27th Session of the CIE
South Africa 2011

Commission Internationale de l'Eclairage
International Commission on Illumination
Internationale Beleuchtungskommission

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PROCEEDINGS
Volume 1 Part 1

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

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THE PRESIDENTS OF THE CIE

1913	Th Vauthier	France
1921	E P Hyde	U.S.A.
1927	C C Paterson	Great Britain
1931	A R Meyer	Germany
1935	Ch Fabry	France
1939	N A Halbertsma	Netherlands
1951	W Harrison	U.S.A.
1955	J W T Walsh	Great Britain
1959	I Folcker	Sweden
1963	L Schneider	Germany, Fed. Rep.
1965	I Folcker	Sweden
1967	D Vermeulen	Netherlands
1971	W R Stevens	Great Britain
1975	S K Guth	U.S.A.
1979	J B de Boer	Netherlands
1983	G Wyszecki	Canada
1985	A M Marsden	Hong Kong
1987	H W Bodmann	Germany, Fed. Re
1991	R C Aldworth	Great Britai
1995	J Hsia	U.S.A.
1999	H A Löfberg	Sweden
2003	W J M v Bommel	The N nds
2007	F Hengstberger	So th Af a

OBJECTIVES OF THE CIE

THE INTERNATIONAL COMMISSION ON ILLUMINATION

The International Commission on Illumination (CIE) is an organisation devoted to international co-operation and exchange of information among its member countries on all matters relating to the art and science of lighting. Its membership consists of the National Committees in about 40 countries.

The objectives of the CIE are:

1. To provide an international forum for the discussion of all matters relating to the science, technology and art in the fields of light and lighting and for the interchange of information in these fields between countries.
2. To develop basic standards and procedures of metrology in the fields of light and lighting.
3. To provide guidance in the application of principles and procedures in the development of international and national standards in the fields of light and lighting.
4. To prepare and publish standards, reports and other publications concerned with all matters relating to the science, technology and art in the fields of light and lighting.
5. To maintain liaison and technical interaction with other international organisations concerned with matters related to the science, technology, standardisation and art in the fields of light and lighting.

The work of the CIE is carried on by seven Divisions each with about 20 Technical Committees. This work covers subjects ranging from fundamental matters to all types of lighting applications. The standards and technical reports developed by these international Divisions of the CIE are accepted throughout the world.

A plenary session is held every four years at which the work of the Divisions and Technical Committees is reviewed, reported and plans are made for the future. The CIE is recognised as the authority on all aspects of light and lighting. As such it occupies an important position among international organisations.

LA COMMISSION INTERNATIONALE DE L'ECLAIRAGE

La Commission Internationale de l'Eclairage (CIE) est une organisation qui se donne pour but la coopération internationale et l'échange d'informations entre les Pays membres sur toutes les questions relatives à l'art et à la science de l'éclairage. Elle est composée de Comités Nationaux représentant environ 40 pays.

Les objectifs de la CIE sont :

1. De constituer un centre d'étude international pour toute matière relevant de la science, de la technologie et de l'art de la lumière et de l'éclairage et pour l'échange entre pays d'informations dans ces domaines.
2. D'élaborer des normes et des méthodes de base pour la métrologie dans les domaines de la lumière et de l'éclairage.
3. De donner des directives pour l'application des principes et des méthodes d'élaboration de normes internationales et nationales dans les domaines de la lumière et de l'éclairage.
4. De préparer et publier des normes, rapports et autres textes, concernant toutes matières relatives à la science, la technologie et l'art dans les domaines de la lumière et de l'éclairage.
5. De maintenir une liaison et une collaboration technique avec les autres organisations internationales concernées par des sujets relatifs à la science, la technologie, la normalisation et l'art dans les domaines de la lumière et de l'éclairage.

Les travaux de la CIE sont effectués par 7 Divisions, ayant chacune environ 20 Comités Techniques. Les sujets d'études s'étendent des questions fondamentales, à tous les types d'applications de l'éclairage. Les normes et les rapports techniques élaborés par ces Divisions Internationales de la CIE sont reconnus dans le monde entier.

Tous les quatre ans, une Session plénière passe en revue le travail des Divisions et des Comités Techniques, en fait rapport et établit les projets de travaux pour l'avenir. La CIE est reconnue comme la plus haute autorité en ce qui concerne tous les aspects de la lumière et de l'éclairage. Elle occupe comme telle une position importante parmi les organisations internationales.

DIE INTERNATIONALE BELEUCHTUNGSKOMMISSION

Die Internationale Beleuchtungskommission (CIE) ist eine Organisation, die sich der internationalen Zusammenarbeit und dem Austausch von Informationen zwischen ihren Mitgliedsländern bezüglich der Kunst und Wissenschaft der Lichttechnik widmet. Die Mitgliedschaft besteht aus den Nationalen Komitees in rund 40 Ländern.

Die Ziele der CIE sind :

1. Ein internationaler Mittelpunkt für Diskussionen aller Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik und für den Informationsaustausch auf diesen Gebieten zwischen den einzelnen Ländern zu sein.
2. Grundnormen und Verfahren der Meßtechnik auf dem Gebiet der Lichttechnik zu entwickeln.
3. Richtlinien für die Anwendung von Prinzipien und Vorgängen in der Entwicklung internationaler und nationaler Normen auf dem Gebiet der Lichttechnik zu erstellen.
4. Normen, Berichte und andere Publikationen zu erstellen und zu veröffentlichen, die alle Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik betreffen.
5. Liaison und technische Zusammenarbeit mit anderen internationalen Organisationen zu unterhalten, die mit Fragen der Wissenschaft, Technik, Normung und Kunst auf dem Gebiet der Lichttechnik zu tun haben.

Die Arbeit der CIE wird in 7 Divisionen, jede mit etwa 20 Technischen Komitees, geleistet. Diese Arbeit betrifft Gebiete mit grundlegendem Inhalt bis zu allen Arten der Lichtanwendung. Die Normen und Technischen Berichte, die von diesen international zusammengesetzten Divisionen ausgearbeitet werden, sind von der ganzen Welt anerkannt.

