TCO DEVELOPMENT

TCO Certified Projectors 2.0

11 November 2015

TCO DEVELOPMENT

Contents - TCO Certified Projectors

Certification Support

If you would like to certify your products and need support in understanding TCO Certified, this criteria document and the certification process, TCO Development's test and verification partners around the world are available to help clarify this document and assist you with certification in your native language.

For a list of accredited test and verification partners, contact; certification@tcodevelopment.com or log onto www.tcodevelopment.com

Introduction

TCO Certified is an international third party sustainability certification for IT products. By choosing TCO Certified computers, displays and other devices, businesses and organizations around the world are able to help meet environmental and social challenges associated with electronics.

Since the end of the 1980s, TCO Development has advanced the sustainable development of IT products. Today our international certification system – TCO Certified – makes it easier to choose sustainably designed and manufactured IT products such as displays, computers, smartphones and tablets. TCO Certified is a third party certification, Type 1 Eco Label according to ISO14024.

Sustainability in all phases of the product life cycle

Electronics are associated with many different sustainability risks throughout the life cycle, including manufacturing, use and end of life phases. Criteria in TCO Certified aim to address many of these challenges throughout the life cycle, making it the most comprehensive third party certification for IT products. For each criteria area in this document, the relevant life cycle phase is indicated by the following icons:

Criteria – Manufacturing phase
Socially responsible manufacturing, environmental management system.

Criteria – use phase
Climate, ergonomics, health and safety, extended product life and emissions.

Criteria – end of life phase
Reduction of hazardous content and chemicals, design for recycling

With every major update we aim to enhance the criteria in line with technology innovation and sustainability challenges. Updates are a result of dialog with key stakeholders, such as purchasers, users, industry, and subject matter experts. This criteria document, TCO Certified Projectors 2, is the second version of TCO Development's certification of projectors. Moving forward, subsequent versions, 2.1, 2.2 etc., may be released, but will be considered only as updates within the second version, with improved precision of the mandates and test methods.

Citing from these criteria (e.g. in procurement contracts) is permitted, provided that the source is disclosed and the extent of the quotation is consistent with sound copyright practice. For further information, please visit www.tcodevelopment.com.

TCO Development, Stockholm, November, 2015

TCO DEVELOPMENT

A Criteria

A.1 General information

This document contains requirements, test methods and references for front screen projectors with fixed resolution, herein referred to as “projectors” throughout. Projectors are devices 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 (so-called front screen projection with fixed resolution).

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. (See References 1 and 2)

The aim of this criteria document is to provide relevant criteria and test methods for the actual life cycle of the product. This criteria document consists of two parts; Part A- the mandated criteria and Part B - clarifications and test methods.

Compliance with the mandates in this criteria document is achieved in one of two ways; either through a test report or through a verification report.

1. A test report is defined as a report based on:
    - Testing conducted by the facility issuing the test report for the product identified in the report.
2. A verification report is defined as a summary report and a verdict (pass or fail) based on either:
    - A test report issued by the same facility
    - A test report issued by a different facility.
    - Declarations from the Company or Brand owner applying for the certificate.

The options accepted by TCO Development for each criterion can be found under each mandate.

A.1.1 Information to End-Users

Background
It is important that the purchaser of a product that has been certified in accordance with TCO Certified Displays receives information concerning the sustainability features of the product. This information, contained in the TCO Certified Document, is developed and provided by TCO Development.

Applicability
All front screen projectors with fixed resolution.

Life Cycle Phases

Clarification
See B.1.1

References
The contract between TCO Development and the Applicant/Brand owner.

Mandate A.1.1:

An information document called "TCO Certified Document" provided by TCO Development, shall accompany the product to describe why these particular criteria have been chosen for the products within the TCO Certified program, and what is expected to be achieved by them. The document shall be written in English or the native language where the product is to be sold.

Examples of how the document can accompany the product:

- As a separate printed document.

- As a digital file or printed in the user manual.

- As a direct link from the user manual or digital file to the document on the manufacturer's web site.

Submit the following to an approved verifier:

1. Information on how the TCO Certified Document accompanies the product

2. A written guarantee that the above mandate is fulfilled. The document shall be signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

A copy of a verification report from a test facility approved by TCO Development.

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.2 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 m2) which can be verified readable. The term used throughout this criteria document is for this measurement is: “TCO Image size”.

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

1. Based on acceptable visual levels, as determined by scientific research.
2. Based on statistics from tests carried out in accordance with TCO Development, ISO, MPR regulations and from specialized tests.
3. Based on manufacturers’ knowledge and experience. 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.

Life Cycle Phase

A.2.1 Light flux characteristics

A.2.1.1 Luminous flux

Background

It shall be possible to have a sufficiently high light flux with respect to the ambient lighting in order to present a comfortable viewing situation with sufficient luminance and luminance contrast. Poor light flux can affect legibility and colour discrimination of the presented image content, leading to misinterpretation and extended visual work load.

The light flux must be suitable for the viewing conditions. In dim lighting conditions a too high light flux can be disturbingly high 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 criteria, hereinafter named "**TCO Image size**". A_{max} is measured in m².

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

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

- $\Phi_{white/measured}$ is the measured light flux from the projector in lumens falling on a white screen. (In the calculations the screen is considered to have a Lambertian surface with gain=1).
- L_{white} is the minimum required imaging luminance in cd/m^2 of white to achieve the "TCO 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	$L_{white/office}$ = 170 cd/m²	$L_{white/video}$ = 85 cd/m²
Ambient illuminance falling on the screen	$E_{amb/office}$ = 100 lux	$E_{amb/video}$ = 20 lux

Applicability
All front screen projectors with fixed resolution.

Test procedure
See B.2.1.1.

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

Mandate A.2.1.1:

The diagonal length in inches for the "TCO Image Size" for the native aspect ratio of the projector shall be declared in the TCO Certificate.

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.1.2 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 shall 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 shall be able to give a contrast ratio of 10:1 in normal "video room" ambient illuminance (20 lux). To achieve this the luminous flux of black must not be higher than $\Phi_{black/max/video}$

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

- $\Phi_{white/measured}$ and A_{max} can be collected from A.2.1.1.

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.2.1.2

References

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

Mandate A.2.1.2:

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

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

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.1.3 Light flux uniformity

Background

Image quality e.g. the identification of individual letters, could be badly affected by non-uniform image illuminance. When poor image illuminance uniformity is visible, it can locally affect the contrast and consequently the legibility of information on the projector. The areas of deviating image illuminance can have different sizes and cause varying edge sharpness.

Definition

Light flux uniformity is the capability of the projector to maintain the same illuminance level over 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.

Test procedure

See B.2.1.3.

References

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

Mandate A.2.1.3:

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

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

For short throw projectors (throw ratio 0.38< x ≤ 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:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.2 Image detail characteristics

A.2.2.1 Native display resolution requirement

Background

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

The necessary resolution to avoid a low fill factor resulting in jaggies poor rendering of details etc is dependent on the viewing distance. If the viewing distance is larger, a lower fill factor (resolution) can be acceptable.

For most TCO Image Sizes a viewing distance of 1.5 x the diagonal is defined for the first row of viewers.

However, for very small TCO Image Sizes (e.g. presented by pico projectors) it is likely that the first row of viewer is slightly further away than 1.5 x the diagonal. This means that a lower resolution can be accepted for small TCO Image Sizes. Because of this, the viewing distance in this TCO Certified criteria document is defined for three different TCO Image Size spans.

Example
To achieve 30 pixels/degree for a 4:3 aspect ratio image with a viewing distance of 1.5 times the diagonal it is necessary to have XGA native resolution. In the same way it is necessary to have SVGA native resolution if the viewing distance is increased to 1.8 times the diagonal and VGA native resolution is acceptable if the viewing distance is increased to 2.2 times the diagonal.

This means that if the intended use is to project 4:3 images of $0.5m^2$ it is enough with VGA native resolution. If the intended use is to project larger images than $1.5m^2$ it is necessary with XGA resolution.

For other aspect ratios the minimum accepted resolution must be calculated according to the formulae in B.2.2.1.

Definition

A pixel is the smallest addressable imaging element of the digital picture capable of reproducing a full range of luminance and colours.

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.

Test procedure

See B.2.2.1.

References

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

Mandate A.2.2.1:

The projected image shall have a *pixel* density ≥ 30 pixels/degree visual angle. To achieve this the necessary native resolution is dependent on the viewing distance.

For projectors with a declared TCO Image size ≥ 1.5 m^2 (≈ 70" diagonal) the viewing distance is considered to be 1.5 x diagonal of the TCO Image Size. (This corresponds to at least XGA for 4:3).

For projectors with a declared TCO Image size < 1.5 m^2 (≈ 70" diagonal) the viewing distance is considered to be 1.8 x diagonal of the TCO Image Size. (This corresponds to at least SVGA for 4:3).

For projectors with a declared TCO Image size ≤ 0.5 m^2 (≈ 40" diagonal) the viewing distance is considered to be 2.2 x diagonal of the TCO Image Size. (This corresponds to at least VGA for 4:3).

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.3 Colour characteristics

A.2.3.1 Correlated colour temperature, CCT variation

Background

If the Projector is equipped with pre-set correlated colour temperature settings the user has the right to expect that the colour hue of the measured correlated colour temperature setting is close to the one indicated by the pre-set. This makes it possible to more accurately evaluate the colour of an image on the Projector compared to real scenes or prints.

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

The colour rendering of the projected image is very dependent on the screen used.

Normal daylight has a correlated colour temperature in the range 5000 – 10000 K. As an example, the daylight on a cloudy day at midday is about 6500K.

Definition

The correlated colour temperature CCT is the temperature of the Planckian radiator whose perceived colour most closely resembles that of a given (whitish) stimulus at the same brightness and under specified viewing conditions.

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.2.3.1.

References

5, 8, 10, 11, 13, 14, 15, 16, 17, 18, 9, 29, 21, 22, 23, 24, 25, 26 and 27.

Mandate A.2.3.1:

The correlated colour temperature of the projected bright white image shall be in the range of 5000K to 10000K.

Each pre-set correlated colour temperature shall have a colour difference $\Delta u'v' \leq 0.015$ when compared to CIE u´ and v´ chromaticity co-ordinates for corresponding correlated colour temperatures.

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.3.2 Colour uniformity

Background

The human visual system is very sensitive to changes in colour hue in white and grey areas. Since the white or grey colour hues are the background on which most colours are judged, the white or grey areas are the reference colours of the image.

Patches of colour variation on an active white or grey image could reduce the contrast locally, be disturbing and affect the legibility, colour rendering and colour differentiation.

The colour rendering of the projected image is very dependent on the screen used.

Definition

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

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.2.3.2.

References

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

Mandate A.2.3.2:

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

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.3.3 Colour gamut

Background

Accurate colour rendering is important when realistic colour images or colour presentations are to be presented using the projector. Poor colour rendering can lead to poor legibility and misinterpretation. The u' and v' chromaticity co-ordinates of the primary colours red (R), green (G) and blue (B) of the projected image shall aim at values given in international IEC, EBU and ITU standards. The u' and v' chromaticity co-ordinates of the primary colours 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 colours the projector is capable of presenting.

The colour rendering of the projected image is very dependent on the screen used.

Definition

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

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.2.3.3.

References

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

Mandate A.2.3.3:

For projectors with a throw ratio > 0.38

The minimum colour triangle shall have the following coordinates at factory default setting:

	Red		Green		Blue	
Co-ordinate	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 colour triangle shall have the following coordinates at factory default setting:

	Red		Green		Blue	
Co-ordinate	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:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.3.4 Colour greyscale linearity

Background

A well-tuned colour greyscale is the basis for good colour rendering of any imaging device. This is measured via steps in a greyscale in the test image. Each greyscale step shall have similar colour hues in order to simplify colour interpretation and to avoid confusion for the user. Only the luminance shall vary (within acceptable limits).

The colour rendering of the projected image is very dependent on the screen used

Definition

Colour greyscale linearity is the capability of the imaging device to maintain the same u', v' coordinates of a greyscale pattern at all tested greyscale levels, i.e. only the luminance shall change from one greyscale step to the next.

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.2.3.4.

References

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

Mandate A.2.3.4:

	Maximum Δu´v´difference							
Greyscale	**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

The Δu'v' ≤ the maximum allowed difference for each step according to table 2.3.4

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.2.4 Compatibility characteristics

A.2.4.1 Video- and computer interfaces

Background

Interactivity across work devices is very important. Users should find it easy to securely connect a projector to an external device in order to show both video and computer signals. Therefore, in the case of projectors, it is important that suitable interfaces are available for the most common video- and computer signals, e.g. s-video, component, VGA, DVI and HDMI. Developments in the wireless market are making advances. However, for this version it is considered too soon to require that all TCO Certified Projectors be equipped with wireless technology.

Definition

An *interface* is a system of standardised regulations for devices to handle electrical signals and physical connections. These are different for video and computer purposes.

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.2.4.1

References

10, 12 and 19.

Mandate A.2.4.1:

A projector shall have at least one *interface* for video signals and one interface for computer signals following common standards.

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.4 Emissions

Users of IT equipment increasingly have several nearby electrical and magnetic field sources placed on work surfaces that they are exposed to. When the first TCO certification for IT products was introduced in 1992, one of the main issues was the criteria for reducing electrical and magnetic fields. To this day scientists and experts are divided on the question of whether these fields pose any risks to human health.

Due to continued public concern and the increasing amount of emissions surrounding us, TCO Development remains convinced that the criteria in TCO Certified are still relevant, even with today's 'slimline' low emission products. TCO Certified emissions criteria are intended to make certain that internal shielding is used to ensure that a TCO Certified product's emissions are at a technically achievable low level and will not raise normal background levels when the product is used in a working environment.

TCO Certified criteria cover emissions around the certified product since it may be placed near other persons working in close proximity.

Many people find acoustic noise annoying, especially high pitched noise. To prevent this problem, TCO Development sets criteria for products with integrated fans.

Life Cycle Phase

A.4.1 Alternating electric fields

Background

Electrical alternating fields are created between objects that have different levels of electrical potential which 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 about a possible health risk arising from electrical alternating fields generated by IT products. The mandatory criteria are aimed at reducing the electrical alternating fields to such a low level so as not to burden the work and home environment with unnecessary factors. The mandatory criteria shall not be regarded as hygienic limit values.

