

TCO Certified

Generation 8, 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 eight product categories: displays, notebooks, tablets, smartphones, desktops, all-in-one PCs, projectors and headsets. 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 brand owners, factories and 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 8, for projectors, released in December 2018. 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 product categories are generation 8

TCO Certified is available for eight product categories and they all have the same generation number: generation 8. 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 eighth 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

1. 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:
 - As a separate printed or digital document.
 - Included in a printed or digital user manual.
 - 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.
2. The product and its packaging must be labeled with the TCO Certified logo. See clarifications for details.

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

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.

- a. The logo must be visible on the top or front of the product.
- 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 reverse/back side of the product.

or

Alternative B

Via electronic labeling displayed on the screen. The logo must cover at least 4% of the screen and must be larger than or equal to 76 pixels x 47 pixels. 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 2 seconds.

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 time 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.

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 60 950:1 clause 1.7.1.

Applicability

All product categories.

References

1.1.

1.2.1 Mandate

A product specification and marking label must be provided for the product.

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.

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.

1.3 Sustainability performance

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 to not affect the business negatively. The sustainable performance indicators will help us follow the development of products and brand owners, enabling us to set criteria that are challenging but yet reasonable, and that cover the most relevant parts of the product life cycle.

The published sustainability performance indicators help determine the sustainability benefits that the certified products create, and track this over time. A purchasing organization can use the published 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.

All sustainability performance indicators criteria are beyond the scope of TCO Certified and it is not necessary to conform with any of them to qualify for TCO Certified.

Applicability

Projectors.

Definitions

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

TCO Certified Portal: An online system to apply for TCO Certified, administer, and view certificates.

Recycled plastic is post-consumer recycled plastic that has been used in products.

1.3.1 Mandate

- By the end of April each year, information on the previous calendar year's global production volume of the product must be reported in TCO Certified Portal (this applies until the year after a certificate has expired).
- Complete all fields for the sustainability performance indicators in chapter 11.3.

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 results of the sustainability performance indicators must be reported in TCO Certified Portal.

1.3.2 Clarification

Production volumes of certified products

- The production volumes may be reported directly by the brand owner or through an intermediate industry association.
- Reporting of production volumes can be done by combining all certified products within each product category.

The published sustainability performance indicators

The published sustainability performance indicators are parameters that are considered extra important in order for purchasers to determine the sustainability benefits of certified products. In this generation of TCO Certified, the published sustainability performance indicators are:

1. Total product weight is an indication of the amount of potential e-waste at end-of-life. By decreasing the total product weight, e-waste can be reduced.
 - Total weight of the product and power supply (without packaging) in kg.
2. If the energy consumption of a product is known, the climate impact during the use phase can be calculated.
 - For displays, all-in-one PCs, notebooks, desktops:
Measured energy consumption according to ENERGY STAR®.
 - For projectors:
Measured energy consumption according to TCO Certified in On mode (normal operation) for the reported TCO Certified Image Size.
3. Use of recycled plastics lowers the environmental impact, including up to 80 percent lower energy consumption in manufacturing 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.
 - Percentage of post-consumer recycled plastic by weight of total weight of all product parts made out of plastic. (Except panels, electronic components, cables, connectors, PWBs, insulating mylar sheets and labels)

The sustainability performance indicators

All certified products must be evaluated against the sustainability performance indicators in this chapter, but it is not necessary to conform with any of them to qualify for TCO Certified.

The verifier must issue a test report covering all the criteria and upload the results to TCO Certified Portal at the time of application. The published sustainability performance indicators in the form are marked with * and will be published by TCO Development and printed on the certificate. The rest of the data will be kept confidential and collected by TCO Development for the purpose of developing future criteria and measure the impact of TCO Certified. Compiled data may be published in an anonymous format in for example annual sustainability reports by TCO Development.

New applications

Before a product is certified according to TCO Certified, conformity is verified by a verifier approved by TCO Development. When all tests have been carried out, the verifier submits answers to the questions in the sustainability performance indicators form. Additional tests are carried out if needed in order to answer the questions. Finally, a test report for the sustainability performance indicators is issued by the verifier and the results are 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 test 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 test report based on these tests, the sustainability performance indicators may also be the same for all accepted configurations.

Sustainability performance indicators

1.3.3 Public factory list

Does the brand owner have a public list of all final assembly factories for certified products?

if yes, then the following proof must be confirmed by an approved verifier:

A link to the public list of all final assembly factories on the brand owners website.

Clarifications

A list of final assembly factories (including own and ODM factories) that at least include those registered by the brand owner in TCO Certified Portal must be made public on the brand owner website under the 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.

1.3.4 SA8000

Are all final assembly factories manufacturing the certified product SA8000 certified?

if yes, then the following proof must be confirmed by an approved verifier:

All final assembly factories manufacturing the certified product must have a valid SA8000 certificates uploaded to TCO Certified Portal.

1.3.5 Replaceable components

Is it possible to replace all of the critical parts listed in the “Replaceable components” criteria (6.2), without the use of heat or other tools than those intended to turn, slotted (ISO 2380), cross-recessed (Phillips® and Pozidriv®, ISO 8764) or hexalobular recess heads (Torx®, ISO 10664)?

if yes, then the following proof must be confirmed by an approved verifier:

Documentation proving that the sustainability performance indicator is fulfilled..

1.3.6 Halogens

1. Is the halogens criteria (7.2) met for all plastic parts regardless of weight?
2. Is the halogens criteria (7.2) met for the whole product without any excepted parts?

if yes, then the following proof must be confirmed by an approved verifier:

A copy of manufacturer’s halogen-free implementation specification or similar.

Clarifications

Included are all types of plastic in for example panels, internal and external cables, connectors, printed wiring board and substrate laminates, insulating mylar sheets and labels.

The allowed maximum concentration limit is set to 900 ppm by weight for chlorine and bromine individually (maximum 1500 ppm for chlorine + bromine) derived from flame retardant/plasticizer/PVC (including PVC copolymer)/plastic (polymeric) material.

For electronic components other than printed wiring board and substrate laminates, each plastic within the component must contain < 1000 ppm (0.1%) of bromine and < 1000 ppm (0.1%) of chlorine by weight in homogeneous materials (maximum 1500 ppm for chlorine + bromine) derived from flame retardant/plasticizer/PVC (including PVC copolymer)/plastic (polymeric) material.

The limit value of 900 ppm as the maximum content of chlorine or bromine contained in the resin (or 1500 ppm for chlorine + bromine) has been chosen to harmonize with the IEC 61249-2-21 and IPC 4101B standards.

The limit value for electronic components (< 1000 ppm (0.1%) of bromine and < 1000 ppm (0.1%) of chlorine by weight in homogeneous materials derived from flame retardant/plasticizer/PVC (including PVC copolymer)/plastic (polymeric) material) has been chosen to harmonize with the iNEMI Definition of “Low Halogen” Electronics.

A “manufacturers halogen-free implementation specification or similar” is for example an implementation plan on how and when the brand owner is shifting towards halogen-free alternatives and for which products.

1.3.7 Non-halogenated substances

1. Is the non-halogenated substances criteria (7.3) met with no substances used with a GreenScreen® benchmark lower than 3?
2. Do all plastic parts regardless of weight fulfill the non-halogenated substances criteria (7.3)?

if yes, then the following proof must be confirmed by an approved verifier:

Documentation proving that the sustainability performance indicator is fulfilled.

1.3.8 Final assembly renewable energy consumption

Do all final assembly factories manufacturing the certified product use at least 20% renewable energy?.

if yes, then the following proof must be confirmed by an approved verifier:

A copy of final assembly factories renewable energy purchases or similar documents.

1.3.9 Heavy metals

Is the heavy metals criteria (7.1) fulfilled without any exception for mercury in lamps?

if yes, then the following proof must be confirmed by an approved verifier:

Documentation proving that the sustainability performance indicator is fulfilled.

2 Socially responsible manufacturing

Human rights and social responsibility in the IT supply chain

Market competition and the constant push for new technologies have increased pressure on the IT industry to deliver new product models faster and at a lower cost. With these pressures comes the continued social risk throughout the supply chain. Problems remain around human rights and working conditions, including forced labor, working hours, wages, discrimination and unsafe work environments. From more responsible mineral supply chains, to safer factory conditions and protection of worker rights, a sustainable approach to IT products requires attention to these social responsibility issues as well as environmental factors.

IT buyers are increasingly focused on supply chain responsibility and human rights, and rely on TCO Certified as verification of product and brand owner conformity.

