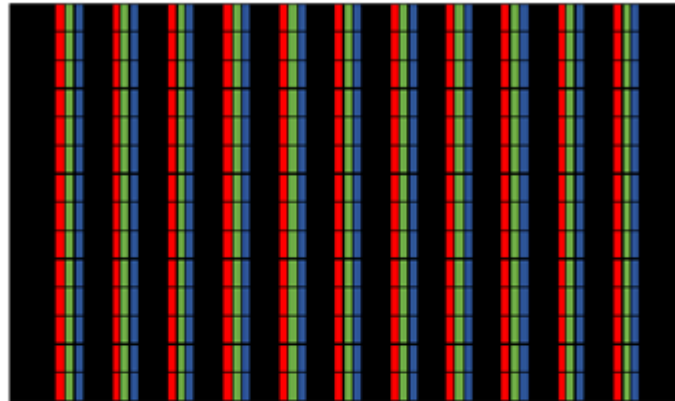


Figure *Luminance contrast - characters 1*: Measurement principle (from IDMS 7.2).

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 chapter 9

References

1. ISO 9241-3 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 3: Visual display requirements. International Organisation of Standardisation, 1992
2. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
3. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 567-569.
4. ISO 3664:1999, Viewing conditions for graphic technology and photography, p. 9 Uniformity of screen luminance.
5. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 179 - 181
6. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds, p. 261.
7. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press
8. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 105 - 106. (ISBN 0-8194-3496-5)
9. Kokoschka S. (1986). Visibility aspects of VDUs in terms of contrast and luminance. Behaviour and information technology. vol.5, No. 4, pp 309-333.

4.18 Luminance uniformity – angular-dependence

Background

The luminance of a display may be angular-dependent which means that 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 display to maintain a certain luminance level irrespective 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

Displays and all-in-one PCs with backlit or light-emitting pixels.

4.18.1 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 ≤ 1.73 .
2. In landscape mode, when the screen is rotated around the horizontal axis through the center of the screen, the largest value of the L_{\max} to L_{\min} ratios at $\pm 15^\circ$ must be ≤ 1.73 .

The following 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.
-

4.18.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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 present 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 chapter 9

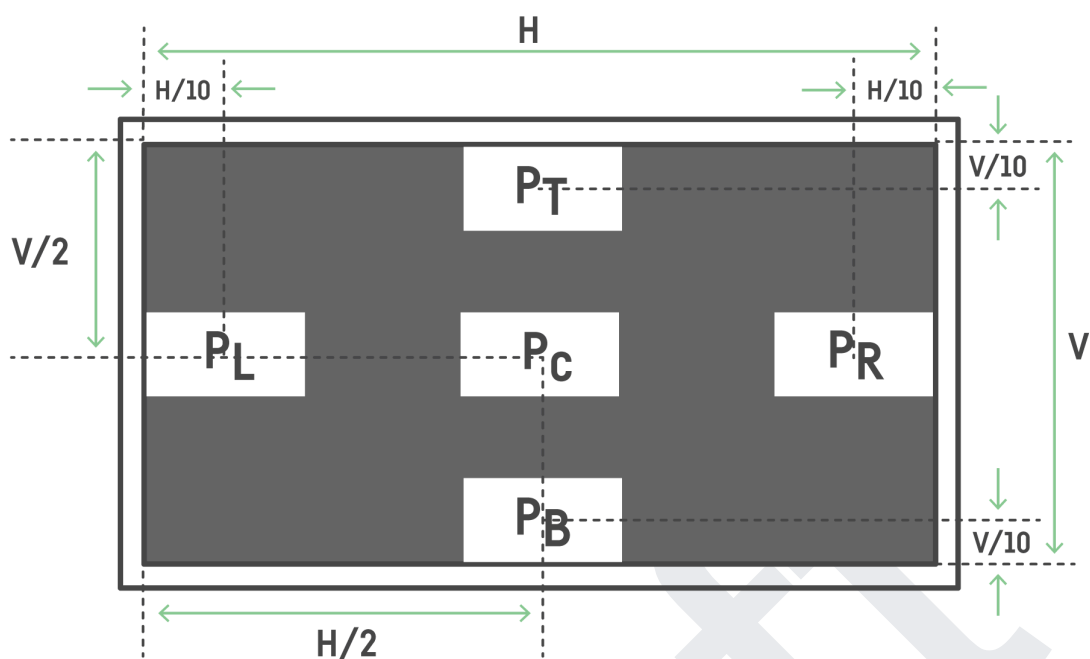


Figure: *luminance uniformity - angular-dependence 1*. Measurement positions for luminance uniformity - angular dependence.

Equipment

Luminance meter.

Test method (steps)

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 measurement) through the focal point of its front lens with a distance as described in chapter 9.
2. In landscape mode the display must be rotated +30 degrees around a vertical axis through the display-glass center-point and the luminance at positions P_L and P_R ($L_{P_L/+30/0}$ and $L_{P_R/+30/0}$ 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 display-glass center-point and the luminance at positions P_L and P_R ($L_{P_L/-30/0}$ and $L_{P_R/-30/0}$ respectively) must be recorded. See figure *luminance uniformity - angular-dependence 2*.
4. In landscape mode, the display must then be tilted +15 degrees backward around a horizontal axis through the display-glass center-point and the luminance at positions P_T and P_B ($L_{P_T/0/+15}$ and $L_{P_B/0/+15}$ respectively) must be recorded. See figure *luminance uniformity - angular-dependence 3*.
5. In landscape mode the display must then be tilted -15 degrees forwards around a horizontal axis through the display-glass center-point and the luminance at positions P_T and P_B ($L_{P_T/0/-15}$ and $L_{P_B/0/-15}$ respectively) must be recorded. See figure *luminance uniformity - angular-dependence 3*.

6. The measurements to be carried out are summarized in table *luminance uniformity - angular-dependence 4*. The steps numbers in the step column correspond with the test method paragraphs.

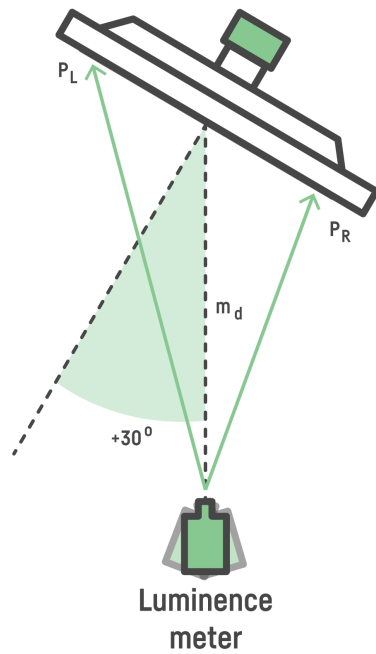


Figure *luminance uniformity - angular-dependence 2*. Top view of test set-up when the display is rotated ± 30 degrees. The + rotation is defined clockwise.

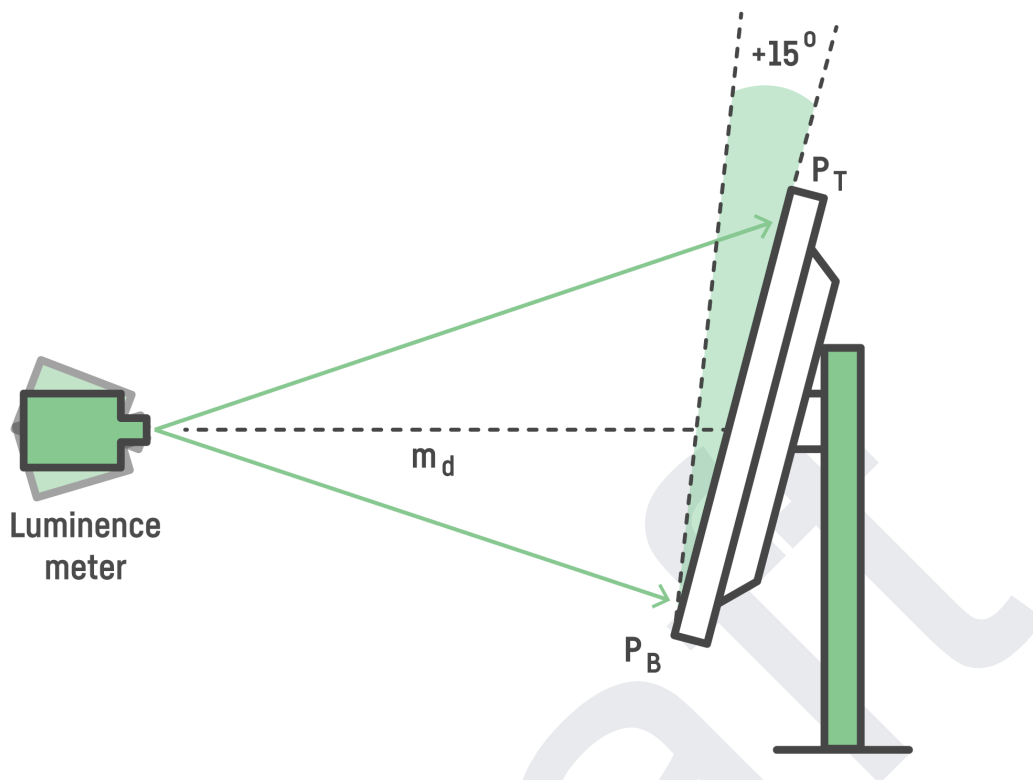


Figure *luminance uniformity - angular-dependence 3*. Side view of the test set-up when the display is tilted $\pm 15^\circ$. The + rotation is defined as backwards.

