COMMISSION INTERNATIONALE DE L'ECLAIRAGE
INTERNATIONAL COMMISSION ON ILLUMINATION
INTERNATIONALE BELEUCHTUNGSKOMMISSION

ACTIVITY REPORT

DIVISION 1

VISION AND COLOUR

January 2010

Director:	Prof. Ronnier Luo (GB)
Assoc. Director - Vision:	Dr. Miyoshi Ayama (JP)
Assoc. Director - Color:	Dr. Ellen Carter (US)
Editor:	John Setchell (US)
Secretary:	Dr Michael Pointer (GB)
	mrpointer@btinternet.com

This report presents an overview of the status of CIE Division 1 - Vision and Color since the last Activity Report that was issued in February 2009. The annual meeting of Division 1 was held on Tuesday 2 June 2009 at the Lorond Eötvös University, Budapest, Hungary. Eighteen countries were represented and 32 people were present.

The following Technical Committees met in Budapest:

- TC1-55 Uniform colour spaces for industrial colour-difference evaluation
- TC1-63 Validity of the range of CIEDE2000
- TC1-69 Colour rendering of white light sources
- TC1-70 Metameric samples for indoor daylight evaluation
- TC1-72 Measurement of appearance network
- TC1-74 Methods for re-defining CIE D-Illuminants

The following activities were closed in Budapest:

- TC1-66 Indoor daylight
- R1-32 Emotional aspects of colour
- R1-39 Alternative forms of the CIE DE2000 colour-difference equations
- R1-44 Limits of normal colour vision
- R1-46 Whiteness
- R1-47 Hue angles of elementary colours

And the following activities were started in Budapest:

- TC1-74 Methods for re-defining CIE D illuminants
- TC1-75 A comprehensive model of colour appearance
- TC1-76 Unique hue data
- TC1-77 Improvement of the CIE whiteness and tint equations
- TC1-78 Evaluation of visual performance in the real lit environment
- TC1-79 Limits of normal colour vision
- R1-48 Colour emotion and harmony
- R1-49 Above-threshold pulsed lights
- R1-50 3D aspects of visual appearance measurement

In addition, a new TC was proposed:

Testing the CIE Method for Quantifying Daylight Simulators

Terms of Reference:

a. Test the validity of the CIE method (Publication 51.2) for quantifying daylight simulators with reference to white and coloured fluorescent specimens for

illuminants D50, D55, D65, ID50 and ID65.

b. To recommend modification to the method if required.

No chair was suggested or forthcoming in Budapest. If you can help by volunteering or suggesting someone who might do this important work, please contact the Division Secretary.

The following publications have appeared during the last year:

CIE 184:2009 *Indoor daylight illuminants*
Written by TC1-66 Indoor daylight

CIE 185:2009 *Reappraisal of colour matching and Grassmann's Laws*
Written by TC1-56 Improved colour matching functions

CIE 014-5/E:2009: *Colorimetry - Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram*
Written by TC1-57 Standards in colorimetry

A summary of the status of each of the Technical Committees in Division 1 is included in this report together with summaries from the Reporters and Liaisons. The reports are grouped such that the Vision Section is precedes the Colour Section followed by the Liaison reports.

VISION SECTION: TECHNICAL COMMITTEES

TC1-36 (V) Fundamental Chromaticity Diagram with Physiologically Significant Axes

Established: 1991
Terms of Reference: To establish a chromaticity diagram of which the coordinates correspond to physiologically significant axes.
Chairman: F Viénot FR
Members: D MacLeod US, JD Mollon GB, JD Moreland GB, Y Nakano JP, J Pokorny US, LT Sharpe DE, A Stockman US, A Valberg NO, PL Walraven NL, J Wold NO
Consultants: H Scheibner DE, P Trezona GB, and H Yaguchi JP

A TC meeting was held in Braga, Portugal along with the ICVS meeting.

Chapter 6 “Photometric aspects; the choice of the spectral luminous efficiency functions $V_F(\lambda)$ and $V_{F10}(\lambda)$” was approved. It recommends use of the following formulas:

$$V_F(\lambda) = [1{,}980647\,\bar{T}(\lambda) + \bar{m}(\lambda)] / 2{,}870908$$

or

$$V_F(\lambda) = 0{,}689903\,\bar{T}(\lambda) + 0{,}348322\,\bar{m}(\lambda)$$

and

$$V_{F,10}(\lambda) = [1{,}981377\,\bar{T}_{10}(\lambda) + \bar{m}_{10}(\lambda)] / 2{,}859793$$

or

$$V_{F,10}(\lambda) = 0{,}692839\,\bar{T}_{10}(\lambda) + 0{,}349676\,\bar{m}_{10}(\lambda)$$

The TC is working on chapter 7 “Development of 2-dimensional chromaticity diagrams.” One of these diagrams will be developed according the system used for the CIE 1931 chromaticity diagram; the other will be a MacLeod-Boynton diagram. Chapters 6 and 7 will form part II of the TC report when it is completed.

TC1-37 (V) Supplementary System of Photometry

Established: 1992
Terms of Reference: To recommend a system of photometry to assess lights in terms of their comparative brightness relationships at any level.
Chairman: K Sagawa JP
Members: S Ashizawa JP, WB Cowan CA, CM Howard US, M Ikeda JP, JAS Kinney US, S Kokoschka DE, Y Nakano JP, T Takeuchi JP, PW Trezona GB, F Viénot FR, H Yaguchi JP, and A Yujiri JP. Also, HJ Schmidt-Clausen DE (Observer).

No report.

TC1-41 (V) Extension of $V_M(\lambda)$ Beyond 830 nm

Established: 1993
Terms of Reference: To write a report on the feasibility of the extension of $V_M(\lambda)$ beyond 830 nm, including modification of $V_M(\lambda)$ in the 660-780 nm region of the spectrum.
Chairman: PL Walraven NL
Members: DH Sliney US and JJ Vos NL

Now that the Division agreed on the text of chapter 6 (see TC1-36 report, above), TC 1-41 has taken the first steps to implement these latter data in the formulation of the extension of V(λ).

TC1-42 (V) Color Appearance in Peripheral Vision

Established: 1993
Terms of Reference: To prepare a technical report on color appearance zones for colored lights in terms of unique hues in peripheral vision.
Chairman: M Ayama JP
Members: I Abramov US, M Ayama JP, H Chan US, G Derefeldt SE, L Eriksson SE, L MacDonald GB, K Okajima JP, A Yujiri JP

No report.

TC1-54 (V) Age-Related Change of Visual Responses

Established: 1999
Terms of Reference: To establish luminous efficiency, visual acuity, and contrast sensitivity as a function of age.
Chairman: K Sagawa JP
Members: H Bouma (NL), L Halonen (FI), W Iwai(JP), J Werner (UA), Donald Kline (CA), Anna Szucs (HU)

No report.

TC1-58 (V) Visual Performance in the Mesopic Range

Established: 2000
Terms of Reference: To define mesopic visual performance and related terms.
To investigate performance based photometry in the luminance region below approximately 10 cd m^{-2}.
To propose a model for the basis of performance based mesopic photometry.
Chairman: L Halonen FI
Members: M Eloholma FI (Sercretary). W Aiqun CN, M Ayama JP, P Bodrogi HU, EC Burini Jr BR, DL Crawford US, O da Pos IT, C Dahua CN, G Derefeldt SE, T Goodman GB, N Itoh JP, CS Kim KR, C Knight, L Leetzow, US, I Lewin US, M Nicholson GB, J Richards US, K Sagawa JP, J Schanda HU, F Viénot FR, S Völker DE, L Yandan CN, E Yandek GB

The Technical Report has been approved by the TC and sent to the Central Bureau for National and BA ballot.

TC1-60(V) Contrast Sensitivity Function (CSF) for Detection and Discrimination

Established: 2001
Terms of Reference:
1. To specify a baseline achromatic CSF with its reference conditions and reference observer
2. To specify CSF extensions based on discrimination thresholds, as well as chromatic CSFs for both detection and discrimination

Chairman: E. Martinez-Uriegas ES
Members: D Alleyson FR**,** M. Artigas Verdes ES, C-C Chen US, M Fairchild US, RV Klassen US, L MacDonald GB, S McFadden CA, Chaker Larabi FR, E Peli US, AB Watson, S Wuerger HU, H Yaguchi JP.
Observers: L Beke, MH Brill US, D Couzin US, P Hanselaer BE, N Itoh JP, O da Pos IT, K Richter DE, K Sagawa JP

No report.

TC1-67 (V) The Effects of Dynamic and Stereo Visual Images on Human Health

Established: 2005
Terms of Reference: To write a technical report on the physiological and psychophysical effects of dynamic and stereo visual images in terms of photosensitive seizures, visually induced motion sickness and eyestrain.

Chairman: H Ujike JP
Members: Not known

The first Technical Report is expected by early 2010.

TC1-78 (V) Evaluation of Visual Performance in the Real Lit Environment

Established: 2009

Terms of Reference: To investigate and report on current research on visual performance that relates to psycho-physical and physiological measurements in the real lit environment, and to produce a plan for future work.

Chairman: Monica Billger SE

Members: Steve Fotios GB, Frédéric Leloup BE, M. Ronnier Luo GB, Barbara Matusiak NO, Yoshiki Nakamura JP, Wouter Ryckaert BE, Monica Säter SE, Jan Wienold DE

Interested but pending: Mark Rea US, Dragon Sekulovski NL, Ingrid Vogel NL

TC 1-78 is a new committee and it starts now in 2010. The aim is to investigate and report on current research on visual performance that relates to psychophysical and physiological measurements in the real lit environment, and to produce a plan for future work. This report presents the members of the committee (those who have accepted and those who are interested but pending) and our work plan. This work plan is not complete; we are in the process of discussing member contributions and organisation of work.

