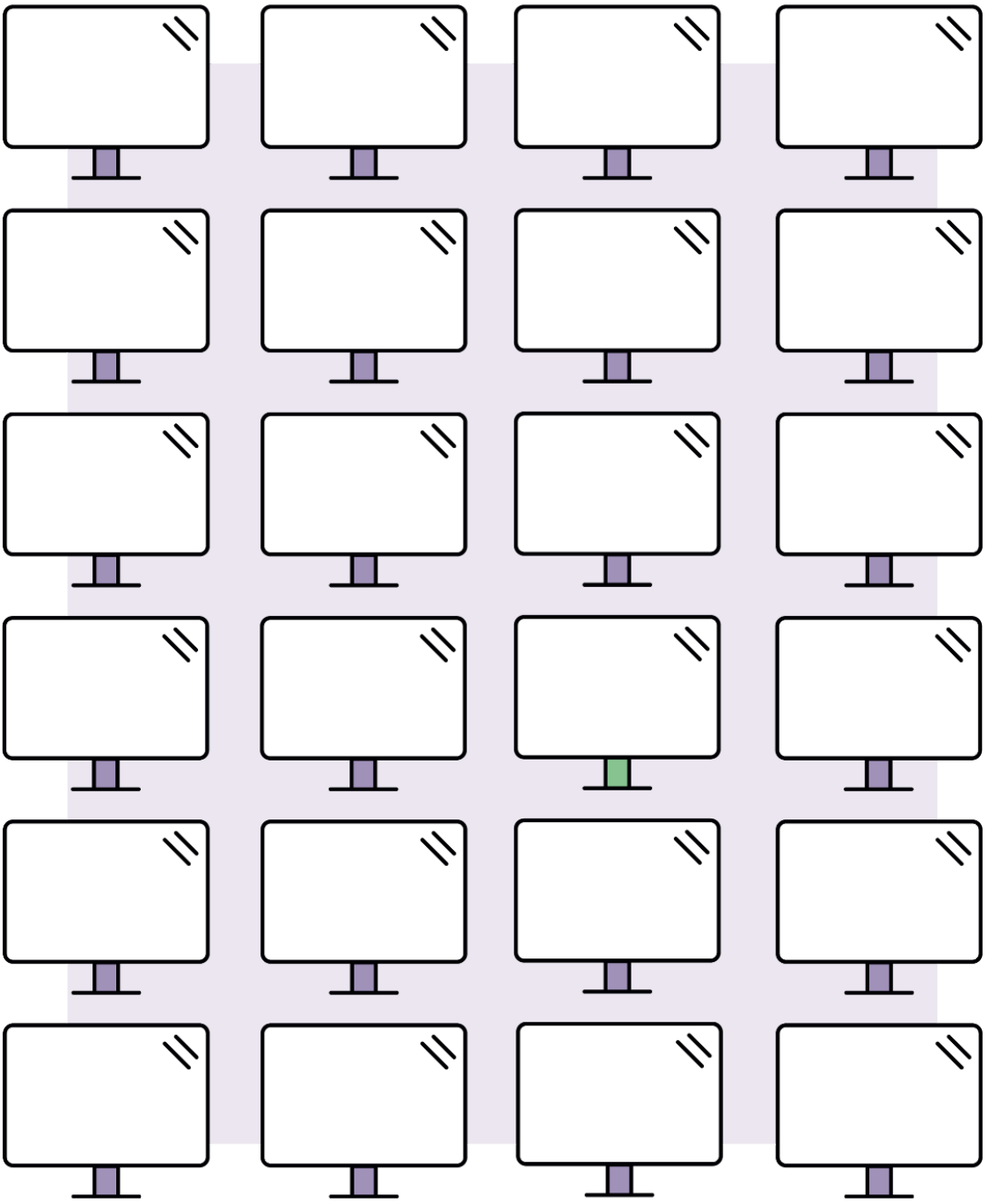

Draft 1

TCO Certified, Generation 11

For displays

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 displays, released in [date]. A display is defined as a visual display unit with fixed positions of the pixels. The criteria cover the display, 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. Televisions and large-format public displays may also be certified in accordance with this criteria document. Some visual ergonomics criteria in TCO Certified are only applicable to non-monochromatic backlit (LCD) or light emitting (oled or plasma) pixels. (This means that reflective displays such as those in many E-book readers are not covered by some of the visual ergonomics criteria. Such displays can still be certified if they pass all other applicable criteria in TCO Certified.)

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

Table of contents

1 Product and sustainability information

Intro text for chapters will be published in Draft 2

1.1 Information to end users

Background

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

Applicability

All product categories.

1.1.1 Mandate

A. The product must be labelled with the TCO Certified logo.

B. The retail packaging must be labelled 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 dedicated TCO Certified page with:

1. Information about TCO Certified.
   Descriptive text,
   TCO Certified logo,
   Link to the TCO Certified website.
2. All public statements as required in TCO Certified, including but not limited to:
   - Product warranty criteria.
   - Security and functionality software updates criteria.
   - Carbon offset criteria.
   - Digital product passport criteria.

Submit the following to an approved verifier:

Necessary documentation describing and proving how:

- The information document to end users is distributed to the end user.
- 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

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.

Logo colors and quality
The TCO Certified logo must be reproduced using the designs, colors and resolutions as shown by the originals published and available for download on:
tcocertified.com/industry/logos-and-images/

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

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 or temporary label.
A temporary label must be affixed to the product with an adhesive or cling-type application.
The minimum acceptable size of the logo is 16x10mm, and the minimum acceptable distance to other graphical elements is 2.5 mm.
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.

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.

Alternative 3: Preinstalled link to “Information document for end users”
The “information document for end users” must be accessible through a preinstalled shortcut on the desktop screen or as a pinned link in the start menu.
The shortcut icon must be the TCO Certified logo, and clicking it should link to “information document for end users” which is available at tcocertified.com.

B. Labeling of the 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.

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.

C. Mention of TCO Certified on the brand owner's website where the specific certified product is marketed and or sold.

TCO Certified must be mentioned on the brand owner's website.

- The inclusion of the text “TCO Certified”

  or
- “TCO Certified” as TEXT in a product-specific PDF-file if it is accessible from the brand owner's website(s) where the specific certified product is marketed and or sold.

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

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

The brand owner website must have a dedicated TCO Certified page with:

Colors and quality of the TCO Certified logo

The TCO Certified logo must be reproduced using the designs, colors and resolutions as shown by the originals published and available for download on:
tcocertified.com/industry/logos-and-images/

Specifications for Explanatory text about TCO Certified.

The following text must be used:
“Placeholder Text about TCO Certified"
If an another text is to be used it needs to be accepted by TCO Development and a written and signed approval of the alternative text must be submitted

Public statements required in other criteria.

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.

1.2 Product specification

Background

The brand owner must provide a product description that enables reliable identification and categorization of the certified product.

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

1. **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.

2. **Product names**

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

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 Clarification

A physical sample representing each product to be certified must be sent to an approved verifier, who examines it carefully to ensure that product marking and physical aspects conform with the reported information from the applicant or brand owner.

Clarification about 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 a list containing 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.

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

Background

Reliable product identification is essential for achieving a circular product life. When a product cannot be uniquely traced, important information such as configuration details, repair instructions and sustainability attributes can be lost. This lowers the product's value and limits opportunities for reuse, refurbishment and responsible end of life handling. A persistent scannable identifier ensures that accurate information follows the physical product throughout its entire lifespan, regardless of ownership changes or where the product is used.

By linking each unit or model to a stable URL based information source, this criterion enables continuous access to trustworthy lifecycle data. This supports correct servicing, extends product life, improves material recovery and strengthens transparency. In this way, reliable information flow becomes a key enabler of circular IT products.

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.
Date of end of placement on the market: The last manufacturing date.
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.

Applicability

All product categories.

1.3.1 Mandate

- The product must be equipped with a data carrier containing a URL based product identifier.
- The URL based identifier must lead to a website displaying the following information about the product:
    - Model name
    - GTIN
    - Serial number
    - Service manual and/or maintenance manual 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 on how to order all critical replaceable components as required in the "replaceable components" criterion.
    - Section about TCO Certified, containing:

        - TCO Certified Logo
        - Link to “document to end user” https://tcocertified.com/your-product/
        - Link to Brand page for TCO Certified as specified in the “information to end user” criterion
- The URL based identifier must support access to different sets of information and data formats by allowing credentials to be added to the end of the encoded URL

Submit the following to an approved verifier:

- Documentation showing how the product will be marked.
- Sample URL as encoded in the data carrier
- Sample URL for the destination website.

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

Accepted types of data carriers

QR code or 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 encoded product identifier

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	
Projectors	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).

Examples illustrating Compliant URLs for Product identification on Unit level:

All the examples below are compliant but it is recommended to implement a solution according to an example with as low a number as possible. (Example 1 = best practice, Example 3 = least recommended).

Example 1: Standardized full product identifier (**recommended)**

URL: https://www.exampledoimain.com/01/GTIN/21/serial number

The brand uses GTIN, model name, (GIAI or own) serial number in offline data carriers.

Example 2: ***Standardized serial number in a GS1 digital link URI syntax URL***

URL: https://www.exampledoimain.com/8004/GIAI

The brand uses the GS1 identifier (GIAI) Global individual asset identifier using the GS1 digital link URI syntax.

Example 3: *Brand owner serial number in non-standardized URL.*

URL: https://www.exampledoimain.com/support /productid?sn=brandowner serial number

The brand uses its own non-standardized serial numbers and its own URL syntax.

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 information that any alphanumeric string that functions as a persistent and unique identifier for an individual item).

Examples illustrating Compliant URLs for Product identification on Model level:

Example 1: GTIN-based product identifier (**recommended)**

URL: https://www.exampledoimain.com/GTIN

Example 2: model name-based product identifier

URL: https://www.exampledoimain.com/modelname.

Clarifications for the Product Information Page (PIP)

Information requirements

The following information needs to be displayed on the PIP:

Information requirement 1: 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.

Information requirement 2: Product lifetime extension information:

- Service manual and/or maintenance manual 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 on how to order all critical replaceable components as required in the "replaceable components" criterion.
- Section about TCO Certified, containing:
    - TCO Certified Logo
    - Link to "document to end user" https://tcocertified.com/your-product/
    - Link to Brand page for TCO Certified as specified in the "information to end user" criterion

Tiered data access.

Tired data access means that the UPI solution is able to support both open access information and Restricted data that is available after using credentials.

It must be possible to submit credentials by attaching a query string to the URL request made when the URL based product identifier is scanned by a smart device.

Example illustrating tired data access

Default access without credentials, leading to the product information page: https://www.exampledoimain.com/01/GTIN/21/serial number Access with credentials that leads to extended product data in a machine readable format: https://www.exampledoimain.com/01/GTIN/21/serial number?access_token=abc123

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 on the market (which is defined as the last manufacturing date).

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. See the underlined text in the examples below:

Example illustrating language and region subdirectories in the URL

One subdirectory: *https://support.brand.com/us-en/product/model-123-abc-notebook-pc/123456789* Two subdirectories: *https://support.brand.com/us/en/product/model-123-abc-notebook-pc/123456789*

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.

2 Climate

Cloud services have a considerable and increasing climate impact. Data centers require large amounts of electricity to power servers and cooling systems. Many cloud providers still depend on fossil-fuel-based energy sources, leading to substantial greenhouse gas emissions. As the demand for cloud services continues to rise, the number of data centers is also increasing. Consequently, the sector's climate footprint is expected to grow in the coming years. To begin reducing the climate impact of cloud services, we need to improve energy efficiency and increase the share of renewable energy used to power data centers.

Criteria in chapter 2 focus on:

- Establishing responsibility for reducing the climate footprint of certified cloud resources and their data center facilities.
- Establishing transparency to end customers and the public of the climate footprint of certified cloud resources and their data center facilities.
- Creating incentives for different actors to reduce the climate footprint of certified cloud resources and their data center facilities.

2.1 Renewable energy

Background

Energy use in manufacturing is a major contributor to the climate impact of IT products. Increasing the share of renewable electricity in production reduces carbon emissions and strengthens market demand for Renewable Energy Certificates (RECs).

To incentivize brand owners and factories to increase the share of verified renewable electricity used in product manufacturing. The criterion supports TCO Certified's climate strategy to reduce Scope 3 emissions through credible, REC-based verification of renewable energy use. REC registries prevent double-counting by tracking each unit of renewable electricity, and cancelled RECs can be independently verified to confirm exclusive ownership and use claims.

Definitions

Electricity is used in a factory is considered to be renewable if it is covered by Renewable Electricity Certificates designated to that factory.

Applicability

All product categories.

2.1.1 Mandate

For each final assembly factory and each factory manufacturing display panels >10 at least 30% of the electricity used to produce the certified product must be procured and/or generated from renewable sources.

Submit the following to an approved verifier:

For each final assembly factory and each factory manufacturing display panels >10" for the certified product, the following must be submitted once a year:

- Documented proof of the total electricity [MWh] for each factory
- Documented proof of the renewable electricity ratio for the manufacturing of the certified product in each factory.

Submit the following to TCO Development:

- A copy of the verification report from a verifier approved by TCO Development.
- For each final assembly factory and each factory manufacturing display panels >10" for the certified product the following must be reported in the TCO Certified portal once a year:
    - The total electricity used in each factory [MWh]
    - The renewable electricity ratio for the brand owner's manufacturing of certified product at in each factory (%)

2.1.2 Clarification

Brand owner reporting
The reporting by the brand owner must be submitted by 31 August each year, including one year after the certificate has expired.

The reporting must cover a consumption period (the period during which the electricity was used by the factory), corresponding to the previous calendar year. The same consumption period must be stated on the REC cancellation statements.

The production period of the Renewable Energy Certificates (the period during which the renewable electricity was generated) referenced in the cancellation statements must fall within six months before and three months after the consumption period.

Example:
Reporting submitted in 2025 must be received by 31 August 2025. It must cover electricity consumption from 1 January 2024 to 31 December 2024. The renewable energy claims must be supported by REC cancellation statements covering RECs produced between 1 July 2023 and 31 March 2025.