Table *luminance uniformity - angular-dependence 4*.

Test method step (reference above)	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°	+15°			X	X
Step 5	Forwards tilt = (turned around the horizontal axis)	0°	-15°			X	X

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 is presented in table *luminance uniformity - angular-dependence 4* (test steps 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 in 2 decimal places.
- In landscape mode, for the vertical direction (turned around the horizontal axis). Tilt backwards and tilt forwards $+15^\circ$ test steps 4 and 5. 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 larger of the two ratios $+15^\circ$ and -15° . The result must be presented to 2 decimal places.

Overall uncertainty

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

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

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

See chapter 9.

References

1. CIE Publication 69 (1987), Methods of characterizing illuminance meters and luminance meters: performance characteristics and specifications.
2. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 567-569.
3. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, p. 119
4. ISO 3664:1999, Viewing conditions for graphic technology and photography, p. 9 Uniformity of screen luminance.
5. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 179 - 181
6. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds, p. 261.
7. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds.

4.19 Grayscale gamma curve

Background

A calibrated gamma curve makes it easier to distinguish between similar light levels. A well-tuned grayscale is the basis for accurate detail rendering of any imaging device. The grayscale rendering is measured by comparing a set number of steps in a grayscale in the test image. In order to give accurate rendering of the grayscale of the original image, each grayscale step, regardless of gray level, must have a luminance level close to what is specified by the common standard sRGB.

Definition

Grayscale gamma curve is the capability of the imaging device to maintain the original grayscale luminance or a grayscale pattern at all tested grayscale levels.

Applicability

Non monochromatic displays and all-in-one PCs with backlit or light emitting pixels.

4.19.1 Mandate

The different grayscale luminance levels must be within the max and min levels specified in the table below, where 100% is the luminance level measured for white: RGB 255, 255, 255.

gray level	L_{sRGB}	L_{min}	L_{max}
	%	%	%
255	100	100,0	100,0
225	75	70	93
195	55	46	68
165	38	29	49
135	24	17	36
105	14	8	24
75	7	3	14
45	3	1	7

The following 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.

4.19.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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: R=G=B=255, 225, 195, 165, 135, 105, 75 and 45.

Equipment

Luminance meter or spectroradiometer.

Test method

Measure the luminance at the center of the measurement area for each grayscale setting specified above. Change the grayscale of the area for each measurement.

Comments on the limits tolerance from the sRGB curve

A linear tolerance has been applied symmetrically around the sRGB gamma curve. However, as many displays on the market today have a somewhat S-shaped gamma curve, a "S-correction" has been added to the linear tolerance on the gamma level 225 and 195.

This correction has been determined based on statistics from measured displays. TCO Development may decide to remove this "S-correction" in the next generation of this criteria document.

Overall uncertainty

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

See chapter 9

References

1. Bilissi, E., Jacobson, R. E., and Attridge, G. G (2008): "Just noticeable gamma difference and acceptability of sRGB image display on a CRT monitor, Imaging Technology Research Group, University of Westminster, Harrow, UK, The Imaging Science Journal Vol 56, 189-200.
2. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 105 - 106. (ISBN 0-8194-3496-5)
3. ITU-R Recommendation BT.709-5: Parameter values for the HDTV standards for production and international programme exchange
4. E.B.U. Standard for chromaticity tolerances for studio monitors Tech. 3213-E August 1975.
5. SMPTE 170M-1999 Television - Composite Analogue Video Signal - NTSC for Studio Applications.
6. Hunt, R.W.G. Measuring colour. 3rd edition (1998), Kingsley-Upon-Thames: Fountain Press.

7. Shimodaira, Y. et al., (1995), "Acceptable limits of gamma for a TFT-liquid crystal display on subjective evaluation of picture quality" Consumer Electronics, IEEE Transactions Volume 41, Issue 3, 550-554.
8. Poynton, C. (2003), Digital video and HDTV Algorithms and interfaces, Morgan Kaufmann Publishers, An Imprint of Elsevier Science. Chapter 23 Gamma sRGB transfer function page 267 to 269. ISBN 1-55860-792-7

Draft

4.20 Luminance uniformity

Background

Poor luminance uniformity 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 display to maintain the same white 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

Displays and all-in-one PCs with backlit or light emitting pixels.

4.20.1 Mandate

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

The following 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

4.20.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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 display screen plane at nine points. The four corner positions (1, 3, 7 and 9) are measured 1° from the edges of the screen as shown in figure *luminance uniformity 1*. The four 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 $1/2^\circ$ 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 outside of the nine 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*.

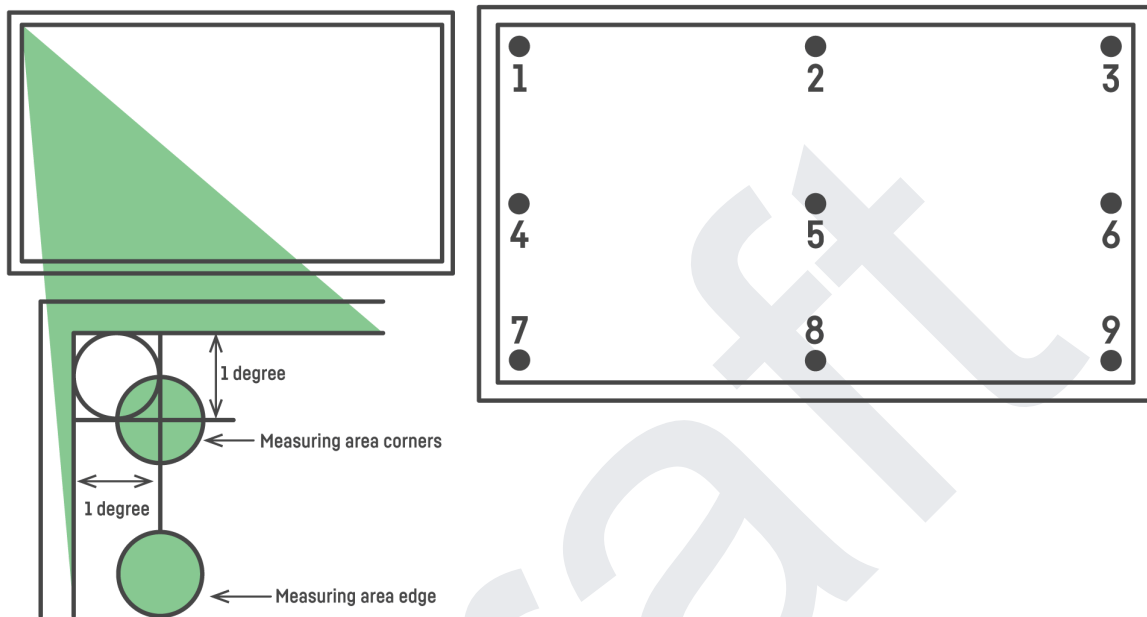


Figure *luminance uniformity 1* Measurement positions for the measurement of luminance and color uniformity.

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

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

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

See chapter 9

References

1. ISO 9241-3 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 3: Visual display requirements. International Organisation of Standardisation, 1992
2. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.

3. ISO 13406-2 Ergonomic requirements for work with visual displays based on flat panels - Part 2: Ergonomic requirements for flat panel displays. International Organisation of Standardisation.
4. Bilissi, E., Jacobson, R. E., and Attridge, G. G (2008): "Just noticeable gamma difference and acceptability of sRGB image display on a CRT monitor, Imaging Technology Research Group, University of Westminster, Harrow, UK, The Imaging Science Journal Vol 56, 189-200.
5. CIE Publication 69 (1987), Methods of characterizing illuminance meters and luminance meters: performance characteristics and specifications.
6. ISO 3664:1999. Viewing conditions for graphic technology and photography, p. 10 Monitor luminance.
7. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 179.
8. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 567-569.
9. ISO 3664:1999, Viewing conditions for graphic technology and photography, p. 9 Uniformity of screen luminance.
10. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 179 - 181
11. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds, p. 261.
12. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds.

