

TCO Certified

Generation 9, for projectors

TCO Certified – driving sustainable development in IT products

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

Comprehensive criteria with a life cycle perspective

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

A third-party certification, independently verified

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

How to certify

Certifying your products is straightforward. You'll find a guide that explains the process and what you need to do at tcocertified.com. It generally takes three to five weeks to receive the certificate, once all documents and the product sample are delivered to the verification organization.

Need help?

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

About this document

This is TCO Certified, generation 9, for projectors, released in December 2021. A projector is defined as a front screen projectors with fixed resolution that focus an image onto a screen by projected light. The image from a light-reflecting screen is viewed from the projector side of the screen.

Since projectors are developed for different purposes and viewing conditions as well as for use in different ambient lighting conditions, TCO Development has found it necessary to develop the two following criteria levels:

1. Criteria levels for office projectors
2. Criteria levels for video projectors.

The criteria levels for office projectors are for projectors designed to produce a static image in a highly illuminated room. The criteria levels for video projectors are for projectors designed to produce a moving image in darker or sparsely illuminated rooms.

All power cables and external power supplies are considered a part of the projector.

All product categories are generation 9

TCO Certified is available for ~~twelve~~eleven product categories and they all have the same generation number: generation 9. A majority of the criteria are the same for all product categories.

The criteria include:

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

Definitions: Explanations of important terms relevant to the criterion.

References: References to sources, presented in chapter 10.

Clarifications: Further details and explanations of the mandate.

Conformity

Conformity with the mandates is verified by verification organizations (verifiers) independent of both the certification body (TCO Development), the applicant and the brand owner. Each mandate 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 complies with the new edition of the criteria document, the criteria levels are never raised within a generation.

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1 Product and sustainability information

TCO Certified — sustainability certification in accordance with ISO 14024

TCO Certified is a third-party certification that meets the requirements of ISO 14024 Ecolabel Type 1. The certification has been assessed and approved by the Global Ecolabelling Network, as part of the GENICES peer review process. The ISO 14024 standard establishes the principles and procedures for third-party ecolabels, ensuring that consumers and professional purchasers are given accurate and comparable information. Criteria must cover the product life cycle and be based on scientific principles. Compliance with criteria must be verified by an independent party.

Data gathering in TCO Certified

To measure the impact of TCO Certified and the sustainability benefits of certified products, TCO Development continually collects data based on the use of the certification. The collected data is used in several ways:

- For TCO Development, the data is crucial for the continuous development of TCO Certified. It is used to ensure that criteria are set at reasonable levels and that the most relevant sustainability challenges are being addressed, throughout the product's life cycle.
- Manufacturers and brand owners use the data to verify their performance in various sustainability areas, and compare with their peers.
- Other stakeholders, such as purchasing organizations, use the data as key performance indicators to determine the sustainability benefits for their organization by asking for TCO Certified, and to track this over time.

1.1 Information to end users

Background

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

Applicability

All product categories.

References

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

1.1.1 Mandate

- a. The information document for end users must be written in English or in the local language of the country where the product is to be sold. It must accompany the product in at least one of the following ways:
 1. As a separate printed or digital document.
 2. Included in a printed or digital user manual.
 3. As a separate digital document that is hosted on the brand owner's website. A direct link to the document must be included in the printed or digital user manual mentioned above.
- b. The product and its retail packaging must be labeled with the TCO Certified logo. See clarifications for details.
- c. "TCO Certified" must be mentioned on the brand owner's website(s) where the specific certified product is marketed and or sold.

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

1.1.2 Clarification

Products that are designed to be installed in a rack (supporting framework to hold hardware modules, typically servers, data storage products and networking equipment) are excluded from “Part 2 - labeling of the product and packaging”.

Part 1: information document for end users

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

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

The mandate is fulfilled in one of the following ways:

1. As a separate printed or digital document

The information document for end users in print or on digital media is placed together with the product in the packaging.

2. In a printed or digital user manual

The information document for end users is included in a printed or digital user manual that accompanies the product when it is distributed to the end user. The content of the document, with the headline "TCO Certified", must be a separate chapter of the user manual and be included in the table of contents.

3. As a separate digital document that is hosted on the brand owner's website.

The information document for end users is placed on the brand owner's website. A direct link to the information document is placed in the printed or digital user manual that accompanies the product when it is distributed to the end user. TCO Certified must be a separate headline in the user manual. The headline must be visible in the table of contents.

Part 2 - labeling of the product and packaging

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

Alternative A

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

- a. The logo must be visible on the top or front of the product. (The front of the product is defined as the surface seen when viewing the product from the front and may include the stand. The top is defined as the surface that is seen from the top and the back is the surface that is seen from the back.)
- b. The minimum size of the logo is 16mm in width and 10mm in height.

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

Exception

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

or

Alternative B

Via electronic labeling displayed on the screen in one of the below ways:

- a. During the startup of the product:
The logo must cover at least 1% of the screen. The logo must be legible and be in color, black, or white; must appear at system start-up, and must be displayed for a minimum of 0,5 seconds.
- b. Via a shortcut on the desktop screen of the product. The shortcut must be in the form of the TCO Certified logo in color and clicking it should link to "the information document for end users" available at tcocertified.com.
- c. TCO Certified logo as a part of the product picture The TCO Certified logo is shown on the first product picture where the product is marketed on the brand owners web site. In the product specification on this page, TCO Certified is also listed with a link to the "information to end-user document" which is the document required under mandate 1.1 point 1.

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

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

- a. The minimum size of the logo must be 16mm in width and 10mm in height.
- b. If the logo is to be placed alongside other logos or graphic elements, a minimum of 2,5mm padding must be used on all sides of the TCO Certified logo.

The certificate owner and brand owner must also conform with all the other logo rules on color, design, marketing, etc., that are specified in the TCO Certified license agreement

appendix 2. The following two paragraphs (§2.2 and §2.5 in appendix 2 of the license agreement) are replaced by the rules listed above if a conflict occurs:

Paragraphs that may be replaced:

§2.5 The TCO Certified logo must at all times be reproduced in a quality that allows the text of the TCO Certified logo to be read under normal circumstances. Recommended minimum size for the trademarks TCO Certified and TCO Certified Edge can be found in "Using the TCO Certified brand" guide available at tcocertified.com. If there are limitations and a smaller or different type of logo is used this must first be agreed on in writing with TCO Development.

Part 3 - Mention of TCO Certified on the brand owner website

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

1.2 Product specification

Background

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

Definition

The marking label is a label with the product's electrical rating (voltage, frequency, current), the manufacturer's name, trademark or identification mark, and the manufacturer's model or type reference according to IEC ~~60-950:62368~~-1 clause ~~4.1.7-15~~.

Applicability

All product categories.

References

1.1.

1.2.1 Mandate

- A product specification of the typical product.
- A marking label must be provided for the product.
- The total weight of the typical product configuration and power supply (without packaging) in kg must be reported.

Submit the following to an approved verifier:

1. A copy of the marking label, for the product and all external power supplies.
2. A completed and signed product form (chapter 11.3).

Submit the following together with the application to TCO Development:

1. A copy of the verification report(s) from a verifier approved by TCO Development.
 2. The total weight of the typical product configuration and power supply (without packaging) in kg must be reported in TCO Certified Portal.
-

1.2.2 Clarification

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

The typical product configuration is defined as the product configuration which is expected to be manufactured in the largest number.

The total weight includes the product and any power supply unit and power cable needed to power the device.

Sustainability performance indicator(s):

Product weight is an indication of the amount of potential e-waste at end-of-life. By decreasing the product weight, e-waste can be reduced. The product weight (in kg) of the typical configuration of the product including any power supply but excluding packaging must be reported by the brand owner. A product weight tolerance of +/- 10% is accepted.

1.3 Sustainability performance indicators

Background

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

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

Applicability

Projectors.

1.3.1 Mandate

- All sustainability performance indicators must be evaluated.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3)

Submit the following together with the application to TCO Development:

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

1.3.2 Clarification

New applications

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

Reassessments

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

Quoting sustainability performance indicators in the marketing of a product

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

“Worst case” reporting

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

1.3.3 Sustainability Performance Indicators (SPI) list

The sustainability performance indicators are collected through the SAQ, submissions to TCO Development, or during the application process. All sustainability performance indicators must be evaluated. The results will be used to benchmark the performance of products within different aspects of the certification and to provide purchasers with information on sustainability benefits of certified products.

All SPIs marked with “X”

are collected annually either through the SAQ or together with annual submissions.

(X = Always collected during annual reporting)

All SPIs marked with “Y”

are collected by the verification organization during application and product testing.

(Y = Always collected during product testing/verification/application process)

All SPIs marked with “Z”

are considered beyond the scope of mandates in TCO Certified and are therefore not required for compliance with TCO Certified. Products will receive the lowest classification if

no data is provided for the evaluation. By submitting the additional data, the product will always receive a better classification than if no data is submitted. It is possible to submit and re-evaluate these SPIs at any time the product is certified.

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

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

SPI's described under product specification

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

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

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

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

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

- **Z 3.5** Classification of data age (Class A-E)
- **Z 3.5** Classification on availability of PCF (Class A-D)

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

- **Y 4.4** The sound power level (LWAd) in operating and Idling mode

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

- **Y 5.1** Energy efficiency
- **Y 5.3** The pixel density
- **Y 5.4** The default CCT difference $\Delta u'v'$ compared to D65
- **Y 5.5** The minimum color triangle area
- **Y 5.6** The color uniformity
- **Y 5.7** The largest $\Delta u'v'$ measurement of color grayscale linearity
- **Y 5.8** Luminous flux
- **Y 5.9** Light flux uniformity
- **Y 5.10** The black level

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

- **Y 6.1** Classification of warranty period (Class A-G)
- **Z 6.1** Classification of extended warranty availability (Class A-G)
- **Z 6.1** Classification of public repair policy (A-C)
- **Z 6.2** Classification of fasteners and connectors (Class A-D)
- **Z 6.2** Classification of necessary tools for repair/upgrade, (Class A-E)
- **Z 6.2** Classification of availability of spare parts by target group (Class A-E)
- **Z 6.2** Classification of availability of spare parts by duration of availability (Class A-D)
- **Z 6.2** Classification of availability of comprehensive information (Class A-C)

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

- **Z 8.2** Membership in multi-stakeholder initiatives working towards solving the problems connected to e-waste (Class A-C)
- **ZX 8.2** Use of internationally accredited reuse and recycling facilities (Class A-D)
- **Z 8.2** Brand owner public policy for treatmentRatio of electronicscompensated versus manufactured products (Class A-~~CG~~)

2 Socially responsible manufacturing

Human rights and social responsibility in the IT supply chain

Ensuring factory conditions that are safe for workers and adhere to an established code of conduct is essential to a sustainable life cycle for IT products. Much of the manufacturing is carried out in low-cost, low-wage countries, where workers are often less protected and employment less regulated than in more developed countries. Shorter product cycles and a growing demand for new technologies puts added pressure on the IT industry and its complex supply chain to deliver new devices faster and at a low cost. The result can be poor working conditions throughout the supply chain, putting human health and worker lives at risk.

Continuing risk areas include health and safety protection, forced labor, working hours, wages, discrimination and worker exposure to hazardous chemicals.

TCO Certified — driving worker safety, human rights and closing non-conformities
Chapter 2 in TCO Certified, generation 9, aims to drive more socially responsible manufacturing in the final assembly factories and throughout the supply chains.

To support continuous and systematic improvements, TCO Certified includes a framework that encourages proactive work and helps brand owners structure their work with sustainability. We drive change where it's needed the most by intensifying our monitoring of high-risk factories and ensuring that any identified non-conformities are corrected and closed.

Brand owner companies and their suppliers are required to conform with criteria that cover responsible minerals sourcing, anti-bribery management and responsible manufacturing practices of the certified product, designed to increase transparency, protect worker rights and reduce exposure to hazards during the manufacturing phase.

In this generation of TCO Certified, we go further down in the supply chain to increase transparency and accountability, and drive improvements in areas such as working conditions, anti-corruption, hazardous substances and conflict minerals.

New criteria in this generation require that brand owners provide transparency on their responsible mineral sourcing due diligence for the certified product at smelter and refiner levels, an anti-bribery management system covering all business of the certified product,

and are taking further steps to eliminate worker exposure to hazardous chemicals in the final assembly factories and the supply chains of the certified product.

Verification

Verification of conformity of supply chain responsibility uses a risk-based factory assessment model. Continued follow up verification is conducted for all areas in TCO Certified and is vital for monitoring that any non-conformities are corrected and closed.

Definitions Chapter 2

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

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

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

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

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

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

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

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

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

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

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

Next tier major suppliers: Next tier major suppliers to the final assembly factory registered in TCO Certified Portal. Supplies parts and packaging for the certified product.

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

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

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

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

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

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

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

2.1 Supply chain responsibility

Background

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

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

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

Applicability

All product categories.

References

2.1, 2.2, 2.3

2.1.1 Mandate

By signing this mandate, the brand owner agrees to (1.) the Commitment and agrees to conduct (2) the Structured work. Additionally, TCO Development requires that the brand owner shows (3) Proof of the commitment and the structured work by allowing inspections

in the final assembly factories and the supply chains of the certified product, by sharing audit reports and CAPs, and by providing other documented proof described below.

1. Commitment

- The brand owner must have a public code of conduct for the manufacture of certified products, that is considered consistent with the following:
 - ILO's eight core conventions: 29, 87*, 98*, 100, 105, 111, 138 and 182.
 - 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

- When applying for a new certificate, the brand owner must report all final assembly factories manufacturing the product model(s) that the application covers to TCO Certified Portal.
- The brand owner must supervise the implementation of the code of conduct at all final assembly factories that the brand owner is using to manufacture the certified product.
- The brand owner must ensure that corrective action plans are developed and implemented within reasonable time, for all non-conformities to the code of conduct that the brand owner is made aware of, at all final assembly factories where certified products are made, and in their supply chains.
- Final assembly factories that are registered to TCO Certified Portal must have a management system to identify their next tier major suppliers of parts and packaging for certified products.
- A code of conduct consistent with this mandate must be effectively communicated to the next tier major suppliers.
- The final assembly factory must have a self-reported risk assessment of their next tier major suppliers.

3. Proof

- TCO Development may conduct/commission factory inspections (spot checks) at any SA8000 final assembly factory manufacturing a certified product and may require full audit reports during the certification period in order to assess social commitment and advancement.

- The supply chain identification template must be submitted to TCO Certified Portal for each registered final assembly factory.
- TCO Development may annually select a factory from the list of major next tier suppliers it identifies as higher risk to submit one or more of the following:
 - An independent audit report in accordance with RBA or SA8000 procedures.
 - A completed Process Chemical Data Collection (PCDC) Tool.
 - Proof of an independently verified OHS management system.
- TCO Development may also require seeing audit reports and corrective action plans from factories further down 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.

Submit the following to an approved verifier:

Once a year at the Senior Management Representative interview:

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

For each application:

- Names and addresses of all final assembly factories manufacturing the product model that the application covers. If any final assembly factory manufacturing certified products is not registered to TCO Certified Accepted Factory List, then the brand owner must submit the factory identification template to register final assembly factories to the list.

For each final assembly factory manufacturing the certified product:

- The most recent independent audit and a corrective action plan for each non-conformity. The audit interval is determined by the risk category of the factory. The risk category is determined by the verifier according to the mandate.
- The supply chain identification template must be completed and submitted to TCO Certified Portal.

Submit the following, together with the application 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 factory, for all final assembly factories manufacturing the certified product.
-

2.1.2 Clarification

General clarifications

The mandate is a social performance mandate and criteria are based on the eight ILO (International Labour Organization) core 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 situation at their own and/or their supplier factories manufacturing certified products.

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

* Local labor law: The limit and enforcement of local law regarding working hours differs tremendously across the world. 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.

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

To monitor continued conformity during an agreed period of time, when considered necessary the factory will be required to submit workweek data to TCO Development using a workweek data template. For factories up to 15000 employees the tolerance for excessive working hours per week in TCO Certified is up to 2% of the total workforce working between 60 and 72 hours per week for minor, 2-15% for major and over 15% for priority. Any working hours above 72 hours per week is considered a priority.

The verification process

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

1. The code of conduct

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

- The code of conduct must be considered consistent with:
 - ILO's eight core conventions: 29, 87*, 98*, 100, 105, 111, 138 and 182.
 - 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 local labor law clarifications under "General clarifications" above.

- 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 relate to the manufacturing of the certified product.

2. Information about the code of conduct

The brand owner must annually submit a description of how management and workers at all final assembly factories manufacturing certified products are informed about the code of conduct. It will be reviewed by an approved verifier. 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. 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 Senior Management Representative must report this to an approved verifier.

Examples may be that the brand owner:

- has translated the code of conduct into local languages. This shows that the company has made efforts to inform management and employees about the code's content in their own language.

- has conducted training on the code for employees and/or management at final assembly factories of the certified product.
- has made suppliers of the certified product complete a questionnaire (self-assessment) on their understanding of, and conformity with, the code of conduct.

3. The brand owner form

The brand owner signs the brand owner form to confirm that one or all products that are included in the application to TCO Development complies with this criterion.

4. Factory registration on TCO Certified Portal

For each certified product, all final assembly factories the brand owner is using to manufacture the certified product must be identified. Also, the final assembly factory's next tier major suppliers for parts and packaging of the certified product must be identified using the supply chain identification template provided by TCO Development. The approved verifier will ensure that final assembly factories are listed on TCO Certified Accepted Factory List and that a completed supply chain identification template has or will be submitted to TCO Certified Portal before the due date stated on the portal.

- Final assembly factories of the certified product must be registered to TCO Certified Accepted Factory List using the factory identification template for final assembly factories.
- The supply chain identification template must be submitted for each final assembly factory covering next tier major suppliers of parts and packaging for the certified product. The template shall primarily be completed by the responsible person at the final assembly factory to verify their supply chain management systems and cover all certified brand owners using the final assembly factory. If judged necessary by TCO Development the brand owner can be required to provide additional information on major next tier suppliers they have direct contracts with to fill in any data gaps. TCO Development may require the responsible person at the final assembly factory to work with an approved verifier to complete the template correctly.
Data gaps in the template increases the risk for spot check action, such as independent social audits or submitting a Process Chemical Data Collection (PCDC) Tool.
- Each time a final assembly factory is removed, added or updated in any way, it is the brand owner's responsibility to ensure that this information is updated on TCO Certified Portal by submitting the correct documentation to an approved verifier.

5. Independent social audit reports

The brand owner must ensure that TCO Certified Portal is continuously updated with the most recent independent initial audit report, and corrective action plans for all non-conformities that were found during this audit, from all final assembly 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. Consistency of the reports are ensured through annual spot-checks by TCO Development.

The audit interval is 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. An independent party is considered to be a person or body that is recognized as being independent of the parties involved, regarding the issue in question.
2. Types of accepted audits are:
 - a. SA8000,
 - b. RBA VAP,
 - c. Other audit types, if they are independently verified to be of equal quality to one of the accepted audits (a or b). This includes auditor qualification, audit process (e.g. triangulation of non-conformities), reporting and CAP. Verification will be conducted by an approved verifier before an alternative audit is accepted as proof.

Defining the factory risk category and audit intervals

If a newly added final assembly factory is not yet risk categorized, then TCO Certified Portal must be updated with either the latest independent audit report (less than 36 months old), a valid SA8000 certificate, or proof of an RBA recognition from the factory. The proof of an RBA recognition must be submitted with an initial audit report showing that working hours are under 60 hours per workweek. Initial audit reports must cover at least this criterion and be an accepted type of audit according to the definition in "Verification process" above. The factory will then be assigned a risk category 1, 2 or 3 depending on the latest audit results. A factory assigned risk category 1, 2 or 3 will reflect the interval, in years, during which a factory must conduct the next initial audit and submit the documentation proof to TCO Certified Portal.

Until the brand owner has submitted a factory audit report, the factory will automatically be categorized as risk category 1. (See below: “Audit report and factory risk categorization”.) Brand owners that are new to TCO Certified, or apply for certification to a new product category will need to undergo an additional risk assessment in order for TCO Development to be sure factory audit requirements will be fulfilled within the given time. If the brand owner is considered a high risk for not fulfilling the initial audit requirements, then the brand owner is required to submit an audit report and a corrective action plan before the factory can be registered to TCO Certified Portal.

Factories will receive a better risk category categorization if they:

- are situated in lower risk countries,
- are involved in a social conformity certification and surveillance system that requires a minimum level of conformity before approval,
- have proven a high level of progress in non-conformity closure meaning that all non-minor non-conformities are closed.
- providing proof of well-functioning dialogue between the factory management and a democratically elected trade union or worker representatives. See clarification section: Qualification method and assessment of worker-management dialogue.

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. A full list is available here: saasaccreditation.org.

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 with the risk category (excluding factories which are directly owned by a brand owner, which can only be accessed by the owner). This is an advantage for those factories that work proactively with sustainability issues, closing non-conformities and monitoring continued conformity. These factories will be considered a better choice to do business with than risk category 1 factories.

Audit report and factory risk categorization

Initial audits are required regularly. The audit interval is based on the factory risk category.

- An **initial audit** is covering the full scope of the 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. However, they can be used for the initial risk categorization of new registered factories to TCO Certified Portal.

Initial risk categorization

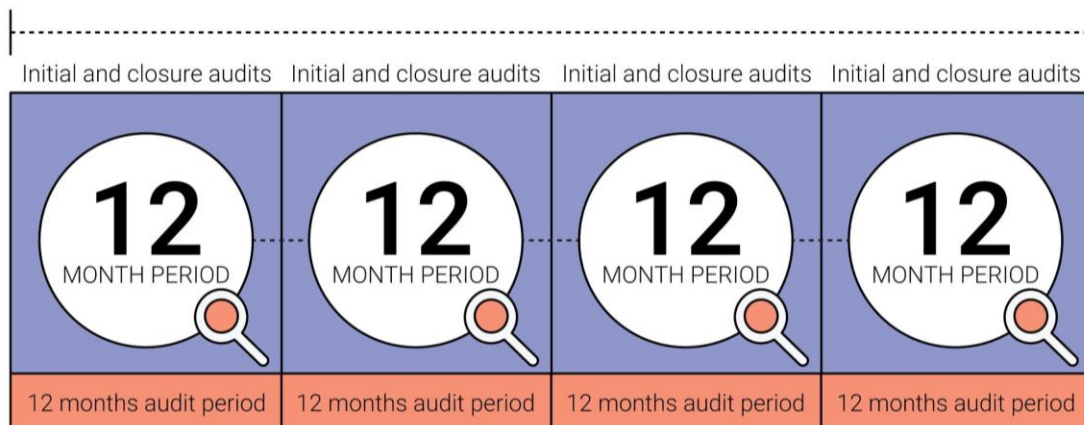
- For all new factories on TCO Certified Portal, existing independent audits that are less than 36 months old must be uploaded to TCO Certified Portal for risk categorization. If no such audit exists, then the factory will be classified as risk category 1 by default.