Work plan

How to work in the committee

We are spread out geographically and will use email and a website for communication. A simple website will be set up exclusively for the TC in January (until it works we will use email!). For those who can attend, we will have meetings at CIE conferences/Division 1 meetings. The first “official” meeting of the TC is at the CIE conference in South Africa 2011. At this meeting, we will present the TC and give an overview of relevant research.

Year 1: State of the Art

The first task is to make an overview of relevant studies and work in progress.

Aims: to map out relevant research and to define different types of studies (aims, methodology...)

For the overview of published studies, step 1 can be a reference list. The TC chair will send out, or post at the website, a list of relevant research that members can add references to. Step 2 is a review that we can develop until it will be included in the final report. Among the TC members and their research groups there is work in progress that can be used for compiling a review, such as state of the art written for various theses.

For work in progress, The TC members can contribute with information about on-going studies. On the TC website, the TC chair will start a list to fill in. The format will be “title, who, where+a few lines on aim and method”

Year 2:

Problematize and define future needs of study

Divide us in subgroups with different focus.

Year 3: Work out plans for future research and recommendations

We will develop an experimental plan how to study the visual comfort in the real

environment. This work also needs to be divided into different groups, for example physical measurements of light distribution, psychophysics and how to visually assess the spatial experience, design of the room and design the visual tasks to be performed in the room.

Year 4: Conclude and write a report

TC1-79 (V) Limits of Normal Colour Vision

Established:	2009
Terms of Reference:	1. To document the correlation between performance on colour matching, colour discrimination, colour naming, and colour deficiency tests and factors such as variation in the peak spectral sensitivity of the M and L cones, density of the lens, density of macular pigment, variation in the optical density of the cones, L to M cone ratio, rod intrusion, illumination level, stimulus size, gender, stimulus duration and identify any substantive gaps in the existing literature. 2. Using the above database, develop a model or models that will allow the prediction of the effect of the above factors on colour discrimination, colour matching, and colour naming performance.
Chairman:	John Barbur UK
Members:	Members are being sought

The stated terms of reference for TC 1-79 are broad and in the view of the chairman difficult to achieve within four years using available data. The need for this work and the setting up of this committee was triggered largely by occupational, clinical and industrial needs to measure and diagnose accurately congenital and / or acquired colour deficiency, to quantify the severity of colour vision loss and to specify appropriate, minimum colour vision requirements within certain operational environments. The many different colour vision tests and procedures that are currently employed often yield inconsistent results which cause problems, both in terms of unfair discrimination as well as safety. Sharon McFadden's excellent reports (R1-44) describe well the current situation and form the basis for TC1-79.

At this stage, it is useful to examine what we may desire to achieve and also to assess what the proposed technical committee can realistically achieve in the specified period. The "desired" terms of reference could in fact be made even more extensive, but also more difficult to achieve. Following consultation with colleagues, we would like to suggest that we limit our aim to work that fulfills current clinical and occupational needs. These are more limited, but "realistic" objectives that can be achieved and are likely to be of significant social and clinical value.

Overall, we should aim to understand the observed variability in chromatic sensitivity in normal trichromacy and congenital deficiency and to use this knowledge to enhance the usefulness of colour assessment techniques with immediate occupational and clinical applications. The following is a brief listing of desired and in our view, achievable terms of reference:

Desired terms of reference:

1. To document the correlation between performances on colour matching, colour discrimination, colour naming and colour deficiency tests in normal trichromats and in subjects with congenital colour deficiency.
2. To document how factors such as variation in the peak spectral sensitivity of the M and L cones, density of the lens, density of macular pigment, variation in the optical density of the cones, the relative numbers of L and M cones, gender, rod intrusion, illumination level, stimulus size, and stimulus duration contribute to variability in the colour related functions listed in 1.

3. To document how light level and the state of chromatic adaptation of the eye affects chromatic sensitivity and to establish statistical limits for within- and inter-subject variability.
4. To document how the factors mentioned above affect the outcome of existing colour assessment tests.
5. To identify any substantive gaps in available knowledge / data in relation to any of the above.
6. To develop models that allow adequate prediction of the effects each of the factors above can have on colour discrimination, colour matching and colour naming performance and the subsequent outcome of colour assessment tests.
7. To produce limits of “normal” chromatic sensitivity as a function of age against which colour discrimination data derived from specific tests can be used to classify normal trichromacy, congenital colour deficiency, acquired colour deficiency and combined congenital and acquired deficiency. In addition, the tests should also quantify the severity of colour vision loss.

Achievable terms of reference:

Document how red / green and yellow / blue chromatic sensitivity (measured as thresholds for detection of colour signals) in normal trichromats and in subjects with congenital colour deficiency is affected by the following parameters:

- Variation in the peak spectral sensitivity of the M and L cones
- The spectrally selective absorption of light by the lens and the macular pigment
- Variation in the optical density and relative numbers of cones
- Retinal illuminance level, stimulus size and state of chromatic adaptation

Identify any substantive gaps in current knowledge and formulate the experiments required to obtain the data needed to model the effects of the above parameters on chromatic sensitivity.

Document the statistical limits of inter-subject variability in chromatic sensitivity as a function of age, model measured data and produce template that defines the “standard” normal observer for the most commonly used parameters. Use these limits as guidelines in tests of chromatic sensitivity to fulfill the following important current needs within occupational and medical environments:

- Detect congenital colour deficiency with high sensitivity and specificity and distinguish between congenital and acquired loss of chromatic sensitivity
- Quantify the severity or red / green and yellow / blue loss of chromatic sensitivity and detect significant changes as a result of aging, disease progression or effect of treatment
- Develop and validate methods for establishing minimum colour vision requirements within specified professional environments.

VISION SECTION: REPORTERS

R1-19 (V) Specification on Individual Variation in Heterochromatic Brightness Matching

Established: 1997
Terms of Reference: To report on the possibility to develop a simple test of individual characteristics for heterochromatic brightness matching.
Reporter: H Yaguchi JP

The report will shortly be available on the D1 website.

R1-36 (V) Action Spectra for Glare

Established: 2004
Terms of Reference: To summarize the literature on the subject and make recommendation for terms of reference for a technical committee.
Reporter: J Fekete HU

No report.

R1-37 (V) Definition of the Visual Field for Conspicuity

Established: 2004
Terms of Reference: To summarize the literature on the Visual Field for conspicuity and make a recommendation for terms of reference for a Technical Committee.
Reporter: N. Itoh JP

No report.

R1-40 (V) Scene Dynamic Range

Established: 2006
Terms of Reference: To investigate the concept of scene dynamic range, the appearance of colors brighter than the adapted white, and adaptation to the dynamic range when viewing, and make recommendations regarding work to be done by the CIE.
Reporter: J Holm US

No report.

R1-43 (V) Standard Deviate Observer

Established: 2007
Terms of Reference: To document available databases that could yield a definition of a new standard deviate observer.
Reporter: B Oicherman GB

An investigation was conducted during the years 2004 - 2007 in the Department of Colour Science in Leeds University, UK. A full account of this investigation can be found in the PhD thesis of Boris Oicherman (reference 56, available for download at http://www.oicherman.com/Boris_Oicherman_Phd_thesis.pdf). The thesis includes comprehensive literature surveys on number of topics related to the Standard Deviate Observer such as Observer Metamerism, the development of the CIE Standard Deviate Observer, Real World Metamers and Colorimetric Additivity Failures (Sections 2.5-2.8). Chapter 3 of the thesis provides detailed description and analysis of the experimental work on large field quasi-symmetric colour matching. A cross-media colour matching experiment is described in detail in Chapter 4 of the thesis.

R1-49 (V) Above-threshold Pulsed Lights

Established: 2009

Terms of Reference:	To review methods for photometric prediction of the brightness and colour of supra-threshold pulsed signal lights.
Reporter:	Ian Tutt GB & Dennis Couzin US

PhD Study on Conspicuity of Signal Lights

The PhD study on the conspicuity of marine signal lights, to be hosted by Leeds University, UK under Professor Peter Rhodes, has a short list of one. An interview will take place with the prospective candidate at the end of January 2010. Significant milestones within this study will be reported to CIE and IALA.

Since the first part of the study will be a literature review of the human visual perception of pulsed light sources, a library of relevant documents is being compiled. If any CIE members know of any relevant information (papers etc.), their input would be greatly appreciated. Please contact Ian Tutt in the first instance (ian.tutt@gla-rrnav.org).

1st Generation Conspicuity Model

Malcolm Nicholson of the General Lighthouse Authorities Research and Radionavigation Directorate has completed a model that encompasses several factors affecting the conspicuity of marine Aid to Navigation (AtoN) lights. The model may be used as a tool for AtoN providers or users and is currently being peer reviewed.

Parameters under broad headings of observer, atmosphere, target and background may be input or output to facilitate, design and use of AtoN signal lights. Functions used in the model come from our current, incomplete knowledge of visual perception.

COLOR SECTION: TECHNICAL COMMITTEES

TC1-27 (C) Specification of Color Appearance for Reflective Media and Self-Luminous Display Comparison

Established: 1990

Terms of Reference: To study and make recommendations for the specification of a color appearance match between a reflective image and a self-luminous display image.

Chairman: PJ Alessi US

Members: TF Chong HK, G Derefeldt SE, MD Fairchild US, T Fuchida JP, AR Hanson GB, M Ikeda JP, E Khoury FR, V Kojtcheva BU, MR Luo GB, D Rich US, K Richter DE, AR Robertson CA, T Suzuki JP, J Walraven NL.

Consultants: RWG Hunt GB, Y Nayatani JP, MR Pointer GB

The final technical report was reformatted by Peter Zwick and returned to the chairman for final approval by the end of January 2010. At that point, it will go out for BA and National ballot.