TCO Certified – driving worker safety, human rights and closing non-conformities

Chapter 2 in TCO Certified, generation 8, aims to drive more socially responsible manufacturing throughout the supply chain. Brand owner companies and their suppliers are required to conform with criteria that cover responsible minerals sourcing, anti-corruption management and responsible manufacturing practices designed to increase transparency, protect worker rights and reduce exposure to hazards during the production phase.

The criteria are categorized into five main areas:

- Supply chain responsibility
- Supply chain transparency
- Anti-corruption management system
- Responsibly sourced minerals
- Process chemicals

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. New criteria in this generation require that brand owners have a global policy for responsible mineral sourcing, have an anti-corruption management system in place, and are taking steps to eliminate worker exposure to hazardous chemicals.

2.1 Supply chain responsibility

Background

Supply chains of IT products are complex and spread all over the world. The most basic aspect of socially responsible manufacturing in the supply chains is to define the responsibility. After this is done, the level of conformity and the implementation in the supply chains need to be defined. Finally, to get required results, verification is crucial. Without verification there are no considerable results. The contribution of TCO Certified is to:

- Place the responsibility on the brand owners' which are on the top of the value chains.
- Define a minimum level of conformity to the code of conducts of the brand owners.
- Provide a control system to ensure that the brand owners take responsibility and work in a structured way in accordance with their code of conducts.
- Create an incentive for brand owners to work proactively.

Definitions

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

Final assembly factory: The whole factory where final assembly of the certified product is taking place.

Corrective action plan (CAP): A list of actions and an associated timetable detailing the remedial process to address a specific problem.

Applicability

All product categories.

References

2.1, 2.2, 2.3.

2.1.1 Mandate

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

1. Commitment

- The brand owner must have a 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.
 - 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 60 hour working week including overtime*.

*See clarifications 2.1.2

2. Structured work

- The brand owner must report the final assembly factories for each certified product model in TCO Certified Portal in the application for a new certificate.

- For all factories listed in TCO Certified Portal that the brand owner is using, the brand owner must supervise the implementation of the code of conduct.
- In the final assembly factories and in the rest of the supply chain, the brand owner must ensure that CAPs are developed and fulfilled within reasonable time for all non-conformities against their code of conduct that the brand owner is made aware of.

3. Proof

1. TCO Development may conduct / commission random factory inspections (spot checks) at any final assembly factory manufacturing certified products for the brand owner and may require full audit reports during the certification period in order to assess social commitment and advancement.
2. TCO Development may also require seeing audit reports and CAPs from factories further down the supply chain to ensure that corrective actions have been successfully implemented.
3. TCO Development additionally requires the documentation below to be verified by an independent verifier approved by TCO Development:

Submit the following to an approved verifier:

Once a year:

- The most recent version of the brand owner's code of conduct, which must be considered consistent with the TCO Certified mandate.
- Information on the routines of how management and workers have been informed about the brand owner's code of conduct.
- A completed and signed brand owner form covering one or all products (chapter 11.1).

For each application:

- Name and address of all final assembly factories manufacturing the certified product. If any factory is used that is not on the TCO Certified accepted factory list then the factory identification template must be submitted for this factory.

For each final assembly factory of the certified product

- The most recent independent audit and a CAP 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.

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 code of conduct in English must be uploaded to TCO Certified Portal.
- All final assembly factories manufacturing the certified product must be reported in TCO Certified Portal.
- An independent audit and a CAP for each non-conformity must be reported in 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 is in conformity 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 clarifications:

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 working week, including overtime, as a global requirement regardless of the local law.

The criteria in TCO Certified sets a global limit for weekly working hours that includes overtime based on ILO convention 1 (56 hours per working week including overtime) and an additional 4 hours per working week is given to harmonize with SAI and RBA. Therefore, working weeks including overtime are not to exceed a total of 60 hours. A working week is considered 1 day of every 6 consecutive work days.

To monitor continued conformity during an agreed period of time, when considered necessary the factory will be required to submit working week data to TCO Development using the working week template. The template to be used will be shared with the brand owner or factory owner by TCO Development.

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 following principles.

1. The code of conduct

The brand owner must have their code of conduct 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.
 - 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 60 hour working week including overtime*.

* See local labor law clarifications 2.1.2.

- The contents of the code of conduct must have been adopted by the board and addressed by management.
- The code of conduct must relate to the manufacturing of the specific product being certified.

2. Proof of the supply chain being informed of the code of conduct.

The brand owner must annually submit for review by an approved verifier a description of how management and workers at all their final assembly factories of certified products are informed about the code of conduct. Proof of training classes or other means of worker training and how the factory measures the effectiveness of the worker training must be submitted for review. 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 production facilities.
- has made suppliers complete a questionnaire (self-assessment) on their understanding of, and conformity with, the code of conduct.

3. Signed brand owner form

The brand owner signs that the mandate is fulfilled for one or all products to be certified.

4. Identification of final assembly factories

For each certified product, all final assembly factories the brand owner is using to manufacture the certified product must be identified. The approved verifier will ensure that all these factories are listed on the TCO Certified accepted factory list.

- For new factories that are not already on the TCO Certified accepted factory list the factory must be added. This is done by submitting the factory identification template with the factory's name, full address and audit information to an approved verifier.
- Each time a factory is removed, added or updated in any way, the brand owner must ensure that this information is updated in the TCO Certified accepted factory list by contacting an approved verifier.

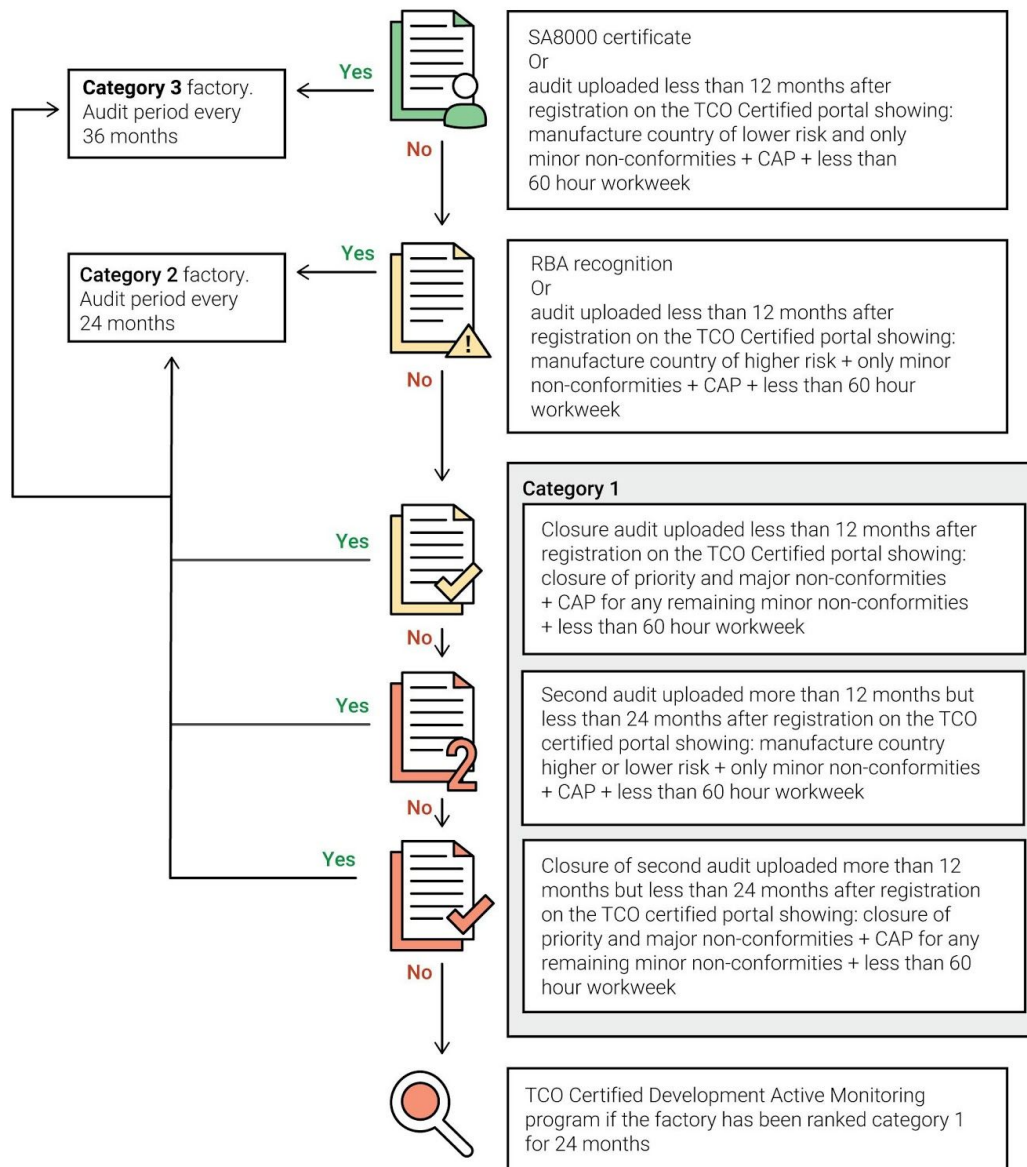
5. Independent social audit reports to TCO Development

The brand owner must ensure that TCO Certified Portal is continuously updated with the most recent independent initial audit report and CAPs for any non-conformities from all the final assembly factories manufacturing the certified product.

