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CIE AND SOLID STATE LIGHTING

Solid State Lighting, or as now abbreviated SSL, has become a buzz-word. One can find no lighting journal or magazine that would not feature an article on its properties and advantages. CIE tried to clarify some of the obscure points at its 2009 Midterm Meeting, where the subtitle of the conference was "with special emphasis on LEDs and Solid State Lighting". LEDs (light emitting diodes) certainly provide opportunities for the modernization of lighting, and SSL will change many of our lighting techniques. There are, however, a number of unsolved questions, both fundamental and applications oriented, where further research is needed, and CIE is busy to solve these.

In every aspects of life the proper use of terms is important. CIE has a long history of terminology documents, and the updating of its International Lighting Vocabulary is in its very final stage. Unfortunately this new dictionary will not contain detailed terms on SSL, as the collection of terms to be included was started before the rapid growth of this new field of lighting. But CIE realized this lack of information and suggested to the Board of Administration the establishment of a new Technical Committee dealing with the subject. Hopefully this will help to avoid such nonsense terms, as "LED incandescent lamp" that some advertisements use to describe LED lamps with Edison screw base as replacements of traditional incandescent lamps.

But there are many fundamental questions that have to be solved. CIE is struggling for some time with the proper description of the colour quality of LED light sources. The CIE Technical Committee, TC 1-69, dealing with the issue had a meeting at the Budapest Conference and one can hope that in the near future the first draft recommendations will become available. In this respect it is also worth mentioning that the results of the very fundamental research done by CIE 1-36 (Fundamental Chromaticity Diagram) might have implications on describing the colour of LEDs, and helping applied lighting engineering in blending the light of different coloured LEDs in a modern coloured environment. SSLs will certainly bring to light further fundamental questions where CIE still has no answer, thus e.g. in determining the discomfort glare of LED luminaires: To calculate the UGR glare rating value one has to determine the effective projected area of the luminaire. This was easy in case of luminaires, where the luminance of the luminaire was more or less homogeneous. But the luminance of LED luminaires is very inhomogeneous, consisting of tiny high luminance spots and quite dark regions in-between. Further investigations will be needed to find out how this has to be taken into consideration in the discomfort glare calculation.

A major problem in SSL quality evaluation is the determination of its luminous efficiency. The usual technique in luminaire photometry is to measure the spatial distribution of the luminous intensity, determine the total luminous flux of the luminaire and of the lamps used in the luminaire,

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and finally report the efficiency for 1000 lumen lamp luminous flux. This technique cannot be used in case of LEDs, where the temperature of the LEDs in the luminaire determines their luminous efficacy, and if the same LEDs would be powered outside of the luminaire (what is in most cases impossible), their efficacy would be quite different. There are recommendations in the literature how this should be taken into consideration, but the CIE reports providing guidance on luminaire photometry have not dealt with this question yet.

The temperature of the LEDs in the luminaire has a strong influence on the lifetime and aging of the LEDs as well. Standardized techniques are needed to determine the LED junction temperature that can be used in case of SSL equipment. A CIE TC is working on this question (TC 2-63: Optical measurement of high-power LEDs), but harmonisation with methods recommended by other international organisations will be needed.

Regarding the measurement techniques of LEDs there is a further issue, where CIE is active already for some time and that is the recommendation how the luminance of LEDs and their visually effective surface should be determined (TC 2-58). This is of particular interest for the determination of the photo-biological evaluation of LEDs. In the past there were two – partly contradictory standards – one by IEC that regarded LEDs as a sub-category of lasers – and one by CIE that regarded LEDs to be incoherent light sources. Although the standpoint of the two organisations was quite close to each other, with the ever increasing radiance of modern LEDs the proper safety categorization of high power LEDs is still a question that has to be solved.