TC1-44 (C) Practical Daylight Sources for Colorimetry

Established: 1995

Terms of Reference:
1. To compare existing daylight simulators for color measuring instruments and colour matching booths.
2. On the basis of this intercomparison, to recommend practical methods for simulating daylight sources.

Chairman: R. Hirschler HU

Members: A Bristow SE, P Chong US, W Czepluch DE, D Hinks US, H Fairman US, R Hunt GB, T Kehlibarov BU, T Ichijo JP, J van Kemenade NL, M R Luo GB, C McCamy US, M Pointer GB, Y Ohno US, B Powell AU, C Puebla DE, M L Rastello IT, A Rodrigues US, J Schanda HU, K Witt DE, R Young US, and J Zwinkels CA

Consultants: P Bradfield US, G Dakin GB, R Harold US, C Hughes US, K Imura JP, C Lam HK, N Lena US, G Lorditch US, D Rich US

The final (fourth) draft of the Technical Report that incorporates the D1 Editor's corrections and several new remarks and observations by TC members and consultants, has been completed by the TC Chair and sent for TC ballot in January 2010.

TC1-55 (C) Uniform Color Space for Industrial Color Difference Evaluation

Established: 1999

Terms of Reference: To devise a new uniform color space for industrial color-difference evaluation using existing experimental data.

Chairman: M Melgosa ES

Members: D Alman US, R Berns US, E Carter US, G Cui GB, M D Fairchild US, R Kuehni US, M R Luo GB, J Nobbs GB, C Oleari IT, M R Pointer GB, D Rich US, K Richter DE, B Rigg (GB), A R Robertson CA, J Romero ES, G Rösler DE, M Vik CZ, K Witt DE, J H Xin CN, Haisong Xu CN, and H Yaguchi JP

Advisor: R Huertas ES

During last CIE Midterm Meeting in Budapest (May 28 to June 3, 2009) a meeting of CIE TC 1-55 was held, and its chairman provided general information on the current and future activities of the TC. The performance of CIELAB-based colour-difference formulas, as well as CIECAM02 and OSA-based formulas, and IPT models, are being currently tested using new experimental datasets, not employed for the development of CIEDE2000. The use of the STRESS index seems generally to be accepted (J. Opt. Soc. Am. A, 24, 1823-1829, 2007) to test the performance of new colour-difference formulas. Members of this TC have been asked about criteria to be considered in the

future to choose a new colour space for industrial colour-difference evaluation. Prof. Melgosa and Dr. Huertas spent a one-month research period at the University of Leeds (UK) testing new experimental datasets with Prof. Luo and Dr. Cui, in close cooperation with Prof. Berns, Dr. Shamey, and Dr. Vik. In December 2009, Prof. Haisong Xu (China) joined this TC as a new member. In addition to several interesting papers presented at the AIC 2009 Quadrennial Meeting by members from the University of Leeds (UK), amongst recent interesting publications related to the activities of our TC, the following should be mentioned:

1. Melgosa, R. Huertas, R.S. Berns "Performance of recent advanced color-difference formulae using the Standardized Residual Sum of Squares index". *J Optical Society of America A* **25**, 1828-1834 (2008).
2. R.S. Berns "Generalized industrial color-difference space based on multi-stage color vision and line-element integration". *Óptica Pura y Aplicada* **41**, 301-311 (2008).
3. R. Kuehni. "Variability in Estimation of Suprathreshold Small Color Differences". *Color Research and Application* **34**, 367-374 (2009).
4. S. Shen, R.S. Berns. "Evaluating Color Difference Equation Performance Incorporating Visual Uncertainty". *Color Research and Application* **34**, 375-390 (2009).
5. C. Oleari, M. Melgosa, R. Huertas. "Performance of a Euclidean color-difference formula defined in log-compressed OSA-UCS space for small-medium color differences". *J Optical Society of America A* **26**, 121-134 (2009).

TC1-56 (C) Improved Color Matching Functions

Established: 1999

Terms of Reference:
1. To compare results based on the current CIE color matching functions, color matching functions proposed by Dr. W. Thornton's laboratory, and those of CIE TC1-36.
2. To initiate experiments to obtain data for such comparison in different laboratories.
3. To report to CIE Division 1 on the results of the above investigation and make an eventual recommendation for future CIE color matching functions.
4. To report to CIE Division 1 an eventual recommendation for the use of the new color matching functions in specifying color spaces and color-difference formulas.

Chairman: M Brill US

Members: M Fairchild US, H Fairman US, K Houser US, R Kuehni US, MR Luo GB, Y Nakano JP, B Oicherman GB, C. Oleari IT, D Oulton GB, D Rich US, A R Robertson CA, J Schanda HU, A Stockman US, A Tarrant GB, *W A Thornton US, K Wenzel HU

*deceased

CIE TC1-56 has completed its work with the publication of CIE 185:2009 *Reappraisal of Colour Matching and Grassmann's Laws*.

TC1-57 (C) Standards in Colorimetry

Established: 2000

Terms of Reference: AR Robertson CA

Chairman: To prepare a series of CIE/ISO/IEC Standards that describe:
1. The method of calculating CIE tristimulus values and chromaticity co-ordinates
2. A uniform colour space and its associated metrics
3. A formula for industrial colour difference evaluation

Members: P Alessi US, JA Bristow SE, J Campos Acosta ES, R Connelly US, JF Decarreau FR, R Harold US, R Hirschler HU, H Ikeda JP, B Jordan CA, C

Kim KR, D McDowell US, P McGinley AU, Y Ohno US, MR Pointer UK, K Richter DE, G Roesler DE, JD Schanda HU, R Sève FR, K Witt DE, H Yaguchi JP, J Zwinkels CA

Liaisons: IEC TC100/TA2, H Ikeda; ISO TC 6, B Jordan; ISO TC35/SC9/WG22, G Roesler; ISO TC38/SC1/WG7(UK), M Pointer; ISO TC38/SC1/WG7(US), R Harold; ISO TC42, D. McDowell; ISO TC130, D. McDowell; ISO/IEC/JTC1/SC28, K Richter

TC 1-57 is responsible for preparing four CIE Standards, as follows:
S 014-3 Colorimetry – Part 3: Calculation of CIE tristimulus values
*S 014-4 Colorimetry – Part 4: CIE 1976 L*a*b* colour space*
*S 014-5 Colorimetry – Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram*
S 014-6 Colorimetry – Part 6: CIEDE2000 colour-difference formula

Part 4 (CIE 1976 L*a*b* colour space) has been approved and was published in September 2007 as CIE Standard S 014-4/E:2007. It has also been approved by ISO and published as ISO 11664-4:2008(E).

Part 5 (CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram) was approved by the National Committees in January 2009 and was published in March 2009 as CIE Standard S 014-5/E:2009. Approval by ISO through the “fast-track” process is pending.

A fourth draft of Part 3 (Calculation of CIE tristimulus values) was prepared in January 2009 for liaison members to solicit comments from their ISO or IEC Committees or Working Groups. As in the past, three months was allowed for this consultation process. No comments were received. The draft then underwent a TC ballot and was approved in June 2009 with a few minor editorial changes. These changes were incorporated into draft 5 which was submitted for CIE Division 1 and Board of Administration ballots. These ballots concluded in December 2009. The BA voted five in favour (two with comments) and none against. The Division voted ten in favour (two with comments) and none against. The comments will be incorporated into a revised draft to be sent for National Committee comments and, subsequently, for ballot.

The final work of the TC will be Part 6 (CIEDE2000 colour-difference formula).

TC1-61 (C) Categorical Color Identification

Established: 2001

Terms of Reference: To prepare a report describing a color categorization map for the photopic and mesopic illumination levels.

Chairman: T Ishida JP

Members: N Johnson US, K Okajima JP, M Pointer UK, L Ronchi IT, K Sagawa JP, J Schanda HU, H Shinoda JP, O Da Pos IT, MR Luo UK, H Yaguchi JP, F Viénot FR(observer)

This TC has not been active in 2009. The chair continues to prepare the first draft report.

TC1-63 (C) Validity of the Range of CIE DE2000

Established: 2003

Terms of Reference: To investigate the application of the CIEDE2000 equation at threshold, and to CIELAB colour differences greater than 5 units.

Chairman: K Richter, DE

Members: P. Alessi US, K.R. Gegenfurtner DE, T. Holtsmark NO, M.R. Luo GB, M. Melgosa ES, Y. Nakano JP, J. Nobbs GB, C. Oleari IT, D. Rich US, J. Schanda HU, T. Seim NI, M. Vik CZ, P. Walraven NL, H. Yaguchi JP

At a CIE TC1-63 meeting in Budapest in 2009, 4 members and about 15 guests were present. According to the Terms of Reference, there are reports for large colour differences from the four countries DE, CZ, ES, and GB. For large colour differences, the mean of the four countries indicate that CIELAB is better than or equal to CIE DE2000. This is no change compared to the CIE Activity Report "January 2009."

According to Melgosa and Kittelmann, for threshold colour differences the stress index indicates bad results for both CIELAB and CIE DE2000. In Budapest P. Kittelmann gave a report about his new experimental results for threshold (small) colour differences. He has produced threshold results as a function of many parameters, including field size and sample distance; these data will be available during 2010 when his PhD thesis is proposed to be published. A special procedure of adding coloured light to one half of the sample allows P. Kittelmann to avoid the hairline effect at the border of adjacent colours. According to K. Witt, 20% of the observers report colour differences even if the samples are identical. This effect produces problems for the evaluation of the experimental data, and this effect is excluded by the Kittelmann procedure (no gloss differences and no hairline geometric differences).