If the product is manufactured in multiple final assembly factories, the reporting must cover each factory separately. Each factory must meet the criterion individually; averaging results across factories is not permitted. The worst-case renewable electricity ratio between all the factories will be designated to the product.

Exception for new factories
For any factory where no TCO Certified Generation 11 product (for any brand) was certified prior to 31 August, the brand owners manufacturing at that factory must achieve compliance within the following calendar year.

If reporting is done for the whole factory
Brand owners may choose to report either for the entire factory or for their brand's share of manufacturing. Reporting on the whole factory level is generally simpler. In this case, all products manufactured at the factory are assigned the same share of renewable electricity as the factory.

If reporting is done for the whole factory, the brand owner must submit the following:

- Documented proof of the total electricity consumption of the factory (X)
- All REC cancellation statements designated to the factory (with the factory name) for the renewable electricity (Y) generated or purchased by the factory during this period OR A cancellation summary report signed by an agent approved by TCO Development.

Calculations:

- The ratio of renewable electricity by the factory (R_F = Y/X).

If reporting is done for a brands share of the manufacturing (more detailed information)
If the factory does not comply with the renewable electricity mandate or if the brand owner wishes to demonstrate a higher share of renewable electricity than the factory as a whole, the brand owner may report for their own share of the manufacturing.

In such cases, the share of total electricity used to manufacture the brand owner's products is estimated to be proportional to the brand owner's share of the factory's revenue or manufacturing volume.

If reporting is done for a brands share of the manufacturing, for each reporting period and final assembly factory, the brand owner must report the following:

- Documented proof of the total electricity consumption of the factory (X)
- All REC cancellation statements assigned to the factory (with the factory name) for the renewable electricity (Y) generated or purchased by the factory during this period.
- All REC cancellation statements assigned to the factory and brand owner (with the factory name and brand name) for the renewable electricity for the manufacturing of products for the brand owner at the factory (S).
- Documented proof to estimate the brand owner's share of the electricity consumption, based on either::
    - the total number of units manufactured by the factory (Z) and the number of units manufactured for the brand owner (W),
      OR
    - the total revenue of the factory (Z) and the revenue for the brand owner's manufacturing at the factory (W).

Calculations:

- Estimated electricity used to manufacture the brand owner's products (E = X/Z*W)
- Ratio of renewable electricity for all manufacturing at the factory (R_F = Y/X).
- Ratio of renewable electricity only for the brand owners manufacturing (R_B = S/E)
- Total ratio of renewable electricity for the brand owners manufacturing ($R_T = R_F + R_B$)

Renewable electricity must be generated from:
Renewable electricity must be generated from, wind, solar, geothermal, hydropower (pumped hydro storage is only accepted if the amount of grid-imported electricity used to run the pumps is specified on the submitted REC and deducted from the generated electricity) or biomass (agricultural waste and residues, forest biomass, biofuels plants).

Renewable energy certificates (RECs)
Renewable electricity used by factories may be either purchased or self-generated. Generation facilities may be on-site or off-site, grid-connected or off-grid.

All renewable electricity must be issued with Renewable Energy Certificates (RECs). Factories or brands may:

- Consume electricity directly from their own renewable generators, retain the RECs, and claim the use of renewable electricity,
  OR
- Sell electricity to the grid, retain the RECs, and claim the use of renewable electricity.

REC registries prevent double-counting by tracking each unit of renewable electricity. Cancelled RECs can be independently verified in the registry to confirm exclusive ownership and use claims.

RECs must be sourced and purchased within the same national region as the factory that uses the electricity. The renewable electricity production facility from which the RECs originate must also be located within the same national region. The national region defines the market boundary for transacting and claiming renewable electricity attributes.

To claim the renewable electricity for a specific beneficiary, cancellation statements are issued by the registry or issuing body when RECs are cancelled by an end-user (e.g., a company).

Accepted agents
To simplify the purchase and verification of RECs, brand owners may engage an agent accepted by TCO Development.
Accepted agents may:

- Assist in purchasing RECs across different markets
- Confirm REC cancellation statements
- Issue a "cancellation summary report"

Accepted agents have access to certain REC registries that may otherwise be difficult for independent verifiers to access. A current list of accepted agents is available on the TCO Certified website.

Exception for a high market price of RECs
When REC prices are significantly above average in a given market, partial sourcing from neighbouring regions is allowed under the following conditions:

- 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.

Regional exception: For factories located in Taiwan, RECs may be sourced from China, Japan, the Philippines, or South Korea under this rule.

Only RECs recognised as "**Accepted REC systems"** by TCO Development are valid as proof of compliance. Additional countries or credible REC systems may be added to this list following 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, (CPPA is not an REC but allowed)
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

Verification guidelines for brand owner and factory data
Three aspects need to be verified:

1. The claimed electricity consumption,
2. The authenticity of cancellation statements, and
3. The coverage of renewable electricity claims.

Claimed electricity consumption.
Verify that the submitted documentation supports the reported electricity consumption and includes correct calculations.

The documentation must:

- Cover the total electricity consumption for the previous calendar year, and
- Clearly show that the electricity consumption covers the entire business license (address) under which the factory is registered on the Accepted Factory List (AFL).
  It must not be limited to individual buildings, assembly lines, or partial operations.

Examples of documentation to verify a factory's annual electricity use include:

- Energy bills
- Metering records
- Energy audit reports
- Monitoring system data

If reporting is done for a brand's share of the manufacturing instead of the whole factory, the share of the factory's electricity consumption for, which the brand is accountable, must also be verified with documentation showing units manufactured or revenue for both the factory and the brand.

Examples of documentation examined to verify a brands share of a factory's annual total revenue or manufacturing volume include:

- Production records
- Shipping logs
- Internal financial documents
- External audit reports
- Contractual agreements

All records submitted must be verifiable copies or digital system outputs that can be checked during an on-site audit. The verified factory, or brand owner share of, electricity consumption is added to the Accepted Factory List and only needs to be verified once per factory, brand, and year.

Authenticity - Verification of cancellation statement authenticity:
Verify that a cancellation statement is authentic by confirming that the information on the cancellation statement matches the information listed in the registry of the issuing body. This must be done in one of the following:

A. Verifier accesses the issuing body registry from the QR-code on a cancellation statement or gets an account login at the issuing body registry and verifies the authenticity of the cancellation statements.
B. Verifier gets a signed confirmation that the submitted cancellation statement is authentic from either the issuing body or an accepted agent.
C. Verifier gets a signed "cancellation summary report" from an accepted agent.

Coverage - Verification of correct coverage of cancellation statements:
Verify correct coverage and compliance with the TCO Certified mandate by confirming that:

- The beneficiary is the factory name only to count for the factory's renewable electricity share, OR that the beneficiary is the factory and brand name to count for the brand-specific renewable energy share in the factory (for REC systems that do not allow this type of specific beneficiary a "purpose" of "free text" field may be used to add this information).
- The total MWh cancelled matches the claimed consumption
- The REC production period falls within 6 months before and up to 3 months after the previous calendar year in line with the TCO Certified mandate.
- The energy source is of an accepted type (see criteria document).

For more information on how to verify renewable energy, see supporting documentation.

Supporting documentation

1. Climate - verification guidelines

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

2.2 Annualized PCF

Background

Manufacturing is typically the largest source of greenhouse-gas emissions for IT products; for some categories like notebook computers it can exceed 80% of a product's total Product Carbon Footprint (PCF). Every premature replacement triggers a new round of manufacturing emissions.

A PCF estimates the climate impact across the full life cycle, from raw material extraction and production, through use, to end-of-life. PCFs are valuable for understanding where emissions occur, but the result can vary widely depending on calculation method, scope, data sources, and assumptions. That means using PCFs to rank products against each other can be misleading, even if the numbers appear precise.

This criterion shifts the focus from producing the "most precise" footprint number to achieving real, verifiable reductions in climate impact. It aims to:

- Incentivize longer supported product lifetimes, which spread manufacturing emissions over more years and reduce premature replacement.
- Incentivize independently verified Scope 3 reductions in the supply chain and scale those practices across the industry.
- Provide a simple annualized metric that makes these levers visible to buyers.

The annualized PCF expresses a product's footprint as the category average Scope 2 and Scope 3 values (minus any verified Scope 3 reductions), divided by the supported product lifetime. This lets purchasers compare products based on two things that matter: how long the product is supported by the brand owner and how much Scope 3 has been reduced.

Applicability

All product categories where a Scope 2 and 3 category averages has been defined

2.2.1 Mandate

1. For all product categories where a Scope 2 and 3 category averages has been defined an annualized PCF is estimated for the certified product, based on:
    - The product category average Scope 2 and 3, the supported product lifetime and any implemented accepted Scope 3 reductions.
2. For notebooks:
    - The estimated annualized PCF for the certified product must be at least 33% lower than the market average. (This can be achieved by 5% scope 3 reduction or 7 years supported product life).

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 (submitted in the *Product Warranty* 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 (as defined in this criterion).
- The estimated annualized PCF.
- Any approved Scope 3 reductions.

2.2.2 Clarification

Product category averages

The product category averages for scope 2, 3 and product life are developed by extracting and averaging these aspects in a large number of public PCFs in each product category. The product category average Scope 2 is calculated based on an EU average energy mix. These values may be updated periodically to reflect products currently available on the market. The list of currently applicable product categories and the methodology of how the product category averages are developed are explained in "Scope 2 and 3 product category averages" (see *Supporting document*).

Supported product lifetime

The supported product lifetime is defined by TCO Development as the shortest duration (worst case) of the available *Product warranty* and *Security and functionality software updates* (see these two separate criteria).

Scope 3 reductions

The list of accepted Scope 3 reductions is populated by TCO Development and continuously updated as brand owners submit suggestions and independent experts evaluate them to determine how much they exceed the industry average and what reduction should be awarded. To claim a reduction on the list, a brand owner must provide documented proof of the implementation of the reduction covering the certified product.

The mandate requires that the "Product individual annualized PCF" of the certified product is 33% lower than the "Product category average annualized PCF" of an average product. This because the certified product has a longer supported product life and/or some scope 3 reductions compared to an average product on the market.

Individual annualized PCF

TCO Development estimates and publishes an individual annualized PCF for each certified product. With an EU average energy mix.

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

Product category average annualized PCF

TCO Development also estimates and publishes a product category average annualized PCF for an average product in each category. With an EU average energy mix. This is used as a baseline to determine how each individual certified product compares to this baseline based on Scope 3 reductions and supported product life (which are currently the only aspects differentiating between products and this baseline).

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

Addition of new Scope 3 reductions to the list

Brand owners who have implemented measures that reduce the Scope 3 beyond the industry average may submit their proposal to TCO Development for evaluation.
An independent expert organization will assess whether the proposal meets the criteria for inclusion and determine an applicable reduction percentage compared to the product category average Scope 3. Upon approval, the Scope 3 reduction is added to the list, and all brand owners implementing it can claim the associated reduction.

To qualify for the list of Scope 3 reductions, at least the following criteria must be met:

- The Scope 3 reduction must result in a significant reduction in Scope 3 emissions compared to the industry average for the product category.
- The reduction of Scope 3 emissions can be estimated with credibility.
- The Scope 3 reduction should be formulated so that it is not limited to a specific brand owner.
- There must be a credible methodology for implementing and verifying the reduction activity, which TCO Development can make public.

The purpose of this list is to recognise brand owners who have a deep understanding of Scope 3 carbon footprint reductions. By sharing their solutions with other brand owners, they can gain approval for their methods and subsequently claim a lower annualized PCF value for their certified products. Over time, this will result in a list of field-tested solutions for Scope 3 reductions, assessed by experts, that will make a significant impact on the industry climate impact. Each verified scope 3 reduction is presented with a methodology for implementation and verification.

Calculation examples

Market average notebook:

$$PCF_{annualized} = \frac{237}{4} + 6,5 = 65,75kg\ CO2\ /\ year$$

Example with prolonged supported product life:
A notebook with a supported product life of 7 years would have an estimated annualized PCF that is 39% lower than a market average notebook .

$$PCF_{annualized} = \frac{237}{7} + 6,5 = 40,4\ kg\ CO2/year$$

$$(65,75 - 40,4)/65,75 = 39\%$$

Supported product life	Annualized PCF $\frac{(Scope\ 3_{Prod.\ cat.av.} - Scope\ 3_{reductions})}{Supported\ product\ lifetime} + Scope\ 2_{Prod.cat.av}$	Reduction of annualized PCF
4 years	$\frac{237}{4} + 6,5 = 65,75 \frac{kg\ CO2}{year}$	Market average annualized PCF: 65,75 CO2/year
6 years	$\frac{237}{6} + 6,5 = 46 \frac{kg\ CO2}{year}$	46/65,75= 70% 30% lower than market average
7 years	$\frac{237}{7} + 6,5 = 40,4 \frac{kg\ CO2}{year}$	40,4/65,75= 61% 39% lower than market average
8 years	$\frac{237}{8} + 6,5 = 36,1 \frac{kg\ CO2}{year}$	36,1/65,75= 55% 45% lower than market average

Example with high renewable electricity share in manufacturing:
50% renewable electricity in panel manufacturing and Motherboard fabrication (PCB) results in an annualized PCF 35% lower than a market average notebook .

$$PCF_{annualized} = \frac{237-237*(0,05+0,03)}{6} + 6,5 = 42,84 kg\ CO2/year$$

$$(65,75 - 42,84)/65,75 = 35\%$$

Supporting documentation

1. Scope 3 reductions
2. Scope 2 and 3 category averages

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

References

- Integrity Council for the Voluntary Carbon Market (ICVCM) — Core Carbon Principles
- ISO 14068 – Climate Change Management: Greenhouse Gas Mitigation and Removals – Carbon Neutrality

2.3 Energy efficiency

Background

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

This criterion focuses on energy efficiency in the use phase and helps purchasing organizations independently verify that the IT product they source meets the energy efficiency requirements of EU eco-design directive.

Applicability

All product categories covered by EU eco-design directive.

2.3.1 Mandate

- All products must meet the energy efficiency, power consumption and power supply requirements of the applicable EU Eco-Design Directive.
- All internal power supplies with a rated wattage >200W must achieve ≥ 90 % efficiency at 50 % load.
- All external power supplies must bear the Efficiency Level VI marking or higher for external power supplies in accordance with the International Efficiency Marking Protocol (IEMP).