Brand owners or applicants / manufacturers must submit audit reports and CAPs to an approved verifier for upload to TCO Certified Portal. Consistency of these 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, RBA or BSCI certified 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. RBA Non-VAP: full audit with same auditor qualification, audit and report quality as a RBA VAP audit, or
 - d. BSCI: full audit with at least 'C' grade and completed CAP.
 - e. Other audits with evidence that could prove 'equal quality to other approved audits' must include auditor qualification, audit process (e.g. triangulation of non-conformities), audit report and CAP. This option will need to be verified by an approved verifier and accepted by TCO Development before it is used.



Risk category diagram 2.1.2

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), 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 working week. Initial audit reports must cover at least the TCO Certified mandate and be an accepted type of audit. The factory will then be assessed in accordance with the process shown in the *Risk category diagram 2.1.2* for its level of risk for continued non-conformity. 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.

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 a product group 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 CAP before the factory can be registered on 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, or
- have proven a high level of progress in non-conformity closure meaning that all non-minor non-conformities are closed.

Lower risk countries

Some countries are considered as lower risk of social non-conformities in 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 the 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 are proactive in closing non-conformities and monitor continued conformity. These factories will be considered a better choice to do business with than risk category 1 factories that do not show progress.

Audit report and factory risk categorization

Initial audits are required regularly, with an audit interval based on the factory risk category.

- An **initial audit** is covering the full scope of the factory and this mandate in TCO Certified.
- A **closure audit** only has to cover the open non-conformities.
- An initial audit is more comprehensive and is accepted as a closure audit.
- Audits older than 12 months are not accepted unless for the initial risk categorization of new factories.

Initial risk categorization

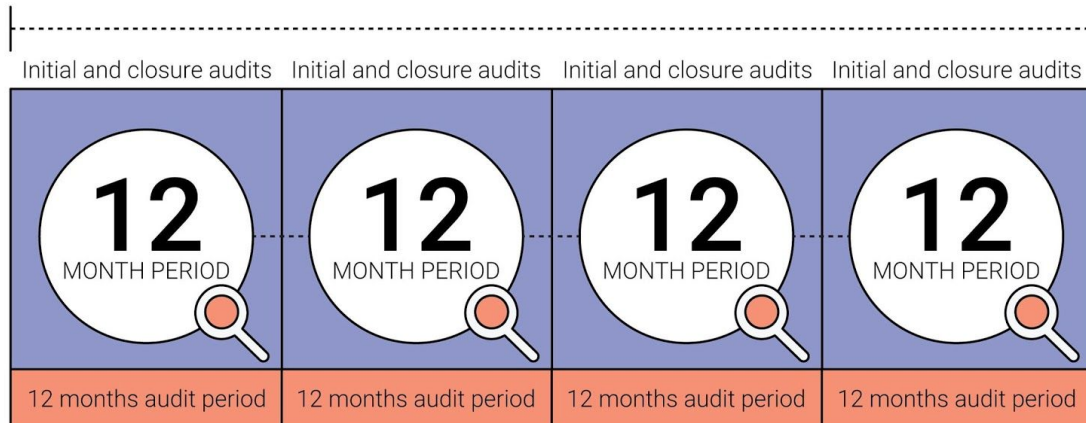
- For all new factories, existing independent audits that are less than 36 months old must be uploaded to TCO Certified Portal for risk categorization. If no such audit exists, then the factory will be classified as risk category 1 by **default**.

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 in TCO Certified Portal.

Category 1



CAP

- When an audit has been uploaded it often has some non-conformities. For each non-conformity to the mandate in TCO Certified a CAP must be uploaded to TCO Certified Portal together with the closure deadline that the audit program allows 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 on TCO Certified Portal. For minor non-conformities the CAP 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 is categorized as 3 instead of 2.
- Otherwise the factory will continue to be categorized as risk category 1.

Final assistance

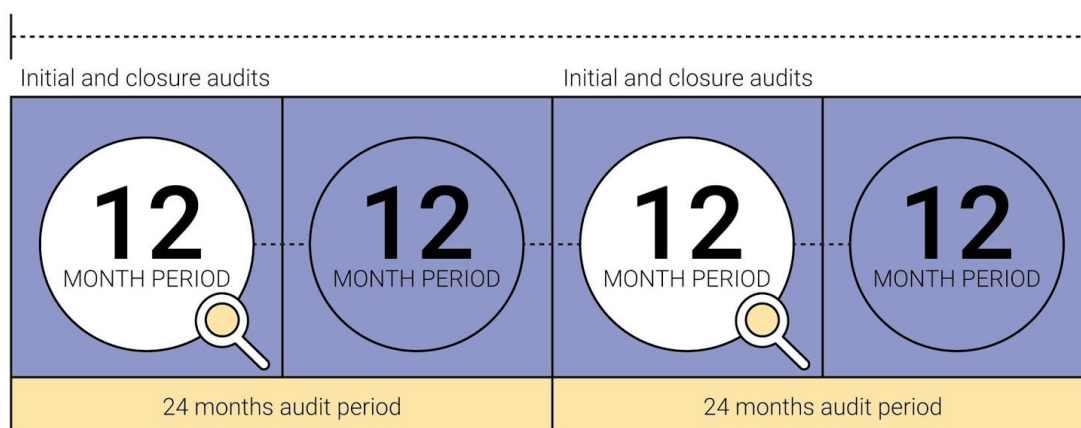
- If the factory has been categorized as a risk category 1 for 24 months, then the factory management will receive final assistance toward conformity through the TCO Certified active monitoring program on tcocertified.com.

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 in TCO Certified Portal.

Category 2



CAP

- When an audit has been uploaded it often has some non-conformities. For each non-conformity to the mandate in TCO Certified a CAP must be uploaded to TCO Certified Portal together with the closure deadline that the audit program allows 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 CAP must be completed but it is not necessary to upload the closure audit to TCO Certified Portal. The closure of minor non-conformities are 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 CAP 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 CAP, the factory will continue to be categorized as risk category 2. If it is certified according to SA8000 it is categorized as 3 instead of 2.
- Otherwise, the factory will be categorized as risk category 1.

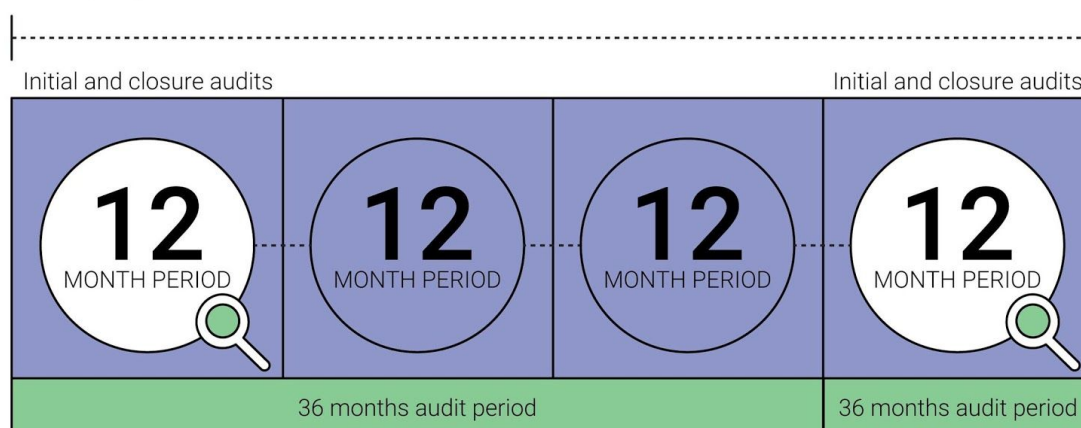
Conformity option: As proof of conformity to risk category 2 without the need to upload a closure audit report to TCO Certified Portal, factories that can prove they have received the status of Platinum, Gold or Silver under the RBA recognition program and provide additional proof that working hours are under 60 hours per working week 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 the mandate in TCO Certified.