Risk category 1

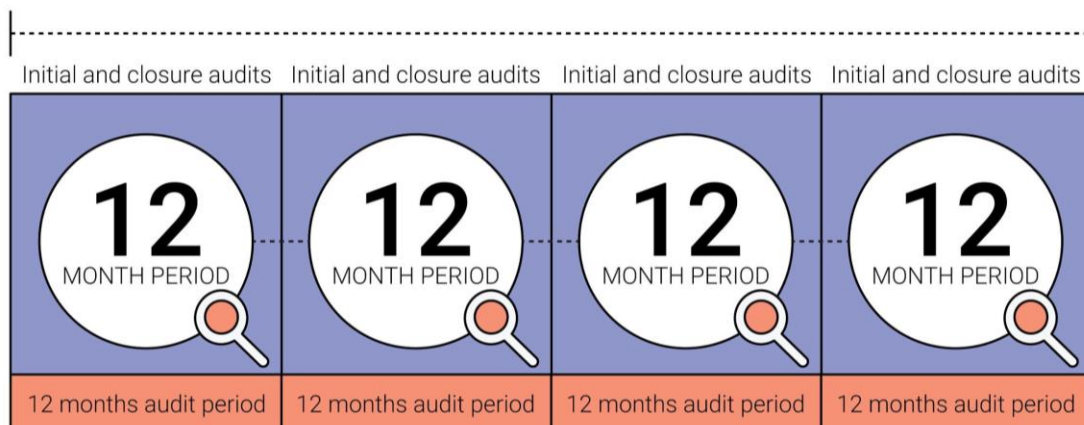
Initial audit

- For risk category 1, the factory must be audited every 12 months and a new initial audit must be uploaded to TCO Certified Portal during these 12 months. The start and end date of a new period is always on the date when the factory was first registered to TCO Certified Portal.

Category 1



Category 1



Corrective action plan

- When an audit has been uploaded it often includes some non-conformities. For each non-conformity to the mandate in TCO Certified, a corrective action plan must be uploaded to TCO Certified Portal. It must include closure deadlines, set by the audit program, for the completion of each corrective action.

Closure audit

- If there are major or priority non-conformities, a closure audit must be submitted within 12 months of the date the factory was registered to TCO Certified Portal. For minor non-conformities, the corrective action plan must be completed but it is not necessary to submit the closure audit.

Re-categorization

- When all non-conformities other than minor are closed, the factory will be categorized as risk category 2. If the factory is also placed in a lower risk country, or if it is certified according to SA8000, it will be categorized as 3 instead of 2.
- Otherwise the factory will continue to be categorized as risk category 1.

Final assistance

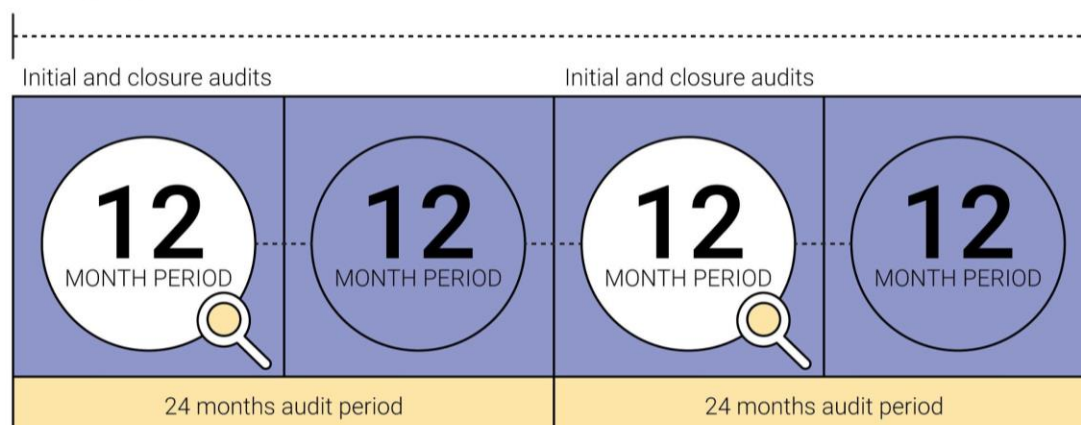
- If the factory has been categorized as a risk category 1 for 24 months, then the factory management will receive final assistance toward conformity through TCO Certified Active Monitoring Program on tcocertified.com. If the brand owner or factory decides to not commit to the active monitoring program, 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

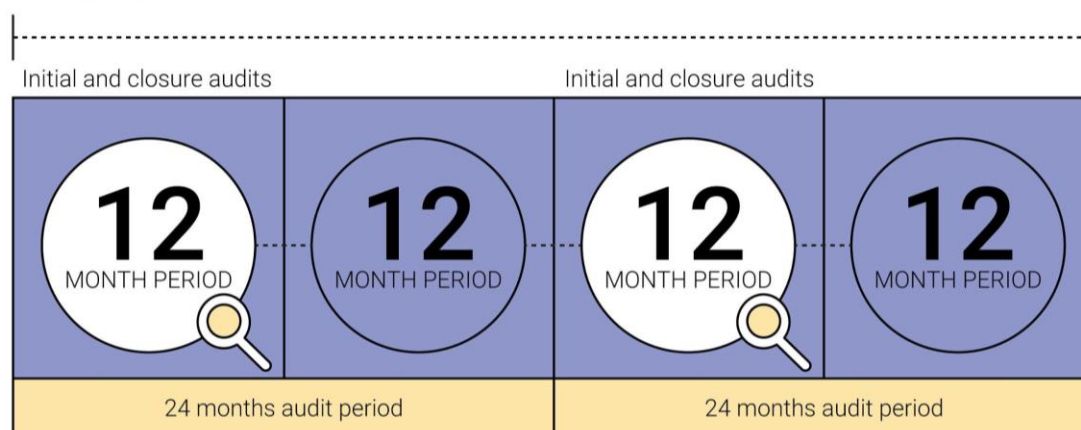
Initial audit

- For risk category 2, the factory must be audited every 24 months and a new initial audit must be uploaded to TCO Certified Portal during the first 12 months of every audit period. The start and end date of a new period is always on the date when the factory was first registered to TCO Certified Portal.

Category 2



Category 2



Corrective action plan

- When an audit has been uploaded it often includes some non-conformities. For each non-conformity to the mandate in TCO Certified, a corrective action plan must be uploaded to TCO Certified Portal. It must include closure deadlines, set by the audit program, for the completion of 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 first 12 months of every audit period. If the factory only has minor non-conformities, the corrective action plan must be completed but it

is not necessary to upload the closure audit to TCO Certified Portal. The closure of minor non-conformities will be verified in the next initial audit.

ATTENTION

It is recommended to conduct the initial audit early in the first 12 month audit period, to have time to also provide the closure audit during the first 12 months. If the closure audit is provided later than 12 months after the start of the audit period, the factory may be re-categorized. This may happen even if the audit closure deadline in the corrective action plan allows for more time to close the non-conformities.

Re-categorization

- As long as all non-conformities other than minor are closed within the time specified in the corrective action plan, the factory will continue to be categorized as risk category 2. If it is certified according to SA8000, it will be categorized as risk category 3 instead of 2.
- Otherwise, the factory will be categorized as risk category 1.

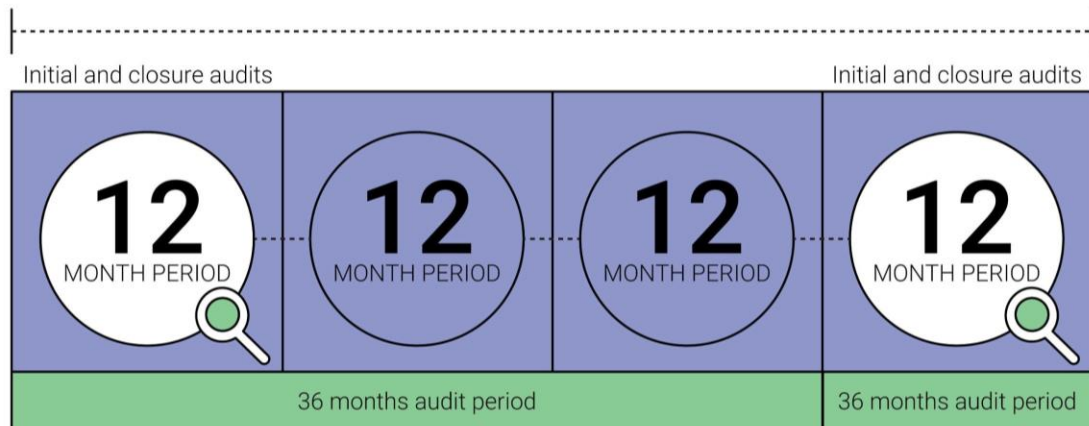
Conformity option: As proof of conformity to risk category 2 without the need to upload a closure audit report to TCO Certified Portal, factories that can prove they have received the status of Platinum, Gold or Silver under the RBA recognition program and provide additional proof that working hours are under 60 hours per workweek will be categorized risk category 2, or 3 if the factory is placed in a lower risk country. Silver level is only accepted if there are no major non-conformities to this criterion.

Risk category 3

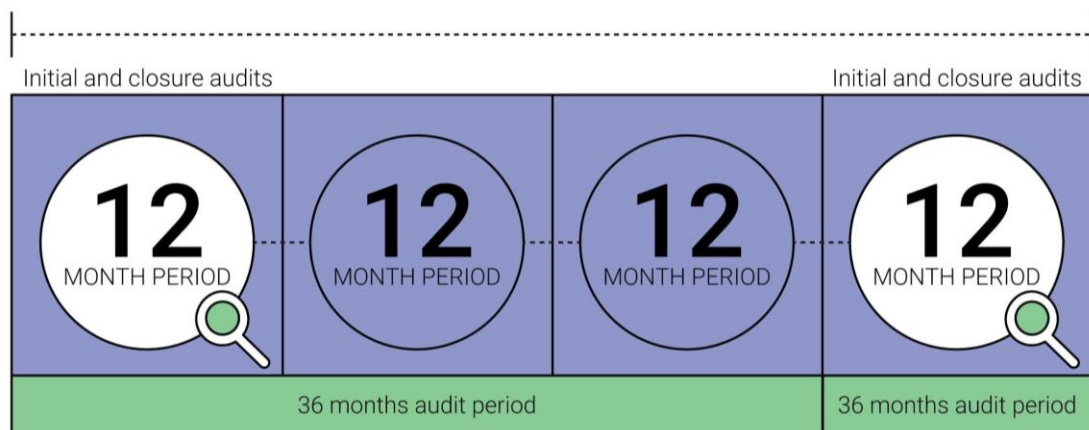
Initial audit

- For risk category 3, the factory must be audited every 36 months and a new initial audit must be uploaded to TCO Certified Portal during the first 12 months of every audit period. The start and end date of a new period is always on the date when the factory was first registered to TCO Certified Portal.

Category 3



Category 3



Corrective action plan

- When an audit has been uploaded it often includes some non-conformities. For each non-conformity to the mandate in TCO Certified, a corrective action plan must be uploaded to TCO Certified Portal. It must include closure deadlines, set by the audit program, for the completion of each corrective action.
 - If the factory is SA8000 certified then the non-conformities are solved in accordance with 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 first 12 months of every audit period. If the factory

only has minor non-conformities, the corrective action plan must be completed but it is not necessary to upload the closure audit to TCO Certified Portal. The closure of minor non-conformities will be verified in the next initial audit.

- A valid SA8000 certificate is considered proof that major and priority non-conformities are being monitored during regular intervals by SAAS accredited verifiers, and that issues are being solved.

Re-categorization

- Factories certified according to SA8000 are categorized as risk category 3. If it is discovered that non-conformities other than minor still occur, the factory will be categorized as risk category 1.
- Factories that are not SA8000 certified but are situated in lower risk countries and have provided a satisfactory closure of all non-minor non-conformities within the first 12 months of the audit period can achieve risk category 3 status.
- Factories of risk category 2 can apply for re-categorization to risk category 3 by providing proof of well-functioning dialogue between the factory management and a democratically elected trade union or worker representatives. See the qualification method below.

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 SA8000 Standard.

Additional clarifications that are valid for all risk categories

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

Spot checks of supply chain responsibility

Spot checks are financed by TCO Development as long as no non-conformities are found. If non-conformities are found and further investigations are necessary, the cost for this must be covered by the license holder.

Audit reports and corrective action plans

Central to the spot check conformity program is the review of the factory audit report and corrective action plan conducted by a verifier approved by TCO Development. TCO Development will randomly select audit reports and corrective action plans on

TCO Certified Portal to be spot checked. This is to ensure that the data uploaded to TCO Certified Portal is correct.

During the spot check conformity program, the corrective action plan will also be evaluated for effectiveness by the approved verifier. A judgement on the remedial effectiveness and a summary will be given in the verification report issued by the approved verifier. This summary is permitted to be shared with the clients of the factory.

On-site inspection initiated by TCO Development

TCO Development reserves the right to require full audit reports and conduct or commission on-site inspections at final assembly factories manufacturing the certified product, to verify that the brand owner is fulfilling the obligations in this criterion. The planning of social audits will be done in cooperation with the Senior Management Representatives appointed by the brand owner.

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

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 interviews 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.

2.2 Supply chain transparency

Background

Supply chain transparency includes two vital parts: a) the extent to which information about a company and its sourcing locations is made public to end-users and stakeholders and b) the company's process of taking action through supply chain visibility, to manage it effectively. Companies struggle to achieve supply chain transparency since they lack a solid process and structure to manage risks and monitor behavior in their extended supplier network. Without visibility into their supply chains, brand owners create a blind spot where damage to reputation can emerge.

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

Applicability

All product categories.

2.2.1 Mandate

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

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

The SMR must annually complete TCO Development's self-assessment questionnaire (SAQ) and complete a follow-up interview with an approved verifier.

Submit the following to an approved verifier:

- A completed and signed self-assessment questionnaire (SAQ)
- A completed and signed brand owner form covering the certified product (chapter 11.1)

Submit the following together with the application to TCO Development:

- A copy of a verification report from a verifier approved by TCO Development.
- The report from the SMR interview including the verified self-assessment questionnaire (SAQ).



2.2.2 Clarifications

General clarifications

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

Senior Management Representative (SMR) details

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

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

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

- Name, title, telephone number and email address of the SMR.
- A date, with a period of less than 12 months, of the completed and / or planned SMR interview with the name of the approved verifier.

SMR interview

The interview with the SMR must be done with one of the verifiers approved by TCO Development. It is booked and paid for by the SMR. The purpose is to ensure that the appointed person has the necessary authority and is working in a structured way to implement the brand owner's code of conduct. Primarily, the interview will cover the self-assessment questionnaire (SAQ) answers about supply chain management.

All questions in the SAQ must be answered and submitted to the verifier prior to the interview. During the part of the interview that covers the SAQ, the SMR will be required to explain in more detail the brand owner's work toward a socially responsible supply chain of the certified product and provide supporting documentation where needed. It is recommended that SMRs involve colleagues in the meeting who can provide necessary expertise in the areas covered by the SAQ.

The interview will likely be an online meeting. If for some reason it is not possible to have an online meeting or if the interview does not obtain an acceptable quality due to language difficulties, then the verifier may require a face to face interview.

The report from this interview is then uploaded to TCO Certified Portal. TCO Development have the right to participate at the interview with the SMR. In this case TCO Development will cover their own expenses.

About the self-assessment questionnaire (SAQ) and result benchmarking

The SAQ is a set of questions aimed at gaining transparency into the brand owner's risk management in the supply chain of the certified product. This includes areas such as child labor, worker representation, unions, ethics and minerals.

The SMR is responsible for answering all questions and providing supporting documentation where needed. The SMR must follow the SAQ guidelines when answering. Each answer must be given according to the following three levels of commitment that can be proven. Answers are color benchmarked for easy reference: invested (green), involved (yellow) or interested (red).

There is no minimum graded level required to be fulfilled, since the SAQ is only intended to gather information on the actual level of social commitment and assist in the development of future generations of TCO Certified criteria. Feedback to the brand owner is given in the form of a report and table that shows the brand owner's final grading (after the interview) in comparison to other certifying brand owners (all brand names will remain anonymous). This will help the brand owner identify areas for improvement and measure their progress within the industry.

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

The questionnaire and guidelines for the assessment are public and available for download at tcocertified.com.

Clarification of sustainability performance indicator(s)

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

- Public factory list

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

In order to count a final assembly factory as publicly listed it must be made public on the brand owner website under a heading "Supply Chain" or similar. The factory

information must show at least the supplier name, factory full address and type of products produced at the factory. Additional information on whether the supplier has produced a GRI-based sustainability report is optional.

2.3 Anti-bribery management system

Background

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

Organizations have a responsibility to prevent all forms of corruption within their businesses and their supply chains. To do so, organizations must align their business policy, monitoring and enforcement mechanisms with internationally recognized best practices against all forms of bribery.

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

Applicability

All product categories.

References

2.4.

2.3.1 Mandate

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

Submit the following to an approved verifier:

- A completed and signed brand owner form covering the certified product (chapter 11.1).

- An ISO 37001 certificate, or a booked date for the self-assessment questionnaire (SAQ) and follow-up interview with an approved verifier.

Submit the following together with the application to TCO Development:

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

2.3.2 Clarification

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

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

Each answer of the SAQ will be graded using a color. Green is pass, yellow is room for improvement and red is non-compliance. A completed SAQ and required supporting documentation must be submitted to the verifier prior to the interview. These will be verified in the online interview between the verifier and the brand owner SMR and any experts responsible for anti-bribery the SMR wishes to include.

Verification guidelines

- If all answers are scored green (except 12.1) in the first annual interview, then there's no need to include the anti-bribery interview in the following annual cycle.
- If any point is yellow (except 12.1), only these need to be covered in the following annual interview, to check if the brand owner has improved to green level.
- If any point is red, a corrective action plan must be submitted and the point will be included in the following annual interview and must then be either yellow or green.
- Only question 12.1 can be graded red indefinitely, since the interview is considered an independent verification of the anti-bribery management system.

2.4 Responsibly sourced minerals

Background

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

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

Applicability

All product categories.

References

2.5, 2.6, 2.7, 2.8.

2.4.1 Mandate

The brand owner must:

- Have a strict supply chain policy for responsible minerals sourcing, for the certified product that can be considered to cover at least 3TG and cobalt. The policy must be both public and communicated to the supply chain.
- Have a process to identify smelters and refiners of at least 3TG and cobalt for the certified product.
- Annually submit the completed responsibly sourced minerals template.

Submit the following to an approved verifier:

- The most recent version of the public responsibly sourced minerals policy and a description of how it is communicated to the supply chain of the certified product.

- A description of the brand owner's structured work on identifying risk areas in the supply chain of the certified product with supporting documentation.
- The responsibly sourced minerals template must be completed and submitted to TCO Certified Portal before the brand owner annual due date stated on the portal.
- A completed and signed brand owner form covering the certified product (chapter 11.1).

Submit the following together with the application to TCO Development:

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

2.4.2 Clarifications

Responsibly sourced minerals policy

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

Verification guidelines

The verifier must be able to verify that the responsibly sourced minerals policy can be considered to cover at least 3TG and cobalt for the certified product, is public, and also that it is clear how the policy communicated to suppliers.

- "Public" means that the policy is visible on the brand owner website, or is included in the brand owner's annual sustainability or responsible minerals report.
- "Communicated" could be as part of a contract and/or in a written agreement with suppliers.

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

- That suppliers conform with the policy.
- That suppliers neither directly nor indirectly finance armed groups in conflict-affected regions.
- That suppliers neither tolerate nor contribute to human rights abuses that include forced labor, child labor and environmental degradation.
- A commitment to supporting responsible sourcing from those regions in which specific mining operations may present risk.

Structured work on identifying risk areas

The brand owner must carry out structured work to identify if at least 3TG and cobalt are present anywhere in the supply chain of the certified product, with the goal to identify the smelters and refiners.

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

Verification guidelines

The verifier has been provided a description of how the brand owner identifies risk areas in its supply chain of the certified product. The verifier can also require a copy of the completed template as further evidence of compliance. See below examples:

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

Regulated smelters and refiners

Brand owners are required to annually submit information of the smelter and refiner facilities identified as the source of 3TG and cobalt in the supply chain of the certified product. The required information identifies those facilities that are conformant, active or otherwise registered through independent verification for their mineral sourcing due-diligence process.

Verification guidelines

The verifier is provided with the responsibly sourced minerals template with the required columns covering information on the identified smelters and refiners identified as the source of 3TG and cobalt in the supply chains of the certified products.

The template section; 'Regulated facilities' requires that the brand owner is transparent about which 3TG and cobalt smelter and refiner facilities are conformant or active with RMAP or registered on the EU 'white list'.

For the template section 'facility details', the brand owner has the option to add a link for their public report that covers 3TG, Cobalt and the 'required' information. If there is no public report or only some of the minerals are covered in the report, then the brand owner must complete the template with the additional required information that is not found in their public report.

More information:

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

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

- EU 'white list' of smelters and refiners. The regulation (EU) 2017/821 works to promote the responsible sourcing of smelters and refiners of tin, tantalum, tungsten and gold, whether they are based inside the EU or not. This is because EU importers will be required to identify the smelters and refiners in their supply chains and check whether they have the correct due diligence practices in place. Whenever EU importers find smelters and refiners' practices to be insufficient or associated with risks, they will have to manage and report on this.

To help companies, the European Commission is creating a so-called 'white list' of global smelters and refiners which source responsibly.

2.5 Process chemicals management

Background

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

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

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

Applicability

All product categories.

References

2.9, 2.10

2.5.1 Mandate

Each final assembly factory manufacturing the certified product:

- must have a structured health and safety management system in place, that is independently certified to ISO 45001.
- must only use cleaning solvents necessary for product and PCB process cleaning that contain individual chemicals or mixtures that appear on the TCO Certified Accepted Substance List for process chemicals.
- All substances of a mixture must be accounted for. Non-accepted substances must not exceed concentration levels of 0.1% by weight of the chemical product.

Submit the following to an approved verifier:

- A copy of the ISO 45001 certificate for each final assembly factory manufacturing the certified product.

- A completed Process Chemical Data Collection (PCDC) Tool for each final assembly factory manufacturing the certified product. The chemical data must cover cleaning solvents used for product cleaning and PCB process cleaning at the production lines where certified products are manufactured. The scope of chemical data to be submitted is stated in the Process Chemical Data Collection (PCDC) Tool, that can be downloaded at tcocertified.com.
- A completed and signed factory form (chapter 11.2).

Submit the following together with the application to TCO Development:

- A copy of a verification report from a verifier approved by TCO Development.
- A copy or access to a copy kept on a database of the complete assessment report conducted and issued by an approved licensed profiler independent of the approved screened chemistry program.
- The process chemical data template must be reported in TCO Certified Portal.