For the area of image technology, a relative CIELAB space lab* compared to the two elementary colour pairs Yellow-Blue (J-B) and Red-Green (R-G) is very useful. A new vision model assumes that the standard white monitor or the standard white paper produces four antagonistic (opponent) chromatic signals Yellow-Blue and Red-Green. In an ideal case, the chroma of both is equal, and the luminance factors Y of both add to the luminance factor Y=100 of white. In CIELAB, the four colours RJGB have the maximum chroma. Chroma and lightness of the four can be calculated. The CIELAB elementary hue angles of RJGB are h_{ab} = 26, 92, 162 and 272 according to the report CIE R1-47:2009 *Hue angles of Elementary Colours*.

A new vision model assumes that the two ratios between the two chromatic signals of any colour and the signals of two of the four chromatic antagonistic colours are basic coordinates. Similar ratios are produced for lightness. Therefore, for related colours, relative chroma and relative lightness play a special role to describe colour thresholds and small colour differences. For example, the Swedish Natural Colour System (NCS) uses the relative coordinates chroma and blackness, and the color order system DIN 6164 uses relative lightness (Dunkelstufe). However, CIE DE2000 and CIELAB use chroma and lightness, and both fail to describe thresholds according to Melgosa and Kittelmann.

This antagonistic vision model calculates, for example, the CIELAB lightness L*=95 (Y=92) for Yellow J and L*=30 (Y=8) for Blue B and equal CIELAB chroma for both. For isolated colours, the threshold is about 2% for both Yellow and Blue of equal luminance and in addition for different luminances in a dark room. However, for the related colours Yellow and Blue in a white background, the threshold is about 2% of the luminance factor of Yellow J (Y=2) and 2% of the luminance factor of Blue B (Y=0,16). In experiments, the last theoretical value is increased because of large scattering in the eye media for the white background, which reduces the saturation and increases the luminance factor at threshold.

In future, a relative CIELAB standard with coordinates lab* (small letters) instead of the ISO CIELAB standard with coordinates LAB* (capital letters) may play a basic role for both colour vision and image technology, which already uses many relative colour coordinates, for example lab*rgb.

The main experiments of CIE TC1-63 in four countries for large colour differences have been slightly modified in 2009. The 16 steps of the elementary hue circle of the Relative Elementary Colour System RECS were evaluated by three different criteria.

1. Do the colours with the elementary hue angles h_{ab}=26, 92, 162, and 272 appear as elementary colours, for example J as neither reddish nor greenish? For example, if not for J, please specify the hue location, for example J10G for a 10% greenish content.
2. Specify the hue location of the four 5-step scales, for example between J and G on a scale between 0 and 1.
3. Guess the relative chroma and relative blackness compared to a virtual colour in mind of maximum chroma and with the blackness zero.

All materials for the experiments - the 16 step elementary hue circle of the RECS, a white cover sheet with 16 holes, and the form to fill out are available on request by email to klaus.richter@mac.com. See the cover sheet (with some example colours and data on pages two and three) and the form to fill out at the URL:
http://130.149.60.45/~farbmetrik/IE12/IE120-7X.PDF
http://130.149.60.45/~farbmetrik/IE14/IE140-7X.PDF

First results of many observers of at least two countries will be presented at the next meeting of CIE TC1-63 in June 2010.

CIE T1-57 has started to produce a CIE and an ISO standard for DE2000. CIE DE2000 recommends an application range between 0 to 5 CIELAB according to the CIE Technical Report 142:2001 *Improvement to Industrial Colour Difference Evaluation*. This application range shall be reduced for example between 1 to 5 in the standards according to the failure of CIEDE2000 to describe colour thresholds. For colour thresholds, further systematic experimental results and/or improved vision models are necessary.

TC1-64 (C) Terminology for Vision, Color, and Appearance

Established: 2003
Terms of Reference: To monitor the terminology requirements of Division 1 including the revision of the present ILV terms and the addition of new terms.
Chairman: S. McFadden CA
Members: P Bodrogi HU, EC Carter US, O da Pos IT, J Gardner, AU, Y Nakano JP, MR Pointer GB, J Schanda HU, R. Seve FR

The list of terms that were distributed to TC members has to date been reviewed by two members. The list includes issues arising out of the original Division ballot and new terms introduced in recent Division 1 TC reports. A revised list of new terms will be distributed shortly. The TC is also collaborating with ASTM E12.01 through one of its members to minimize inconsistencies between ASTM E284 and future editions of DS017. With Board of Administration approval of the ILV, a method for updating the ILV is now under development. A key issue is the translation of current and future terms into other languages. In support of that objective, TC1-64 is seeking members with linguistic backgrounds that are not currently represented.

TC1-68 (C) Effect of Stimulus Size on Color Appearance

Established: 2005
Terms of Reference: To compare the appearance of small (<2) and large (>20) uniform stimuli on a neutral background.
Chairman: Peter Bodrogi HU
Members: P Alessi US, KF Anter SE, EC Carter US, I-P Chen TW, O da Pos IT, CS Kim KR, G Kutas HU, MR Luo GB, M Nicholson GB, T Nilsson CA, K Sagawa JP, J Schanda HU, R Űnver TR, F Viénot FR, K Xiao KR
Advisor: G Derefeldt SE

No report.

TC1-69 (C) Colour Rendition by White Light Sources

Established: 2006

Terms of Reference: To investigate new methods for assessing the colour rendition properties of white-light sources used for illumination, including solid-state light sources, with the goal of recommending new assessment procedures.

Chairman: Wendy Davis (US)

Members: Richard Young US, Ronnier Luo GB, Changsoon Kim KR, Peter Bodrogi HU, Danny Rich US, Yoshi Ohno US, Ferenc Szabó HU, János Schanda HU, Emil Radkov US, Hirohisa Yaguchi JP, Peter van der Burgt NL, Boris Shugaev RU, Kenjiro Hashimoto JP, Robert Hirschler HU, Danielle Ferreira de Oliveira BR, Ian Ashdown CA, Osvaldo da Pos IT, Cheng Li GB, Andrew Jackson US, Günther Heidel DE, Ronald Daubach US, Ulrich Binder DE, Werner Jordan DE, Rolf Bergman US, Peter Hanselaer BE, Klaus Richter DE, Maria Thompson US, Sophie Boissard FR, Françoise Viénot FR, Katalin Toth HU

Working Plan:

1. Agree on some basic criteria for a new metric (or system of metrics) such that it (or they) could be developed to be scientifically sound, acceptable to lighting industry, and useful.
2. Solicit, share, and discuss proposals for new assessment procedures for colour rendition properties of white light sources.
3. Evaluate proposed assessment procedures with visual experiments and compatibility with basic criteria (in #1).
4. Recommend a new metric (or system of metrics) based on evaluation (in #3).
5. Prepare a CIE Technical Report on recommended new metric (or system of metrics), including calculation procedures and justification for recommendation.

This committee met in Budapest, Hungary at the CIE Midterm Meeting. Many members presented research results and a final-year timeline was developed. Short presentations were given at the TC meeting by Janos Schanda, Osvaldo da Pos, Françoise Viénot, Yoshi Ohno, Peter Brodogi, Sophie Jost-Boissard, Kati Toth, and Ronnier Luo. The newer, more detailed timeline is intended to aid the decision-making process for the TC. Based on this new timeline, all committee members who wished to submit research reports or proposals for a new color rendition metric were required to provide documentation to the chair by 15 September 2009. Research reports included detailed descriptions of the methods and results, as well as supporting information such as the spectra of light sources used and reflectance factors of objects. Metric proposals included a written description of the rationale for the proposal, a complete list of mathematical formulae used, and an Excel spreadsheet that implemented the formulae. Approximately 16 research reports and six metric proposals were submitted and put on the TC website for review by all members. On 15 January 2010, after four months of review, a month-long period of discussion will begin. The TC plans to vote to select a new color rendition metric on 15 February 2009. Then, a draft of the TC report will be written in time for our next meeting in Princeton, New Jersey.

TC1-70 (C) Metameric Samples for Indoor Daylight Evaluation

Established: 2007

Terms of Reference: To investigate the derivation of a set of metameric samples to enable the evaluation of indoor daylight simulators

Chairman: B Kránicz HU

Members: Péter Bodrogi DE, Robert Hirschler HU, Danny Rich US, Alexander Rosemann CA, János Schanda HU

Background

As the updated and extended version of publications CIE 51-1981 [1] and CIE 51.2-1999 [2] the standard ISO 23603:2005(E) – CIE S 012/E:2004 is now available. For this standard the terms of reference are: *Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour* [3].

The *indoor* versions of D65 and D50 have been defined and have been published recently [4].

The task of the committee TC 1-70 was to derive metameric samples for the assessment of the quality of *indoor daylight* simulators. The intention of the committee was to generate such metameric samples that are in harmony with those given in ISO 23603:2005(E) – CIE S 012/E:2004, i.e. the spectral functions of the samples for ID65 or ID50 should be as similar to those for D65 or D50 as possible, while the concept of metamerism is fulfilled.

Generating metameric samples for ID65 and ID50 in the visible range
The concept of the committee for generating metameric pairs for illuminants ID65 and ID50 was that the standard specimens be the same as given in [Table 3] in standard ISO 23603:2005(E) – CIE S 012/E:2004. So the *standard specimens* have been *preserved*.

For generating metameric pairs to the standard specimens under illuminants ID65 and ID50 many numerical processes can be applied. For this purpose the gradient method has been chosen as it is available in *Microsoft Excel*. As the initial value or starting point of the optimization process the comparison specimens for D65 and D50 have been applied. This choice ensured that the results under ID65 or ID50, i.e. the spectral reflectance factors look 'almost the same' as those derived for D65 or D50. Rounding the spectral data to 3 decimal places needed some manual 'cosmetics' but the results are in accordance with standard [3]. For further details see publication [5].

Fig 1 and Fig 2 show the comparison specimens for D65, ID65, D50 and ID50. The difference between the specimens can hardly be detected by the naked eye.