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 in TCO Certified Portal.

Category 3



CAP

- When an audit has been uploaded it often has some non-conformities. For each non-conformity to the mandate in TCO Certified a CAP must be uploaded to TCO Certified Portal together with the closure deadline that the audit program allows for the completion of each corrective action.
 - If the factory is SA8000 certified then the non-conformities are solved in accordance to 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 CAP must be completed but it is not necessary to upload the closure audit to TCO Certified Portal. The closure of minor non-conformities are verified in the next initial audit.
 - A valid SA8000 certificate is considered proof that non-minor non-conformities are being monitored and closed during regular intervals by SAAS accredited verifiers.

Re-categorization

- SA8000 factories 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-conformity within the first 12 months of the audit period will be considered for risk category 3 status.

Additional clarifications that are valid for all risk categories

- If the audit program and lead auditor accepts an offsite closure audit it is also accepted in TCO Certified.
- Any time proven conditions change, such as non-conformities from a spot check, the risk categorization will be re-assessed.
- 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 CAPs

Central to the spot check conformity program is the review of the factory audit report and CAP conducted by an approved verifier approved by TCO Development. TCO Development will randomly select audit reports and CAPs in TCO Certified Portal to be spot checked. This is to ensure that the data uploaded in TCO Certified Portal is correct.

During the spot check conformity program the CAP 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 may 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 mandate. 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 CAP. 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 name

- Code of conduct
- Communication of the code of conduct
- Supporting documentation
- Conduct interview with senior management representative

Other assessments

- Review evidences 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, audit report and CAP.

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, who reports directly to senior management. Irrespective of other duties, this person must have the authority to ensure that certified products meet the supply chain criteria in TCO Certified.

The SMR must annually complete the TCO Certified 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 one or all products (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.

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 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 supply chain risk management. 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 brand owners 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.

2.3 Anti-corruption management system

Background

The risk of corruption can never be completely eliminated, but it can be minimized through strict monitoring and enforcement procedures that are in place to prevent it. Organizations have a responsibility to prevent corruption within their businesses and their supply chains. Many organizations rely on their ability to create programs that align with their own risk profiles, but conformity standardization is the best way to verify that business policy, monitoring and enforcement mechanisms are compatible with internationally recognized best practices against corruption.

Definitions

ICC: International Chamber of Commerce.

ICC rules and guidelines: Good commercial practices for responsible businesses conduct.

Whistleblowing system: A confidential means for whistleblowers to report suspicions and deviations to company policy.

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 corruption that, at a minimum, aligns with the following:

- ICC Rules on Combating Corruption article 10 points a-p.
- ICC Guidelines on Whistleblowing.

Submit the following to an approved verifier:

- A completed and signed brand owner form covering one or all products (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.

2.3.2 Clarification

The brand owner's anti-corruption program must be considered to at least include all of the good practices stated under article 10 of the ICC Rules on Combating Corruption (points a-p) and the ICC Guidelines on Whistleblowing.

A follow-up review of the brand owner program 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. As long as the process is not changed then the interview does not need to be repeated annually.

2.4 Responsibly sourced minerals

Background

To certify products according to TCO Certified, brand owners must develop a global approach in their understanding, traceability and policies for a responsible mineral supply chain. They must also support in-region initiatives working in conflict-affected and high-risk areas. Commonly mentioned risk minerals are considered as tantalum, tin, tungsten, gold (3TG conflict minerals) and cobalt, mica, lithium, copper, nickel and rare earth elements.

Definitions

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.

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 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.
- Be a part of an established multi-stakeholder program that works at supporting responsible sourcing programs for at least 3TG and cobalt.

Submit the following to an approved verifier:

- The most recent version of the public policy and a description of how it is communicated to the supply chain.
- A description of the brand owner's structured work on identifying risk areas in their supply chain.
- Proof of participation in an approved multi-stakeholder program.
- A completed and signed brand owner form covering one or all products (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 policy in English must be uploaded to TCO Certified Portal.
- A list of the approved multi-stakeholder programs the brand owner is participating in.

2.4.2 Clarifications

Responsibly sourced minerals policy

The brand owner policy is an essential statement by the brand owner. It reflects the brand owner's commitment toward responsible sourcing of minerals and the expectations of their raw material suppliers regarding the use of these minerals.

Verification guidelines

The verifier must be able to verify that the policy can be considered to cover at least conflict minerals (3TG) and cobalt, is public and also understand how it is communicated to suppliers.

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

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

- Requirement 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 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

The verifier has been provided a description of how the brand owner identifies risk areas in their supply chain. The verifier may 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 conflict minerals reporting template.

Supporting in-region responsible sourcing programs

Involvement in multi-company coordinated action that supports the development of responsible sourcing initiatives within the conflict-affected and high-risk areas is essential, since they help suppliers meet due diligence requirements, maintain trade and benefit local mining communities, whose livelihoods depend on a legitimate mining trade.

Verification

The verifier is provided with proof of brand owner participation or membership in one of the following that are considered examples of initiatives that go beyond 3TG or is global:

- European Partnership of Responsible Minerals (EPRM)
- Responsible Mineral Initiative (RMI)
- Responsible Cobalt Initiative (RCI)
- Other initiatives not listed above, but that are verified to be a multi-company program that works to support responsible sourcing programs for conflict minerals and other risk minerals. This is judged on a case by case basis.

For more information:

- The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas ("the Guidance"). [oecd.org](https://www.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.
- EPRM: The European Partnership for Responsible Minerals is a multi-stakeholder partnership established with the goal to create better social and economic conditions for mine workers and local mining communities, by increasing the number of mines that adopt responsible mining practices in conflict and high-risk areas.
- 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 Conflict Free Smelter Program (identification of smelters and refiners that source conflict-free minerals).
- Responsible Cobalt Initiative: Chinese Chamber of Commerce for Metals, Minerals & Chemical launched the Responsible Cobalt Initiative (RCI), a multistakeholder initiative where a number of companies in the supply chain are participating in collective action to address social and environmental risks in the cobalt supply chain.

2.5 Process chemicals

Background

Scientific research shows that exposure to chemical substances used in the manufacture of electronic products is linked to increased rates of cancer, reproductive damage, birth defects and other serious illnesses among workers. Chemicals such as benzene (used as a cleaning agent) and n-hexane (an industrial solvent) have well-documented toxic human health effects. These chemicals need to be phased out of production, and not be replaced with equally hazardous chemicals. To replace chemicals with safer alternatives, process chemicals and their suitable safer alternatives must be identified and assessed. The Personal Protective Equipment (PPE), training and exposure monitoring provided to the workers who risk toxic chemical exposure also need to be reviewed and improved. This mandate is focused on cleaners and industrial solvents used in final assembly factories.

Definitions

Cleaners and solvents: Liquids used to remove stains, dirt, grease etc from electronics. These products are commonly a mixture of chemicals.

Process chemicals: Cleaner and solvent substances used in manufacturing processes during the final assembly of the certified product.

Process chemical inventory: A record kept by the factory showing at least the process chemicals used at the factory.

Safety data sheets: intended to provide the users of hazardous chemicals with the necessary information to help them protect human health and the environment.

Applicability

The company or companies that manufacture the product.

References

2.1, 2.2, 2.9, 2.10, 2.11, 2.12, 2.13.

2.5.1 Mandate

Every final assembly factory manufacturing certified products:

- must have a structured health and safety management system in place, that is independently audited.
- must complete the process chemical data template provided by TCO Development
- must provide exposure controls and personal protective equipment as recommended in section 8 of the 16 section format safety data sheet.

Submit the following to an approved verifier:

- A certificate or audit report for every final assembly factory manufacturing certified products to prove conformity with a structured health and safety management system (OHSAS18001, ISO45001, SA8000, RBA VAP, BSCI).
- A completed process chemical data template for every final assembly factory manufacturing certified products
- 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.
- The process chemical data template must be reported in TCO Certified Portal.

2.5.2 Clarification

Process chemical management

TCO Development requires that all final assembly factories provide evidence of a structured health and safety management system and transparency towards TCO Development on cleaners and solvents. They must also provide appropriate training and protection to lower the risk of worker exposure to hazardous substances.

The process chemical data template is intended to help identify chemicals of concern and their suitable safer alternatives. If no safer alternative is available for practical use, then improved worker protective equipment and health monitoring becomes the main priority until a safer alternative is found.

Proof of health and safety management system conformity

The applicant must upload a valid OHSAS18001, ISO45001 or SA8000 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 can submit an RBA VAP or BSCI audit that is less than 12 months old, showing that the factory's health and safety management system is audited as being in conformity.