4.21 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 display to maintain the same white/black 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

Displays and all-in-one PCs with backlit or light emitting pixels.

4.21.1 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).

The following 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.

4.21.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 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 chapter 9.
- The 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

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

See chapter 9

References

1. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
2. ISO 3664:1999, Viewing conditions for graphic technology and photography, p. 9 Uniformity of screen luminance.
3. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds.
4. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press
5. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 105 - 106. (ISBN 0-8194-3496-5)
6. Kokoschka S. (1986). Visibility aspects of VDUs in terms of contrast and luminance. Behaviour and information technology. vol.5, No. 4, pp 309-333.
7. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 574-575.

4.22 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

Displays and all-in-one PCs with backlit or light emitting pixels.

4.22.1 Mandate

The following conditions must be fulfilled:

- The luminance at default setting must be $\geq 150 \text{ cd}/\text{m}^2$
- The maximum luminance must be $\geq 200 \text{ cd}/\text{m}^2$
- The minimum luminance must be $\leq 100 \text{ cd}/\text{m}^2$

The following 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 and minimum luminance must be reported in TCO Certified Portal
-

4.22.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 must be done.
- 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.

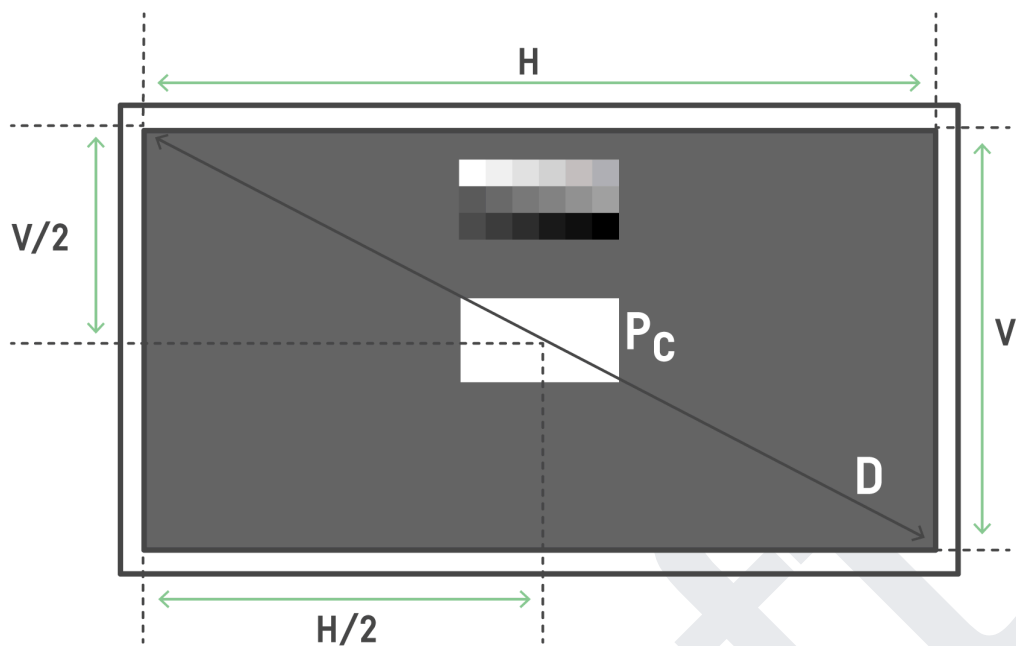


Figure *Luminance level 1*. TCO Certified default test image with the 18-step grayscale inserted.

- The measurement position P_C must be at the center of the measurement area without line borders, have an RGB setting of 255, 255, 255, and be positioned at the center of the screen. The background must be RGB 102,102,102.
- Reset the display to its default setting. Check that the luminance is $\geq 150 \text{ cd/m}^2$.

The following evaluations 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 grayscale pattern presented on the screen. From the default setting, adjust the controls on the display to achieve as high luminance as possible with an acceptable image quality. The image quality is considered acceptable if at least 15 of the 18 grayscale steps are visible. Check that the display has a luminance of $\geq 200 \text{ cd/m}^2$.
- Reset the display to its default setting. From the default setting, adjust the controls on the display to achieve as low luminance as possible with an acceptable image quality. The image quality is considered acceptable if at least 15 of the 18 grayscale steps are visible. Check that the display has a luminance of $\leq 100 \text{ cd/m}^2$.
- If it difficult to visually determine if 15 of the 18 grayscale steps are visible, then the display must conform with the *grayscale gamma curve* criteria in the max and min luminance setting.
- After this test is completed the display must be put back in its default mode by pressing a reset button or similar. After each reset, the display has to stabilize before other test measurements are made.

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 chapter 9.

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 for all conditions 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 chapter 9

References

1. ISO 9241-3 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 3: Visual display requirements. International Organisation of Standardisation, 1992
2. Flat Panel Display Measurements Standard, (FPDM), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
3. ISO 13406-2 Ergonomic requirements for work with visual displays based on flat panels - Part 2: Ergonomic requirements for flat panel displays. International Organisation of Standardisation.
4. CIE Publication 69 (1987), Methods of characterizing illuminance meters and luminance meters: performance characteristics and specifications.
5. ISO 3664:1999. Viewing conditions for graphic technology and photography, p. 10 Monitor luminance.
6. Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 179.
7. Wyszecki, G., Stiles, W.S., (1982) Colour Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 567-569.
8. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, p. 119

4.23 Black level

Background

It is important that a display can produce a black level dark enough to show shadow details in pictures at high and low white luminance levels. The black level is also important for achieving a good contrast ratio.

Definition

Black level is the capacity of the display to maintain a good reproduction of black even when its white luminance is high.

Applicability

Displays and all-in-one PCs with backlit or light-emitting pixels.

4.23.1 Mandate

The luminance of black must be ≤ 2 cd/m² at a white luminance setting of ≥ 200 cd/m².

The following 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 luminance must be reported in TCO Certified Portal.

4.23.2 Clarification

Preparations for testing

- All necessary preparations described in chapter 9 must be done.
- The TCO Certified default test image with an 18-step grayscale as shown in figure *luminance level 1* or alternative the larger measurement area image also described in chapter 9 must be used for luminance level measurement.
- The measurement position P_c must be at the center of the measurement area without line borders, have an RGB setting of 0, 0, 0, and be positioned at the center of the screen. Alternatively, a measurement area with a size that is 80% of the active screen size may be used.
- The black level must be tested at maximum luminance, i.e., ≥ 200 cd/m².
- 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 on the display to achieve as high luminance as possible with an acceptable image quality. The image quality is considered acceptable if at least 15 of the 18 grey scale steps are visible. The maximum luminance level must be ≥ 200 cd/m².

- If it is difficult to visually determine if 15 of the 18 grey scale steps are visible, then the display must conform with the *grayscale gamma curve* criteria in the max luminance setting.
- Change the color of the white measurement area in the test image to black (RGB: 0,0,0) and measure the luminance of the black area, check that it is ≤ 2 cd/m².

Equipment

Luminance meter or spectroradiometer.

Test method

The luminance at the center of the black measurement area must be measured with the luminance meter directed orthogonally to the measurement area as described in chapter 9.

Test evaluation

The measured luminance is the required value. The luminance must be reported to one decimal place.

Overall uncertainty

$\leq \pm 10$ % in luminance.

See chapter 9

References

1. Bilissi, E., Jacobson, R. E., and Attridge, G. G (2008): "Just noticeable gamma difference and acceptability of sRGB image display on a CRT monitor, Imaging Technology Research Group, University of Westminster, Harrow, UK, The Imaging Science Journal Vol 56, 189-200.

5 Supply chain

Direction and focus

The supply chain area criteria are intended to move the IT industry toward more responsible production and support the TCO Certified roadmap vision of production carried out with the well-being of people in mind and without harm to the environment. The criteria focus on working conditions, supplier accountability, anti-bribery, responsible mineral sourcing, environmental management and water management in the supply chain of certified products.

How the criteria create change

The supply chain area is built around structured responsibility, transparency, risk-based follow-up and corrective action. Criteria on supply chain responsibility are intended to place clear responsibility on the brand owner, define minimum expectations for working conditions, and create a system for identifying, correcting and following up non-conformities. Criteria on supply chain transparency are intended to make key supplier relationships visible and strengthen the management systems needed to understand risks, benchmark performance and drive improvement.

The area also addresses governance, minerals and environmental risks that can affect responsible production. Criteria on anti-bribery are intended to reduce the risk that corruption hides labor, safety or environmental non-conformities. Criteria on responsible mineral sourcing are intended to strengthen due diligence for mineral supply chains linked to conflict, human rights risks, worker health and environmental harm. Criteria on environmental and water management are intended to strengthen systematic work with environmental impacts, water-related risks, efficiency and supplier engagement where the criteria apply.