Submit the following to an approved verifier:

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

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 following is submitted to TCO Development and may be published:

- Measured energy values and product configuration must be reported in the TCO Certified Portal

2.3.2 Clarification

The product must be tested in accordance with the latest in force EU Ecodesign regulations, including but not limited to:

- Commission Regulation (EU) 2019/2021 for electronic displays
- Commission Regulation (EU) 2019/424 for servers and data storage products
- Commission Regulation (EU) 2013/617 for computers and computer servers

Testing can be carried out at any test facility accredited according to ISO/IEC 17025, but the test report must be verified by a verification organization approved by TCO Development.

The certificate shall state which EU Ecodesign regulations 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 relevant EU Ecodesign regulation. The product does not need to be CE-marked or registered in EPREL to be approved for TCO Certified.

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

- Brand
- Product name
- Model number
- Processor brand
- Processor model
- System memory (GB)
- Integrated or dedicated GPU
- Operating system name
- Power supply unit

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

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

References

1. Directive 2009/125/EC – Ecodesign Framework Directive for energy-related products
2. International Efficiency Marking Protocol (IEMP) – Efficiency Level VI marking for external power supplies
3. Generalized Test Protocol for Calculating the Energy Efficiency of Internal AC–DC and DC–DC Power Supplies
4. ISO/IEC 17025 – General requirements for the competence of testing and calibration laboratories

2.4 Energy management system

Background

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

Definitions

See definitions chapter 5.0

Applicability

All product categories

2.4.1 Mandate

- Each final assembly factory, each display panel factory (panels >10”), and each PCB mainboard fabricator (manufacturer) for the certified product must have a structured energy management system that is independently certified to ISO 50001.
- All ISO 50001 certified factories covered by this mandate shall identify and submit their three Significant Energy Uses (SEUs) with the highest estimated annual energy consumption, as determined in their ISO 50001 energy review. For each SEU, indicate the energy type, relevant variables, and annual consumption or share of total energy use if available.

Submit the following to an approved verifier:

For each required factory for the certified product:

- A valid ISO 50001 certificate must be uploaded to TCO Certified Portal before the due date.
- SEU data collection template

The following is submitted to TCO Development:

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

2.4.2 Clarification

The applicant must ensure that a valid ISO 50001 certificate is available on TCO Certified Portal at all times for every factory type required to be ISO 50001 certified. The certificate(s) or an appendix to the certificate(s) must clarify what the certification covers, and 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 by an accreditation body covered by the International Accreditation Forum (IAF) Multilateral Arrangement on Environmental Management Systems.

Extended time application.

If necessary, an applicant may request an extension of up to 24 months on behalf of a factory that is not yet ISO 50001 certified. The application must include a detailed time plan for achieving certification and be accompanied by a signed agreement. 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

Factories must report the same Significant Energy Uses (SEUs) that are identified as part of their ISO 50001 energy management system, to ensure consistency between the TCO Certified submission and the factory's energy review process.

According to ISO 50001, factories are required to conduct an energy review (Clause 6.3) to identify and evaluate energy uses and consumption to determine which are significant. Significance shall be based on criteria such as:

- The amount of energy consumed by the process, equipment, or system;
- The potential for improvement in energy performance; and
- The impact of the energy use on overall energy performance at the facility.

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

- The three SEUs with the highest estimated annual energy consumption.
- The energy type used by each of these SEU (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, as identified in the ISO 50001 energy review.

If exact kWh or percentage data are not available, 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

1. SEU data collection template

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

References

1. ISO 50001 - https://www.iso.org/iso-50001-energy-management.html
2. International Accreditation Forum (IAF) - www.iaf.nu

2.5 Carbon offsets

Background

TCO Certified requires reductions in Scope 3 emissions emissions within the value chain through independently verified reduction activities and an increased supported product lifetime to reduce the estimated annualized Product Carbon Footprint (PCF) *see Annualized PCF criterion*. Since the purpose of the annualized PCF is to measure the product's actual carbon footprint, only genuine reductions achieved within the manufacturing value chain can be counted.

Carbon offsets contribute to climate action by directing funding toward projects that reduce or remove emissions elsewhere, making them a useful tool in climate strategies. However, offsets do not reduce the actual, on-site, or supply-chain emissions generated during the manufacturing of a product. Offsets are therefore excluded from the annualized PCF estimation in TCO Certified.

Any recognized carbon compensation must be based on high-quality, independently verified carbon offsets aligned with international best practice.

Applicability

All product categories where Scope 3 category averages have been defined

2.5.1 Mandate

The brand owner must offset at least 30% of the certified products scope 3 category average, as defined by TCO Development, through carbon credits.

Submit the following to an approved verifier:

- A link to a public statement in English, published on the webpage required in the information to end user criterion, where the brand commits to the carbon offset for each certified product sold.
- Documented proof of any carbon offset claims.

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 percentage of the product's scope 3 category average that has been offset through carbon credits.

2.5.2 Clarification

The scope 3 product category averages are developed by averaging the scope 3 components in a large number of public PCFs in each product category. These values may be updated periodically to reflect products currently available on the market. The list of currently applicable product categories and the methodology of how the product category averages are developed are explained in “Scope 2 and 3 product category averages” (see *Supporting documents*)

Claiming carbon offsets

Any carbon offsets claimed must be third-party verified under a recognized standard that is approved by the Integrity Council for the Voluntary Carbon Market (ICVCM) as aligned with its Core Carbon Principles, which include requirements for additionality, permanence, robust monitoring, and retirement in public registries to prevent double-counting.

In addition, climate neutrality or compensation claims must be made in accordance with the principles of ISO 14068 or equivalent internationally recognised standards.

Public statement

The carbon offset must be declared in kg CO2 equivalents per product or product category. For more information on public statement requirements, see *information to end user* criterion.

In TCO Certified generation 11 the mandated carbon offsets (30% of scope 3 category average) are defined for the following product categories as:

- 71 kg CO2 for each sold certified notebook
- 90 kg CO2 for each sold certified desktop
- 98 kg CO2 for each sold certified display
- Others may be added (contact TCO Development)

Verified carbon offsets

The brand owner must submit an annual report by the end of August each year covering the previous calendar year's activities containing:

- The number of sold certified products manufactured during the reporting year for each products category.
- The amount of carbon offset claimed for certified products of each product category
- Proof of retirement of carbon credits in public registries (with a clear designation (e.g., in the notes or retirement purpose field) stating that the carbon credits are allocated to products certified with TCO Certified of the total amount of carbon offsets claimed.

Calculation example

The sale of 20,000 certified notebooks in 2027 would require documented proof in the form of retired carbon credits allocated to certified notebooks covering 1,420,000 kg CO2 in 2027.

Supporting documentation

1. Scope 2 and 3 category averages

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

References

- Integrity Council for the Voluntary Carbon Market (ICVCM) — Core Carbon Principles

ISO 14068 – Climate Change Management: Greenhouse Gas Mitigation and Removals – Carbon Neutrality

3 Substances

Intro text for chapters will be published in Draft 2

3.1 Process chemicals management

Background

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, have been restricted in some parts of the world but are often used by the manufacturing industry in developing countries where legislation is weaker, and workers are less protected. These chemicals need to be phased out of production and not be replaced with equally hazardous substances.

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

Definitions

Cleaners: refer to chemical formulations used in manufacturing processes to eliminate dust, flux residues, oils, and other contaminants from display assemblies, product housings, printed circuit boards, SMT machinery, and production tools, ensuring surface cleanliness and reliable assembly quality.
Adhesives: Component bonding adhesives used to join or secure structural, mechanical, or electronic parts (e.g., housings, components, connectors, PCBs, batteries, modules) within IT products, providing structural integrity, precise alignment, and vibration resistance during assembly.

See also definitions Chapter 5.0

Applicability

All product categories.

3.1.1 Mandate

1. Each of the following must have a structured health and safety management system independently certified to ISO 45001:
    a. The final assembly factory of the certified product.
    b. Each next-tier key component factory that must be reported in the supply chain identification template (SCIT).

2. Each final assembly factory, each factory manufacturing display panels >10”, and each factory manufacturing mainboards (bare or assembled) for the certified product.
    a. Must only use cleaning and adhesive ingredients or formulations that appear on TCO Certified Accepted Substance List.
    b. Must submit chemical inventory data covering at least cleaners, adhesives and lubricants.

All substances of a mixture must be accounted for. Non-accepted substances must not exceed concentration levels of 0.1% by weight of the chemical product.

Submit the following to an approved verifier:

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.
- The accepted process chemical template (PCT) must be provided before the factory can be added to TCO Certified Accepted Factory List.

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 data template must be reported in TCO Certified Portal.

3.1.2 Clarification

ISO 45001 certification.

The applicant must ensure that a valid ISO 45001 certificate is always available on the TCO Certified Portal for every factory type required to be ISO 45001 certified. The certificate(s) or an appendix to the certificate(s) must clearly state what the certification covers, and the ISO 45001 certification must cover the entire operation included in the factory's business license. Certificates must be issued by an independent certification body accredited by an accreditation body covered by the International Accreditation Forum (IAF) Multilateral Arrangement on Environmental Management Systemsiaf.nu.

Supply Chain Identification Template (SCIT)

For each final assembly factory listed on TCO Certified Accepted Factory List, the SCIT must be submitted to register the list of key suppliers. The SCIT submission due date will be displayed in TCO Certified Portal.

Submission of the SCIT is required under mandate 5.1. Information on next-tier key component factories to the final assembly factory entered on the SCIT will be recorded and monitored in TCO Certified Portal, but this information will not be visible to brand owners on the TCO Certified Accepted Factory List. Only factories required to appear on TCO Certified Accepted Factory List, in accordance with mandate 5.1, will be visible to brand owners. These are the final assembly, display panel assembly and PCB mainboard factories.

The following next-tier key component factories supplying to the final assembly factory must be reported in the SCIT:

- 1. Product housing: Enclosure (chassis) including stand: Parts >0.5 grams.
- 2. Printed circuit board: Mainboard (motherboard) and power board.

- 3. External cables: Power and peripheral connecting cables.
- 4. Processors and memory: CPU, chipset, DRAM, RAM, SSD and HDD.
- 5. Battery: The remote power source of the product.
- 6. Power supply: internal and external.
- 7. Display panel assembly.

Extended time application.
If necessary, an applicant may request an extension of up to 12 months on behalf of a factory that is not yet ISO 45001 certified. The application must include a detailed time plan for achieving certification and be accompanied by a signed agreement. TCO Development reserves the right to deny an extension if there is a significant risk that the factory will be unable to achieve ISO 45001 certification within the requested period.

Process Chemical Template.
The Process Chemical Template (PCT) must be submitted at the time a factory is registered on TCO Certified Accepted Factory List. Any updated submission to verify compliance must be submitted before the due date on TCO Certified Portal. The chemical data must at least cover the chemical formulations and ingredients shown in the chemical safety data sheet and used on the production lines where certified products are manufactured.
The accepted and most recent PCT can be downloaded at tcocertified.com
The data must cover the cleaners, adhesives and lubricants used to produce the certified product. The process chemical template can be downloaded from the supporting documents webpage.

Factory production lines of certified products must only use cleaners and adhesives listed on the TCO Certified Accepted Substance List. To be included on the list, chemicals must be independently assessed and receive a GreenScreen® benchmark score of 2, 3 or 4 or ChemFORWARD hazard band A, B or C. GreenScreen certified platinum or gold set by a licensed GreenScreen Profiler is accepted for chemical formulations.

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

Completing the Process Chemical Template
- The senior representative at the factory, whose responsibilities cover chemical management, must assist the applicant in completing the accepted template.
- The areas that must be completed by the applicant are listed as ‘required’.
- Listed chemical substances must show the CAS# number. If a CAS# number is withheld for any reason, the chemical ingredient is treated as a restricted substance, and it must be replaced with an accepted alternative. An alternative is to have the formulation GreenScreen Certified and listed by trade name only.
- The information must cover at least all chemical types required under the mandate and used to manufacture certified products.
- Upon request, the process chemical inventory at the factory must also be submitted for independent verification purposes.

- The template must be updated at the request of TCO Development.
- TCO Development has the right to compile confidential information with CAS numbers. TCO Development reserves the right to publish such compiled, anonymous information. Still, no information will be presented so that the company or the products in question can be identified.

Exposure controls and personal protective equipment (PPE)

TCO Certified Accepted Substance List reduces the risk of worker exposure to highly hazardous chemicals. However, safer alternatives do not remove the responsibility of the factory management to provide personal protection equipment as described in the chemical's safety data sheet, which covers exposure controls and personal protection. Verification of PPE (availability, training and use) is included in the ISO 45001 standard and as part of the required factory audits.

Supporting documentation

1. available at: https://industry.tcocertified.com/documents/

References

1. https://www.iso.org/iso-45001-occupational-health-and-safety.html
2. http://www.centerforsustainabilitysolutions.org/clean-electronics/

3.2 Restricted product substances

Background

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 introduces additional concerns due to additives like plasticizers and stabilizers.

Safer alternatives are available and increasingly adopted in power and signal cables, housings, and other components. Options such as thermoplastic elastomers (TPE) and thermoplastic polyurethane (TPU) are free from halogens and associated additives, while offering effective performance, durability, and improved recyclability. Transitioning to these alternatives supports safer working conditions, less toxic products, and more efficient reuse and material recovery at end-of-life.

Definitions

An electronic component is considered an individual part or combination of parts that, when together, perform a design function(s) and are typically directly attached to a printed circuit board. Internal and external power supplies are not included in the definition.
Product housing protects internal components and safeguards the user against injury from these electrical components. Product safety standards define these safeguards as different types of protective enclosures. These enclosures are added to safeguard against electrical shock, high temperatures, fire, mechanical (moving parts such as the fan), and radiation (such as any internal laser), whilst also protecting internal parts.
Printed circuit board (PCB) or printed wiring board (PWB) laminate is a printed board that provides point-to-point connections.
A power board or power PCB regulates the power leading to the device, converting alternating current to direct current.
External cables are delivered with the product and are provided to supply power to the product and connect it to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc.). 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:

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 supplied with the product must be free from polyvinyl chloride (PVC).
5. All halogenated flame retardants, plasticizers and stabilizers used for the following parts: product housing, PCBs, and cable/wire parts >0.5g. It also includes any non-halogenated substitutes that are not listed on TCO Certified Accepted Substance List.
6. The largest PCB by area in the power supply unit (internal/external) must be tested for bromine and chlorine (see clarification below).