LEDs become used in an increasing number of internal and external lighting applications. Together with promotional descriptions also the number of complaints is increasing that the installations do not fulfil the expectations. In interior applications in the past mainly decorative applications were described, where the aesthetics predominate, thus these were generally accepted. With the ban on incandescent light bulbs the demand for Edison screw LED lamps has increased, and a number of such lamps has been brought onto the market and the proper quality evaluation of these products becomes urgent. Here the fundamental standard requirements that should be used, have to be developed by CIE. Light distribution, correlated colour temperature, colour rendering are quite frequently very different from the similar parameters found in incandescent lamps. Also the production and control of electronic smog – a question that is perhaps not a CIE problem – is important in case of these replacement lamps.

In outdoor lighting LED systems proved to be superior to traditional ones in every application where coloured light has to be applied for

signalling purposes, should it be traffic lights or automotive signalling. But again the colour of these signal lights is slightly different from those of the traditional ones, and that lead to many complaints of glare and visibility, a question that will need re-evaluation.

Much interest has been directed towards SSL applications in both automotive headlamps and in street lighting. CIE is actively investigating the application of LEDs in transport signalling and lighting (TC 4-47), and organized a very successful workshop in conjunction with the CIE Midterm Meeting in Budapest this May. There are many questions in street lighting that have to be answered, starting with best correlated colour temperature (can the blue shift under mesopic conditions, the Purkinje effect, be utilized in re-defining street-lighting luminance levels?), visibility and glare problems, encountered in these modern sources with unusual spectral power distributions, but also issues that were not so important with traditional light sources have to be solved, e.g. the light distribution of LED systems can be designed very precisely, so that only the road surface is illuminated, leaving the surrounding in darkness. This was not possible with traditional luminaires, therefore up to now less attention was given to what the required illumination of the surrounding has to be. The necessary surrounding illumination will have to be provided in the standards in the future, as this influences design parameters and efficacies of the illumination. Also in these applications electronic smog, third harmonics, and thermal issues, related to life expectancy, vulnerability by high voltage pulses (lightning) become important and users need proper guidance.

The complex character of these issues that branch over many international organisations dealing with only one segment of the question, makes it more difficult to deal with them. Therefore CIE initiated international and inter-society co-operation to solve these and other energy related questions by organizing next March in Vienna an international conference, where all players of this game can meet and discuss mutually interesting questions. CIE Technical Committees and all interested organisations are urged to take advantage of this possibility to air their requirements, suggest solutions by organizing workshops, satellite meetings and/or only offering contributed papers for this unique opportunity to discuss energy and vision related issues at the CIE 2010 Lighting Quality & Energy Efficiency Conference in Vienna, Austria next March 14-17.

Dr. János Schanda

CIE Vice-President Technical

CIE Midterm Meeting 2009

May 2009, Budapest, Hungary

From May 24th to June 3rd, the CIE Board of Administration, its different subcommittees, the CIE General Assembly as well as CIE Divisions 1, 2, 3, 4 and 5 and several TCs met in Budapest, Hungary.

Major decision taken were:

The General Assembly elected the Officers for the next quadrennium (2011-2015):

President-Elect 2009-2011 and President 2011-2015	Ann Webb (Great Britain)
Past President	Franz Hengstberger (South Africa)
Vice-President Technical	Yoshi Ohno (USA)
Vice-President Publications	Teresa Goodman (Great Britain)
Vice-President Standards	Axel Stockmar (Germany)
Vice President without Portfolio	Marc Fontoynt (France)
Vice-President without Portfolio:	Cui Yipping (China)
Secretary:	Yoshiki Nakamura (Japan)
Treasurer:	Johann Schleritzko (South Africa)

The General Assembly approved the 2006-2007 budgets.

The following persons received a CIE Award:

Prof. Pan Jiagen	China
David Loe	Great Britain
Sándor Almási	Hungary
Kenjiro Hashimoto	Japan
Kohji Kawakami	Japan
Takashi Ohyama	Japan
Hirohisa Yaguchi	Japan
Prof. Władysław Dybczyński D.Sc., PhD.	Poland
Alicja Peczyńska M.Sc.Eng.	Poland
Małgorzata Skonieczna M.Sc.Eng.	Poland
Dr. Rolf S. Bergman	USA
Norbert Johnson	USA
Dr. Alan L. Lewis	USA
Justin Rennilson	USA

Heartiest congratulations to the recipients of the awards. The Central Bureau would like to thank them for their contribution to the CIE work and would like to wish them good health and much success in their future activities. May we rely also in the future on their expertise!