2.5.2 Clarification

The process chemicals that appear on TCO Certified Accepted Substance List are commonly used by final assembly factories to clean display panels, product enclosures and printed circuit boards (PCBs) and SMT machinery. They have been identified by TCO Development during the previous generation of TCO Certified. PCB cleaners are relevant since many final assembly factories include surface-mount technology (SMT) production lines that cover solder machines, stencils, flux, ovens, PCBs, glues and tools.

These processes must only use cleaners that are listed on TCO Certified Accepted Substance List. To be included on the list, chemicals must be independently assessed, and receive a GreenScreen[®] benchmark score of 2, 3 or 4. Alternatively chemical mixtures that are GreenScreen certified (gold or platinum) by a licensed GreenScreen Profiler are accepted. Chemicals on the list without an approved benchmark or certification will receive a sunset date for when they will be removed from the list. Before the sunset date, the chemical may be used on production lines where products certified according to TCO Certified are made. This gives the supplier/s time to have an independent assessment of the chemical, or to replace it with an approved benchmarked or certified alternative from the list.

From the date when the factory is registered on the TCO Certified Accepted Factory List, a factory has up to 12 months to make sure that the cleaning chemicals used on production

lines where certified products are made are listed as safer alternatives on TCO Certified Accepted Substance List.

TCO Development and Clean Production Action (CPA) must have access to a copy of the GreenScreen assessment report before the substance can be added to TCO Certified Accepted Substance List, available at tcocertified.com.

Proof of health and safety management system conformity

The applicant must upload a valid ISO 45001 certificate to TCO Certified Portal. The certificate must be issued by a certification body that is accredited to issue the certification. Factories that do not yet have a certified health and safety management system according to ISO 45001, may apply to TCO Development for an extended time period of up to 24 months to complete certification by annually submitting an extension application on the status of the certification. This application and status template can be obtained from TCO Development. TCO Development has the right to deny the applicant an extended period of time if there is reason to believe the factory will not be able to achieve the ISO 45001 certification within the extended time period (for example, if other critical non-compliance issues are pending, or if the timeplan is insufficient). A factory that has been certified to OHSAS 18001 has good prerequisites for an extended time approval.

Process Chemical Data Collection (PCDC) Tool and guidelines

The applicant must complete and upload the PCDC Tool to TCO Certified Portal. TCO Development has entered the scope of the data to be entered, therefore it is preferred that applicants download it from tcocertified.com/certification-documents.

For the default PCDC Tool, guidelines and films on how to complete the tool, go to: http://www.centerforsustainabilitysolutions.org/pcdctool_

Completing the Process Chemical Data Collection (PCDC) Tool

- The senior representative at the factory, whose responsibilities cover chemical management, must assist the applicant in the completion of the PCDC Tool.
- The areas that must be completed by the applicant are stated in the Requested Scope tab of the PCDC Tool that can be downloaded from tcocertified.com.
- In cases of proprietary, confidential business information of a CAS# number, the chemical supplier can directly submit this information to TCO Development. This must first be agreed upon by the applicant and TCO Development. If this information is not submitted, then the chemical ingredient must be treated as a restricted substance and the cleaning product must be replaced with an accepted alternative.

- The information must cover all cleaning solvents and their chemical ingredients used in the assembly of certified products.
- Upon request, the process chemical inventory at the factory must also be submitted for independent verification purposes.
- The PCDC Tool must be updated at the request of TCO Development.
- TCO Development has the right to compile confidential information with CAS numbers. TCO Development reserves the right to publish such compiled, anonymous information, but no information will be presented in such a way that the company or the products in question can be identified.

To verify compliance with this criterion, the completed PCDC Tool will be reviewed by TCO Development. The factory will be audited by independent assessment bodies.

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 section 8 of the chemical safety data sheet (SDS), that covers exposure controls and personal protection. Verification of PPE (availability, training and use) is included in the factory audit requirement of mandate 2.1.

3 Environmentally responsible manufacturing

Environmental risks in the manufacturing phase

Of the wide range of environmental risks throughout the IT product life cycle, many of these occur in the manufacturing phase. For example, life cycle assessments confirm that a typical IT product consumes more energy during its manufacture than during its entire usable life. Other problems include the extensive use of natural resources required to manufacture IT products, along with resulting soil, water, air pollution and greenhouse gas emissions.

TCO Certified – focused on environmental management and energy efficiency in manufacturing

In chapter 3 of TCO Certified, generation 9, the criteria focus on five areas designed to create a more environmentally responsible manufacturing process in the final assembly factories of the certified product:

- Environmental Management System, EMS - With an environmental management system (EMS) in place in the final assembly factories of the certified product, the brand owner can work systematically to continuously improve the environmental performance of the product.
- Energy efficiency indicators - Measurement of energy efficiency in the final assembly factories of the certified product.
- Energy management system - With a certified energy management system the manufacturer will work systematically to continuously improve energy efficiency in the manufacturing phase.
- Post-consumer recycled content and renewable materials - Reporting on the amount of recycled material that the product contains.
- Product carbon footprint - Determining the carbon footprint of the product.

3.1 Environmental management system

Background

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

Definitions

Final assembly factory: A Final assembly factory is where the final assembly of the certified product is taking place and is defined as the whole operation covered by a business license, and thereby the employment agreements of the factory workers.

Applicability

All product categories.

The company or companies that manufacture the product.

References

2.11

3.1.1 Mandate

Each final assembly factory manufacturing the certified product must be certified in accordance with ISO 14001.

Submit the following to an approved verifier:

- A copy of a valid ISO 14001 certificate for every final assembly factory manufacturing certified products.

Submit the following together with the application to TCO Development:

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

3.1.2 Clarification

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

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

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

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

3.2 Energy efficiency indicators

Background

While IT products become increasingly energy efficient in the use phase, there are still improvements to be made in the manufacturing phase. Life cycle assessments show that many IT products consume more energy during manufacturing than during the use phase.

Applicability

All product categories.

3.2.1 Mandate

Each final assembly factory which manufactures the certified product must report the previous calendar year energy efficiency indicators by the end of August each year. (This applies until the year after a certificate has expired.)

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
 - The energy efficiency indicators must be reported in TCO Certified Portal.
-

3.3 Energy management system

Background

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

Definitions

Final assembly factory: Factory where the final assembly of the certified product takes place.

Applicability

All product categories

3.3.1 Mandate

Each final assembly factory manufacturing the certified product must be certified in accordance with ISO 50001

Submit the following to an approved verifier:

- A copy of a valid ISO 50001 certificate for every final assembly factory manufacturing certified products.

Submit the following together with the application to TCO Development:

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

3.3.2 Clarification

The applicant must ensure that a valid ISO 50001 certificate is available on TCO Certified Portal at all times, for every final assembly factory manufacturing certified products.

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

Factories that do not yet have a certified energy management system according to ISO 50001, may apply to TCO Development for an extended time period of 24 months to

complete certification by annually submitting an extension application on the status of the certification. This application and status template can be obtained from TCO Development. TCO Development has the right to deny the applicant an extended period of time if there is a substantial risk that the factory will not be able to achieve ISO 50001 certification within the extended time period. The certificate must be issued by a certification body that is accredited by an accreditation body covered by the International Accreditation Forum, iaf.nu, Multilateral Arrangement on Energy Management Systems

3.4 Post-consumer recycled content

Background

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

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

Definition

PCR – Post-consumer recycled: Post-consumer recycled materials are derived from used consumer products, often packaging, bottles, durable goods including IT products.

(aluminum cans, PET bottles)

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

Recycled Content: means the total percentage of recovered material in a product, including pre-consumer and post-consumer materials.

Applicability

All product categories.

3.4.1 Mandate

The brand owner must report the following information for the typical product configuration (mandate 1.2.1 - product specification) of the certified product (including any external power supply):

- Percentage of post-consumer recycled plastics by weight versus the total weight of all plastics.
- Percentage of identified post-consumer recycled materials by weight versus the product weight

Submit the following to an approved verifier:

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

- Documentation on PCR content of all parts with a weight above 0.5g

Submit the following together with the application to TCO Development:

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

3.4.2 Clarification

Only post-consumer recycled content where the weight is confirmed by documented proof from the material vendor as described below may be reported.

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

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

Exceptions plastics

Optical components and display panels, electronic components, cables, connectors, PCBs, insulating mylar sheets, hard sheets for insulation, soft sheets for heat dissipation, elastomer feet, sponge materials, and labels may be excluded. This means that the weight of these items is not included when calculating the total weight of the plastic in the product in this requirement.

The following information must be submitted to an approved verifier

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

- Name of part/Part ID
- Material manufacturer name
- Weight (grams)
- Post-consumer recycled content in weight (grams)

For identified non-plastic post-consumer recycled content:

- Name of part/Part ID
- Material manufacturer name
- Weight (grams)
- Type of material
- Post-consumer recycled content in weight (grams)

The PCR template which is available at tcocertified.com/certification-documents may be used to provide this information.

Clarification of sustainability performance indicator(s)

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

Percentage of post-consumer recycled plastics (Class A-G)

Percentage of post-consumer recycled plastics by weight versus the total weight of all plastic parts. All exceptions listed in the above clarification are applicable.

- **Class A:** 85% or more
- **Class B:** ~~50~~70-85%
- **Class C:** 50-70%
- **Class D:** 30-50%
- **Class E:** 10-30%
- **Class F:** 1 -10%
- **Class G:** 0%

Percentage of identified post-consumer recycled materials (Class A-G)

Percentage of identified post-consumer recycled materials by weight versus the typical product weight.

- **Class A:** 50% or more
- **Class B:** 40% or above
- **Class C:** 30% or above
- **Class D:** 20% or above
- **Class E:** 10% or above
- **Class F:** 1-10%
- **Class G:** 0% or no information provided.

3.5 Product carbon footprint

Background

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

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

Definitions

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

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

Applicability

All product categories.

3.5.1 Mandate

A classification of the PCF methodology, age of source data, and availability must be conducted by an approved verifier.

Submit the following to an approved verifier:

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

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Submit the following together with the application to TCO Development:

- A copy of the PCF report (if available) and a verification report(s) from a verifier approved by TCO Development.
 - The classification of the PCF method, age of source data, and availability must be reported in TCO Certified Portal.
-

3.5.2 Clarification

It is not required to have conducted a PCF for the product. If no PCF data is available at the time of certification, the product will receive the lowest classification of the method, data age, and availability. It is possible to submit data for PCF evaluation at any time in order to update the classification.

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

For product models which can be configured, the typical product configuration must be used. The typical product configuration is defined as the product configuration which is expected to be manufactured in the largest number.

PCF Requirements

The product carbon footprint result must include the following:

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

The accuracy of product carbon footprint results is determined by the type, method, and age of data sources.

The PCF method (Class A-E)

Class A

- The PCF for the product is based on the product model.
- The PCF consists of primary data in foreground system processes.
- The PCF is critically reviewed by a third party. The review report must at least include:
 - Number of years experience in the LCA/PCF field
 - Number of carbon footprints reviewed
 - Number of carbon footprints conducted

Class B

- The PCF for the product is based on the product model.
- The PCF is critically reviewed by a third party. The review report must at least include:
 - Number of years experience in the LCA/PCF field
 - Number of carbon footprints reviewed
 - Number of carbon footprints conducted

Class C

- The PCF for the product is based on the product model.

Class D

- The PCF for the product is based on the product model family.
 - **Example**
 - Similar chassis appearance
 - Same display size
 - Similar functionality (e.g. headset with microphone)

Class E

- No data available

Data age (Class A-E)

The development of ICT products is happening at a rapid pace. Therefore the age of data is of high importance in order to make accurate PCF estimates.

Class A

- The data used to calculate the PCF is maximum 3 years old.

Class B

- The data used to calculate the PCF is maximum 5 years old.

Class C

- The data used to calculate the PCF is maximum 7 years old

Class D

- The data used to calculate the PCF is older than 10 years old.

Class E

- No data available

Availability (Class A-D)

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

Class A

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

Class B

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

Class C

- The results of the PCF as defined in the PCR Requirements are not publicly available.

Class D

- No PCF available

4 User health and safety

User health and safety — essential for IT product sustainability

An IT product must be safe to use and should provide the user with the function and comfort needed to support productivity.

Examples of identified safety risks that are relevant to IT products include:

- product overheating, leading to increased fire risk.
- battery volatility, burning, or explosion.
- poor electrical safety design, that may give the user an electric shock or cause a fire.

In addition, an ergonomically designed IT product is better positioned to meet the user's needs longer and be a more sustainable product choice.

TCO Certified — verifying product safety, protecting the user

Chapter 4 in TCO Certified includes criteria for product and electrical safety as well as ergonomic design and user health.

4.1 Electrical safety

Background

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

Applicability

All products with built-in power supplies as well as any external power supply intended to be used together with the product.

References

4.1.

4.1.1 Mandate

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

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

4.2 Alternating electric fields

Background

Electrical alternating fields are created between objects that have different levels of electrical potential that change over time. When the potential changes in a periodic manner, an electrical alternating field is set up, with a field strength and a frequency. An IT product can contain many sources of electrical alternating fields. The field characteristics depend on the actual electrical potential difference and the distance from the product.

Some users are concerned that electric alternating fields may be a health risk. The aim of this criteria is to reduce the electrical alternating fields to such a low level so as not to burden the work and home environment with unnecessary factors. The criteria must not be regarded as hygienic limit values.

Band I is very dependent on the emission from the power cable and is therefore normally only measured 30 to 50 cm in front of a product. Band II is depending on the circuitry of the product and is measured around the product. During normal use, the user is not sitting in front of the projector at a distance of 30 cm to 50 cm. Therefore, only Band II is measured for projectors.

Applicability

Projectors.

4.2.1 Mandate

Band II: 2 kHz to 400 kHz, ≤ 1.0 V/m measured at 1 m around and topside of the projector.

Submit the following together with the application 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.

4.2.2 Clarification

Test facility requirements

Background electric field strengths in the test facility, including disturbances transmitted by power lines and internally generated noise in the measuring system, must together not exceed 0.20 V/m in band II. The mains voltage to the projector under test must be within ± 3 % of its nominal value.

Preparation of the projector for testing

All necessary preparations described in 9.1 and 9.3 must be done. An external optical filter may not be used in order to comply with the mandatory requirement.

Equipment

Alternating electric field meter.

Test method

The true r.m.s.-value of the amplitude of the electric field strength, at the surface of the measuring probe, is measured in four azimuths in band II. The frequency ranges are selected by means of filters in the measuring equipment.

The projector must be positioned so that the tangential plane, to the center-center point of the projector lens, is at a right angle to the horizontal plane. The distance between the center-center points of the projector lens and the back of the projector, including any part of a stand holder, along the normal to this tangential plane is called L, see figure alternating electric fields 1.

The origin of the cylindrical coordinate system must be situated at a distance $L/2$ behind the projector lens on the normal to the tangential plane through the center-center point. The z-axis must be at a right angle to the horizontal plane. The angular reference direction is along the above mentioned normal in the direction pointing outwards from the projector. An angle (ϑ) is positive in the counterclockwise direction.

Measurements are taken in four directions around the product at 0° , 90° , 180° and 270° . Measurements must be made at all points and have a clearance of 1 m to the outer surface of the projector. Another measurement of the top of projector must be taken at the center, center.

If clearance is less than 1 m, the instrument must be moved out radial until 1 m clearance is achieved.

Distances are given in meters and angles in degrees. The coordinates are given for the center of the measuring probe. The surface of the probe must be perpendicular, within $\pm 5^\circ$, to the radial axis.

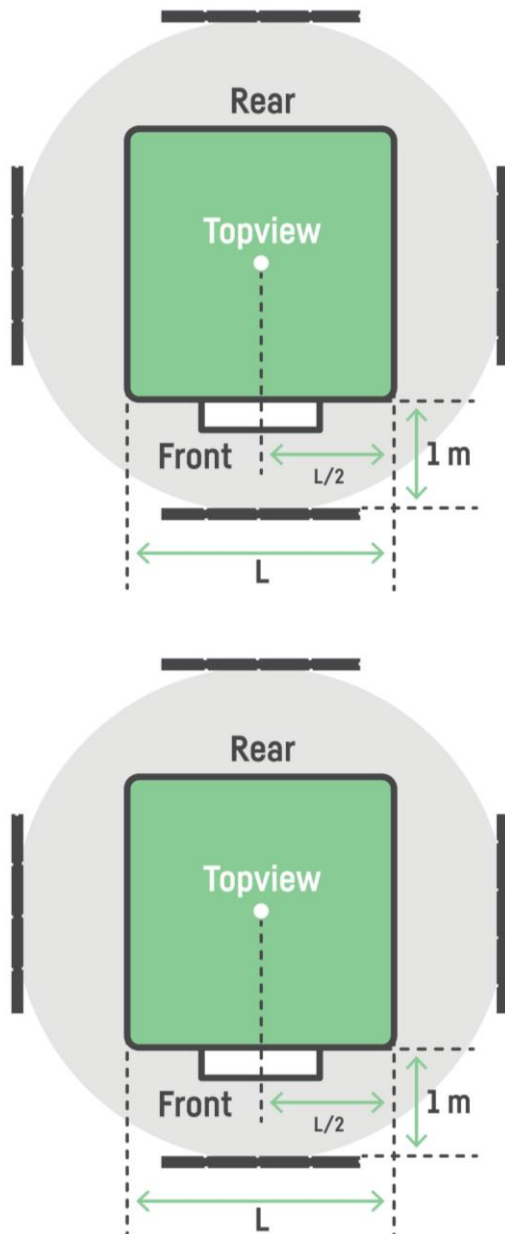


Figure alternating electric fields 1. Measurement geometry for band II.

The projector and the measuring probe must be positioned at least 2 m from all significant metallic structures and objects.

Additional units and connecting cables necessary for the operation of the projector, that are not part of the test, must be placed so far away from the measuring setup so that the fields they emit do not influence the measurement. Shielding may be added to these units and cables, as long as the 2 m clearance is maintained.

The measuring probe must be connected to ground. Any cables running between the measuring probe and the measuring instrument must be positioned in such a way that they do not influence the measured value.

The power cable of the test object must be connected to the phase and the neutral conductors of the mains power supply. The projector does not need to be measured with the phase and neutral interchanged in this case, as the Band II electric fields are not influenced by such a change.

Test evaluation

Results must be presented as r.m.s. values of the alternating electric field expressed in volt per meter (V/m). For band II, the measured values in front of the projector and the maximum value at rotation must be presented for normal and stand-by operations if they differ.

If the measured values are less than 1.0 V/m in band II, the result must be reported as "< 1.0 v/m".

Overall uncertainty

The test must be performed in such a way that the total extended uncertainty in the test result will be less than $\pm (10 \% \text{ of the reading} + 0.1 \text{ V/m})$ for band II.

4.3 Alternating magnetic fields

Background

Alternating magnetic fields are created when an alternating electrical current flows through a conductor. IT products are surrounded by alternating magnetic fields that are generated by different parts of the product, e.g. external power supply, voltage inverters and other electrical circuits. The field strength depends on the actual electric current and on the distance from the product.

Some users are concerned that alternating magnetic fields may be a health risk. The aim of this criteria is to reduce the electrical alternating fields to such a low level so as not to burden the work and home environment with unnecessary factors. The criteria must not be regarded as hygienic limit values.

Applicability

Projectors.

4.3.1 Mandate

Band I: 5 Hz to 2 kHz, ≤ 200 nT, measured at 1 m around and top side of the product.

Band II: 2 kHz to 400 kHz, ≤ 25 nT measured at 1 m around and top side of the product.

Submit the following together with the application 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.

4.3.2 Clarification

Test facility requirements

Background magnetic fields in the test facility, including disturbances transmitted along the power line and internally generated noise in the measuring system, must together not exceed 40 nT in band I and 5 nT in band II.

Preparation of the product for testing

All necessary preparations described in 9.1 and 9.3 must be done.

Equipment

Alternating magnetic field meter in band I and band II

Test method

The true r.m.s. value of the amplitude of the magnetic flux density vector is measured at twelve points on a cylindrical surface around the test object in the two frequency ranges, band I and band II. The frequency ranges are selected by specified filters in the alternating magnetic field meter.

The measuring geometry is illustrated in figure alternating magnetic fields 1. The measurement points are mathematically defined in the following way.

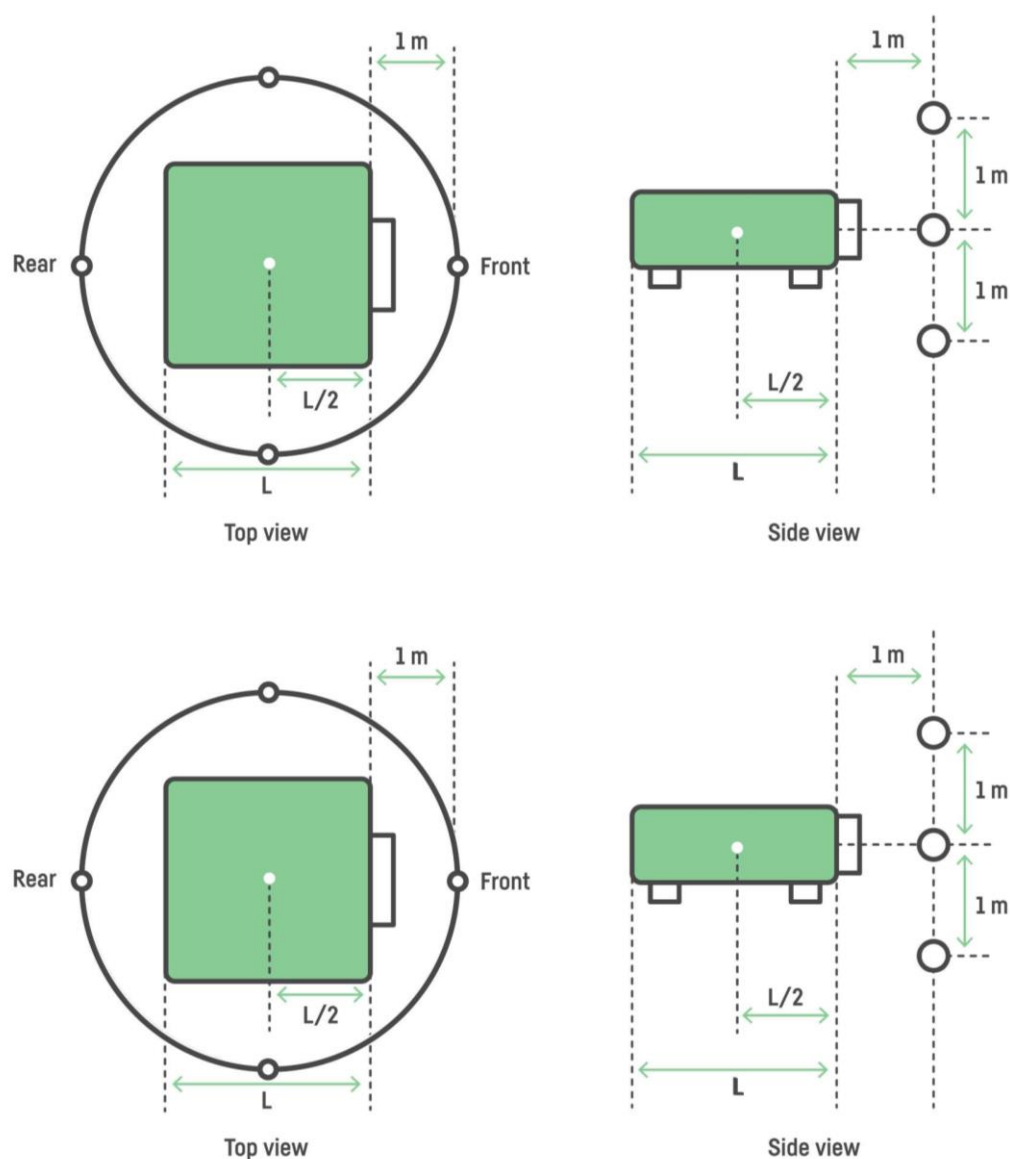


Figure alternating magnetic fields 1. Measurement geometry for the test object.

