

ISA Technical Report



ISA Position Statement on Healthy Lighting in Asian Region

SN: ISA-TR-0005-2018

2018-04-30

International Solid State Lighting Alliance
Technical Committee on Standardization

This statement is prepared by ISA Technical Committee on Standardization.

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(1st DRAFT) ISA Position Statement on Healthy Lighting in Asian Region

1. BACK GROUND

It is well known that Florence Nightingale was not only a famous care giver but also talented architectural designer for medical facilities. In her publication titled “NOTES ON NURSING: What it is, and What it is not”, she stated “ It is the unqualified result of all my experience with the sick, that second only to their need of fresh air is their need of light; that, after a close room, what hurts them most is a dark room”. Although now we all know that light has some effects on our physiology, she already knew it more than one hundred years ago.

Regarding the physiological mechanism, one significant discovery was achieved in this century. That is discovery of intrinsic photosensitive retinal ganglion cells (ipRGC). ipRGC is novel photo-receptor which has peak sensitivity around 480 nm and is thought to play the major role for circadian rhythm regulation¹⁾. At the almost same time, action spectrum of melatonin suppression was also reported²⁾. Melatonin is considered to be an important hormone for circadian regulation and sleep. The action spectrum shows the peak sensitivity of melatonin suppression is located around 460nm which is very close to the peak in ipRGC depolarization by light. These findings suggest that short wavelength light especially in 460-480nm range (i.e. blue light) significantly affects our circadian system. This means quality of light is also very important factor for our health and well-being.

2. INFLUENCE ON LIGHTING TECHNOLOGY

White light is generally used in our living environment and it consists of light which has various wavelengths including blue range. High CCT light has relatively bigger portion of blue light than low CCT light. This means lighting quality created by SPD design possibly affects our health and well-being. Because general white LED light consists of blue chip, many people think it has bigger portion of blue light than other classic light sources in some cases. This is totally misunderstanding and ISA has already reported that there is no difference between them if CCT is same through the research activity.

Biological clock recognizes day or night by detecting light in environment. As explained, blue light is the most sensitive in that detection. Therefore blue light in day and night has positive and negative effects respectively. Blue light in daytime (especially morning) is considered to promote circadian synchronization and enhances alertness. This means higher CCT lighting possibly has positive effects in our health and productivity. On the other hand, higher CCT lighting from evening to night has negative effects. It suppresses melatonin more efficiently, raises alertness before sleep and delays circadian phase.

All these facts suggest that lighting quality especially SPD design has to be carefully considered

and dynamically controlled through day and night for our future lighting.

(Some related figures)

3. ASIAN CULTURE IN LIGHTING AND EXPECTED PROBLEMS

Every place has different culture and preference in lighting. In Asia, there is a distinct difference compared to Western countries. It is the selection of color of light. Generally speaking, Asian people prefer higher CCT lighting. It is not very rare for Asian residential lighting to employ high CCT light like 5000K or higher even for night lighting. Recently, researchers in China, Japan and Korea formed a research team and carried out surveys on features of residential lighting in their countries. They investigated 485, 450 and 176 living room lighting in China, Japan and Korea, respectively³⁾ and found that white colored lighting (CCT 4000K or higher) is the most frequently used. Frequency of lower CCT lighting like incandescent color is just around 25% (Table 1). These figures objectively show higher preference of high CCT lighting in Asian countries than Western countries. There is no systematic data like above in south-east Asian countries but similar trend can be seen there as well. Because lower CCT lighting causes hot sensation in physically hot environment, they prefer higher CCT lighting all day.

As explained above, use of higher CCT light from evening to night possibly causes negative effect. It could harm our sleep and health, therefore color of light has to be reconsidered especially in Asian countries from the view point of circadian physiology.

Color of light in living room N (%)				
Color	Korea	China	Japan	Total
Red-tinged	13 (8.3)	69 (19.8)	259 (30.9)	341 (25.4)
White	136 (87.2)	276 (79.1)	557 (66.5)	969 (72.1)
Bluish White	7 (4.5)	4 (1.1)	22 (2.6)	33 (2.6)

Table 1. Survey result on color of light in living room of China, Japan and Korea³⁾

4. PROPOSAL

In January 2013, top scientists in chronobiology from all over the world held the first international workshop on circadian and neurophysiological photometry. Through the discussion, they concluded that it was not yet possible to predict the non-image-forming impact of a given illuminant based on its intensity and spectral composition because of incomplete method to measure light⁴⁾. However, they also suggested that it was possible to control the impact by balancing shorter and longer wavelength light in SPD.

Given these, ISA encourages employment of lower CCT light like below 3000K for evening to

night lighting in Asian countries. To realize it, development of CCT tunable luminaires with LED technology has to be promoted in the industry. This additional value of LED luminaires surely contributes not only health and well-being of users but also prosperity of lighting industry.

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- 1) Berson, et al, "Phototransduction by Retinal Ganglion Cells that Set the Circadian Clock", Science, 295, 2002, pp.1070-1073
- 2) Brainard, et al, "Action Spectrum for Melatonin Regulation in Humans: Evidence for a Novel Circadian Photoreceptor", J Neurosci, 21, 2001, pp.6405-6412
- 3) Okhee et al., "The Characteristics of Illumination Environments of Living Room in Korea, China and Japan", 2013 CJK Lighting Conference Proceeding, 2013, pp.63-66
- 4) Lucas et al., "Measuring and using light in the melanopsin age", Trends in Neurosciences, 37(1), 2014