Alle vier Jahre findet eine Session statt, in der die Arbeiten der Divisionen überprüft, berichtet und neue Pläne für die Zukunft ausgearbeitet werden. Die CIE wird als höchste Autorität für alle Aspekte des Lichtes und der Beleuchtung angesehen. Auf diese Weise unterhält sie eine bedeutende Stellung unter den internationalen Organisationen.

CIE-SOUTH AFRICA ORGANISING COMMITTEE

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Gert Hofman (Treasurer)
Sue Swash (Secretary)
Elsie Coetzee
Eddie Minnie
Carrol Beattie
Comé Lewis

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Division 3	Interior Lighting	Director:	Jan Ejhed
Division 4	Lighting for Transport	Director:	Ad de Visser
Division 5	Exterior Lighting	Director:	Nigel Bollard
Division 6	Photobiology	Director:	Ann Webb
Division 8	Image Technology	Director:	Sabine Süsstrunk

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DIVISIONS AND TECHNICAL COMMITTEES

Division 1
Vision & Colour
Vision et Couleur
Sehen und Farbe

Terms of Reference:
To study visual responses to light and to establish standards of response functions, models and procedures of specification relevant to photometry, colorimetry, colour rendering, visual performance and visual assessment of light and lighting.

Domaine d'activité:
Etudier les réponses visuelles à la lumière et établir des normes pour les fonctions-réponses, les modèles et des procédures de spécification, applicables à la photométrie, la colorimétrie, le rendu des couleurs, la performance visuelle et le jugement visuel de la lumière et de l'éclairage.

Arbeitsbereich:
Untersuchung von Sehfunktionen als 'Antwort' auf Lichtreize und Erstellung von Standard-Sehfunktionen, -Sehmodellen und -Spezifikationsverfahren, soweit diese für die Photometrie, Farbmessung, Farbwiedergabe, visuelle Leistung und für die Bewertung von Licht und Beleuchtung relevant sind.

Director:	Ronnier M Luo
Associate Director-Vision:	Miyoshi Ayama
Associate Director-Colour:	Ellen Carter
Secretary:	Michael R Pointer
Editor:	John Seetche

Technical Committees:

No.	Title	Chair
1-36	Fundamental Chromaticity Diagram with Physiologically Significant Axes	Francoise Viénot
1-37	Supplementary System of Photometry	Ken Sagawa
1-41	Extension of V(λ) beyond 830nm	Pieter Walraven
1-42	Colour Appearance in Peripheral Vision	Miyoshi Ayama
1-55	Uniform Colour Space for Industrial Colour Difference Evaluation	Manuel Melgosa
1-57	Standards on Colorimetry	Alan Robertson
1-58	Visual Performance in the Mesopic Range	Liisa Halonen
1-60	Contrast Sensitivity Function for Detection and Discrimination	Eugenio Martinez-Uriegas
1-61	Categorical Colour Identification	Taiichiro Ishida
1-63	Validity of the Range of CIE DE2000	Klaus Richter
1-64	Terminology for Vision, Colour and Apppearance	Sharon McFadden
1-67	The Effects of Dynamic and Stereo Visual Images on Human Health	Hiroyasu Ujike

No.	Title	Chair
1-68	Effect of Stimulus Size on Colour Appearance	Peter Bodrogi
1-69	Colour Rendering of White Light Sources	Wendy Davis
1-70	Metameric Samples for Indoor Daylight Evaluation	Balasz Kranicz
1-71	Tristimulus Integration	Changjun Li
1-72	Measurement of Appearance Network: MApNet	Michael Pointer
1-73	Real Colour Gamut	Changjun Li
1-74	Methods for Re-defining CIE D Illuminants	Janos Schanda
1-75	A Comprehensive Model of Colour Appearance	Ronnier Luo
1-76	Unique Hue Data	Sophie Wuerger
1-77	Improvement of the CIE Whiteness and Tint Equations	Robert Hirschler
1-78	Evaluation of Visual Performance in the Real Lit Environment	Monica Bullough
1-79	Limits of Normal Colour Vision	John Barbur
1-80	Research Methods for Psychophysical Studies of Brightness Judgements	Steve Fotios
1-81	Validity of Formulae for Predicting Small Colour Differences	Klaus Richter
1-82	The Calculation of Colour Matching Functions as a Function of Age and Field Size	Jan Henrik Wold

Division 2
Physical Measurement of Light and Radiation
Mesures physiques de la lumière et des radiations
Physikalische Messungen von Licht und Strahlung

Terms of Reference:
1. To study standard procedures for the evaluation of ultraviolet, visible and infrared radiation, global radiation, and optical properties of materials and luminaires.
2. To study optical properties and performance of physical detectors and other devices required for their evaluation.

Domaine d'activité:
1. Etudier les procédures normalisées pour l'évaluation des radiations ultraviolettes, visibles et infrarouges, de la radiation globale et des propriétés optiques des matériaux et des luminaires.
2. Etudier les propriétés optiques et les performances des détecteurs physiques et autres dispositifs utilisées pour leur évaluation.

Arbeitsbereich:
1. Untersuchung von Standardverfahren zur Messung und Bewertung ultravioletter, sichtbarer und infraroter Strahlung, der Globalstrahlung und der optischen Eigenschaften von Leuchten und Baustoffen.
2. Untersuchung der optischen Eigenschaften und der Leistung physikalischer Detektoren und anderer Einrichtungen, soweit dies für ihre Bewertung notwendig ist.