   See clarifications for maximum concentration values.

Submit the following to an approved verifier:

- A copy of the test report(s) from any laboratory accredited according to ISO 17025 covering the largest PCB in the power supply.
- The worst-case concentrations by weight in homogeneous materials and the worst-case concentrations in batteries for cadmium, mercury, lead and hexavalent chromium must be provided.

The following is submitted to TCO Development:

- A copy of the test report(s) from any laboratory accredited according to ISO 17025 and a copy of the verification report(s) from a verifier approved by TCO Development.

3.2.2 Clarification

1. **Heavy metals**
   The worst-case concentration report must be signed by the brand owner and may cover several products. Exemptions are according to EU Directive 2011/65/EU (RoHS) and the documents supporting the directive, except that mercury in lamps is not permitted.
2. **Halogens: PBB, PBDE and HBCDD.**
   Applies to the whole product, including components, parts, and raw materials in all assemblies and sub-assemblies, such as batteries, paint, surface treatment, plastics, electronic components, and printed wiring boards.

3. **Plasticizers: DEHP, BBP, DBP, and DIBP.**

   Applies to the whole product. The worst-case concentrations reported for restricted plasticizers must be signed by the brand owner and may cover several products.

4. **External cable free from polyvinyl chloride (PVC)**

   Applies to all external cables delivered with the product. External cables delivered with the product are considered cables provided to supply power to the product and connect the product to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc).

5. **All halogenated flame retardants, plasticizers and stabilizers**

   Applies to all: product housing parts, printed circuit boards, and cable/wires above 0.5 grams. This includes the product stand and the housing of the external power supply. The internal or external power supply socket or inlet is included in the definition of product housing. Examples of cable/wire parts include: Internal product cables that interconnect between components and are detachable at both ends, such as power and data/signal cables. Cables permanently attached to electronic components, such as fans and speakers.

   Exempted are all other parts, such as electronic components and PCB laminates sealed inside electronic components

6. **Testing for bromine and chlorine, where the following is required:**

   The largest PCB by area in the power supply unit must be tested for bromine and chlorine. The PCB must be tested in its final state with PCB laminates included but does not need to be tested with electrical components attached. Testing must be conducted through either IEC 62321-3-1:2013, 62321-3-2:2020 or EN14582 by an ISO 17025 accredited laboratory. If the same PCB is used in multiple products, a test report may be used for multiple products if traceability between the tested sample and the product is verified.

   ● If indications of bromine or chlorine >0.1% are discovered, the applicant must proceed with additional testing to prove compliance with this criterion.

   ● If the concentration of a detected substance is <0.1%, then no additional testing is needed.

   Maximum concentration values

   ● **Heavy metals:** The maximum concentration values tolerated by weight in homogeneous materials are 0.01% for cadmium, 0.1% for mercury, 0.1% for lead and 0.1% for hexavalent chromium according to EU RoHS Directive (2011/65/EU annex II) and the documents supporting the directive.

   The limit value for batteries is 0.0005 % for mercury, 0.002 % for cadmium and 0.004 % lead per listed part, according to Regulation (EU) 2023/1542

   ● **Halogens and plasticizers:** The maximum concentration values tolerated for a non-accepted substance (including decaBDE) is 0.1% by weight of the material in homogeneous materials.

   Fluoroorganic additives, used to modify the dripping behavior of plastics in fire conditions or to improve the processing behavior, are exempted provided that they do not exceed 0.5% by weight of the material in homogeneous materials.

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, Authorisation and Restriction of Chemicals (REACH), EC 1907/2006

3.3 Accepted product substances

Background

Hazardous non-halogenated substances are problematic in the manufacturing and material recovery phases, where workers and the environment can be exposed, leading to 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: Independent toxicology firms licensed/qualified by CPA/ChemFORWARD to provide assessment services for a fee to clients.
TCO Certified Accepted Substance List: Public list of independently assessed safer available alternatives considering toxicity and functionality.
An electronic component is considered an individual part or combination of parts that when together, perform a design function(s) and are typically directly attached to a printed circuit board. Internal and external power supplies are not included in the definition.
Product housing protects internal components and safeguards the user against injury from these electrical components. Product safety standards define these safeguards as different types of protective enclosures. These enclosures are added to safeguard against electrical shock, high temperatures, fire, mechanical (moving parts such as the fan), and radiation (such as any internal laser), whilst also protecting internal parts.
External cables are those delivered with the product and are provided to supply power to the product and connect it to an external peripheral (USB-USB, HDMI-HDMI, HDMI-DP, VGA-VGA, etc). External cables permanently attached to a peripheral delivered with the product are not included in the requirements.

Applicability

All product categories.

3.3.1 Mandate

Product housing parts, printed circuit board (PCB) laminates, and cable/wire parts above 0.5 grams must only contain intentionally added (additive or reactive) non-halogenated flame retardants, plasticisers and stabilizers that appear on TCO Certified Accepted Substance List

Exempted are all other parts, such as electronic components and PCB laminates sealed inside electronic components.

See clarifications for maximum concentration values.

Submit the following to an approved verifier:

- For any substance to be added to the Accepted Substance List, a document copy or access to a database copy of the certified assessment report conducted and issued by a licensed GreenScreen Profiler must be provided.

The following is submitted to TCO Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A document copy or access to a database copy of the certified assessment report conducted and issued by a licensed GreenScreen Profiler.

3.3.2 Clarification

All substances of a flame retardant, plasticizer and stabilizer mixture must be accounted for. Non-accepted substances must not exceed concentration values of 0.1% by weight of the flame retardant, plasticizer and stabilizer.
Applies to all: product housing parts, printed circuit boards, and cable/wires above 0.5 grams.. This includes the product stand and the housing of the external power supply. The internal or external power supply socket or inlet is included in the definition of product housing.
Examples of cable/wire parts include: Internal product cables that interconnect between components and are detachable at both ends, such as power and data/signal cables. Cables permanently attached to electronic components, such as fans and speakers.
Exempted are all other parts, such as electronic components and PCB laminates sealed inside electronic components

TCO Certified Accepted Substance List

Non-halogenated alternatives can be used in certified products once they receive an accepted GreenScreen benchmark or ChemFORWARD hazard band, and appear on the public TCO Certified Accepted Substance List. GreenScreen benchmarks 2, 3 or 4 assigned by a licensed GreenScreen profiler or hazard bands A, B or C assigned by a qualified ChemFORWARD assessor are accepted to appear on TCO Certified Accepted Substance List. A GreenScreen benchmark U may only be accepted when the “worst case scenario” for data gaps is considered a benchmark 2 or above. The list is dynamic, which allows new substances that have undergone a valid assessment to be added at any time. Accepted substances may be reassessed in light of new scientific findings. TCO Development must have access to a copy

of the GreenScreen and ChemFORWARD assessment reports before the substance can be added to TCO Certified Accepted Substance List.

Conformity procedure

- When suppliers confirm that all substances relevant to this mandate are on the TCO Certified Accepted Substance List and the verifier considers all documentation submitted and compliant, they will issue an environmental verification to the applicant.
- If any substance relevant to this mandate does not yet appear on TCO Certified Accepted Substance List, then it must be added before approval can be given by a verifier. An extended time period to comply can be applied here (see “Applying for an extended period…” below).
- TCO Development will require manufacturers to disclose substance details used in randomly chosen products. To verify that the obligations according to this mandate are fulfilled, CAS number disclosure and laboratory assessments of selected parts will be conducted to assess the completeness, quality and validity of a benchmark score.

Adding a substance to TCO Certified Accepted Substance List

TCO Certified Accepted Substance List.
https://industry.tcocertified.com/guidance/accepted-substance-list/

Guidelines on how to add a substance to the list.
https://industry.tcocertified.com/guidance/accepted-substance-list/how-it-works/

Applying for authorization for an extended period to substitute or add a substance to TCO Certified Accepted Substance List

Applicants signing the mandate must first seek authorization for an extended period to complete hazard assessments or substitute a restricted substance not on TCO Certified Accepted Substance List. The applicant must complete a risk assessment questionnaire and submit it to TCO Development. The risk assessment requires the applicant to clarify why an extension is necessary, provide information on the chemical and its substitute, and include a timeline for completing the assessment and/or substitution. If an extension application is not granted, the applicant must ensure that all used formulations only include substances on TCO Certified Accepted Substance List before an environmental verification can be issued for the product model. If an extension due date is exceeded without conformity, the verifier must contact TCO Development, and a course of action will be decided upon after discussing the issue with the applicant.

References

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

4 Circularity

Intro text for chapters will be published in Draft 2

4.1 Product warranty

Background
A prerequisite for extended product lifetime is high product quality. A warranty creates an economic incentive for brand owners to design durable products and encourages users to keep products longer before replacement.

Definitions
- **Warranty**: Manufacturer or brand owner's undertaking to repair, replace or refund a product due to material or manufacturing defects, corresponding to the commercial guarantee as defined in Directive (EU) 2019/771.
- **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 6-year minimum available warranty, where at least the first year must be included free of charge.
- Each year of warranty, which is not included free of charge, must be offered for a maximum of 10% of the product's MSRP and must be available for purchase together with the product.
- For notebooks, tablets, and smartphones, at least one replacement of the main battery must be provided free of charge within the user-selected warranty period (1-6 years) if the battery has degraded to ≤ 80 % State of Health (SoH). The free battery replacement is not required for products where the main battery can be replaced without the use of tools.

Submit the following to an approved verifier:

A link to a public statement in English, published on the webpage required in the information to end user criterion, showing compliance with the mandate on the following aspects for the certified product:

- Minimum included warranty in years
- Minimum purchasable extended warranty in years
- The maximum cost (in % of product's MSRP) per year for the extended warranty
- Free battery replacement coverage (notebooks/tablets/smartphones).

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:

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

4.1.2 Clarification

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 warranty statement may be in the user manual as long as it is under a headline called "Warranty" in the table of contents.
- If the statement is not in the user manual then the link to the public commitment on warranty covering the certified product must be functioning during the validity of the certificate. If the URL is changed, then the new URL must be added to the certificate.
- The supporting document “Public policy for warranty and software updates 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 understands the language of the warranty statement 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.
- It 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 80% SoH within the warranty period for notebooks/tablets/smartphones with batteries requiring tools to replace..
- If several years can be purchased at the same time, the total cost is divided by the extra years (in addition to the first year, which must be included free of charge). All available lengths of the plan must fulfill the criterion.

  Example: MSRP = 1000EUR, 15% gives warranty cost per year ≤ 150 EUR
  2-year warranty for 70 EUR gives 70EUR/ year.
  3-year warranty for 200 EUR gives 100EUR/ year.
  5-year warranty for 600 EUR gives 150EUR/ year.

Note

A pre-installed battery information and protection software that can determine if the main battery has degraded to ≤ 80% SoH is mandatory in TCO Certified under the “battery information and protection software” criterion.

Supporting documentation

1. Public policy for warranty and software updates template

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

4.2 Security and functionality software updates

Background

Devices may become obsolete or vulnerable due to infrequent software updates, putting user data at risk and curtailing device longevity. 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 functionality updates, devices remain relevant longer, delivering better value to users and reducing electronic waste.
- Holding Manufacturers Accountable: This enforces a set support duration, nudging manufacturers towards more sustainable designs and post-sale maintenance.

Definitions

- **Security update**: A software 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 update, including corrective patches, whose purpose is to provide corrections to bugs, or malfunctions in the operating system.
- **"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

4.2.1 Mandate

The brand owner must publicly ensure the availability of free-of-charge security and corrective software updates necessary to retain the initial functionality of the product 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 in English, published on the webpage required in the information to end user criterion, where the brand ensures the availability of these updates for the certified product.
- The number of years after the end of placement of the product on the market, the brand owner publicly committed to delivering such 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 these updates.
- The number of years after the end of placement of the product on the market, the brand owner publicly committed to delivering such updates.

4.2.2 Clarification

The brand owner must provide a link to a public statement in English where the brand owner ensures the availability of free-of-charge security and corrective software updates necessary to retain the initial functionality of the product for at least six years after the end of placement of the product on the market.

For generic operating systems developed by third-party vendors (e.g. Microsoft, Google, Linux, etc.), the product's brand owner must instead ensure in the public statement that, at the time of certification, the third-party operating system vendor is committed to providing updates free of charge and that any announced minimum hardware requirements needed to continue receiving these updates are met (e.g if the existing operating system ceases to be supported and a new version must be installed).

The statement must include information on how these updates will be provided. The link must be functioning during the validity of the certificate. (The software update statement may be in the user manual as long as it is under a headline called "Software updates" in the table of contents.)

Supporting documentation

1. Public policy for warranty and software updates template

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

4.3 Post-consumer recycled content

Background

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.

Definition

PCR materials - Post consumer recycled materials, materials derived from used consumer products.
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 10% 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 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.

4.3.2 Clarifications

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 proofs

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 has the right to require a full bill of material.

4.4 Product packaging

Background

Packaging is a well-known environmental problem that is regulated in many countries worldwide. Packaging material has a short lifetime and generates large volumes of waste. More than 50% of global waste ends up in landfills or open dumps.

- To reduce the waste generated by packaging materials, it shall be possible to separate them into single material types without the use of tools so that material can be recycled instead of becoming waste.
- Even for packaging materials that may be separated into single materials, little of the plastic is properly recycled. Plastics that degrade into microplastics should be prevented from entering landfills or waterways, as the incomplete degradation process leads to the accumulation of highly mobile microplastics in the environment.

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 ≥ 10% plastic, by weight of all packaging materials, the following must be fulfilled:
    - ≥ 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.
- The worst-case hazardous substances concentrations in the packaging material.

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.

Document proof from the material vendor must be provided for each part containing post-consumer recycled plastics if it is to be included in the PCR percentage.
If no proof exists, then 0% must be reported.

