EBU

OPERATING EUROVISION AND EURORADIO

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TELEVISION LIGHTING CONSISTENCY INDEX-2012 AND TELEVISION LUMINAIRE MATCHING FACTOR-2013

Recommendation

Source: FTV-LED

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Television Lighting Consistency Index - 2012 and Television Luminaire Matching Factor - 2013

EBU Committee	First Issued	Revised	Re-issued
FTV-LED	2012	2014, 2016*	

Keywords: Lighting, LED, Luminaire, Colorimetric performance, Tech 3353, Tech 3354, Tech 3355

Important Note

TLCI-2012 has become widely accepted by the industry with many vendors now including the TLCI-2012 Qa-factor in their datasheets. However in order to clarify any potential confusion it should be noted that the differences between three sensor cameras which employ dichroic colour filters and single sensor cameras where organic dyes work independently to share light over a wider range of wavelengths was carefully considered and included in the work behind the TLCI-2012.

It is a matter of course that high-end TV/Film productions use extensive colour processing during post production in order to realise the desired 'colour expression' and 'sentiment' or 'look-and-feel' of the production. Any remaining and very small imperfections related to differences between 3-chip/1-chip cameras are insignificant and easily corrected in this process.

Recommendation

The EBU, considering that,

1. television lighting must have a minimum quality standard in order to satisfy the audience, the international exchange of programmes and the archive,

2. new, energy efficient, luminaires may not perform as well as expected, and that

3. in order to achieve repeatability, reliability and accuracy in spectroradiometric measurements of luminaires, some conditions must be observed that whilst not onerous, should ensure credibility for measurements and calculations.

recommends that,

1. the analytical method specified in EBU Tech 3355 be used to identify problem luminaires, so that existing and potential users of such luminaires may be advised of the colorimetric problems involved in using them.

2. the procedures described in the Annex be used when making spectroradiometric measurements for use in TLCI-2012 and TLMF-2013 calculations.

* In version 2.0, dated August 2016 the '*Important Note*' is added for clarification. The recommendation is otherwise unchanged.

Annex

1. Background

The purpose of this recommendation is to give technical aid to broadcasters who intend to assess new lighting equipment or to re-assess the colorimetric quality of lighting in their television production environment.

Knowing its performance limitations in advance can help in the choice of luminaire, identifying the potential extra cost of colour correction in post-production as against the cost saving in power consumption of high-efficiency luminaires.

This advice is based on a mathematical calculation implemented in software, the “TLCI-2012” and “TLMF-2013, both specified in EBU Tech 3355 and available from the EBU as ‘TLCI-2012.zip’.

2. Assessment process

The only measurement needed for assessment of light sources is the spectral power distribution of the luminaire. The software analysis specified in EBU Tech 3355 clearly identifies poorly performing luminaires, and gives advice to programme colourists if such luminaires should be used along with others.

The process is designed to supplant the *Color Rendering Index* (CRI) for use in television production. The CRI is the sole colour-error measuring method approved by the CIE (Commission International d`Éclairage/International Commission on Illumination), but has many points of criticism, and was never intended to take into account any of the special features of television. Work on the Television Lighting Consistency Index (TLCI) was started in 1971 by W.N. Sproson and E.W. Taylor, and has now been updated to deal meaningfully with modern television systems (TLCI-2012 and TLMF-2013).

3. Measurement procedures

An introduction to spectroradiometry is given in Supplement 1 to EBU Tech 3355.

3.1 Operating temperature

The ambient temperature for measurement should not have a great effect on a luminaire, but it might (it can change the correlated colour temperature a little). Therefore, measurements should not be made in ambient temperatures lower than 18°C.

3.2 Orientation

In television lighting, the luminaires mostly point downwards, therefore it makes sense to measure in such a condition. The lamp should be pointed downwards, at an angle between 40° and 50°. This in itself will cause heating in the lamp-holder, which should be allowed to stabilise before measurements are made.

Measurement should be made on the central axis of the beam, and with the sensing surface (usually a diffuser on the end of a fibre-optic cable) normal to this direction. The spectroradiometer sensing surface should be placed at a distance which ensures sufficient light for a good measurement to be taken while eliminating any stray light, typically 0.5 m to 1.5 m should be acceptable. If the polar diagram of the light source is to be measured, then the distance from the sensing surface to the source must be kept constant, and only the angle varied.

If the luminaire has discrete light sources of different colours, then the sensing surface should be placed such that it is equally light by an even mixture of those sources. This may not always be possible, in which case a separate diffusing screen will be needed.

