Conclusion 31/2007 ISO TC159/SC4/WG2
Ergonomics − Visual Display Requirements

ISO TC159/SC4/WG2 realizes that the colour spaces CIELAB and CIELUV of ***CIE Division 1*** will soon become ISO/CIE standards. In applications we use these CIE colour spaces and *device−dependent* relative RGB colour spaces. For users of visual display systems a *device−independent* RGB colour space is useful. This produces via software the elementary hues Red, Green and Blue for the RGB data 100, 010 and 001 and equally spaced output in CIE colour spaces for equally spaced RGB input. We recommend that ***CIE Division 1*** study the colorimetric definition of such a space, which can be used in visual display applications.

Remark: We have realized that an example colour space of this type is published in CIE X030:2006, p. 139−144.
Note: For this table text compare the content on page 2 of the document CIE R1-47, see http://files.cie.co.at/526.pdf

SS380−1N

At the CIE meeting in Stockholm, June 2008, ***CIE Division 1*** decided to establish the CIE Reportership R1-47: **Hue Angles of Elementary Colours** by *Thorstein Seim (Norway)* in respose to a request of ISO TC 159 SC4/WG2 **Visual Display Requirements** and to present the result at the next CIE meeting in Budapest 2009.

The report **CIE R1-47:2009 Hue Angles of Elementary Colours** lists in chapter 3.6 the average CIELAB hue angles 26, 92, 166, and 270 of *Miescher, NCS, and the CIE.*

CIE R1-47 defines the CIELAB hue angles **25, 92, 162 and 271** of the CIE test colours no. 9 to 12 according to CIE 13.3 for the four elementary colours $\boldsymbol{R_e}$, $\boldsymbol{Y_e}$, $\boldsymbol{G_e}$, and $\boldsymbol{B_e}$.
For the text of the request of ISO TC159/SC4/WG2, the text of the decisions of CIE Division 1, the result, and the free download of CIE R1−47 see
http://web.archive.org/web/20160304130704/http://files.cie.co.at/526.pdf

SS380−3N

Resolution Busan 18/2009 of ISO/IEC JTC1/SC28 "Office Equipment"
SC28 Review of the AWG recommendation on jn28n1280 (DIN 33872−1 to 6)
The German proposal included the concept of a human visual RGB. SC28 recognizes the importance of correct understanding of the human visual system and the potential importance and application of this understanding to office equipment and office systems. SC28 welcomes the German plan to continue development of the human visual RGB within ***CIE Division 1 and Division 8.***
In addition SC28 welcomes a new proposal from Germany in the future based on this CIE human visual RGB work, potentially in relation to AWG/PWG5 NWI−9 ***(Office colour space).***
Two CIE Reportership Reports appeared since 2009: ***R1-57:2012 (public) and R8-09:2015 (CIE internal)***
CIE R1-57:2012, Border between blackish and luminous colours, see
http://web.archive.org/web/20150413002133/http://files.cie.co.at/716_CIE%20R1-57%20Report%20Jul-13%20v.2.pdf
CIE R8-09:2015 (CIE internal), Output linearization methods for displays and printers,
with the same technical content of *Richter (2016), see* http://farbe.li.tu-berlin.de/OUTLIN16_01.PDF

SS380−5

At the CIE meeting in South Africa, June 2011, ***CIE Division 1*** decided to establish the Reportership
CIE R1−57 Border between Luminous and Blackish Colours by *Thorstein Seim (Norway)*
in response to the resolution 18/2009 of ISO/IEC JTC1/SC28.
In addition ***CIE Division 8*** decided to establish the Reportership
CIE R8−09 Output Linearization Methods for Displays and Printers by *Klaus Richter (Germany)*
in response to the same resolution 18/2009 of ISO/IEC JTC1/SC28.
Both reports **CIE R1−57:2012** ([1] public) and **CIE R8−09:2015** ([2] CIE internal) have relations.
[1] http://web.archive.org/web/20150413002133/http://files.cie.co.at/716_CIE%20R1-57%20Report%20Jul-13%20v.2.pdf
[2] with the same technical content from *Richter (2016), see* http://farbe.li.tu-berlin.de/OUTLIN16_01.PDF
Possible Result: Definition of a *device−independent visual RGB*$^*_{\mathbf{e}}$ system as response to the request of SC28.
All surface colours define a hue circle of maximum chroma located within the CIE *(x,y)* chromaticity diagram.
CIELAB chroma $\boldsymbol{C^*_{ab}}$ and lightness $\boldsymbol{L^*}$ of this circle as function of hue $\boldsymbol{h_{ab}}$ serves as reference points of a *device−independent visual* ***RGB*$^*_{\mathbf{e}}$ system*** (compare the reference $\boldsymbol{C^*_{ab}}$, $\boldsymbol{L^*}$ hue circle of the *NCS* system).

SS380−7

Proposed CIE output linearization for printers and offset machines

Printer or offset company

realized output options:
Company preference (Y/N)?
DIN 33872 (CIE?) linearized (Y/N)?
Only one option not specified (Y/N)?

User printer or offset device without or with device specific ***PS linearization code*** in print output software.

Linearization company:
Measures 1080 user colours and produces ***PS linarization code*** for user device and paper

For test charts of DIN 33872−1 to −6 see
http://farbe.li.tu-berlin.de/A/33872E.html

Advantages of Output Linearization:
− Linear relation between rgb and CIELAB data.
− No loss of visual information for 16 step colour series on different colour devices.
− Grey is printed by black only and not by CMY (complete under colour removal), low cost.

User visual test
with output of DIN 33872-X test charts.
Agrees the output with the user wishes (Y/N)?

If No (N) agreement to the user wishes then:
Output of reference test chart with 1080 colours.
Continues colour change in output (Y/N)?
If Yes, then linearization possible and decision:
Mail the output to a linearization company.

SS381−3

Proposed CIE output linearization for display and data projector devices

Display or data projector company:

realized output options:
One Company preference (Y/N)?
One ISO 9241−306 linearized (Y/N)?
Eigth ISO 9241−306 linearized (Y/N)?
Only one option not specified (Y/N)?

User display or data projector without or with device specific ***up to 8 PS linearization codes*** in display output software.

Linearization company:
Measure 1080 colours of display output with no room light reflection and produces ***8 PS linarization codes*** for eight room light reflections.

For test charts of ISO 9241−306 see (1,7 and 20MB)
http://standards.iso.org/iso/9241/306/ed-2/AE09/AE09F0PX.PDF
http://standards.iso.org/iso/9241/306/ed-2/AE27/AE27F0PX.PDF

Advantages of Output Linearization:
− Linear relation between rgb and CIELAB data.
− No loss of visual information for 16 step colour series on different colour devices.
− Linearized output of whole display for ergonomic work depending on room light reflections, for solutions see ISO 9241−306.

User visual test for up to 8 room light reflections
with output of ISO 9241−306 test charts.
Agrees the output with the user wishes (Y/N)?

If No (N) agreement to the user wishes then:
Output of reference test chart with 1080 colours.
Continues colour change in output (Y/N)?
If Yes, then linearization possible and decision:
Ask display or linearization company for help.

SS381−7