Director:	Yoshihiro Ohno
Associate Director:	Georg Sauter
Associate Director:	Norbert Johnson
Associate Director:	Guy Vandermeersch
Secretary:	Armin Sperling
Editor:	Jim Gardner

Technical Committees:

No.	Title	Chair
2-17	Recommendation for Integrated Irradiance and Spectral Distribution of Simulated Solar Radiation	Gene Zerlaut
2-19	Measurement of the Spectral Coefficient of Retroreflection	Norbert Johnson
2-28	Methods of Characterizing Spectrophotometers	Teresa Goodman
2-29	Measurement of Detector Linearity	George Eppeldauer
2-32	Measuring Retroreflectance of Wet Horizontal Road Markings	Norbert Johnson
2-37	Photometry Using Detectors as Transfer Standards	Yoshi Ohno
2-40	Characterizing the Performance of Illuminance and Luminance Meters	Peter Blattner
2-43	Determination of Measurement Uncertainties in Photometry	Georg Sauter
2-46	CIE/ISO Standards on LED intensity measurements	John Scarangello
2-47	Characterization and Calibration Methods of UV Radiometers	Armin Sperling
2-48	Spectral Responsivity Measurement of Detectors, Radiometers and Photometers	George Eppeldauer
2-49	Photometry of Flashing Light	Yoshi Ohno
2-50	Measurement of the Optical Properties of LED Clusters and Arrays	Richard Distl

No.	Title	Chair
2-51	The Calibration of Diode Array Spectrometers	Richard Young
2-53	Multi-Geometry Colour Measurement of Gonioapparent Materials and Metrics for Evaluation	Gerhard Rösler
2-56	CIE/ISO Standard on Retroreflection Measurements	Cameron Miller
2-57	Revision of CIE S014-2	Balasz Kranicz
2-58	Measurement of LED Radiance and Luminance	Kohtaro Kohmoto
2-59	Characterisation of Imaging Luminance Measurement Devices	Udo Krueger
2-60	Effect of Instrumental Bandpass Function and Measurement Interval on Spectral Quantities	Emma Woolliams
2-62	Imaging-Photometer-Based Near-Field Goniophotometry	Walter Steudtner
2-63	Optical Measurement of High-Power LEDs	Yuqin Zong
2-64	High Speed Testing Methods for LEDs	Günther Heidel
2-65	Photometric Measurments in the Mesopic Range	Terese Goodman
2-66	Terminology of LEDs and LED Assemblies	János Schanda
2-67	Photometry of Lighting and Light-Signalling Devices for Road Vehicles	Gösta Werner
2-68	Optical Measurement Methods for OLEDS used for Lighting	Thorsten Gerloff
2-69	CIE Classification Systems of Illuminance and Luminance Meters	Peter Blattner
2-70	Standards for Measurement of Reflectance and Transmittance Properties of Materials	Danny Rich
2-71	CIE Standard on Test methods for LED Lamps, Luminaires and Modules	Yoshi Ohno

Division 3
Interior Environment and Lighting Design
Environnement intérieur et étude de l'éclairage
Innenraum und Beleuchtungsentwurf

Terms of Reference:
1. To study and evaluate visual factors which influence the satisfaction of the occupants of a building with their environment, and their interaction with thermal and acoustical aspects, and to provide guidance on relevant design criteria for both natural and man-made lighting.
2. To study design techniques, including relevant calculations, for the interior lighting of buildings, incorporating the findings and those of other CIE Divisions into lighting guides for interiors in general, for particular types of interiors and for specific problems in interior lighting practice.

Domaine d'activité:
1. Etudier et évaluer les facteurs visuels qui agissent sur la satisfaction des occupants d'un bâtiment par rapport à leur environnement et leur interaction avec les aspects acoustiques et thermiques, et fournir un guide sur les critères d'étude correspondant à la fois à l'éclairage naturel et a l'éclairage conçu par l'homme.
2. Procéder à l'examen des techniques d'étude, y compris les calculs correspondant pour l'éclairage intérieur des bâtiments, en incorporant les résultats des travaux et de ceux d'autres Divisions de la CIE dans des guides pour l'éclairage intérieur en général, pour des types particuliers d'intérieurs et également pour traiter des problèmes spécifiques de la pratique de l'éclairage intérieur.

Arbeitsbereich:
1. Untersuchung und Bewertung visueller Einflussfaktoren auf die Akzeptanz eines Raumes durch die Benutzer des Gebäudes sowie diesbezüglicher Wechselwirkungen visueller, thermischer und akustischer Bedingungen, und Anleitung zu relevanten Entwurfskriterien für natürliche und künstliche Beleuchtung.
2. Untersuchung von Entwurfsverfahren einschliesslich notwendiger Berechnungen für die Innenbeleuchtung von Gebäuden, Einbau dieser Ergebnisse (sowie der von anderen CIE Divisionen) in Beleuchtungsrichtlinien für Innenräume, Spezialräume und für spezifische Probleme der Innenbeleuchtung.

Director:	Jan Ejhed
Associate Director for Natural Lighting:	Dominique Dumortier
Associate Director for Artificial Lighting:	Yoshiki Nakamura
Secretary:	Jennifer Veitch
Editor:	Peter Thorns

Technical Committees:

No.	Title	Chair
3-25	Co-ordination of the IDMP and its data	Norio Igawa
3-34	Protocols for Describing Lighting	Jennifer Veitch
3-39	Discomfort Glare from Daylight in Buildings	Werner Osterhaus
3-42	Lighting Design Applications	Karen Pero
3-44	Lighting for Older People and People with Visual Impairment in Buildings	Yukio Akashi
3-45	Luminance Based Daylight Analysis	Yoshiki Nakamura
3-46	Research Roadmap for Healthful Interior Lighting Applications	Jennifer Veitch

No.	Title	Chair
3-47	Climate-Based Daylight Modelling	John Mardaljevic
3-48	CIE Standard Method of UF Table Calculation for Indoor Luminaires	Peter Thorns
3-49	Decision Scheme for Lighting Controls for Tertiary Lighting in Buildings	Peter Dehoff
3-50	Lighting Quality Measures for Interior Lighting with LED Lighting Systems	Martine Knoop
3-51	CIE Standard General Sky	Stanislav Darula
3-52	Energy Performance of Buildings – Energy Requirements for Lighting	Dieter Schornick

Division 4
Lighting and Signalling for Transport
Eclairage et signalisation pour les transports
Beleuchtung und Signale für den Verkehr

Terms of Reference:
To study lighting and visual signalling and information requirements of transport and traffic, such as road and vehicle lighting, delineation, signing and signalling for all types of public roads and all kinds of users and vehicles, and visual aids for modes other than road transport.