What this enables

Together, these criteria help make supply-chain responsibility more structured, transparent and credible. Together, these criteria make supply-chain responsibility more structured, transparent and credible. Purchasers get a clearer basis for using TCO Certified to support responsible procurement decisions. Brand owners are required to manage risks and close non-conformities through structured systems. Independent verifiers get defined evidence points for consistently checking supply-chain responsibility, transparency, due diligence and management-system requirements.

5.1 Supply chain responsibility

Purpose

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 responsibility in the 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 incentivise the brand owner to work proactively.

Definitions

PCB fabricators: Manufacturers of the physical substrate on which components are later mounted. These manufacturers carry out the full sequence of chemical, mechanical, and thermal processes required to create the multilayer board structure, including substrate preparation, imaging, etching, lamination, plating, cleaning and surface finishing. This is PCB fabrication, in which the electrical pathways, insulation layers, and plated interconnections of the board are formed.

Mainboard (Motherboard): The primary printed circuit board (PCB) of a product, providing electrical connections and interfaces for core components such as the processor, memory, storage, and input/output systems.

Bare printed circuit boards are unpopulated PCBs manufactured and supplied for later component assembly.

Applicability

All product categories.

5.1.1 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 supply chains of the certified product, sharing audit reports and corrective action plans (CAPs), and providing other documented proof described below.

1. Commitment

The brand owner must have a public code of conduct for the manufacture of certified products 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 in TCO Certified Portal all factories involved in manufacturing the certified product model(s) of the following types:

- Final assembly factories
- Display panel assembly factories (panels >10")
- PCB mainboard fabricators

The brand owner must ensure the code of conduct is implemented at all registered factories. The brand owner must ensure all registered factories have identified and communicated the code of conduct to their next-tier suppliers of parts for certified products.

3. Proof

The brand owner's code of conduct and the process for communicating it in the supply chain of the certified product must be independently verified annually as part of the annual review process.

For each registered factory, the following documents must be uploaded to TCO Certified Portal:

- The independent initial audit report -
 - For SA8000-certified factories, a valid copy of the certificate is also required.
- The corrective action plan for each non-conformity
- The closure audit report (where applicable).

Supplier identification and communication: The supply chain identification template (SCIT) must be submitted for each registered final assembly factory. This template must be uploaded within one (1) month of the factory's registration in TCO Certified Portal.

TCO Development may require audit reports and corrective action plans from factories further upstream in the supply chain to verify that corrective actions have been successfully implemented.

Submitted documentation must be reviewed by an independent verifier approved by TCO Development.

TCO Development may commission random factory audits (spot checks) at any factory registered in TCO Certified Portal.

Submit the following to an approved verifier:

Once a year at the brand owner annual review:

- The brand owner's public code of conduct, communicated to the supply chain of the certified product. The code of conduct must be consistent with this mandate.
- Supporting information on the routines and communication methods used to ensure that management and workers in each registered factory are informed about and trained on all parts of the code of conduct.

For each application:

CB certificate factory list (final assembly)

- Upload a copy of the factory list included in the CB certificate, showing the names and addresses of all final assembly factories manufacturing the certified product model.
- If any listed final assembly factory is not registered on TCO Certified Portal, the brand owner must submit an updated factory identification template to register the factory or provide evidence that the factory is not manufacturing the certified product model.

Display panel assembly factories (>10") and PCB mainboard fabricators.

- Provide the factory information of each display panel assembly factory (panels >10") and each applicable PCB mainboard fabricator for the certified model.
- Factories must be registered using the factory identification template.

Brand compliance status

Verify that the brand name is listed as compliant in TCO Certified Portal with no missed due dates. Any missed due dates will postpone the application for a brand owner until the required documentation is submitted and the due date is extended or marked compliant.

The following is submitted to TCO Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A copy of the public code of conduct in English must be uploaded to TCO Certified Portal.

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

- The status (YES/NO) indicating whether all factories manufacturing the certified products are categorized as risk category 3 (automatically collected).

5.1.2 Clarification

The mandate is a social performance mandate. The criteria are based on ILO's (International Labor Organization) fundamental conventions and applicable local legislation. The mandate requires the brand owner to comply with minimum standards for a code of conduct, inspection, and corrective action in the supply chain of the certified product.

* Convention 87 and 98: Freedom of association and collective bargaining:

All workers must have the right to form, join and organize trade unions of their choice and to bargain collectively on their behalf with employers. Where this is restricted by law, employers must allow workers to freely and democratically elect their own representative(s) to defend their rights and interests.

* Local labor law and working hours:

The limits and enforcement of local law regarding working hours differ significantly across countries where manufacturing takes place. To harmonize expectations and set a reasonable, achievable level for the brand owners to enforce, TCO Certified sets a maximum 60-hour workweek, including overtime, as a global requirement regardless of the local law.

* Maximum 60-hour workweek and consecutive days of work:

This criterion sets a global limit of 60 working hours per week, including overtime. It is based on a maximum 48-hour regular workweek plus a maximum of 12 hours of overtime. This limit is applied to align with widely accepted audit frameworks, particularly in contexts where local legislation is weak or not effectively enforced.

Workers must also be provided with at least one day off every seven consecutive days.

Any exceedance of these limits constitutes non-compliance.

Compliance may be assessed and presented in an accepted audit report as a percentage based on working hours data over a defined review period. This percentage reflects the proportion of working time observations (e.g. worker-weeks or equivalent records) where 60 hours per week may have been exceeded.

This aggregated proportion may be used by the verifier to determine the severity of non-compliance. A limited tolerance is permitted for minor (non-systemic) deviations. The severity of non-compliance is therefore determined based on the proportion of observations exceeding 60 hours, as follows:

- Minor non-compliance: up to 2% of observations exceed 60h/week
- Major non-compliance: >2% – 15% of observations exceed 60h/week
- Priority non-compliance: >15% of observations exceed 60h/week, or any occurrence above 72 hours in a single week

The verification process

Proof documentation must be reviewed by an independent verifier approved by TCO Development. The verifier is responsible for requesting any additional documentation needed to assess compliance. The verifier evaluates the information submitted by the brand owner in accordance with the verification guidelines below, covering:

- Code of conduct
- Communication and training on the code of conduct
- Factory identification and registration on TCO Certified Portal
- supply chain identification template (SCIT)
- Independent social audit reports

The code of conduct

The brand owner must have a public code of conduct covering the supply chain of the certified product.

The code of conduct must:

- be consistent with all parts under 1. Commitment
- be adopted by the brand owner's board and addressed by management
- cover manufacturing activities relevant to the certified product

Annual review of the code of conduct

The code of conduct must be verified annually by an approved verifier during the annual review process.

If the code of conduct has not changed since the previous annual review, it does not need to be resubmitted. In such cases, the Senior Management Representative (SMR) must confirm this to the approved verifier during the annual review.

Communication and training on the code of conduct

The brand owner must be annually reviewed on how the code of conduct is communicated to management and workers (or worker representatives) at all registered factories in TCO Certified Portal.

Supporting documentation must include:

- how training is delivered (e.g., workshops, e-learning, online programs)
- proof that training is conducted specifically for this purpose (not only as part of routine business meetings)
- how the effectiveness of the training is measured.

Annual review of communication and training.

All of the following must be verified as compliant during the annual review:

- Training covers all parts of the code of conduct
- Training is conducted through workshops, e-learning, or online training programs
- A questionnaire/self-assessment process is used to assess understanding and conformity with the code of conduct.

If the communication routine has not changed since the previous annual review, it does not need to be resubmitted. In such cases, the Senior Management Representative (SMR) must confirm this to the approved verifier during the annual review.

Scoring in the annual review.

Green (mandatory): All requirements are fulfilled and verified.

Red: One or more elements are missing, unclear, or not implemented.

A corrective action plan must be established for any non-conformity. The affected requirement(s) must be re-verified and achieve compliance no later than the next annual review (within 12 months).

Factory identification and registration on TCO Certified Portal

For each certified product model, the brand owner must identify and register in the TCO Certified Portal each of the following:

- final assembly factories
- display panel assembly factories (panels >10")
- PCB mainboard fabricators

Factories are registered using the **factory identification template**. The template specifies the factory details to be provided, including:

- Name and address
- Product and factory type
- Global Location Number (GLN)

Factory list updates

At least annually, the factory identification template must be updated and uploaded to TCO Certified Portal. The due date is shown in TCO Certified Portal. Any factory changes, i.e., additions, removals, or information updates, must be communicated to the approved verifier immediately using the previously submitted factory identification template.