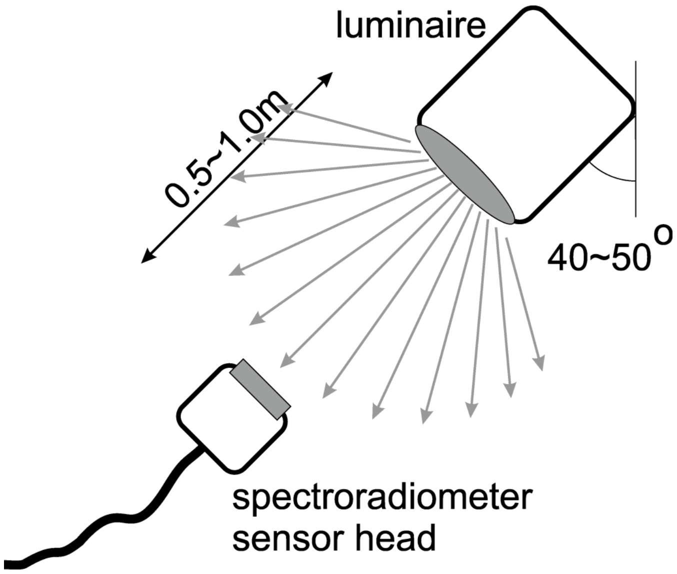

Figure 1: Luminaire measurement

3.3 Warm-up period

Different types of light source need different warm-up periods before it can be assumed that the output is stable. The following minimum times should be allowed for stabilisation, not only for the light source itself but for the associated electronics and mounting components.

Source type	Minutes
Incandescent filament, e.g. tungsten.	2
Discharge, e.g. plasma, HMI	10
Fluorescent	20
LED	20

The spectroradiometer should also be allowed to warm up to achieve stability. Generally, this will require about 30 minutes, but large spectroradiometers may take considerably longer, and small ones considerably less. If the manufacturer's specification does not give a warm-up time, then at least 30 minutes should be allowed.

4. Reporting and recording results

The software provides both a graphical representation and numerical data of the potential colorimetric problems when not using ideal luminaires. Both can be used to estimate the potential cost of colour correction.

Figure 2 shows a screenshot of the graphical representation. The light source is identified by its file name, 'Candle flame' in this case, together with other information that is described more fully below.

The graphical representation cannot convey all the data that may be relevant to the measurement and the software can generate an Excel table such as that shown in Table 1. Some items in the

Excel table are automatically filled in by the TLCI-2012 software; entries for those marked with an asterisk should be provided by the operator, if they are relevant. This metadata file should be retained as evidence should there be any dispute over TLCI or TLMF measurements.