The next GA meeting will be held at the 27th CIE Session in Sun City on July 10th, 2011.



News from the Divisions

Division 1 – Vision and Colour

<http://www.cie.co.at/div1/>

The following new TCs have been established:

TC 1-75: A Comprehensive Model of Colour Appearance (Chair: M. Ronnier Luo, GB)

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.

TC 1-76: Unique Hue Data (Chair: Sophie Wuerger, GB)

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.

TC 1-77: Improvement of the CIE Whiteness and Tint Equations (Chair: Robert Hirschler, HU)

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.

TC 1-78: Evaluation of Visual Performance in the Real Lit Environment (Chair: Monica Billger, SE)

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.

TC 1-79: Limits of Normal Colour Vision (Chair: John Barbur, GB)

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.

Change in Terms of Reference:

TC 1-70: Metameric Samples for Indoor Daylight Evaluation (Chair: Balász Kranicz, HU).

New Terms of Reference: Amendment: To update Publication CIE 51.2-1999 to cover metameric samples over the visible wave-length range 380 nm to 780 nm and add indoor daylight illuminants and associated metameric samples.

The following new Reporterships were established:

- R1-48: Colour Emotion and Harmony (Li-Chen Ou, TW)
- R1-49: Above-Threshold Pulsed Lights (Ian Tutt, GB)

Division 2 – Physical Measurement of Light and Radiation

<http://www.cie.co.at/div2/>

The following new TCs have been established:

TC 2-65: Photometric Measurements in the Mesopic Range (Chair: Teresa Goodman, GB)

Terms of Reference: 1) To produce a Technical Report setting out measurement requirements and

procedures for implementation of the CIE task-based system for mesopic photometry. 2) To consider the implications of the new system for mesopic photometry for existing Div.2 publications.

TC 2-66: Terminology of LEDs and LED Assemblies (Chair: János Schanda, HU)

Terms of Reference: To review LED and LED assemblies related terms and definitions in other international and regional organisations and prepare a recommendation for CIE.

TC 2-67: Photometry of Lighting and Light-Signalling Devices for Road Vehicles (Chair: Göster Werner, SE)

Terms of Reference: To prepare guidelines for the measurement of photometric performance of lighting and light-signalling devices for road vehicles

Change in Terms of Reference:

TC 2-50: Measurement of the Optical Properties of LED Assemblies (Chair: Richard Distl, DE).

New Terms of Reference: To produce a technical report for the measurement of optical properties of LED assemblies.

Change in TC Chairmanship:

- TC 2-50: *Measurement of the Optical Properties of LED Clusters and Arrays*
New TC Chair: Richard Distl (DE)

The following new Reporterships were established:

- R2-42: Measurement Methods for LED Luminaires (Jianguan Pan, CN)
- R2-43: Measurement of Integrated LED Light Sources (Pei-Ting Chou, TW)
- R2-44: Photometric Characterisation of Large Area Flat Sources Used for Lighting (Armin Sperling, DE)
- R2-45: Measurement of the Illumination Uniformity for Critical Applications (Meena Lysko, ZA)
- R2-46: Photobiological Safety Measurement of Lighting Products (Tongsheng Mou, CN)

Division 3 – Interior Environment and Lighting Design

<http://www.cie.co.at/div3/>

TC 3-49: Decision Scheme for Lighting Controls for Tertiary Lighting in Buildings (Chair: Peter Dehoff, AT)

Terms of Reference: To offer guidelines in order to balance lighting quality, user comfort and energy efficiency in lighting controls solutions for tertiary lighting in buildings (i.e. for commercial, institutional and industrial buildings). Work on a decision scheme with focus on the user requirements (visual comfort, performance, personal control) to determine the most applicable

control solution, including the consequences for possible savings. In this, it needs to be assumed that there are no technological or financial hurdles.