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.4.1.

Mandate A.4.1:

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 a test report and a verification report from a test facility approved by TCO Development.

A.4.2 Alternating magnetic fields

Background

Magnetic alternating fields are created when an electrical alternating current flows through a conductor. IT products are surrounded by magnetic alternating fields. These magnetic alternating fields are generated by different parts of the product, e.g. external power supply unit, 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 about a possible health risk arising from electrical alternating fields generated by IT products. The mandatory criteria are aimed at reducing the magnetic alternating fields to such a low level so as not to burden the work and home environment with unnecessary factors. The mandatory criteria shall not be regarded as hygienic limit values.

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.4.2.

Mandate A.4.2:

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

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

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.4.3 Acoustic Noise

Background

Acoustic noise from fans can be disturbing. To prevent such disturbance, projectors should cause a minimum of noise during usage. 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 shall 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 shall 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 lamp is increased than in on mode.

Applicability

All front screen projectors with fixed resolution.

Test procedure

See B.4.3.

References

32, 33 and 34.

Mandate A.4.3:

1. The declared *A-weighted sound power level* shall not exceed:

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

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

2. The declared *A-weighted sound power level* (L_{WAd}) for eco mode according to ISO 7779:1999 shall 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 declared A-weighted sound power level in the online database.)***

Submit the following together with the application to TCO Development:

A copy of a test report from a facility accredited according to ISO10025 and a verification report from a test facility approved by TCO Development.

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.5 Electrical safety

A.5.1 Electrical safety

Background
Electrical safety concerns the electrical design of apparatus with respect to its electrical insulation and other arrangements that are intended to prevent accidents resulting from contact with live components, and the risk of fire or explosion as a result of electrical flash-over due to inadequate or faulty electrical insulation.

Applicability
All front screen projectors with fixed resolution.

References
35, 36 and 56.

Mandate A.5.1:

The Projector and the internal or external power supply/supplies shall be certified in accordance with EN/IEC 60 950, UL 60950 or EN/IEC 60065 (home usage) or EN 62368-1.

Submit the following together with the application to TCO Development:

A copy of a CB or UL certificate or a national certificate from a CB member (NCB) shall be submitted.

A.6 Environment

This section details the environmental criteria in TCO Certified, which offer a unique, integrated balance of environmental issues in the manufacturing, use and end of life phases of the product.

The environmental criteria are divided into the following sections:

1. Manufacturing – criteria focusing on the manufacturing phase and environmental management
2. Climate – energy consumption, one of the most important issues in the environmental impact of IT products.
3. Hazardous Substances – heavy metals, flame retardants, plastics.
4. Material resource efficiency – factors to extend the life of the product and influence better use of material resources.
5. End of life – factors to stimulate recycling and minimize the impact of e-waste.

Potential environmental effects are evident at each stage of the product life cycle. The environmental criteria TCO Development has focused on in this document are those that we consider most relevant to the product group. They have also proved to be attainable in volume manufacturing and are verifiable. Future criteria updates will likely focus on the manufacturing phase, hazardous substances and climate issues.

Compliance with these criteria (except section *A.6.3 Climate)* is verified by sending the requested information to a verifier approved by TCO Development. The energy consumption requirements in section A.6.3 shall be tested at a test facility approved by TCO Development or an EPA approved test facility.

Life Cycle Phases

A.6.1 Product description

Background

The aim of this product description is to provide third party verified information about the product. The information is used by TCO Development to verify that the product complies with the criteria in TCO Certified.

The information is also provided on the certificate to buyers so that it helps them calculate the sustainability impact of the products and the benefit of buying products that fulfil TCO Certified.

Using the declared sustainability information a buyer can, for example, implement climate compensation or other sustainability-related measures connected to the sustainability impact of the product. This data is often used by organisations in their annual sustainability report or internal programs aimed at minimizing the environmental impact of IT.

Definitions

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

Plastic parts are all product parts made out of plastic except panels, electronic components, cables, connectors, PWBs, insulating mylar sheets and labels. This is primarily due to insufficient available alternatives. This also means that the weight of these items is not included when calculating the total weight of the plastic in the product in this requirement.

Marking plate /Marking label is the label that contains the product's electrical rating in terms of voltage, frequency, current and the manufacturer's name, trademark or identification mark together with the manufacturer's model or type reference. The label shall be in accordance with IEC 60 950:1 clause 1.7.1.

Applicability

All front screen projectors with fixed resolution.

Life Cycle Phases

Clarification

B.6.1

References

2 and 36.

Mandate A.6.1:

A product declaration shall be provided for the Projector. The following information shall be verified by the third party facility and is printed by TCO Development on the certificate.

Submit the following to an approved verifier:

1. The declaration below, completed where applicable.

2. A copy of the marking label for the Projector and any external power supply.

The information submitted shall be signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

A copy of a verification report including all information in the table below from a verifier approved by TCO Development and a copy of the marking label.

Declaration of a projector.

Projectors	Information
Manufacturer	
Brand name	
Brand Owner	
Type/Model name	
Type of lamp	
Lamp manufacturer	
Type of LED	
LED manufacturer	
Type of Laser	
Laser manufacturer	
Type of panel*	
Panel manufacturer*	
Type of DMD chip**	

* Only for LCD / ** Only for DLP

External power supplies

Brand & model name	**Rating & Class**

Declared sustainability information

Percentage of *recycled plastic* by weight of total weight of plastic parts	
Total weight of the product and power supply (without packaging) in Kg	

We hereby guarantee that the above mandate is fulfilled.

…… ……

Product brand name Model name(s)

....

Signature Name and title in block capitals

....

Date Company

A.6.2 Manufacturing

A.6.2.1 Environmental management system certification

Background
A certified environmental management system shows that the company has chosen to work in a systematic way with constant improvement of the environmental performance of the company and its products. A certified environmental management system includes external independent reviews.

Definitions
Manufacturing plant: Manufacturing facility where the final assembly of the TCO Certified product takes place.

Applicability
The company or companies that manufacture the Projector.

Life Cycle Phase

Clarification
B.6.2.1

References
37 and 38.

Mandate A.6.2.1:

Each *manufacturing plant* must be certified in accordance with ISO 14001, or EMAS registered. If the product is manufactured by a third party, it is this company that shall be certified or registered.

Submit the following to an approved verifier:

1. A document showing the names and addresses of the manufacturing plants.

2. Copy of the ISO 14001 certificate or EMAS registration from each manufacturing plant.

3. A written guarantee that the certificate/registration is valid and that the mandate above is fulfilled, signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.6.3 Climate

A.6.3.1 Energy Consumption

Background
Energy is the single most important topic in the issue of climate change. Energy efficient equipment is an important and effective way to fight climate change. With an ever-increasing volume of IT equipment in use, the efficiency 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 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 instruction.

Applicability
All front screen projectors with fixed resolution.

Life Cycle Phase

Test procedure
B.6.3.1

References
48, 49, 50, 57 and 58.

Mandate A.6.3.1:

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

1. The Projector shall be possible to set in an eco-mode.

2. The following levels for maximum power consumption in the following modes shall be fulfilled and verified through testing by a test facility approved by TCO Development:

On Mode

Area	Requirement level
$A_{Max/office}$	*On Mode (normal operation)*
≤ 3 m^2	≤ 260 W
≤ 6 m^2	≤ 310 W
> 6 m^2	≤ 310+150*(A_{max}- 6) W
Projectors with a throw ratio of 0.82 and less 30% more energy consumption is allowed.	
≤ 3 m^2	≤ 260 x 1.30W
≤ 6 m^2	≤ 310 x 1.30W
> 6 m^2	≤ (310+150*(A_{max}- 6)) x 1.30W
$A_{Max/video}$	*On Mode (normal operation)*
≤ 6.6 m^2	≤ 260 W
≤ 13.3 m^2	≤ 310 W
> 13.3 m^2	≤ 310+150*(A_{max}- 13.3) W
Projectors with a throw ratio of 0.82 and less 30% more energy consumption is allowed.	
≤ 6.6 m^2	≤ 260 x 1.30W
≤ 13.3 m^2	≤ 310 x 1.30W
> 13.3 m^2	≤ (310+150*(A_{max}- 13.3)) x 1.30W

Eco-mode **≤ 90% of the measured *On Mode (normal operation)* value.**

Standby Mode ≤ 0.5 W or should follow the latest EU directive

Off Mode ≤ 0.5 W

There shall 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 shall be signed by the responsible person at the applicant company and submitted to the test facility.

3. It shall 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.

4. Energy consumption levels in all modes shall be declared in the user manual and product specification. There shall 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 next generation of TCO Certified Projectors.

Submit the following together with the application to TCO Development:

A copy of a test report and a verification report from a test facility approved by TCO Development.

A.6.3.2 Energy consumption – external power supply

Background

Energy is the single most important topic in the issue of climate change. Energy efficient equipment is an important and effective way to fight climate change. With an ever-increasing volume of IT equipment in use, the efficiency of each product is vital. To reduce energy consumption of the product the external power supply shall comply with the International Efficiency Marking Protocol for External Power Supplies.

Applicability

All external power supplies.

Clarification

B.6.3.2

References

59.

Mandate A.6.3.2:

The external power supply shall meet at least the International Efficiency Protocol requirement for level V.

Submit the following to the verifier at the test facility:

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.6.4 Hazardous substances

A.6.4.1 Cadmium (Cd), mercury (Hg), lead (Pb) and hexavalent chromium (CrVI)

Background

The effects of cadmium, mercury, lead and hexavalent chromium are well documented as substances hazardous both to our health and the environment. Electronic devices contain hazardous substances like heavy metals and brominated flame retardants. This may causes problems, both in the manufacturing phase where workers or the environment can get exposed, in the use phase (additives can leak from the plastic and accumulate in dust, harming both our health and the environment) and at end of life, where uncontrolled recycling can cause the release of toxins such as dioxins and furans.

Applicability

All front screen projectors with fixed resolution.

Life Cycle Phase

Clarification

B.6.4.1

References

39 and 40.

Mandate A.6.4.1:

1. The Projector shall not contain cadmium, mercury, lead and hexavalent chromium. The requirement 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. For lamps containing mercury a declaration applies.

2. The total amount of mercury in the lamp(s) shall be declared in the "Mercury declaration template" below.

Submit the following to an approved verifier:

1. A written guarantee that the mandate above is fulfilled. The guarantee shall be signed by the responsible person at the applicant company.

2. A declared "Mercury declaration template" below.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

Mercury declaration template

Projector brand name:.....

Projector type/model name:.....

Projector technology .....

Type of lamp: .....

Mercury lamp supplier:	**Lamp ID code:**	**Max. mg Hg/lamp:**

We hereby guarantee that the above mandate is fulfilled.

…… ……

Product brand name Model name(s)

....

Signature Name and title in block capitals

....

Date Company

A.6.4.2 Halogenated substances

Background

Halogenated flame retardants and plasticizers are often persistent, can bio-accumulate in living organisms and have been detected in both humans and the environment. These substances may be problematic in the manufacturing and end of life phases where workers or the environment can be exposed. They can also migrate from the products during the use phase with unknown health effects as a result.

Definitions

Plastic parts are parts made mainly of plastics, e.g. the 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.

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 front screen projectors with fixed resolution.

Clarification

B.6.4.2

References

41.

TCO DEVELOPMENT

Mandate A.6.4.2:

1. *Plastic parts* weighing more than 25 grams shall not contain flame retardants or plasticizers that contain halogenated substances.

Note*:* This applies to plastic parts in all assemblies and sub-assemblies. Exempted are *printed wiring board laminates*, electronic components and all kinds of cable insulation.

2. The Projector shall not contain PBB, PBDE and HBCDD.

Note: This applies to components, parts and raw materials in all assemblies and sub-assemblies of the product e.g. batteries, paint, surface treatment, plastics and electronic components.

Submit the following to an approved verifier:

A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.6.4.3 Non-halogenated substances

Background

The purpose of this mandate is to increase the knowledge of substances with regards to their human and environmental impacts and to drive a shift towards less hazardous alternatives. These substances may be problematic in the manufacturing and end of life phase where workers or the environment can get exposed and can also migrate from the products during the use phase with unknown health effects as a result.

The 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 methodology can be used for identifying substances of high concern and safer alternatives.

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 on the GreenScreen™ for Safer Chemicals.

Definitions

Plastic parts are parts made mainly of plastics, e.g. the 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.

Licenced Profilers are organisations approved by CPA with the capacity to provide GreenScreen assessments.

Accepted substances are considered the most sustainable alternatives which are possible for the industry to use, also taking into consideration aspects such as availability and functionality. Accepted substances are found on the TCO Development website under *"Accepted Substances list"*.

Applicability

All front screen projectors with fixed resolution.

Clarification

B.6.4.3

Mandate A.6.4.3:

Non halogenated flame retardants used in plastic parts that weigh more than 25 grams shall be on the publically available Accepted Substance List for TCO Certified. This means that the substance has been assessed by a licensed profiler according to GreenScreen™ and been assigned a benchmark score ≥ 2

The following acceptance decisions apply to substances given Benchmarks 4, 3, 2, 1 or designated U (undefined):

4: Accepted – (Few concerns)

3: Accepted – (Slight concern)

2: Accepted – (Moderate concern)

1: Not accepted - (High concern)

U: Not accepted - (Unspecified)

All substances of a flame retardant mixture shall be accounted for. Non-accepted components shall 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.

A grace period for the above may be granted, see B.6.4.3 for rules

TCO Development will conduct spot-checks and require full disclosure of the flame retardants, including CAS number, used in the product to verify that the obligations according to this mandate are fulfilled.

Submit the following to an approved verifier:

A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.6.4.4 Halogenated plastics

Background

PVC is by far the most common halogen containing plastic. There are however other plastics that contain halogens in the plastic itself. Halogens are problematic from both a health and environmental perspective throughout the product life cycle and should be phased out.

Definitions

Plastic parts are parts made mainly of plastics, e.g. the 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.

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

Applicability

All front screen projectors with fixed resolution.

References

43 and 47.

Mandate A.6.4.4:

Plastic parts **in the Projector weighing more than 25 grams shall not contain intentionally added halogens as a part of the polymer.**

Note: *Printed wiring board laminates*, and all kinds of internal and external cable insulation are not considered to be part of *plastic parts* and are therefore not included in the mandate.