The projector must be positioned so that the tangential plane, to the center-center point of the projector lens, is at a right angle to the horizontal plane. The distance between the center-center points of the projector lens and the back of the projector, including any part of a stand holder, along the normal to this tangential plane is called L.

The origin of the cylindrical coordinate system must be situated at a distance $L/2$ behind the projector lens on the normal to the tangential plane through the center-center point. The z-axis must be at a right angle to the horizontal plane. The angular reference direction is along the above-mentioned normal in the direction pointing outwards from the projector. An angle (ϑ) is positive in the counterclockwise direction.

Measurements are taken in four directions around the product at 0° , 90° , 180° and 270° . Measurements must be made at all points and have a clearance of 1 m to the outer surface of the projector. Another measurement of the top of projector must be taken at the center-center, point at 1 m clearance over the projector.

If clearance is less than 1 m, the instrument must be moved out radial until 1 m clearance is achieved.

Distances are given in meters and angles in degrees.

The measuring coils must be stationary during the measurements.

For projector luminance settings – see chapter 9, General test conditions for emissions.

The power cable of the test object must be connected to the phase and the neutral conductors of the mains power supply. The projector does not need to be measured with the phase and neutral interchanged in this case, as the magnetic fields are not influenced by such a change.

Test evaluation

Results must be presented as r.m.s. values of the magnetic flux density expressed in nanotesla (nT) for the two frequency bands. The maximum value around the projector and its position must be given both for normal and for standby operation if they differ. If measured values are less than 200 nT in band I or less than 25.0 nT in band II, the result must be reported as "< 200 nT" and "< 25.0 nT" respectively.

Overall uncertainty

The test must be performed in such a way that the total extended uncertainty in the test result will be less than $\pm (10 \% \text{ of the reading} + 30 \text{ nT})$ for band I and $\pm (10 \% \text{ of the reading} + 1.5 \text{ nT})$ for band II.

Note

The uncertainties given are worst case limits. In many cases it will be possible to obtain better accuracy, especially in band II.

4.4 Acoustic noise

Background

Acoustic noise from fans can be disturbing to users. Therefore, projectors should be as silent as possible during use. In this criterion the sound power level is required since this includes the total noise emitted from the projector and describes the noise characteristics of the projector in the most reliable way. Sound power level is the only value that can be used to compare different products.

Definitions

A-weighted sound power level (L_{WA}) in decibels: The sound power level of the projector, determined in accordance with ISO 7779:1999, with A weighting. The reference sound power is 1 pW.

Reported A-weighted sound power level (L_{WAd}): in bels (B). Defined in accordance with ISO 9296:1988 3.2.5. NOTE: besides the unit bels (B) a declaration in decibels (dB) is common.

Operating mode: A condition in which the system must be operated in accordance with ISO 7779:1999 C.15.3.2 and C.9.3.2.

Idling mode: A condition in which the system must be operated in accordance with ISO 7779:1999 C.15.3.1.

Eco Mode: A reduced power state that the projector enters on the user's initiative following the manufacturer's instructions. Eco mode is when the projector consumes less energy, the acoustic noise level is reduced and the possible life of the lamp is increased when compared with on mode.

Applicability

Projectors.

References

32, 33 and 34.

4.4.1 Mandate

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

TCO Certified Image Size $A_{\text{Max/office}}$	$\leq 3 \text{ m}^2 (\sim 1900 \text{ lumens})^*$	$\leq 6 \text{ m}^2 (\sim 3800 \text{ lumens})^*$
Reported sound power level L_{WAd}	$\leq 5.0 \text{ B(A)}$	$\leq 5.5 \text{ B(A)}$
TCO Certified Image Size $A_{\text{Max/video}}$	$\leq 6.6 \text{ m}^2 (\sim 1900 \text{ lumens})^*$	$\leq 13.3 \text{ m}^2 (\sim 3800 \text{ lumens})^*$
Reported sound power level L_{WAd}	$\leq 5.0 \text{ B(A)}$	$\leq 5.5 \text{ B(A)}$

*Equivalent light output setting where products fulfil the picture quality requirements in TCO Certified (often lower than max light output).

2. The A-weighted sound power level (L_{WAd}) for eco mode according to ISO 7779:1999 must be at least 0.2 B(A) lower than the reported A-weighted sound power level (L_{WAd}) for operating mode.
(TCO Development will present the A-weighted sound power level at our Product Finder, available at tcocertified.com.)

Submit the following to an approved verifier:

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

Submit the following together with the application 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 A-weighted sound power level must be reported in TCO Certified Portal
-

4.4.2 Clarification

The noise measurements can be performed at any facility accredited according to ISO 17025.

The noise measurements must follow ISO 7779:1999 and must be reported according to ISO 9296:1988. (However, the principle for how the measurement uncertainty is handled must be the same as for all the other criteria in the certification. This means that no uncertainty must be added to the result presented in the report.)

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

Overall uncertainty

The test must be performed in such a way that the total extended uncertainty in the test result will be less than $\pm 2.5\text{dB}$.

Note

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

5 Product performance

Product performance is vital for extended life and user productivity

Product performance is essential for user satisfaction and productivity. A well-performing product can also likely be used effectively for a longer period of time before being replaced. Products that maintain a high level of performance can also be valuable for re-use, further extending its usable life. Cost savings and reduced environmental impact are also viable outcomes.

To move toward greater sustainability, product performance factors must also be in balance with environmental effects. For example, high product performance should not be at the expense of energy efficiency, which is vital for reducing the climate impact of IT products.

A high performing product should also be comfortable to use. It may improve user productivity and reduce the risk of health and safety problems, such as eyestrain, headache and repetitive strain injuries.

TCO Certified – product performance for extended life and lower environmental impact

In chapter 5 of TCO Certified, generation 9, criteria for product performance are specific to each product category and focus on energy efficiency, display image quality, computer keyboard design as well as volume control and sound quality, where relevant.

5.1 Energy efficiency

Background

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

Definitions

On mode with lamp in normal operation: A state when the projector is producing an image.

Eco mode: A reduced power state that the projector enters on the user's initiative following the manufacturer's instructions. Eco mode is when the projector consumes less energy than in on mode, the acoustic noise level is reduced and the possible life of the lamp is increased.

Standby mode: The reduced power state that the projector is capable of entering automatically after a period of inactivity or by manual selection.

Off mode: The power consumption level in the lowest power mode, which cannot be switched off by the user and that may persist for an indefinite time when a projector is connected to the main electricity supply and used in accordance with the manufacturer's instructions.

Applicability

All projectors.

References

48, 49, 50, 57 and 58.

5.1.1 Mandate

For Class B products pursuant to Part 15 subpart B of the FCC Rules or IEC/EN 55022:

1. The projector must be possible to set in an eco-mode.
2. The following levels for maximum power consumption in the following modes must be fulfilled and verified through testing by a test facility approved by TCO

Development:

On Mode

Area	Requirement level
------	-------------------

$A_{\text{Max/office}}$	On Mode (normal operation)
$\leq 3 \text{ m}^2$	$\leq 260 \text{ W}$
$\leq 6 \text{ m}^2$	$\leq 310 \text{ W}$
$> 6 \text{ m}^2$	$\leq 310 + 150 * (A_{\text{max}} - 6) \text{ W}$
Projectors with a throw ratio of ≤ 0.82 are allowed 30% more energy consumption.	
$\leq 3 \text{ m}^2$	$\leq 260 \times 1.30 \text{ W}$
$\leq 6 \text{ m}^2$	$\leq 310 \times 1.30 \text{ W}$
$> 6 \text{ m}^2$	$\leq (310 + 150 * (A_{\text{max}} - 6)) \times 1.30 \text{ W}$
$A_{\text{Max/video}}$	On Mode (normal operation)
$\leq 6.6 \text{ m}^2$	$\leq 260 \text{ W}$
$\leq 13.3 \text{ m}^2$	$\leq 310 \text{ W}$
$> 13.3 \text{ m}^2$	$\leq 310 + 150 * (A_{\text{max}} - 13.3) \text{ W}$
Projectors with a throw ratio of ≤ 0.82 are allowed 30% more energy consumption.	
$\leq 6.6 \text{ m}^2$	$\leq 260 \times 1.30 \text{ W}$
$\leq 13.3 \text{ m}^2$	$\leq 310 \times 1.30 \text{ W}$
$> 13.3 \text{ m}^2$	$\leq (310 + 150 * (A_{\text{max}} - 13.3)) \times 1.30 \text{ W}$

Eco-mode $\leq 90\%$ of the measured on mode (normal operation) value.

Standby mode $\leq 0.5 \text{ W}$ or should follow the latest EU directive.

Off mode $\leq 0.5 \text{ W}$.

1. There must be an adequate description explaining how the projector is brought into its energy mode(s) and how this will be indicated on the projector. The description must be signed by the responsible person at the applicant company and submitted to the test facility.

2. It must be possible to set the projector to automatically enter standby mode or off mode, after a specified time period when the video or computer interface is disconnected.
3. Energy consumption levels in all modes must be published in the user manual and product specification. There must be an adequate description explaining how the projector is brought into its energy mode(s) and how this will be indicated on the projector.

For Class A products pursuant to Part 15 subpart B of the FCC Rules or IEC/EN 55022.

TCO Development reserves the right to introduce new energy levels to allow certification of class A projectors in the next generation of TCO Certified for projectors.

Submit the following to an approved verifier:

- A signed description of how to change the energy settings on the projector

Submit the following together with the application 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. Sustainability performance indicators for this criterion must be reported in TCO Certified Portal.

5.1.2 Clarification

Sustainability performance indicator(s):

Measured energy consumption according to TCO Certified in On mode (normal operation), Eco-mode, standby mode and off mode for the reported TCO Certified Image Size must be reported in TCO Certified Portal, together with the application.

Preparations of for testing

The projector must be warmed-up for a minimum of 20 minutes.

Connect a computer to the projector that produces an image.

Record the AC voltage.

The measurements have to be performed with graphics or computer interface connected and without any connection of any other peripheral devices.

Equipment

RMS power meter.

Test method

The following are test steps for measuring the true energy requirements of the projector in on mode, eco mode, standby mode and off mode. Note that the testing must be performed in normal operation with no additional equipment connected.

On mode with lamp in normal operation

Initiate the projector to present a default test image, full screen bright white picture, RGB settings 255, 255, 255 (100% image loading) on the reported maximum projected screen size Amax/office or Amax/video. Allow the projector to remain in this mode until stable energy readings are measured. Measurements are considered stable if the wattage reading does not vary by more than 1% for the duration of a three-minute period.

Eco mode

Eco mode helps to reduce energy consumption.

Initiate the projectors eco mode. An adequate method of adjustment must be documented. Allow the projector to remain in this mode until stable energy readings are measured. Measurements are considered stable if the wattage reading does not vary by more than 1% for the duration of a three-minute period.

Standby mode

Initiate the projectors standby mode. An adequate method of adjustment must be documented. Allow the projector to remain in standby mode until stable energy readings are measured. Measurements are considered stable if the wattage reading does not vary by more than 1% for the duration of a three-minute period.

Off mode

Initiate the projectors off mode. An adequate method of adjustment must be documented. Allow the projector to remain in off mode until stable energy readings are measured. Measurements are considered stable if the wattage reading does not vary by more than 1% for the duration of a three-minute period.

Test evaluation

Record the test conditions and test results as specified for each mode in "Test method".

Overall uncertainty

The uncertainty in the test results must be better than $\pm 5\%$.

5.2 Energy efficiency – external power supply

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 volume of IT equipment in use grows, greenhouse gas emissions are also increasing. Reducing the problem requires a number of measures, of which energy-efficient products are one part.

Applicability

All external power supplies.

References

5.2.

5.2.1 Mandate

The external power supply must meet at least the International Efficiency Protocol requirement for level VI.

Submit the following to an approved verifier:

A copy of the marking label for the external power supply.

Submit the following together with the application to TCO Development:

- A copy of the marking label for the external power supply.
- A copy of a verification report from a verifier approved by TCO Development.

Visual ergonomics

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

In developing criteria for visual ergonomics TCO Development considered the various environments the projector would be used in. Other features that characterise high quality projectors have also been in focus when developing these criteria, with the goal of simplifying the process of buying a projector. For example, TCO Development developed an approach that specifies the maximum projected image size (area m^2) which can be verified readable. The term used throughout this criteria document is for this measurement is: "TCO Certified Image Size".

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

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

5.3 Display resolution

Background

Image quality is negatively affected by a low pixel density with visible pixels, “jaggies”, poor rendering of details, etc. The resolution and image size regulates the necessary viewing distance to achieve a pixel density ≥ 30 pixels/degree of visual angle for the first row of audience to ensure that they do not perceive individual pixels.

As the image size increases at a given resolution, the audience must be moved further away from the screen (by X times the diagonal). For larger image sizes it becomes increasingly difficult to place the first row of audience far enough from the screen due to room constraints. However, if the resolution is increased the viewing distance multiple “X” is reduced and the audience may be closer to the screen.

Definition

- A pixel is the smallest addressable imaging element of the digital picture capable of reproducing a full range of luminance and colors.
- The native resolution is the actual, true, physical resolution of the projector. The projector will never be able to display more actual pixels than it has on those panels or chips.
- Viewing distance is the distance between the screen and first row of viewers.

Applicability

All front screen projectors with fixed resolution.

References

3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14.

5.3.1 Mandate

The minimum resolution in megapixel of the projector (horizontal pixels x vertical pixels) must be at least according to the below table depending on the reported TCO Certified Image Size. (It is possible to report a smaller TCO Certified Image size to pass this criterion.)

TCO Certified Image size	Minimum resolution in megapixel	Example resolutions
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> 6,9 m ² (≈ 150" diagonal)	1.57	UXGA, Full HD
≤ 6,9 m ² (≈ 150" diagonal)	1.16	SXGA+
≤ 3,1 m ² (≈ 100" diagonal)	0.54	XGA, HD
≤ 1,5 m ² (≈ 70" diagonal)	0.37	SVGA
≤ 0,5 m ² (≈ 40" diagonal)	0.25	VGA

Submit the following together with the application 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 resolution must be reported in TCO Certified Portal.

5.3.2 Clarification

Preparations for testing

No specific preparation of the projector is needed.

Equipment

Calculator and projector manual or similar information about the resolution of the projector.

Test method

The maximum resolution and frequencies of the projector are found in the manual or similar information from the manufacturer.

Test evaluation

- For projectors with a reported TCO Certified Image Size > 6.9 m² (≈ 150" diagonal) a viewing distance multiple of 0.85 times the diagonal is considered necessary. This gives a necessary resolution of at least 1.57 megapixel.

- For projectors with a reported TCO Certified Image Size $\leq 6.9 \text{ m}^2$ ($\approx 150''$ diagonal) a viewing distance multiple of 1 times the diagonal is considered necessary. This gives a necessary resolution of at least 1.16 megapixel and a maximum 3.8 m distance to the first row.
- For projectors with a reported TCO Certified Image Size $\leq 3.1 \text{ m}^2$ ($\approx 100''$ diagonal) a viewing distance multiple of 1.5 times the diagonal is considered necessary. This gives a necessary resolution of at least 0.54 megapixel and a maximum 3.8 m distance to the first row.
- For projectors with a reported TCO Certified Image Size $\leq 1.50 \text{ m}^2$ ($\approx 70''$ diagonal) a viewing distance multiple of 1.8 times the diagonal is considered necessary. This gives a necessary resolution of at least 0.37 megapixel and a maximum 3.2 m distance to the first row.
- For projectors with a TCO Certified Image Size $\leq 0.5 \text{ m}^2$ ($\approx 40''$ diagonal) a viewing distance multiple of 2.2 times the diagonal is considered necessary. This gives a necessary resolution of at least 0.25 megapixel and a maximum 2.2 m distance to the first row).

Overall uncertainty

Uncertainty is not applicable in this case. Product data information is sufficient.

5.4 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 by a number of standards ex. D65, sRGB, ITU rec 709 which are widely used in photo and video editing.

Definition

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

Applicability

All projectors

References

5.4, 5.5, 5.10, 5.19-5.22, 5.23, 5.26, 5.27, 5.30-5.33, 5.34-5.40.

5.4.1 Mandate

The products default preset correlated color temperature may have any name but must have a color difference $\Delta u'v' \leq 0.015$ when compared to CIE u' and v' chromaticity coordinates for D65 or D75.

Submit the following together with the application 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.

5.4.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- The default test image is a full-screen with color “bright white” (RGB setting of 255, 255, 255).

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
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 mentioned above.

The relevant CIE material – conversion formulae and tabulated data for u'_{CCT} and v'_{CCT} – can also be found on the TCO Certified website: tcocertified.com.

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

Overall uncertainty

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

See 9.1.8

5.5 Color gamut

Background

Accurate color rendering is important when realistic color images or presentations are to be shown using the projector. Poor color rendering can lead to poor legibility and misinterpretation. The u' and v' chromaticity coordinates of the primary colors red (R), green (G) and blue (B) of the projected image must aim at values given in international IEC, EBU and ITU standards. The u' and v' chromaticity coordinates of the primary colors R, G and B form a triangle in the CIE 1976 uniform chromaticity scale diagram. The larger the area of the triangle, the wider the range of colors the projector is capable of presenting. The color rendering of the projected image is very dependent on the screen used.

Definition

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

Applicability

Projectors.

References

5, 10, 13, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28 and 29.

5.5.1 Mandate

For projectors with a throw ratio > 0.38

The minimum color triangle must have the following coordinates at factory default setting:

	Red		Green		Blue	
Coordinate	u'	v'	u'	v'	u'	v'
Requirement	≥ 0.400	≥ 0.510	≤ 0.160	≥ 0.550	≥ 0.145	≤ 0.210

For projectors with a throw ratio ≤ 0.38

The minimum color triangle must have the following coordinates at factory default setting:

	Red		Green		Blue	
Coordinate	u'	v'	u'	v'	u'	v'
Requirement	≥ 0.400	≥ 0.510	≤ 0.160	≥ 0.550	≥ 0.135	≤ 0.240

Submit the following together with the application 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.
-

5.5.2 Clarification

Preparation of the projector for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- Use full-screen test pattern with the following RGB settings:
(255, 0, 0) for red,
(0, 255, 0) for green,
(0, 0, 255) for blue.

Equipment

- Spectro-radiometer capable of presenting CIE u' and v' chromaticity coordinates with at least 3 decimals.
- Color neutral reflectance standard.

Test method

Place the color neutral reflectance standard at measurement location 5 (see figure luminous flux 1). Measure the spectral properties at the centre of the color neutral reflectance standard with a spectroradiometer for red, green and blue according to Preparation of the projector for testing.

Test evaluation

The recorded chromaticity coordinates u' and v' for red, green and blue must be reported as well as the luminance for each of red, green and blue. The u' and v' must be presented to 3 decimal places.

Overall uncertainty

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

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

See 9.1.8

5.6 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 of the image, that affect how all other colors are perceived. Patches of color variation in an active white or gray image may reduce the contrast, be disturbing and affect readability, color rendering and color differentiation. The color rendering of the projected image is very dependent on the screen used.

Definition

The color uniformity of a projector is the capability to maintain the same color in any part of the projected image area.

Applicability

All front screen projectors with fixed resolution.

References

5, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 27, 30 and 31.

5.6.1 Mandate

$\Delta u'v' \leq 0.015$ for the maximum color deviation between measured active areas on the TCO Certified Image Size that are intended to maintain the same color.

Submit the following together with the application 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.
-

5.6.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- The default test image is a full-screen with color “bright white” (RGB setting of 255, 255, 255).

Equipment

- Spectro-radiometer capable of presenting CIE u' and v' chromaticity coordinates with at least 3 decimals.
- Color neutral reflectance standard.

Test method

- The color uniformity must first be evaluated visually by the technician in order to find those areas where the color varies the most.
- Measure the chromaticity coordinates u' and v' in the visually most color-deviating areas. Then, in addition to this, measure the chromaticity coordinates in the corner positions as shown in figure luminous flux 1 and in the center.
- It is not recommended to perform this parameter together with *luminous flux* uniformity, since the reflectance standard is likely not calibrated for the angles involved and consequently will give false luminance results for the light flux uniformity.

Test evaluation

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

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

where A and B are the two points found to have the largest color difference between them. The largest difference in $\Delta u'v'$ 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 similar to the example below:

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

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

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

Overall uncertainty

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

See 9.1.8

5.7 Color grayscale linearity

Background

A well-tuned color grayscale is the basis for good color rendering of any imaging device. This is measured by comparing steps in a grayscale in the test image. To enable correct color interpretation, each grayscale step should have similar color hues. To avoid confusion for the user, only the luminance should vary. The color rendering of the projected image is very dependent on the screen used.

Applicability

All front screen projectors with fixed resolution.

References

5, 14, 15, 18, 20, 21, 24, 25 and 31.

5.7.1 Mandate

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

Table color grayscale linearity 1.

	Maximum $\Delta u'v'$ difference							
Grayscale	255	225	195	165	135	105	75	45
255	0							
225	0,015	0						
195	0,015	0,015	0					
165	0,020	0,020	0,020	0				
135	0,025	0,025	0,020	0,020	0			
105	0,025	0,025	0,025	0,025	0,020	0		
75	0,035	0,035	0,035	0,035	0,035	0,025	0	
45	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0

Submit the following together with the application to TCO Development:

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

5.7.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- Use a full-screen test pattern with the following RGB settings: R=G=B=255, 225, 195, 165, 135, 105, 75 and 45.

Equipment

- Spectro-radiometer capable of presenting CIE u' and v' chromaticity coordinates with at least 3 decimals.
- Color neutral reflectance standard.

Test method

Place the color neutral reflectance standard at measurement location 5 (see figure luminous flux 1). Measure the spectral properties at the centre of the color neutral reflectance standard for the RGB settings stated above with a spectroradiometer.

Test evaluation

The evaluation procedure is exemplified below

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

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

- Fill in the chromaticity values of u' and v' for each measured grayscale step into the corresponding cells of the spreadsheet.
- The table color grayscale linearity 1 contains colored cells indicating difference requirements. The principle is that the darker the grayscale the more difficult it is to see a color difference.
- Examples on how to use the table: By using the column 255 (grayscale 255) and go down to line 165 (grayscale 165) you find that the maximum allowed color difference $\Delta u'v'$ is 0.020 (orange cell). For the grayscales 225 and 75 the maximum allowed difference is 0.035 (green cell).