Domaine d'activité:
Etudier l'éclairage et la signalisation visuelle, les besoins en information pour les transports et la circulation, tels que l'éclairage des routes et des véhicules, le marquage, les panneaux de signalisation et la signalisation pour tous les types de routes publiques ansi que pour tous les types d'usagers et de véhicules, et les aides visuelles pour d'autres modes de transport que l'éclairage routier.

Arbeitsbereich:
Untersuchung von Beleuchtung und visuellen Signalen sowie der Informations-Anforderungen im Transport-und Verkehrswesen. Hierzu zählen: Strassen-und Fahrzeugbeleuchtung,Fahrbahnmarkieru ng, Verkehrszeichen und Verkehrssignale für alle Kategorien öffentlicher Strassen, für alle Benutzer und Fahrzeuge, aber auch die visuelle Führung und Unterstützung in anderen Verkehrsbereichen.

Director:	Ad de Visser
Associate Director:	Tapani Nurmi (- 2010),
Associate Director:	Ron Gibbons (2011-)
Associate Director:	Yandan Lin (2011-)
Secretary:	Hans Huijben (-2010)
	Ans van den Broek (2011-)
Editor:	Doug Simpson

Technical Committees:

No.	Title	Chair
4-15	Roadlighting Calculations	Ronald Simons
4-19	Road Visibility in Fog	Michele Colomb
4-21	Interference by Light with Astronomical Observations	Marc Gillet
4-32	Surface Colours for Traffic Signs	Jürgen Ewald
4-33	Discomfort Glare in Road Lighting	Ron Gibbons
4-36	Visibility Design for Roadway Lighting	Richard E. Stark
4-40	Requirements for Retroreflective Traffic Signs	PJ Carlson
4-45	Performance Assessment Method for Vehicle Headlamps	Gert Langhammer
4-46	300 mm Roundel Signals	Carl Andersen
4-47	Application of LED's in Transport Lighting and Signalling	Steve Jenkins
4-48	White Light on Road Lighting	Stephan Voelker
4-49	Guide to the Properties and uses of Retroreflectors at Night	Gernot Sauter
4-50	Road Surface Characterization for Lighting Applications	Cyril Chain
4-51	Optimization of Road Lighting	Carl Andersen

Division 5
Exterior and other Lighting Applications
Eclairage extérieur et autres applications
Aussenbeleuchtung und andere Lichtanwendungen

Terms of Reference:
To study procedures and prepare guides for the design of lighting for exterior working areas, security lighting, flood lighting, pedestrian and other urban areas without motorized traffic, areas for sports and recreation, and for mine lighting.

Domaine d'activité:
Etudier les procédures et préparer des guides pour l'étude de l'éclairage des zones de travaux extérieurs, pour l'éclairage de sécurité, pour l'éclairage par projecteur, pour l'éclairage des zones piétionnes et autres zones urbaines sans circulation motorisée, les zones destinées aux sports et à la récréation ainsi que l'éclairage des mines.

Arbeitsbereich:
Untersuchung von Methoden und Erstellen von Anleitungen zur Beleuchtungsplanung für Arbeitsplätze im Freien, Beleuchtung von Sicherheitsbereichen, Anstrahlungen, Fussgängerzonen und andere städtische Bereiche ohne motorisierten Verkehr, Sport-und Freizeitanlagen und für Bergwerke.

Director:	Nigel Pollard
Secretary:	Thomas M Lemons
Editor:	Mary Crawford

Technical Committees :

No.	Title	Chair
5-18	Practical design guidelines for the lighting of exterior work areas	Kelvin Austin
5-20	Guide for Sports Lighting	Thomas M. Lemons
5-21	Masterplanning Urban Lighting	Müjgan Serefhanoglu-Sözen
5-22	Beam Patterns for Exterior Floodlighting Luminaires	Scott Davis
5-23	Guidelines for the Use of Different Illuminance Parameters in Outdoor Applications	Patrick Rombauts
5-24	Guide for Architectural and Decorative Lighting	Andre Tammes
5-26	Guide for the Lighting of Sport Events for Colour Television and Film Systems	Alan Smith
5-27	Artificial Light and its Impact on the Natural Environment	Peter Strasser
5-28	Guide on the Limitation of the Effects of Obtrusive Light	Nigel Pollard

Division 6
Photobiology and Photochemistry
Photobiologie et photochimie
Photobiologie und Photochemie

Terms of Reference:
To study and evaluate the effects of optical radiation on biological and photochemical systems (exclusive of vision).

Domaine d'activité:
Etudier et évaluer les effets de radiations optiques sur les systèmes biologiques et photochimiques (à l'exclusion de la vision).

Arbeitsbereich: Untersuchung und Bewertung der Wirkungen optischer Strahlung auf photobiologische und photochemische Systeme. Hierbei ist die visuelle Wahrnehmung ausgenommen.

Director:	Ann Webb
Associate Director:	Kohtaro Kohmoto
Associate Director:	Karl Schulmeister
Secretary:	Andrew Smedley
Editor:	John O'Hagan

Technical Committees:

No.	Title	Chair
6-08	Guidelines for Obtaining Action Spectra	David Sliney
6-15	A Computerized Approach to Reflection, Transmission and Absorption Characteristics of the Human Eye	David J. Lund
6-20	Phototoxicity in Domestic and Industrial Environments	Neil K. Gibbs
6-21	Low Lewel UV Cataract	David Sliney
6-28	Standardization of Sunscreen Testing: Method for UV-A sunscreen testing	Uli Osterwalder
6-33	Photoimmunological Effects Mediated through the Skin	Edward C. de Fabo
6-36	UVR Protective Materials Used in Shading	Natasha Nel-Sakharova
6-37	Light and Retinal Disease	David Sliney
6-39	UV Radiation at Lighted Environments	Kohtaro Kohmoto
6-42	Lighting Aspects for Plant Growth in Controlled Environments	Mojtaba Navvab
6-43	UV Water Disinfection	Alexander Cabaj
6-44	Illuminators for Treatment of Infant Hyperbilirubinemia	Myron L. Wolbarsht
6-45	Optical Radiation Hazard Measurements in the Workspace	R. Angelo
6-46	Standardized Action Spectrum for UV Disinfection	Petra Rettberg
6-48	Typical Minimal Erythema Doses	Janusz Z. Beer
6-49	Infrared Cataract	Tsutomu Okuno
6-50	Photodegradation of Pharmaceuticals	Hanne Tønnesen

