

Development of a Technical Report: Comparison between ISO and CIE			
process name	process owner	process members	ISO stage & vote rule
NWIP	CB	TCMs CIE:DD	10/2/3
assign of WG/TC	CB	BA+TCC WGT/TC	2/3/3
development WD & Ballot	TCC	TCC+TCMs assigned of TCms	30/2/3
development CD & Ballot	TCC	ISO...TCMs CIE:+DD:DE	30/2/3
development DIS/ED & B.	CB	TCC+TCMs +CB	50/2/3
development FD/IS/AD & B.	CB	TCC+TCMs +CD	50/2/3
publica-tion of TR	CB	TCC	70/12

Abbreviations: TR: Technical Report, TC: Technical Committee, Convener (Chair) or Member, WD/CD Working or Committee Draft, DIS/ED and FDS/AD Enquiry or Approval Draft, U: Unanimous vote, CB: ISO or CIE Central Board, BA: CIE Board of Administration, DD:HE: CIE Division Director/Editor/Editorial, seen by public (to buy) seen by parent committee seen only by committee

Technical problems to write standard documents in the field of colour vision and image technology.

Problem: For example the standard organisations ISO, CEN, DIN, and CIE use **antiquity software**. This software is **incompatible** with the EPS vector graphic of the software **Adobe Illustrator**. However, this image software is used since 20 years in standard documents. How to revise these ISO documents?

Some existing problems for **visibility, readability, resolution, and colour** are listed. A solution shall maintain the former high quality of ISO standards. If the **antiquity software** is necessary then it shall be **compatible** with EPS vector graphic.

Many problems show the PDF document N1581 of ISO TC159/SC4/WG2 **Visual Display Requirements**. Many colours of three 16 spot colour wheels between white and RGB disappear on page 36. The Word document with EPS graphic shows all colours as intended.

Solution 1: The vector graphic files are transferred to pixel graphic files and are included in the Word file.

Disadvantages:

- The test results of ISO standards for **visibility, readability and resolution** are determined by the pixel software and not by the colour vision properties of users.
- For example the word file size of ISO 9241:306 increases from 3 to 60 MB. This is not accepted by the email servers of standard organisations.

Solution 2: ISO 9241:306:2018 is published in pixel graphic (low quality). ISO-test charts in vector graphic are for download from the **ISO Standard Maintenance portal**. Therefore the test quality of ISO 9241:306:2009 remains, see <http://standards.iso.org/iso/9241/306/ed-2/index.html>.

Technical Problems to write standard documents in the field of colour vision and image technology					
ISO document	graphic software	file size Word PDF	antiquity software	possible magnification	remarks quality
ISO/DIS 9241-306:2017	vector graphic	2MB 4MB	No	16x	very high quality
option used in secretariat	vector graphic	2MB 4MB	Yes	16x	colours disappear (1)
ISO IS 9241-306:2018	pixel graphic	60MB 15MB	Yes	1x	very low quality (2)
DIN print 9241-306:2018	pixel graphic		Yes	1x	not use-able (3)

1) about 30% of the colours disappear; 2) the output is defined by the software, and not by the vision properties of users.
3) 4 of 16 grey steps are not distinguishable. The minimum requirement is failed.

References and access to archive-web sites with navigation Basic References

[1] CIE Toolkit for Technical Work. see <https://www.cie.co.at/technical-work/technical-resources>

[2] ISO What delegates and experts need to know <https://www.iso.org/publications/PUBN00037.pdf>

[3] ISO How to write standards <http://www.iso.org/iso/how-to-write-standards.pdf>

[4] K. Richter, 2016, How to find public Web Pages with broken links http://farbe.li.tu-berlin.de/WBM_find_PfB_16.pdf

WBM access to public CIE documents until 2017
Navigate for Reports of CIE: D1, Meeting (MR), Activity (AR)
http://web.archive.org/web/20170624031105/http://div1.cie.co.at/?i_c_id=544
Navigate for Reports of Meeting (MR), Activity (AR), Reportership (RR)
http://web.archive.org/web/2016040200138/http://div1.cie.co.at/?i_c_id=544
List of more than 300 CIE documents: http://web.archive.org/web/*http://files.cie.co.at/

WBM and direct access to public BAM documents until 2010
<http://web.archive.org/web/20061116034852/http://www.ps.bam.de/index.html>
Most content of this BAM web site has been transferred in 2018 to: <http://farbe.li.tu-berlin.de/A/indexA/E.html>

WBM access to public ISO/IEC JTC1/SC28 documents until 2006
http://web.archive.org/web/*http://www.bham.or.jp/sc28-sc28docs/28a/
http://web.archive.org/web/*http://www.actech.com.br/sc28/

Weber-Fechner law in CIE 230:2019 for threshold colour differences of surface colours

The **Weber-Fechner law** describes the lightness L^* as **logarithmic function** of L_c .
The **Stevens law** describes the lightness L^* as **potential function** of $L_c = Y/5$.
IEC 61966-2-1 uses a similar potential function $L_{TC} = m \cdot L_c^{1/2.4}$.
The **Weber-Fechner law** is equivalent to the equation: $\Delta L_c = k \cdot L_c$ [1]
Integration leads to the logarithmic equation: $L_c^* = k \cdot \log(L_c)$ [2]
Derivation leads for $\Delta L_c^* = 1$ to the linear equation: $L_c^* / \Delta L_c^* = k = 57$. [3]
For **Adjacent colours** in offices the standard contrast range is 25:1=90:3.6.
Table 1: CIE tristimulus value Y, luminance L, and lightnesses L*