The following information must be submitted to an approved verifier

For each packaging part 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

Background

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 10% of the combined total weight of certified products sold across these countries. Only take-back systems with a Benchmark 1 or above on the *TCO Certified Accepted E-waste Management List* may be used for this collection.
- 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 without 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 tcocertified.com.

TCO Certified Accepted E-Waste Management List

TCO Development provides a list of evaluated and accepted actors in the E-waste chain of custody. These are take-back systems and Reuse- and recycling facilities. The systems on the list are divided into three benchmark levels of credibility and impact, as well as a candidate level (candidate, BM1-3).

TCO Certified Accepted Take-Back systems List

In the TCO Certified Accepted E-waste Management List a list of accepted take-back systems can be found. The systems on the list are divided into three levels of credibility and impact. For each take-back system added as a candidate, the following information must be provided:

- System name
- Website
- Country
- System type (EPR / non-EPR)

TCO Certified Accepted First-tier Reuse- and Recycler List

In the TCO Certified Accepted E-waste Management List, accepted first-tier reuse- and recycling facilities can be found. To add a first-tier reuse and recycling facility to the list, the following information must be provided:

- Facility name, address, country
- A Global Location Number (GLN) for each facility
- Certification type (R2, e-Stewards, WEEELABEX, EN 50625, TS.LB.001 v1.1, or equivalent)
- Copy of a valid and active certificate of the chosen certificate type

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 0.1% of their global certified sales, the brand owner must ensure that at least one take-back system covers that country.

- The selected take-back system must have at least Candidate status on the TCO Certified Accepted E-waste Management List.
- 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

All first-tier reuse and recycling facilities used in all countries without a Functional E-waste Management System must be on the TCO Certified Accepted E-waste Management list with at least candidate status. At least 60% must be listed with BM1 or higher.

- 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 AIOs 6 kg
- Notebooks 2 kg
- Tablets 1 kg
- Smartphone 0.3 kg

- Desktop 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.
- If the take-back system used is not already listed on the TCO Certified Accepted E-Waste Management List, it must be added with at least BM1 status before its take-back volumes can count toward the 10% take-back requirement.

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.

Supporting documents

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

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.

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

4.6 Electrical safety

Background
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 and thermal injury.

Applicability
All products with built-in or external power supplies.

4.6.1 Mandate

The product and external power supply/supplies must be certified according to IEC 62368-1 edition 4 or newer.

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 newer can be used instead of IEC 62368-1.

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

4.7 Replaceable components

Background

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

Definitions

CPU: Central processing unit.
GPU: Graphics processing unit.
RAM: Random access memory.
Storage: Any computing hardware that is used for storing, porting, and extracting data files and objects, including temporary and permanent storage of information (SSD, HDD, RAM).
Display 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.
Keyboard: Built-in keyboard.
External/Internal PSU: The power supply unit used to convert AC to low voltage DC power for the internal components of the product.
Hygiene components: Parts that come into direct contact with the user's skin, hair, or breath. Examples of hygiene components are headband cushioning, microphone shields and ear cushioning for headsets.

Applicability

All product categories.

4.7.1 Mandate

- Replacement manuals: The brand owner must provide a manual describing how to replace at least all critical replaceable components. The manual must be available for anyone to read, free of charge.
- Access to spare parts: The brand owner must provide instructions on how to order all critical replaceable components.

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 showcasing where to purchase the 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 manual.

4.7.2 Clarification

Replacement manuals

- The brand owner must provide a service manual including step-by-step instructions and component descriptions for the disassembly and assembly.
    - External PSU, charger, and AC Adapters are exempted from the disassembly instructions.
- A critical, replaceable component must be possible to replace with an equivalent component. However, the replacement component does not have to be identical to the original component.
- Instructions on how to replace critical components must be available online during the validity of the certificate.
- If a critical component is soldered, step-by-step instructions are not needed, however it must be stated that the component is soldered in the manual.
- If a component can be replaced without using tools, it may be exempted from replacement instructions in the manual.

Access to spare parts

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

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.

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

4.8 Standardized connectors

Background

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 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 Clarification

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

4.9 Standardized external power supply compatibility

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

Definitions
USB Type-C: A 24-pin USB connector system with a horizontally symmetrical "reversible" connector based on the “Universal Serial Bus Type-C Cable and Connector Specification”.
EPS: External Power Supply

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

4.9.1 Mandate

A. The product must carry a USB Type-C standardized receptacle (port) for USB Power Delivery according to the standard EN/IEC 63002:2021 - Identification and communication interoperability method for external power supplies used with portable computing devices or newer.

OR

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

Submit the following to an approved verifier:

- 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.

4.9.2 Clarification

Interoperability guidelines for external power supplies are defined according to the IEC 63002:2021 or newer (Identification and communication interoperability method for external power supplies used with portable computing devices.)

For products delivered with a charging case, the case must fulfill the criterion.

4.10 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.

4.10.1 Mandate

The following mandates must be met:

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

	Red		Green		Blue	
Coordinate	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.

4.10.2 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 x |(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

≤ ± 0.003 in u' and v' for red and green.
≤ ± 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.

4.11 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.

4.11.1 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.

4.11.2 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 1º 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 1º from the edge. These measurement points have a 1/2º margin to the edges if the measurement area of the instrument is 1º (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 1º 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

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

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

where A and B are the two points found to have the largest color difference between them.
The largest difference in u'v' value must be reported.
The result must be presented to 3 decimal places.
The evaluation procedure is exemplified below:

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

Measurement position no.	u [1]	v [1]
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, Δu', is 0.005 (between 0.190 and 0.185) at measurement positions 1 and n-1.
- The largest v' difference, Δv', is 0.015 (between 0.447 and 0.432) at measurement positions 1 and n.
- Since Δv' (= 0.015) is much larger than Δu' (= 0.005), the Δv' value must be used for the calculation of Δu'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

≤ ± 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.

4.12 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..

4.12.1 Mandate

Δu'v' ≤ 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 Δu'v' measurement must be reported in TCO Certified Portal.

4.12.2 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 tcocertified.com, which will calculate the Δ 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

≤ ± 10% in luminance.
≤ ± 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

4.13 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.

4.13.1 Mandate

The product's default preset correlated color temperature may have any name but must have a color difference Δu'v' ≤ 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.

4.13.2 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.

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

≤ ± 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.
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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
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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 Kjelldahl, 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.

4.14 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.

4.14.1 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

4.14.2 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, $C= (S_W-S_K)/(S_W+S_K)$.

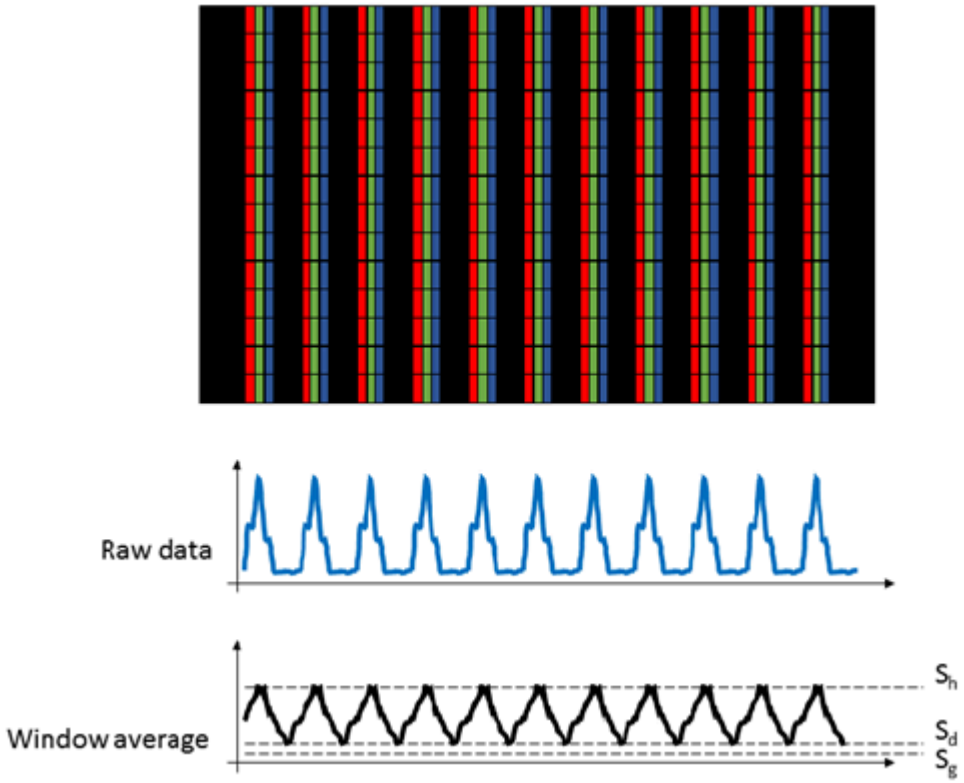

Figure *Luminance contrast - characters 1*: Measurement principle (from IDMS 7.2).

In summary:

$S_K = S_d - S_g$ (1)

$S_W = S_h - S_g$ (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

≤ ± 0.05 in contrast.
The misalignment between the screen surface normal and the optical axis of the luminance meter must be ≤ 0.3°.
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.

4.15 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 Δu'v' of white color between areas on the left side and the right side of the screen when it is positioned at +30° 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.

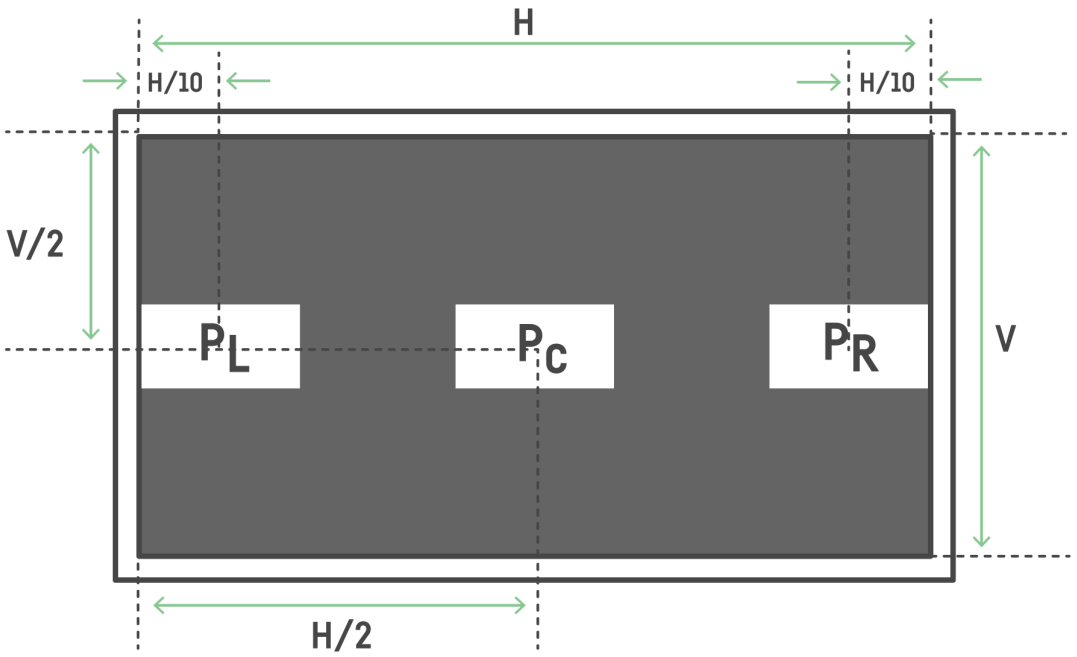

Figure *color uniformity - angular dependence 1*. Measurement positions for color uniformity-angular dependence.

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 ($u'_{PL/0}$, $v'_{PL/0}$ and $u'_{PR/0}$, $v'_{PR/0}$ 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, ($u'_{PL/+30}$, $v'_{PL/+30}$ and $u'_{PR/+30}$, $v'_{PR/+30}$ 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, ($u'_{PL/-30}$, $v'_{PL/-30}$ and $u'_{PR/-30}$, $v'_{PR/-30}$ respectively) must be recorded.
- Pivot screens must only be measured in the usual landscape mode.

Test evaluation

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

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

where A and B are the two points found to have the largest color difference between them. The largest difference in u'v' value must be reported

The result must be presented to 3 decimal places.
The evaluation procedure is exemplified below:

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

Measurement position no.	**Example value u'**	**Example value v'**
PL /+30	0.190	0.447
PR /+30	0.187	0.442
Difference at +30º	0.003	0.005
Δu' v' at +30º	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 -30º	0.007	0.004
Δu' v' at -30º	0.0081	
Largest difference Δu'v'	0.0081 in this example	

The largest calculated Δu'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

≤ ± 10% in luminance.
≤ ± 0.003 units for u' and v'.
≤ ± 0.3° 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.

4.16 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.

4.16.1 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 ±30° 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 ±15° 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.

4.16.2 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

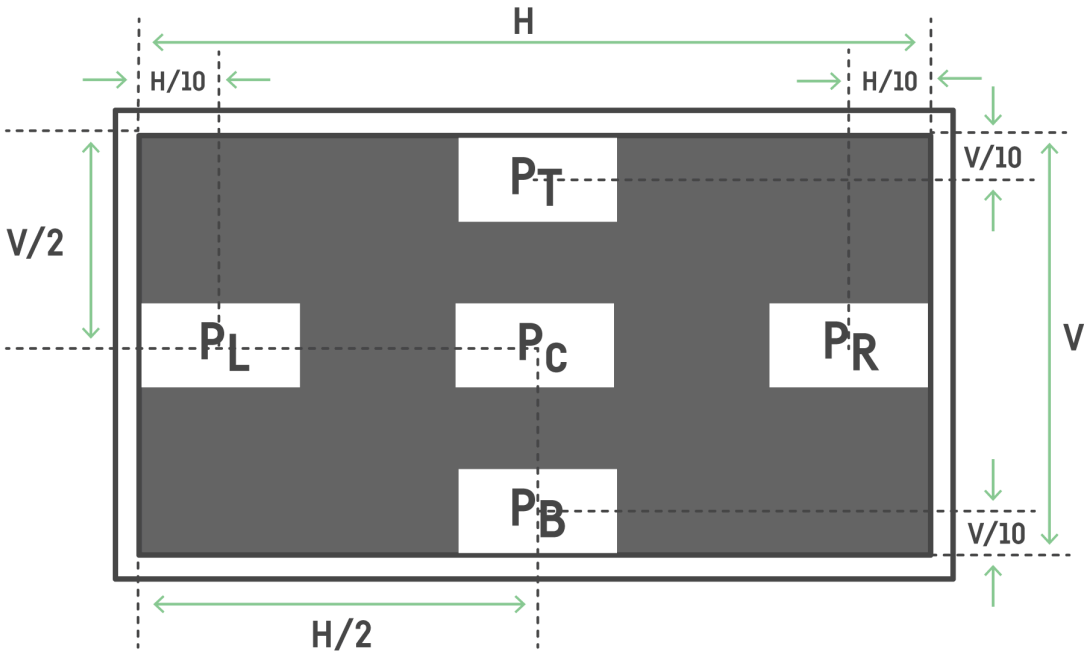

Figure: *luminance uniformity - angular-dependence 1*. Measurement positions for luminance uniformity - angular dependence.