Table 1 shows colour differences between the standard specimens and comparison specimens in case of D65, D50, ID65 and ID50. Based on data in Table 1 the comparison specimens derived for ID65 and ID50 are appropriate for assessing the quality of ID65 or ID50 simulators. The assessment process for ID65 or ID50 should be performed exactly in the same way as given in standard [3] for D65 or D50.

Table 1 – Average and maximal colour differences of the 5 metameric samples for D65, ID65, D50 and ID50

Illuminant	**Maximal colour difference,** ΔE^*_{ab}	**Average colour difference,** ΔE^*_{ab}
D65	0,004	0,002
ID65	0,008	0,007
D50	0,021	0,006
ID50	0,009	0,006

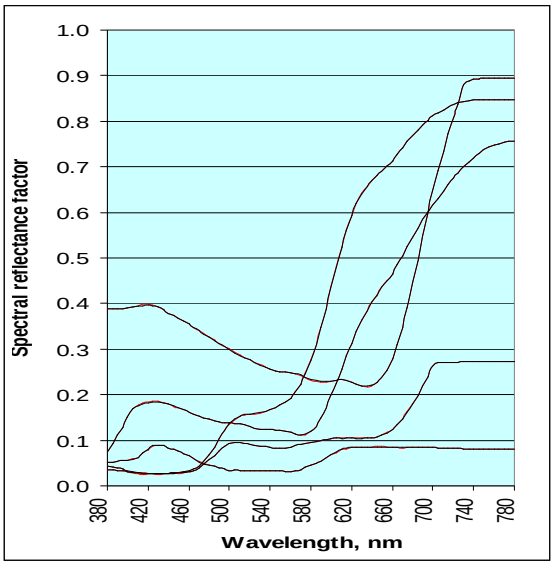


Figure 1 – Spectral reflectance factors of comparison specimens for assessing the quality of D65 simulators (black lines) and ID65 simulators (red lines)

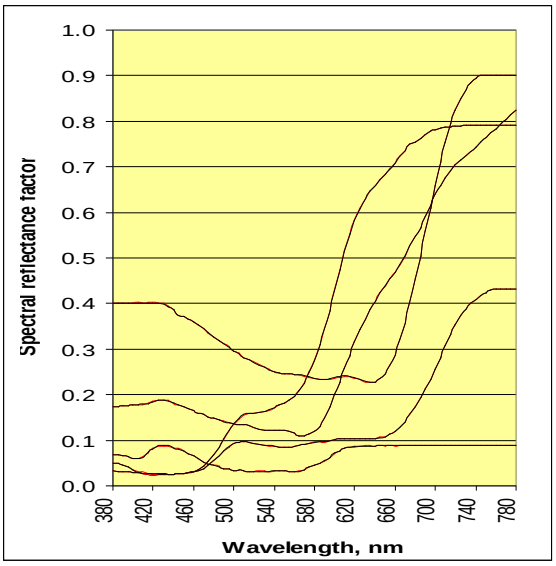


Figure 2 – Spectral reflectance factors of comparison specimens for assessing the quality of D50 simulators (black lines) and ID50 simulators (red lines)

Generating comparison samples for ID65 and ID50 in the ultraviolet range

At the classification procedure for the ultraviolet range in standard [3] the comparison specimens have the same data as the *total radiance factors* of the fluorescent samples to be investigated under D65 or D50. So the decision was to calculate the total radiance factors for the fluorescent samples for both ID65 and ID50, and these data have been defined to be the comparison specimens for ID65 and ID50, respectively – after having rounded all data to 3 decimal places.

The spectral properties of the fluorescent samples in [Table 5] in standard [3] have been preserved. So it should also be used for ID65 and ID50.

Based on the data of the comparison specimens for the *ultraviolet range* the assessment process for ID65 or ID50 should be performed exactly in the same way as given in standard [3] for D65 or D50.

References

1. 1CIE 51-1981, A Method for Assessing the Quality of Daylight Simulators for Colorimetry.
2. CIE 51.2-1999, A Method for Assessing the Quality of Daylight Simulators for Colorimetry.
3. ISO 23603:2005(E) – CIE S 012/E:2004, Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour.
4. CIE 184:2009, Indoor daylight illuminants.
5. Kránicz B.: Derivation and Application of Metameric Samples in Colorimetry. In Conference proceedings, *CIE – Light and Lighting Conference with Special Emphasis on LEDs and Solid State Lighting*, May 27-29, 2009, Budapest, Hungary.

TC1-71 (C) Tristimulus Integration

Established:	2007
Terms of Reference:	To investigate methods for computing weighting tables for the calculation of tristimulus values from abridged data.
Chairman:	C Li CN
Members:	J Campos Acosta ES, M Brill US, H Fairman US, B Jordan CA, Y Ohno US, C Oleari IT, M Pointer UK, AR Robertson CA, G Roessler DE, J Schanda HU, R

Seve FR, G Wang CN

With the great demand from industry for a unified method for accurately computing the CIE tristimulus values and for the best agreement among the laboratories, CIE formed a new technical committee: TC1-71 on tristimulus integration during the 26th Session of the CIE in Beijing, July 2007.

In the past year,

1. Claudio Oleari IT and Gerhard Roesler DE have joined the TC.
2. Claudio Oleari published a method in 2000 in CR&A. The method was recommended to the members of the TC for comparison. Claudio Oleari joined us for further clarifying the computations of his method and will help in making comparisons. Currently, based on his method, procedures for computing weighting tables are being developed.
3. Gerhard Roesler is interested in the work of this TC and will provide light source data if required.
4. Currently, draft (1) of a technical report is being written and should this be completed soon. The following methods are included for further comparison:

   ASTM Table 5,

   ASTM Table 6,

   Venable method,

   Optimum weights by Li, Luo and Rigg

   Least Square Weights by Wang, Li and Luo

   Direct Selection method,

   'CIE-R' method

   Oleari's Local Power Expansion

TC1-72 (C) Measurement of Appearance Network: MApNet

Established: 2007

Terms of Reference:
1. To establish a network of those interested in the measurement of visual appearance.
2. The network shall be under the direction and guidance of a group of at least four Technical Leaders each responsible for a particular aspect of the subject.
3. Each Technical Leader shall provide substantial periodic reports in a form that might be published.
4. A second Expert Symposium on Appearance shall be organised at an appropriate time within the next 4 years.
5. A database of relevant published work shall be maintained.
6. Consideration shall be given to the establishment of separate Technical Committees when appropriate.

Chairman: MR Pointer GB

The TC met on Monday 1st June 2009, Hungary, as part of the CIE Mid-Term Meeting, and there were 14 people present. Following some discussion, Peter Hanselaer from the Catholic University College, St Lieven, Gent, Belgium gave a presentation on the subject of gloss.
A team from the Catholic University College St.-Lieven, Gent, Belgium, headed by Peter Hanselaer, is actively planning the next CIE Expert Symposium for 8-10 September 2010. Titled 'When Appearance meets Lighting …' the symposium is for those

concerned with the measurement of aspects of visual appearance and the understanding of the human factors of lighting. The symposium aims:

- To present the state of the art in our understanding of the perception of colour and gloss.
- To explore the possible applications of visual appearance knowledge to several aspects of lighting design and comfort.

TC1-73 (C) Real Colour Gamut

Established: 2007
Terms of Reference: To recommend a gamut representative of real (non-fluorescent) surface colours and defined by associated spectral reflectance data.
Chairman: C Li CN
Members: Maeng-Sub Cho, MR Luo, Jan Morovic, M R Pointer GB, Jin-Seo Kim, Krisztián Samu, Pei-Li Sun
Observers: Ellen C Carter, Siu-Kei Tin

In the past year, the chair has written a draft report which was distributed to the members of the TC. The report reviewed all the available real surface colour gamuts and the accumulated reflectance data. The available gamuts include the published Pointer gamut and the ISO reference colour gamuts as well as a newly gamut newly developed in Leeds. The data accumulated in Leeds include 85 900 reflectance functions which can be used for evaluating gamuts and developing a new gamut. Some discussions were made via email and further evaluations and development are underway.

TC1-74 (C) Methods for Re-Defining CIE D Illuminants

Established: 2009
Terms of Reference: To investigate the issue of smoothing the values of the D illuminants such as described in CIE 15:2004 Appendix C and to propose the calculation methods for new definitions of the D Illuminants.
Chairman: Janos Schanda HU
Members:

Work is on-going to produce a Technical Report.

TC1-75 (C) A Comprehensive Model of Colour Appearance

Established: 2009
Terms of Reference: To derive colour appearance models that include prediction of the appearance of coloured stimuli viewed in typical laboratory conditions: that appear as unrelated colours that are viewed under illumination down to scotopic levels that include consideration of varying size of stimulus.
Chairman: Ronnier Luo UK
Members:

Ten people have agreed to be members of this TC. The work plan is in preparation and it is aimed to be agreed by June 2010.

TC1-76 (C) Unique Hue Data

Established: 2009
Terms of Reference: To study and report on unique hue data, including an analysis of the scatter of those data: this to include practical viewing conditions.
Chairman: Sophie Wuerger GB
Members: Miyoshi Ayama JP, Rolf Kuehni US, Katsurnori Okajima JP, Galina Paramei GB, Renzo Shamey US, Vicki Volbrecht US, Michael Webster US, Kaida Xiao GB

A work plan with time lines is being drafted.

TC1-77 (C) Improvement of the CIE Whiteness and Tint Equations

Established:	2009
Terms of Reference:	To recommend improvements or modifications to the existing CIE Equations for Whiteness and Tint to extend their scope of application to a wider range of instrument conditions and white materials; e.g. various tints and levels of fluorescence.
Chairman:	Robert Hirschler HU
Members:	Members not yet appointed

The membership list and the work plan will be submitted to the CB for approval in January 2010.