Overall uncertainty

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

See 9.1.8

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

5.8 Luminous flux

Background

Poor light flux can affect readability and color discrimination of the presented image content, which may cause misinterpretations and eye strain.

The light flux must be suitable for the viewing conditions. In dim lighting conditions, a too high light flux can be disturbing for human eyes that have adapted to the dim lighting, while a high light flux may be necessary for an adequate image quality in very bright viewing conditions where the projected light must compete with the degrading ambient light.

Definition

A_{max} is the maximum projected image size that is verified readable according to the criteria in TCO Certified, hereinafter referred to as "TCO Certified Image Size". A_{max} is measured in m^2 .

$$A_{max} \leq \frac{\Phi_{white/measured}}{L_{white} \times \pi + E_{amb}}$$

This is the largest "TCO Certified Image Size" that the certificate owner can report. However, it may be necessary to report a smaller "TCO Certified Image Size" in order to pass other criteria that depend on the "TCO Certified Image Size", such as black level.

- $\Phi_{white/measured}$ is the measured light flux from the projector in lumens falling on a white screen. (In the calculations the screen is considered to have a Lambertian surface with gain=1).
- L_{white} is the minimum required imaging luminance in cd/m^2 of white to achieve the "TCO Certified Image Size".
- E_{amb} is the ambient illuminance in lux falling on the white screen.

Both L_{white} and E_{amb} illuminate the screen image, but L_{white} contributes to the image because it comes from the projector, while E_{amb} has no positive imaging effects and degrades the image from the projector. The E_{amb} and the L_{white} for the two viewing conditions used in this document are shown in the table below.

The following light values have been chosen to represent adequate standard viewing conditions for home video and office environment.

Lighting condition	Office projectors	Video projectors
Minimum luminance of white screen in a dark room	$L_{white/office} = 170 \text{ cd/m}^2$	$L_{white/video} = 85 \text{ cd/m}^2$
Ambient illuminance falling on the screen	$E_{amb/office} = 100 \text{ lux}$	$E_{amb/video} = 20 \text{ lux}$

Applicability

All front screen projectors with fixed resolution.

References

3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14.

5.8.1 Mandate

The diagonal length in inches for the “TCO Certified Image Size” for the native aspect ratio of the projector must be reported.

Submit the following together with the application 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.
-

5.8.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be done.
- For determination of the light flux, the default test image is a full-screen with color “bright white” (RGB setting of 255, 255, 255).

Equipment

Illuminance meter.

Test method for the light flux

- The illuminance is measured at location 1 to 9 according to the following figure.
- However, for wide format image (16:10 or 16:9) the measurement positions should be evenly distributed according to the same principle as the picture below.
- The optical axis of the illuminance meter must be perpendicular to the surface of the test image and parallel to the optical axis of the projector.
- The chosen test-area of the projected image A_{test} in m² is measured in dark room conditions.

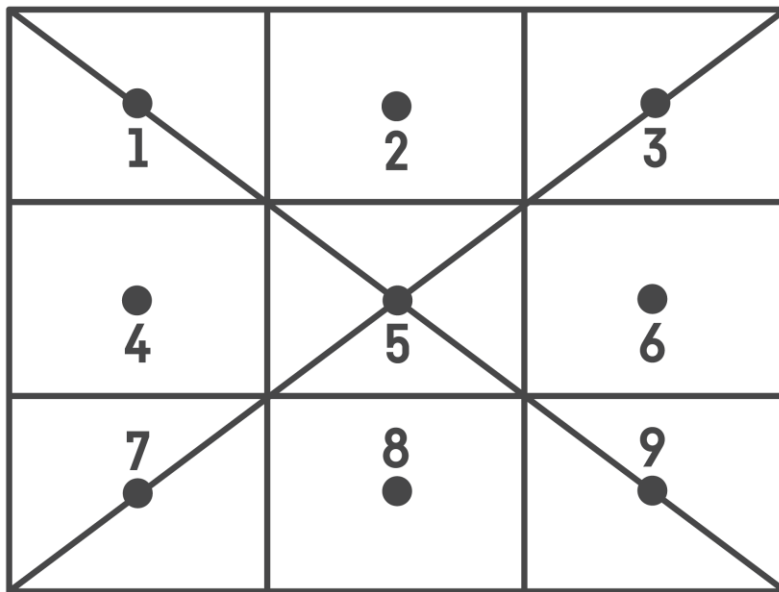
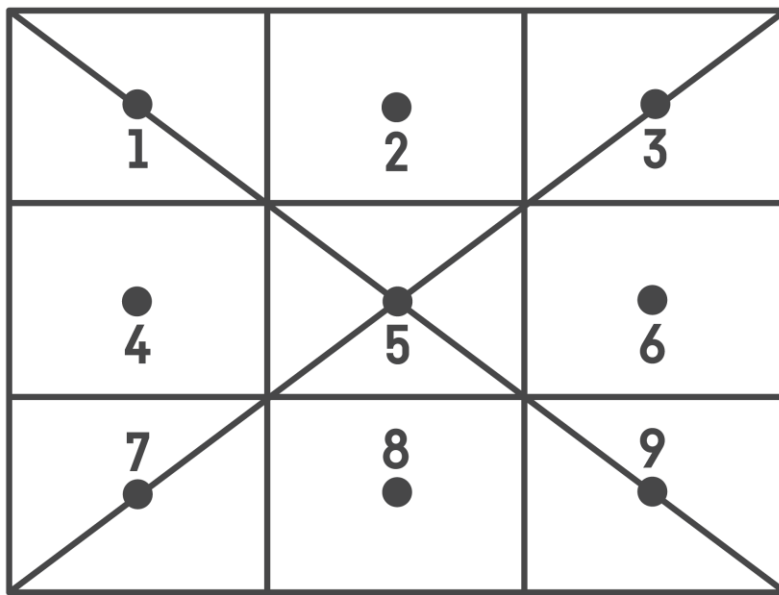


Figure luminous flux 1.

Measurement locations

Table luminous flux 2.

Measuring point	Horizontally from left	Vertically from top
Point 1	1/6	1/6
Point 2	3/6	1/6
Point 3	5/6	1/6

Point 4	1/6	3/6
Point 5	3/6	3/6
Point 6	5/6	3/6
Point 7	1/6	5/6
Point 8	3/6	5/6
Point 9	5/6	5/6

Test evaluation for the light flux

The measured light flux is determined by the following equation:

$$\begin{aligned}\Phi_{white/measured} &= \frac{A_{test}}{9} \times E_{white/measured} \\ &= \frac{A_{test} \times \sum_{n=1}^9 E_{white/measured_n}}{9}\end{aligned}$$

Where:

A_{test} is the chosen test-area of the projected white screen in m² in a dark room.

$E_{white/measured}$ is the illuminance of white (255, 255, 255) in lux at location n = 1 to 9.

$\Phi_{white/measured}$ is the luminous flux in lumen (according to IEC 61947-1).

Test evaluation for the TCO Certified Image Size

Office projectors

For office projectors (projectors intended to be used in illuminated rooms) the reported TCO Certified Image Size in m² must be calculated according to the following formula:

$$\begin{aligned}A_{max/office} &= \frac{\Phi_{white/measured}}{L_{white/office} \times \pi + E_{amb/office}} \\ &= \frac{\Phi_{white/measured}}{170 \times \pi + 100}\end{aligned}$$

Where:

$A_{max/office}$ = TCO Certified Image Size for office projectors in m².

$L_{white/office}$ = Minimum luminance of white screen in a dark room in cd/m² for office projectors according to reference 4.

$E_{amb/office}$ = ambient illuminance falling on the projection screen for office projectors according to reference 4.

Video projectors

For video projectors intended to be used in dark or sparsely illuminated rooms, the reported TCO Certified Image Size in m² must be calculated according to the following formula:

$$\begin{aligned} A_{max/video} &= \frac{\Phi_{white/measured}}{L_{white/video} \times \pi + E_{amb/video}} \\ &= \frac{\Phi_{white/measured}}{85 \times \pi + 20} \end{aligned}$$

Where:

$A_{max/video}$ = TCO Certified Image Size for video projectors in m².

$L_{white/video}$ = Minimum luminance of white screen in a dark room in cd/m² for video projectors according to reference 4.

$E_{amb/video}$ = ambient illuminance falling on the projection screen for video projectors according to reference 4.

To be included in the test report

- The highest possible light output and the light output needed to achieve the TCO Certified Image Size in lumen.
- The throw ratio and picture format.

Overall uncertainty

≤ ± 10 % in illuminance measurements.

See 9.1.8

5.9 Light flux uniformity

Background

Image quality, e.g. the identification of individual letters, could be badly affected by non-uniform image illuminance. Poor image illuminance uniformity can locally affect the contrast and consequently the readability of information displayed by the projector. The areas of deviating image illuminance can have different sizes and cause a variation of edge sharpness.

Definition

Light flux uniformity is the capability of the projector to maintain the same illuminance level within the whole projected screen area. It is given as a ratio according to:

$$\frac{E_{max}}{E_{min}}$$

- E_{max} is the maximum illuminance of measuring location 1 to 9
- E_{min} is the minimum illuminance of measuring location 1 to 9

Applicability

All front screen projectors with fixed resolution.

References

3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14.

5.9.1 Mandate

$$\frac{E_{max}}{E_{min}} \leq 1.45$$

For ultra-short throw projectors (throw ratio ≤ 0.38) an extra + 0.85 is allowed.

For short throw projectors (throw ratio $0.38 < x \leq 0.75$) an extra + 0.30 is allowed.

For wide format (16:9 or 16:10) an extra + 0.10 is allowed.

Submit the following together with the application 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.



5.9.2 Clarification

Preparations for testing

- All necessary preparations described in 9.1 and 9.2 must be made.
- The default test image is a full-screen with color "bright white" (RGB setting of 255, 255, 255). The size of the test image must be the "TCO Certified Image Size".

However, if the test facility is not large enough to project the "TCO Certified Image Size" it is allowed to do testing on an image size larger or equal to 50% of the "TCO Certified Image Size".

Equipment:

Illuminance meter.

Test method:

- The illuminance is measured at location 1 to 9 according to figure luminous flux 1.
- It is not recommended to perform this parameter together with the *Color uniformity* measurement, since the reflectance standard used in *Color uniformity* is likely not calibrated for the angles involved and consequently will give false luminance results for the light flux uniformity.

Test evaluation

Evaluate the equation as given in the mandate.

Overall uncertainty

$\leq \pm 10 \%$ in illuminance measurements.

See 9.1.8

5.10 Black level and contrast ratio

Background

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

Definition

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

Office projectors must be able to give a contrast ratio of 5:1 in normal “conference room” ambient illuminance (100 lux). To achieve this, the luminous flux of black must not be higher than $\Phi_{black/max/office}$

$$\Phi_{black/max/office} \leq \frac{\Phi_{white/measured} - 400 \times A_{max/office}}{5}$$

Video projectors must be able to give a contrast ratio of 10:1 in normal “video room” ambient illuminance (20 lux). To achieve this, the luminous flux of black must not be higher than $\Phi_{black/max/video}$

$$\Phi_{black/max/video} \leq \frac{\Phi_{white/measured} - 180 \times A_{max/video}}{10}$$

$\Phi_{white/measured}$ and A_{max} can be collected from *luminous flux*.

Applicability

Projectors.

References

3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 30.

5.10.1 Mandate

Office projectors must be able to give a contrast ratio of 5:1 for the TCO Certified Image Size in normal “conference room” ambient illuminance (100 lux).

Video projectors must be able to give a contrast ratio of 10:1 for the TCO Certified Image Size in normal “video room” ambient illuminance (20 lux).

Submit the following together with the application to TCO Development:

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

5.10.2 Clarification

Preparation of the projector for testing

- All necessary preparations described in 9.1 and 9.2 must be made.
- The default test image is a full-screen with color “black” (RGB setting of 0, 0, 0).
- The projector must be adjusted to the default CCT.

Equipment

Illuminance meter.

Test method

Measure the black illuminance $E_{black/measured}$ at location 1 to 9 according to figure *luminous flux 1* using the test pattern according to “preparation of the projector for testing” to see that the result is lower or equal to the required calculated level $\Phi_{black/max/office}$ for office projectors or $\Phi_{black/max/video}$ for video projectors.

Test evaluation

Measurements of black illuminance

Calculate the average light flux $\Phi_{black/measured}$ from the measured illuminance $E_{black/measured}$ according to the following formula:

$$\Phi_{black/measured} = \frac{A_{test} \times \sum_{n=1}^9 E_{black/measured_n}}{9}$$

- $\Phi_{black/measured}$ is the calculated average light flux of the nine points measured.
- $E_{black/measured}$ is the measured average illuminance of the nine points measured.
- A_{test} is the chosen test-area of the projected image in m² measured in dark room conditions.

Calculation of requirements level

For office projectors:

$\Phi_{black/max/office}$ is the requirements level of the maximum light flux for office projectors. This is the requirement level which the measured illuminance $\Phi_{black/measured}$ must be compared against.

$$\Phi_{black/max/office} \leq \frac{\Phi_{white/measured} - 400 \times A_{max/office}}{5}$$

- $\Phi_{white/measured}$ is the measured light flux of the tested white projected image in dark room conditions (see *luminous flux*).
- $A_{max/office}$ is the TCO Certified Image Size (see *luminous flux*).

For video projectors:

$\Phi_{black/max/video}$ is the requirements level of the maximum light flux for video projectors. This is the requirement level which the measured illuminance $\Phi_{black/measured}$ must be compared against.

$$\Phi_{black/max/video} \leq \frac{\Phi_{white/measured} - 180 \times A_{max/video}}{10}$$

- $\Phi_{white/measured}$ is the measured light flux of the tested white projected image in dark room conditions (see *luminous flux*).
- $A_{max/video}$ is the TCO Certified Image Size (see *luminous flux*).

A quick reference table showing the relation between measured ANSI flux, A_{max} and max black level is found on tcocertified.com.

Overall uncertainty

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

See 9.1.8

6 Product lifetime extension

IT products and the circular economy

The concept of a circular economy is one that moves away from the linear “take, make and dispose” approach to products, to an economy that is more regenerative, and decouples economic activity from the consumption of finite resources. For products, a move to a more circular approach means designing out waste from the product ecosystem, and keeping products and materials in their intended use longer.

Today, too many IT products are discarded prematurely because of components or performance aspects that could have been upgraded or repaired. There is also a growing market for second hand use of IT products, which also allows computers and other electronics to stay in use longer.

The best way to begin taking a more circular approach to the production and consumption of IT products, is extending their usable life. Product reuse is also more resource efficient than remanufacturing and recycling. For the IT industry, this means designing products that are durable, built to last, upgradeable and repairable, making them more attractive for reuse or secondary markets.

TCO Certified – extending product life, upgradability, durability

We believe that a more circular approach to IT products is critical in the drive toward an environmentally and socially responsible life cycle. Therefore, in TCO Certified, generation 9, we have included criteria that enable and promote product lifetime extension.

6.1 Product warranty

Background

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

Definitions

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

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

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

Applicability

All product categories.

6.1.1 Mandate

The brand owner must:

- Provide a product warranty for at least one year,

AND

- Provide information about the minimum product warranty period for the product

covering all markets where the product is sold.

Submit the following to an approved verifier:

- A completed and signed brand owner product form (chapter 11.4).

Submit the following together with the application to TCO Development:

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

6.1.2 Clarification

Clarification of sustainability performance indicator(s)

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

Warranty period (Class A-G)

The minimum number of years the whole product is covered by warranty

- **Class A** - Product warranty for at least 7 years, covering all markets where the product is sold
- **Class B** - Product warranty for at least 6 years, covering all markets where the product is sold
- **Class C** - Product warranty for at least 5 years, covering all markets where the product is sold
- **Class D** - Product warranty for at least 4 years, covering all markets where the product is sold
- **Class E** - Product warranty for at least 3 years, covering all markets where the product is sold
- **Class F** - Product warranty for at least 2 years, covering all markets where the product is sold
- **Class G** - Product warranty for at least 1 years, covering all markets where the product is sold

Verification: Documentation proving the product warranty period, covering all markets where the product is sold. If product components have different warranty periods, the worst case scenario (least number of years) must be reported.

The following SPI(s) is not required for compliance with TCO Certified. If no information is provided the product will receive the lowest classification by default.

Extended warranty availability (Class A-G)

The maximum number of years the product warranty can be extended to covering the whole product.

- **Class A** - Extended warranty for the product is available for 7 years or more on all markets where the product is sold

- **Class B** - Extended warranty for the product is available for at least 6 years on all markets where the product is sold
- **Class C** - Extended warranty for the product is available for at least 5 years on all markets where the product is sold
- **Class D** - Extended warranty for the product is available for at least 4 years on all markets where the product is sold
- **Class E** - Extended warranty for the product is available for at least 3 years on all markets where the product is sold
- **Class F** - Extended warranty for the product is available for at least 2 years on all markets where the product is sold
- **Class G** - No information provided

Verification: Documentation proving the maximum availability of an extended warranty for the product for all markets where the product is sold. If product components have different warranty periods, the worst case scenario (least number of years) must be reported.

Public repair policy (A-C)

- **Class A**
 - Product repair is favored before product replacement.
 - A repair policy is publicly available.
- **Class B**
 - No policy on product repair vs. replacement
- **Class C**
 - No information provided

Verification: A link to a Public policy proving the type of repair policy.

6.2 Replaceable components

Background

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

Definitions

CPU: Central processing unit.

GPU: Graphics processing unit.

RAM: Random access memory.

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

Display assembly: Main display panel.

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

System board: Also referred to as the motherboard.

Keyboard: Built-in keyboard.

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

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

Applicability

All product categories.

References

6.1, 6.2.

6.2.1 Mandate

1. The brand owner must provide a service manual describing how to replace at least all critical replaceable components. The service manual must be available for anyone to read, free of charge in case the critical replaceable components are available for anyone to purchase or to the service network.
2. The brand owner must guarantee that, during the validity of the certificate, all critical replaceable components for the product type; that are listed in the clarifications of this criterion;
 - are available for anyone to purchase
or
 - may be replaced by a service network for repair and maintenance of the certified product on all markets where it is sold.

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

6.2.2 Clarification

Replaceable parts management

- The brand owner must provide a service manual including step-by-step instructions and component descriptions for the disassembly and assembly.
 - External PSU, charger, and AC Adapters are exempted from the disassembly instructions.
 - If instructions on how to replace all critical replaceable components (listed below) are included in the user manual, no additional service manual is needed to comply with the mandate 6.2.1.
- A critical, replaceable component must be possible to replace with an equivalent component. However, the replacement component does not have to be identical to the original component.

- Instructions on how to replace the critical components must be available online during the validity of the certificate.
- Step-by-step instructions on how to replace soldered components does not need to be listed in the service manual (mandate 6.2.1)
- For data center products (Servers, Storage products, Network equipment), if one or more critical replaceable component(s) are part of a controller canister or system board, the controller canister or system board must be treated as the critical component.
- Headband cushions which are molded do not need to be replaceable. Headband cushions designed to be snapped/mounted (for eg, with adhesive) shall be replaceable.

Critical replaceable components:

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

Displays Connectivity cables Power cables External PSU <i>For SPI evaluation only:</i> System board/motherboard Display panel assembly	Tablets Battery Display Panel/display assembly External/internal PSU
All-in-one PCs CPU External/internal PSU Storage (SSD, HDD, ODD) System memory (RAM) System board/motherboard	Smartphones Battery Display Panel/display assembly Charger
Notebooks Battery Display Panel/display assembly Storage (SSD, HDD) System memory (RAM)	Headsets Battery External/internal PSU Earloop Neckband

External/internal PSU Keyboard System board/motherboard	Ear tips Ear cushions Microphone shield Headband
Desktops CPU GPU (PCIe) External/internal PSU Storage (SSD, HDD, ODD) System memory (RAM) System board/motherboard	Projectors The light source (except lasers) Filters External PSU

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

Component table

Clarification of sustainability performance indicator (SPI)(s)

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

Replaceability and repairability of the product

For each critical component in the component table above, the following evaluation must be completed to calculate the repairability and reusability of the product. The evaluation is based on the standard EN 45554:2020 - General methods for the assessment of the ability to repair, reuse and upgrade energy-related products.

1. Fasteners and connectors (Class A-D)
2. Necessary tools for repair/upgrade, (Class A-D)
3. Availability of spare parts
 - a. Availability by target group (Class A-E)
 - b. Duration of availability (Class A-D)
4. Types and availability of information - Availability of comprehensiveness (Class A-C)

1. Fasteners and connectors (Class A-D)

The reusability of fasteners and connectors is interlinked with the repairability and reusability of products and components. Knowledge of type of fasteners can assist with the assessment of tools and skills necessary for repair reuse or upgrade.

Evaluation procedure

The assessment of the fasteners and connectors must be done from the start until the component is removed. This means that if any other part needs to be removed before it is possible to remove the critical component, then those steps must also be taken into consideration for the final score.

- **Class A: Reusable**
 - An original fastening system that can be completely reused, or any elements of the fastening system that cannot be reused are supplied with the new part for the repair, reuse or upgrade process.
- **Class B: Removable**
 - An original fastening system that is not reusable, but can be removed without causing damage or leaving residue which hinders reassembly (in case of repair or upgrade) or reuse of the removed part (in case of reuse) for the repair, reuse or upgrade process.

- **Class C: Neither removable nor reusable**
 - An original fastening system that is not removable and not reusable, as defined above, for the repair, reuse or upgrade process.
- **Class D: No evaluation performed**

Example for a battery in a notebook:

Example 1

Step 1 - Remove eight screws to open the chassis - Class A

Step 2 - Remove four screws and loosen the connector to the motherboard - Class A

Step 3 - The battery can now be removed without using tools - Class A

Total score for battery component: Class A

Example 2

Step 1 - Remove eight screws to open the chassis - Class A

Step 2 - Remove four screws and loosen the connector to the motherboard - Class A

Step 3 - The battery is glued with non-reusable adhesive - Class B

Total score for battery component: Class B

If a component is soldered to another component, it automatically receives Class C.

2. Necessary tools for repair/upgrade (Class A-E)

The availability of tools necessary for repair, service or upgrade, are interlinked with the product lifetime. Without easy access to tools needed for repair, upgrade or service the likelihood of these decrease. Therefore, it is important to make use of tools that are readily available instead of using proprietary tools.

- **Class A: Basic tools, no tools, provided tools**

- Replacing critical components can be carried out without the use of any tools, or with a tool or set of tools that is supplied with the product or spare part, or with basic tools as listed in Table A.
- All tools required must be listed in the service manual.