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, ($L_{PL/+30/0}$ and $L_{PR/+30/0}$ respectively) must be recorded. See figure *luminance uniformity - angular-dependence 2*.
3. In landscape mode the display must then be rotated -30 degrees around the vertical axis through the display-glass center-point and the luminance at positions P_L and P_R ($L_{PL/-30/0}$ and $L_{PR/-30/0}$ respectively) must be recorded. See figure *luminance uniformity - angular-dependence 2*.
4. In landscape mode, the display must then be tilted +15 degrees backward around a horizontal axis through the display-glass center-point and the luminance at positions P_T and P_B ($L_{PT/0/+15}$ and $L_{PB/0/+15}$ 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 ($L_{PT/0/-15}$ and $L_{PB/0/-15}$ 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.

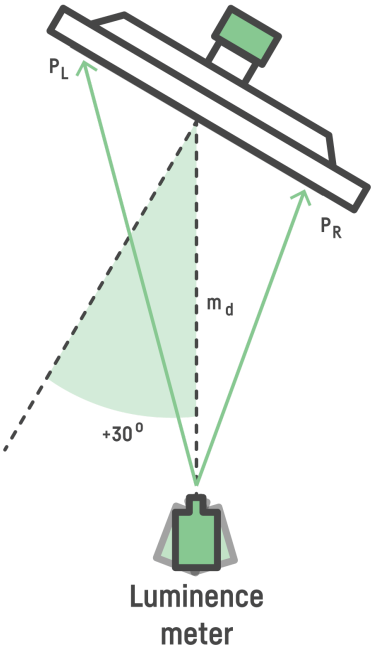

Figure *luminance uniformity - angular-dependence 2.* Top view of test set-up when the display is rotated ±30 degrees. The + rotation is defined clockwise.

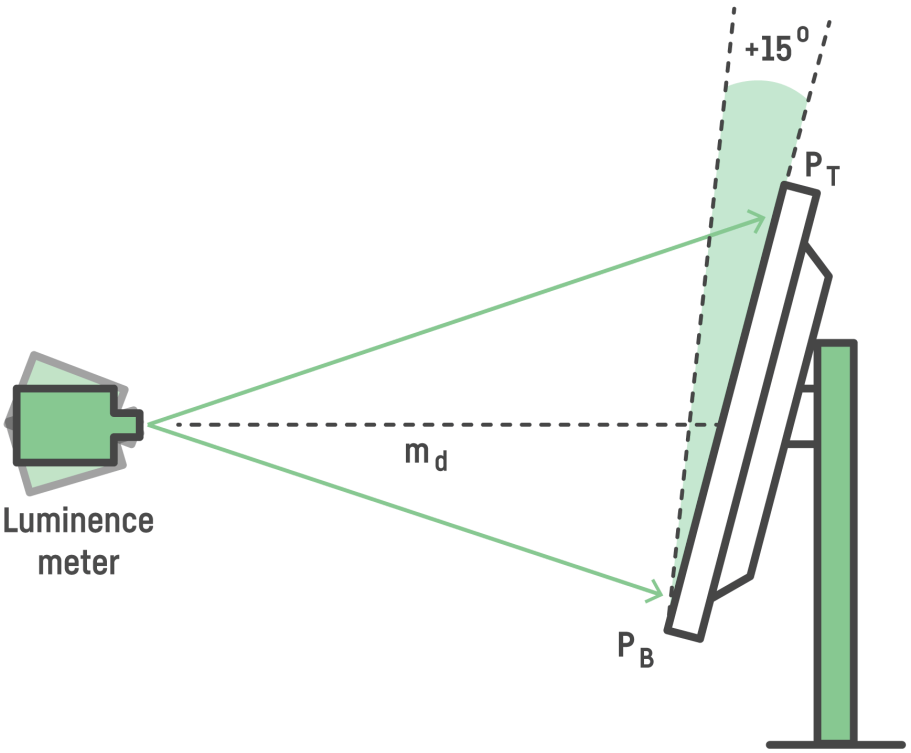

Figure *luminance uniformity - angular-dependence 3*. Side view of the test set-up when the display is tilted ±15°. The + rotation is defined as backwards.

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° 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° 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° and -15°. The result must be presented to 2 decimal places.

Overall uncertainty

≤ ± 10 % in luminance.
≤ ± 0.3° in rotation angle.
≤ ± 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.

4.17 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.

4.17.1 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.

4.17.2 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:

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

Overall uncertainty
Measurement uncertainty in diagonal measurement is ≤±2mm. 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.

4.18 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.

4.18.1 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

4.18.2 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 1º 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, 1º from the edge. Finally, the center position (5) is measured. This means that all measurement points have 1/2º marginal to the edges if the measurement area of the instrument is 1º.

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*.

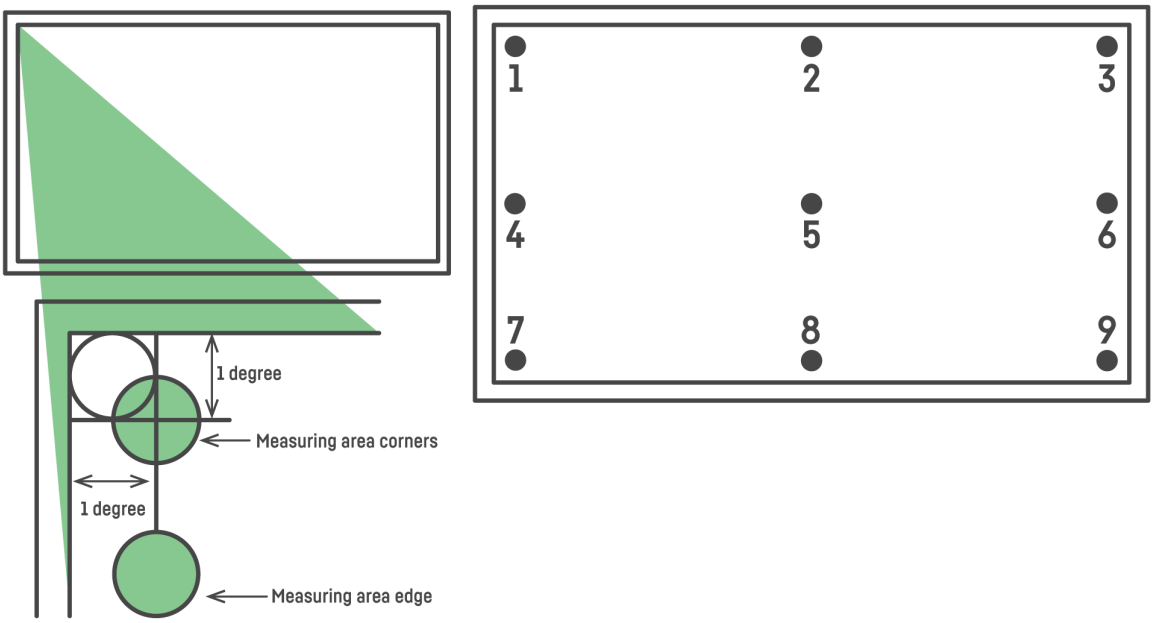

Figure *luminance uniformity 1* Measurement positions for the measurement of luminance and color uniformity.

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

≤ ± 10 % in luminance.
≤ ± 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.

4.19 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.

4.19.1 Mandate

The following conditions must be fulfilled:

- The luminance at default setting must be **≥** 150 cd/m^2
- The maximum luminance must be **≥** 200 cd/m^2
- The minimum luminance must be **≤** 100 cd/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

4.19.2 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.

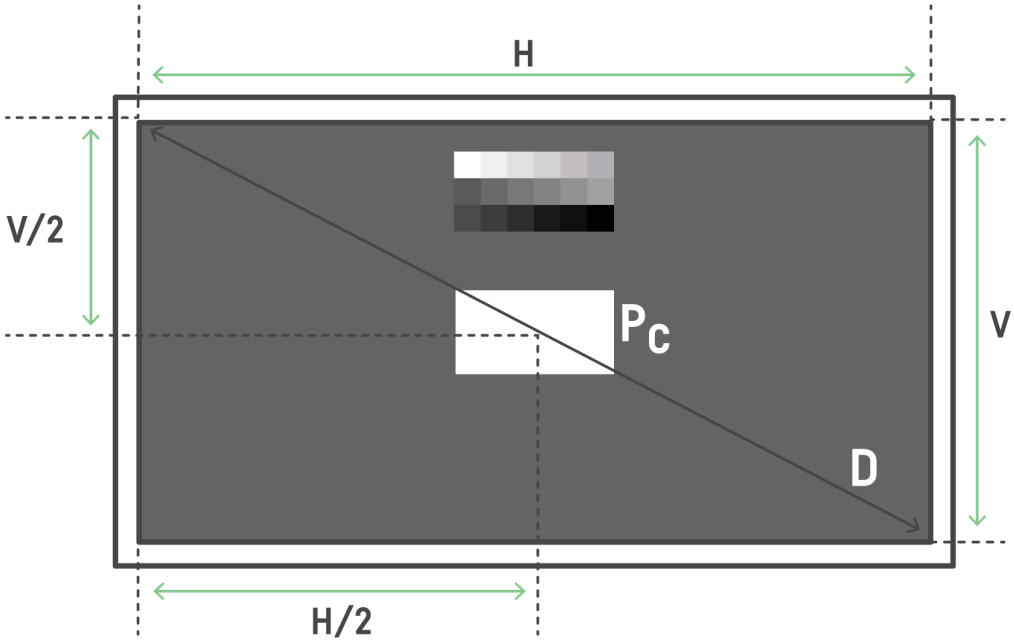

Figure *Luminance level 1*. TCO Certified default test image with the 18-step grayscale inserted.

- 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 ≥ 150 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 ≥ 200 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 ≤ 100 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

≤ ± 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

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4.20 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.

4.20.1 Mandate

In landscape mode, the luminance contrast-angular dependence must be ≥ 0.80 at ± 30° 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.

4.20.2 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

≤ ± 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.
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4.21 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.

4.21.1 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.

4.21.2 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: 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

≤ ± 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
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5. SMPTE 170M-1999 Television - Composite Analogue Video Signal - NTSC for Studio Applications.
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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

4.22 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.

4.22.1 Mandate

The luminance of black must be ≤ 2 cd/m^2 at a white luminance setting of ≥ 200 cd/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 measured 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* 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/m^2.
- 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/m^2.
- 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/m^2.

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
≤ ± 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

Intro text for chapters will be published in Draft 2

5.1 Supply chain responsibility

Background

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

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

- The responsibility for correcting non-conformities is placed on the brand owner, which is at the top of the product value chain.
- Define minimum standards of the brand owner code of conduct covering the manufacturing of the certified product.
- We provide a control system to ensure that the brand owner takes 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 are factories that manufacture bare printed circuit boards (PCBs) — the physical substrate on which components are later mounted.
These factories 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 constitutes PCB fabrication, where the electrical pathways, insulation layers, and plated interconnections of the board are formed.
Mainboard (Motherboard): This is the primary printed circuit board (PCB) of a product, providing the 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 assembly of components. Assembled PCBs are populated with mounted components.

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

3. Proof

- The brand owner code of conduct and communication process must be annually verified during the annual review process.
- Accepted initial audit reports, closure audit reports and corrective action plans for each registered factory must be uploaded to TCO Certified Portal. For factories that are SA8000 certified, a copy of the valid SA8000 certificate should also be uploaded.
- The supply chain identification template (SCIT) must be submitted for each registered final assembly factory and any applicable PCB mainboard fabricator*.

  The template must be uploaded to TCO Certified Portal when a factory is registered on TCO Certified Accepted Factory List. If necessary, an additional month after the factory is registered can be given to complete the SCIT. An updated SCIT may be required to be resubmitted at any time.
  Data on the suppliers for the following parts must be included in the SCIT:
    - Product housing: Enclosure (chassis) including stand: Parts >0.5 grams.
    - Printed circuit board supplied with and without components attached: Mainboard (motherboard) and power board.
    - External cables: Power and peripheral connecting cables.
    - Processors and memory: CPU, GPU, chipset, DRAM, RAM, SSD and HDD.
    - Battery: Remote power source of the product.
    - Power supplies: internal and external.
    - Display panel (all sizes).

* If the PCB mainboard fabricator also supplies the assembled PCB (PCB with mounted components) they must also complete and submit the provided SCIT. The template must be uploaded to TCO Certified Portal and needs only to cover the suppliers for the following processors and memory components: CPU, GPU, chipset, DRAM, RAM, SSD and HDD.

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

Submit the following to an approved verifier:

Once a year at the Senior Management Representative annual review:

- The brand owner's public code of conduct communicated to the supply chains of the certified product. The code of conduct must be considered consistent with this mandate.
- Supporting Information on the routines of how management and workers in each registered factory are informed about the code of conduct.

For each application:

- A copy of the factory list in the CB certificate with the names and addresses of all final assembly factories manufacturing the certified product model. If any of these factories are not registered on TCO Certified Accepted Factory List, the brand owner must submit the factory identification template to register the factory or prove that the factory is not manufacturing the certified product model.
- Name and address of each display panel assembly factory (panels >10") for the certified model. This includes a clarification of the manufacturer ID on the panel marking label. The name and addresses must be registered to TCO Certified Accepted Factory List using the factory identification template.
- Verify that the brand name is listed as compliant, with no missed due dates, on the TCO Certified Portal. Any missed due dates will postpone the application until the required documentation is submitted, and the due date is extended or marked compliant.