Supply chain identification template (SCIT)

The SCIT must be submitted at the time the final assembly factory is registered in TCO Certified Portal. It is not necessary to submit the SCIT for any other factory type unless required by TCO Development.

This template must be uploaded within one (1) month of the factory being registered in TCO Certified Portal. TCO Development may require an updated SCIT to be submitted at any time.

The SCIT must include supplier data for the following parts:

- Product housing: Enclosure (chassis) including stand: Parts >0.5 grams.
- Printed circuit board, mainboard and power board.
- External cables: Power and peripheral connecting cables.
- Processors and memory: CPU, GPU, chipset, DRAM, RAM, SSD and HDD.
- Battery: The product's remote power source.
- Power supplies: internal and external.
- Display panel (all sizes).

Independent social audit reports

The brand owner must ensure that TCO Certified Portal is continuously updated with the required audit documentation. Documents must be submitted to an approved verifier for upload to TCO Certified Portal

Factory audit intervals are determined by the factory risk category.

Independent audits must be conducted by organizations accredited to ISO 17021 and carried out by SA8000 or RBA lead auditors who are APSCA certified. The lead auditor's APSCA membership number must appear in the audit report.

Accepted audits:

- SA8000
- RBA VAP
- Other audit types, if independently verified by an approved verifier to be of equal quality to RBA VAP. This assessment includes, but is not limited to, auditor qualifications, audit methodology (e.g., triangulation of non-conformities), reporting quality, and CAPs.

Defining the factory risk category and audit intervals

A factory new to TCO Certified Portal must be independently audited using an accepted audit type. Any SA8000 certificate or RBA recognition document must be submitted together with the latest initial audit report. Each factory is assigned a risk category (1, 2, or 3) according to the procedure below.

Brand owners or manufacturers new to TCO Certified must undergo a risk assessment. If the brand owner or manufacturer is considered a higher risk (for example, due to previously being removed from TCO Certified Portal), an audit report and CAP must be submitted before the factory can be registered in TCO Certified Portal.

Country risk level and its influence on the factory risk category

Some countries are considered lower risk for social non-conformities according to the SA8000 Country Risk Assessments Process, which is based on the World Governance Indicators (WGI). Lower-risk countries are typically characterized by stronger governance structures, more effective enforcement of labor rights, and more robust legal protections for workers. Country risk level is a factor considered when assigning risk categories 2 and 3.

TCO Certified Accepted Factory List

All brand owners with access to TCO Certified Portal can view TCO Certified Accepted Factory List. This list includes information such as factory risk category, audit non-conformities, and due dates for submitting additional proof documentation.

Access to information for factories directly owned by a brand owner and dedicated to their own production is limited to that brand owner and the approved verifier.

Factory risk category procedure.

Independent initial audits are required at regular intervals. The audit interval is determined by the factory's risk category. The following audit definitions apply:

- An initial audit must cover the whole factory and this criterion.
- A closure audit must cover at least the open non-conformities from the latest initial audit. An initial audit can be accepted as a closure audit.
- Audits older than 12 months at the time of submission are not accepted.

Corrective action plans (CAPs)

For each non-conformity to the mandate, a corrective action plan must be uploaded to the TCO Certified Portal. The CAP must include closure deadlines set by the audit program.

Initial factory risk categorization

All new factories entering TCO Certified Portal and TCO Certified Accepted Factory List are assigned risk category 1.

Factories cannot remain in category 1 for more than 18 months and cannot return to category 1 once categorized as 2 or 3.

Factory risk category 1 (higher risk)

Initial audit and timeframe

Risk category 1 factories receive up to 18 months to achieve risk category 2 or 3.

An initial audit must be submitted within the first 12 months after registration. If required, an additional 6 months will be granted to conduct and submit the closure audit. Any major or priority non-conformities must be independently corrected and verified as closed through the closure audit.

Only initial audits less than 12 months old from the date the factory is registered on TCO Certified Portal are accepted.

Closure audit

If major or priority non-conformities are identified, a closure audit must be submitted within the remaining time. For minor non-conformities, the CAP must be completed, but a closure audit is not required.

Re-categorization

When all non-conformities other than minor ones are closed, the factory will be re-categorized to risk category 2 or 3, as applicable.

Final assistance

If a factory remains in risk category 1 for 18 months, factory management may receive final assistance through the TCO Certified Active Monitoring Program. If the brand owner or factory does not commit to the program, the factory will be removed from TCO Certified Accepted Factory List and will no longer be allowed to manufacture products certified to TCO Certified.

Factory risk category 2 (moderate risk).

Initial audit and timeframe

Risk category 2 factories must be audited every 24 months. A new initial audit report must be uploaded during the final 12 months of the 24-month period. Any major and priority findings must be independently verified closed within these 12 months. The due date is shown on TCO Certified Portal.

Closure audit

If major or priority non-conformities are identified, a closure audit must also be uploaded before the due date. If only minor non-conformities are identified, the CAP must be completed, but a closure audit is not required. 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 due date to allow time for a closure audit if needed.

Risk category 3 (lower risk).

Initial audit and timeframe

For risk category 3, the factory must be audited every 36 months. A new initial audit report must be uploaded during the final 12 months of the 36-month period. Any major or priority findings must be independently verified closed within these 12 months. The due date is shown in the TCO Certified Portal.

Closure audit

If major or priority non-conformities are identified, a closure audit must also be uploaded before the due date. If only minor non-conformities are identified, the CAP must be completed, but a closure audit is not required. 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 due date to allow time for a closure audit if needed.

A valid SA8000 certificate serves as proof that non-conformities are regularly monitored by SAAS-accredited verifiers and that issues are being addressed.

Failure to retain category 2 or 3.

Failure to retain a category by the due date will cause the factory to be flagged in TCO Certified Portal. No certification applications for products manufactured at the factory will be approved until the remaining non-compliances are closed.

Additional time may be granted following a risk assessment and a closure time plan. If the brand owner or factory does not commit to retaining category 2, the factory will be removed from the TCO Certified Accepted Factory List and will no longer be allowed to manufacture certified products.

Qualification method and assessment of worker-management dialog

Factories categorized as risk category 1 are generally not considered to have a sufficiently mature worker–management dialog due to the presence of persistent non-conformities. Once a factory has closed all major and priority non-conformities and achieved risk category 2, it may apply for re-categorization to risk category 3 based on the quality of its worker–management dialog.

To qualify for re-categorization to risk category 3, all applicable verification points below—for either a trade union or a non-union worker representation—must be assessed as compliant without remarks.

Verification of the level of worker/management dialog at the factory.

Re-categorization from risk category 2 to 3 based on worker–management dialog requires joint proof from factory management and worker representatives.

- The assessment must be conducted during a factory audit every three (3) years.
- The assessment must be carried out by an independent auditor approved by TCO Development.
- In addition to meeting all auditor qualification requirements in TCO Certified, the auditor must have documented experience and a deep understanding of trade union work.

In the case of a Trade union (TU)

Requirements on the trade union

- The TU is independent of factory management and local or national government and is not interfered with or financed by them.
- The TU is non-profit and financed through membership fees or donations from non-profit organizations.
- The TU has collective bargaining rights and represents employees in negotiations with management.
- The TU sets and fulfills some or all of its objectives to improve workers' conditions, such as working hours, wages, benefits, and occupational health and safety.

Requirements for management

- Management support is limited to providing meeting space and materials.
- Payroll and personnel records demonstrate that TU members are not discriminated against.
- Management does not interfere with TU representatives meeting new, consenting employees to inform them of their rights and membership options.

- The TU has the ability to call a strike without restriction from company management or government authorities.

Requirements on the worker-management dialog

- The TU meets regularly with management to further and defend workers' rights and interests for mutual benefit.
- Meeting minutes and financial records are maintained and made available. TU representatives have access to:
 - risk assessments
 - internal audits and monitoring results
 - relevant aspects of management review
 - opening and closing meetings of labor audits
- TU representatives report:
 - corrective and preventive actions for workers, and
 - performance and outcomes of actions to senior management.

In the case of non-union worker representation

Where freedom of association and collective bargaining are restricted by law, workers must be allowed to freely and democratically elect non-union representatives. Such representation must not be considered a substitute for trade unions where workers are free to organize.

Requirements for the worker committee

- The committee consists of democratically elected representatives from non-management personnel.
- The committee is independent of factory management and local or national government.
- Representation is proportional to the workforce, typically one representative per 50–100 workers.
- The committee has the right to represent workers in collective negotiations.
- The committee sets and fulfills some or all objectives to improve working conditions, working hours, wages, and benefits.