Colour (matte)	Tristimulus value Y	offset luminance L	relative luminance L_r	CIE lightness L^*	relative lightness L^*_r
(contrast) (25:1=90:3.6)	Y	L [cd/m ²]	$L_r = L/L_c$	$L^*_{CIE,LAB} = -m \cdot L_r^{1/2.4}$	$L^*_r = k \cdot \log(L_r)$
White W (paper)	90	142	5	94	40
Black N (paper)	$\approx 18^*5$	$\approx 28,2^*5$	1	≈ 50	$\approx k \log(5)$
Grey Z (paper)	18	28.2	1	50	$= k \cdot \log(1)$
Black N (paper)	3.6	5.6	0.2	18	-40
(paper)	$\approx 18^*5$	$\approx 28,2^*5$	1	≈ 50	$\approx k \log(0.2)$

For the lightness range between $L^*_r = -40$ and 40 the constant is: $k = 40 \cdot \log(5) = 57$

Weber-Fechner law in CIE 230:2019 for threshold colour differences of surface colours

The **Weber-Fechner law** describes the lightness L^* as **logarithmic function** of L_c .
For local adaptation to **Adjacent colours** there is a **visible contrast 100:1**.
The **Stevens law** describes the lightness L^* as **potential function** of $L_c = Y/5$.
IEC 61966-2-1 uses a similar potential function $L_{TC} = m \cdot L_c^{1/2.4}$.
For **separate colours** on a grey surround there is a **visible contrast 25:1=90:3.6**.
See K. Richter, 2006, Relation of **Weber and Stevens law** at achromatic threshold. <http://farbe.li.tu-berlin.de/A/BAMAT.PDF>

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Access of ISO-TC42 members to working documents of CIE Division 1				
CIE document created	until 2017	since 2018	copy-right	public access to CIE documents
CIE D1 Annual Meeting Report DIMR	public	internal	CIE	until 2017, see WBM archive [1]
CIE D1 Annual Activity Report DIAR	public	internal	CIE	until 2017, see WBM archive [1]
CIE D1 Reportership Report DIRR	public	internal	Author	until 2017, see WBM archive [1]
CIE D1 WD/CD/ED/AD	internal	internal	CIE	until 2015, limited TC42 access
CIE D1 TR or IS D1TR, D1IS	public, see CIE shop	public, see CIE shop	CIE	TC42 members: buy in CIE shop

[1] see >300 documents: http://web.archive.org/web/*http://files.cie.co.at/

Access of ISO-TC42 members to working documents of CIE Division 1

CIE D1 Vision and Colour produces 3 more document types compared to ISO: CIE D1 Reports: Annual (AR), Meeting (MR), and Reportership (RR). There were requests of ISO committees to the CIE for a colorimetric support. In some cases a CIE TC was created to solve this ISO problem with a document exchange until the final publication. An example is IEC 184 (indoor daylight). In other cases the CIE nominates a Reportership Reporter to write a (public) RR. Many Reporters liked this job because the copyright remained by the author.
Table 1: Access of TC42 members to CIE Liaison documents?

Colorimetric scan, display, and print for archiving based on the ergonomic International Standard ISO 9241-306:2018 for work places

Klaus Richter, Berlin University of Technology (TUB), Germany

Abstract
ISO 9241-306:2018 shows colorimetric methods for output optimization of displays and projectors at work places. The optimization for equal spacing of colour series, visibility and readability is intended.

There are input linearization methods for scanners and photography and output linearization methods for displays, printers, and offset print. By a start output of a digital ISO-test chart with 729 colours ($9 \times 9 \times 9 \text{ } r g b^*$ values) for example the loop "ISO standard file -> ISO print -> ISO scan -> ISO file" is closed and the rgb^* colour data of the original ISO file are approximately reproduced at the end of the loop. For any hue there is a linear relation in both directions between the rgb^* and the CIE LAB LCh^* data. The closed loop and the linear relations are important properties for archiving.

Motivation and Problem

The ideal reproduction for archiving occurs, if the loop:

- ISO-standard file -> ISO print -> ISO scan -> ISO file is closed, and the rgb^* values in the **start and final file are equal**.
- ISO-standard print -> ISO scan -> ISO file -> ISO print is closed, and the LCh^* values in the **start and final print are equal**.

Both goals are approximately possible, if the output linearization method **OLM_16** is applied, see

Richter, 2016, Output linearization method OLM16 for displays, printers and offset: http://farbe.li.tu-berlin.de/OUTLIN16_01.PDF (similar to CIE R8-09:2015)

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CIE D1 Annual Activity Report DIAR	public	internal	CIE	until 2017, see WBM archive [1]
CIE D1 Reportership Report DIRR	public	internal	Author	until 2017, see WBM archive [1]
CIE D1 WD/CD/ED/AD	internal	internal	CIE	until 2015, limited TC42 access
CIE D1 TR or IS D1TR, D1IS	public, see CIE shop	public, see CIE shop	CIE	TC42 members: buy in CIE shop

[1] navigate for MR, AR, RR: http://web.archive.org/web/2016040200138/http://div1.cie.co.at/?i_c_id=544

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