COLOR SECTION: REPORTERS

R1-42 (C) Extensions of CIECAM02

Established: 2007

Terms of Reference: To evaluate potential additions to CIECAM02 in liaison with Division 8 and to include:
Those published in the literature;
Extension to include unrelated colours;
Extension of the range down to scotopic levels

Reporter: C Li CN

TC8-11 held an open meeting in Albuquerque, US, during the CIC17 2009 meeting. At the meeting, the Chair of TC8-11, Changjun Li, gave an overview of the history of the committee, including the work of Gill, Susstrunk, and Brill. Then, Marc Mahy gave a presentation on the feasibility regions in chromaticity space for test and reference colors under various conditions.

The following was decided as the way forward:

1. A new version of CIECAM02 with the Hunt-Pointer-Estevez (HPE) primaries used in place of any version of CAT02 should be vetted. Then, the documentation of the model should be rewritten to reflect this simplification. (Several matrix operations will not be needed.)
2. The corresponding-color data sets that were used to validate CAT02 should be compared with the predictions of HPE-based chromatic adaptation to discover how much change is made in prediction quality relative to CAT02.
3. Graeme Gill's CIECAM02 modifications should be reviewed and tested. Starting from any point in the valid domain (inside the spectrum locus), if one uses HPE adaptation, one will never encounter most of the pathologies noted by Gill. However, the model may still benefit from Gill's repair of the post-adaptation infinite-slope problem.

The present goal is to develop an interim recommendation until further improvements can be made. Specifically, we anticipate the two remaining issues will be:

1. Improving the robustness of the revised appearance model by the use of arbitrary range points such as might be commanded in a color-management system.
2. Improving the predictive accuracy of the chromatic adaptation model.

R1-48 (C) Colour Emotion and Harmony

Established: 2009

Terms of Reference: To review methods for relating the emotion and harmony responses to coloured stimuli with associated colorimetric measurement of those stimuli.

Reporter: Li-Chen Ou TW

A review report has been prepared on the basis of findings and development of research in this area for the past 10 years. Attention has been paid so far to the following two methods: psychophysical (e.g. categorical judgement) and psychophysiological (e.g. heart rate, skin conductance and facial muscle movement). Comparisons of the methods will be based on the significance of findings and reliability of the methodology. Implications of findings obtained from various methods will also be compared and discussed in the final report.

A provisional outline of the report is given below:

1. **Background** – describing definitions of colour emotion and harmony and the conventional theories and methods related to this area. For colour emotion, the following related areas will be included: emotion, colour meaning and colour association. For colour harmony, the following researchers' work will be included: Goethe, Chevreul, Ostwald, Munsell, Moon-Spencer and Itten.
2. **Development over the past 10 years** – an overview of the findings and development of research into colour emotion and harmony over the past 10 years.
3. **Psychophysical methods** – comparisons of psychophysical methods used in this area, such as categorical judgement and semantic differential.
4. **Psychophysiological methods** – comparisons of psychophysiological methods used in this area, such as heart rate, skin conductance, facial electromyography (EMG), electroencephalography (EEG) and functional magnetic resonance imaging (fMRI).
5. **Discussions** – comparisons and discussions of the above methods and other related approaches to the subject area.
6. **Conclusion** – summary of the review and suggestions for future direction.

R1-50 (C) 3D Aspects of Visual Appearance Measurement

Established: 2009

Terms of Reference:
1. To review the activity of relevant organisations related to 3D vision, 3D image capture, 3D model storage and 3D display where these are relevant to visual appearance issues
2. To establish a database of key research articles, technology and terminology related to 3D aspects of visual appearance
3. To establish an international panel of experts able and willing to advise on 3D matters
4. To liaise with other CIE divisions

Reporter: David Simmons GB

Work is in progress.

LIAISONS

L1-1 AIC (Association International de la Couleur)
Liaison: P J Alessi

The AIC held its 11th Congress in Sydney, Australia from September 27 to October 2 of 2009. This congress was a very successful meeting with many stimulating state-of-the-art papers on color. For the first time in AIC history, there were some refereed papers. Also a new feature for AIC Congresses was a Color Market. The Color Market will be held was an opportunity to showcase to delegates, a boutique selection of colorful items unique to Australia. The coveted 2009 Judd Award was given to Arne Valberg for his outstanding lifetime achievements in color vision. Following the presentation of the Judd medal and the citation of the award, Arne Valberg delivered the Judd lecture on "Colour vision: Different roads from perception to neuroscience". At the AIC General Assembly held in Sydney, the election of the next AIC executive committee for the term 2010-2013 was conducted. According to the results of the election, the executive committee will be composed of:

President: Berit Bergström (Sweden)
Vice President: Javier Romero (Spain)
Secretary/Treasurer: Nick Harkness (Australia)
Ordinary members: Lindsay MacDonald (Great Britain)
Shoji Tominaga (Japan)
Verena M. Schindler (Switzerland)
María Luisa Musso (Argentina)

The following modification to article 4 of the AIC statutes was proposed at the Assembly in Sydney.

Proposed changes (deletions in red strikethrough text; additions or changes in blue):
Regular members (article 4)
Only one national organization from each country
A color organization from a country or a region, at the discretion of the AIC executive committee, can become a regular member of the AIC. To be admitted, the organization shall be one
(a) whose aims are essentially in conformity with the objects of the AIC as defined in the first paragraph of article 2;
(b) which is broadly representative of those people in its country or region interested in these aims;
(c) which is properly constituted so as to enable an authorized representative to speak on its behalf.
Where no single organization adequately meeting these conditions exists in a country
Also, a national color committee may be set up representative of the various organizations and interests concerned with color in a country or region, and thiscommittee may then apply to become a regular member of the AIC.

The aim of the modification is to make the AIC stronger and more open to some color associations which at this moment cannot have a place as regular members. It was approved by more than a two-thirds majority of votes by the regular members (19 positive votes / 25 regular members at that moment).

Two new regular members have joined the AIC. They are the Chilean Color Assoication and the Color Association of Taiwan. The AIC now has 26 regular members from the five continents of the world.

The AIC was very sad to hear of the passing of Dr. Yoshinobu Nayatani on May 29, 2009. He was a great color scientist and a diligent contributor to the color research

community. He has been well-known as a recipient of the AIC Judd Award and as a prolific author and a member of the Editorial Board of the journal *Color Research and Application*. His last article in this journal appeared in April 2009. Nayatani received the AIC Judd Award in 1993, during the 7th Congress of the International Color Association, in recognition of his work on colorimetry and color vision, including many contributions to models of chromatic adaptation and color appearance.

The AIC study group on Color Education has a new chairman. It is Dr. Robert Hirschler from Hungary and Senai/Cetiqt, Rio, Brazil. The AIC also has a new study group called The Language of Color. This study group was proposed by Lucia Ronchi, who presented the details of the idea, the suggested aims and scope at the AIC executive committee meeting in Sydney. The chair will be Jin-Sook Lee (Korea), js_lee@cnu.ac.kr, and Paul Green-Armytage (Australia) will act as co-chair, p.green-armytage@curtin.edu.au.

The following AIC meetings have been planned for 2010 and beyond:

2010 AIC Interim Meeting, Mar del Plata, Argentina
28 September – 1 October 2010
Theme: "Color and food: from the farm to the table;"
Organizer: Organized by the Argentine Color Group Info: www.aic2010.org

2011 AIC Midterm Meeting, Zurich, Switzerland
7 - 10 June 2011
Theme: "Interaction of color & light"
Organizer: Pro/colore. Info: www.aic2011.org

2012 AIC Interim Meeting
open for proposals from AIC regular members

2013 AIC 12th Congress, Newcastle, Great Britain
8 - 12 July 2013
Organizer: The Colour Group of Great Britain and the Society of Dyers and Colourists
Info: www.aic2013.org

2014 AIC Interim Meeting
open for proposals from AIC regular members
2015 AIC Midterm Meeting, Tokyo, Japan
May 2015
Theme: "Color and image"
Organizer: The Color Science Association of Japan

L1-2 **CCPR (Comite Consultatif de Photometrie et Radiometrie), BIPM**
Liaison: M. Stock

No report.

L1-3 **ISO/TC6/W3: Paper, Board and Pulp - Optical Properties**
Liaison: J C Zwinkels

The following recent activities may be of interest to the CIE:

This working group last met on 16 November 2009 in Berlin, Germany in conjunction with ISO TC6 week. The following five Standards have been published in the last year:

ISO 2470-1 *Paper, board and pulps – Measurement of diffuse blue radiance factor – Part 1: Indoor daylight conditions (ISO brightness)* 2009-09-24

ISO 9416: *Paper – Determination of light scattering and absorption coefficients using Kubelka-Munk theory* 2009-04-17

ISO 8254-1 *Measurement of specular gloss – Part 1: 75° gloss with a converging beam, TAPPI method* 2009-02-09
ISO 5631-1 *Paper and board - Determination of colour by diffuse reflectance – Part 1: Indoor daylight conditions (C/2°)*
ISO 11476: *Paper and board - Determination of CIE whiteness, C/2° (Indoor illumination conditions)*

A preliminary new work item was proposed and accepted at the TC6 plenary meeting: The development of a new International Standard entitled: *Pulp and paper – Determination of CIE Whiteness, D65/10° (indoor and outdoor illumination conditions).* This Standard may eventually supersede ISO 11476 and/or 11475 which have been recently published.

The working draft WD 2469 *Paper, board and pulps – Measurement of diffuse radiance factor* will need further experimental results to justify the implementation of this revised procedure (to incorporate a means to ensure that the UV intensity is negligible below 300 nm) to advance this Standard to the CD stage. A round-robin comparison that included fluorescent paper containing 4 different OBAs (different excitation spectra and different amounts) was performed on a variety of different colorimeters and showed that the inter-instrument agreement (coefficient of variation) was best for those samples whose excitation spectrum was most similar to that of the reference paper used for the UV adjustment. A follow-up round-robin comparison is planned using the proposed UVB filter on different types of existing instruments.