Change in TC Chairmanship:

- TC 3-42: *Lighting Design Applications*
New TC Chair: Karen Pero (CA)

Division 4 - Lighting and Signalling for Transport <http://www.cie.co.at/div4/>

Change in Terms of Reference:

TC 4-45: Performance Assessment Method for Vehicle Headlamps (Chair: Geoff Draper, GB)

New Terms of Reference: To produce a technical report describing the development of requirements for an objective procedure to evaluate forward-lighting system performance in terms of active safety. The previous work of CIE TC4-45 and the former GTB NCAP taskforce shall be used as a basis.

In line with the technical report produce standards to define the assessment procedure, a generic description of routines to be incorporated into software and a method of scoring and ranking the performance of various forward lighting systems.

These technical standards shall be aligned to the requirements of all parties (e.g. manufacturers, consumer associations, publishers, NCAP organisations) involved in actively promoting improvements in the safety of automotive forward-lighting systems.

Division 5 – Exterior Lighting and other Applications <http://www.cie.co.at/div5/>

Change in TC Chairmanship:

- TC 5-20: *Guide for Sports Lighting*
New TC Chair: Alan Smith (GB)

Division 6 – Photobiology and Photochemistry <http://www.cie.co.at/div6/>

Change in TC Chairmanship:

- TC 6-28: *Standardization of Sunscreen Testing: Method for UV-A sunscreen testing*
New TC Chair: Uli Osterwalder (CH)

The following new Reportership was established:

- TC 6-41: The Issues of Vitamin D Kinetics
(Irina Terenetskaya, RU)



New CIE Publication

Ocular Lighting Effects on Human Physiology and Behaviour (including Erratum 1)

CIE 158:2009

ISBN 978 3 901906 74 9

The nonvisual biological and behavioural effects of light in animals and humans are mediated by specific neuroanatomical pathways. Controlled empirical studies have shown that light can be used to treat some clinical disorders and may have broader, nonclinical applications for problems of shift work and jet lag. Studies are testing how lighting may be incorporated into architectural designs that are optimal for vision as well as physiological and behavioural stimulation.

This publication corrects and replaces CIE 158:2004 "Ocular Lighting Effects on Human Physiology and Behaviour".

The Technical Report consists of 60 pages with 9 figures. The price of this publication is EUR 56,-- (Members of the National Committees of the CIE get 50% discount).

The Photometry and Goniophotometry of Luminaires – Supplement 1: Luminaires for Emergency Lighting

CIE 121-SP1:2009

ISBN 978 3 901906 77 0

This report provides information regarding the photometric measurements of emergency lighting luminaires. It is the intention of this document to provide measurement methods for testing the compliance of emergency luminaires with the photometric requirements of IEC safety standards IEC 60598-2-22 and IEC 61347-2-7 issued by IEC/TC34 "Lamps and related equipment". Photometric methods for the measurement of other photometric parameters currently in use are also provided, but the measurement of safety signs is not included. Measurement procedures relate to the editions in use at the date of publication of this report and may vary for future editions. It is the responsibility of the laboratory to check for current applicable procedures. The concept of emergency ballast lumen factor applies only to emergency luminaires equipped with classical discharge lamps and for which a reference ballast has been normalised. For LED luminaires mostly absolute values apply, not related to the luminous flux of the LEDs alone.

The Technical Report consists of 19 pages with 1 table. The price of this publication is EUR 38,-- (Members of the National Committees of the CIE get 50% discount).

CIE 2010 Lighting Quality and Energy Efficiency

Letter of Invitation

Dear Colleagues,

the CIE, founded in 1913, is the oldest and most respected International Lighting Organisation, which deals with all the different aspects of this subject. It is totally committed to the development of energy efficient lighting technologies and standards but without sacrificing safety, security and other important aspects of lighting quality. This objective can be achieved through the intelligent use of new technologies and a scientific understanding of the varied human needs for different types of lighting in different settings.