No.	Title	Chair
6-51	Standardized Solar Simulator Spectral Irradiance for Sunscreen Testing	Robert S .Sayre
6-52	Proper Measurement of Passive UV Air Disinfection Sources	Richard Vincent
6-53	Personal Dosimetry Radiation	vacant
6-55	Photobiological Safety of LEDs	Werner Horak
6-57	Standardization of Terms and Action Spectra for Blue Light and Retinal Thermal Hazard Functions	Kohtaro Kohmoto
6-58	A Recommendation on Lower Limits for UV Exposure	Wim Passchier
6-61	Measurement of Radiation Using the Phytometric System for Plant Application	Gilberto da Costa
6-62	Action Spectra and Dosimetric Quantities for Circadian and Related Neurobiological Effects	H. Cooper
6-63	Photobiological Strategies for adjusting Circadian Phase to Minimize the Impact of Shift Work and Jet Lag	Stephen W. Lockley
6-64	Optical Safety of Infrared Eye Trackers Applied for Extended-Durations	David Sliney
6-65	Photobiological Dosimetry for Low Level Laser/Light Phototherapy	Terry L Lyon

Division 8
Image Technology
Technologie des images
Bildverarbeitung

Terms of Reference:
To study and evaluate activities in terminology, education, economics of lighting and to provide information on the development of light sources.

Domaine d'activité:
Etudier et évaluer les activités en terminologie, enseignement, économie de l'éclairage et fournir l'information sur le développement des sources de lumière.

Arbeitsbereich:
Untersuchung und Bewertung von Fragen der Terminologie, Ausbildung und Wirtschaftlichkeit im Bereich der Beleuchtungstechnik sowie Information über die Entwicklung von Lichtquellen.

Director:	Sabine Süsstrunk
Secretary:	Nathan Moroney
Editor:	Ann McCarthy

Technical Committees:

No.	Title	Chair
8-02	Colour Difference Evaluation in images	Ronnier Luo
8-07	Multispectral Imaging	Jussi Parkkinen
8-08	Testing of Spatial Colour Appearance Models	Garret Johnson
8-09	Archival Colour Imaging	Robert Buckley
8-10	Office Lighting for Imaging	Todd Newman
8-11	CIECAM02 Mathematics	Changjun Li
8-12	Video Compression Assessment	Christine Fernandez-Maloigne

CURRENT CIE PUBLICATIONS

Recommendations

17.4 International lighting vocabulary, 4th ed. (Joint Publication IEC/CIE), 1987.

23 International recommendations for motorway lighting, 1973.

39.3 Recommendations for surface colours for visual signalling, 2nd ed., 1983.

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ISO 16508/CIE S006 Road traffic light - 200 mm roundel signals photometric properties, 1999.

ISO 17166/CIE S007 Erythema reference action spectrum and standard erythema dose, 1998.

ISO 8995-1/CIE S008-2001 Lighting of work places - Part 1: Indoor, 2002.

CEI IEC 62471/CIE S009:2006 Sécurité photo-biologique des lampes et des appareils utilisant des lampes / Photobiological safety of lamps and lamp systems (bilingual edition), 2006.

ISO 23539/CIE S010:2005 Photometry - The CIE system of physical photometry, 2005.

ISO 15469/CIE S011:2003 Spatial distribution of daylight - CIE standard general sky, 2003.

ISO 23603/CIE S012:2005 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour, 2005.

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Colorimetry Series

ISO 11664-1/CIE S014-1:2006 CIE Colorimetry – Part 1: Standard Colorimetric Observers, 2007.

ISO 11664-2/CIE S014-2:2006 CIE Colorimetry – Part 2: Standard Illuminants for Colorimetry, 2006.

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1 Guide lines for minimising urban sky glow near astronomical observatories (Joint publication IAU/CIE), 1980.

13.3 Method of measuring and specifying colour rendering of light sources, 1995.

15 Colorimetry, 3rd ed., 2004.

16 Daylight, 1972.

18.2 The basis of physical photometry, 2nd ed., 1983.

19.21 An analytic model for describing the influence of lighting parameters upon visual performance, 2nd ed., Vol.1.: Technical foundations, 1981.

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23 International recommendations for motorlighting, 1973.