Requirements for the management

- Management does not interfere with the nomination, election, or operation of the committee.
- Worker representatives are not discriminated against and may carry out their representative duties during normal working hours without wage deductions.
- Worker representatives are protected from discrimination, harassment, intimidation, or retaliation.
- Worker representatives may meet new, consenting employees to explain labor rights.
- Committee members may attend relevant training during working hours without wage deductions.
- Management provides meeting space and materials.

Requirements for the worker-management dialog

- The committee meets regularly with management for mutual improvement.
- Meeting minutes and financial records are maintained and available.
- Worker representatives have access to:
 - risk assessments
 - internal audits and monitoring
 - relevant aspects of management review
 - opening and closing meetings of labor audits, including RBA and SA8000 audits

- Worker representatives report:
 - corrective and preventive actions to workers, and
 - outcomes and performance improvements to senior management.

Additional clarifications applicable to all risk categories

- Off-site closure audits accepted by the audit program and lead auditors are also accepted in TCO Certified.
- Risk categorization may be re-assessed if conditions change, including findings from spot checks.
- A major non-compliance related solely to stricter local working-hour limits (compared to the 60-hour TCO Certified limit) may be adjusted to compliance in the TCO Certified Portal, provided the 60-hour requirement is met.
- Closure of priority non-conformities within CAP deadlines is monitored 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 to conduct or commission on-site inspections at factories registered in the TCO Certified Portal.

- Audits are planned in cooperation with the brand owner's Senior Management Representative, approved social auditors, and factory management.
- Audits are announced in advance and conducted on a judgment-sample basis.
- Audit results are shared with factory management and all brand owners using the factory to support coordinated corrective action.
- Spot checks are financed by TCO Development. If non-conformities to TCO Certified require further investigation, the license holder must cover any additional costs, including the closure audit.

The verifier approved for supply chain responsibility

Only an independent verifier approved by TCO Development may approve:

- the brand owner's code of conduct
- communication and training of the code of conduct
- supporting documentation
- reviews conducted with a Senior Management Representative

Supporting documentation

available at: <https://industry.tcocertified.com/documents/>

References

1. SA8000, <http://www.sa-intl.org>
2. Responsible Business Alliance (RBA), <http://www.responsiblebusiness.org>

5.2 Supply chain transparency

Purpose

Supply chain transparency itself has two key dimensions: (a) the extent to which sourcing information is publicly disclosed to stakeholders and (b) the level of visibility and action a company takes to effectively manage its supply chain. Many companies struggle with transparency due to weak processes and limited oversight of extended supplier networks, which can create reputational and compliance risks.

By disclosing information to an independent party, brand owners gain opportunities to benchmark performance, share learning, and access solutions. Effective transparency relies on robust management systems where shared data supports collaboration and leads to concrete improvements across the supply chain.

The annual review – self-assessment questionnaire (SAQ) is designed to go beyond traditional factory audits. Its purpose is to evaluate how brand owners actively support and improve standards across their supply chains. This includes assessing whether brand owners provide a clear code of conduct, allocate sufficient resources, deliver training, offer tools, and establish long-term practices that enable suppliers to strengthen their own management systems.

The annual review - SAQ is structured into sections that define minimum requirements and highlight gaps against best practices. It functions both as a compliance check and an improvement tool, helping brand owners identify where further engagement is needed, track progress over time, and strengthen supply chain approaches year on year.

Applicability

All product categories.

5.2.1 Mandate

The brand owner must meet the following requirements for the certified product:

Senior management representative

The brand owner must appoint a Senior Management Representative (SMR) with responsibility for the supply chain of the certified product, who reports directly to senior management. Irrespective of other duties, the SMR must have the authority to ensure that the certified product meets the supply chain requirements in TCO Certified.

Annual review - self-assessment questionnaire (SAQ)

The SMR must ensure that the Annual Review - SAQ is completed, reviewed with an approved verifier and uploaded to the TCO Certified Portal before the annual due date. The SMR is responsible for this process.

Final assembly factories.

At a minimum, all final assembly factories manufacturing certified products must be publicly disclosed.

Smelters and refiners

At a minimum, all smelters and refiners associated with the certified product's supply chain must be publicly disclosed.

Submit the following to an approved verifier:

The following must be submitted to an approved verifier once per year, as part of the annual review - SAQ interview:

- A link to the webpage or report where final assembly factories and smelters/refiners are publicly disclosed.
- A completed annual review report - SAQ, verified by an approved social verifier.

TCO Certified Portal must contain up-to-date information on the SMR, including:

- Name, title, telephone number, and email address.

The following is submitted to TCO Development:

- The verified annual review - SAQ report, uploaded to TCO Certified Portal.
- A copy of a verification report from a verifier approved by TCO Development.

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

- Status (Yes/No) and a link confirming whether all final assembly factories manufacturing the certified product are publicly listed by the brand owner.

5.2.2 Clarification

The purpose of this mandate is to establish transparency and accountability between TCO Development and senior management at the brand owner of the certified product.

Senior Management Representative (SMR)

Details of the appointed SMR must be available in the TCO Certified Portal. The SMR must be available for dialogue in English with TCO Development and approved verifiers throughout the validity of all certificates held by the brand owner.

If the appointed SMR changes, the brand owner must update the information in the TCO Certified Portal and inform TCO Development without delay.

The SMR is responsible for ensuring that the TCO Certified Portal is kept up to date, including:

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

The SMR is responsible for ensuring that the brand owner's annual review process is completed with an approved social verifier and uploaded to the TCO Certified Portal before the annual due date. This includes the SMR interview and verification of the SAQ covering, at a minimum, brand owner communication and code of conduct, minerals policy and due diligence, and anti-bribery management systems.

Annual review - Self-assessment questionnaire (SAQ)

The annual review must be conducted by an approved verifier and is booked and paid for by the brand owner. Its purpose is to confirm that the SMR has sufficient authority and that the brand owner works systematically with the requirements set out in the SAQ.

If the brand owner has multiple registered brand names, the annual review must cover each brand separately and confirm that all TCO Certified requirements are met. The verifier must also assess whether the required information is clearly and intuitively accessible on each brand owner website.

Before the interview, the SMR must complete and submit all SAQ questions together with supporting documentation. The interview, normally conducted online, focuses on social performance and how the brand owner supports a socially responsible supply chain. Colleagues with relevant expertise are encouraged to participate. If online quality is insufficient, the verifier may request a face-to-face interview. TCO Development may participate at its own expense.

The verifier is responsible for uploading the final verified report to TCO Certified Portal. The SAQ is revised with each new generation of TCO Certified, typically every three years. Results are aggregated and presented in table format across all participating brand owners, without identifying individual companies. This aggregated analysis is intended to encourage brand owners to compare performance levels and identify common gaps and areas for improvement. This is part of TCO Development's capacity-building work.

Publicly listed suppliers

Brand owners must demonstrate transparency by gathering and publishing specific information about their supply chains. At a minimum:

- The public list of final assembly factories must include the supplier name, full address, and the type of products manufactured by all factories that assemble the certified products.
- The public disclosure of smelters and refiners must include the supplier name and country or region of each smelter or refiner, as well as the minerals processed (such as tin, tantalum, tungsten, gold, and cobalt).

To be considered publicly listed, supplier information must be published on the brand owner's website. It must be clear that the brand owner has an active business relationship with the supplier, and include the required supplier information listed above. Links to public disclosures are recorded in TCO Certified Portal and checked by the verifier as part of the annual review.

Scoring in the annual review for publicly listed suppliers

Green (mandatory): All requirements are fulfilled and verified.

Red: One or more elements are missing, unclear, or not implemented.

A corrective action plan must be established for any non-conformity. The affected requirement(s) must be re-verified and achieve compliance no later than the next annual review (within 12 months).

Supporting documentation

available at: <https://industry.tcocertified.com/documents/>

5.3 Anti-bribery management system

Purpose

Bribery undermines fair competition, weakens governance, and distorts markets. While brand owners may operate in low-risk environments domestically, bribery risks are often higher in global production supply chains, particularly in regions with weaker regulatory enforcement or higher governance risk.

In manufacturing and sourcing contexts, bribery can conceal labor rights violations, environmental non-compliance, and unsafe working conditions. It may compromise due diligence, distort procurement decisions, and undermine audit integrity. This not only creates legal and reputational risks but also affects product credibility, worker protection, and environmental performance.

Preventing bribery requires more than policies or training. Organizations are responsible for implementing a structured, risk-based anti-corruption management system covering their own operations and relevant business partners. Effective governance, risk assessment, independent verifier controls, monitoring, and continuous improvement are essential to ensure that anti-bribery commitments are implemented in practice.

Applicability

All product categories.

5.3.1 Mandate

The brand owner must have internal processes and routines in place to prevent and respond to all forms of bribery across all business activities related to the certified product. This includes risk-based management of relevant business partners connected to the certified product.