Tool type	Reference
Screwdriver for slotted heads, cross recess or for hexalobular recess heads	ISO, 2380, ISO, 8764, ISO 10664
Hexagon socket key	ISO 2936
Combination Wrench	ISO 7738
Combination pliers	ISO 5746
Half round nose pliers	ISO 5745

Diagonal cutters	ISO 5749
Multigrip pliers (multiple slip joint pliers)	ISO 8976
Locking pliers	
Combination pliers for wire stripping and terminal crimping	
Prying lever	
Tweezers	
Hammer, steel head	ISO 15601
Utility knife cutter with snap off blades	
Multimeter	
Voltage tester	
Soldering iron	
Magnifying glass	

Table A - Basic tools

- **Class B: Other commercially available tools.**

- Replacing critical components can be carried out with non-proprietary tools that are not Class A.
- All tools required must be listed in the service manual.

Verification: The brand owner must include a link to a shop where the tools can be bought in the service manual.

- **Class C: Can be carried out with proprietary tools.**

- The tools required to replace critical components can be carried out with use of proprietary tools. These are tools that are not available for purchase by the general public or for which any applicable patents are not available to license under fair, reasonable, and non-discriminatory terms.

Verification: The brand owner must state in the service manual that the tools needed are proprietary.

- **Class D: Not enough information, or not feasible with any existing tools.**
 - The tools listed in the service manual are not Class A, and no extra information is made available on where usable tools can be purchased, or if they are proprietary.

or

- The tools required to replace the critical components are not listed in the service manual.
- **Class E: No evaluation performed**

3. Availability of spare parts

The availability of spare parts is a prerequisite for a successful repair. Spare parts availability refers to both the availability to various target groups and the availability over a specific period of time. These two perspectives are assessed in sequence.

3.a. Availability by target group (Class A-E)

- **Class A: Publicly available**
- **Class B: Available to independent repair service providers**
- **Class C: Available to manufacturer-authorized repair service providers**
- **Class D: Available to the manufacturer only**
- **Class E: No spare parts available or no information on availability**

Verification: The brand owner must pledge the availability of spare parts in the service manual.

3.b. Duration of availability (Class A-D)

- **Class A: Long-term availability (6 or more years)**
- **Class B: Mid-term availability (4 or more years)**
- **Class C: Short-term availability (2 or more years)**
- **Class D: No information on duration of availability**

Verification: The brand owner must pledge the minimum duration of availability for spare parts in the service manual.

4. Comprehensiveness of available information (Class A-C)

The comprehensiveness of service information facilitates the possibility for repairs, maintenance and upgrades, which enables the extension of product lifetime.

- **Class A: Comprehensive information available**

A repair, reuse or upgrade process, for which the following information is available for anyone to read, free of charge:

- Step-by-step disassembly instructions with identification of tools needed.
- Information on where to attain all tools needed for repair/upgrade.
- An overview of repair or upgrade services offered by the manufacturer.
- Troubleshooting charts.

- Circuit board schematics.(only main board)
- Functional specification of parts (e.g. resistance value of resistors).
- Recommended torque for fasteners.
- Diagnostic and error resetting codes.

or

- Appropriate formats for reporting comprehensive information can include IEEE1874 (IEEE Standard for Documentation Schema for Repair and Assembly of Electronic Devices).

- **Class B: Basic information available**

A repair, reuse or upgrade process, for which the following information is available for anyone to read, free of charge:

- Step-by-step disassembly instructions with identification of tools needed.
- Information on where to attain all tools needed for repair/upgrade.
- An overview of repair or upgrade services offered by the manufacturer.
- Troubleshooting charts.

- **Class C: Limited information available**

A repair, reuse or upgrade process, for which the following information is available for anyone to read, free of charge:

- Step-by-step disassembly instructions with identification of tools needed.

Verification: Unless the brand owner provides documentation showing compliance with Class A or B, the product will be categorized as Class C.

7 Reduction of hazardous substances

Hazardous substances in IT products: A human health and environmental risk

Chemicals and heavy metals used in IT products present a wide variety of human health and environmental hazards. Products may release dioxins and other highly toxic substances, which can persist in the natural environment and human body. Hazardous substances include flame retardants and plasticizers contained in plastics and cables, and also process chemicals used in manufacturing

Risks include worker and environmental exposure in the manufacturing supply chain as well as during end of life handling when these harmful substances risk leaching out into soil, water and air. Also, from a circularity perspective, contaminated materials cannot responsibly be reused in future products, and therefore risk being incinerated or discarded directly into the waste stream.

While some hazardous substances have been phased out through legislation or voluntary initiatives, too little is known about what's being used to replace them. Only a small percentage of chemicals in use today have been evaluated for their environmental and human health risk. Better knowledge and transparency around these chemicals is needed, along with pathways for making safer substitutions.

Our approach

Criteria in TCO Certified restrict the use of hazardous substances and drive a shift towards greater transparency and use of safer alternatives. Criteria go beyond RoHS and cover heavy metals, halogens, non-halogenated flame retardants and plasticizers.

Criteria in chapter 7 focus on:

- Reducing or eliminating the use of hazardous substances in IT products and their packaging, beyond RoHS.
- Identifying a pathway to safer alternatives to hazardous flame retardants, plasticizers and process chemicals by requiring that these substances are independently assessed and benchmarked. The approved safer alternatives are presented on the TCO Certified Accepted Substance List.

7.1 Heavy metals

Background

Electronic devices contain hazardous substances like heavy metals and brominated flame retardants. The effects of cadmium, mercury, lead and hexavalent chromium are well documented as substances hazardous both to human health and the environment. They may cause problems, both in the manufacturing phase where workers or the environment can be exposed, and at the material recovery, where uncontrolled recycling can cause the release of toxins such as dioxins and furans.

This criterion is harmonized with EU RoHS Directive (2011/65/EU), except that in TCO Certified, mercury is not allowed in lamps. As TCO Certified is a global certification, this also affects products sold outside the EU.

Applicability

Displays, notebooks, tablets, smartphones, desktops, all-in-one PC's, headsets, servers, network equipment, data storage products.

References

7.1, 7.2.

7.1.1 Mandate

The product must not contain cadmium, mercury, lead and hexavalent chromium

Exemptions are according to EU Directive 2011/65/EU (RoHS) and the documents supporting the directive except that mercury in lamps is not permitted.

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

The limit value for batteries is 0.0005 % for mercury, 0.002 % for cadmium and 0.004 % lead per listed part, according to EU Directive 2006/66/EC.

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

7.2 Halogens

Background

Halogenated substances are often persistent and can bio-accumulate in living organisms. They are problematic from both a human health and environmental perspective throughout the product life cycle and should be phased out. Workers may be exposed during manufacturing. Substances risk leaking out into the natural environment at end of life. PVC is by far the most common halogen-containing plastic.

Definitions

Electronic component is considered an individual part or combination of parts that, when together, perform a design function(s).

Product housing is considered the external enclosure or casing that protects the internal parts of a product. This includes a product stand and external power supplies.

Printed circuit board (PCB) or printed wiring board (PWB) laminate is a printed board that provides point-to-point connections.

Power board or power PCB regulates the power leading to the device, converting alternating current to direct current

Polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) are restricted in the EU RoHS Directive (2011/65/EU) due to the hazardous properties of these substances. Hexabromocyclododecane (HBCDD) has been identified as a substance of very high concern in accordance with EU REACH criteria due to PBT (persistent, bio accumulative, toxic) properties.

Applicability

All product categories.

References

7.2, 7.3.

7.2.1 Mandate

1. Product housing above 0.5 grams and the power PCB laminate of the internal/external power supply unit must not contain intentionally added (additive or reactive) flame retardants or plasticizers with halogenated substances. Exempted are all other parts, such as electronic components, other PCB

laminates and all kinds of cable insulation.

2. The product must not contain PBB, PBDE and HBCDD.

No parts of the product are exempted.

3. The largest PCB by area in the power supply unit (internal/external) must be tested for bromine and chlorine, (see clarification below).

Maximum concentration values tolerated for a restricted substance (including decaBDE) is 0.1% by weight of the material in homogeneous materials.

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

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

7.2.2 Clarification

Point 1 of the mandate applies to plastic product housing parts above 0.5 grams. This includes the product stand and the plastic housing of the external power supply. The internal or external power supply socket or inlet is not included in the definition of product housing.. The power board laminate of the internal or external power supply is the only PCB that is mandated due to the high risk for their being added flame retardants to this part. All other PCBs inside the product are exempted.

Point 2 of the mandate applies to the whole of the product, including components, parts and raw materials in all assemblies and sub-assemblies, such as batteries, paint, surface treatment, plastics, electronic components and printed wiring boards.

Point 3 of the mandate applies to the testing for bromine and chlorine where the following is required:

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

- If indications of bromine or chlorine >0.1% are discovered, the applicant must proceed with additional testing in order to prove compliance with this criterion.
- If the concentration of detected substance is <0.1%, then no additional testing is needed.

7.3 Non-halogenated substances

Background

Hazardous non-halogenated substances are problematic in the manufacturing and material recovery phases where workers and the environment can be exposed, leading to both human health and environmental risks. The purpose of this criterion is 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 hazard assessment and decision logic framework GreenScreen® for Safer Chemicals, developed by the non-profit organization Clean Production Action (CPA). GreenScreen criteria are in line with international standards and regulations that assess the human health and environmental risks of chemicals. These include the Regulation on the classification, labelling and packaging of substances and mixtures (CLP), 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

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

TCO Certified Accepted Substance List: Public list of independently assessed safer available alternatives considering toxicity and functionality. Go to tcocertified.com.

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

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 is considered the external enclosure or casing that protects the internal parts of the product. This includes the product stand.

Applicability

All product categories.

References

7.4, 7.5, 7.6.

7.3.1 Mandate

- Product housing ~~and printed circuit boards~~ above 0.5 grams and the power PCB laminate of the internal/external power supply unit must only contain intentionally added (additive or reactive) non-halogenated flame retardants that have been assigned a GreenScreen benchmark score of 2, 3 or 4 by a licensed GreenScreen Profiler and appear on the public TCO Certified Accepted Substance List. (A benchmark U may only be accepted when the “worst case scenario” for data gaps is considered to be a benchmark 2 or above.)
- All substances of a mixture must be accounted for. Non-accepted substances must not exceed concentration levels of 0.1% by weight of the flame retardant.
- Exempted are all other parts, such as electronic components and all kinds of cable insulation.

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

7.3.2 Clarification

The mandate applies to ~~the plastic~~ product housing ~~and printed circuit boards (PCBs)~~ parts above ~~the weight of~~ 0.5 grams. This includes the product stand and the plastic housing of ~~internal and the~~ external power ~~supplies and supply. The internal or external power supply socket or inlet is not included in the definition of product housing..~~

The power board laminate of the internal or external power supply is the only PCB that is mandated due to the high risk for their PCBs. PCBs that being added flame retardants to this part. All other PCBs inside the product are exempted ~~are those enclosed inside electronic components such as a HDD, SSD and ODD..~~

TCO Certified Accepted Substance List

Non-halogenated flame retardants can be used in certified products once they receive an accepted benchmark and appear on the public TCO Certified Accepted Substance List. The

list is dynamic, which allows new substances that have undergone a valid assessment to be added. Accepted substances may be reassessed in light of new scientific findings. If an accepted substance is reassessed and given a benchmark score lower than 2, TCO Development reserves the right to remove the substance from TCO Certified Accepted Substance List. Before a substance is removed from the list a sunset date (at least one year) is set and shown on the list. This is to give chemical and product manufacturers time to submit additional information to improve the benchmark score or to transfer to an alternative on the list. Product models that use a removed chemical but were certified before the sunset date are permitted to keep their TCO Certified certificate. Models certified after the sunset date may only contain flame retardants or plasticisers that are listed on TCO Certified Accepted Substance List.

Any spot checks by TCO Development will require manufacturers to disclose substance details being used in randomly chosen products. To verify that the obligations according to this mandate are fulfilled CASNR disclosure and laboratory assessments of selected plastic parts will be conducted to assess the completeness, quality and validity of a benchmark score.

TCO Development and Clean Production Action (CPA) must have access to a copy of the GreenScreen assessment report before the substance can be added to TCO Certified Accepted Substance List, available at tcocertified.com.

Conformity procedure

- The applicant must contact relevant suppliers and ask them to confirm that the flame retardants and plasticizers they use only include substances listed on TCO Certified Accepted Substance List.
- If all flame retardants and plasticizers only include substances on TCO Certified Accepted Substance List, complete the product form 11.3 and submit it to an approved verifier. When the verifier considers all documentation to be compliant, they will issue an environmental verification to the applicant.
- If any flame retardant or plasticizer is used that contains a substance that is above the threshold level but doesn't appear on TCO Certified Accepted Substance List, then it must be added before approval can be given by a verifier. An extended time period to comply can be applied for here (see "Applying for an extended period..." below).

Adding a substance to the TCO Certified Accepted Substance List:

1. Contact TCO Development directly to see if we have any additional information on the substance. Reasons for the substance's absence can be that the substance has received benchmark 1, that no assessment has been conducted or that it has a benchmark score U (unspecified), due to a high number of data gaps.
2. If TCO Development requires the substance to be benchmarked, we recommend that you contact your suppliers and inform them that the substance will need an assessment by a licensed GreenScreen Profiler. The list of licensed profilers can be found on the Clean Production Action website at [greenscreenchemicals.org](https://www.greenscreenchemicals.org).
3. A draft report per substance (not per product) is assembled by the licensed profiler from the available information (literature search, structural similarity comparison, expert judgment).
4. It is the licensed profiler that sets the benchmark score per relevant substance, which is valid for at least five years.
5. Benchmark reports must be submitted to TCO Development for final approval before a substance is added to TCO Certified Accepted Substance List. A copy must also be made available to CPA.
6. When the final approval is complete, TCO Development will add the substance to the TCO Certified Accepted Substance List, showing the substance's name, CASRN, type, benchmark score, date of the assessment and profiler.
7. Once a substance is added to the list and the environmental verifier identifies them, then they will issue the environmental verification to the applicant (see above point 1: "If all flame retardants and plasticizers only include substances on TCO Certified Accepted Substance List the procedure is as follows").

Applying for an extended period of time to add a substance to TCO Certified Accepted Substance List

Applicants signing the mandate have the option to seek an extended period of time in order to complete assessments or substitute substances with unknown hazard levels. Upon request for an extension, the applicant is required to complete a risk assessment questionnaire and submit it to TCO Development. The risk assessment requires the applicant to clarify why an extension is necessary, provide information on the chemical and its substitute in question, and include a timeline for the assessment and/or substitution to be completed. If an extension application is not granted, the applicant is required to ensure that all used flame retardants or plasticizers only include substances that are on TCO Certified Accepted Substance List before an environmental verification can be issued for the product

model by an environmental verifier. If the agreed extension due date is exceeded without conformity, then the environmental verifier must contact TCO Development and a course of action will be decided after discussing the issue with the applicant.

7.4 Plasticizers

Background

Plasticizers are increasingly associated with negative environmental and human health impacts. RoHs is a restricted substances list that, beginning in 2019, restricts the use of four phthalates. TCO Development is committed to take a much broader approach by identifying and restricting not only these four, but all substances of high concern used in IT products. Our criteria are therefore designed to make sure that replacement substances are independently assessed as safer alternatives, and that transparency increases. The full list of safer alternatives is available on tcocertified.com.

This mandate uses the hazard assessment and decision logic framework called GreenScreen® for Safer Chemicals, developed by the non-profit organization Clean Production Action (CPA).

GreenScreen criteria are in line with international standards and regulations that assess chemicals on their human health and environmental hazards. These include the Regulation on the classification, labelling and packaging of substances and mixtures (CLP), Globally Harmonized System of Classification and Labelling of Chemicals (GHS), OECD testing protocols, European REACH Regulation that includes RoHs, POPs, SVHCs and the U.S. EPA's Design for Environment (DfE) Alternatives Assessment .

Definitions

Plasticizer: An additive to a polymer (plastic), to increase its flexibility, transparency, durability, or longevity.

Phthalates: The most common type of plasticizer in PVC cables.

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

TCO Certified Accepted Substance List: Public list of independently assessed safer available alternatives considering toxicity and functionality. Available at tcocertified.com.

Clean Production Action (CPA). Developers of GreenScreen® for Safer Chemicals, Product housing is considered the external enclosure or casing that protects the internal parts of the product. This includes the product stand.

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.

Applicability

All product categories.

References

7.4, 7.5, 7.6.

7.4.1 Mandate

- Plasticizers used in product housing and cable and wire insulations must have been assigned a GreenScreen benchmark score of 2, 3 or 4 by a licensed GreenScreen profiler and appear on the public TCO Certified Accepted Substance List. A benchmark U is only accepted when the “worst case scenario” for data gaps is considered to be a benchmark 2 or above.
Exempted are connectors and wires inside electronic components.
- The product must not contain Bis (2-ethylhexyl) phthalate (DEHP), Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP), and Diisobutyl phthalate (DIBP). No parts of the product are exempted.
- All substances of a plasticizer mixture must be accounted for. Non-accepted ingredients must not exceed concentration levels of 0.1% by weight of the plasticizer.

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

7.4.2 Clarification

The mandate applies to the product housing, cable and wire insulations with no weight threshold. This includes internal and external power supply plastic housing and their cables and wires. Wires that are exempted are those enclosed inside electronic components such as a HDD, SSD and ODD.

TCO Development and Clean Production Action (CPA) must have access to a copy of the GreenScreen assessment report before the substance can be added to TCO Certified Accepted Substance List. Once this is done, the substance will be added to the list, available at tcocertified.com.

For more clarifications on TCO Certified Accepted Substance List, conformity procedure, rules for adding a substance and applying for an extended period of time for substances not

on the list, refer to clarifications under the mandate non-halogenated substances 7.3 clarifications.

7.5 Hazardous substances in product packaging

Background

The use of hazardous substances in packaging materials is problematic and should be minimized. It poses a risk to human health and the environment, not least because packaging materials have a short lifespan and generate large volumes of waste. Several hazardous substances are regulated in many countries, and the use of them should be phased out.

Applicability

All product categories.

References

7.7.

7.5.1 Mandate

The packaging material must not contain lead (Pb), cadmium (Cd), mercury (Hg) or hexavalent chromium (Cr6). Plastic packaging material must not contain organically bound halogens.

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

7.5.2 Clarification

Limit values are according to Directive 94/62/EC on packaging and packaging waste.

8 Material recovery

E-waste prevention and recovery of safer materials is essential for a sustainable life cycle

According to the United Nations University, around 50 million metric tons of e-waste is generated every year. Around 80 percent is unaccounted for, and thereby risks ending up in landfill, being incinerated or illegally exported, causing pollution, human health hazards and the loss of valuable resources such as copper, gold and rare earth metals.

The amount of e-waste can be reduced if IT products are used longer, and once usage options are exhausted, the material can be recovered at their end of life. Product and material recovery should be made easier for three main reasons: to conserve natural resources, encourage material reuse, and reduce negative environmental and social impacts.

Our approach

Taking back used products and recovering their materials supports a more sustainable, circular approach to the product life cycle. To do so, products and their packaging must be designed in a way that enables reuse, remanufacturing and recycling. To be effective, this approach also requires that products are made using safer materials that are more viable for reuse.

Criteria in chapter 8 focus on:

- Saving natural resources and limiting hazardous waste by requiring that all packaging must be recyclable, if not reusable.
- Gathering information on how reuse and recycling facilities are being used today, to prepare for future criteria on material recovery.

8.1 Product packaging

Background

Packaging is a well-known environmental problem that is regulated in many countries worldwide. Packaging material has a short lifetime and generates large volumes of waste.

Applicability

All product categories.

8.1.1 Mandate

- Non-reusable packaging components of the certified product weighing more than 25 grams must be possible to separate into single material types without the use of tools in order for the material to be recycled.
- Exempted is reusable packaging.

Submit the following to an approved verifier:

A completed and signed product form (chapter 11.3)

The following information must be submitted with the application to TCO

Development:

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

8.1.2 Clarification

A reusable package or container is designed for repeated reuse without impairment of its protective function. A take back system of the packaging must also be available for all end users in order for packaging to be defined as reusable.

8.2 E-waste management

Background

Enormous amounts of e-waste is generated every year. It is one of the world's fastest growing waste streams, and much of it is exported to developing countries, burdening local communities with this global problem. Unsafe handling of e-waste causes pollution, human health hazards and the loss of valuable, finite resources. The Basel Convention governs the export of many types of electronic waste, however, it is not properly implemented in all countries. To help reduce the e-waste problem, manufacturers need to provide mechanisms to take back their products. This is consistent with the principle of individual producer responsibility, where each manufacturer is financially responsible for managing its own branded products at end-of-use. The purpose of this criterion is to influence the expansion of better electronic waste management practices to more countries.

Applicability

All product categories.

8.2.1 Mandate

By the end of August each year, the brand owner must report the following for the previous calendar year on a global scale for each certified product. (This applies until one year after the certificate expires):

1. The number of certified products that were manufactured
2. All countries the certified products were sold in
3. The name of the take-back system or extended producer responsibility schemes (EPRs) used for each country
4. The name and address of the reuse and recycling facilities processing the collected products together with the standards met by the facilities (i.e. R2, e-Stewards, EN50625, or equivalent).

Submit the following to an approved verifier:

A completed and signed brand owner product form (chapter 11.4).

Submit the following together with the application to TCO Development:

- A copy of the verification report(s) from a verifier approved by TCO Development.
- ~~All results in the mandate above~~[The e-waste management template](#) must be [reported/uploaded](#) annually in TCO Certified Portal



8.2.2 Clarification

Instead of reporting manufacturing volumes for each certified product, reporting may be done by combining all certified products within each product category.

Reuse and recycling facilities that are used by government-approved EPRs are excluded from point 4 in the mandate.

The e-waste management template can be found at <https://tcocertified.com/certification-documents/>

Clarification of sustainability performance indicator(s)

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

The following SPI(s) is not required for compliance with TCO Certified. If no information is provided the product will receive the lowest classification by default.

Membership in multi-stakeholder initiatives working towards solving the problems connected to e-waste (Class A-C)

- **Class A:** Membership in a multi-stakeholder initiative working towards solving the problems connected to e-waste (i.e StEP, PREVENT Waste Alliance, PACE)
- **Class B:** No membership
- **Class C:** No information provided

Verification: The brand owner must provide documentation showing an active membership in a multi-stakeholder initiative working towards solving the problems connected to e-waste.

Use of internationally accredited reuse and recycling facilities (Class A-D)

Brand Owners use EPRs and/or reuse/recycling facilities that are certified to internationally accredited standards (R2, e-Stewards, EN50625 or equivalent).

- **Class A:** For all markets where certified products are sold, only internationally accredited EPRs and reuse/recycling facilities are used by the brand owner.
- **Class B:** For all markets where certified products are sold, internationally accredited reuse/recycling facilities (EPRs excluded) are used.
- **Class C:** Not all markets where certified products are sold are covered by accredited EPRs or reuse/recycling facilities.

- **Class D:** No markets where certified products are sold are covered by accredited EPRs or reuse/recycling facilities.
- ~~**Class E:** No information provided~~

Verification: The data must be provided during the reporting at the end of August.