31 Glare and uniformity in road lighting installations, 1976.

32 Lighting in situations requiring special treatment (in road lighting), 1977.

33 Depreciation of installation and their maintenance (in road lighting), 1977.

34 Road lighting lantern and installation data: photometrics, classification and performance, 1977.

38 Radiometric and photometric characteristics of materials and their measurement, 1977.

40 Calculations for interior lighting: Basic method, 1978.

41 Light as a true visual quantity: Principles of measurement, 1978.

42 Lighting for tennis, 1978.

43 Photometry of floodlights, 1979.

44 Absolute methods for reflection measurements, 1979.

45 Lighting for ice sports, 1979.

46 A review of publications on properties and reflection values of material reflection standards, 1979.

47 Road lighting for wet conditions, 1979.

48 Light signals for road traffic control, 1980.

49 Guide on the emergency lighting of building interiors, 1981.

51.2 A method for assessing the quality of daylight simulators for colorimetry, 1999.

52 Calculations for interior lighting: Applied method, 1982.

53 Methods of characterising the performance of radiometers and photometers, 1982.

54.2 Retroreflection: Definition and measurement, 2001.

55 Discomfort glare in the interior working environment, 1983.

57 Lighting for football, 1983.

58 Lighting for sports halls, 1983.

59 Polarisation: Definitions and nomenclature, instrument polarisation, 1984.

60 Vision and the visual display unit work station, 1984.
61 Tunnel entrance lighting: A survey of fundamentals for determining the luminance in the threshold zone, 1984.
62 Lighting for swimming pools, 1984.
63 The spectroradiometric measurement of light sources, 1984.
64 Determination of the spectral responsivity of optical radiation detectors, 1984.
65 Electrically calibrated thermal detectors of optical radiation (absolute radiometers), 1985.
66 Road surfaces and lighting (joint technical report CIE/PIARC), 1984.
67 Guide for the photometric specification and measurement of sports lighting installations, 1986.
69 Methods of characterising illuminance meters and luminance meters: Performance, characteristics and specifications, 1987.
70 The measurement of absolute luminous intensity distributions, 1987.
72 Guide to the properties and uses of retroreflectors at night, 1987.
73 Visual aspects of road markings (joint technical report CIE/PIARC; French translation: Aspects visuels des marquages routiers is available from PIARC), 1988.
74 Roadsigns, 1988.
75 Spectral luminous efficiency functions based upon brightness matching for monochromatic point sources, 2° and 10° fields, 1988.
76 Intercomparison on measurement of (total) spectral radiance factor of luminescent specimens, 1988.
77 Electric light sources: State of the art - 1987, 1988.
78 Brightness-luminance relations: Classified bibliography, 1988.
79 A guide for the design of road traffic lights, 1988.
80 Special metamerism index: Change in observer, 1989.
81 Mesopic photometry: History, special problems and practical solutions, 1989.
82 CIE History 1913 - 1988, 1990.
83 Guide for the lighting of sports events for colour television and film systems, 1989.
84 Measurement of luminous flux, 1989.
85 Solar spectral irradiance, 1989.
86 CIE 1988 2° spectral luminous efficiency function for photopic vision, 1990.
87 Colorimetry of self-luminous displays - A bibliography, 1990.
88 Guide for the lighting of road tunnels and underpasses, 2nd ed., 2004.
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- 89/1 Results of a CIE detector response intercomparison
- 89/2 Photobiological effects of sunlamps
- 89/3 On the deterioration of exhibited museum objects by optical radiation
- 89/4 Guide for the measurement of underground mine lighting.

90 Sunscreen testing (UV.B), 1991.
93 Road lighting as an accident countermeasure, 1992.
94 Guide for floodlighting, 1993.
95 Contrast and visibility, 1992.
96 Electric light sources - State of the art, 1992.
97 Maintenance of indoor electric lighting systems, 2nd ed., 2005.
98 Personal dosimetry of UV radiation, 1992.
99 Lighting education (1983-1989), 1992.
100 Fundamentals of the visual task of night driving, 1992.
101 Parametric effects in colour-difference evaluation, 1993.
102 Recommended file format for electronic transfer of luminaire photometric data, 1993.
103 Technical Collection 1993:
- 103/1 Colour appearance analysis
- 103/2 Industrial lighting and safety at work
- 103/3 Reference action spectra for ultraviolet induced erythema and pigmentation of different human skin types
- 103/4 Biologically effective emissions and hazard potential of desk-top luminaires incorporating tungsten halogen lamps
- 103/5 The economics of interior lighting maintenance
- 103/6 Clarification of maintained illuminance and associated terms.

104 Daytime running lights (DRL), 1993.
105 Spectroradiometry of pulsed optical radiation sources, 1993.
106 CIE Collection in Photobiology and Photochemistry, 1993:
- 106/1 Determining ultraviolet action spectra
- 106/2 Photokeratitis
- 106/3 Photoconjunctivitis
- 106/4 A reference action spectrum for ultraviolet induced erythema in human skin
- 106/5 Photobiological effects in plant growth
- 106/6 Malignant melanoma and fluorescent lighting
- 106/7 On the quantification of environmental exposures: limitations of the concept of risk-to-benefit ratio
- 106/8 Terminology for photosynthetically active radiation for plants.

107 Review of the official recommendations of the CIE for the colours of signal lights, 1994.
108 Guide to recommended practice of daylight measurement, 1994.
109 A method of predicting corresponding colours under different chromatic and illuminance adaptation, 1994.
110 Spatial distribution of daylight - Luminance distributions of various reference skies, 1994.
111 Variable message signs, 1994.
112 Glare evaluation system for use within outdoor sports- and area lighting, 1994.
113 Maintained night-time visibility of retroreflective road signs, 1995.
114 CIE Collection in photometry and radiometry, 1994:
- 114/1 Survey of reference materials for testing the performance of spectrophotometers and colorimeters
- 114/2 International intercomparison on transmittance measurement - Report of results and conclusions
- 114/3 Intercomparison of luminous flux measurements on HPMV lamps
- 114/4 Distribution temperature and ratio temperature
- 114/5 Terminology relating to non-selective detectors
- 114/6 Photometry of thermally sensitive lamps.

115 Lighting of roads for motor and pedestrian traffic, 2010.
116 Industrial colour-difference evaluation, 1995.
117 Discomfort glare in interior lighting, 1995.
118 CIE Collection in colour and vision, 1995:

- 118/1 Evaluation of the attribute of appearance called gloss
- 118/2 Models of heterochromatic brightness matching
- 118/3 Brightness-lu minance relations
- 118/4 CIE guidelines for co-ordinated research on evaluation of colour appearance models for reflection print and self-luminous display image comparisons
- 118/5 Testing colour appearance models: Guidelines for co-ordinated research
- 118/6 Report on color difference literature
- 118/7 CIE guidelines for co-ordinated future work on industrial colour-difference evaluation.

121 Photometry and goniophotometry of luminaires, 1996.

121-SP1 Photometry and goniophotometry of luminaires - Supplement 1: Luminaires for Emergency Lighting, 2009.

122 The relationship between digital and colorimetric data for computer-controlled CRT displays, 1996.

123 Low Vision - Lighting needs for the partially sighted, 1997.

124 CIE Collection in Colour and Vision, 1997:
- 124/1 CIE TC 1-31 Report: Colour notations and colour order systems
- 124/2 CIE TC 1-18 Chairman's Report: On the course of the disability glare function and its attribution to components of ocular scatter
- 124/3 Next step in industrial colour difference evaluation, Report on a colour difference research meeting.

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126 Guidelines for minimizing sky glow, 1997.