The brand owner's Anti-Bribery Management System (ABMS) must be aligned with the principles of ISO 37001. Alignment must be demonstrated either by a valid ISO 37001 certification or through verification against requirements 1.1–12.1 of the ABMS annual review, which assesses conformity with ISO 37001 principles.

Submit the following to an approved verifier:

- An ISO 37001 certificate or the ABMS annual review report by an approved verifier

The following is submitted to TCO Development:

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

5.3.2 Clarification

Anti-Bribery Management System

The brand owner's Anti-Bribery Management System (ABMS) must cover all business activities related to the certified product, including risk-based management of relevant business partners.

Alignment with the principles of ISO 37001 means that the ABMS includes structured governance, bribery risk assessment, operational controls, reporting and investigation mechanisms, internal audit, corrective action, independent verifier risk management, and a structured annual system review.

Alignment may be demonstrated in one of the following ways:

- A valid ISO 37001 certificate covering relevant business activities; or
- Verification against requirements 1.1–12.1 of the ABMS annual review, which assesses conformity with ISO 37001 principles.

The ABMS annual review (requirements 1.1–12.1) constitutes a structured assessment of the management system. All requirements must be verified as compliant in order to demonstrate alignment.

Where ISO 37001 certification is not provided, the brand owner shall undergo verification against the ABMS annual review requirements by an approved verifier.

All requirements must be verified as compliant. If requirements 1.1–11.2 are verified as compliant, reassessment of these is not required in subsequent annual reviews unless material changes occur in the organization's structure, risk exposure, governance arrangements, or anti-bribery processes that may affect compliance. In such cases, only the affected requirement(s) shall be re-reviewed.

Requirement 12.1 must be verified annually, irrespective of the status of other requirements.

Verification guidelines for the ABMS annual review

- The verifier must use the ABMS guidelines when assessing compliance levels.
- Alignment with ISO 37001 principles is confirmed when all requirements 1.1–12.1 of the ABMS annual review are verified as compliant (Green).
- If any requirement is not verified as compliant (Yellow or Red), a corrective action plan must be established. The affected requirement(s) shall be re-verified and must achieve compliance no later than the next annual review (within 12 months).
- The ABMS annual review of requirement 12.1 forms part of the structured system-level assurance and does not replace verification of individual requirements when material changes occur.

Supporting documentation

available at: <https://industry.tcocertified.com/documents/>

References

<https://www.iso.org/iso-37001-anti-bribery-management.html>

5.4 Responsible mineral sourcing

Purpose

Minerals such as tin, tantalum, tungsten, gold, and cobalt are linked to armed conflicts and human rights abuses in the regions 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, making informed choices about mineral sourcing, from extraction to finished product, is challenging.

TCO Certified drives more responsible mineral sourcing in all places where the mining industry and trade are present. Suppliers are required to adopt a responsible approach to mineral sourcing, regardless of where they operate, on land or in water. For emerging mineral extraction types such as deep-sea or marine mining, enhanced due diligence is required, with credible studies demonstrating that irreversible damage to the marine environment may or will occur beyond the mining boundary. This aligns with the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas and the OECD Handbook on Environmental Due Diligence in Mineral Supply Chains, and is consistent with our requirement that brand owners and suppliers address serious human rights risks within their due diligence frameworks.

Definitions

Recycled materials: As defined by the OECD Guidance, are reclaimed end-user or post-consumer products, or processed scrap metals generated during product manufacturing.

Applicability

All product categories.

5.4.1 Mandate

For the supply chain of the certified product, the brand owner must:

- Maintain a publicly available responsible mineral sourcing policy covering at least tin, tantalum, tungsten, gold (3TG) and cobalt.
- Conduct supply chain due diligence aligned with OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas process, and the OECD Handbook on Environmental Due Diligence in Mineral Supply Chains.
- Annually submit the Responsible Mineral Sourcing Template (RMST) to demonstrate that at least 80% of publicly listed smelters and refiners (SORs) for 3TG and cobalt are conformant to an accepted independent third-party due diligence program.

Submit the following to an approved verifier:

Once a year at the brand owner annual review:

- The brand owner's public responsible mineral sourcing policy. The policy must be consistent with this mandate.
- Supporting Information describing how the policy is communicated to at least the factories that brand owner has registered on TCO Certified Portal.
- A description of the structured due diligence used to identify and assess risks in the certified product's mineral supply chain, including supporting documentation.

- A completed RMST and all required supporting documents. The RMST must be uploaded to TCO Certified Portal by the annual due date, and must cover the supply chains of the final assembly factories registered for the certified products.

The following is submitted to TCO Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A copy of the public responsible mineral sourcing policy in English must be uploaded to TCO Certified Portal.

5.4.2 Clarifications

General clarifications

The verification of the ‘responsibly sourced mineral policy’ and ‘OECD-aligned due diligence process’ is to be carried out by an approved verifier as part of the annual review - self-assessment questionnaire.

Responsibly sourced minerals policy

The responsibly sourced minerals policy must publicly reflect the brand owner’s commitment to responsible sourcing of minerals and define expectations for suppliers in the supply chain of the certified product.

Annual review of the policy

The brand owner must demonstrate:

- The policy is publicly available
- Supporting documentation demonstrates that the policy is communicated to suppliers relevant to the certified product.
- The policy is consistent with this mandate
- The policy commits to supply chain due diligence aligned with
 - the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and
 - High-Risk Areas process and the OECD Handbook on Environmental Due Diligence in Mineral Supply Chains.

“Publicly available” means the policy is accessible on the brand owner’s website or included in a publicly available sustainability or responsible minerals report, and explicitly applies to the brand name registered on the TCO Certified Portal.

“Communicated” may include incorporation into supplier contracts, supplier codes of conduct, or formal written agreements.

Content of the policy.

To be consistent with this mandate, the policy must include, at a minimum:

- Coverage of at least 3TG and cobalt.
- Requirement that suppliers comply with the policy.
- Requirement that suppliers neither directly nor indirectly finance or benefit armed groups in conflict-affected and high-risk areas.
- Requirement that suppliers neither tolerate nor contribute to human rights abuses, including forced labor, child labor and severe environmental degradation.

- Commitment to responsible sourcing from conflict-affected and high-risk areas where risks are effectively identified and mitigated.
- Requirement that suppliers identify smelters/refiners (SORs) for 3TG and cobalt and report sourcing information using CMRT, EMRT or equivalent reporting templates.
- Requirement that sourcing of 3TG and cobalt is from SORs participating in OECD-aligned independent third-party audit programs and working toward or maintaining certification.
- Requirement that corrective action plans are developed for SORs not participating in or conforming to an accepted audit program, including removal from the supply chain or documented engagement toward audit participation.

OECD-aligned due diligence process (Identification of risk areas)

The brand owner must conduct structured due diligence to determine whether 3TG and cobalt are present in the certified product supply chain and to identify associated smelter and refiners (SORs).

The due diligence process must align with:

- The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (CAHRAs), and
- The OECD Handbook on Environmental Due Diligence in Mineral Supply Chains.

The process must include a Reasonable Country of Origin Inquiry (RCOI).

The RCOI must determine whether identified SORs process minerals originating from mined, recycled, or scrap sources, as defined in OECD guidance.

For emerging mineral extraction types, this requires the brand owner to respect established moratoriums on mining activities until it is demonstrated that such operations do not cause irreversible environmental harm.

In the context of deep-sea or marine mining, this requires the brand owner not to engage in, commit to, or invest in mining activities in deep-sea locations until credible scientific evidence demonstrates that irreversible environmental damage does not occur beyond the mining boundary.

Annual review of the due diligence process

To be consistent with this mandate, the brand owner must demonstrate:

- A documented due diligence process is in place to identify SORs for at least 3TG and cobalt in the certified product supply chain
- A Reasonable Country of Origin Inquiry (RCOI) is conducted.
- Identified SORs are collected using a recognized minerals reporting template (e.g., CMRT, EMRT or equivalent).
- The origin type of minerals (mined, recycled, scrap) is determined where information is available.
- The brand owner publicly states that its mineral due diligence process follows the required OECD Due Diligence Guidances.
- The Responsible Mineral Sourcing Template (RMST) is submitted to the verifier and covers the certified product supply chain.
- The due diligence process includes consideration of environmental risks and screening for emerging high-risk extraction types (including deep-sea mining, where applicable).

Scoring in the annual review (Policy and Due diligence process)

Green (mandatory): All requirements are fulfilled and verified.

Red: One or more elements are missing, unclear, or not implemented.

A corrective action plan must be established for any non-conformity. The affected requirement(s) must be re-verified and achieve compliance no later than the next annual review (within 12 months).