- A more efficient use of daylight augmented with the use of more efficient lamps and the latest lighting technology now enable us to save energy without sacrificing good lighting.
- Findings in medical science reveal that light plays important roles in maintaining optimum regulation of biological rhythms and hormones on a daily basis. However, the improper choice of lamps or luminaires (fixtures) and poor lighting design and/or lighting installation maintenance, can actually have negative consequences for health and also for traffic safety, personal security, work performance and well being.
- Electronic control systems enable us to adapt light levels and timing of artificial lighting to minimize energy consumption depending on the levels of available daylight and occupancy in buildings as well as traffic volumes on roadways.

Good lighting brings safety, security and a better quality of life to all but needs to be related to the supply of the correct amount of light and with good colour rendering, with the minimal use of resources.

CIE 2010 will therefore highlight

- Surveys of experimental projects
- Lighting techniques & scenarios
- Integrated approaches in Lighting Design
- Lighting quality criteria
- Future possible lighting schemes
- Methods to compare lighting installations
- Case studies of energy-efficient lighting
- Review of energy-efficient lighting control systems
- Energy efficiency and environmental compatibility

As President of the CIE, and as Conference President, I am proud to present [CIE 2010 "Lighting Quality & Energy Efficiency"](#) as a unique forum to get to know the latest developments and results and invite you to join in the effort to enhance lighting quality and reduce energy consumption worldwide.

Looking forward to seeing you in Vienna next year

Dr Franz Hengstberger
Conference President



Future Meetings



INTERLIGHT MOSCOW

**15th International Trade Fair for
Lighting, Lighting Technology &
Intelligent Building Technology**

**10-13 November 2009,
Moscow, Russian Federation**

INTERLIGHT MOSCOW is Russia's leading trade fair for lighting and lighting technologies with a history of 15 years of successful growth.

This year INTERLIGHT MOSCOW offers an extensive three-day lecture supporting programme

- Nov. 10th – *Technical Lighting*
Lectures on technical lighting including exterior lighting, road/tunnel lighting and outside lighting will open INTERLIGHT MOSCOW supporting programme. Concepts for building illumination will be presented as well as underlying technological developments.
- Nov. 11th – *Lighting Control Systems*
Lighting control is steadily gaining importance in Russia. This has two basic reasons: The price for electricity keeps rising frightfully. The other reason is the growing demand for sophisticated and complex lighting applications in large-scale building projects. Demand exists mostly for upscale lighting technology applications in office buildings but private households also show interest in lighting systems in the mid-priced range. Lectures and workshops on trends, technical standards and business perspectives will cast a light on this important topic.
- Nov. 12th – *Architecture and Lighting Concepts*
Lighting is becoming an ever more important mean of design in architecture. Both Russian architects and lighting engineers show great interest in architectural lighting concepts. As in 2008, the organisers of INTERLIGHT MOSCOW will invite international architects and designers for presenting international tendencies in architectural lighting concepts.

LED FORUM MOSCOW will be held parallel to INTERLIGHT MOSCOW.

- Nov. 11th – *Plenary Session*
LED Technologies: A new Quality of Lighting
- Nov. 12th – *Workshop Sessions*
Technologies and new Application Fields
Workshop A: Shop Lighting/ LEDs
Workshop B: Outdoor and Indoor Lighting/
Street Lighting/ LEDs
Workshop C: Lighting Control Systems/
LEDs

www.ledforum-moscow.com

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From the Lighting Journals

Color Research & Application

www.interscience.wiley.com

Volume 34, Issue 3, June 2009

Adaptation and Colour Matching of Display and Surface Colours

B. Oicherman, M.R. Luo, B. Rigg, A.R. Robertson

Theoretical Considerations on Small Colour Differences Ascribed to the Standard Observer made on the Basis of Individual Colour-Matching Functions

F. Carreño, J.M. Ezquerro, J.M. Zoido

A Colour Temperature Adjustment Method for Multi-primary displays using Nonlinear Programming