Process chemical data template

The applicant must complete and upload the process chemical data template to TCO Certified Portal. The template and guidelines on how to complete it can be found on tcocertified.com/certification-documents.

- The senior representative whose responsibilities cover chemical management at the factory must assist the applicant in the completion of the process chemical data template.
- All areas of the template must be completed except the GHS and GreenScreen® list translator columns, which are optional as reference use.
- In cases of confidential business information (CBI), it is possible for the chemical supplier to directly submit the chemical information to TCO Development. This must first be agreed upon by the applicant and TCO Development.
- The information must cover all cleaner and solvents and their chemical ingredients used in the final assembly of certified products.
- Upon request, the process chemical inventory at the factory must also be submitted to TCO Development for verification purposes.
- The process chemical data template must be updated every two years, to monitor progress in hazardous chemical substitution and worker protection.

- 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.

Exposure controls and personal protective equipment

Each final assembly factory must provide personal protection equipment as described in section 8 of the safety data sheet (SDS), that covers exposure controls and personal protection. The SDS must be of a quality that is aligned with the rules of the global harmonised system (GHS), following the 16 part format. This is verified through the social audit required in TCO Certified.

Verification will be a review of the completed process chemical data template by TCO Development and independent factory audits by assessment bodies.

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 and air pollution, and greenhouse gas emissions.

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

In chapter 3 of TCO Certified, generation 8, the criteria focus on two main areas designed to create a more environmentally responsible manufacturing environment where certified products are made:

- Environmental Management System, EMS. With an environmental management system (EMS) in place, the brand owner can work systematically to continuously improve the environmental performance of the company and its products.
- Energy efficiency indicators - measurement of energy efficiency in final assembly factories where certified product models are made.

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 improvement at both company and product levels. To be efficient, an environmental 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.

The company or companies that manufacture the product.

References

3.1 and 3.2.

3.1.1 Mandate

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

Submit the following to an approved verifier:

- A copy of a valid ISO 14001 certificate or EMAS registration 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 or EMAS registration 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 a maximum 12 months on behalf of a factory that is not yet certified or registered, by completing 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 or EMAS registration 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 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:

Completed and signed factory form(s) (chapter 11.2)

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 energy efficiency indicators must be reported in TCO Certified Portal.

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 60950 or EN/IEC 60065 or EN/IEC 62368-1.

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 $\pm 3\%$ 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.

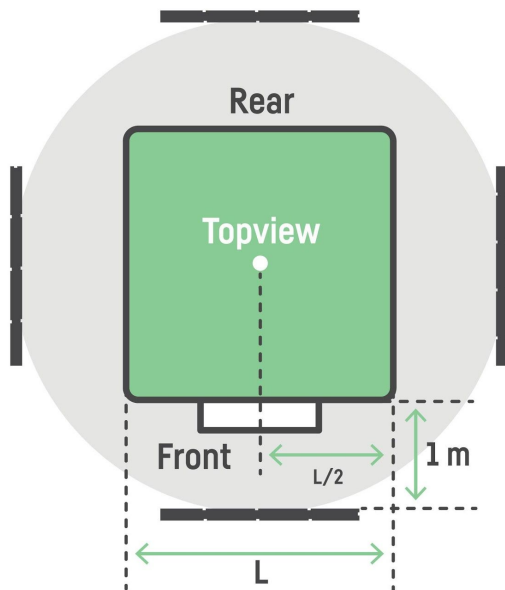


Figure alternating electric fields 1. Measurement geometry for band II.

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 topside of the product.

Band II: 2 kHz to 400 kHz, ≤ 25 nT measured at 1 m around and topside 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.

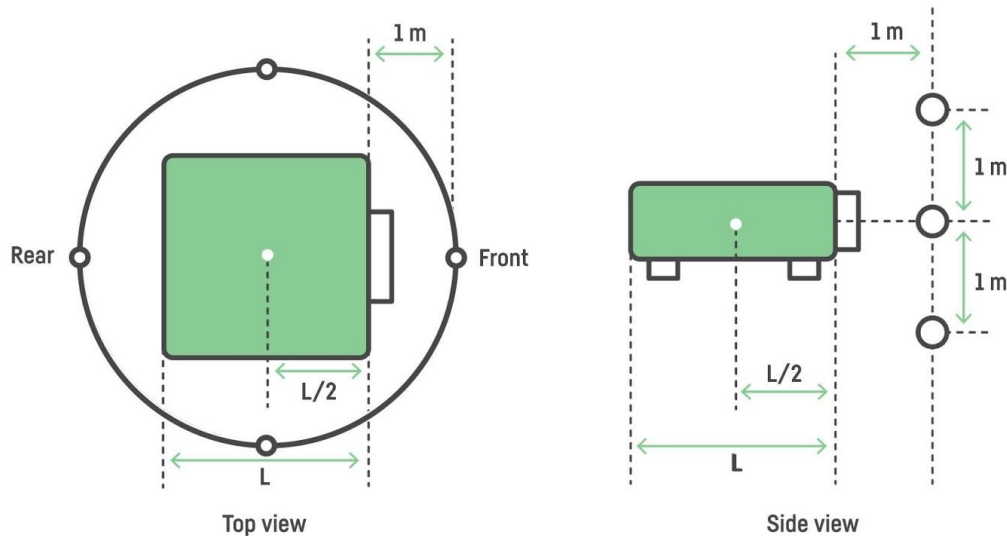


Figure alternating magnetic fields 1. Measurement geometry for the test object.

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.

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

*Equivalent light output setting where products fulfil TCO Certified picture quality requirements (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 declared 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 declared 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 8, 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

Energy production is a large source of greenhouse gas emissions globally. Therefore, one of the most important factors in decreasing the carbon footprint of IT products, is to make sure that they are energy efficient. With an ever-increasing volume of IT equipment in use, the energy efficiency in the production and use phase of each product is vital.

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)
$\leq 3 \text{ m}^2$	$\leq 260 \text{ W}$
$\leq 6 \text{ m}^2$	$\leq 310 \text{ W}$
$> 6 \text{ m}^2$	$\leq 310 + 150 \cdot (A_{\text{max}} - 6) \text{ W}$
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:

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

5.1.2 Clarification

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

Energy production is a large source of greenhouse gas emissions globally. Therefore, one of the most important factors in decreasing the carbon footprint of IT products, is to make sure that they are energy efficient. With an ever-increasing volume of IT equipment in use, the energy efficiency in the production and use phase of each product is vital. To reduce the energy consumption of the product the external power supply must conform with the International Efficiency Marking Protocol for External Power Supplies.

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
$> 6,9 \text{ m}^2$ ($\approx 150''$ diagonal)	1.57	UXGA, Full HD
$\leq 6,9 \text{ m}^2$ ($\approx 150''$ diagonal)	1.16	SXGA+
$\leq 3,1 \text{ m}^2$ ($\approx 100''$ diagonal)	0.54	XGA, HD
$\leq 1,5 \text{ m}^2$ ($\approx 70''$ diagonal)	0.37	SVGA
$\leq 0,5 \text{ m}^2$ ($\approx 40''$ 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 $> 6.9 \text{ m}^2$ ($\approx 150''$ 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

Projectors using metal halide lamps.

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

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 TCO Certified criteria, hereinafter named "TCO Certified Image Size". A_{\max} is measured in m².

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

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.

- $\Phi_{\text{white/measured}}$ 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/m² 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 affects 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	$L_{\text{white/office}} = 170 \text{ cd/m}^2$	$L_{\text{white/video}} = 85 \text{ cd/m}^2$
Ambient illuminance falling on the screen	$E_{\text{amb/office}} = 100 \text{ lux}$	$E_{\text{amb/video}} = 20 \text{ lux}$

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 on the TCO Certified certificate.

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.

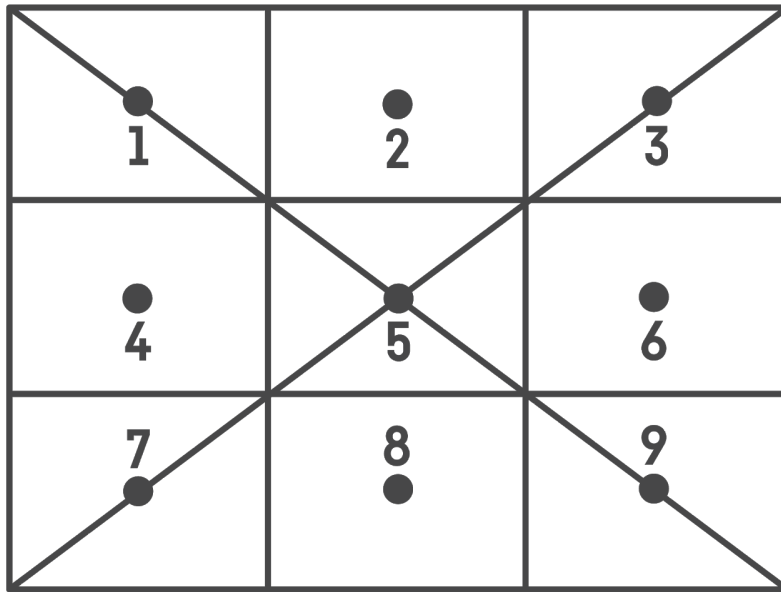


Figure luminous flux 1.