127 Measurement of LEDs, 2007.

128 Guide to the lighting for open-cast mines, 1998.

129 Guide for lighting exterior work areas, 1998.

130 Practical methods for the measurement of reflectance and transmittance, 1998.

132 Design methods for lighting of roads, 1999.

134 CIE Collection in Photobiology and Photochemistry, 1999.
- 134/1 CIE TC 6-26 Report: Standardization of the terms UV-A1, UV-A2 and UV-B
- 134/2 CIE TC 6-30 Report: UV protection of the eye
- 134/3 CIE TC 6-38 Report: Recommendation on photobiological safety of lamps. A review of standards

135 CIE Collection 1999: Vision and colour, physical measurement of light and radiation.
- 135/1 Disability Glare
- 135/2 Colour rendering, closing remarks
- 135/3 Virtual metamers for assessing the quality of simulators of CIE illuminant D50 (Supplement 1-1999 to CIE 51-1981)
- 135/4 Some recent developments in colour-difference evaluation
- 135/5 Visual adaptation to complex luminance distribution
- 135/6 45°/0° Spectral reflectance factors of pressed polytetrafluoroethylene (PTFE) power (Reprint of NIST Technical Note 1413)

136 Guide to the lighting of urban areas, 2000.

137 The conspicuity of traffic signs in complex background, 2000.

138 CIE Collection 2000: Photobiology and Photochemistry.
- 138/1 Blue-light photochemical retinal hazard
- 138/2 Action spectrum for photocarcino-genesis (non-melanoma skin cancers)
- 138/3 Standardized protocols for photocarcino- genesis safety testing
- 138/4 A proposed global UV index.

139 The influence of daylight and artificial light on diurnal and seasonal variations in humans. A bibliography, 2001.

140 Road lighting calculations, 2000.

141 Testing of supplementary systems of photometry, 2001.

142 Improvement to industrial colour-diffence evaluation, 2001.

143 International recommendations for colour vision requirements for transport, 2001.

144 Road surface and road marking reflection characteristics, 2001.

145 The correlation of models for vision and visual performance, 2002.

146/147 Collection on Glare, 2002.
- 146 CIE equations for disability glare
- 147 Glare from small, large and complex sources.

148 Action spectroscopy of skin with tunable lasers, 2002.

149 The use of tungsten filament lamps as secondary standard sources, 2002.

150 Guide on the limitation of the effects of obtrusive light from outdoor lighting installations, 2003.

151 Spectral weighting of solar ultraviolet radiation, 2003.

153 Report on an intercomparison of measurements of the luminous flux of high pressure sodium lamps, 2003.

154 The maintenance of outdoor lighting systems, 2003.

155 Ultraviolet air disinfection, 2003.

156 Guidelines for the evaluation of gamut mapping algorithms, 2004.

157 Control of damage to museum objects by optical radiation, 2004.

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159 A colour appearance model for colour management systems: CIECAM02, 2004.

160 A review of chromatic adaptation transforms, 2004.

161 Lighting design methods for obstructed interiors, 2004.

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163 The effects of fluorescence in the characterization of imaging media, 2004.

164 Hollow light guide technology and applications, 2005.

165 CIE 10 degree photopic photometric observer, 2005.

166 Cognitive colour, 2005.

167 Recommended practice for tabulating spectral data for use in colour computations, 2005.

168 Criteria for the evaluation of extended-gamut colour encodings, 2005.

169 Practical design guidelines for the lighting of sport events for colour television and filming, 2005.

170-1 Fundamental chromaticity diagram with physiological axes – Part 1, 2006.

171 Test cases to assess the accuracy of lighting computer programs, 2006.

172 UV protection and clothing, 2006.

173 Tubular daylight guidance systems, 2006.
174 Action spectrum for the production of previtamin D_3 in human skin, 2006.
175 A framework for the measurement of visual appearance, 2006.
176 Geometric tolerances for colour measurements, 2006.
177 Colour rendering of white LED light sources, 2007.
179 Methods for characterizing tristimulus colorimeters for measuring the colour of light, 2007.
180 Road transport lighting for developing countries, 2007.
181 Hand protection by disposable gloves against occupational UV exposure, 2007.
182 Calibration methods and photoluminescent standards for total radiance factor measurements, 2007.
183 Definition of the cut-off of vehicle headlights, 2008.
184 Indoor Daylight Illuminants, 2009.
185 Reappraisal of Colour Matching and Grassmann's Laws, 2009.
186 UV-A Protection and Sunscreens, 2010.
187 UV/C Photocarcinogenesis Risks from Germicidal Lamps, 2010.
188 Performance Assessment Method for Vehicle Headlighting Systems, 2010.
189 Caldulation of Tunnel Lighting Quality Criteria, 2010.
190 Calculation and Presentation of Unified Glare Rating Tables for Indoor Lighting Luminaires, 2010.
191 Recommended System for Mesopic Photometry based on Visual Performance, 2010.
192 Practical Daylight Sources for Colorimetry, 2010.
193 Emergency Lighting in Road Tunnels, 2010.
194 On Site Measurement of the Photometric Properties of Road and Tunnel Lighting, 2011.
195 Specification of Colour Appearance for Reflectivity Media and Self-Luminous Display Comparisons, 2011.
196 CIE Guide to Increasing the Accessibility in Light and Lighting, 2011.

Proceedings of the Sessions

1921		Paris
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1927		Bellagio
1928		Saranac
1931		Cambridge
1935		Berlin
1939		Scheweningen
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Discs & CD-ROMs

D001 Disc version of CIE Colorimetric Data (Publ. 18.2, and 86 Tables), 2006.
D002 Disc version of CIE Colorimetric and Colour Rendering Data (Publ. 13.2 and 15 Tables), 2004.
D006 Automatic quality control of daylight measurement - Software for IDMP stations (computer program to CIE 108-1994), 1994.
D007 A computer program implementing the "Method of predicting corresponding colours under different chromatic and illuminance adaptation" (described in CIE 109-1994), 1994.
D008 Computer program to calculate CRIs (according to CIE 13.3-1995), 1995.

