RESEARCH AND STANDARDISATION

RESPONSE FORM for Standardisation groups

To contribute to *EMPIR - the European Metrology Programme for Innovation and Research* *

Objective: to collect standardization needs and suggestions to develop research projects in testing and measurements for the upcoming EMPIR calls (2019 and 2020)

In the frame of the between CEN, CENELEC and EURAMET, CEN and CENELEC have been invited by the EURAMET Management to put forward their **testing and measurement needs in research** for consideration by metrology institutes for future calls under EMPIR.

Relevant technical groups (sector fora, advisory boards, coordination groups, TCs, WGs...) **are invited to contribute with**

- a short introduction or an overview paper of their unaddressed standardization needs for testing and measurement, and
- a contact person (secretary, chair, convenor, liaison officer, etc.) whom proposers for the Potential Research Topics can contact,

by using this Response Form and send it at :

STAIR EMPIR secretariat, Mr Ortwin Costenoble: empir@nen.nl

Deadline for the consultation: **14 December 2018**.
Proof of need by the TC/SC is highly recommended for a successful submission.

Source of the identified need (identification of TC, WG, etc, incl. title)	☐ CEN/TC 0/WG 0 ☐ CLC/TC 0/WG 0 ☐ ISO/TC 0/SC 0 / WG 0 ☐ IEC/TC 0/SC 0 / WG 0 ☒ Other, namely *CIE, International Commission on Illumination*
European entity responsible for submission of the need	*CIE Division 6* *Photobiology and Photochemistry*
Person that can be contacted for more detail	*Luke Price, Secretary CIE Division 6* *Luke.Price@phe.gov.uk* *+44 (0)1235 825068* *UK* *Dr Luc Schlangen, elected Director CIE Division 6 for the period 2019-2023* *luc.schlangen@signify.com* *+31 629121871* *NL*

Unaddressed need (short description)	Performance of “light dosimeters” for monitoring non-visual effects and related visual effects Although light is defined as electromagnetic radiation that provides the stimulus for vision, there is abundant scientific evidence that light received by the eye also has important biological effects relevant for human health, performance and wellbeing that are not dependent on visual images. Pioneering work over the last 25 years revealed another kind of retinal photoreceptor, next to rods and cones. This photoreceptor plays an important role in non-visual effects of light and has an intrinsic light sensitivity that peaks in the shorter wavelength part of the visible spectrum. Such photoreceptors are known as intrinsically-photosensitive retinal ganglion cells (ipRGCs), and their intrinsic photosensitivity is based on the photopigment melanopsin that is contained within them. These findings have opened up a new research field, investigating how light as detected by any of the five photoreceptor types (3 cones, rods and ipRGCs) drives biological, non-visual responses. Although this research programme is far from complete, there is significant interest within the lighting community to develop and define lighting innovations and applications that are based on non-visual responses to light. Such applications can also now take advantage the high flexibility in design of new types of light sources, like solid state lighting (SSL), which also includes light-emitting diodes (LEDs). In view of their potential benefits for human health and well-being, such applications are sometimes marketed under the term “Human Centric Lighting”. Moreover, many other applications that are not (exclusively) related to human vision, can be envisioned, in particular in horticulture lighting. In general, standardization work has significantly increased over the last few years: – CIE has published a new international standard (CIE S 026:2018) defining quantities and action spectra for the measurement of light with respect to its non-visual effects. – In Europe a technical report CEN/TR 16791:2017 "Quantifying irradiance for eye-mediated non-image-forming effects of light in humans" was published, drafted within CEN TC169 on “Light and Lighting”. – ISO TC274 JWG 4 "Integrative lighting (joint working group with CIE-JTC 14)" is presently undertaking an analysis of published scientific studies and reviewing experiences from published application studies on non-visual effects of light on humans, aiming to provide guidance for safe and beneficial use in lighting applications beyond illumination for vision.

	Measurement of spectral distributions of light sources in testing laboratories and the field are usually well understood and the measurement uncertainties are at acceptable level. For the assessment of (spectrally weighted) non-visual irradiances, radiance and doses in the field, the situation is more difficult. Guidance and standards are now needed regarding the optical performance of wearable digital sensors ("light dosimeters") used to monitor the environmental irradiance /light exposure in terms of the newly defined five retinal photoreceptor inputs (intrinsically-photosensitive Retinal Ganglion Cells or ipRGCs, rods, and the three cone types) that can contribute to both non-visual and related visual responses to light in humans. Such light dosimeters are used in research and also in clinical practice (*e.g.* sleep and exercise related applications), and in the near future may be expected to be produced for the general retail sector. They are based on compact filter radiometers having intrinsically limitations on the accuracy due to different sources of errors (*i.e.* spectral match, linearity, directional response, temperature effects, out-of-band sensitivity…). Researchers spend large amount of their funding resources on purchasing these devices, which, through better optical design, could relatively easily provide data to their studies that much more closely relate to the effects that they are studying. So far, no international standard exists for the calibration or performance characterizations of this class of field measurement device. The design and quality of exposure measurements varies greatly between models and is unsuitable in the vast majority of cases (if not all cases), and as a result the market does not adequately meet users' needs. To draft such standard, additional research is need, in particular to defining calibration conditions, quality indices and measurement uncertainty analysis.
Further explanation of need (TC business plan, road map, formal decision, work item, etc.)	Develop agreement, best practices and further deployment on the non-visual effects of lighting environments, making use of the definitions within the new global standard (CIE S 026:2018) on ipRGC-influenced responses to light (IIL responses). The research into non-visual effects of light, or IIL responses, that support human wellbeing, health and functioning currently is an international priority area that merits a coordinated effort that would be greatly supported by a consensus approach and best practice examples how to implement the new metrics. CIE has identified the need for research in the research strategy (http://www.cie.co.at/research-strategy, research topic no 1 and no 9). Different technical committees are relate to the topic: CIE JTC-9 *CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light* CIE 218:2016 *This technical report "Research Roadmap for Healthful Interior Lighting Applications"* (available at

	http://www.cie.co.at/publications/research-roadmap-healthful-interior-lighting-applications mentions the five principles of healthy lighting established in CIE symposia in 2002 and 2004: 1. The daily light dose received by people in Western (industrialized) countries might be too low. 2. Healthy light is inextricably linked to healthy darkness. 3. Light for biological action should be rich in the regions of the spectrum to which the non-visual system is most sensitive. 4. The important consideration in determining light dose is the light received at the eye, both directly from the light source and reflected off surrounding surfaces. 5. The timing of light exposure influences the effects of dose. CIE TC 2-51 *Calibration, Characterisation and Use of Array Spectroradiometers* CIE TC 2-69 *CIE Classification Systems of Illuminance and Luminance Meters* Unsurprisingly, similar standards exist in related fields with varied scopes, such as relating to monitoring the ultraviolet radiation (UVR) exposure of the skin (and cornea/lens of the eye), and luminance and illuminance meters (as maintained by CIE TC 2-69). However, these approaches need to be adapted and standardized for retinal exposures to environmental light and further changes are needed so that the general mismatch metrics for spectral, directional and dynamic responses consistently estimate the expected resulting errors and reliability in general field research applications, best practice implementations and possibly for other important specific applications.
Enclosures	☐ Yes ☒ No

*See **more information at** **EMPIR website**
CEN/CENELEC website "Standards and metrology"