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:

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

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:

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

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:

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

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

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

$\Phi_{white/measured}$ 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:

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

- $\Phi_{black/measured}$ 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, and upgradeable, 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 8, 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 and water 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, 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.

6.2 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

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.

Storage: any computing hardware that is used for storing, porting and extracting data files and objects, including temporarily and permanently storage of information. E.g. (SSD, HDD, RAM).

Display assembly: main display panel.

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

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 potential to fail during normal use. A list of the critical replaceable components as defined by TCO Certified is specified for each product group.

Applicability

All product categories.

References

6.1, 6.2.

6.2.1 Mandate

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

Replaceable parts management

- The brand owner must provide a service manual including step by step instructions and component descriptions for the disassembly/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 fulfill 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 throughout the whole lifetime of the certificate.
- Step-by-step instructions on how to replace CPU and RAM does not need to be listed in the service manual (mandate 6.2.1) when CPU or RAM is soldered directly onto the main board.

The critical replaceable components for each product type are listed below:

Critical replaceable components:

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

The critical replaceable components listed in the clarification need only be made available if they are part of the certified product.

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. Throughout the life cycle, products may release dioxins, halogens and other toxins, which can persist in the natural environment and human body.

IT products contain a number of substances that can be categorized as hazardous. These include flame retardants, used to prevent products from catching fire, and plasticizers, that make plastics, especially cables, more flexible.

Risks include worker and environmental exposure in the manufacturing supply chain as well as during end of life handling. In addition, contaminated materials cannot responsibly be used in new products since they include substances that may be banned in the future. These materials risk being incinerated or discarded directly into the waste stream, adding to the problem.

While some hazardous substances have been phased out through legislation or voluntary initiatives, too little is known about the substances 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 a pathway for making substitutions.

TCO Certified – reducing risk, driving a shift to safer substitutes

Criteria in chapter 7 focus on:

- Further reducing the use of hazardous substances by restricting the use of them in certified products. These substances include heavy metals, halogens and high hazard non-halogens.
- Driving a shift toward transparency and safer substitutes through independent assessment and use of safer alternative substances to non-halogenated flame retardants and plasticizers. The assessed and 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, in the use phase where additives can leak from the plastic and accumulate in dust, harming both our health and the environment, 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 RoHS2 Directive (2011/65/EU). As TCO Certified is a global certification, this also affects products sold outside the EU.

Applicability

Projectors.

References

7.1, 7.2.

7.1.1 Mandate

The projector must not contain cadmium, mercury, lead and hexavalent chromium. The criterion applies to components, parts and raw materials in all assemblies and sub-assemblies of the product, e.g. paint, surface treatment, plastics and electronic components.

Submit the following to an approved verifier:

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

Submit the following together with the application to TCO Development:

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

7.1.2 Clarification

Exemptions are according to EU Directive 2011/65/EU (RoHS) and the documents supporting the directive.

The maximum concentration values tolerated by weight in homogeneous materials for cadmium, mercury, lead and hexavalent chromium are according to EU Directive 2011/65/EU (RoHS) 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.

7.2 Halogens

Background

Halogenated flame retardants and plasticizers 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. The substances may migrate from the products to humans during the use phase, with unknown health effects. At end of life, the substances risk leaking out into the natural environment. PVC is by far the most common halogen-containing plastic.

Definitions

Printed wiring board laminate is a printed board that provides point-to-point connections.

Halogens are a group of five chemically related non-metallic elements in the Periodic Table; fluorine, chlorine, bromine, iodine and astatine.

Polybrominated biphenyls (PBB) and Polybrominated diphenyl ethers (PBDE) are restricted in the RoHS directive (2002/95/EC) 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. Parts that weigh more than 25 grams (10 g for headsets and 5 g for smartphones) and are made mainly of plastics must not contain flame retardants or plasticizers with halogenated substances or intentionally added halogens as part of the polymer.
 - a. Exempted are printed wiring board laminates, electronic components and all kinds of cable insulation.
2. The product must not contain PBB, PBDE and HBCDD.
 - a. Note: This applies to components, parts and raw materials in all assemblies and sub-assemblies of the product, such as batteries, paint, surface treatment, plastics and electronic components.

Submit the following to an approved verifier:

- A completed and signed product form (chapter 11.3)

Submit the following together with the application to TCO Development:

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

7.2.2 Clarification

1. The criterion applies to plastic parts in all assemblies and sub-assemblies. LCD panels are included in the requirement.
2. The criterion 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.

HBCDD has been identified as a Substance of Very High Concern in accordance with EU's REACH criteria. The main application of HBCDD in EEE is a flame retardant in HIPS plastic being used for closures and structural parts of different types of EEE. TCO Development considers that the use of HBCDD in EEE is not deemed essential as technically suitable alternative substances and materials are available and already used extensively today.

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 behaviour of plastics in fire conditions or to improve the processing behaviour, are exempted provided that they do not exceed 0.5 % by weight of the material in homogeneous materials.

7.3 Non-halogenated substances

Background

The purpose of this criterion is to increase the knowledge of what non-halogenated substances are used in certified products, how hazardous they are to human health and the environment, and to drive a shift towards less hazardous alternatives. Non-halogenated substances may be problematic in the manufacturing and material recovery phases where workers and the environment can be exposed.

This mandate uses the hazard assessment and decision logic framework GreenScreen® for Safer Chemicals, developed by the non-profit organization Clean Production Action (CPA). The GreenScreen criteria are in line with international standards and regulations including the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), OECD testing protocols and the European REACH Regulation. The U.S. EPA's Design for Environment (DfE) Alternatives Assessment is also an important influence for GreenScreen.

Definitions

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. Go to tcocertified.com.

Applicability

All product categories.

References

7.4, 7.5, 7.6.

7.3.1 Mandate

- Non-halogenated flame retardants used in parts that weigh more than 25 grams (10 g for headsets and 5 g for smartphones) and are made mainly of plastics 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 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 printed wiring board laminates, 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 copy of the full certified assessment report or a certificate/summary with remote access to the full report issued by a GreenScreen licensed profiler.

7.3.2 Clarification

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 or for accepted substances to come under reassessment 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 the TCO Certified Accepted Substance List. The date for removal will be announced at least one year before it is made effective, to give product manufacturers time to switch to safer alternatives.

Any spot-checks by TCO Development will include disclosure of relevant flame retardants being used in randomly chosen products. Spot checks are conducted to verify that the obligations according to this mandate are fulfilled and will include the safety data sheet (SDS) and the right to request that a substance undergo further reviews to assess the completeness, quality and validity of a draft benchmark score, such as through a verified GreenScreen assessment.

TCO Development require to review the full certified assessment report. It is acceptable for the applicant to submit a copy of a certificate / summary of the certified assessment result as long as it is issued by a licensed profiler. In this case TCO Development must be given access to the the certified assessment report kept on the service provider’s database. Once TCO Development has reviewed the certified assessment report, the substance will be added to the TCO Certified Accepted Substance List available at tcocertified.com.