Submit the following to an approved verifier:

A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.6.4.5 Phthalates

Background
Phthalates are substances mainly used as plasticizers. The substances restricted in the mandate are listed as Substances of Very High Concern and are included in REACH Annex XIV classified as toxic to reproduction. These substances are problematic from both a health and environmental perspective throughout the product life cycle and should be phased out.

Applicability
All front screen projectors with fixed resolution.

Clarification
B.6.4.5

References
60, 61, 62 and 63

Mandate A.6.4.5:

The Projector shall 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.

Submit the following to an approved verifier:

A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.6.4.6 Hazardous substances in product packaging

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

There are three main areas of concern; content of hazardous substances, use of resources and transport volume.

Applicability
All packaging material.

Clarification
B.6.4.6

References
55.

Mandate A.6.4.6:

The packaging material shall not contain lead (Pb), cadmium (Cd), mercury (Hg) or hexavalent chromium (Cr6).

Plastic packaging material shall not contain organically bound halogens.

Submit the following to an approved verifier:

A written guarantee that the mandate above is fulfilled. The guarantee shall be signed by the responsible person at the applicant company.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

.....	.....
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.6.5 Material Resource Efficiency

A.6.5.1 Lifetime extension

Background

A longer product lifetime makes a significant positive contribution to more efficient resource use as well as the reduction of air and water pollution. A pre-condition for prolonged lifetime is that the product is of high quality, which is supported by good warranties. Another requirement is the availability of spare parts for a number of years once it is taken out of production. During this period, products should, if possible, be repaired and not replaced.

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 a period where the Brand owner offers to repair or replace broken products during a period of time at no charge.
Spare parts are those parts that have the potential to fail during normal use of the product. Product parts whose life cycle usually exceeds the average usual life of the product need not be provisioned as spare parts. When the cost for replacing a broken part (e.g. panel) exceeds the cost of replacing the whole product, then that part need not be considered as a spare part under this mandate.

Applicability

All front screen projectors with fixed resolution.

Life Cycle Phases


Clarification

B.6.5.1

TCO DEVELOPMENT

Mandate A.6.5.1:

1. **The *brand owner* shall provide a *product warranty* for at least one year on all markets where the product is sold.**

2. **The *brand owner* shall guarantee the availability of *spare parts* for at least three years from the time that production ceases. Instructions on how to replace these parts shall be available to professionals upon request.**

Submit the following to an approved verifier:

A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the responsible person at the *brand owner* company.

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

.....	.....
Product brand name	Model name(s) or ”All products”
.....	.....
Signature	Name and title in block capitals
.....	.....
Date (Declaration valid 1 year from date)	Brand Owner Company

A.6.6 End of life

A.6.6.1 Material coding of plastics

Background
Prolonging the life of IT-products by reuse is the best way to minimize their environmental impact.. But when this is no longer possible it is important to facilitate material recycling of the products. Material coding of plastics aims at making the recycling of plastics easier so that the plastic can be used in new IT equipment.

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

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

Applicability
All front screen projectors with fixed resolution.

Life Cycle Phase

Clarification
B.6.6.1

References
45, 47 and 48.

Mandate A.6.6.1:

Plastic parts weighing more than 25 grams shall be material coded in accordance with ISO 11469 and ISO 1043-1, -2, -3, -4.

Exempted are *printed wiring board laminates*.

The following information shall be submitted to an approved verifier:

A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the responsible person at the applicant company.

The following information shall be submitted with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

A.6.6.2 Take back system

Background

The amount of electronic waste in the world today is enormous and a growing environmental problem. It is important that manufacturers provide mechanisms to take back their equipment at end-of-life under the principle of individual producer responsibility wherein each manufacturer must be financially responsible for managing its own branded products at end-of-life. Currently much electronic waste is being exported to developing countries where it is managed unsustainably and disproportionately burdens those regions with this global environmental problem. The Basel Convention and its decisions govern 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 Projector

Applicability

All front screen projectors with fixed resolution.

Clarification

B.6.6.2

References

47.

Mandate A.6.6.2:

The *brand owner* (or its representative, associated company or affiliate) shall 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.

The following information shall be submitted to an approved verifier:

The information stated in the list below shall be submitted and the guarantee signed by the responsible person at the *brand owner* company.

The following information shall be submitted with the application to TCO Development:

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

The requirement can be fulfilled by one of three options (to be verified):

☐ 1. Product only sold on markets with WEEE legislation or similar

☐ 2. World-wide product take back*

☐ 3. One additional market lacking WEEE legislation where product take back is offered*

Name of market…….

*The brand owner shall also submit a short description, to an approved eco-verifier, of the take back system or reference to the representative, associated company or affiliate taking care of the take-back system

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s) or ”All products”
.....	.....
Signature	Name and title in block capitals
.....	.....
Date (Declaration valid 1 year from date)	Brand Owner Company

A.6.6.3 Preparation for recycling of product packaging material

Background

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

There are three main areas of concern; content of hazardous substances, use of resources and transport volume.

Applicability

All packaging material.

Mandate A.6.6.3:

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

Exempted is reusable packaging.

The following information shall be submitted to an approved verifier:

A written guarantee that the mandate above is fulfilled. The guarantee shall be signed by the responsible person at the *applicant* company.

The following information shall be submitted with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

TCO DEVELOPMENT

DECLARATION FORM FOR TCO CERTIFIED PROJECTORS 2.0 ENVIRONMENTAL REQUIREMENTS

Applicant company

By signing this Declaration Form the Company confirm that the Company has read and accepts to be bound by the below listed environmental requirements as stated in this criteria document. The signature of this form is to be considered equal to a signature under each of the below listed individual mandates in this criteria document. The text in this form is compressed to save space so please make sure to read the full explanation under each mandate. Check the boxes for the documents that have been attached to this form..

A.1.1 TCO Certified Document
A.6.1 Product description
- □ Completed product declaration form
- □ Copy of the marking label for Projector and external power supply

A.6.2.1 Environmental management system certification
- □ Addresses of manufacturing plants
- □ Valid EMAS certificate or ISO 14001 certificate

A.6.4.1 Cadmium, mercury, lead and hexavalent chromium
A.6.4.2 Halogenated substances
A.6.4.3 Non-halogenated substances
A.6.4.4 Halogenated plastics
A.6.4.5 Phthalates
A.6.4.6 Hazardous substances in product packaging
A.6.6.1 Material coding of plastics
A.6.6.3 Preparation for recycling of product packaging material

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s)
.....	.....
Signature	Name and title in block capitals
.....	.....
Date	Company

TCO DEVELOPMENT

DECLARATION FORM FOR TCO CERTIFIED PROJECTORS 2.0 ENVIRONMENTAL REQUIREMENTS

Brand owner

By signing this Declaration Form the Company confirm that the Company has read and accepts to be bound by the below listed environmental requirements as stated in this criteria document. The signature of this form is to be considered equal to a signature under each of the below listed individual mandates in this criteria document. The text in this form is compressed to save space so please make sure to read the full explanation under each mandate. Check the boxes for the documents that have been attached to this form.

A.6.5.1 Lifetime extension

A.6.6.2 Take back system

□ 1. Product only sold on markets with WEEE legislation or similar

□ 2. World-wide product take back*

□ 3. One additional market lacking WEEE legislation where product take back is offered*

*□ Short description or reference of the above

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s) or ”All products”
.....	.....
Signature	Name and title in block capitals
.....	.....
Date (Declaration valid 1 year from date)	Company

A.7 Socially responsible manufacturing

Shorter product cycles and growing demand for new technologies put increasing pressure on industry and its complex supply chain to deliver new devices faster and at a low cost. The result is often inadequate working conditions at manufacturing facilities, long working hours, low wages and a lack of health and safety measures.

TCO Development aims for greater brand engagement throughout their supply chains by setting criteria and verification routines that create strict social policies toward suppliers, as well as factory audit structures and an open dialog within the IT industry.

Life Cycle Phase

A.7.1 Supply chain responsibility

Background
It is TCO Developments opinion that codes of conducts and factory audits are currently the tools that are most practical to help the majority of brands to work with socially responsible manufacturing in a structured way. It is also TCO Developments opinion that these tools are improving the situation incrementally as long as they are used in the correct and committed way by the brand.

The contribution of TCO Certified is:

- TCO Certified defines a minimum level of the Brand owner's code of conduct.
- TCO Certified is a control system to ensure that the brand takes the responsibility and work in a structured way in accordance with their code of conduct.
- TCO Certified creates an incentive for Brand owners to work proactively.

Definitions
Brand owner: The company or organization owning or controlling the Brand Name.
First tier manufacturing facility: Manufacturing plant where the final assembly of the TCO certified product is taking place.
Corrective action plan: A list of actions and an associated timetable detailing the remedial process to address a specific problem

Applicability
The Brand owner.

Clarification
B.7.1

References
53 and 54

Mandate A.7.1:

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 show (3. Proof) of the commitment and the structured work by allowing random inspections, by sharing audit reports and corrective action plans and by providing other documented proof described below.

1. Commitment:

The *Brand owner* shall have a code of conduct that is considered consistent with the following in the manufacturing of TCO Certified products:

- **ILO eight core conventions: 29, 87*, 98*, 100, 105, 111, 138 and 182.**
- **UN Convention on the Rights of the Child, Article 32.**
- **Relevant local and national Health & Safety and Labour laws effective in the country of manufacture.**

***In situations with legal restrictions on the right to freedom of association and collective bargaining, non-management workers must be permitted to freely elect their own worker representative(s) (ILO Convention 135 and Recommendation 143).**

2. Structured work:

- **The Brand owner shall ensure that routines are in place to implement and monitor their code of conduct in the manufacturing of TCO Certified products.**
- **In the final assembly factories the Brand owner shall ensure the implementation of their code of conduct through factory audits.**
- **In the final assembly factories and in the rest of the supply chain the Brand owner shall ensure that a corrective action plan is developed and fulfilled within reasonable time for all violations against their code of conduct that the Brand owner is made aware of.**

3. Proof:

- **TCO Development may conduct/commission random factory inspections (spot-checks) at any final assembly factory manufacturing TCO Certified products for the Brand owner and may require full audit reports during the certification period in order to assess social commitment and advancement.**
- **TCO Development may also require seeing corrective action plans and auditing reports from factories further down the supply chain to ensure that corrective actions have been successfully implemented.**
- **TCO Development additionally requires the documentation below to be verified by a third party approved verifier.**

Submit the following to an approved verifier:

The Brand owner shall submit all of the following as proof of their commitment and structured work:

1. **The Brand owner shall submit their code of conduct, which must be considered consistent with the criteria under 1. Commitment.**
2. **The Brand owner shall annually submit proof that management and workers at all final assembly factories manufacturing TCO Certified products have been informed about the Brand owner's code of conduct.**
3. **The Brand owner shall annually submit a list of all final assembly factories manufacturing TCO Certified products. This list shall include the dates of the most recent social audits covering the Brand owner's code of conduct and the dates of planned audits for each factory. The list shall show that all factories have or will be audited at least once over a 3-year period.**
4. **The Brand owner shall annually submit for review one third party audit report from one final assembly factory manufacturing TCO Certified products to demonstrate that the audits are conducted in a serious manner. The audit report shall at least cover the criteria in A.7.1 of TCO Certified and be of equal quality as an EICC audit. It shall not be more than 12 months old.**
5. **The Brand owner shall submit a corrective action plan for all nonconformities against A.7.1 of TCO Certified found in the submitted third party factory audit..**

If this is the first time the *Brand owner* certifies products to this generation of the criteria and time is needed to develop the proof above then the Brand owner can seek a 12 months grace period on the first application. TCO Development reserves the right to deny grace period if the Brand owner is considered a high risk for not meeting the 12 month due date. When seeking grace period an agreement must be completed/signed by the senior management representative at the *Brand owner* company.

The following information shall be submitted to an approved verifier:

- **A written guarantee that the mandate above is fulfilled. The guarantee shall be signed by the responsible person at the *brand owner* company.**

Submit the following together with the application to TCO Development:

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

We hereby guarantee our commitment to fulfilling the mandate.

.....	.....
Product brand name	Model name(s) or "All products"
.....	.....
Signature	Name and title in block capitals
.....	.....
Date (Declaration valid 1 year from date)	Brand Owner Company

A.7.2 Senior Management Representative

Background

It is beneficial to all parties that an open and transparent dialogue between TCO Development and the Brand owner exists for the monitoring of compliance with the criteria or when issues concerning working conditions at manufacturing facilities require clarification. A contact person responsible for the organization's efforts to enforce the social responsible manufacturing criteria needs to be consistently available for dialogue with TCO Development throughout the validity of the certificate.

Applicability

The Brand owner.

Clarification

B.7.2

Mandate A.7.2:

The Brand owner shall have an appointed Senior Management Representative (SMR) who, irrespective of other responsibilities, has the authority to ensure that the social criteria in the manufacturing of TCO Certified are met and who reports directly to top management.

- **The contact details of the SMR shall be submitted and the SMR shall be available for dialogue in English with TCO Development throughout the validity of all the Brand owners' certificates.**
- **To ensure that the SMR has the necessary authority and is working in a structured and proactive way implementing the code of conduct, a review of the SMR shall be done every year according to B.7.2.2.**

Submit the following to an approved verifier:

1. **Name, Title, Telephone Number and Email Address of the SMR.**
2. **A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the SMR at the Brand owner company.**

Submit the following together with the application to TCO Development:

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

Complete the table using block lettering

Name	
Business title	
Telephone	
E-mail	

We hereby guarantee that the above mandate is fulfilled.

…… ……

Product brand name Model name(s) or "All products"

....

Signature Name and title in block capitals

....

Date (Declaration valid 1 year from date) Brand Owner Company

A.7.3 Conflict minerals

Background

The exploitation and trade of the natural resources, Tantalum, Tin, Tungsten and Gold (3T+G) from conflict-affected areas is commonly regarded as a major source of conflict financing. TCO Development supports the underlying goal of the EU conflict minerals measures and those contained in the Dodd Frank Act 1502, but believe it is also vital to support in-region responsible sourcing programs in order to help suppliers meet these Due Diligence requirements, maintain trade and develop mining that directly benefits the people whose livelihoods depend on a legitimate trade. TCO Development now requires all Brand owners who use TCO Certified to address the issue of conflict minerals in their certified products in a progressive and proactive way.