- For EPR systems:
 - a link to their public policy must be provided which must include their requirement on internationally accredited standards (R2, e-Stewards, EN50625 or equivalent).
- For reuse and recycling facilities:
 - a valid certificate for R2, e-Stewards, EN50625, or equivalent must be provided.

Ratio of compensated versus manufactured products (Class A-G)

For product category applicability, see the corresponding TCO Certified Edge, E-waste compensation criteria document.

For this SPI, products have the possibility to be compliant with the model of TCO Certified Edge - E-waste compensation without achieving the full 100% compensation threshold. The compensation must still follow the rules in TCO Certified Edge - E-waste compensation.

- **Class A:** Fully compliant with TCO Certified Edge, E-waste compensated. (100%)
- **Class B:** 75% or above
- **Class C:** 50% or above
- **Class D:** 25% or above
- **Class E:** 10% or above
- **Class F:** 1-10%
- **Class G:** 0% or no information provided.

Verification: The brand owner must provide a verification of conformity report from an approved verification organization which follows the TCO Certified Edge, E-waste compensated rules.

8.3 Material coding of plastics

Background

The best way of reducing IT products' environmental impact is to extend product life through reuse. Once this no longer is possible, the materials must be recycled. By coding the plastic parts, recycling is made easier and the materials can be used in new products.

Definitions

Plastic parts are parts made mainly of plastics, e.g. the product housing. Parts containing other materials in any significant amounts, e.g. cables with metal conductors, are not included in the definition.

Printed wiring board laminate is a printed board that provides point-to-point connections but not printed components in a predetermined configuration on a common base.

Applicability

Displays, desktops, all-in-one PCs, projectors, servers, network equipment, data storage products, Imaging equipment.

References

8.1-8.3.

8.3.1 Mandate

- Parts made with a majority of plastics weighing more than 25 grams must be material coded in accordance with ISO 11469 and ISO 1043-1, -2, -3, -4.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3)

The following information must be submitted with the application to TCO

Development:

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

8.3.2 Clarification

Printed wiring board laminates, wires and cables, connectors, electronic components, optical components, acoustic components, ESD and EMI components are exempted from the mandate.

If the amount of flame retardant exceeds 1 % by weight, the coding must be complemented in accordance with ISO 1043-4.

The requirements also apply to plastics in the LCD panel, however, labeling of the light guide may instead consist of the application of a label in close proximity, for example PLASTIC LIGHT GUIDE:>*plastic type(s)*< or >PLASTIC LIGHT GUIDE:*plastic type(s)*<.

Labeling of plate diffuser (not thin plastic film diffuser) must follow the same rules as for the light guide. The requirement does not cover other thin plastic films in the panel due to difficulties in labeling these.

9 Test conditions for projectors

9.1 General test conditions

9.1.1 Definition of a test object

The product that are subject to tests within this product category are defined in the chapter "About this document".

9.1.2 Required information about the product

The applicant must specify:

- Name(s), type designation(s) and manufacturer for all exchangeable parts of the product.
- Photo/copy of the type plate (rated voltage, rated frequency, rated current, rated power consumption).
- Information of type of projection system, projection lamp, lifetime of projection lamp and information on different power modes.
- Lens, model/type name, effective focal length, zoom. Throwing distance (equation or graph which shows the relationship between the throwing distance d [m] and the TCO Certified Image Size [m²]).
- Displayable formats including the native resolution and aspect ratio.
- Video and computer compatibilities.
- Vertical frequency band width, horizontal frequency bandwidth, video bandwidth (max. pixel rate).
- Reported sound power level.

9.1.3 Test conditions

- The product must be delivered to the test facility in test-ready condition and include any required accessories. All necessary information about how to operate and adjust the product must be provided.
- The performance of the tested product must in all aspects be equal to the product that is delivered to the end-user.
- The applicant must inform the test facility if any image enhancement software or hardware is used for the test object and which input ports that have image enhancement.

- The projector must be physically prepared for testing and must be warmed up until it is fully stabilised, but at least for 30 minutes and after lamp aging (see 9.1.5).
- The projector lens surface must be clean when tested.
- The projector must be tested under nominal conditions of input voltage, current, etc. If sold on different markets, one setup must be chosen by the manufacturer which must represent the conditions of the country in where it will be sold the most.
- The projector must be connected to a computer, if the manufacturer does not specify a different presentation host. In the computer, a graphics board of high quality, which offers a digital output and a typical output voltage on RGB of $0.7\text{ V} \pm 10\%$ must be used.
- When possible, testing must be done with the digital signal input. In the case of several digital inputs, the one with the lowest bandwidth which can still support the native resolution must be used. The same signal input must be used for testing of all parameters. The signal input used must be specified in the test report.
- A video generator must not be used to drive the projector.

9.1.4 Product alignment for testing

- The throwing distance, the distance between the front lens of the projector and the measurement plane (screen), should be set according to the manufacturer's specifications.
- The measuring plane must be perpendicular to the optical axis of the projector lens, if not specified otherwise in the test method. The measuring plane must be defined as the focus plan at the centre of the projected image.
- The image must be focused and the main focus must be set for the centre of the image. Use a test image containing both horizontal and vertical black and white details of different sizes. If no change of focus arises during the test period, no refocusing should be necessary between the different tests.

9.1.5 Settings of the projector

- The projector resolution must be set to the native resolution.
- The projector must be put in its factory default mode. The CCT of the default mode must be used. All tests must be performed with the projector settings set in the factory default mode if not stated otherwise in the test methods.
- Testing may be done with a pre-set instead of the default mode if the user is informed in the user manual which preset is used for conformity with the criteria in TCO Certified. In this case, this preset must be treated as the default mode in the criteria document and noted in the test report.

- The focal length of the lens of the projector must be set to the minimum, if not specified otherwise by the manufacturer. The focal length used for testing must be specified in the test report.
- Measurements must be carried out between the 48 and 64 working hours of the projection lamp as this is necessary to get realistic and repeatable results.
- All measurements must be taken with no adjustments made between the measurements, if not specified otherwise in the test method.
- The color depth of the source signal must be 24 bits (8 bits per color channel) or more.

9.1.6 Instruments used for testing

All instruments used for testing must be calibrated and there must be a valid calibration report. Calibration must be done before the tests are carried out. Calibrations must be traceable to national standards. The instruments must not be used handheld, but be mounted or stabilised by some sort of support, i.e. a tripod.

- The surface of the sensor of the illuminance meter must be parallel to the screen surface. The flat detector surface is supposed to simulate a small screen, and consequently be positioned as such. Make sure not to shadow the illuminance meter or get in front of it so that you reflect a bunch of light into the illuminance meter.

9.1.7 Test report

The test results are valid only for the presentation form(s) and configuration(s) that are included in the test. However, configurations may be accepted by the test facility based on tests of a “worst case” configuration. In this case, it must be clearly specified in the test report which of the configurations that have been tested.

The test report must include the following information:

- Any changes to the test methods.
- The manufacturer, brand name, model type and serial number (if available).
- The manufacturer, brand name, model/type name, lens and lamp used and serial number (if available)
- The supply voltage and frequency used during the test and whether it is a CLASS I or CLASS III type. If CLASS III the AC external power supply brand name and model number must also be stated.
- The degree of uncertainty for each given measurement result.
- Photographs of the product showing: front, rear and, if applicable, the external power supply with legible marking label.
- The working hours of the lamp when the testing started must be reported.
- List of all exchangeable parts used during the test.
- The mode(s) (i. e. horizontal and vertical scan frequency and resolution) used during the test.

9.1.8 Overall uncertainty

The overall uncertainty of the test facility must be calculated for each measurement procedure in this document and presented in the test report. The uncertainty must be within the required levels for each criterion. All measurement uncertainties claimed for used instruments must be referred to traceable calibration reports.

About combining overall uncertainty values during test measurements:

- Criteria are fulfilled without adding or subtracting the overall measurement uncertainty.
- Report the value shown on the instrument without adding or subtracting the overall measurement uncertainty.
- The overall measurement uncertainty of the test facility must be printed in the test report together with the reported value.

If a test facility has an overall measurement uncertainty higher than the one allowed by TCO Development for a certain criterion, then the test report for that criterion is not valid for certification and the test result will not be accepted by TCO Development.

9.2 Visual ergonomics

9.2.1 General test requirements

General test requirements are specified in section 9.1. During all tests, the projector lens surface must be clean.

9.2.2 Photometric test facility general requirements

Photometric measurements must be performed under darkroom conditions. This means that measurement data must not be affected by direct light from sources or light reflected from interiors, equipment, clothes etc.

(All calculations must correspond to a projector screen with a gain=1.0.)

9.2.3 Power supply and test room climate requirements for testing

- AC mains voltage* 230 VAC RMS, tolerance $\leq 1 \%$
- AC mains frequency* 50 Hz, tolerance $\leq 2 \%$
- Test room temperature $23 \pm 3 \text{ }^{\circ}\text{C}$
- Humidity 20-75 % RH (non condensing)

* – or other voltage and frequency combination specified by the client.

9.2.4 Photometric and spectrometric measurements

Several instruments are to be used when carrying out measurements for visual ergonomics. All instruments must be recently calibrated and carry a calibration certificate from a certified testing facility. No photometric instruments must be used handheld, but be mounted or stabilised by some sort of support, i.e. a tripod.

The following instrument types must be used for testing:

- **Illuminance meter.** An illuminance meter must have a $V(\lambda)$ -sensitivity. (Requirements for luminance meters are covered by CIE Publication 69 (1987). Illuminance meters of CIE Class A (with a combined performance characteristic $\leq 5 \%$ must be used.). The illuminance meter must incorporate an appropriate time constant of integration in order to ensure averaging of the pulsation of the light emitted by projectors. Use a cosine corrected illuminance meter.

The illuminance meter must be calibrated both at very low and high illuminance levels. No illuminance meter must be used handheld, but be mounted or stabilised by some sort of support, i.e. a tripod.

- **Color neutral reflectance standard.** The color neutral reflectance standard must have a reflectance factor of 0.95 ± 0.05 and vary $\leq \pm 0.01$ within the wavelength interval 380 nm till 780 nm and be calibrated to the angles involved. This must only be used for color measurements as the reflectance standard may be unreliable for luminance measurements at certain angles.
- **Spectroradiometer.** An instrument for the measurement of radiant flux as a function of wavelength must be used. A spectroradiometer for the measurement of light and color is normally equipped with a microprocessor that makes it possible to obtain luminance and color coordinates directly from raw measurement data. A spectroradiometer can replace the luminance meter when suitable. The wavelength resolution must be at least 4nm for accurate color measurements. The sensitivity must be independent of the polarization of the measured light (often referred to as f_θ error). No spectroradiometer must be used handheld, but be mounted or stabilised by some sort of support, i.e. a tripod.
- The relevant CIE material – conversion formulae and tabulated data for u'_{CCT} and v'_{CCT} – can also be found on tcocertified.com. A computer program based on the given equations can be supplied by TCO Development.

9.2.5 Stray light

Stray light may cause errors which can negatively affect measurement of illuminance and chromaticity coordinates. It is therefore necessary to make an evaluation of stray light influence for the different measurement procedures described in this document.

If stray light affects the measurement result, actions must be taken to eliminate the source of error. One possible way to solve the problem is to use a lab with low reflections from walls, floor and ceiling or a much larger room (an infinitely large room with white walls is black).

The light proof room must fulfill the requirements given by IEC 61947-1 clause 4:

- Less than 1% of the light on the screen where a white image is projected must be from any source other than direct light from the projector.
- For contrast ratio measurement, less than 10 % of the light on the screen where a black image is projected must be from any source other than direct light from the projector.

9.3 Emissions

9.3.1 General test requirements

General test requirements are specified in section 9.1. During all tests, the projector lens surface must be clean.

9.3.2 Power supply and test room climate requirements for testing

- AC mains voltage* 230 VAC RMS, tolerance $\leq 1 \%$
- AC mains frequency* 50 Hz, tolerance $\leq 2 \%$
- Test room temperature $23 \pm 3 \text{ }^{\circ}\text{C}$
- Humidity 20-75 % RH (non condensing)

The equipment must be connected to phase and neutral.

* – or other voltage and frequency combination specified by the client.

9.3.3 Product conditions and set up

The tests must be performed with the full TCO Certified Image Size activated.

The projector control settings must be the same as for visual ergonomics. This means the light flux test image at the default setting must be used for the emission testing of alternating electric and magnetic fields. See section 9.1.5 for details concerning this setting.

The projector must focus the test image defined in light flux characteristics.

The projector must conform with the mandatory requirements without having to rely on an earth connection via the signal cable. In order to test a projector without an earth connection via the power cable, a battery operated computer, with no connection to earth, can be used to operate the projector.

If the projector is connected to mains via a detachable mains cord, the measurement must be performed with a shielded mains cord of normal type, (connected to earth for CLASS I device). Shielded power cords have the text “shielded” printed on them. The shielding must be of such quality that when the cable is measured by itself, hanging in its correct position at the turntable but with the test sample removed, the values must be below the accepted background level (2.0 V/m in band I and 0.20 V/m in band II).

A projector without an external power supply must be connected to mains via the above mentioned power cable, which must run from the point of its connection on the projector

and then horizontally straight to a point 0.4 m behind the projector surface. The cable must then from this point run downwards at least 1 m (see figure 9.3.3.1).

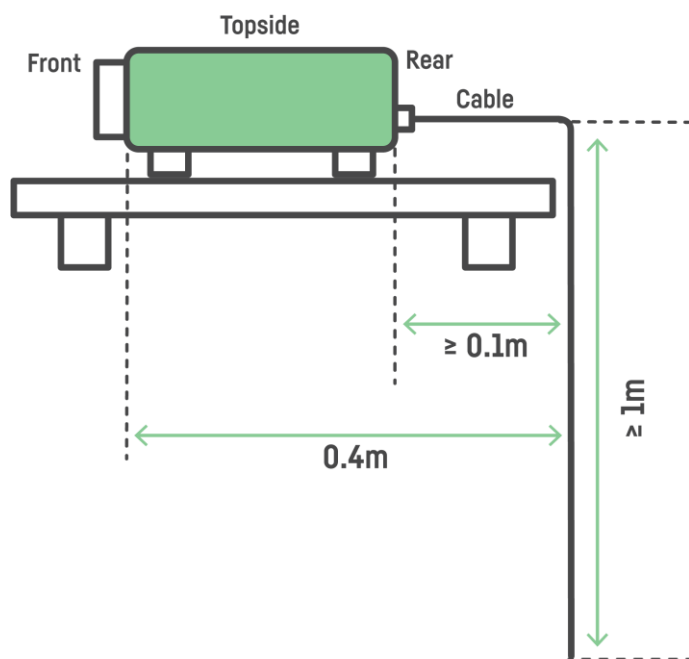
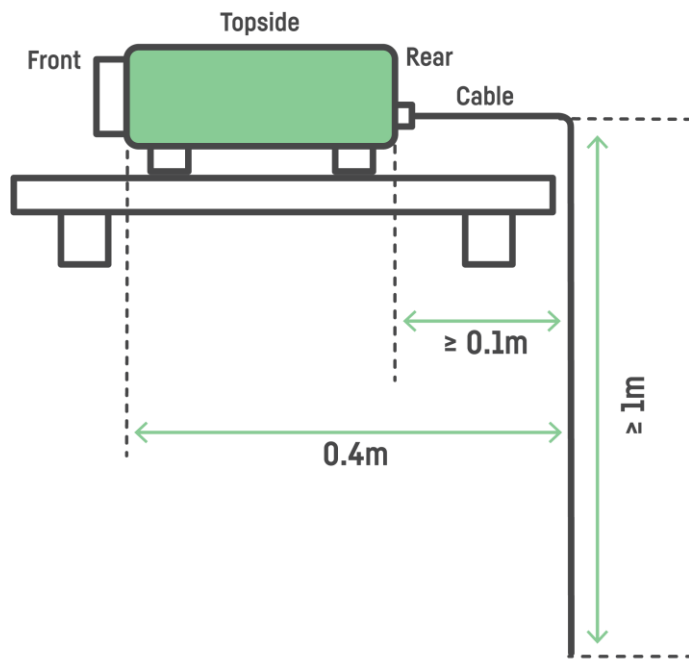


Figure 9.3.3.1. Projector without external power supply unit.

If the projector is provided with a fixed holder for the power and signal cables, to secure them together, then this holder is to be used during the test.

The external power supply unit, if any, will contribute to the electromagnetic fields around the projector. External power supply units, which are connected via a primary cable to the outlet, must be positioned centrally, directly behind the test sample, on the turntable, with the secondary side towards the projector. The primary cable must extend horizontally, on the turntable to a point 0.4 m behind the screen surface. The cable must then, from this point, run downwards at least 1 m. If the power supply can be positioned with different sides up, it must be tested in all positions and the “worst case” result must be used. However, if it is obvious which side is intended to be the top side or bottom side by the placement of LED indicator or integrated supports to stand on, testing the power supply in the one intended position is enough.

The secondary cable of the power supply must run the shortest distance from the point of its connection on the projector to the secondary side of the power supply. The unused portion of the secondary cable, if any, must be bundled together with the power supply unit. The bundle loops must have a length equal to the longest dimension of the power supply. For supply units with dimensions less than 0.1 m, a 0.1 m bundle loop length must be used.

For power supply units which are designed to be put directly in the outlet, without a primary cable, the secondary cable must run vertically down to the (turntable from the point of its connection on the projector and then horizontally straight to a point 0.4 m behind the projector surface. The cable must then, from this point, run downwards at least 1 m.

For measurements of alternating magnetic fields, the power cable may be positioned in another way, as the cable contributes a negligible amount to the magnetic field. However external power supplies must be correctly positioned, as they may give rise to magnetic fields.

If positioning in accordance with the above rules is not possible, then the positioning of the supply unit and cables must be described in the test report.

9.3.4 Emission measurement instruments

The instruments used for emission testing must conform with the requirements and calibration procedures described below:

Alternating electric field meter

The alternating electrical field emission from the projector under test must be determined by measuring the displacement current passing a given surface of the measuring probe. The

probe consists of a disc of double sided printed circuit board laminate with a diameter of 300 mm. On the front of the board the copper layer is removed in the annulus between radii 50 and 52 mm (see figure 9.3.4.1).

The copper foil surrounded by the annulus is the active measuring surface. It is connected to one input terminal of an operational amplifier, with capacitive feedback. The other input terminal of the operational amplifier, the copper ring outside the active surface, and the back of the board are connected to ground. The output voltage (U) from the probe (active surface with area (A)) is related to the incident electric field, E, averaged over the active surface according to $U = \epsilon \cdot E \cdot A/C$ where C is the capacitance in the feedback loop of the operational amplifier and ϵ is the permittivity for a vacuum.

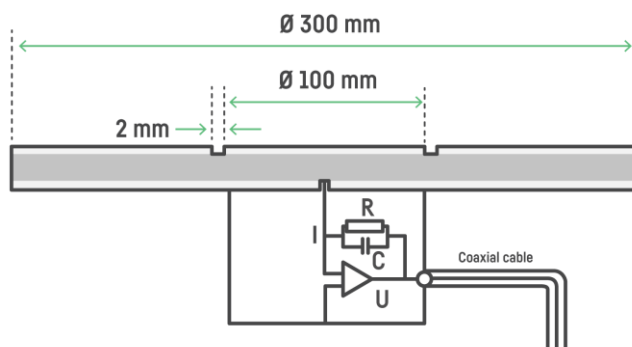


Figure 9.3.4.1. Sketch and circuit principle of the alternating electric field meter for alternating electrical field measurements. The feedback circuit of the operational amplifier is a capacitance C in parallel with a high value resistor R to ensure that there is no DC voltage across the plates of the capacitor C.

The specifications for the frequency response of the measuring probe are given by the calibration procedure. The signals from the probe must be filtered by high-pass and low-pass filters. The specification of the filters is given in table 9.3.4.2.

Table 9.3.4.2 Filter specifications

Frequency Band I					
Frequency	< 5 Hz	5 Hz	100 Hz	2 kHz	> 2 kHz
Attenuation	> 80 dB/decade	3 dB	0 dB	3 dB	> 40 dB/decade

Frequency Band II					
Frequency	< 2 kHz	2 kHz	30 kHz	400 kHz	> 400 kHz
Attenuation	> 80 dB/decade	3 dB	0 dB	3 dB	> 40 dB/decade

After amplification and filtering the output voltage of the measuring probe must be used to determine the r.m.s. value of the electric field strength in both frequency bands.

The measuring time must be sufficiently long to enable measurements with an accuracy of $\pm 5\%$ at 50/60 Hz.

The measuring system must be capable of measuring at least down to 2.0 V/m in band I and down to 0.20 V/m in band II.

The measuring probe must be calibrated using a parallel plate capacitor (air dielectric) consisting of the measuring probe and a metal plate of at least 300 mm diameter. The distance between the surface of the probe and the plate must be 30 mm.

The calibration must be performed with sinusoidal fields at the amplitudes and frequencies specified in table 9.3.4.3

Table 9.3.4.3 Calibration frequencies and amplitudes

	Frequencies	Amplitude
Band I	50, 100, 500, 1000 Hz	10, 25 V/m
Band II	15, 30, 60, 120 kHz	1.0, 2.5, 10 V/m

Recorded values at these calibration points must be within $\pm 5\%$ of the nominal value. Due to the nature of the specified filters the deviation must be calculated at 1 kHz from 9.5 and 22.5 V/m and at 120 kHz from 0.95, 2.4 and 9.5 V/m.

Alternating magnetic field meter in band I and band II

The magnetic field must be measured using coil systems that must consist of three mutually perpendicular concentric circular coils each with an area of 0.01 m². The coils may depart from a circular shape where they intersect. The minimum inner diameter must be 110

mm and the maximum outer diameter 116 mm. The measuring coils must not be sensitive to electric fields.

The resonance frequency of each coil appropriately connected to cables and amplifiers must not be so low that it may influence the specified frequency response according to table 9.3.3.

Amplifiers and integrating networks to make the output voltage proportional to the magnetic flux density and independent of frequency must follow each coil. The specifications in respect of the frequency response are given in the calibration procedure.

High-pass and low-pass filters must filter the signals from the coil systems. The specifications of the filters are given in table 9.3.4.2.

After amplification, integration and filtering, the signals from the three coils in each coil set must be used as input values for calculating the r.m.s. values of the amplitudes of the magnetic flux density vectors in both frequency bands. It is permissible to calculate the r.m.s. value for each of the coil signals and use the root of the squared sum of those r.m.s. values as the test result.

The measuring time must be sufficiently long to enable measurement with an accuracy of $\pm 5\%$ at 50/60 Hz.

The alternating magnetic field meter in band I and band II must be capable of measuring down to at least 40 nT in band I and down to 5.0 nT in band II.