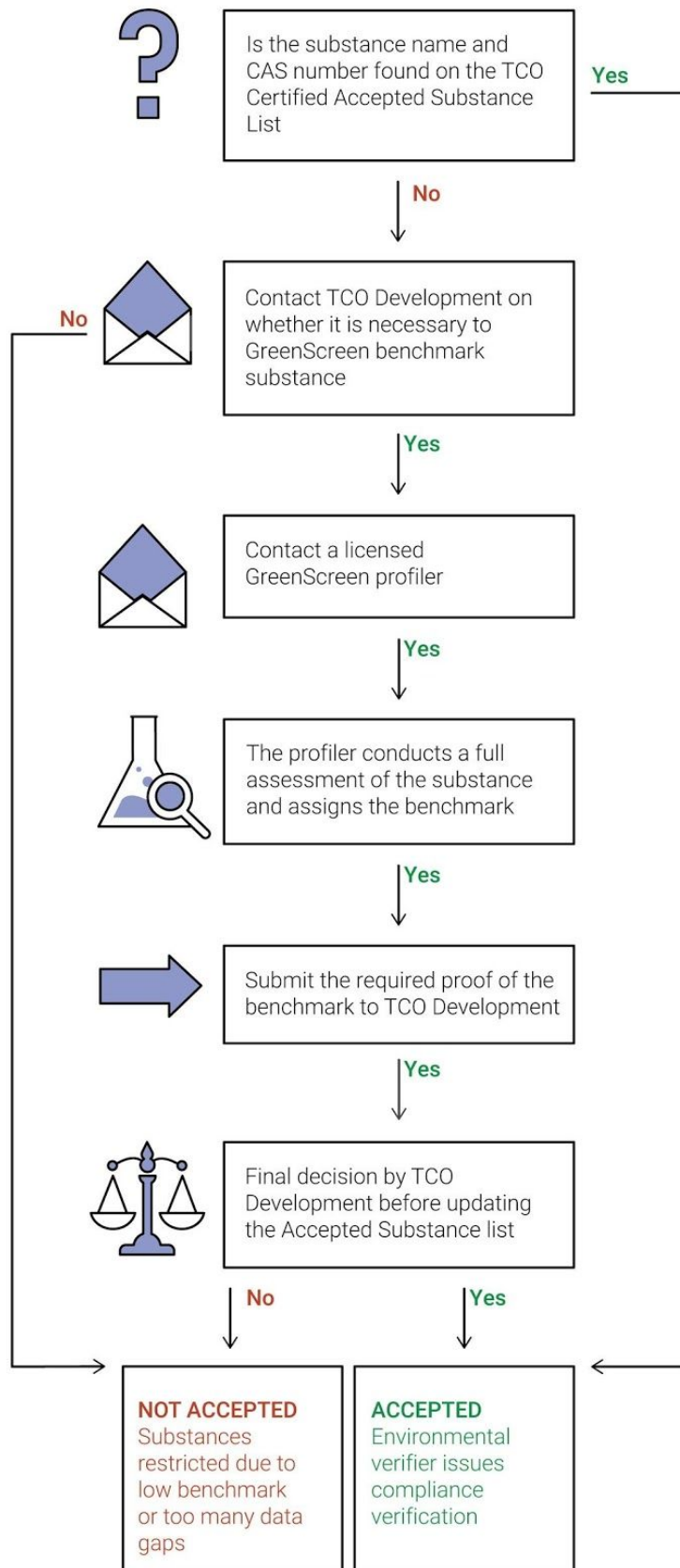
Sites that have GreenScreen assessment reports publicly available are GreenScreen Store (greenscreenchemicals.org) and Interstate Chemicals Clearinghouse (theic2.org).

Conformity procedure (See also Flow chart 7.3.2)

- The applicant must contact suppliers such as the plastic and panel manufacturer and ask them to confirm that they only use flame retardants and plasticisers that include substances on TCO Certified Accepted Substance List.
- If all flame retardants and plasticisers only include substances on TCO Certified Accepted Substance List, complete the product form 11.3 and submit it to an approved environmental verifier. When the verifier considers all environmental documentation to be in conformity they will issue an environmental verification to the applicant.
- If any flame retardant or plasticiser 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 an environmental verifier.

For this, the procedure is as follows:

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 GreenScreen licensed profiler. The list of licensed profilers can be found on the Clean Production Action website at 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 three years.
5. Benchmark reports or certificate / summary must be submitted to TCO Development for final approval before a substance is added to the TCO Certified Accepted Substance List.
6. 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 the TCO Certified Accepted Substance List the procedure is as follows").



Flow chart 7.3.2 Conformity procedure TCO Certified Accepted Substance List

Applying for an extended period of time for substances not on the 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 plasticisers only include substances that are on the 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, restrict 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).

The GreenScreen criteria are in line with international standards and regulations including the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), OECD testing protocols and the European REACH Regulation. The U.S. EPA's Design for Environment (DfE) Alternatives Assessment is also an important influence for GreenScreen.

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.

Applicability

All product categories.

References

7.4, 7.5, 7.6.

7.4.1 Mandate

- Plasticizers used in product housing and cable 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.
- 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 copy of the full certified assessment report or a certificate/summary with remote access to the full report issued by a GreenScreen licensed profiler.

7.4.2 Clarification

TCO Development require to review the full certified assessment report. It is acceptable for the applicant to submit a copy of a certificate / summary of the certified assessment result as long as it is issued by a licensed profiler. In this case TCO Development must be given access to the the certified assessment report kept on the service provider’s database. Once TCO Development has reviewed the certified assessment report, the substance will be added to the TCO Certified Accepted Substance List available at tcocertified.com.

For details on the rules for adding a substance to the TCO Certified Accepted Substance 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 essential for a sustainable life cycle

According to the United Nations University, electronic waste is the fastest growing waste stream in the world, with nearly 50 million metric tons generated every year. Today, a large share of e-waste ends up in scrap heaps or is incinerated, 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 recovered at their end of life.

Product and material recovery should be made easier for three main reasons:

- to conserve natural resources,
- to decrease environmental impact and,
- to encourage material reuse.

Taking back used products and recovering their materials supports a more sustainable, circular approach to the product life cycle. To drive this positive development, products and their packaging must be designed in a way that enables remanufacturing and recycling. To be effective, this approach also requires that products are made using safer materials, that are more attractive for re-use.

IT brand owners must also have systems in place for taking back discarded products and handling them in a responsible way.

TCO Certified — supporting take-back and material recovery

In TCO Certified, chapter 8, the criteria place responsibility on the brand owner for:

- material coding of plastics,
- product packaging and,
- product take back system.

8.1 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, notebooks, tablets, smartphones, desktops, all-in-one PCs and projectors.

References

8.1-8.3.

8.1.1 Mandate

- Parts made mainly of plastics weighing more than 25 grams (5 grams for smartphones) must be material coded in accordance with ISO 11469 and ISO 1043-1, -2, -3, -4.
- Exempted are printed wiring board laminates as well as plastic parts containing other materials in any significant amounts.

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.

8.1.2 Clarification

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.

8.2 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.

8.2.1 Mandate

- Non-reusable packaging components weighing more than 25 grams must be possible to separate into single material types without the use of tools.
- 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.

8.3 Take back system

Background

The vast amount of electronic waste in the world today is a rapidly growing environmental problem. It is therefore important that manufacturers provide mechanisms to take back their equipment. This is consistent with the principle of individual producer responsibility, wherein each manufacturer must be financially responsible for managing its own branded products at end-of-use. Currently, large amounts of electronic waste is being exported to developing countries where it is managed unsustainably, burdening local communities with this global environmental problem. The Basel Convention governs the export of many types of electronic waste, however it is not properly implemented in all countries. With this mandate, TCO Development aims to influence the expansion of better electronic waste management practices to more countries.

Definition

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.

Take back system is a system that makes sure that the customer can return used products to be recycled. The system can be with or without a fee.

Environmentally acceptable recycling methods are:

- Product and component reuse
- Material recycling with secured handling of hazardous chemicals and heavy metals
- Pollution-controlled energy recovery of parts of the product

Applicability

All product categories.

References

8.4.

8.3.1 Mandate

The brand owner (or its representative, associated company or affiliate) must offer their customers the option to return used products for environmentally acceptable recycling methods in at least one market where the product is sold and where electronics take back regulation is not in practice at the date of application.

At least one option must be fulfilled:

1. Product is sold only on WEEE legislation markets or similar
2. World-wide product take back
3. One additional market lacking WEEE legislation where product take back is offered

Submit the following to an approved verifier:

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

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.

8.3.2 Clarification

If the applicant chooses *option 1* (Product only sold on markets with WEEE legislation or similar) and signs the form, the requirement is fulfilled.

If *option 2* or *3* (World-wide product take back or one additional market lacking WEEE legislation where product take back is offered) is chosen, the form must be signed and the applicant must provide a short description of how the take-back system on that market works. This can also be done by giving a reference (for example a link to a website) to the representative, associated company or affiliate taking care of the take-back system on that market.

In case of *option 3*, the applicant must also provide the name of the market (country) where a take back system is provided.

TCO Development has no requirement on the take-back system being free of charge.

It is important to point out that any recycling and waste export control legislation in countries where the applicant operates must always be met.

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_g 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).