For each required factory for the certified product:

- The most recent independent initial audit report, corrective action plan for each non-conformity and closure audit report must be uploaded to TCO Certified Portal. For factories that are SA8000 certified, a copy of the valid SA8000 certificate should also be uploaded. The audit interval is determined by the risk category of the factory. The risk category is set by the verifier according to the process described under: **Defining the factory risk category and audit intervals.**
- The SCIT for the final assembly factories and applicable PCB mainboard fabricators must be completed and submitted to TCO Certified Portal for each registered final assembly factory.

The following is submitted to TCO Development:

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

- A copy of an English version of the public code of conduct must be uploaded to TCO Certified Portal.
- An independent audit and a corrective action plan for each non-conformity must be reported to TCO Certified Portal at an interval determined by the risk category of the registered factory for the certified product.

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

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

5.1.2 Clarification

General clarifications

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

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

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

* 60 hour working week: This criterion sets a global limit for weekly working hours that includes overtime based on ILO convention 1 (56 hours per work week including overtime). An additional four hours per workweek is given to harmonize with SAI and RBA. Therefore, workweeks, including overtime, are not to exceed 60 hours, and workers must receive at least 1 day off every 7 consecutive days.

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

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

The verification process

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

1. The code of conduct:

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

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

2. Information about the code of conduct:

The brand owner must annually submit a description of how management and workers at all registered factories manufacturing certified products are informed about all parts of the code of conduct. Proof of training classes or other means of worker training and how the factory measures the effectiveness of the worker training must be submitted for review. The training must be held specifically for the purpose of training and not just part of a regular business review meeting. If there are no changes to the communication routine since the previous annual review, then the brand owner does not have to submit it again. In this instance, the SMR must report this to an approved verifier. The approved verifier carries out the verification during the annual review process.

Accepted proof of compliance. All parts must be fulfilled:

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

3. Factory registration on TCO Certified Portal

For each certified product, each final assembly factory, each display panel assembly factory for panels >10", and each PCB mainboard fabricator for the certified product must be identified and registered to TCO Certified Portal.
The approved verifier will ensure that factories are listed on TCO Certified Accepted Factory List.

- Factories are registered to TCO Certified Portal Accepted Factory List using the factory identification template.
- A SCIT must be submitted for each final assembly factory and each applicable PCB mainboard fabricator for the certified product at the time the factory is registered on

TCO Certified Accepted Factory List. It is not necessary to submit the SCIT for the display panel factories or PCB mainboard fabricators supplying bare boards.

- The full list of factories must be submitted at least once annually to an accepted verifier using the factory identification template. The due date for submitting the template appears on TCO Certified Portal. An approved verifier must be notified immediately of factory changes. The template is downloaded from tcocertified.com.

4. Independent social audit reports

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

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

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

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

Defining the factory risk category and audit intervals

A factory new to TCO Certified Portal must be independently audited using an accepted audit type. Any SA8000 certificate or RBA recognition diploma must be submitted with the initial audit report. A factory is assigned a category 1, 2 or 3 based on the risk categorization procedure below.

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

Lower risk countries

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

TCO Certified Accepted Factory List

All brand owners, applicants and verifiers who have access to TCO Certified Portal will have access to see TCO Certified Accepted Factory List of registered factories. This list includes information such as the risk category, audit non-conformities and due dates for submitting supporting documentation. Access to information for factories directly owned by a brand owner is limited to that brand owner.

Risk categorization procedure.

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

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

Initial risk categorization

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

Risk category 1 (higher risk choice).

Initial audit

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

Corrective action plan

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

Closure audit

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

Re-categorization

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

Final assistance

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

Risk category 2 (moderate risk choice).

Initial audit

- For risk category 2, the factory must be audited every 24 months. For a factory that is Category 2, a new initial audit report must be uploaded to TCO Certified Portal during the final 12 months of the 24 months period. Any major and priority findings must be independently verified closed within these 12 months. The due date for submitting audit proof to retain a place on TCO Certified Accepted Factory List is shown on TCO Certified Portal.

Corrective action plan

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

Closure audit

- If there are major or priority non-conformities, a closure audit must also be uploaded to TCO Certified Portal during the 12 months remaining before the due date on TCO Certified Portal. If the factory only has minor non-conformities, the corrective action plan must be completed, but it is not necessary to upload the closure audit to TCO Certified Portal. The closure of minor non-conformities will be verified in the next initial audit.

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

Failure to retain category 2

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

Risk category 3 (lower risk choice).

Initial audit

- For risk category 3, the factory must be audited every 36 months. For a factory that is Category 3, a new initial audit must be uploaded to the TCO Certified Portal during the final 12 months of the 36 months audit period. Any major and priority findings must be independently verified closed within these 12 months. The due date for submitting audit proof to retain a place on TCO Certified Accepted Factory List is shown on TCO Certified Portal.

Corrective action plan

- For each non-conformity to the mandate in TCO Certified, a corrective action plan must be uploaded to TCO Certified Portal. It must include closure deadlines set by the audit program to complete each corrective action.
    - If the factory is SA8000 certified, then the non-conformities are solved following the SA8000 certification procedure.

Closure audit

- If there are major or priority non-conformities, a closure audit must also be uploaded to TCO Certified Portal during the 12 months remaining before the due date on TCO Certified Portal. If the factory only has minor non-conformities, the corrective action plan must be completed, but it is not necessary to upload the closure audit to TCO Certified Portal. The closure of minor non-conformities will be verified in the next initial audit.
    - A valid SA8000 certificate is considered proof that major and priority non-conformities are monitored regularly by SAAS-accredited verifiers and that issues are being solved.

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

Qualification method and assessment of worker-management dialogue
For factories at-risk category 1 it is very likely that the worker-management dialogue is not mature enough due to the number of persistent non-conformities. However, once a factory has managed to solve their major and priority non-conformities and achieved risk category 2, they may apply for risk category 3 re-categorization based on worker-management dialogue. To qualify for re-categorization to risk category 3 all the below verification points for a Trade union or non-union worker representation must be considered compliant without remarks.

Verification of the level of worker/management dialogue at the factory.
In order for a factory to be able to get re-categorization from risk category 2 to 3 based on the worker-management dialogue, the factory management, and worker representatives must together prove the following. The proof must be assessed during the factory audit every 3 years by an independent auditor approved by TCO Development. To become approved the auditor evaluating worker management dialogue must fulfill all the requirements of auditors in TCO Certified and must also have documented experience and deep understanding of trade union work.

In the case of a Trade union (TU)
Criteria for assessing a Trade union (TU) presence at factories in high-risk countries for consideration for TCO Certified risk category 3 status.
Requirements on the trade union

1. The TU is not in any way interfered with or financed by the factory management and is independent from the local and national government.
2. The TU is financed by membership fees or donations from non-profit organisations and is non-profit
3. The TU has bargaining rights and acts on the behalf of employees in collective bargaining negotiations with employers.
4. The TU should set and fulfill some or all of the goals it sets itself to win concessions for workers, such as: improve working conditions, working hours, wages and benefits

Requirements on the management

5. Factory management contributions are limited to providing meeting space/materials
6. Payroll records etc show TU employees are not discriminated if they also work at the factory
7. No management interference with the TU representative meeting new consenting employees to explain their rights to freely join the TU and membership is open to all employees.
8. The TU has the ability to call a strike, without restriction from government or company management.

Requirements on the worker - management dialogue

9. TU meets with management regularly for the purpose of furthering and defending the rights and interests of workers for mutual gains. TU meeting minutes and financial records are kept and made available.
10. TU representatives have access to
    a. Risk assessments
    b. Internal audits and monitoring of the organization
    c. Relevant and appropriate aspects of management review
    d. Opening and closing meetings of labor audits
    e. Reporting back to workers on any corrective and preventive actions taken

f. Reporting back to Senior Management on the performance and benefits of actions taken to meet the criteria in the audit

In case of a non-union worker representation

If the above union criteria are not possible to fulfill due to country laws restricting freedom of association and collective bargaining, workers shall be allowed to freely elect their own non-union representatives. (Note: worker representation should not be seen as a substitution for a union representative in organizations where workers freely choose to organize.)
An organised committee of democratically elected worker representatives from non-management personnel is defined as a democratic trade union like system and must meet the following criteria:

1. An organised committee consists of democratically elected representatives from non-management personnel and is independent from the local and national government.
2. The number of representatives shall be in proportion to the number of workers at the factory and must be in the range 1 for every 50-100 workers.
3. The worker committee has the right to represent the workers in collective negotiations with management.
4. The committee has set and fulfills some or all of the goals it sets itself to win concessions for workers, such as: improve working conditions, working hours, wages and benefits.

Requirements on the management

5. Management has not intervened or interfered in any way in the nomination, election, operation, administration of the committee.

6. Payroll records etc show worker representatives are not discriminated against if they also work at the factory. Workers representatives must be allowed to carry out their duties in the organized worker committee during normal working hours without any wage deductions.
7. The worker committee is free to fulfill their goals without being subjected to discrimination, harassment, intimidation, or retaliation for being representative(s) of workers or engaged in organizing workers, and that all workers have access to the representatives in the workplace and access to their services.
8. Worker representatives have the possibility to meet all new consenting employees to explain their labor rights.
9. Committee members shall be allowed to attend relevant committee-training during normal working hours without getting wage deductions to help fulfill their duties
10. Factory management must provide meeting space/materials

Requirements on the worker - management dialogue

11. Committee meets with management regularly for the purpose of furthering and defending the rights and interests of workers for mutual gains. Meeting minutes and financial records are kept and made available.
12. The non-union committee have access to
    a. Risk assessments
    b. Internal audits and monitoring of the organization
    c. Relevant and appropriate aspects of management review
    d. Opening and closing meetings of labor audits, includes RBA and SA8000 audits
    e. Reporting back to workers on any corrective and preventive actions taken

f. Reporting back to Senior Management on the performance and benefits of actions taken to meet the corrective and preventative actions.

Additional clarifications that are valid for all risk categories

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

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

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

Social audits initiated by TCO Development will be realized on a judgment sample basis, in each case decided upon by TCO Development. Audit results will be shared with the audited factory management and all the brand owners listed using the audited factory to combine the effort to close any non-compliance.
Spot check audits are financed by TCO Development. If priority non-conformities are found and further investigations are necessary, the license holder must cover this cost.

The verifier approved for supply chain responsibility

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

For each brand owner:

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

Other assessments

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

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

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

Background

Supply chain transparency itself has two key dimensions: (a) the degree to which sourcing information is shared publicly with stakeholders and (b) the visibility and actions 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, creating reputational risks.

By disclosing information to an independent party, brands gain the opportunity to benchmark their performance, share learning, and access solutions. Effective transparency depends on robust management systems where shared data leads to concrete improvements across the supply chain.

The Annual Review – SAQ (Self-Assessment Questionnaire) must be completed each year by the brand owner and is designed to go beyond traditional factory audits. Its purpose is to evaluate how brands actively support and improve standards across their supply chains. This includes assessing whether brands provide a clear code of conduct, allocate resources, deliver training, offer tools, and establish long-term practices that enable suppliers to strengthen their own management systems.

The SAQ is structured into sections that set out minimum requirements and highlight gaps against best practices. This makes it both a compliance check and a practical improvement tool: results help brands 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

1. The brand owner must collect information on the supply chain of the certified product and publicly disclose the names and addresses of the following:
    a. Final assembly factories.
        i. At least all final assembly factories producing certified products are publicly disclosed, including their names and addresses.
    b. Smelters and refiners
        i. At least all smelters and refiners associated with the brand's supply chain of the certified product are publicly disclosed. The brand must specify which minerals are included (e.g., tin, tantalum, tungsten, gold, cobalt).
2. The brand owner must appoint a Senior Management Representative (SMR) for supply chain responsibility for the certified product, who reports directly to senior management. Irrespective of other duties, this person must have the authority to ensure that the certified product meets the supply chain criteria in TCO Certified.

3. The SMR is responsible for the brand owner 'annual review' process (SMR questionnaire, Brand owner code of conduct/communication, minerals policy/due diligence, and anti-bribery management systems) being completed with an approved

social verifier, and the report is uploaded to TCO Certified Portal before the annual due date.

Submit the following to an approved verifier:

Once a year at the Senior Management Representative interview:

- Webpage or report where final assembly factories and Smelters/refiners are public.
- A completed annual review report - SAQ, verified by an approved social reviewer.

TCO Certified portal must have up-to-date information on:

- Name, title, telephone number and email address of the SMR

The following is submitted to TCO Development:

- The report from the annual review must be uploaded to TCO Certified Portal.
- A copy of a verification report from a verifier approved by TCO Development.

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

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

5.2.2 Clarifications

General clarifications

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

Publicly listed suppliers.

Brand owners must demonstrate transparency by gathering and publishing specific information about their supply chains. This involves two core requirements:

1. The brand owner's public list of final assembly factories must include, at a minimum, the names and addresses of all factories that assemble the certified products.

2. The brand owner must publicly disclose, at a minimum, all smelters and refiners linked to the certified product's supply chain, as well as the minerals processed (such as tin, tantalum, tungsten, gold, and cobalt).

To count as publicly listed, factory/supplier information must be published on the brand's website, state that the brand has a business relationship, and include the supplier name, full address, and type of products manufactured. Links to such disclosures are recorded in the TCO Certified Portal and checked by the verifier.

Senior Management Representative (SMR) details

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

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

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

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

SMR and annual review

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

If the brand owner has multiple registered brand names, the review must cover each separately and confirm that all TCO Certified requirements are met. The verifier must also check that it is clear and intuitive where the required information can be found on each brand's website.

Before the interview, the SMR must complete and submit all SAQ questions with supporting documentation. The interview—normally held online—focuses on social performance and how the brand 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 also join at its own expense. The verifier uploads the final report to the TCO Certified Portal.

