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.

AN700−1N

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 R_e, Y_e, G_e, and 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 the CIE Division 1 web site
http://cie.co.at *under MINUTES & REPORTS*

AN700-3

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).

AN700-5

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** and **CIE R8-09** have relations and may appear during 2013 at the CIE web site.

Possible Result: Definition of a *device-independent visual RGB*$_e$* **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 C^*_{ab} and lightness L^* of this circle as function of hue h_{ab} serves as reference points of a *device-independent visual RGB*$_e$ system* (compare the reference C^*_{ab}, L^* hue circle of the *NCS* system).

AN700-7

Proposed CIE output linearization for printers and offset machines
Printer or offset company

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

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 linarization code
in print output software.

For test charts of DIN 33872-1 to -6 see
http://www.ps.bam.de/33872E

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.

AN701-3

Proposed CIE output linearization for display and data projector devices
Display or data projector company:

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

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

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

For test charts of ISO 9241−306 see (1,7 and 20MB)
http://www.ps.bam.de/ME15/10L/M15E00FP.PDF
http://130.149.60.45/~farbmetrik/OE58/OE58D1PX.PDF

Advantages of Output Linearization:
- Linear relation between rgb and CIELAB data.
- No loss of visual information for 16 step
  colour series on different 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.

AN701-7

TUB-test chart AN70; ISO resolutions and CIE reports
methods for output linearization of colour devices, 3D=0, de=0, $N74$

input: *w/rgb/cmyk −> rgb*$_d$
output: *RGB* no change compared