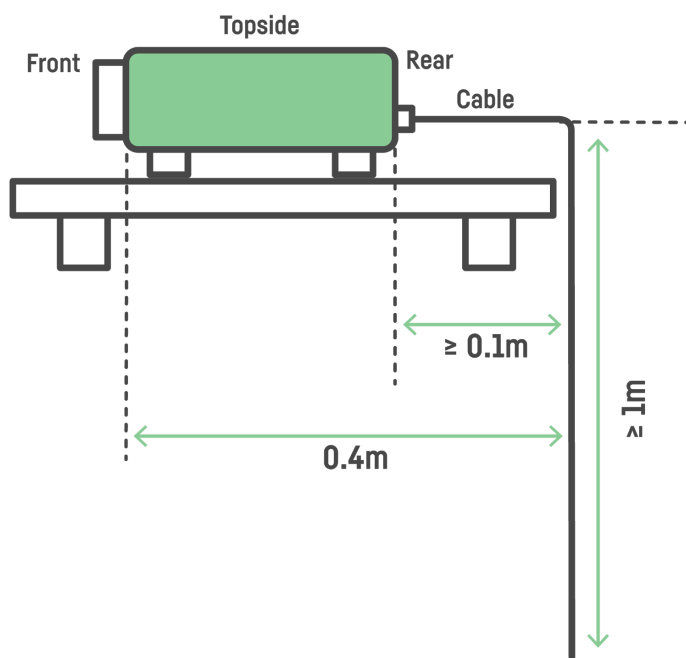


Figure 9.3.3.1. Projector without external power supply unit.

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.

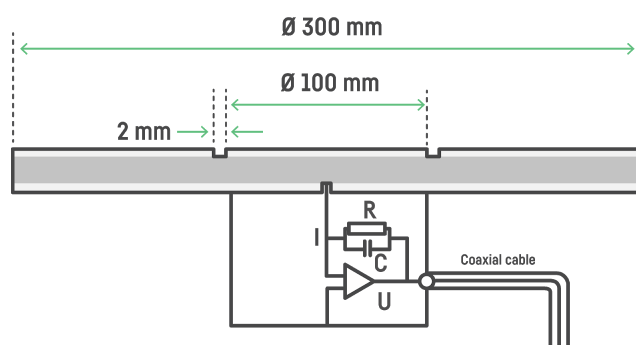


Figure 9.3.4.1. Sketch and circuit principle of the alternating electric field meter for alternating electrical field measurements. The feedback circuit of the operational amplifier is a capacitance C in parallel with a high value resistor R to ensure that there is no DC voltage across the plates of 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

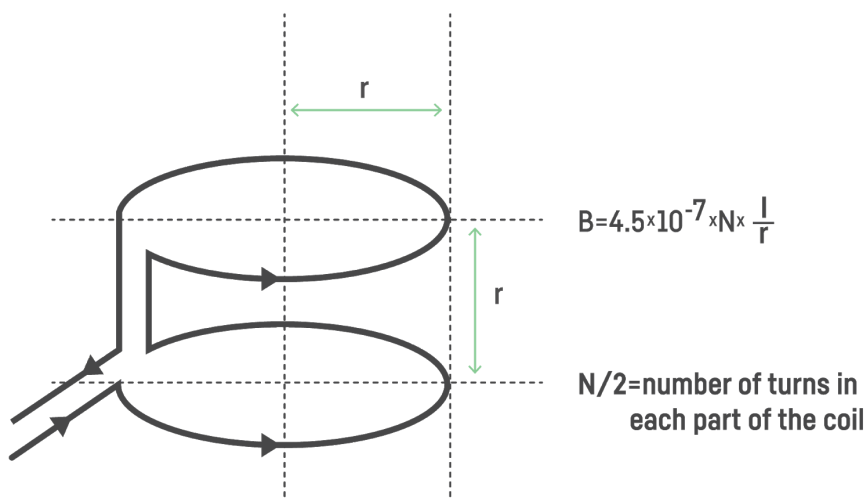


Figure 9.3.4.4. Calibration using a Helmholtz-type calibration coil.

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 $\pm 1\%$
AC mains frequency*	50 Hz, tolerance ± 0.5 Hz
Line impedance	0.25 Ω
Total harmonic distortion	< 2%
Test room temperature	23 \pm 3°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 ± 2.5 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. Brennessoltz, 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/finalresultats/Annex6_RoHS_AnnexII_Dossier_DEHP.pdf [DEHP]
61. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/abfall/ROHS/finalresultats/Annex7_RoHS_AnnexI_Dossier_BBP.pdf [BBP];

62. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/abfall/ROHS/finalresults/Annex8_RoHS_AnnexI_L_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 8, 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 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 corruption management system (mandate 2.3.1)

Anti corruption management mandate is fulfilled (yes/no)	
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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)	
Proof of participation in an approved multi-stakeholder program is attached (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 8, 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 Process chemicals (mandate 2.5.1)

A certificate or audit report for every final assembly factory manufacturing certified products to prove conformity with a structured health and safety management system (OHSAS18001, ISO45001, SA8000, RBA VAP, BSCI) is attached (yes/no)	
A completed process chemical data template for every final assembly factory manufacturing certified products is attached (yes/no)	
Process chemicals mandate is fulfilled (yes/no)	

11.2.2 Environmental management system (mandate 3.1.1)

A copy of a valid ISO 14001 certificate or EMAS registration for every final assembly factory manufacturing certified products is attached (yes/no)	
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11.2.3 Energy efficiency indicators (mandate 3.2.1)

Does the factory have an energy management system? (no/which)	
Total energy consumption for the factory. (KWh/Year)	
Percentage of renewable energy consumed by the factory (%)	
Are there cleanroom facilities in house? (no/classification and amount)	
Is compressed air used for handheld tools at the assembly (no/which)	
Is there in house reflow PCB soldering? (yes/no)	

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 8, 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)

mandate fulfilled through (A, B or C): A: As a separate printed or digital document. B: Included in a printed or digital user manual. C: 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. (A/B/C)	
Information to end users mandate is fulfilled (yes/no)	

11.3.2 Product specification

Product manufacturer	
Product brand name	
Product brand owner	
Product type/model name	
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

External Power Supplies

Brand name	Model/type	Rating	Class

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 Sustainability performance indicators (mandate 1.3.1)

The questions marked with * are the published sustainability performance indicators, which will be printed on the certificate. The rest of the data may be published anonymously, ensuring that no brand owner can be identified.

*Percentage of recycled plastic by weight of total weight of plastic parts	%	
*Total weight of the product and power supply (without packaging)	Kg	
*Measured energy consumption according to TCO Certified in On mode (normal operation) for the declared TCO Certified Image Size.	On mode (W)	
Does the brand owner have a public list of all final assembly factories for the certified product?	yes/no	
Are all final assembly factories manufacturing the certified product SA8000 certified?	yes/no	

Do all final assembly factories manufacturing the certified product use at least 20% renewable energy?	yes/no	
Is it possible to replace all of the critical parts listed in the "Replaceable components" criteria (6.2), without the use of heat or other tools than those intended to turn, slotted (ISO 2380), cross-recessed (Phillips® and Pozidriv®, ISO 8764) or hexalobular recess heads (Torx®, ISO 10664)?	yes/no	
Is the "halogens" criteria met for all plastic parts regardless of weight?	yes/no	
Is the "halogens" criteria met for the whole product without any excepted parts?	yes/no	
Is the "non-halogenated substances" criteria met with no substances used having a GreenScreen® benchmark lower than 3?	yes/no	
Is the "non-halogenated substances" criteria met for all plastic parts regardless of weight?	yes/no	
Is the heavy metals criteria fulfilled without any exception for mercury in lamps?	yes/no	

11.3.5 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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11.3.6 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)		
A-weighted sound power level (L_{WAd}) in $A_{Max/office}$	Operating mode (B)	
	Idle mode (B)	
	Eco operating mode (B)	
A-weighted sound power level (L_{WAd}) in $A_{Max/video}$	Operating mode (B)	
	Idle mode (B)	
	Eco Operating mode (B)	
Acoustic noise mandate is fulfilled (yes/no)		

11.3.7 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)	

11.3.8 Hazardous substances

7.1.1 Heavy metals mandate is fulfilled (yes/no)	
7.2.1 Halogens mandate is fulfilled (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)	

11.3.9 Material recovery

8.1.1 Material coding of plastics mandate is fulfilled (yes/no)	
8.2.1 Product packaging mandate is fulfilled (yes/no)	

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 8, 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)

Product warranty - brand owner mandate is fulfilled (yes/no)	
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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 Take back system (mandate 8.3.1)

Option 1. Product is sold only on WEEE legislation markets or similar (yes/no)	
Option 2. World-wide product take back reference attached (yes/no)	
Option 3. One additional market lacking WEEE legislation where product take back is offered (yes/no)	
Markets:	
Take back system mandate is fulfilled (yes/no)	

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 8, 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.