Definitions

Conflict minerals: Tantalum, Tin, Tungsten and Gold = 3T+G
DRC: Democratic Republic of the Congo

Applicability

The Brand owner.

Clarification

B.7.3

Reference

64

Mandate A.7.3:

The Brand owner shall have a public conflict minerals policy and also indicate all the initiatives they are using/funding. It is TCO Developments opinion that the OECD Due Diligence Guidance for Responsible Supply Cain of Conflict-Affected or High-risk Areas is the most ambitious approach in the list.

At least one of the following options shall be marked:

- ☐ **A Due Diligence process based on the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected or High-risk Areas**
- ☐ **iTSCi (International Tin Research Institute (ITRI) Tin Supply Chain Initiative).**
- ☐ **CFTI (Conflict-free Tin Initiative).**
- ☐ **PPA (The Public-Private Alliance for Responsible Minerals Trade).**
- ☐ **Other relevant DRC in-region initiative:……**
- ☐ **CFSI (EICC/GeSi Conflict-Free Sourcing Initiative).**

Submit the following to an approved verifier:

1 **The completed TCO Certified Conflict Minerals Questionnaire and supporting documents**

2 **A written guarantee that the above mandate is fulfilled. The guarantee shall be signed by the responsible person at the Brand owner company**

Submit the following together with the application to TCO Development:

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

We hereby guarantee that the above mandate is fulfilled.

……	……
Product brand name	Model name(s) or ”All products”
.....	.....
Signature	Name and title in block capitals
.....	.....
Date (Declaration valid 1 year from date)	Brand Owner Company

R References

International standard organisations referred to in the reference list below and their Web sites.

1. IEC 61947-1/-2
2. ISO/IEC 21118 Information to be included in specification sheets – Data projectors.
3. IEC 61947-1:2002 Electronic projection – Measurement and documentation of key performance criteria – Part 1: Fixed resolution projectors
4. Rea, M. S., IESNA Lighting Handbook - Reference and Application, Illuminating engineering society of North America, New York, NY, USA (2000). Chapter 10 and 11.
5. Brennesholtz, M. S., Stupp, E. H., (2008) "Projection Displays, Second Edition" John Wiley & Sons Ltd. Chapter 2.
6. CIE Publication 69 (1987), Methods of characterizing illuminance meters and luminance meters: performance characteristics and specifications.
7. Le Grand, Y. (1957). Light, colour and vision. Chapman and Hall, p. 119
8. Wyszecki, G., Stiles, W.S., (1982) Color Science: Concepts and methods, quantitative data and formula, Second Edition, John Wiley & Sons, Inc. Chapter 7, Visual thresholds, pp 567-569.
9. ISO/IEC 21118:2005 Information to be included in specification sheets — Data projectors
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11. ITU, International Telecommunication Union www.itu.int/home/index.html
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14. Flat Panel Display Measurements Standard, (M), Version 2.0, VESA - Video Electronics Standards Association Display Metrology Committee. June 1, 2001, CA 95035, Milpitas.
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18. CIE Publication 15.2 (1986), Colorimetry, p. 11, p.27-28 and p. 53-54, table 1.3).
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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.
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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.
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39. EU Directive 2006/66/EC on batteries and accumulators containing certain dangerous substances
40. EU Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment
41. Regulation concerning Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), EC 1907/2006
42. EU Directive EC 1272/2008 on classification, labelling and packaging of substances and mixtures
43. EU Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances
44. The EU Green Paper "Environmental questions concerning PVC" KOM (2000) 469
45. ISO 1043-1, -2, -3, -4 Plastics - Symbols and abbreviated terms
46. ISO 11469 Plastics - Generic identification and marking of plastics products
47. EU Directive 2002/96/EC on waste electrical and electronic equipment (WEEE)
48. Energy Star, EPA – http://www.energystar.gov
49. EU regulation 1275:2008
50. Eco design Directive 2005/32/EC
51. Global Reporting Initiative (GRI), www.globalreporting.org

52. United Nations Global Compact (UNGC), http://www.unglobalcompact.org/
53. Electronic Industry Citizenship Coalition (EICC), http://www.eicc.info
54. SA8000, http://www.sa-intl.org
55. Directive 94/62/EC on packaging and packaging waste.
56. UL 60950 Information Technology Equipment – Safety
57. FCC Part 15 Subpart B
58. IEC/EN 55022 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
59. International Efficiency Marking Protocol for External Power Supplies
60. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/abfall/ROHS/finalresults/Annex6_RoHS_AnnexII_Dossier_DEHP.pdf [DEHP]
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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
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- 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

B Test Methods and clarifications

The following definitions, test conditions, requested specifications from clients, and other information apply to the test methods described in this document.

Test results are valid only for the presentation form(s) and configuration(s) tested.

B.0 General test conditions

B.0.1 Definition of a test object

- Test objects covered by this document are front screen projectors with fixed resolution.
- A test object with all necessary information for its operation shall be delivered to the test facility in test ready condition including any required accessories that are delivered as part of the product to the end user. All necessary information about how to operate and adjust the test object shall be provided.
- The performance of the test object shall in all aspects be fully in accordance with the performance of the final product.
- The client shall 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.

B.0.2 Required test object information

- The client shall supply:
- Name(s), type designation(s) and manufacturer for all different exchangeable parts of the test object
- 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 show the relationship between the throwing distance d [m] and the TCO Image Size [m²]
- Displayable formats including the native resolution and aspect ratio
- Video and computer compatibilities
- Vertical frequency band width, horizontal frequency band width, video band width (max. pixel rate)
- Declared sound power level
- User's Manual

B.0.3 Conditions for the equipment under test

- The projector being tested shall be physically prepared for testing and shall be warmed up until it is fully stabilised, but at least for 30 minutes and after lamp aging (see B.0.6).
- The projector lens surface shall be clean when tested.
- The projector shall be tested under nominal conditions of input voltage, current, etc. If sold on different markets, one setup shall be chosen by the manufacturer which shall represent the conditions of the country in where it will be sold the most.
- The projector shall be connected to a computer, if the manufacturer does not specify a different presentation host. Within the computer a graphics board of high quality, which offers a digital output and a typical output voltage on RGB of 0.7 V ± 10% shall be used.
- When possible testing shall 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 shall be used. The same signal input shall be used for testing of all parameters. The signal input used shall be specified in the test report.
- A video generator shall not be used to drive the projector

B.0.4 Projector alignment for testing

- The distance between front lens of the projector and the measurement plane (screen), the throwing distance, should be according to manufacturer's specifications.

- The measuring plane shall be perpendicular to the optical axis of the projector lens, if not specified otherwise in the test method. The measuring plane shall be defined as the focus plan at the centre of the projected image.

- The image shall be focused and the main focus shall 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.

B.0.5 Instruments used for testing

All instruments used for testing of a projector shall be of good quality and validated by a recent test certificate from a certified testing facility. Any necessary instrument calibration shall be done before the tests are performed. Calibrations shall be traceable to international standards. The instruments shall 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 shall 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.

B.0.6 Settings of the Projector

- The Projector resolution shall be set to the native resolution.
- The projector shall be put in its factory default mode. The CCT of the default mode shall be used. All tests shall 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 pre-set is used for TCO compliance. In this case this pre-set shall 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 shall be set to the minimum, if not specified otherwise by the manufacturer. The focal length used for testing shall be specified in the test report.
- Measurements shall 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 shall be taken with no adjustments made between the measurements, if not specified otherwise in the test method.
- The colour depth of the source signal shall be 24 bits (8 bits per colour channel) or more.

B.0.7 Test report

The test results are valid only for the presentation form(s) and configuration(s) tested. If other configurations are accepted by the test facility based on the results of the tested ones it shall be clearly specified in the test report that these configurations have not been tested.

The test report shall include the following information:

- Any changes in the test methods.
- The working hours of the lamp when the testing started shall be declared.

- The manufacturer, brand name, model/type name, lens and lamp used and serial number (if available).
- 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.
- 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's brand and model number shall also be stated
- The degree of uncertainty for each given measurement result.

B.1 General information

B.1.1 Information to end users

The TCO Certified Document shall accompany the product as provided by TCO Development. No editorial changes without TCO Development's consent are accepted. The Document is available at www.tcodevelopment.com.

If the product that is to be TCO Certified is branded differently from the applicant name, the applicant company signing the guarantee shall be sure that the brand owner agrees with the requirement.

Compliance is through one of the following options:

1. Separate printed document
   The TCO Certified Document is placed in the packaging and accompanies the product to the end user

2. In the user manual or a digital file
   The TCO Certified Document is placed in the user manual or a digital file and accompanies the product to the end user. The TCO Certified Document shall be printed under a headline for TCO Certified. This headline shall be visible in the table of contents of the user manual or digital file.
   The TCO Document must be separated from other text portions of the user manual or digital file so that it is obvious that the TCO Document is not accountable for the content of any other texts.

3. On the brand owner web site.
   A direct link to the TCO Certified Document on the brand owner's web page is placed in the user manual or digital file and accompanies the product to the end user. There shall be a headline for TCO Certified in the user manual or digital file. This headline shall be visible in the table of contents. With this headline there shall be a direct link to the TCO Certified document on the brand owner's website. Also accepted are TCO logos or icons that redirect the visitor by a link to the TCO Certified Document

Back to A.1.1

B.2 Visual ergonomics

B.2.0 General test conditions for visual ergonomics

B.2.0.1 Basic test requirements

As described in section B.0.

B.2.0.2 Photometric test facility general requirements

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

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

B.2.0.3 Power supply and test room climate requirements for testing

- AC mains voltage* 230 VAC RMS, tolerance ≤ 1 %
- AC mains frequency* 50 Hz, tolerance ≤ 2 %
- Test room temperature 23 ± 4 ºC
- Humidity 10-85 % RH (non-condensing)

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

B.2.0.4 Photometric and spectrometric measurements

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

The following instrument types shall be used for testing:

- **Illuminance meter**. An illuminance meter shall have a V(λ)-sensitivity (Requirements for luminance meters are covered by CIE Publication 69 (1987). Illuminance meters of CIE Class A (with a combined performance characteristic ≤ 5 % shall 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 shall be calibrated both at very low and high illuminance levels. No illuminance meter shall be used handheld, but be mounted or stabilised by some sort of support, i.e. a tripod.

- **Colour neutral reflectance standard.** The colour neutral reflectance standard shall have a reflectance factor of 0.95 ± 0.05 and vary ≤ ± 0.01 within the wavelength interval 380 nm till 780 nm and be calibrated to the angles involved. This shall only be used for colour measurements as the reflectance standard may be unreliable for luminance measurements at certain angles.

- **Spectro-radiometer.** An instrument for the measurement of radiant flux as a function of wavelength shall be used. A spectro-radiometer for the measurement of light and colour is normally equipped with a microprocessor that makes it possible to obtain luminance and colour co-ordinates directly from raw measurement data. A spectro-radiometer can replace the luminance meter when suitable. The wavelength resolution shall be at least 4nm for accurate colour measurements. The sensitivity shall be independent of the polarization of the measured light (often referred to as f_8 error). No spectroradiometer shall 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 the TCO Development Web site, www.tcodevelopment.com. A computer program based on the given equations can be supplied by TCO Development.

B.2.0.5 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 it is verified that stray light affects the measurement result it is necessary to take actions 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 lightproof room shall fulfil the requirements given by IEC 61947-1 clause 4:

- Less than 1% of the light on the screen where a white image is projected shall 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 shall be from any source other than direct light from the projector.

B.2.0.6 Overall uncertainty

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

About combining overall uncertainty values during test measurements:

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

B.2.1 Light flux characteristics

B.2.1.1 Luminous flux

B.2.1.1.1 Preparation of the projector for testing

- All necessary preparations described in B.0 and B.2.0 shall be done.
- For determination of the light flux the default test image is a full-screen with colour “bright white” (RGB setting of 255, 255, 255).

B.2.1.1.2 Equipment

Illuminance meter.

B.2.1.1.3 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 shall be perpendicular to the surface of the test image and parallel of the optical axis of the projector.
- The chosen test-area of the projected image A_{test} in m² is measured in dark room conditions.

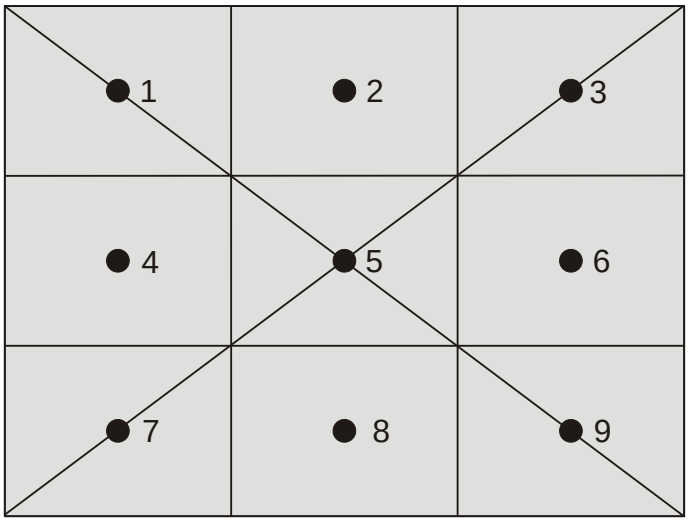

Figure B.2.1.1. Measurement locations.

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

Table B.2.1.1

B.2.1.1.4 Test evaluation for the light flux

The measured light flux is determined by the following equation:

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

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).

B.2.1.1.5 Test evaluation for the TCO Image Size

Office projectors

For **office projectors** (projectors intended to be used in illuminated rooms) the declared TCO Image Size in m^2 shall 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 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 declared TCO Image Size in m^2 shall 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 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 Image Size in lumen.**
- **The throw ratio and picture format.**

B.2.1.1.5 Overall uncertainty

≤ ± 10 % in illuminance measurements.
See B.2.0.6.

Back to A.2.1.1

B.2.1.2 Black level and contrast ratio

B.2.1.2.1 Preparation of the projector for testing

- All necessary preparations described in B.0 and B.2.0 shall be done.
- The default test image is a full-screen with colour “black” (RGB setting of 0, 0, 0).
- The projector shall be adjusted to the default CCT.