Special Publications

x005 Proceedings of the CIE Seminar '92 on Computer programs for light and lighting.
x006 Japan CIE Session at PRAKASH 91.
x007 Proceedings of the CIE Symposium '93 on Advanced Colorimetry.
x008 Urban sky glow - a worry for astronomy (Proceedings of a Symposium of CIE TC 4-21), 1994.
x009 Proceedings of the CIE Symposium '94 on Advances in Photometry.
x010 Proceedings of the CIE Expert Symposium '96 Colour Standards for Image Technology.
x011 Special volume, 23rd Session, New Dehli '95, Late papers.
x012 NPL - CIE-UK Visual Scales Conference.
x013 Proceedings of the CIE LED Symposium '97 on Standard Methods for Specifying and Measuring LED Characteristics, 1998.
x014 Proceedings of the CIE Expert Symposium '97 on Colour Standards for Imaging Technology, 1998.
x015 Proceedings of the First CIE Symposium on Lighting Quality, 1998.
x016 Proceedings of the CIE/ICNIRP Conference on Measurements of Optical Radiation Hazards, 1998.
x017 Special volume, 24th Session, Warsaw '99, Late papers, 2000.
x018 Proceedings of the CIE Symposium '99 "75 Years of CIE Photometry", 2000.
x019 Proceedings of three CIE workshops on Criteria for Road Lighting, 2001.
x020 Proceedings of the CIE Symposium 2001 "Uncertainty Evaluation, Methods for Analysis of Uncertainties in Optical Radiation Measurement", 2001.
x021 Proceedings of the CIE Expert Symposium 2000 "Extended range colour spaces", 2001.

x022 Proceedings of the 2nd CIE Expert Symposium on LED measurement "Standard methods for specifying and measuring LED and LED cluster characteristics, 2001.

x023 Proceedings of two CIE Workshops on photometric measurement systems for road lighting installations, 2002.

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x027 Proceedings of the CIE Symposium ’04. Light and Health: non-visual effects, 2004

x028 Proceedings of the CIE Symposium '05. Vision and Lighting in Mesopic Conditions, 2005.

x029 Proceedings of the 2nd CIE Expert Symposium on Measurement Uncertainty, 2006.

x030 Proceedings of the ISCC/CIE Expert Symposium '06 "75 Years of the CIE Standard Colorimetric Observer", 2006.

x031 Proceedings of the 2nd CIE Expert Symposium on Lighting and Health, 2006.

x032 Proceedings of the CIE Symposium on Visual Appearance, 2007.

x033 Proceedings of the CIE Expert Symposium on Advances in Photometry and Colorimetry, 2008.

x034 Selected Papers of the Light and Lighting Conference with Special Emphasis on LEDs and Solid State Lighting, 2010.

x035 Proceedings of the CIE Conference Lighting Quality and Energy Efficiency, 2010.

x036 Proceedings of the CIE Expert Symposium on Spectral and Imaging Methods for Photometry and Radiometry, 2010.

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SESSION PROGRAMME

Sunday, July 10

18:00	**Welcome Cocktail in the Hall of Treasures**

Monday, July 11

Pilanesberg A + Omega

09:00	OPENING CEREMONY	09:00
09:10	Celebrity Paper	09:10

	Pilanesberg A + Omega (D1) Chair: Ronnier Luo, GB	Pilanesberg B (D2) Chair: Peter Blattner, CH	Royal Ballroom South (D3) Chair: Jan Ejhed, SE	
09:30 - 09:45	OP01 **Teresa Goodman, GB (113)** **The Physics of Perception: Measurement of Naturalness**	OP05 **Stefan Winter, DE (233)** **Detector Based Traceability Chain for Spectral Irradiance using Tuneable Lasers, Independent from Blackbody Radiators**	OP09 **Valerio R.M. Lo Verso, IT (235)** **Climate-Based Metrics for Daylighting and Impact of Building Architectural Features on Daylight Availability**	09:30 - 09:45
09:45 - 10:00	OP02 **Nana Itoh, JP (304)** **Span of Color Similarity of Low Vision: The Meaning of Similar for Low Vision**	OP06 **Stefaan Forment, BE (143);** presented by: Peter Hanselaer, BE **Spectral UV Irradiance Measurements with a Double Monochromator System and with a Combined Monochromator-Spectrograph Measuring Instrument**	OP10 **John Mardaljevic, GB (279)** **Daylighting Metrics for Residential Buildings**	09:45 - 10:00
10:00 - 10:15	OP03 **Ingrid Vogels, NL (159);** presented by: Malgorzata Perz, NL **Visible Artefacts of LEDs**	OP07 **Richard Young, DE (209)** **Wavelength Calibration of Array Spectroradiometers**	OP11 **Tommy Govén, SE (152)** **The Influence of Ambient Light in the Performance, Mood and Endocrine Systems of School Children**	10:00 - 10:15
10:15 - 10:30	OP04 **Di Lou, CN (221)** **The Study of Eyestrain and Lighting Conditions**	OP08 **Yoshi Ohno, US (287)** **Measurement of Bandpass for Array Spectroradiometers**	OP12 **Hongyi Cai, US (32)** **High Dynamic Range Photogrammetric Techniques: A New Tool for Lighting Quality Assessment**	10:15 - 10:30
10:30	**COFFEE BREAK**			10:30

Pilanesberg A + Omega

11:00	Invited Speaker: Ann Webb, GB, "CIE and the Art of Successful Lighting" Chair: Franz Hengstberger, ZA	11:00

	Pilanesberg A + Omega	Pilanesberg B	Royal Ballroom South	
11:30 - 13:00	**Workshop 1** **SSL Standardization** **(Convener: Yoshi Ohno, US & Marc Fontoynont, FR)** **Simon RG Hall, GB (241)** **EMRP Metrology for Solid State Lighting Project**			11:30 - 13:00
13:00	**LUNCH BREAK**			13:00

	Pilanesberg A + Omega	Pilanesberg B	Royal Ballroom South	
14:00 - 17:00	**DIV meeting**	**DIV meeting**	**DIV meeting**	14:00 - 17:00
	6 rooms for TC meetings			
14:00 - 17:00	**TC meetings**			14:00 - 17:00

Cultural Evening in the Botsalanong Boma