see similar files of the whole serie: http://farbe.li.tu-berlin.de/fems.htm
technical information: http://farbe.li.tu-berlin.de or http://color.li.tu-berlin.de

TUB registration: 20240201-fem4/fem4l0na.txt /.ps
application for evaluation and measurement of display or print output

TUB material: code=rha4ta

Development of a Technical Report: Comparison between ISO and CIE

process name	process owner	process members	document created	ISO stage & vote rule	CIE stage & vote rule
NWIP	CB	TCMs CIE:DD	NWI	10 2/3	1 2/3
assign of WG/TC	CB	BA+TCC	WG/TC assigned	20 –	3 –
development WD & Ballot	TCC	TCC+TCMs	WD of TCMs	30 2/3	5 U
development CD & Ballot	TCC	ISO:+TCMs CIE:+DD+DE	CD	40 2/3	7 2/3,U?
development DIS/ED & B.	CB	TCC+TCMs +CB	ISO/DIS CIE/ED	50 2/3	9 2/3
development FDIS/AD &B.	CB	TCC+TCMs +CD	ISO/FDIS CIE/AD	60 Y/N+C	11 Y/N+C
publica-tion of TR	CB	TCC	ISO/TR CIE/TR	70 –	12 –

Abbreviations: TR Technical Report, TC(C, M) Technical Committee Convener (Chair) or Member, WD/CD Working or Committe Draft, DIS/ED and FDIS/AD Enquiry or Approval Draft, U Unanimous vote CB ISO or CIE Central Buero, BA CIE Board of Administration, DD/DE CIE Division Director/Editor.

seen by public (to buy) | seen by parent committee | seen only by committee

fem40−1A

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 ***anticopy 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 ***anticopy 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 step colour scales 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 transfered to pixel graphic files and are included in the Word file.

Disadvantages:

1. 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.
2. 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

fem40−2A

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 ***anticopy 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?

Table 1: Development of the ISO standard ISO 9241-306:2018. Quality with vector or pixel graphic, and without or with anticopy software.

ISO document	graphic software	file size Word PDF	anticopy software	possible magnification	remarks quality
ISO/DIS 9241 -306:2017	vector graphic	2MB 4MB	No	16x	very high quality
option used in secreteriat	vector graphic	2MB 4MB	Yes	16x	colours disapear 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 acceptable 3)

1) about 30% of the colours disapear; 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.

fem40−3A

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

[1] CIE Toolkit for Technical Work, see
http://www.cie.co.at/technical-work/technical-resources
[2] ISO What delegates and experts need to know
https://www.iso.org/publication/PUB100037.pdf
[3] ISO How to write standards
https://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_PFs_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/20170624033105/http://div1.cie.co.at/?i_ca_id=544
Navigate for Reports of Meeting (MR), Activity (AR), Reportership (RR)
http://web.archive.org/web/20160406200138/http://div1.cie.co.at/?i_ca_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/indexAE.html

WBM access to public ISO/IEC JTC1/SC28 documents until 2006
http://web.archive.org/web/*/http://www.jbmia.or.jp/sc28/sc28docs/j28n*
http://web.archive.org/web/*/http://www.actech.com.br/sc28/*

fem40−4A

fem40−3n

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

The *Weber-Fechner* law describes the lightness L^*_r as ***logarithmic*** function of L_r.
The *Stevens* law describes the lightness L^*_{CIELAB} as ***potential*** function of $L_r=Y/5$.
IEC 61966-2-1 uses a similar potential function $L^*_{IEC} = m\,L_r^{1/2,4}$.
The *Weber-Fechner* law is equivalent to the equation: $\Delta L_r = c\,L_r$ [1]
Integration leads to the logarithmic equation: $L^*_r = k \log(L_r)$. [2]
Derivation leads for $\Delta L^*_r=1$ to the linear equation: $L_r/\Delta L_r=k=57$. [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)	Tritimulus value	office luminance	relative luminance	CIE lightness	relative lightness
(contrast) (25:1=90:3,6)	Y	L [cd/m²]	L_r $=L/L_Z$	L^*_{CIELAB} $\sim m\,L_r^{1/2,4}$	L^*_r $=k\log(L_r)$
White W (paper)	90 =18*5	142 =28,2*5	5	94 =50+44	40 =*k*log(5)
Grey Z (paper)	18	28,2	1	50	0 =*k*log(1)
Black N (paper)	3,6 =18/5	5,6 28,2/5	0,2	18 50−32	−40 =*k*log(0,2)

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

fem41−1A

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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.tu-berlin.de/A/BAMAT.PDF

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fem41−2A

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fem41−3A

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For ***separate*** colours on a grey surround there is a ***visible contrast*** **25:1**=90:3,6.
Surface colours cover the ***visible contrast 100:1.*** Negative film covers the ***contrast 100000:1*** (density 5:1). Film stores images from under to over exposure

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fem41−4A

fem41−3n

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: **Anual (AR), Meeting (MR)**, and **Reportership (RR).**
There were requests of ISO committes to the CIE for a colorimetric support.
In some cases a CIE TC was created to solve this ISO problem with a document exchanche until the final publication. An example is CIE 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?

CIE document created	until 2017	since 2018	copy-rigth	public access to CIE documents
CIE D1 Anual Meeting Report D1MR	public CIE Website	internal D1 members	CIE	until 2017, see WBM archive [1]
CIE D1 Anual Activity Report D1AR	public CIE Website	internal D1 members	CIE	until 2017, see WBM archive [1]
CIE D1 Reportership Report D1RR	public CIE Website	internal D1 members	Author	until 2017, see WBM archive [1]
CIE D1 WD/CD/ED/AD WD/CD TC internal	internal TC/ D1 members	internal TC/ D1 members	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

seen by public (to buy) | limited or no access for TC42 members

fem40−5A

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

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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/*

fem40−6A

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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/20160406200138/http://div1.cie.co.at/?i_ca_id=544

fem40−7A

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

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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: http://web.archive.org/web/20170624033105/http://div1.cie.co.at/?i_ca_id=544

fem40−8A

fem40−7n

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 (9x9x9 *rgb** 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 CIELAB *LCh** data. The closed loop and the linear relations are important properties for archiving.

fem41−5A

Motivation and Problem

The ideal reproduction for archiving occurs, if the loop:

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

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

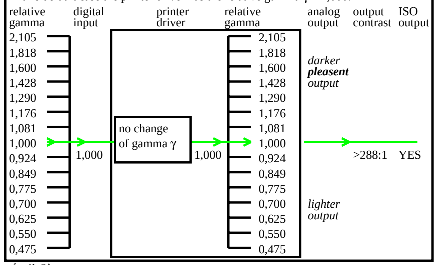
Both goals are approximately possible, if the output linearization method *OLM_16* is applied, see

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)

fem41−6A

Colorimetric workflow: digital input −> printer −> analog output based on the ergonomic Standard ISO 9241-306:2018 for work places

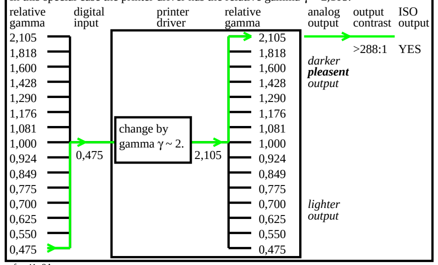
In this default case the printer driver has the relative gamma γ = 1,000.



fem41−7A

Colorimetric workflow: digital input −> printer −> analog output based on the ergonomic Standard ISO 9241-306:2018 for work places

In this special case the printer driver has the relative gamma γ = 2,105.



fem41−8A

fem41−7n