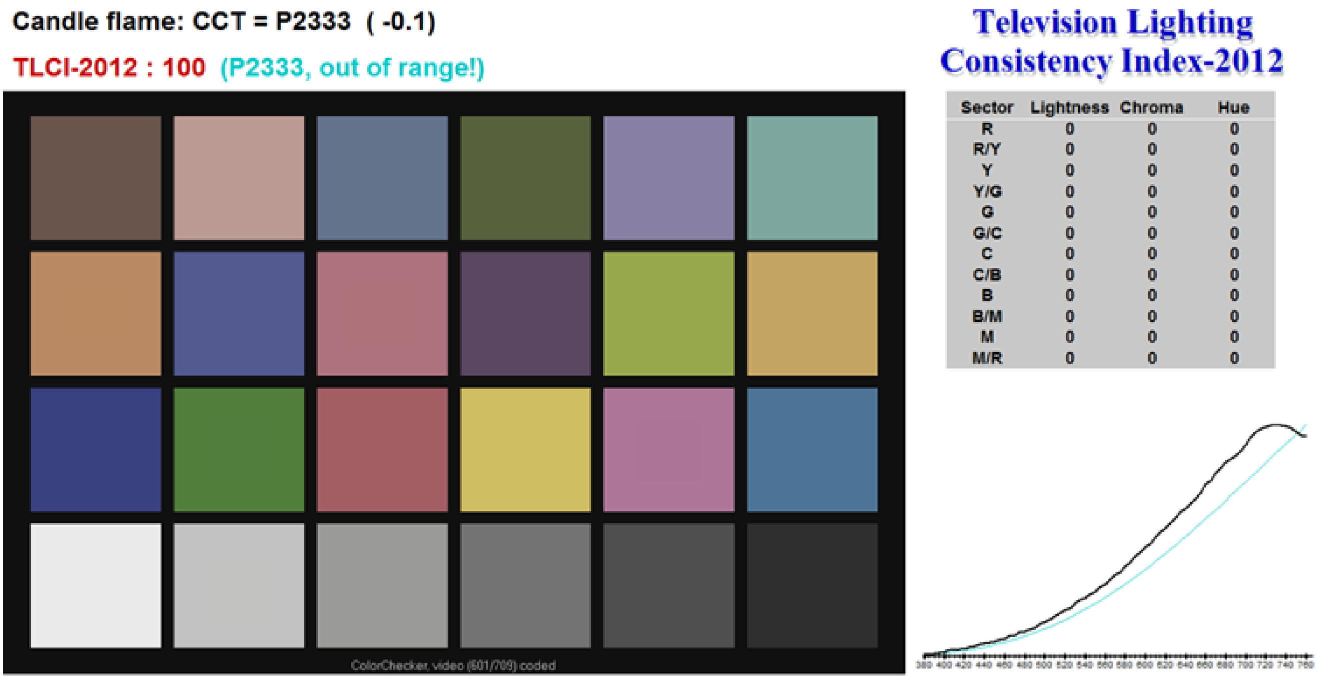

Figure 2: Screenshot from the “TLCI-2012”software, “Candle Flame”

Table 1: (Excel) table generated by “TLCI-2012” software, “Candle Flame”

TLCI/TLMF metadata report	
Report file	Candle flame.lum.xls
Report screen image	Candle flame.lum.bmp
Date	Sat.02 Aug 2014,23:56:04
Author *	Alan Roberts
Spectroradiometer *	ASEQ Instruments LR1, Ocean Optics CC-3 diffuser
Spectroradiometer calibration *	Ocean Optics HL2000, Thu.13 Dec 2012
Test file	Candle flame.lum
Test file date	Fri.21 Jun 2013,15:08:43
Test file CCT	P2333 (-0.1)
Luminaire manufacturer *	(enter the makers name here)
Luminaire model *	(and the model number/reference here)
Luminaire type *	(e.g. tungsten, LED, flu, spot, panel, etc)
Luminaire details *	(e.g. version number, batch number and date, anything unusual)
Luminaire supply voltage *	(if different from makers' spec.)
Luminaire CCT setting *	(if there is a CCT control)
Luminaire level setting *	(if there is a dimmer control)
Luminaire angle *	(if not between 40 and 50 degrees)
Luminaire distance *	(if not between 0.5 and 1.0m)
Test colour	Q value
Dark skin	99.96
Light skin	99.72
Blue sky	99.99
Foliage	99.99

TLCI/TLMF metadata report	
Blue flower	100.00
Bluish green	99.98
Orange	99.95
Purplish blue	100.00
Moderate red	99.78
Purple	99.99
Yellow green	100.00
Orange yellow	99.99
Blue	100.00
Green	99.97
Red	99.50
Yellow	100.00
Magenta	99.98
Cyan	99.97
White 90.01%	100.00
Neutral 8 59.1%	100.00
Neutral 6.5 36.2%	100.00
Neutral 5 19.77%	100.00
Neutral 3.5 9%	100.00
Black 3.13%	100.00
Result Qa value	99.879

Figure 3 is another example of the graphical representation produced by the TLCI-2012 software, this time for a Daylight Fluorescent luminaire that exhibits visible differences between the reference source in the ColorChecker® test card. A more detailed description of the graphical elements follows.