B.2.1.2.2 Equipment

Illuminance meter.

B.2.1.2.3 Test method

Measure the black illuminance $E_{black/measured}$ at location 1 to 9 according to figure B.2.1.1 using the test pattern according to B.2.1.2.1 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.

B.2.1.2.4 Test evaluation

a. <u>Measurements of black illuminance</u>

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

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

- $\phi_{black/measured}$ is the calculated average light flux of the 9 points measured.
- $E_{black/measured}$ is the measured average illuminance of the 9 points measured.
- A_{test} is the chosen test-area of the projected image in m² measured in dark room conditions.

2. 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 $\Phi_{black/measured}$ shall 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 A.2.1.1).
- $A_{max/office}$ is the ”TCO Image Size” (see A.2.1.1).

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 $\Phi_{black/measured}$ shall 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 A.2.1.1).
- $A_{max/video}$ is the ”TCO Image Size” (see A.2.1.1).

A quick reference table showing the relation between measured ANSI flux, A_{max} and max black level is found at the TCO Development homepage.

B.2.1.2.5 Overall uncertainty

≤ ± 10 % in illuminance.

See B.2.0.6.

- Back to A.2.1.2

B.2.1.3 Light flux uniformity

B.2.1.3.1 Preparation of the projector for testing

- All necessary preparations described in B.0 and B.2.0 shall be done.
- The default test image is a full-screen with colour “bright white” (RGB setting of 255, 255, 255). The size of the test image shall be the “TCO image Size”. However, if the test facility is not large enough to project the “TCO Image Size” it is allowed to do testing on an image size larger or equal to 50% of the “TCO Image Size”.

B.2.1.3.2 Equipment:

Illuminance meter.

B.2.1.3.3 Test method:

- The illuminance is measured at location 1 to 9 according to figure B.2.1.1.
- It is not recommended to perform this parameter together with B.2.3.2 Colour uniformity, since the reflectance standard used in B.2.3.2 Colour uniformity is likely not calibrated for the angles involved and consequently will give false luminance results for the light flux uniformity.

B.2.1.3.4 Test evaluation

Evaluate the equation as given in A.2.1.3.

B.2.1.3.5 Overall uncertainty

≤ ± 10 % in illuminance measurements.
See B.2.0.6.

Back to A.2.1.3

B.2.2 Image detail characteristics

B.2.2.1 Native display resolution requirement

B.2.2.1.1 Preparation of the projector for testing

No specific preparation of the projector is needed.

B.2.2.1.2 Equipment

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

B.2.2.1.3 Test method

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

B.2.2.1.4 Test evaluation

For TCO Image sizes equal to or larger than 1.5 m^2 a viewing distance of 1.5 times the diagonal is defined for the first row of viewers.

However, for very small TCO Image Sizes (e.g. presented by pico projectors) it is likely that the first row of viewer is slightly further away than 1.5 times the diagonal. This means that a lower resolution can be accepted for small TCO Image sizes. Because of this, the viewing distance in this TCO criteria document is defined for three different TCO Image Size spans.

Example:
To achieve 30 pixels/degree for a 4:3 aspect ratio image with a viewing distance of 1.5 times the diagonal it is necessary to have XGA native resolution. In the same way it is necessary to have SVGA native resolution if the viewing distance is increased to 1.8 times the diagonal and VGA native resolution is acceptable if the viewing distance is increased to 2.2 times the diagonal.

This means that if the intended use is to project 4:3 images of 0.5m^2 it is enough with VGA native resolution. If the intended use is to project larger images than 1.5m^2 it is necessary with XGA resolution.

The minimum resolution to fulfil the criteria can be calculated for any aspect ratio in the following way:

Minimum amount of pixels in the vertical direction
Half the TCO Image Size height at the viewing distance expressed in degrees is:

- *arctan(width/2/viewing distance)*

The whole TCO Image Size height expressed in degrees is:

- *2 × arctan(width/2/viewing distance)*

The requirement is 30 pixels/degree which gives the amount of pixels needed in the vertical direction to:

- *30 × 2 × arctan(width/2/viewing distance)*

Example:
For the format 5:4:3 and viewing distance 1.5 this gives the formula:

- *30 × 2 × arctan(4/2/(1.5 × 5)) = 896 pixels*

The principle is the same in the vertical direction.

B.2.2.1.4 Overall uncertainty

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

Back to A.2.2.1

B.2.3 Screen colour characteristics

B.2.3.1 Correlated colour temperature (CCT) variation

B.2.3.1.1 Preparation of the Projector for testing

- All necessary preparations described in B.0 and B.2.0 shall be done.
- The default test image is a full-screen with colour “bright white” (RGB setting of 255, 255, 255).

B.2.3.1.2 Equipment

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

B.2.3.1.3 Test method

Place the colour neutral reflectance standard in the centre of the projected image (at measurement location 5 figure B.2.1.1.). Measure the spectral properties at the centre of the colour neutral reflectance standard with a spectro-radiometer.

The spectral data shall then be processed, which is normally done directly in the instrument microprocessor, to give chromaticity co-ordinates. In this case the CIE co-ordinates u' and v' are needed for the test evaluation and are often presented directly by the spectro-radiometer used.

If the client has stated pre-set CCTs, preparation and testing shall be repeated for all additional CCTs

The following rules shall apply:

- The recommended default CCTs is 6500 K, but the CCT can be anywhere between 5000 K and 10000 K.
- Only CCTs with exactly specified numerical values have to fulfil the requirements for Pre-set CCTs.
- CCTs lower than 5000 K shall not be tested.

B.2.3.1.4 Test evaluation

The measured u'_m and v'_m values of the screen for the pre-set CCT and the CIE reference chromaticity co-ordinates u'_{CCT} and v'_{CCT} values for the reported CCT shall be used to calculate the colour difference as follows:

$$\Delta u'v' = \sqrt{(u'_{CCT} - u'_m)^2 + (v'_{CCT} - v'_m)^2}$$

This calculation shall be done for all tested pre-set CCTs.

The CIE 1976 u' and v' reference chromaticity co-ordinates for five common CCTs are given in Table B.2.3.1.1.

Table B.2.3.1.1

CCT in K	u'_{cct}	v'_{cct}
9300	0.1889	0.4457
7500	0.1935	0.4586
6500	0.1978	0.4684
5500	0.2044	0.4808
5000	0.2091	0.4882

If preset CCTs other than those given in Table B.2.3.1.1 are used in the test, u'_{CCT} and v'_{CCT} can be found by using CIE tabulated data or by using CIE formulae presented in CIE Publication 15.2 (1986), Colorimetry, p.11, p. 27-28 and p. 53-54, Table 1.3.

If the spectro-radiometer used can only produce CIE 1931 x and y chromaticity co-ordinates these can be transformed to u' and v' chromaticity co-ordinates by using the formulae in the CIE Publication 15.2 mentioned above.

The relevant CIE material – conversion formula and tabulated data for u'_{CCT} and v'_{CCT} – can also be found on the TCO Development homepage, www.tcodevelopment.com. A computer program based on the given equations can be supplied by TCO Development.

The resulting colour difference calculation shall be presented to 3 decimal places.

If no pre-set correlated colour temperature exists, report the measured correlated colour temperature.

B.2.3.1.5 Overall uncertainty

≤ ± 0.003 in u' and v'.
See B.2.0.6.

Back to A.2.3.1

B.2.3.2 Colour uniformity

B.2.3.2.1 Preparation of the projector for testing

- All necessary preparations described in B.0 and B.2.0 shall be done.
- The default test image is a full-screen with colour “bright white” (RGB setting of 255, 255, 255).

B.2.3.2.2 Equipment

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

B.2.3.2.3 Test method

The colour uniformity shall first be evaluated visually by the technician in order to find those areas where the colour varies the most. The most applicable of the following colour uniformity test shall then be performed.

- Measure the chromaticity co-ordinates u' and v' in the visually most colour-deviating areas. Then, in addition to this, measure the chromaticity co-ordinates in the corner positions as shown in Figure B.2.1.1 and in the centre.
- It is not recommended to perform this parameter together with B.2.1.3 Light 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.

B.2.3.2.4 Test evaluation

Δu'v' according to the CIE (1976) uniform chromaticity scale diagram shall 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 colour difference between them.

The largest difference in Δu'v' value shall be reported.

The result shall be presented to 3 decimal places.

(The evaluation procedure is exemplified below

- Make a table of colour 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, Δu', is 0.005 (between 0.190 and 0.185) at measurement positions 1 and n-1.
- The largest v' difference, Δv', is 0.015 (between 0.447 and 0.432) at measurement positions 1 and n.
- Since Δv' (= 0.015) is much larger than Δu' (= 0.005), the Δv' value shall be used for the calculation of Δu'v'.
- The corresponding two pairs of u' and v' to be used for the calculation are thus the values found at position 1 and position n and thus become the values used for points A and B such that

  $u'_1 = u'_A = 0.190$ and $v'_1 = v'_A = 0.447$ for point A in this example

  and

  $u'_n = u'_B = 0.186$ and $v'_n = v'_B = 0.432$ for point B in this example

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

B.2.3.2.5 Overall uncertainty

≤ ± 0.003 in u' and v'.
See B.2.0.6.

Back to A.2.3.2

B.2.3.3 Colour gamut

B.2.3.3.1 Preparation of the projector for testing

- All necessary preparations described in B.0 and B.2.0 shall 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.

B.2.3.3.2 Equipment

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

B.2.3.3.3 Test method

Place the colour neutral reflectance standard at measurement location 5 (see figure B.2.1.1.). Measure the spectral properties at the centre of the colour neutral reflectance standard with a spectro-radiometer for red, green and blue according to B.2.3.3.1.

B.2.3.3.4 Test evaluation

The recorded chromaticity co-ordinates u' and v' for red, green and blue shall be reported as well as the luminance for each of red, green and blue.

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

B.2.3.3.5 Overall uncertainty

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

≤ ± 0.007 in u’ and v’ for blue.

See B.2.0.6.

Back to A.2.3.3

B.2.3.4 Colour greyscale linearity

B.2.3.4.1 Preparation of the projector for testing

- All necessary preparations described in B.0 and B.2.0 shall be done.
- Use full-screen test pattern with the following RGB settings: R=G=B=255, 225, 195, 165, 135, 105, 75 and 45.

B.2.3.4.2 Equipment

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

B.2.3.4.3 Test method

Place the colour neutral reflectance standard at measurement location 5 (see figure B.2.1.1.). Measure the spectral properties at the centre of the colour neutral reflectance standard for the RGB settings stated above with a spectro-radiometer.

B.2.3.4.4 Test evaluation

The evaluation procedure is exemplified below

- TCO will provide an excel spread sheet at the TCO website www.tcodevelopmet.com which will calculate the Δ u' v' differences between all the greyscale 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 greyscale step into the corresponding cells of the spread sheet.

The table below contains coloured cells indicating difference requirements. The principle is that the darker the greyscale the more difficult it is to see a colour difference.

Examples on how to use the table: By using the column 255 (greyscale 255) and go down to line 165 (greyscale 165) you find that the maximum allowed colour difference Δu´v´ is 0.020 (orange cell). For the greyscales 225 and 75 the maximum allowed difference is 0.035 (green cell).

B.2.3.4.5 Overall uncertainty

≤ ± 0.003 in u' and v'.
See B.2.0.6.

Back to A.2.3.4

B.2.4 Compatibility characteristics

B.2.4.1 Video- and computer ports

B.2.4.1.1 Preparation of the projector for testing

- No preparations are needed

B.2.4.1.2 Equipment

Visual inspection.

B.2.4.1.3 Test method

Visual inspection together with information from manual.

B.2.4.1.4 Test evaluation

All input and output port shall be reported.

B.2.4.1.5 Overall uncertainty

Not applicable.

Back to A.2.4.1

B.4 Emissions

B.4.0 General test conditions for emissions

B.4.0.1 Basic test requirements

As described in section B.0.

For the test methods for emissions described in this document the following conditions apply:

AC mains voltage* 230 VAC RMS, tolerance ≤ 1 %

AC mains frequency* 50 Hz, tolerance ≤ 2 %

The equipment shall be connected to phase and neutral.

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

B.4.0.2 Conditions and set up for the test object

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

The projector control settings shall be the same as for visual ergonomics. This means the light flux test image at the default setting shall be used for the emission testing of alternating electric and magnetic fields. See section B.0.6 for details concerning this setting.

The projector shall focus the test image defined in B.2.1.1.

The projector must comply 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 shall 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 shall be of such quality that when the cable is measured by itself, hanging in its correct position at the turn table but with the test sample removed, the values shall 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 shall be connected to mains via the above mentioned power cable, which shall 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 shall then from this point run downwards at least 1 m. – see figure B.4.0.2.1.

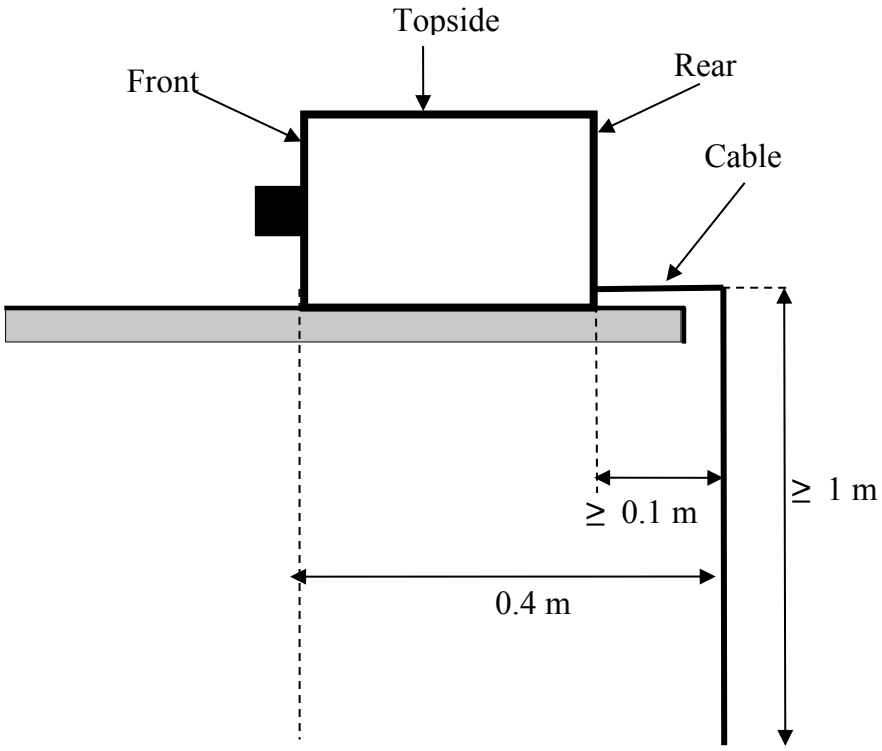

Figure B.4.0.2.1 Projector without external power supply units.