The alternating magnetic field meter in band I and band II must be calibrated using a Helmholtz-type calibration coil as shown in the Figure 9.3.4.4 Calibration set-up. Calibration must be performed with sinusoidal fields at the amplitudes and frequencies specified in table 9.3.4.5

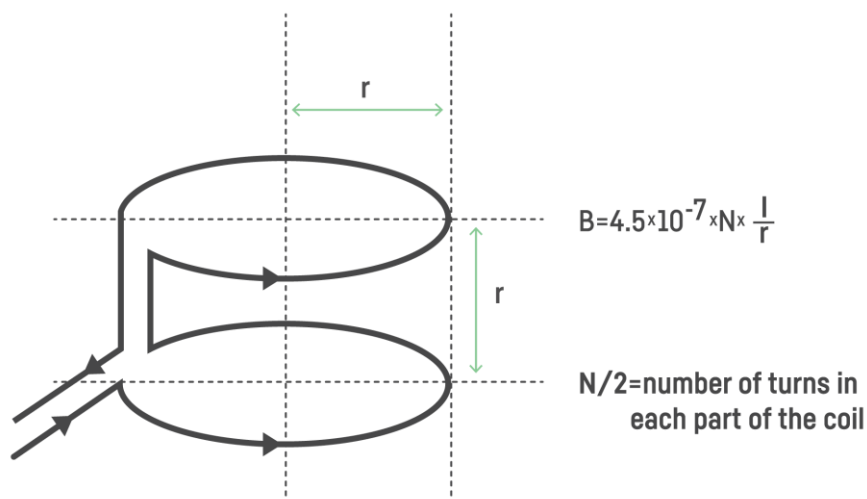
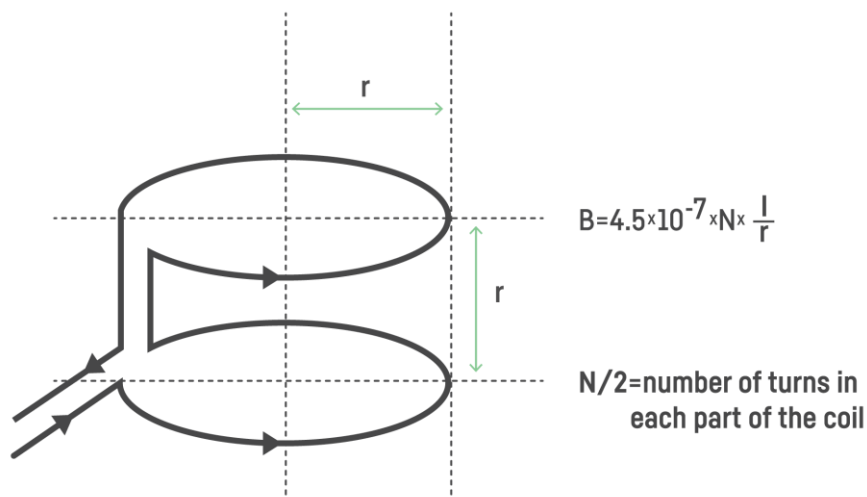


Figure 9.3.4.4. Calibration using a Helmholtz-type calibration coil.

Table 9.3.4.5. Calibration frequencies and amplitudes

	Frequencies	Amplitudes
Band I	60, 100, 500, 1000 Hz	200, 2000 nT
Band II	15, 30, 60, 120 kHz	25, 250 nT

Recorded values for these calibrations must not deviate more than $\pm 5\%$ from the nominal value. Due to the nature of the specified filters the deviation at 1 kHz must be calculated from 180 nT and 1800 nT and at 120 kHz from 24 nT and 240 nT.

The calibration must be performed for each of the three individual coils separately exposed and for one situation where approximately the same flux density passes through all three coils.

9.4 Energy measurements

9.4.1 General test requirements

General test requirements are specified in section 9.1. During all tests, the projector lens surface must be clean.

9.4.2 Power supply and test room climate requirements for testing

AC mains voltage*	230 VAC RMS, tolerance $\pm 1\%$
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AC mains frequency*	50 Hz, tolerance ± 0.5 Hz
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Line impedance	$0.25\ \Omega$
----------------	----------------

Total harmonic distortion	$< 2\%$
---------------------------	---------

Test room temperature	$23\pm 3^{\circ}\text{C}$
-----------------------	---------------------------

Humidity	20-75 % RH (non-condensing)
----------	-----------------------------

* – or other voltage and frequency combination specified by the client.

9.4.3 Power measurements

To measure energy use, the following instrument must be used.

- RMS power meter

The RMS power meter must have a crest factor of at least five, and a frequency response of at least 3 kHz.

9.4.4 Measurement stability

Measurements must be taken after a stable wattage value has been obtained over a three-minute period. Values are considered to be stable when variations in wattage values are 1% or less for the duration of the three minute period.

9.4.5 Acoustic noise

This noise measurement may be done at any test facility accredited according to ISO 17025 but the test report must be verified by a verifier approved by TCO Development, who must sign a verification document for noise, covering all configurations.

The noise measurements must follow ISO 7779:2010 and must be reported according to ISO 9296:1988. (However, the principle for how the measurement uncertainty is handled must be the same as for all the other criteria in TCO Certified. This means that no uncertainty must be added to the result presented in the report.

In addition to reporting the measured A-weighted sound power level (LWA) in Bels (B) the single measurement values of the 9 measurement positions and the mean value of these A-weighted sound pressure level (LpA) in Decibels (dB) have to be included in the test report.

9.4.6 Overall uncertainty

The test must be performed in such a way that the total extended uncertainty in the test result will be less than $\pm 2.5\text{dB}$.

Note

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

10 References

International standards organizations referred to in the reference list below and their web sites.

1. IEC 61947-1/-2
2. ISO/IEC 21118 Information to be included in specification sheets – Data projectors.
3. IEC 61947-1:2002 Electronic projection – Measurement and documentation of key performance criteria – Part 1: Fixed resolution projectors
4. Rea, M. S., IESNA Lighting Handbook - Reference and Application, Illuminating engineering society of North America, New York, NY, USA (2000). Chapter 10 and 11.
5. Brennesholtz, M. S., Stupp, E. H., (2008) "Projection Displays, Second Edition" John Wiley & Sons Ltd. Chapter 2.
6. CIE Publication 69 (1987), Methods of characterizing illuminance meters and luminance meters: performance characteristics and specifications.
7. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, p. 119
8. Wyszecki, G., Stiles, W.S., (1982) Color Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 567-569.
9. ISO/IEC 21118:2005 Information to be included in specification sheets – Data projectors
10. ITU-R Recommendation BT.709-5: Parameter values for the HDTV standards for production and international programme exchange
11. ITU, International Telecommunication Union www.itu.int/home/index.html
12. Poynton, C. (2003), Digital video and HDTV Algorithms and interfaces, Morgan Kaufmann Publishers, An Imprint of Elsevier Science.
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. Flat Panel Display Measurements Standard, (M), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
15. Fairchild M. D. (1995), "Considering the surround in device-independent color imaging". www.cis.rit.edu/people/faculty/fairchild/PDFs/Bart.pdf
16. <http://www.w3.org/Graphics/Color/sRGB.html>
17. SMPTE RP 145-1994: SMPTE C Color Monitor Colorimetry
18. CIE Publication 15.2 (1986), Colorimetry, p. 11, p.27-28 and p. 53-54, table 1.3).
19. ITU-R Recommendation BT.470-6: Conventional television systems.
20. Hunt, R.W.G. Measuring colour. 3rd edition (1998), Kingsley-Upon-Thames: Fountain Press.
21. ISO TC130 WD 12646 p. 5 Section 4.7 Chromaticity and luminance of the white and black points and tracking.

22. Schenkman, B., and Kjell Dahl, L. (1999). Preferred colour temperature on a colour screen. *Displays*, 20, 73 - 81.
23. Le Grand, Y. (1957). *Light, colour and vision*. Chapman and Hall.
24. Wyszecki, G., Stiles, W.S., (1982) *Color Science: Concepts and methods, quantitative data and formula*, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 574-575.
25. 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.
26. www.srgb.com
27. Le Grand, Y. (1957). *Light, colour and vision*. Chapman and Hall, Chapter 12, Colour difference thresholds p. 279.
28. E.B.U. Standard for chromaticity tolerances for studio monitors Tech. 3213-E August 1975.
29. SMPTE 170M-1999 Television - Composite Analog Video Signal - NTSC for Studio Applications.
30. Kokoschka S. (1986). Visibility aspects of VDUs in terms of contrast and luminance. *Behaviour and information technology*. vol.5, No. 4, pp 309-333.
31. Le Grand, Y. (1957). *Light, colour and vision*. Chapman and Hall, pp 278-279.
32. ISO 7779:1999, (EN ISO 7779:2001), Acoustics – Measurements of airborne noise emitted by computer and business equipment. This international standard is based on ECMA-74.
33. ISO 9296:1998, Acoustics – Declared noise emission values of computer and business equipment.
34. ISO 3744:1994 Acoustics – Determination of Sound Power levels.
35. EN /IEC 60065 Audio, video and similar electronic apparatus – Safety requirements.
36. EN 60950-1 (IEC 60950-1). Safety of information technology equipment including business equipment.
37. EMAS EU regulation no 761/2001 concerning the voluntary participation of industrial companies in the Union's environmental control and review structure.
38. ISO 14001 Environmental management systems - Specification with guidance for use
39. EU Directive 2006/66/EC on batteries and accumulators containing certain dangerous substances
40. EU Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment
41. Regulation concerning Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), EC 1907/2006
42. EU Directive EC 1272/2008 on classification, labelling and packaging of substances and mixtures

43. EU Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances
44. The EU Green Paper "Environmental questions concerning PVC" KOM (2000) 469
45. ISO 1043-1, -2, -3, -4 Plastics - Symbols and abbreviated terms
46. ISO 11469 Plastics - Generic identification and marking of plastics products
47. EU Directive 2002/96/EC on waste electrical and electronic equipment (WEEE)
48. Energy Star, EPA – <http://www.energystar.gov>
49. EU regulation 1275:2008
50. Eco design Directive 2005/32/EC
51. Global Reporting Initiative (GRI), www.globalreporting.org
52. United Nations Global Compact (UNGC), <http://www.unglobalcompact.org/>
53. Electronic Industry Citizenship Coalition (EICC), <http://www.eicc.info>
54. SA8000, <http://www.sa-intl.org>
55. Directive 94/62/EC on packaging and packaging waste.
56. UL 60950 Information Technology Equipment – Safety
57. FCC Part 15 Subpart B
58. IEC/EN 55022 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
59. International Efficiency Marking Protocol for External Power Supplies
60. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/abfall/ROHS/finalresults/Annex6_RoHS_AnnexII_Dossier_DEHP.pdf [DEHP]
61. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/abfall/ROHS/finalresults/Annex7_RoHS_AnnexI_Dossier_BBP.pdf [BBP];
62. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/abfall/ROHS/finalresults/Annex8_RoHS_AnnexI_Dossier_DBP.pdf [DBP].
63. http://rohs.exemptions.oeko.info/fileadmin/user_upload/reports/20140520_DIBP_AnnexII_Dossier_final.pdf [DIBP].
64. <http://www.oecd.org/corporate/mne/mining.htm>

Miscellaneous references

- ISO2813:1994.
- DIN 67 530.
- ISO 3664:1999, Viewing conditions for graphic technology and photography, p. 9 Uniformity of screen luminance.
- 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.
- ISO 3664:1999. Viewing conditions for graphic technology and photography, p. 10 Monitor luminance.
- ISO 9241-307 2008 Ergonomics of human-system interaction Part 307: Analysis and compliance test methods for visual displays, chapter 5.4

- Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press
- Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 10P - 106.
- Barten, P.G.J., (1999) Contrast sensitivity of the human eye and its effects on image quality, SPIE Optical Engineering Press p. 179 - 181.
- Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds, p. 261.
- Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, Chapter 11, Luminance difference thresholds.
- EC Directive 90/270/EEC
- EU Directive (76/769/EEC) on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations
- HELCOM article 5, annex I
- JPCA-ES-01
- IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits, the Institute for Interconnecting and Packaging Electronic Circuits (IPC).
- IEC 61947-1:2002 Electronic projection – Measurement and documentation of key performance criteria – Part 1: Fixed resolution projectors
- IEC 61947-2:2001 Electronic projection – Measurement and documentation of key performance criteria – Part 2: Variable resolution projectors
- CIE, Commission Internationale de l'Eclairage, International Commission on Illumination, www.cie.co.at/cie/
- DIN, Deutsches Institut für Normung e. V., www2.din.de
- EBU, European Broadcasting Union, http://www.ebu.ch/tech_info.html
- IEC, International Electrotechnical Commission, www.iec.ch
- ISO, International Organization for Standardization, <http://www.iso.org/>
- SMTPE, Society of Motion Picture Television Engineers, www.smtpe.org
- VESA, Video Electronics Standards Association, www.vesa.org

11 Forms and signatures for application

All forms must be completed, signed and sent to a verifier approved by TCO Development.

The forms in this chapter are for reporting conformity with the mandates in TCO Certified, generation 9, for projectors and for providing information about the brand owner management systems, the product and its manufacture.

11.1 Brand owner form

The information in this form refers to the brand owner. The form may cover several of the brand owner's products. The form must be submitted once a year.

11.1.1 Supply chain responsibility (mandate 2.1.1)

The most recent version of the brand owner's public code of conduct is attached (yes/no)	
Information on the routines of how management and workers have been informed about the brand owner's code of conduct is attached (yes/no)	
Supply chain responsibility mandate is fulfilled (yes/no)	

11.1.2 Supply chain transparency (mandate 2.2.1)

Name, title, telephone number and email address of the SMR on the TCO Certified portal (yes/no)	
The report from the SMR interview including the verified self-assessment questionnaire (SAQ) is attached (yes/no)	
A date, with a period of less than 12 months, of the planned SMR interview with the name of the approved verifier on the TCO Certified portal (yes/no)	
Supply chain transparency mandate is fulfilled (yes/no)	

11.1.3 Anti-bribery management system (mandate 2.3.1)

An ISO 37001 certificate(s) is attached, or a booked date for the self-assessment questionnaire (SAQ) and follow-up interview. (yes/no)	
Anti corruption management mandate is fulfilled (yes/no)	

11.1.4 Responsibly sourced minerals (mandate 2.4.1)

The most recent version of the public policy and a description of how it is communicated to the supply chain is attached (yes/no)	
A description of the brand owner's structured work on identifying risk areas in their supply chain is attached (yes/no)	
The responsibly sourced minerals template is completed and submitted to TCO Certified Portal before the brand owner annual due date stated on the portal. (yes/no)	
Responsibly sourced minerals mandate is fulfilled (yes/no)	

The brand owner guarantees that the provided information in chapter 11.1 is correct, and accepts to be bound by the listed mandates as they are fully stated in TCO Certified, generation 9, for projectors.

.....
Product brand name	Model name(s) or "All certified products"
.....
Signature	Name and title in block capitals
.....
Date	Brand owner company

11.2 Factory form

The information in this form refers to the factory where products included in the application are manufactured. The form may cover several of the brand owner's products. A separate copy of the form must be used for each factory.

11.2.1 Supply chain responsibility (mandate 2.1.1)

The supply chain identification template is completed and submitted to TCO Certified portal before the due date stated on the portal (yes/no)	
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11.2.2 Process chemicals management (mandate 2.5.1)

A copy of the ISO 45001 certificate for each final assembly factory manufacturing the certified product is submitted to TCO Certified Portal (yes/no)	
The Process Chemical Data Collection (PCDC) Tool is completed and submitted to TCO Certified portal before the due date stated on the portal. (yes/no) The PCDC Tool, can be downloaded at tcocertified.com	
Process chemicals management mandate is fulfilled (yes/no)	

11.2.3 Environmental management system (mandate 3.1.1)

A copy of a valid ISO 14001 certificate for every final assembly factory manufacturing certified products is submitted to TCO Certified Portal (yes/no)	
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11.2.4 Energy efficiency indicators (mandate 3.2.1)

Total energy consumption for the factory. (KWh/Year)	
Percentage of renewable energy consumed by the factory (%)	
Energy improvements compared to previous year (%)	

11.2.5 Energy management system (mandate 3.3.1)

A copy of a valid ISO 50001 certificate for every final assembly factory manufacturing certified products is submitted to TCO Certified portal (yes/no)	
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The applicant guarantees that the provided information in chapter 11.2 is correct, and accepts to be bound by the listed mandates as they are fully stated in TCO Certified, generation 9, for projectors.

.....
Factory name	Factory address
.....
Signature	Name and title in block capitals
.....
Date	Applicant

11.3 Product form

The information in this form refers to the product that is included in the application. A separate copy of the form must be used for each product model.

11.3.1 Information to end users (mandate 1.1.1)

<p>mandate fulfilled through (A.1, A.2 or A.3):</p> <p>A. The information document for end users must be written in English or in the local language of the country where the product is to be sold. It must accompany the product in at least one of the following ways:</p> <ol style="list-style-type: none"> 1. As a separate printed or digital document. 2. Included in a printed or digital user manual. 3. As a separate digital document that is hosted on the brand owner's website. A direct link to the document must be included in the printed or digital user manual mentioned above. 	
<p>Information to end users mandate is fulfilled (yes/no)</p>	

11.3.2 Product specification (mandate 1.2.1)

Product manufacturer	
Product brand name	
Product brand owner	

Product type/model name	
Panel(s) screen size (inch)	
Lamp(s) type	
Lamp(s) manufacturer	
LED(s) type	
LED(s) manufacturer	
Laser(s) type	
Laser(s) manufacturer	
Panel(s)* type	
Panel(s)* manufacturer	
DMD chip(s)** type	
* Only for LCD / ** Only for DLP	
Total weight of the typical product configuration and power supply (kg)	
A list of all external power supplies with the following information is attached (yes/no) <div> <div>Manufacturer</div> <div>Model/type</div> <div>Rating</div> <div>Class</div> </div>	
A copy of the marking label is attached (yes/no)	
TCO Certified Image Size Amax/office (m ²)	
Product specification mandate is fulfilled (yes/no)	

11.3.3 Sustainability performance (mandate 1.3.1)

Sustainability performance mandate is fulfilled (yes/no)	
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11.3.4 Non-mandatory sustainability performance indicators (mandate 1.3.1)

(SPIs marked with Z in criterion 1.3)

To achieve a higher classification on the following SPIs, additional information and evaluation is required. The submissions and additional evaluations are optional. By

submitting and performing an evaluation, the product will always receive a higher classification than if no evaluation is conducted.

3.5 A Product carbon footprint report is submitted (yes/no)	
3.5 Documentation regarding PCF data age is submitted (yes/no)	
3.5 Documentation regarding PCF availability is submitted (yes/no)	
6.1 Documentation on extended warranty availability is attached (yes/no)	
6.1 Documentation on public repair policy is attached (yes/no)	
6.2 Should the SPI "Classification of fasteners and connectors" be evaluated? (yes/no)	
6.2 Should the SPI "Necessary tools for repair/upgrade)" be evaluated? (yes/no)	
6.2 Should the SPI "Classification of availability of spare parts by target group" be evaluated? (yes/no)	
6.2 Should the SPI "Classification of availability of spare parts by duration of availability" be evaluated? (yes/no)	
6.2 Should the SPI "Classification of availability of comprehensive information" be evaluated? (yes/no)	
8.2 Documentation showing the brand owner involvement in multi-stakeholder initiatives working towards solving the problems connected to e-waste is submitted (yes/no)	
8.2 Documentation showing the use of internationally accredited reuse and recycling facilities is submitted (yes/no)	
8.2 Documentation on ratio of compensated versus manufactured products is submitted (yes/no)	

11.3.5 Post-consumer recycled content (mandate 3.4)

TCO Certified PCR template may be used for submission for this criterion

Documentation on weight of post consumer recycled plastic parts is attached (yes/no)	
Documentation on weight of all plastic parts is attached (yes/no)	
Documentation on weight of post consumer recycled non-plastic parts is attached (yes/no)	
Post-consumer recycled content mandate is fulfilled (yes/no)	

11.3.6 Electrical safety (mandate 4.1.1)

A copy of a valid CB certificate or a national certificate from a CB member (NCB) for the product is attached (yes/no)	
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11.3.7 Acoustic noise (mandate 4.4.1)

A copy of the test report(s) from a laboratory accredited according to ISO 17025 is attached (yes no)	
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11.3.8 Energy efficiency (mandate 5.1.1)

The projector is possible to set in eco-mode (yes/no)	
Is the signed description on how to change between energy modes and how to see the change on the projector submitted. (yes/no)	
Is the energy consumption levels in all modes published in the user manual and product specification (yes/no)	
Is the description explaining how the projector is brought into its energy mode(s) and how this will be indicated on the projector attached in the user and or product manual (yes/no)	
Energy efficiency mandate is fulfilled (yes/no)	

11.3.9 Hazardous substances

7.1.1 Heavy metals mandate is fulfilled (yes/no)	
7.2.1 Halogens mandate is fulfilled (yes/no)	
7.2.3 A copy of the test report(s) from a laboratory accredited according to ISO 17025 is attached (yes/no)	
7.3.1 Non- halogenated substances mandate is fulfilled (yes/no)	
7.4 1 Plasticizers mandate is fulfilled (yes/no)	
7.5.1 Hazardous substances in product packaging mandate is fulfilled (yes/no)	

11.3.10 Material recovery

8.1.1 Product packaging mandate is fulfilled (yes/no)	
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The applicant guarantees that the provided information in chapter 11.3 is correct, and accepts to be bound by the listed mandates as they are fully stated in TCO Certified, generation 9, for projectors.	
..... Product brand name Model name(s)
..... Signature Name and title in block capitals
..... Date Applicant

11.4 Brand owner product form

The information in this form refers to the product that is included in the application.

The form may be signed once and cover all products, but a copy of the form must be attached to each application.

11.4.1 Product warranty (mandate 6.1.1)

Information about the minimum product warranty period for the product is attached (yes/no)	
Product warranty - brand owner mandate is fulfilled (yes/no)	

11.4.2 Replaceable components (mandate 6.2.1)

A link to the service manual on the brand owner website or a pdf of the material that will be published there during the validity of the certificate is attached (yes/no)	
Replaceable components mandate is fulfilled (yes/no)	

11.4.3 E-waste management (mandate 8.2.1)

E-waste compensation management mandate is fulfilled (yes/no)	
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11.4.4 Factory identification (mandate 2.1.1)

The final assembly factory/factories that manufacture the certified product are reported at the time of application (yes/no)	
The most recent independent audit and a CAP for each non-conformity was/is provided for the factory (yes/no)	

The brand owner guarantees that the provided information in chapter 11.4 is correct, and accepts to be bound by the listed mandates as they are fully stated in TCO Certified, generation 9, for projectors.

..... Product brand name Model name(s) or "All products"
..... Signature Name and title in block capitals
..... Date Company

11.5 Certification documents

The process chemical data template, self-assessment questionnaire and other relevant documents are available on tcocertified.com/certification-documents.

All changes or clarifications made to this document are announced in the “technical updates and changes” newsletter. All previous changes communicated through the newsletter can be found on <https://tcocertified.com/technical-updates-and-changes/>