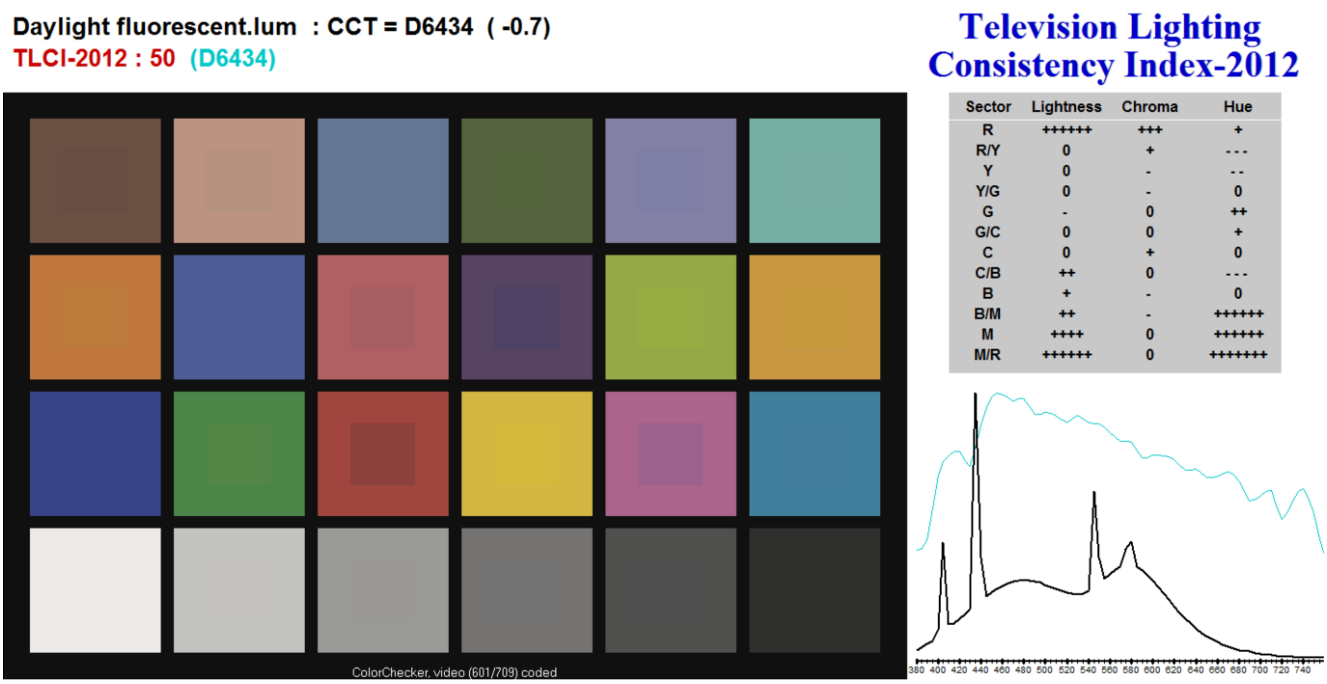

Figure 3: Screenshot from the "TLCI-2012"software, "Daylight Fluorescent.lum"

Description of the elements in the Screenshot

- Across the top of the report, the test source is named and its correlated colour temperature (CCT) is given in black. The number in brackets is the distance from the chromaticity of the test luminaire to its CCT measured in multiples of 0.0054 (in CIE1964 uv units; this value is specified by the CIE as being the maximum at which the CCT can be considered as being reliable). The TLCI-2012 value is shown in red; the reference illuminant is named in cyan.
- The CCT value is prefixed with P (Planckian, black body) for illuminants less than 3400K (degrees Kelvin), with D (Daylight) for illuminants greater than 5000K and with M (Mixed) for colours between 3400 - 5000K. This allows for a smooth transition from Planckian to Daylight CCTs, and provides a meaningful reference for luminaires used in mixed lighting situations.
- At top-right is a table, listing the relative corrections needed to Lightness, Chroma and Hue, for twelve hue sectors. For Lightness and Chroma, "+" and "-" signs indicate that the value should be increased or decreased and multiple such signs indicate the approximate amount of correction needed. For Hue, "+" means anticlockwise rotation (i.e. red towards yellow, yellow towards green and so on) while "-" means clockwise rotation (i.e. red towards magenta, magenta towards blue and so on).
- At bottom right is the spectral power distribution of the test luminaire in black, plotted from 380 - 760nm. The reference luminaire, against which the test luminaire is assessed, is plotted in cyan.
- At left is a representation of a ColorChecker® test card. Each colour patch is shown as lit by the reference source when reproduced by a standard camera and shown on a standard display. Inset into each patch is the performance of the test luminaire, for comparison.
- The TLMF-2013 output is virtually identical, but also gives the name of the Reference Luminaire, and identifies the output by changing the name at the top-right to indicate TLMF.

5. Results Analysis

The TLCI value, Q_a, is generated on a scale from 0 to 100, where 100 indicates a perfect match with the reference source, its CCT. The mathematical analysis is designed to return a value of 50 for a daylight fluorescent tube.

The Q_a scale can be labelled in two ways; using the ITU 5-point quality scale, and using opinions derived from a small set of subjective tests conducted by five professional colourists.

Figure 2: Q_a explanation

6. Bibliography

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EBU Tech 3355-s1	**An Introduction to Spectro-radiometry**	*October 2013*
EBU Tech 3355-zip	**Software package 'TLCI-2012.zip'**	*August 2014*