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, shall be positioned centrally, directly behind the test sample, on the (turn)table, with the secondary side towards the projector. The primary cable shall extend horizontally, on the (turn)table to a point 0.4 m behind the screen surface. The cable shall then, from this point run downwards at least 1 m. If the power supply can be positioned with different sides up, it shall be tested in all positions and the worst case shall 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, it is enough to test the power supply in the one intended position.

The secondary cable of the power supply shall 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, shall be bundled together with the power supply unit. The bundle loops shall 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 shall be used.

For power supply units which are designed to be put directly in the outlet, without a primary cable, the secondary cable shall run vertically down to the (turn)table 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 shall then, from this point, run downwards at least 1 m.

For measurements of alternating magnetic fields (B.4.2) 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 shall be described in the test report.

B.4.0.3 Emission measurement instruments

The instruments used for emission testing shall comply with the requirements and calibration procedures described below:

Alternating electric field meter

- The alternating electrical field emission from the projector under test shall 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 B.4.0.3.1.
- 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 electrical field, E, averaged over the active surface in accordance with
  $U = \varepsilon \times E \times A/C$ where C is the capacitance in the feedback loop of the operational amplifier and ε is the permittivity for a vacuum.

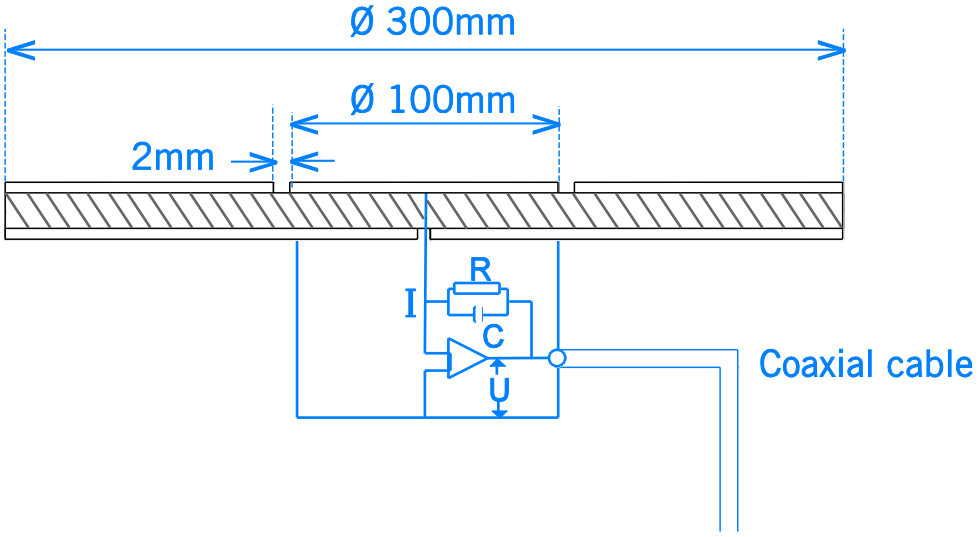

Figure B.4.0.3.1 Sketch and circuit principle of the Alternating electric field meter for alternating electrical field measurements. The feedback circuit of the operational amplifier is a capacitance C in parallel with a high value resistor R to ensure that there is no DC voltage across the plates of the capacitor C.

The specifications for the frequency response of the alternating field meter are given by the calibration procedure. The signals from the probe shall be filtered by high-pass and low-pass filters. The specification of the filters is given in Table B.4.0.3.1.

Table B.4.0.3.1 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 shall be used to determine the r.m.s. value of the electric field strength in both frequency bands.

The measuring time shall be sufficiently long to enable measurements with an accuracy of ± 5 % at 50/60 Hz.

The measuring system shall 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 shall 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 shall be 30 mm.

The calibration shall be performed with sinusoidal fields at the amplitudes and frequencies specified in Table B.4.0.3.2.

Table B.4.0.3.2 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 shall be within ± 5 % of the nominal value. Due to the nature of the specified filters the deviation shall 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 shall be measured using coil systems that shall consist of three mutually perpendicular concentric circular coils each with an area of 0.01 m^2. The coils may depart from a circular shape where they intersect. The minimum inner diameter shall be 110 mm and the maximum outer diameter 116 mm. The measuring coils shall not be sensitive to electric fields.

The resonance frequency of each coil appropriately connected to cables and amplifiers shall not be so low that it may influence the specified frequency response according to table B.4.0.3.1.

Amplifiers and integrating networks to make the output voltage proportional to the magnetic flux density and independent of frequency shall follow each coil. The specifications in respect of the frequency response are given in the calibration procedure.

High-pass and low-pass filters shall filter the signals from the coil systems. The specifications of the filters are given in Table B.4.0.3.1.

After amplification, integration and filtering, the signals from the three coils in each coil set shall 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 shall be sufficiently long to enable measurement with an accuracy of ≤ 5 % at 50/60 Hz.

The alternating magnetic field meter in band I and band II shall 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 shall be calibrated using a Helmholtz-type calibration coil as shown in the Figure B.4.0.3.2. Calibration set-up. Calibration shall be performed with sinusoidal fields at the amplitudes and frequencies specified in Table B.4.0.3.3.

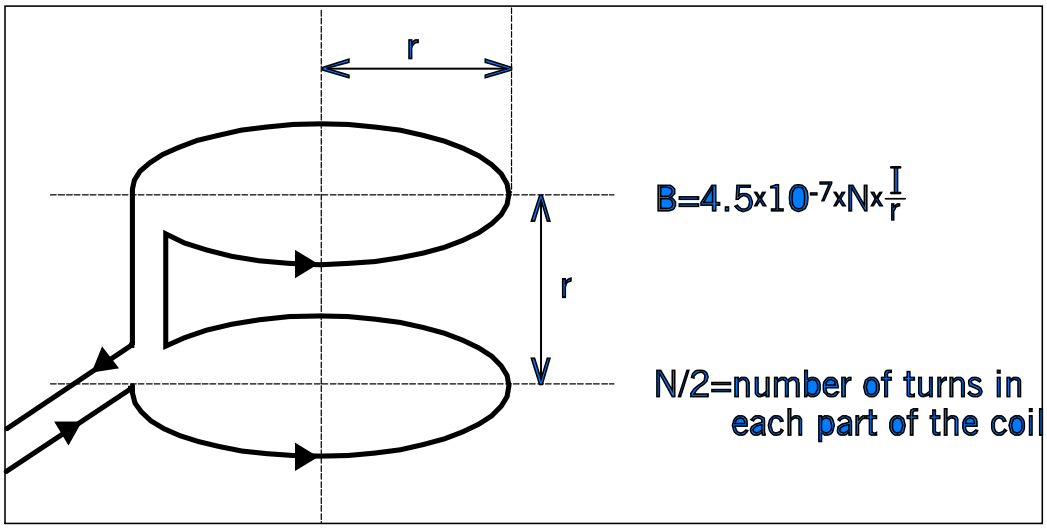

Figure B.4.0.3.2. Calibration using a Helmholtz-type calibration coil.

Table B.4.0.3.3 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 shall not deviate more than ± 5 % from the nominal value. Due to the nature of the specified filters the deviation at 1 kHz shall be calculated from 180 nT and 1800 nT and at 120 kHz from 24 nT and 240 nT.

The calibration shall 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.

B.4.1 Alternating electrical fields

B.4.1.0 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, shall together not exceed 2.0 V/m in band I and 0.20 V/m in band II.

The mains voltage to the projector under test shall be within ± 3 % of its nominal value.

B.4.1.1 Preparation of the projector for testing

All necessary preparations described in B.0 and B.4.0 shall be done.

An external optical filter may not be used in order to comply with the mandatory requirement.

B.4.1.2 Equipment

Alternating electric field meter.

B.4.1.3 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 shall be positioned such that the tangential plane, to the centre-centre point of the projector lens, is at a right angle to the horizontal plane. The distance between the centre-centre points of the projector lens and the back of the projector, including an eventual part of a stand holder, along the normal to this tangential plane is called L, see Figure B.4.1.3.1.

The origin of the cylindrical co-ordinate system is chosen to be situated at a distance L/2 behind the projector lens on the normal to the tangential plane through the centre-centre point. The z-axis is chosen to 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 counter-clockwise direction.

Measurements are taken in four directions around the product at 0°, 90°, 180° and 270°. Measurements shall 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 shall be taken at the centre, centre

In case of less than 1 m clearance the instrument shall be moved out radial until 1 m clearance is achieved.

Distances are given in metres and angles in degrees. The co-ordinates are given for the centre of the measuring probe. The surface of the probe shall be perpendicular, within ± 5°, to the radial axis.

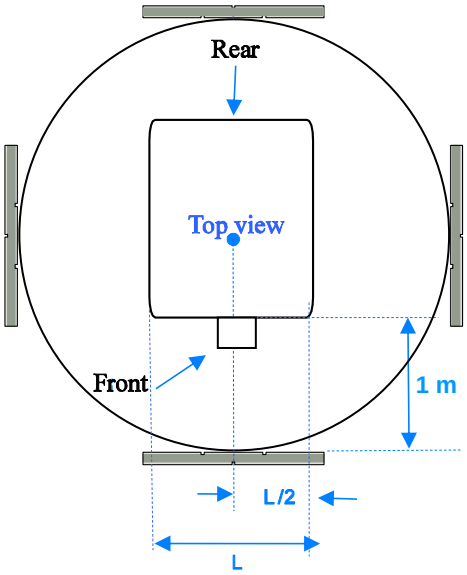

Figure B.4.1.3.1. Measurement geometry for band I (top) and band II (bottom).

The projector under test and the measuring probe shall 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, which are not part of the test, shall be placed so far away from the measuring setup 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 shall be connected to ground. Any eventual cables running between the measuring probe and the measuring instrument shall be positioned in such a way that they do not influence the measured value.

The power cable of the test object shall 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.

be taken with the connection that gives the highest reading in band I.

B.4.1.4 Test evaluation

Results shall 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 shall 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 shall be reported as "< 1.0 V/m".

B.4.1.5 Overall uncertainty

The test shall be performed in such a way that the total extended uncertainty in the test result will be less than ± (10 % of the reading + 0.1 V/m) for band II.

Back to A.4.1

B.4.2 Alternating magnetic fields

B.4.2.0 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, shall together not exceed 40 nT in band I and 5 nT in band II.

B.4.2.1 Preparation of the projector for testing

All necessary preparations described in B.0 and B.4.0 shall be done.

B.4.2.2 Equipment

Alternating magnetic field meter in band I and band II

B.4.2.3 Method

The true r.m.s. value of the amplitude of the magnetic flux density vector is measured at 12 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 B.4.2.3.1.The measurement points are mathematically defined in the following way.

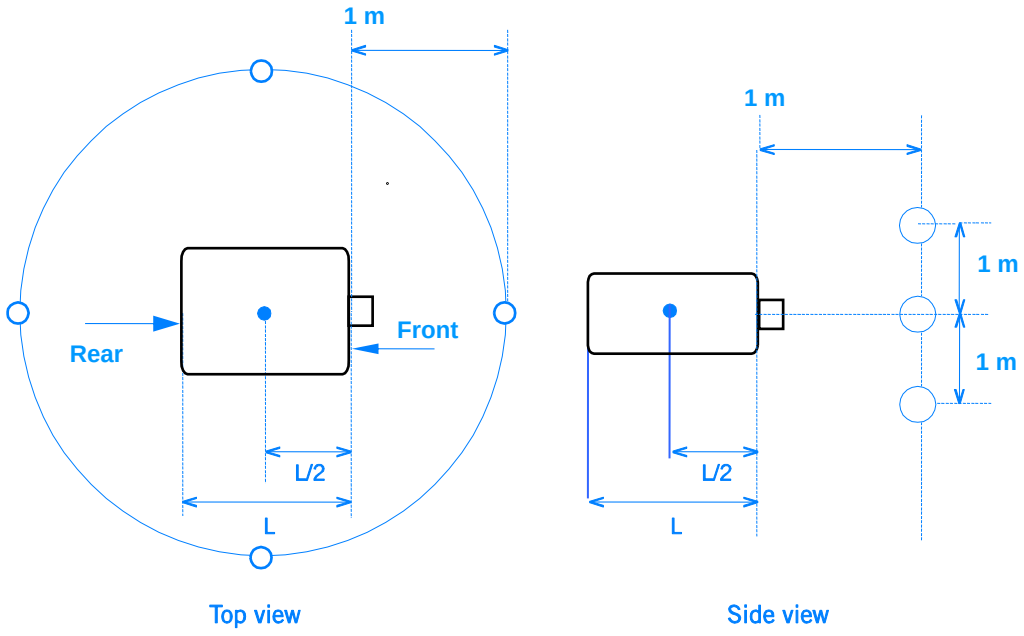

Figure B.4.2.3.1. Measurement geometry for the test object.

The projector shall be positioned such that the tangential plane, to the centre-centre point of the projector lens, is at a right angle to the horizontal plane. The distance between the centre-centre points of the projector lens and the back of the projector,

including an eventual part of a stand holder, along the normal to this tangential plane is called L.

The origin of the cylindrical co-ordinate system is chosen to be situated at a distance L/2 behind the projector lens on the normal to the tangential plane through the centre-centre point. The z-axis is chosen to 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 counter-clockwise direction.

Measurements are taken in four directions around the product at 0°, 90°, 180° and 270°. Measurements shall 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 shall be taken at the centre, centre point at 1 m clearance over the projector.

In case of less than 1 m clearance the instrument shall be moved out radial until 1 m clearance is achieved.

Distances are given in metres and angles in degrees.

The measuring coils shall be stationary during the measurements.