The SAQ is revised every three years with new generations of TCO Certified. Results are benchmarked against other brand owners (anonymously), highlighting areas for improvement and informing TCO Development's capacity-building work. Data also supports the spot-check audit program for final assembly factories.

Supporting documentation

1. Guidelines
2. Annual review - SAQ

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

5.3 Anti-bribery management system

Background

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

Organizations are responsible for preventing all forms of corruption within their businesses and supply chains. To do so, organizations must align their business policy, monitoring and enforcement mechanisms with internationally recognized best practices against all forms of bribery.

Applicability

All product categories.

5.3.1 Mandate

The brand owner must have a structured anti-bribery management system that is independently certified to ISO 37001.

Submit the following to an approved verifier:

- A valid ISO 37001 certificate must 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.

5.3.2 Clarification

The brand owner must ensure that their anti-bribery management system is certified to ISO 37001. This certification must cover all business activities related to the certified product, including the supply chain. The certificate, or any appendix, must clearly state the scope of the certification. Certification must be issued by an independent certification body accredited to provide ISO 37001 certification.
All brand owners may apply for an extended time of up to 24 months to complete the ISO 37001 certification. For clarification, see 'Extended time application' below.

New brand owners to TCO Certified.
If the brand owner does not have an ISO 37001 certification, and this is their first TCO Certified application, they must first complete the anti-bribery questionnaire provided by TCO Certified to assess the gaps and corrective actions in their management system process. An approved verifier must review the completed anti-bribery management system questionnaire. The questionnaire results will then be submitted with the 'Extended time application' for final approval before the application can continue.

Anti-bribery questionnaire guidelines.

All questions must be answered and submitted to an approved verifier. If any item (except 12.1) is scored yellow or red, it indicates a gap in the process compared to ISO 37001. Any point given a green score indicates alignment with ISO 37001.

Extended time application.
Brand owners may request an extension of up to 24 months to complete the ISO 37001 certification. The application must include a detailed time plan for achieving certification and be accompanied by a signed agreement.
TCO Development reserves the right to deny an extension if there is a significant risk that the brand owner is considered unable to achieve ISO 37001 certification within the requested period.

Supporting documentation

1. Anti-bribery questionnaire

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

References

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

5.4 Responsible mineral sourcing

Background
Minerals such as tin, tantalum, tungsten, gold and cobalt are connected to armed conflicts and human rights abuses in the world's regions 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, irrespective of where they operate, both on land and in water. For emerging mineral extraction types such as deep-sea or marine mining, enhanced due diligence is required, where credible studies demonstrate 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.

Definition
Recycled metals are reclaimed end-user or post-consumer products, or scrap processed metals created during product manufacturing. Recycled metal includes excess, obsolete, defective, and scrap metal materials which contain refined or processed metals that are appropriate to recycle in the production of tin, tantalum, tungsten and/or gold. Minerals partially processed, unprocessed or by-product from another ore are not recycled metals

Applicability
All product categories.

5.4.1 Mandate

For the certified product, the brand owner must:

- Maintain and publicly communicate a responsible mineral sourcing policy covering at least 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 demonstrate that at least 80% of their publicly listed smelters and refiners for 3TG and cobalt are conformant to an accepted due diligence program.
- Annually submit the Responsible Mineral Sourcing Template (RMST).

Submit the following to an approved verifier:

1. The most recent publicly available responsible mineral sourcing policy, and a description of how it is communicated to the supply chain of the certified product.
2. A description of the brand owner’s structured process for identifying risk areas in the certified product’s supply chain, including supporting documentation.

3. A completed RMST (a TCO Certified template) and all required supporting documents. These must be uploaded to TCO Certified Portal by the annual due date, and must cover the supply chains of the final assembly factories registered by the brand owner on TCO Certified Accepted Factory List.

The following is submitted to TCO Development:

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

5.4.2 Clarifications

The verification of the 'policy' and 'structured work on identifying risk areas' is carried out as part of the brand owner annual review process - SAQ.

Responsibly sourced minerals policy

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

Verification guidelines:

To verify compliance, the verifier reviews whether the policy:

- Covers, at minimum, 3TG and cobalt for all certified products.
- Is publicly accessible.
- Clearly describes how it is communicated to suppliers.

'Public' means that the policy is available on the brand owner's website or included in the brand owner's annual sustainability or responsible minerals report, and that it explicitly applies to the brand name registered on the TCO Certified Portal.
'Communicated' may include incorporation into supplier contracts and/or formal written agreements.

Verification guidelines.

To verify compliance, the verifier reviews, the policy includes at least the following:

- Suppliers must uphold and comply with the policy.
- Suppliers must neither directly nor indirectly finance armed groups in conflict-affected regions.
- Suppliers must neither tolerate nor contribute to human rights abuses that include forced labor, child labor, and environmental degradation.
- A commitment to supporting responsible sourcing from regions where specific mining operations may present high risk.
- Suppliers must work with the brand owner to identify SORs of at least 3TG and cobalt in the supply chain and report their sourcing details using the conflict minerals reporting template (CMRT) or extended minerals reporting template (EMRT) or similar.
- Sourcing of 3TG and cobalt must be from SORs that participate in third-party audit programs aligned with OECD Due Diligence guidance and are working toward certification.

- Action plans must be developed for SORs that are not participating in or certified by an accepted audit program, either to remove them from the supply chain or ensure their participation and progress toward certification.
- Prohibits engaging in, committing to, or investing in exploration or mining in deep-sea locations where credible evidence shows irreversible damage to the marine environment may or will occur beyond the mining boundary

Structured work on identifying risk areas

The brand owner must prove that they conduct at least a Reasonable Country of Origin Inquiry (RCOI) to identify smelters or refiners (SORs) of 3TG and cobalt, aligned with the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, and the OECD Environmental Due Diligence Handbook for the certified product. For emerging mineral extraction types, this means that Brand owners are required to respect moratoriums on mining until it is proven that such operations will not cause irreversible harm. In the context of deep-sea or marine mining, brand owners must not commit to explore, mine or invest in mining of deep-sea locations where credible studies demonstrate irreversible damage to the marine environment may or will occur beyond the mining boundary.
The RCOI must also determine whether identified SORs process minerals from mined, recycled or scrap sources, as defined in the OECD guidance.

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Verification guidelines:

To verify compliance, the verifier reviews the brand owner's process for identifying risk areas in the certified product's supply chain. Examples are:

- Using an established minerals reporting template as part of the brand owner's due diligence process. Completed examples may be required to be submitted by the verifier.
- A public list of SORs on the brand owner website verifies that the brand owner has identified the list using a minerals reporting template.
- Evidence that the brand owner screens identified SORs for links to emerging extraction types (e.g., deep-sea mining).

Audited smelters or refiners (SORs)

Brand owners are required to annually demonstrate, using the Responsible Minerals Sourcing Template (RMST - a TCO Certified template), that at least 80% of the publicly listed SORs for 3TG and cobalt in the certified product's supply chain are conformant (certified) to an accepted independent third-party due diligence program.
All SORs, including those processing recycled or scrap materials, are to be identified in the RMST and clearly designated as "mined" or "100% recycled/scrap." For both sources, the known percentage of recycled/scrap feedstock is also required.
All identified SORs, shall include their conformance status (conformant, active, or otherwise registered through recognized due-diligence programs). Only SORs that are conformant count toward the 80% requirement.
Brands that achieve only 70–79% conformance may remain compliant for a maximum of one additional annual period if they provide proof of active efforts to improve conformance, such as:

- Engagement with the Responsible Minerals Initiative (RMI) or equivalent initiatives.

- Outreach to non-conformant SORs, requiring participation in an accepted audit program..

- Evidence that relevant SORs are RMAP-active or in the process of joining such programs.

Verification guidelines:

To verify compliance, the verifier must annually be provided with the completed RMST, which includes all required fields related to 3TG and cobalt SORs in the certified product's supply chain.
The template section, 'Audited facilities' must include the SORs in the supply chain of the certified product. SORs must be publicly registered as conformant with the Responsible Minerals Assurance Process (RMAP) or cross-recognised audit program.

- SORs listed as 'active' or 'in-process' are not accepted as compliant, but may be used as evidence of brand owner efforts when overall conformance is 70–79%.

The verifier will compare the submitted information against the latest published list of conformant SORs using the comparison tool provided by TCO Development.

Annual due dates for submitting the RMST are on TCO Certified Portal. The template must be downloaded from the TCO Certified webpage (see supporting documents below) and must be submitted to the accepted verifier by the required deadline.

Audit program cross-recognition

RMAP cross-recognised audit programs are accepted. These presently include the London Bullion Market Association (LBMA) and the Responsible Jewellery Council (RJC). Other programs must first undergo independent verification to access the OECD due diligence guidance implementation before being accepted as an alternative. The brand owner must provide proof of alignment to the accepted verifier for assessment.

Due diligence program information:

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

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

Supporting documentation

1. Responsible minerals sourcing template

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

References

1. http://www.oecd.org/corporate/mne/mining.htm
2. https://policy.trade.ec.europa.eu/development-and-sustainability_en
3. https://www.responsiblemineralsinitiative.org/about/rmi-initiative/

5.5 Environmental management system

Background

A certified environmental management system helps an organization manage environmental performance systematically and continuously improve environmental conditions. To be efficient, an environmental management system must include independent, external reviews.

Definitions

See definitions Chapter 5.0

Applicability

All product categories.

5.5.1 Mandate

Each of the following must have a structured environmental management system that is independently certified to ISO 14001:

- The final assembly factory of the certified product..
- Each next-tier key component factory that must be reported in the supply chain identification template (SCIT).

Submit the following to an approved verifier:

For each required factory for the certified product:

- A valid ISO 14001 certificate must 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

The applicant must ensure that a valid ISO 14001 certificate is always available on the TCO Certified Portal for every factory type required to be ISO 14001 certified. The certificate(s) or an appendix to the certificate(s) must clearly state what the certification covers, and the ISO 14001 certification must cover the entire operation included in the factory's business license. Certificates must be issued by an independent certification body accredited by an accreditation body covered by the International Accreditation Forum (IAF) Multilateral Arrangement on Environmental Management Systems iaf.nu.

Supply Chain Identification Template (SCIT)

For each final assembly factory listed on TCO Certified Accepted Factory List, the SCIT must be submitted to register the list of key component suppliers. The SCIT submission due date will be displayed in TCO Certified Portal.

Submission of the SCIT is required under mandate 5.1. Information on key component factories provided through the SCIT will be recorded and monitored in TCO Certified Portal, but it will not be visible to brand owners on the TCO Certified Accepted Factory List. Only

factories required to appear on TCO Certified Accepted Factory List, in accordance to mandate 5.1, will be visible to brand owners.

The factories providing key components for the certified product include:

- 1. Product housing: Enclosure (chassis) including stand: Parts >0.5 grams.
- 2. Printed circuit board: Main board (mother board) and power board.
- 3. External cables: Power and peripheral connecting cables.
- 4. Processors and memory: CPU, chipset, DRAM, RAM, SSD and HDD.
- 5. Battery: The remote power source of the product.
- 6. Power supply: internal and external.
- 7. Display panel assembly.

Extended time application

If necessary, an applicant may request an extension of up to 12 months on behalf of a factory that is not yet ISO 14001 certified. The application must include a detailed time plan for achieving certification and be accompanied by a signed agreement. TCO Development reserves the right to deny an extension if there is a significant risk that the factory will be unable to achieve ISO 14001 certification within the requested period.

Supporting documentation

1. Supply Chain Identification Template

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

References

1. https://www.iso.org/standards/popular/iso-14000-family

5.6 Water management

Background
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

The brand owner must:

- Have a supply chain policy for responsible water management for the certified product. The policy must be both public and communicated to the supply chain.
- Have a due diligence process for water management that identifies supply chain water risks, implements measures to prevent and mitigate adverse impacts, monitors supplier performance, and supports continuous improvement.

Submit the following to an approved verifier:

- The most recent version of the public water management policy and a description of how it is communicated to the supply chain of the certified product.
- A description of the brand owner's structured work on identifying risk areas in the supply chain of the certified product with supporting documentation.

The 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.

Responsible water management policy
The policy is an essential statement by the brand owner. It must reflect the brand owner's commitment to sustainable water management 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 guidelines:

The verifier must verify that the policy is public and how it is communicated to suppliers.

- "Public" means that the policy is visible on the brand owner's website or is included in the brand owner's annual sustainability report.
- The policy covers the manufacturing of the certified product
- It is communicated that it covers all the brand names the brand owner has registered on the TCO Certified Portal.
- "Communicated" could be part of a contract and/or a written agreement with suppliers.

The policy must require at least the following:

- Implement and maintain a water management program that documents, characterises, and monitors water sources, usage, and discharge within the supply chain..
- Promote water conservation and efficient use of water resources across operations and suppliers.
- Prevent contamination by identifying and controlling potential sources of water pollution in production.
- Ensure proper wastewater management, including characterisation, monitoring, control, and treatment in accordance with applicable laws and environmental standards before discharge or disposal.

Due diligence process for water management

The brand owner must establish a water management due diligence process that aligns with recognised due diligence principles and water stewardship practices covering the manufacturing of the certified product.

Verification guidelines:

The Due diligence process must include the following :

1. **Identification and mapping of high-impact suppliers.**
    - Suppliers with significant water use or wastewater discharge in water-scarce regions are identified and prioritised, as well as facilities, and regions with significant water-related risks.
2. **Assessment of supplier water management programs**
    - Evaluate prioritized supplier water management programs for adequacy in documentation, monitoring, conservation, and pollution control.
3. **Collection of water-related data from prioritized suppliers**
    - The brand requests or requires key suppliers to report on water withdrawal, consumption, reuse rates, and wastewater treatment practices.
4. **Monitoring and follow-up on identified risks**
    - The brand evaluates water-related risks and performance, and follows up with suppliers where issues are identified, through dialogue, corrective actions, or further assessment.
5. **Publicly communicate information on water-related risks and actions taken.**

The brand publicly discloses key findings from water risk assessments, actions taken to prevent or mitigate adverse impacts, and progress toward improving supplier water management.

6. **Promotion of supplier improvements**
    - The brand supports or encourages suppliers to adopt improved practices, such as water recycling, efficiency technologies, or enhanced treatment systems.