Minimum conformance level for smelters and refiners (SORs)

The brand owner must annually demonstrate, using the Responsible Mineral Sourcing Template (RMST), that at least 80% of publicly listed smelters and refiners (SORs) for 3TG and cobalt in the certified product's supply chain are conformant to an accepted independent third-party audit program.

Only SORs verified as **conformant** to an accepted audit program count toward the 80% requirement.

Conditional compliance (70–79%)

If 70–79% of SORs are conformant, the brand owner may remain compliant for one additional annual review period, provided documented evidence of active improvement efforts is submitted.

Examples of acceptable evidence include:

- Engagement with the Responsible Minerals Initiative (RMI) or equivalent initiatives.
- Documented outreach requiring non-conformant SORs to participate in an accepted audit program.
- Evidence that relevant SORs are RMAP 'Active'.

If the 80% threshold is not achieved by the following annual review period, the requirement is not fulfilled.

Verification guidelines for the RSMT:

The RMST has 3 sections, which must be completed:

1. Brand owner information.
(Responder details and completion date)
2. Conformance summary.
(Aggregated overview of the data reported in Section 3, including the total number of SORs and the percentage of conformant facilities.)
3. Individual SOR details.
(Facility-level reporting of each identified SOR for 3TG and cobalt)

Verifier responsibilities

The verifier must:

- Confirm that all required data fields in the three sections are completed.
- Verify each listed SOR against the latest published list of conformant facilities under the Responsible Minerals Assurance Process (RMAP), or an accepted cross-recognized audit program.
- Confirm that only SORs publicly registered as conformant are counted toward the 80% requirement.
- Confirm that SORs listed as "active" are not counted as conformant but may support conditional compliance (70–79%), where applicable.

- Confirm that the calculated conformance percentage in the template is accurate.

Annual submission deadlines are specified in TCO Certified Portal. The RMST must be submitted to the approved verifier by the required deadline.

Accepted audit programs and cross-recognition

The Responsible Minerals Assurance Process (RMAP) is accepted.

RMAP cross-recognized audit programs are also accepted. These currently include:

- London Bullion Market Association (LBMA)
- Responsible Jewelry Council (RJC)

Other audit programs must undergo an independent assessment by an approved verifier to demonstrate alignment with the OECD Due Diligence Guidance before acceptance. The brand owner must provide sufficient documentation to the approved verifier for assessment.

Reference information (non-mandatory guidance)

The OECD Due Diligence Guidance and OECD Environmental Due Diligence Handbook provide the framework for responsible mineral supply chain management.

Commonly used tools include:

- Responsible Minerals Initiative (RMI)
- Conflict Minerals Reporting Template (CMRT)
- Extended Minerals Reporting Template (EMRT)
- Responsible Minerals Assurance Process (RMAP)

RMAP standards are designed to align with OECD Guidance, EU Regulation 2017/821, and the U.S. Dodd-Frank Act.

Supporting documentation

- Responsible minerals sourcing template

available at: <https://industry.tcocertified.com/documents/>

References

- <http://www.oecd.org/corporate/mne/mining.htm>
- https://policy.trade.ec.europa.eu/development-and-sustainability_en
- <https://www.responsiblemineralsinitiative.org/about/rmi-initiative/>

5.5 Environmental management system

Purpose

Manufacturing processes can result in significant environmental impacts, including air and water emissions, waste generation, and intensive use of energy and natural resources. If not systematically managed, these impacts contribute to pollution, ecosystem degradation, and climate change.

An environmental management system certified to ISO 14001 provides a structured framework for identifying, monitoring, and reducing environmental impacts, supporting continuous improvement and independent external oversight.

Applicability

All product categories.

5.5.1 Mandate

Each factory of the types listed below that is involved in the manufacturing of the certified product model(s) and registered in TCO Certified Portal must be certified to ISO 14001:

- Final assembly factories
- Display panel assembly factories (panels >10")
- PCB mainboard fabricators

Submit the following to an approved verifier:

For each required factory for the certified product:

- A valid ISO 14001 certificate issued by an accredited certification body shall be uploaded to TCO Certified Portal before the due date.

The following is submitted to TCO Development:

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

5.5.2 Clarification

Certified to ISO 14001

The applicant must ensure that a valid ISO 14001 certificate is available in TCO Certified Portal for each factory type required to be certified.

The certificate must clearly state the scope of the certification. It must be understood to cover the entire operation under the factory business license.

Certificates must be issued by a certification body accredited by an accreditation body that is a signatory to the International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA)

Applying for an extended period.

The applicant may apply for an extension of up to 18 months for a factory that is not yet ISO 14001 certified. The application must be submitted to the approved verifier at the time the factory is registered in TCO Certified Portal.

The application template is obtained from the approved verifier.

TCO Development reserves the right to deny an extension if there is a significant risk that ISO 14001 certification will not be achieved within the extended period allowance.

References

<https://www.iso.org/standards/popular/iso-14000-family>

Draft

5.6 Water management

Purpose

Water scarcity and declining water quality are critical global challenges. Growing populations, expanding industries, and climate change are placing increasing pressure on freshwater resources, leading to severe water stress in many regions. These issues affect not only local communities and ecosystems but also the global economy, including the production and supply of IT products.

There is a need for a significant improvement in how water is managed across the value chain. Through TCO Certified, we aim to raise the overall level of responsible water management by requiring the IT industry to address risks, increase efficiency, and reduce long-term impacts. Achieving this requires a shared commitment and continuous effort across the industry to ensure that water is used and protected sustainably for the future.

Applicability

All product categories.

5.6.1 Mandate

For the supply chain of the certified product, the brand owner must:

- Maintain a publicly available policy for responsible water management.
- Maintain a due diligence process for water management.

Submit the following to an approved verifier:

Once a year at the brand owner annual review:

- The brand owner's public water management policy. The policy must be consistent with this mandate.
- Supporting Information describing how the policy is communicated to at least the factories that the brand owner has registered on TCO Certified Portal.
- A description of the structured due diligence used to identify and assess risks in the certified product's mineral supply chain, including supporting documentation.

The following is submitted to TCO Development:

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

5.6.2 Clarifications

The brand owner is required to demonstrate a policy and engagement with suppliers on water conservation and wastewater treatment, and identify where these high-impact suppliers are in the supply chain. Verification is carried out by an approved verifier as part of the annual review - self-assessment questionnaire.

Responsible water management policy

The policy must publicly reflect the brand owner's commitment to sustainable water management and define expectations for suppliers in the supply chain of the certified product.

The policy must be publicly available and communicated to suppliers in the supply chain of the certified product.

Verification of the policy

At the annual review, the brand owner must demonstrate that the policy:

- is publicly available
- addresses both operational and supply chain water-related risks and impacts.
- is communicated to suppliers relevant to the certified product.
- consistent with this mandate.

The policy must at least include the following principles:

- Implement and maintain a water stewardship program that measures, manages, and continuously improves water-related impacts, risks, and efficiency within the organization's operations and supply chain.
- Monitor and assess water consumption and related risks, including operations or suppliers located in water-stressed or high-risk areas.
- Promote water conservation and the efficient use of water resources through improvement initiatives and performance goals.
- Engage suppliers on responsible water management practices, including risk identification, efficiency improvements, and reporting.
- Prevent adverse impacts on water quality by effectively managing water-related environmental risks.
- Commit to transparency by tracking and reporting water-related performance and progress.
- Support collaboration and awareness activities related to responsible water management.

Verification of the due diligence process for water management

At the annual review, the brand owner must demonstrate implementation of a water management due diligence process covering the manufacturing of the certified product and aligned with the following due diligence principles and water stewardship practices.

Verification guidelines:

The Due diligence process must include :

- Identification and mapping of high-impact suppliers, including suppliers, facilities, or regions associated with significant water use, wastewater discharge, water scarcity, or other water-related risks.

- Assessment of prioritized suppliers' water management practices, including processes for monitoring, conservation, wastewater management, and control of water-related environmental risks.
- Collection and evaluation of relevant water-related data from prioritized suppliers, such as water withdrawal, consumption, reuse, wastewater treatment, and risk-related information.
- Monitoring and follow-up of identified risks and adverse impacts through supplier engagement, corrective actions, improvement plans, or further assessment, as needed.
- Public communication on significant water-related risks, mitigation activities, and progress in improving water management performance within the supply chain.
- Promotion of continuous improvement by encouraging or supporting suppliers in adopting improved water stewardship practices, including water efficiency, recycling, reuse, or improved treatment systems.

Scoring in the annual review (Policy and Due diligence process)

Green: (mandatory): All requirements are fulfilled and verified.

Red: One or more elements are missing, unclear, or not implemented.

A corrective action plan must be established for each non-conformity. The affected requirement(s) must be re-verified and achieve compliance no later than the next annual review (within 12 months).

Supporting documentation

available at: <https://industry.tcocertified.com/documents/>