Y. Cheng, X. Liu, H. Li

Design of Virtual Illuminants to control the Colours under Multiple Illuminants

F. Agahian, S.H. Amirshani

Experimental Determination of the Laws of Colour Harmony. Part 4: Colour Preference and the Colour Harmony Content

A. Nemcsics

Towards Automation of Colour/Weave Selection in Jacquard Design: Model Verification

K. Mathur, D. Hinks, A-F.M. Seyam, R.A. Donaldson

Complementary Colours: The Structure of Wavelength Discrimination, Uniform Hue, Spectral Sensitivity, Saturation, Chromatic Adaptation and Chromatic Induction

R.W. Pridmore

Colour as a Structural Variable of Historical Urban Form

A. Garcia-Codoñer, J. Llopis Verdú, A. Torres Barchino, R. Villaplana Guillén, J. Serra Lluch

Lighting Design + Application

www.iesna.com

April 2009	LIGHTFAIR Preview - Speakers in the Spotlight
May 2009	Shopping for Answers Strategies for Revitalizing Retail
June 2009	Mood Maker - Scenes Change at the Tulalip Resort Casino

Lighting Research and Technology

<http://lrt.sagepub.com>

Volume 41, Number 2, 2009

A model for the explanation of discomfort and pain in the eye caused by light

P.T. Stone

An experimental study of a façade mounted light pipe

V. Duc Hien, S. Chirarattananon

A camera as a sensor for lighting and shading control

G.R. Newsham, C. Arsenault

A colour harmony rendering index based on predictions of colour harmony impression

F. Szabó, P. Bodrogi, J. Schanda

Lifetime prediction of fluorescent lamps used in photovoltaic systems

F.G. Rosillo, N.M. Chivelet

The Lighting Journal

www.ile.co.uk

Volume 74, Number 3, June 2009

OLEDs for Lighting – the Next Big Thing?

C. Gardner

Ready Steady Light 2009

S. Lisk

Shedding Light on Light and Health

M. Mackay, N. Gurney

Testing Blue Light with the Elderly

D.J. Skene

Lighting and the Perception of Safety

N. Bell

Integrating Lighting for the Future

J. Gunton

Specifying SON

D. Lorrison

Heroes of Light No.2: Robert Grosseteste

C. Gardner

Commuted Sums Applied to Street Lighting

H. Crossman, K. Doran

PLDA Column: Anybody out There?

S. Stammers

LIGHT CO₂RE – The Highway Electrical Carbon Calculator

G. Pritchard

For your Diary

Date	Title of Meeting	Organizer	Place of Meeting
2009			
Sept 9-11	Lux Europa 2009 Lighting and the Environment	Leyla Dokuzer Öztürk luxeuropa2009@itu.edu.tr www.luxeuropa2009.org.tr	Istanbul, Turkey
Sept 27 - Oct 2	AIC 2009 11 th Congress of the International Colour Association	AIC 2009 Congress Managers aic2009@tourhosts.com.au www.aic2009.org	Sydney, Australia
Sept 28-30	ISAL 2009 International Symposium on Automotive Lighting	Prof.Dr.-Ing. habil. Tran Quoc Khanh info@isal-symposium.de www.isal-symposium.de	Darmstadt, Germany
Oct 26-27	Experiencing Light 2009 International Conference on the Effects of Light on Wellbeing	www.experiencinglight.nl	Eindhoven, The Netherlands
Oct. 28-31	PLDC 2009 The 2 nd Global Professional Lighting Design Convention	Louise Ritter lrutter@via-internet.com www.pld-c.com	Berlin, Germany
Nov. 10-13	Interlight Moscow	Ost-West Partner GmbH info@interlight-moscow.com www.interlight-moscow.com	Moscow, Russian Federation
2010			
March 14-17	Lighting Quality and Energy Efficiency	CIE Central Bureau Congress Secretariat Mag. Leena L. Martinez vienna2010@cie.co.at	Vienna, Austria

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