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

The power cable of the test object shall 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.

B.4.2.4 Test evaluation

Results shall 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 shall 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 shall be reported as "< 200 nT" and "< 25.0 nT" respectively.

B.4.2.5 Overall uncertainty

The test shall be performed in such a way that the total extended uncertainty in the test result will be less than ± (10 % of the reading + 30 nT) for band I and ± (10 % of the reading + 1.5 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.

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B.4.3 Acoustic noise

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

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

B.4.3.1 Overall uncertainty

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

Note

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

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B.6 Environment

B.6.0 General Clarification

B.6.0.1 Signatures

The date of signature shall not be older than 12 months at the time of the application. The templates in the ecological declaration shall be sent either with original signatures or as copies of original documents with original signatures. “Copies” are for example telefaxes or pdf-files of scanned signed documents. TCO Development and/or the responsible test facility may later request the original signed document.

However, copies will not be accepted where the signature has been scanned and pasted into the document.

TCO Development accepts digital signature as an alternative to traditional signature on test reports and declarations submitted as pdf files. To approve a digital signature it is necessary to also submit a digital key to the verifier to facilitate identification.

B.6.1 Product description

The A.6.1 template shall 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 panel identification name shall be submitted to the verifier. Only two * may be used in the model type key and each * must include two or more options. For the most up-to-date information about type keys, see the appropriate product Application Process at www.tcodevelopment.com

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B.6.2 Manufacturing

B.6.2.1 Environmental management system certification

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

The applicant shall submit an ISO 14001 certificate or EMAS registration for every final assembly plant used to manufacture products certified according to TCO Certified.

For applicants submitting several applications, it is sufficient to attach ISO 14001 certificate(s) or EMAS registration(s) with the first application. The certificate(s) or an appendix to the certificate(s) shall show the scope of the certification.

Manufacturing plants that are not yet certified (and that do not fall into the above mentioned category) can seek a 12 months grace period on the first application to obtain ISO14001 certification or EMAS registration. TCO Development reserves the right to deny grace period if the Applicant is considered a high risk for not meeting the 12 month due date. When seeking grace period an agreement must be completed/signed by the Applicant company.

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B.6.3 Climate

B.6.3.0 General test conditions for Energy measurements

As described in section B.0.1-B.0.9.

B.6.3.0.1 Basic test requirements

AC mains voltage*	230 VAC RMS, tolerance ± 1 %
AC mains frequency*	50 Hz, tolerance ± 0.5 Hz
Line impedance	0.25 Ω
Total harmonic distortion	< 2%
Test room temperature	23±3°C
Humidity	20-75 % RH (non-condensing)

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

B.6.3.0.2 Power measurements

Several instruments are to be used when carrying out measurements for power as well as the prerequisite luminance and luminance levels. All instruments shall have been recently calibrated and bear a calibration certificate from a certified test facility.

The following instrument types are to be used for testing:

RMS power meter

The RMS power meter shall have a crest factor of at least five, and a frequency response of at least 3 kHz.

B.6.3.0.3 Measurement stability

Measurements shall 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.

B.6.3.1 Energy requirement

B.6.3.1.1 Preparation of the projector for testing

The projector shall 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.

B.6.3.1.2 Equipment

RMS power meter

B.6.3.1.3 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. Please note that the testing shall 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 declared 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 shall 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 shall 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 shall 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.

B.6.3.1.4 Test evaluation

Record the test conditions and test results as specified for each mode in section B.6.3.1.3.

B.6.3.1.5 Overall uncertainty

The uncertainty in the test results shall be better than ± 5%.

B.6.3.2 Energy consumption – external power supply

TCO Development has decided that energy consumption of the external power supply shall follow the EPA demands for compliance with The International Efficiency Protocol requirement for level V, equivalent to the Energy Star version 2.0 for external adapters, also covering battery chargers.

The international efficiency mark consists of a Roman numeral (I – VI) that corresponds to specific minimum Active and No-Load efficiency levels (as well as a power factor requirement for level V) and is printed/applied by the manufacturer on the external power supply marking label.

A test facility approved by TCO Development will require a copy of the display's external power supply marking label where The International Efficiency Protocol requirement for level V symbol is visible as proof of compliance.

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B.6.4 Hazardous substances

B.6.4.1 Cadmium (Cd), mercury (Hg), lead (Pb) and hexavalent chromium (CrVI)

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. No exemption for mercury in lamps is allowed.

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.

Back to A.6.4.1

B.6.4.2 Halogenated substances

Mandate 1. The requirement applies to plastic parts in all assemblies and sub-assemblies.

Exempted are printed wiring board laminates, electronic components and all kinds of cable insulation.

Mandate 2. The requirement applies to the whole of the Projector product, including components, parts and raw materials in all assemblies and sub-assemblies e.g. batteries, paint, surface treatment, plastics and electronic components. Printed Wiring Boards are also included in the requirement.

HBCDD has been identified as a Substance of Very High Concern in accordance with EU REACH criteria. The main application of HBCDD in EEE is as 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 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 weight percent.

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B.6.4.3 Non-halogenated substances

Non-halogenated flame retardants can be used in TCO Certified products once they receive an accepted benchmark. TCO Development makes a list of accepted substances available on its website. The Accepted Substances 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 accepted substance list. Any substance to be removed will be set a sunset date. The sunset date shall give adequate time (at least one year) for equipment manufacturers to switch to a flame retardant alternative.

When considered necessary, TCO Development reserves the right to request a substance undergo further assessment in order to assess the completeness, quality and validity of a draft benchmark score, such as a GreenScreen Verification assessment.

Full GreenScreen Assessments of substances are made publicly available on databases such as GreenScreen Store http://www.greenscreenchemicals.org/gs-assessments/chemicals or IC2 (Interstate Chemicals Clearinghouse) http://theic2.org/hazard-assessment or Techstreet http://www.techstreet.com/searches/3638231. If no public assessment report is available, then TCO Development may place interested persons in contact with the owner of the report.

Table B.6.4.3.1

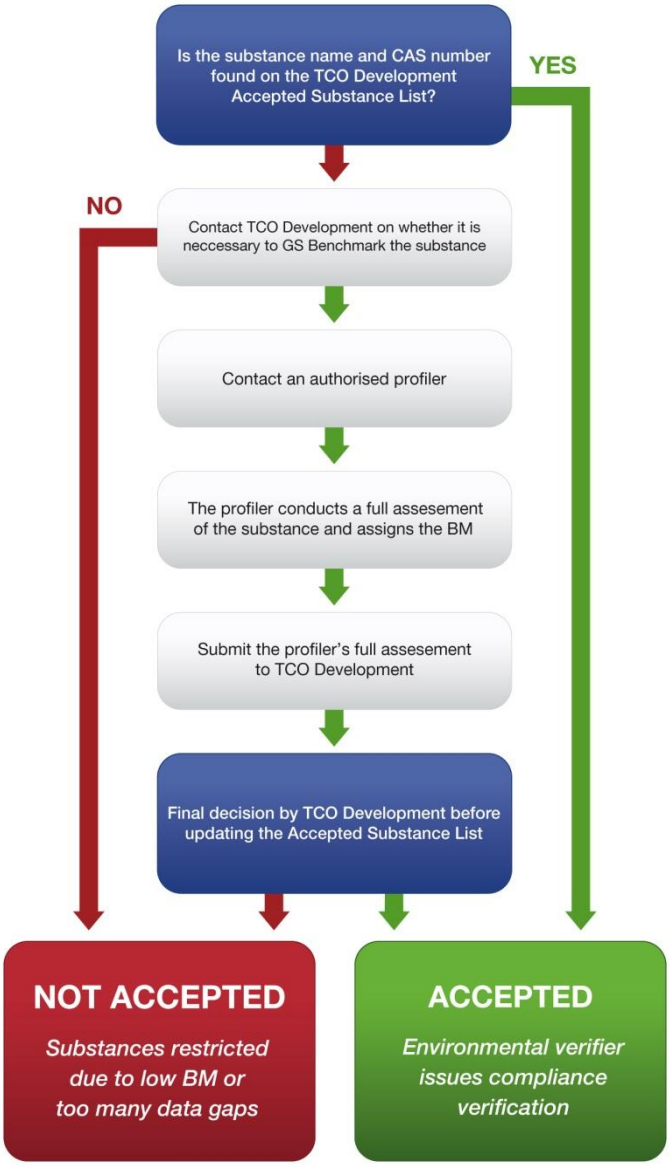
Benchmark key		
Benchmark 4	Few concerns, i.e. safer chemical	Approved for use
Benchmark 3	Slight concern	Approved for use
Benchmark 2	Moderate concern	Approved for use
Benchmark 1	High concern	Not accepted
Unspecified (U)	Insufficient data to assign a benchmark	Not accepted

B.6.4.3.1 Compliance procedures (See also Flow chart B.6.4.3.1)

- **First contact your suppliers such as the plastic and panel manufacturer and ask them to confirm that they only use flame retardants including substances on the accepted substance list.**

- **If all flame retardants only include substances on the Accepted Substances List the procedure is as follows**:
  1. Sign template A.6.4.3 and submit it to the approved environmental verifier. When the verifier considers all environmental documentation is compliant they will issue an Environmental verification to the applicant.

- **If any flame retardant is used that contains a substance that is not on the Accepted Substances List** then it will need to be added before approval can be given by the 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, no assessment has been conducted or it has a benchmark score U (unspecified) due to many data gaps.
  2. If TCO Development requires the substance to be benchmarked, we recommend you contact your supplier and inform them that the substance will need a GreenScreen assessment by a licensed profiler. The list of licensed profilers can be found on the CPA website at http://www.greenscreenchemicals.org/professionals/profilers
  3. A draft report per substance (not flame retardant) is assembled from the available information (literature search, structural similarity comparison, expert judgment) by the profiler.
  4. It is the profiler that sets the benchmark score per relevant substance, which is valid for 3 years. Substances are assessed at 3 year intervals since mandates are revised and more data and new knowledge on the substance may lead to other results.
     Note: All assessments **and** reassessments shall be conducted by licensed profilers.
  5. Full GreenScreen **assessments per substance** shall be submitted to TCO Development for final approval before the Accepted Substances List can be updated.
  6. Once a substance is added to the list and the verifier identifies them, then they will issue the environmental verification to the applicant (see above point 1 under: **If all flame retardants only include substances on the Accepted Substances List the procedure is as follows**)



Flow chart B.6.4.3.1. The Compliance procedure

B.6.4.3.2 Grace period

Applicants signing mandate A.6.4.3 have the option to seek a grace period in order to give them time to assess flame retardants used and substitute these if necessary. The request for a grace period shall be sent to TCO Development together with a description on why a grace period is necessary and a timeline for the GreenScreen assessment and/or substitution. On receiving this request, TCO Development will conduct a risk assessment as to whether the applicant can be given a grace period to show compliance. If a grace period is not granted, then the applicant is required to ensure that all used non-halogenated flame retardants only include substances that are on the TCO Accepted Substances list before a certificate can be issued to them. After the grace period, if an approved a grace period exceeds the due date, then the verifier shall contact TCO Development and a course of action will be decided after talking first with the applicant.

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B.6.4.5 Phthalates

Maximum concentration values tolerated for a restricted substance is 0.1 % by weight of any plasticised homogenous material.

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B.6.4.6 Hazardous substances in product packaging

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

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B.6.5 Material Resource Efficiency

B.6.5.1 Lifetime extension

That spare parts shall be available for three years from “the time that production ceases” is only applicable to the production of the specific Projector, certified by the brand owner according to TCO Certified.

Regarding spare parts:

- If a part of a product is broken (e.g. bezel, stand) the end user shall not need to replace the whole product, only the broken part. The broken part shall be possible to replace with an equivalent part (this part does not have to be identical to the broken part).
- When the cost for replacing a broken part (e.g. panel) exceeds the cost of replacing the whole product, then that part need not be considered as a spare part under this mandate.

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B.6.6 End of life

B.6.6.1 Material coding of plastics

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

The requirements also apply to plastics in the LCD panel, however labelling 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)*<. Labelling of Plate diffuser (not thin plastic film diffuser) shall 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 labelling these.

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B.6.6.2 Take back system

Tick the box of the option chosen.

If the applicant chooses **option 1** (*Product only sold on markets with WEEE legislation or similar*) and signs the declaration, 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 declaration 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 company operates must always be met.

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B.7 Socially Responsible Manufacturing

B.7.1 Supply chain responsibility

B.7.1.1 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 stipulates the minimum standards for Code of Conduct, Inspection and Corrective Action engagement of the brand owners regarding the situation at their own and/or their supplier's manufacturing facilities of TCO Certified products.

B.7.1.2 Background information

B.7.1.2.1 SA8000

SA8000 is based on the UN Universal Declaration of Human Rights, Convention on the Rights of the Child and various International Labour Organization (ILO) conventions. SA8000 is a global social accountability standard for decent working conditions, developed and overseen by Social Accountability International (SAI). SAI contracts with a global accreditation agency, Social Accountability Accreditation Services (SAAS) that licences and oversees auditing organisations to award certification to employers that comply with SA8000.
For more information visit: http://www.sa-intl.org/

B.7.1.2.2 Electronic Industry Citizenship Coalition (EICC)

The Electronic Industry Citizenship Coalition (EICC) is a group of companies working together to create a comprehensive set of tools and methods that support credible implementation of the Electronic Industry Code of Conduct. The EICC Code of Conduct is at the core of member requirements and members are required to commit to it, spread that commitment to their supply chains and undertake a range of assessment activities to ensure they are accountable to their commitment to the Code.
The EICC VAP (Validated Audit Process) is a factory audit framework for identifying risks and driving improvements and robust management systems for labour, ethics, health, safety and environmental conditions in the supply chain. It is a third party validated audit service that provides an independent audit of a supplier, potential supplier, and/or a company's own facilities.
For more information visit: http://www.eicc.info/

B.7.1.2.3 Grace Period.

Brand owners signing mandate A.7.1 for the first time have the option to seek a 12 month grace period in order to give them time to improve their supply chain management systems. On receiving this request, TCO Development will conduct a risk assessment as to whether the brand can be given a grace of 12 months to show compliance. If a grace period is not granted, then the brand is required to make all required improvements and actions before a certificate can be issued to them.
After 12 months, if an approved a grace period exceeds the due date, then the verifier shall contact TCO Development and a course of action will be decided after talking first with the brand owner.

