

MEASUREMENT AND STANDARDIZATION ON PHOTOBIOLOGICAL SAFETY RELATED TO LED PRODUCTS

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Objective

The LED industry has witnessed rapid development in recent years. LED has been widely applied in lighting and other consumer electronics fields due to the improvement in its luminous efficacy, working lifetime and cost reduction. The photobiological safety of optical radiation of LED products, the impact on human retina caused by blue light in particular, has gained more and more attentions.

Standards of CIE S009/IEC 62471 and IEC TR 62471-2 have been published, meanwhile, the new edition of the basic requirements and classification criteria IEC 62471-1 will be published as well, both are concerning to the photobiological safety. The drafting of Standard IEC 62471-4 for measuring methods related to evaluation of photobiological safety is under way, and also relative technical report regarding the measuring techniques for optical radiation quantities will be prepared in CIE TC2-73. The requirements of LED application products for photobiological safety are being also involved in the safety specifications of products standards, which are now limited to the blue light hazard to the Retina. However, in practical, the influences of LED products include its photobiological impact, which have not been covered in standard IEC 62471, therefore, more extensive and well worth concern.

Methods

The major topics of this study are as following:

- 1) Review the international progress of photobiological safety standardization at present.
- 2) Ultraviolet, visible and near-infrared radiation are possibly involved in LED products. According to standard IEC 62471, photobiological hazards need be considered in wide meaning by analysis of exposure level for practical products.
- 3) Discuss the difference of potential photobiological hazards of general lighting applications for different human groups in different occasions, on the basis of optical properties of the eyes
- 4) Measurements of the effective irradiance and the weighted radiance involved in photobiological safety evaluation of LED products are implemented, based on the human exposure condition, especially, by simulating the observing state of human eyes.
- 5) In addition to standard IEC 62471, there are new radiometric parameters related to photobiological influence are important by reference of the studies in other fields.

Results

- A. Photobiological hazards of LED products:
 - a) At present, blue light hazard is mainly concerned for general lighting products. However, near-UV hazard should be considered since the UV-LED becomes increasingly used.
 - b) Blue light hazard and near-UV hazard both worth to be noted for LED products applied in electrical equipment.
 - c) Besides, the wavelength of UV LED has expanded to 240nm, even mainly low power, the UV actinic hazard shall not be ignored.
 - d) Currently, thermal hazard on retina will not be an issue for general LED lighting products, but it will be very different in the particular usage in industry and medical areas.
- B. Issues for special human groups
 - a) The blue light hazards of LED lighting products have different impacts on children and the elderly, because of the difference of spectral transmittance of crystalline lens.
 - b) The limits of exposure for aphakic retina and eyes with fundus oculi disease are very different. The passed LED products certificated as CIE S009/IEC 62471 standard may have potential hazard for these groups. And the limit of exposure should be referred to the level of aphakic retina.
- C. Measurement issues
 - a) The field of view and measuring aperture are crucial for measurement complex beam profiles such as LED lighting products.
 - b) Measuring distance should be combined with the situation of practical applications.
- D. New quantities of photobiological impact
 - a) Flicker causes tiredness of eyes, headache and even epilepsy attack for few patients.
 - b) The chronic effects of the retinal tissues caused by the blue light.
 - c) The impact on human immunity and melatonin disruption.

Conclusions

1. The requirements of photobiological safety should be put into the safety specifications of LED lighting products. The hazards for particular purposes of non-lighting should be considered more comprehensively.
2. The standards of LED application products should be refined according to various populations in the future.
3. For some special groups, lighting products should be assessed according to people with aphakic eyes, and be indicated in instructions and technical specifications.
4. Attention should be attached to the issues, such as flicker and chronic photobiological impact of LED products.