The ISO TC6/WG3 Optical Properties Authorized Laboratories (know as OPAL-group), also met in Berlin on the 13-14 November 2009, and prepared precision statements for the various Optical ISO TC6/IR3 Standards, based on inter-AL reproducibility data for a four year period (2005-2008).

CIE liaison activities: I provided a detailed CIE liaison report to the ISO TC6 plenary meeting in Berlin. This provided recent developments in CIE Divisions 1,2 and 8 that are of possible interest. In particular, the members of WG3 were invited to become members of TC 1-77 (Improvement of the CIE Whiteness and Tint Equations) and to provide experimental spectral data on fluorescent papers to TC 1-70 (Metameric samples for indoor daylight evaluation). The members of WG3 are also very interested on CIE recommendations with regard to the use of the new CIE Indoor Illuminants ID50 and ID65 and on the provision of psychophysical data for ID50.

The next meeting of ISO TC6 is planned for June 2011 in Paris, France.

L1-4 ISO/TC38/SC1: Textiles: Colour Fastness & Measurement
Liaison: M R Luo GB

The comments of the draft International standard ISO/DIS 105-A11 – *Tests for colour fastness. Part A11: Determination of colour fastness grades by digital imaging techniques* were received from different country members. Only minor corrections will be made.

L1-5 ISO/TC42: Photography
Liaison: J Holm US

ISO TC42 met in Tokyo 5-9 October 2009. Approximately 80 delegates from seven P-member countries attended. The active projects in WG18 and JWG 20, 21, 23 and 24 are reported on as follows:

WG18, Digital photography

ISO 12231, Vocabulary
Ed. 3 NP and CD approved with some editorial comments. All comments resolved. DIS text will be prepared and circulated for ballot shortly.

ISO 12232, ISO speed, exposure index, standard output sensitivity and recommended exposure index
Ed. 2 reaffirmed through 2014.

ISO 12233, Resolution measurements
Ed. 2 WD 9.1 to be circulated as CD. This is a technically revised standard with new normative methods.

ISO 12234-1, Removable memory and file formats
Ed. 3 NP for CD to be circulated soon. Includes more extensive metadata table and metadata persistence rules. Adds JPEG 2000 and will reference new CIPA/JEITA Exif & DCF standards. It was noted that work has begun in CIPA to prepare a new edition of the Exif standard.

ISO 12234-2, TIFF/EP file format
The ad-hoc for the development of the proposed 2nd Ed. of TIFF/EP was reconfirmed, and Adobe has taken the lead to accelerate the work. TIFF/EP is comprehensive to support many different use cases, including backward compatibility with current TIFF readers and support of Adobe DNG. There are two interoperability profiles defined:

• Profile 1 (proposed extension .tif) will provide an intended output-referred interpretation (reproduction color appearance), supporting any color encoding that can be supported using an ICC profile, including output-referred, scene-referred, and demosaiced camera raw. It should be readable by any reader that supports ICC color management. sRGB will be the default interpretation if no ICC profile is provided. Backward compatibility with current TIFF readers is desired for cases where the current reader supports sRGB or ICC profiles. DNG metadata is allowed to facilitate re-processing of Profile 1 camera raw or scene-referred images in camera raw applications, but is not required. Profile 1 does not support un-demosaiced raw camera images.

• Profile 2 (proposed extension .dng, if Adobe is in agreement) is intended for camera raw images, including un-demosaiced images. This profile is intended for reading by camera raw applications and a defined output-referred interpretation may be included but is not required, i.e. there may not be any reproduction color appearance specified in the file, as it will be determined by the user and camera raw application. This format will be similar to DNG 1.3, which serves as the starting point for development.

ISO 14524, Opto-electronic conversion function (OECF) measurement
Ed. 2 published earlier this year. Some editorial cleanup, and the specifications for Camera OECF charts have been extended to allow for more patches.

ISO 15739, Noise and dynamic range measurement
Ed. 2 WD2 text will be circulated as an NP; if approved the WD can be progressed to CD. The new draft includes significant cleanup work and technical clarifications, and a new method for visual noise measurements.

ISO 20462-3, Image quality ruler
Ed. 2 CD to be circulated for ballot. Adds softcopy quality ruler method.

ISO 15781, Shutter-lag measurements
WD2 discussed and comments resolved. WD 3 to be prepared for next meeting.

Mobile imaging

An ad-hoc group has been created to investigate opportunities for mobile imaging standardization.

JWG20 with ISO TC130, Graphic Technology, Digital camera color characterization

ISO/TR 17321-2,
Preliminary draft circulated for comment.

JWG21 with ISO TC130, Densitometry

ISO 5 series, Densitometry
DIS drafts approved and submitted to ISO CS for publication. Adds spectral weighting factors for calculation of density from spectral measurements. Addresses some special graphic arts needs. General cleanup and updating.

JWG23 with ISO TC130, Extended color encodings

ISO/TS 22028-2, ROMM RGB
Work ongoing to prepare Ed. 2 PDTS draft with new informative material but no technical changes. Ad-hoc formed to determine whether Ed. 2 should be TS or IS (will be IS if adoption outside the US is found).

ISO/TS 22028-3, RIMM RGB
Preliminary Ed. 2 text discussed, and comments resolved. PDTS will be circulated for ballot shortly. Ed. 2 adds specifications for floating point RIMM (FP-RIMM) and clarifies and simplifies several sections, especially the white balance/adaptation requirements.

ISO/TS 22028-4, ECI RGB
PDTS approved with comments. DTS to be prepared and circulated for ballot.

JWG24 with ISO TC130, Viewing conditions

ISO 3664, Viewing conditions
Ed. 3 published earlier this year. Technical changes to display viewing requirements. New informative annex added with measurement and calculation examples.

TC130 JWG7 with ISO TC42, ICC color management
(has been meeting as the ICC Specification Editing Working Group)
ISO 15076-1, Image technology colour management — Architecture, profile format and data structure
Ed. 2 DIS is currently out for ballot; closes 24 December 2009. This draft incorporates the six ICC specification amendments approved since the last ISO edition and also has undergone a major effort at clarification and cleanup. Ed. 2 is backward compatible with, and will replace Ed. 1.

TC130 JWG9 with ISO TC42, Scene-referred standard color image data
(main meeting 21 September 2009 in Beijing with ISO TC130)
ISO 12640-5, RIMM/SCID
NP draft and image selection nearing completion. NP to be circulated soon. Ed. 1 will use 16-bit RIMM RGB color encoding, so all images will need to fit within the RIMM RGB headroom factor 2 (above scene adopted white). Future work is planned to create additional FP-RIMM/SCID with images requiring more headroom.

Other WGs and projects

There are currently no active projects in JWG 22 as there is currently no collaborative work with IEC TC100. (JWG22 provides coordinated ISO TC42 and TC130 input to joint IEC/ISO color standards administered by IEC TC100, especially TA2.)

ISO TC42 WG5, Image Permanence, also held meetings all week in Tokyo, but as these meetings were concurrent with the meetings listed above, I could not attend them and consequently they are not reported.

ISO TC130 JWG8 with ISO TC42, Spectral measurement and colorimetric computation – ISO 13655 Ed. 2 has been submitted to ISO for publication.

In ISO TC130 WG2, *ISO/DIS 12640-4, Graphic technology – Prepress digital data exchange – Part 4: wide- gamut display-referred standard colour image data [Adobe RGB(1998)/SCID]* was approved and has been submitted to ISO CS for publication.

L1-6 ISO/TC130: Graphic Technology
Liaison: D C Rich

ISO TC 130 held its annual plenary meeting in Beijing, China, 26 September 2009.

Actions and plans of the Technical Committee that are of interest to the CIE
1. Withdrawal of the standard ISO 14981:2000, Graphic technology — Process control — Optical, geometrical and metrological requirements for reflection densitometers for graphic arts use. This is a result of the latest version of the ISO 5 series, recently revised and updated from ISO TC 42
2. Withdrawal of the standard ISO 15994:2005, Graphic technology -- Testing of prints -- Visual luster. This standard, which combines a 45°:45° specular reflectance measurement and a 45°:0° diffuse reflectance measurement to generate an index that was supposed to have a high degree of agreement with the visual ranking of surface appearance, has never been adopted by any national body or instrument maker.
3. A preliminary work item for the development of an International Standard on the Communication of optical and surface properties of printing substrates (e.g. fluorescence, gloss and colour) has been initiated.

The Joint Working Group between ISO TC 130 and ISO TC 42 have completed their work of revising ISO 13655, Graphic technology — Spectral measurement and colorimetric computation for graphic arts images. The standard is due to be published by the end of the year (2009).

The Joint Working Group between ISO TC 130 and ISO TC 42 have completed their work of revising ISO 3664, Graphic technology and photography — Viewing conditions, describing the requirements for a D50 viewing source. The revised standard was announced by ISO as being available in June 2009. Details on the standard were included in the mid-year report.

No other actions or activities were planned or carried out that are of interest to CIE Division 1.

L1-7 ISO/IEC JTC1/SC28 Office Equipment
Liaison: K Richter

1. New standard documents in SC28 "Information Technology -- Office Equipment"

Recent International Standards in the field of Information Technology and colour test

charts are for example:
ISO/IEC 24735:2009 - Method for measuring digital copying machine productivity.
ISO/IEC 24734:2009 - Method for measuring digital printer productivity.

Projects with digital colour test charts are for example
ISO/IEC NP 29103 - Colour photo test pages for measurement of ink cartridge yield for colour photo printing.
ISO/IEC NP TR 29186 - Test method of colour gamut mapping algorithm for office colour equipment.
In addition there are many projects about "Cartridge Charaterization".