B.7.1.3 The verification process

B.7.1.3.1 Proof documentation to be submitted to a Social Reviewer approved by TCO Development

1. Submitting the code of conduct

   The Brand owner shall submit a copy of their code of conduct signed (on the document copy or declaration of identity) by the SMR (or higher ranking member of the company) to an approved Social Reviewer. If the Code of conduct has not changed since last time it was reviewed the brand does not have to send it again. In this instance the SMR shall declare this.

   SA8000: If the brand owners head office is certified according to SA8000 then the code of conduct does not have to be reviewed by the Social Reviewer. It is enough to send a copy of the SA8000 certificate to the Environmental Verifier and the Code of conduct with the application to TCO Development.

2. Submitting the proof of the supply chain being informed of the code of conduct.

   The Brand owner shall submit a description on how their first tier manufacturing facilities of TCO Certified products are informed of their code of conduct for review by an approved Social Reviewer.

   SA8000: If the brand owners head office is certified according to SA8000 then a description does not have to be reviewed by an approved Social Reviewer. It is enough to send a copy of the SA8000 certificate to the Environmental Verifier and the description with the application to TCO Development.

3. Submitting the annual factory list

   The Brand owner shall submit an annual list of all first tier manufacturing facilities of TCO Certified products to the Environmental Verifier and TCO Development. The list shall show the factory name, address, date of conducted audit, date of planned audit and type of audit. Each factory shall have an audit date assigned to it. All these audits may be first, second or third party audits (at least one of the audits shall be 3rd party and have been conducted within 12 months from the date the list is submitted). The list shall show that all factories have or will be audited once over a 3 year period.

4. Submitting the annual third party audit report

   The Brand owner must submit one annual third party audit report carried-out at a first tier manufacturing facility of TCO Certified products for review by an approved Social Reviewer. The audit report shall at least cover the criteria in A.7.1 of TCO Certified and be of equal quality as an EICC audit. When possible the audit report shall be from a different first tier manufacturing facility than the previous years unless otherwise specified by TCO Development.

   SA8000: If the first tier manufacturing facility is certified according to SA8000 then the third party audit report does not have to be reviewed by an approved Social Reviewer. It is enough to send a copy of the SA8000 certificate to the Environmental Verifier and a copy of the audit report with the application to TCO Development.

5. Submitting the annual corrective action plan (CAP) if relevant.
   The Brand owner must submit one corrective action plan (CAP) for review for any non-conformity found in the submitted audit report to an approved Social Reviewer..

   SA8000: If the first tier manufacturing facility is certified according to SA8000 then then the CAP does not have to be reviewed by a n approved Social Reviewer. It is enough to send a copy of the SA8000 certificate to the Environmental Verifier and a copy of the the CAP with the application to TCO Development.

B.7.1.3.2 On-site inspection initiated by the Brand owner (Social revision)

In accordance with the compliance options under A.7.1 the Brand owner shall provide a third party conducted social audit and a CAP for any non-conformities carried out at one of their first tier facilities producing TCO Certified products. The following applies:

- The Brand owner may choose the third party Audit firm.
- Third party auditors used by the Brand owner to carry-out the factory inspection and issue the report shall have documented experience of carrying out social auditing. The auditor should have undergone the SA8000 Advanced Auditor Training or an equivalent training course
- A third party is considered to be a person or body that is recognised as being independent of the parties involved, as concerns the issue in question. Parties involved are normally the Brand owner (first party) and purchaser (second party).

B.7.1.3.3 Review of the proof documents

The approved Social Reviewer will evaluate the documents according to the following principles.

- **Code of conduct:**
  - The code of conduct shall be considered consistent with the ILO:s eight Core Conventions, art 32 in UN:s Convention on the Rights of the Child, the health and safety legislation in force in the country of manufacture, and the labor law, including rules on minimum wage and the social security protection in the manufacturing country
  - The contents of the code of conduct shall have been adopted by the Board and addressed by management.
  - The code of conduct shall relate to the manufacturing of the specific product being certified.
- **Supply chain being informed of the code of conduct:**
  - Examples may be that the Brand Owner has translated the Code of Conduct into local languages. This shows that the company has made efforts so that management and employees are able to be informed about the code’s content in their own language.
  - Or the company has conducted training on the Code for employees and/or management at production facilities.
  - Another common way to inform production facilities can be to have them fill out a questionnaire (self-assessment) on compliance with the code.

- **Audit report reviews:** Central to the compliance options is the review of the factory audit report conducted by a third party Social Reviewer approved by TCO Development. Audit reports sent for review shall not be older than 12 months. It shall be authentic, conducted by an auditor with the correct competence and cover the relevant manufacturing site.
- **Corrective Action Plan (CAP)**: If there were findings during the factory inspection then a CAP (remedial plan plus timelines and evidences) for the findings shall be submitted for review together with the audit report. This CAP will be evaluated for effectiveness by the Social Reviewer. A judgement on the remedial effectiveness and a summary will be given in the Verification Report issued by the Social Reviewer..

- **The approved Social Reviewer:** All supporting documentation shall be reviewed by a third party approved by TCO Development. This reviewer shall not be the same person that conducted the factory audit. The reviewer has the authority to review and verify the following types of documents:
    - Code of conducts
    - Communication of the code of conduct
    - Audit reports,
    - CAPs,
    - SA8000 certificates/audits
    - Supporting documentation

After the review the Social Reviewer issues the Audit Report Verification document to the Brand owner or the applicant. It is the final responsibility of the Brand owner to submit this document to TCO Development to show that they are aware of the situation at the factory and accept the report.
A verification report issued by the approved Social Reviewer is valid for 12 months from the date of the Brand owner's first issued TCO Certified certificate covering mandate A.7.1. The verification must be updated annually. The list of approved Social Reviewers is found at: www.tcodevelopment.com

B.7.1.3.4 On-site inspection initiated by TCO Development (Spot-checks)

TCO Development reserves the right to require full audit reports and conduct or commission on-site inspections at first tier manufacturing facilities to verify that the Brand owner is fulfilling the obligations according to this mandate. The planning of social audits will be done in cooperation with the Senior Management Representative appointed by the Brand owner. Audits will be implemented by TCO Developments partner organisation for the actual geographic region. Social audits initiated by TCO Development will be realized on a judgement sample basis, in each case decided by and financed by TCO Development. Results from the audits will be shared with audited factory (both management and worker representatives) and all the brand owners listed as using the audited factory in order to create a combined effort toward implementing the CAP. For TCO Development, the spot-checks and all other submitted reports contain valuable information on social performance, making it possible to translate findings into metrics and then measure improvement through code of conduct and audit methodology.

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B.7.2 Senior Management Representative

B.7.2.1 General Clarifications

The mandate underlines the importance for the Brand owner to appoint a senior management representative who, irrespective of other responsibilities, has the authority to ensure that the requirements of this mandate are met. This aims to create an open and transparent dialogue between TCO Development and top management at the brand owner company.

B.7.2.2 SMR review

The intention of the review of the SMR is to ensure that the SMR has the necessary authority and is working in a structured way in implementing the Brand owner's code of conduct. The SMR may bring assistants to the review meeting if needed. The following questions will be asked of the SMR:

1. The SMR will be asked questions on how the communication of the Brand owner's code of conduct to first tier factories has been done. (See point 1 of the self-assessment questionnaire)
2. The SMR will be asked questions about the Brand owner's audit schedule and about some of the audits that have been done. (These reports may be first, second or third party audits).
3. The SMR will be asked to show examples of progress for some corrective action plans.
4. The SMR will be asked to fill in the self-assessment questionnaire on proactive work (point 2-19) by TCO Development (B.7.2.2.1) prior to the review and explain in more detail the Brand owner's proactive work to implement their code of conduct during the review. The SMR might be asked to show supporting documentation for this. The self-assessment questionnaire does not have to be reviewed by a verifier approved by TCO Development. It is sent directly to TCO Development prior to the SMR review.

The Questionnaire and Guidelines for the assessment are public and can be downloaded at: www.tcodevelopment.com

As long as the SMR is able to show the relevant documents and explain the Brand owner's structured work to implement their code of conduct the review is accepted. If the SMR is not able to get hold of necessary documents or if he/she cannot explain about the Brand owner's structured work to implement their code of conduct the review is not accepted.

The review may be done through an online meeting. However, it is necessary that documents can be shared (during or prior to the meeting) and that the communication quality is adequate for full understanding.

If it is not possible to set up an online meeting that fulfils the requirements above or if the review does not give an acceptable result then TCO Development has the right to require the SMR to be reviewed by a third party auditor paid by the brand owner. The report from this review is then sent to TCO Development.

TCO Development also has the right to require a face to face review of the SMR. For this type of review, TCO Development will cover their own costs.

B.7.2.2.1 Self-assessment questionnaire on proactive work

The self-assessment questionnaire is provided by TCO Development and is a set of questions covering such areas as the implementation of the Brand owner's code of conduct, auditing and follow-up of social criteria, trade union rights and representation, activities to avoid discrimination and create an open dialogue with suppliers.

The Brand owner SMR is responsible for answering all questions and providing documented proof of how it supports its suppliers in these areas. Each answer is colour graded full- (Green), partial- (Yellow) or non- (Red) compliance level.

In order to highlight the need for progressive improvement and level the commitment between different brands, the questionnaire is required to be submitted annually during the SMR review. However, the self-assessment questionnaire does not have to be reviewed by a verifier approved by TCO Development. It is sent directly to TCO Development prior to the SMR review.

There is currently no minimum level required for the proactive work reported in the questionnaire (point 2-19) in this generation of TCO Certified. The data collected in the questionnaire on proactive work will be used to risk assess Brand owners for the spot-check program. In this program TCO Development make annual third party factory audits according to the code of conduct on a number of Brand owners first tier factories. The questionnaire is also intended to measure the progress in the industry and to be used as a basis for future criteria development in this area.

The Questionnaire and Guidelines for the assessment are public and can be downloaded at: www.tcodevelopment.com

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B.7.3 Conflict minerals

B.7.3.1 General Clarifications

The mandate mainly focuses on the 3T+G minerals which are being mined within the Democratic Republic of Congo (DRC) region and used in a wide range of computer products. Once refined the origins of minerals are hard to trace, therefore we are recommending the importance of participation with legitimate in-region initiatives that directly benefit people in the conflict-affected regions. However, since the number of participants for in-region initiatives are low at this stage we also accept involvement in smelter/refinery certification programs since they complement in-region initiatives. Also we approve brands that can satisfactorily provide proof that they have adopted the *OECD Due diligence guidance*, since it provides a framework for brands to ensure that they respect human rights and do not directly or indirectly contribute to conflict.

B.7.3.2 Background information about the initiatives

TCO Development is demanding brands address the conflict mineral concerns of the private and public sector while delivering solutions that benefit those involved in the responsible minerals trade in the DRC. TCO Development considers participation in the following initiatives facilitates that goal. It is TCO Developments opinion that the OECD Due Diligence Guidance for Responsible Supply Cain of Conflict-Affected or High-risk Areas is the most ambitious approach in the list.

- *The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas* ("the Guidance"). Brands require suppliers to disclose their sourcing origins of conflict minerals by using a questionnaire template such as the EICC 'Conflict Minerals Reporting Template' or similar in order to prevent the potential use of conflict minerals.
- *iTSCi* - ITRI represent tin producers and smelters. This program is a supply chain initiative to verify and trace minerals from the mine to smelter (traceability tagging). Although full membership is focused on upstream companies (Mining, Smelters etc) an Associate membership for downstream companies exists (manufacturers etc). Associate members contribute to the financing of the iTSCi program and so keep informed of initiative activities, specific mining sites whilst they support development in Africa.

  ***For more information*:**

  https://www.itri.co.uk/index.php?option=com_zoo&view=item&Itemid=191
- *Conflict-free Tin Initiative* (CFTI); sources conflict-free tin from the South Kivu province of DRC that implements the ITRI Tin Supply Chain Initiative (iTSCi) the due diligence and traceability system
- *The Public-Private Alliance for Responsible Minerals Trade* (PPA) is a multi-sector and multi-stakeholder initiative that provides funding and support to systems that trace and certify mineral supply chains in the DRC and Great Lakes Region. http://www.resolv.org/site-ppa/

- Other relevant in-region initiative. Initiatives not given in the list but prove active commitment to an initiative that aims at increasing legitimately sourced minerals.

  Examples of other relevant initiatives that are approved:

  - *Solutions for Hope* (SfH); sources conflict-free tantalum from the Katanga province of DRC (incorporates the iTSCi process and CFS program).
  - *The Certified Trading Chains* initiative (CTC) is a program supported by the German government and certifies mines to defined performance standards

- Member of the EICC & GeSi *Conflict-Free Sourcing Initiative* (CFSI). 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).

B.7.3.3 The verification process

At least one of the options in the mandate box shall be marked. Every initiative the Brand is a participant in shall be provided. The following shall occur before the verifier may issue a verification of compliance.

- The template shall be completed by the responsible person at the brand owner company.
- The brand shall complete the TCO Certified Conflict Mineral Questionnaire and submit it and any required supporting documents for review. The verifier then assesses compliance and issues the verification report.

Supporting documents

- If the brand has a management system covering conflict minerals within its supply chain which it states are based on the OECD Due Diligence guidelines, then a supporting document that outlines those due diligence measures shall be submitted. Example of proof are:
  - Due Diligence Roadmap, Sustainability report or Conflict Mineral Report asserting the OECD five step framework.
  - Link to where information/findings are posted on the brand's website.
- The brand shall provide a copy of its conflict mineral policy and state where the information is made public.
- If the brand is part of an in-region initiative or the EICC CFSI, then supporting documents or links to relevant websites shall be provided to the approved verifier in order for them to verify participation.
- If the brand marks the option 'Other relevant initiative', then the name of the initiative shall be entered into the template and information on the initiative (or website) shall be submitted to the verifier and they will contact TCO Development in order to make a joint assessment before it can be accepted as an option. Although unlikely, any additional review fee entailed for an extra assessment will be charged to the applicant, after receiving the applicant's consent.
- When the application is satisfactory, the verifier notes on the verification report the fulfilled options and the type of supporting documentation.

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