SC28 has five Working Groups with the titles "Advisary", "Consumables", "Productivity", "Image Quality Assessment", and "Office Colour". The "Image Quality" working Group is working on standards for monochrome hardcopy output, and printer resolution measurement. In future colour may be added.

2. New Working Group "Office Colour" for printers and multifunctional devices

SC28 considers that there is room for new office equipment standardization in the area of management of colour consistency between office equipment. Therefore a new Working Group "Office Colour" has started in 2009 to produce a Technical Report in the field of gamut mapping (ISO/IEC TR 29186, project editor F. Nakaya, Japan). According to the user needs in many countries "colour" is an important area for office equipment, for example for colour copiers, printers, monitors and projectors.

A new German standards series DIN 33872-1 to -6 (in print) uses the following test charts, see the URL

http://www.ps.bam.de/33872E

The output properties of printers and displays are tested with these test charts. The download is for free with questions about the output properties on the last page of the PDF DIN-test charts. This DIN standard series has been translated on an ISO template and has been distributed in ISO/IEC JTC1/SC1 "Office Equipment" (N1280), ISO/TC159/SC4/WG2 "Visual Display Requirements" (N1068), and ISO SCIT "Steering Committee for Image Technology" for discussion. The following statements have been produced in 2009 by these ISO standard groups:

Resolution Busan 18/2009 of ISO/IEC JTC1/SC28 "Office Equipment"
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 Div. 1 and CIE Div. 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, Unanimous Remark of the Liaison reporter:
The relation AWG/PWG5 NWI-9 is defined in N1194 of SC28, page 10, and has the title: Colour space standards for offices - Provide a device independent common colour space for office equipment.

Conclusion 72/2009 of ISO/TC159/SC4/WG2 "Visual Display Requirements"
ISO/IEC TR 19797:2004 describes an output Linearization Method (LM) for printers. LM stands for making the output of colours visually and colorimetrically equally spaced for equally spaced RGB input values. ISO/TC159/SC4/WG2 accepts the German offer to write a draft Technical Report with an LM for the display output. As examples an LCD display with an LED backlight, a data projector display, and for comparison a standard CRT display will be studied for eight ambient reflection levels.

NOTE: The LM is based on the CIELAB measurement data of the first starting output in a dark room. The data are used by the LM for the linearized display output for eight ambient reflections. The colorimetric output properties are specified according to ISO/IEC TR 19797.

Conclusion 73/2009 of ISO/TC159/SC4/WG2
ISO/TC159/SC4/WG2 takes cognizance of the German contribution N1068 with a preliminary German NWIP together with a translation of the German standard series DIN 33872-X (X=1 to 6, in print). The German Standard is intended to specify the relative colour output properties on both printers and displays. The test charts are designed for output without ambient reflections on the display. Germany is asked to make the DIN-test charts available for different viewing conditions on the TU-web site http://130.149.60.45/~farbmetrik

Eight levels of reflection on the screen will be simulated similarly to what is done with the achromatic test chart in ISO 9241-306, Annex D. In addition Germany is asked to produce colour test charts according to ISO/IEC 15775, which include images for application tests.

Conclusion 74/2009 of ISO/TC159/SC4/WG2
ISO/TC159/SC4/WG2 gratefully appreciates the CIE Division 1 "Vision and Colour" report CIE R1-47:2009 "Hue Angles of Elementary Colours". The CIELAB hue angles 26, 92, 162, and 272 degree of the CIE-test Colours no. 9 to 12 will be used for display output. Based on CIE-R1-47 and for the rgb input data "100", "010" and "001", ISO/TC159/SC4/WG2 can now produce the display output colours of the elementary hues RGB and the intermediate colours of a hue circle.

The resolutions and conclusions of these ISO groups indicate the importance of the report CIE R1-47:2009 for example for a device independent elementary and intermediate hue circle output. The output for 8 reflections of the ambient light on displays is defined in ISO 9241-306, Annex D, see for example the Activity Report "January 2009" and the tests chart with the URL:
http://www.ps.bam.de/ME16/10L/L16E00NP.PDF
http://www.ps.bam.de/ME15/10L/L15E00FP.PDF

3. Present ISO-CIE trend and future work for colour output on displays and printers
Based on the CIE report R1-47:2009 and together with the above statements there is now an ISO-CIE trend for a device independent hue output on any colour device.
Examples for the test chart output for printers, and for 8 reflections of the ambient light on the display surface are given at an URL of the Berlin University of Technology
http://130.149.60.45/~farbmetrik/JE.HTM

The ISO-CIELAB standard is used in many standard documents, for example in ISO/IEC 15775, ISO/IEC TR 19797, and ISO/IEC TR 24705. The relative colour data rgb and cmyk used in these documents have a device dependent relation to CIELAB which is usually described by a lookup-table. If a device is linearized for example according to ISO/IEC TR 19797 then equations instead of lookup-tables describe the relation rgb* - LAB* which simplifies colour management to a high degree. Manufacturers can linearize their display output for example for the 8 standard reflections between 0% and 40% of the ambient light on the display surface. Then in addition fast equations can be used to make for example the output more or less chromatic for any hue.

DIN 33872-1 uses a relative CIELAB space with lab*rgb coordinates relative to the six chromatic colours and white and black. A similar relative space is for example the sRGB space according to IEC 61966-2-1. According to CIE 168, table 2, the sRGB space fills only 20% of the CIELAB coding space with the usual 8 bit coding range between -128 and +127 for a* and b* and the range 0 to 255 for L*. Therefore the quantization

efficiency increases by a factor 5, if a relative RGB space is used for colour mamagement. For a projection display with a 40% reflection of the ambient daylight only 0,6% of the CIELAB coding space is filled. In this case the efficiency increases up to a factor 150 compared to the fixed quantization space used in ISO 15076-1 (ICC colour management). Therefore it is appropriate to use an RGB instead of the CIELAB Profile Connection Space (PCS) for colour management. With both PCSs the preferred output can be produced. This is a linearized output, and in addition a device independent elementary hue output on any colour device. There is only one solution for any device. ISO/IEC 19797 defines a method to specify the result by the CIELAB measurement data of the start and linearized output.

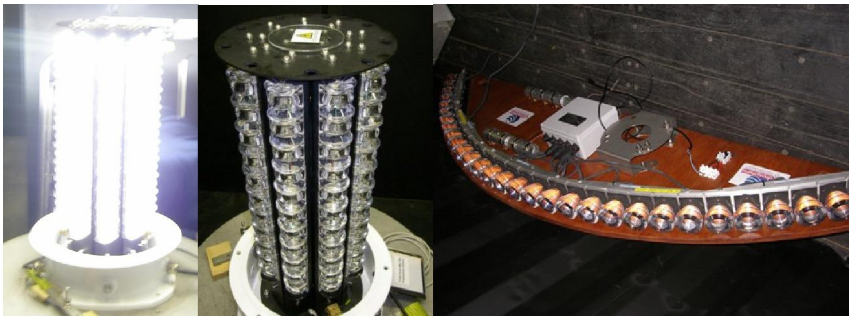
The colour balls in a figure show this preferred device independent hue output in a CIELAB a*-b* diagram for a standard offset process (ORS18a), a standard CRT monitor (TLS00), a photo printer (PRS06a) and a space similar to the Swedish Natural Colour System NCS (NRS11a) for CIE standard illuminant D65, see the URL
http://www.ps.bam.de/De43/10L/L43e00NP.PDF

For more information see the section "publication" on the above web site of the Berlin University of Technology, and the paper: K. Richter: Output linearization in CIELAB for visual displays with eight different luminance reflections of indoor
illuminants, CIE Light and Lighting Conference, Budapest, Hungary, 2009, file pwdas/richter.pdf on CD, 10 pages

L1-8 IALA (International Association of Lighthouse Authorities)
Liaison: M. Nicholson and I. Tutt GB

Conspicuity of Marine Signal Lights
PhD Study on Conspicuity of Signal Lights
The PhD study on the conspicuity of marine signal lights, to be hosted by Leeds University, UK under Professor Peter Rhodes, has a short list of one. An interview will take place with the prospective candidate shortly. Significant milestones within this study will be reported to CIE and IALA.

IALA Liaison
IALA ANM and EEP Committee Meetings, October 2009
The current four-year work programme of both committees has been completed with many new recommendations and guidelines published.
IALA documents can be freely downloaded by visiting their website http://site.ialathree.org/ and clicking on the “Publications” tab, followed by choosing the type of document (e.g. “Recommendations”) from list on the left-hand side.
The 17th IALA Conference takes place in Cape Town, South Africa from 21st to 27th March 2010. http://www.iala2010.co.za/.
Japan Coast Guard is holding an expert meeting in Tokyo during November 2010. They are proposing to make this a joint IALA-CIE meeting on the topic of signal light conspicuity. A small number of experts on this subject will be invited from both organisations once funding has been agreed.



LED Aid-to-Navigation Light Developments

General Lighthouse Authorities of UK & Ireland

The GLAs are progressing with various projects, many of which are calling for long-range LED signal lights, examples of which are shown above.

Useful Links

http://site.ialathree.org/	International Association of Marine Aids to Navigation and Lighthouse Authorities
http://www.cil.ie/	Commissioners of Irish Lights
http://www.nlb.org.uk/	Northern Lighthouse Board
http://www.trinityhouse.co.uk/	Trinity House
http://www.gla-rrnav.org/	General Lighthouse Authorities Research and Radionavigation Directorate

Author:	Ian Tutt	Date:	01.12.2009
Approved:	Nick Ward	Date:	02.12.2009

L1-9 ISO/TC159: Ergonomics

Liaison: K Sagawa JP

No report.