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## Case Study: Housing & Development Board

### Case Study on LED lighting with TÜV SÜD PSB



**HOUSING &  
DEVELOPMENT  
BOARD**

TÜV SÜD PSB helps Housing & Development Board (HDB) in providing photobiological safety evaluation of LED corridor lightings to help improve energy efficiency of LED lighting and reduce costs in the lighting technologies.

#### Key challenges

With the improvement in energy efficiency of LED lighting and the decline in its cost, LED fitting is becoming more popular in the growing lighting market. Nowadays, LED lights are more commonly used to replace high pressure sodium lamps, halogen lights, incandescent bulbs and also fluorescent lights.

As we switched to LED lighting, it is important to ensure the lighting shall remain functional, aesthetically pleasing and safe. The selected LED lighting shall comply with globally-recognised standards such as International Electrotechnical Commission (IEC), which spell out technical and safety requirements for lighting – including the safety limit for exposure to white light.

Blue light hazard test was carried out in March 2018 to ascertain that the product meet IEC standard. With this in place, LEDs can be readily deployed in both commercial and residential dwellings.

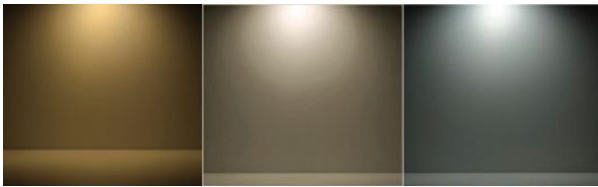
OVERVIEW	
Client name	Housing & Development Board
Industry	Housing
Key challenge	To meet globally-recognised standards such as IEC standard which stipulates the allowable levels of blue light emission, for LEDs deployment in public housing common area.
Our solution	TÜV SÜD assisted to verify that LED lighting installed in public housing is classified under Exempt Risk Group.
Key results	Different colour temperature of LED lightings use in residential area has little blue light hazard impact on human.  LED lighting in public housing do not potentially have a greater photochemical risk to the retinal tissues of the eye as compared to other sources such as fluorescent lamp.

## Technical Specifications for LED lighting

Visible light is made up of 3 colours – Red, Green and Blue. By combining the 3 colours together, we will get white light (see picture below). Reducing the amount of blue colour will result in more yellowish light. This applies to all kinds of light, natural or artificial: Sunlight, incandescent light, fluorescent light, and LED light.



For artificial lighting (including LED lighting), the colour of lighting is determined by the correlated colour temperature (CCT). The CCT ranges from 3000 Kelvin (K) (commonly termed “warm white” as the colour is more yellowish, similar to incandescent light bulbs) to 6000K (commonly termed “cool white”). The picture below shows the typical colour of lighting and the corresponding CCT. For LED lighting, at high CCT (i.e. 6000K), the light carries a bluish tint.



Warm white 3000K      Natural white 4000K      Cool white 6000K

- “Warm white” has the least amount of blue-light, giving it a yellow hue and a colour temperature of 3000 Kelvin
- “Pure white” has a more balanced mix of blue-light, giving it a natural daylight feel and a colour temperature of 4000 Kelvin; while
- “Cool white” has the highest amount of blue-light, resulting in a harsh white colour and a colour temperature of 6000 Kelvin.

The perception of ambient colour and visual satisfaction are based upon:

### i. Colour-Temperature of Lamp

- 3000K (social areas)
- 4000K (working interiors)
- 6000K (supermarkets, department stores, art galleries, museums)

### ii. Tropical or cold climate

Tropical climate generally are warmer environment, thus it prefers cool white (more white) to create a cooling atmosphere. In contrast, cold climate prefers warm white (more yellowish) to have a warmer atmosphere.

### iii. Colour Rendering Index

The higher the CRI, the better the colour reflection. A light source is given a CRI of 100 if there no change in appearance.

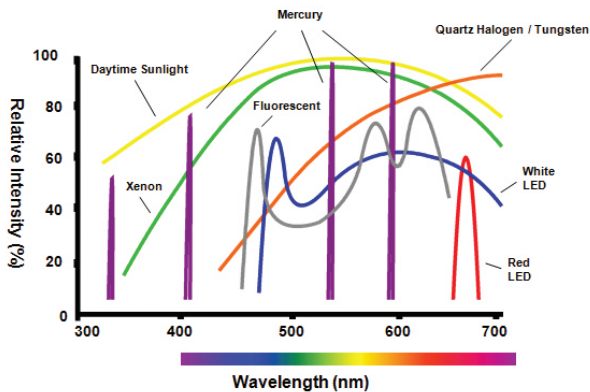
The visible spectrum of light is the portion of the electromagnetic radiation that is visible to the human eye. The human eye responds to visible light wavelengths from 390 to 700 nanometres (nm). For blue light, it has a wavelength of about 450 to 500 nm.

All LED lighting used in public housing shall comply with the relevant IEC standards. These include IEC 62031 (LED modules for general lighting – Safety specifications) and IEC 62471 (Photobiological Safety of lamp and lamp system). In particular, the IEC 62471 focused on the interaction of light with living organisms (human beings, animals) and specifies the exposure limits, reference measurement technique and classification scheme for the evaluation and control of photo biological hazards (see table below). The LED lighting installed in public housing are required to meet the “**Exempt Risk Group to ensure safe usage.**”

Risk Group	Philosophical Basis
Exempt	No photobiological hazard
Group 1 (Low-Risk)	No photobiological hazard under normal behavioral limitations
Group 2 (Moderate-Risk)	Does not pose a hazard due to aversion response to bright light or thermal discomfort
Group 2 (High-Risk)	Hazardous even for momentary exposure

## Product Testing

Blue light hazard assessment was carried for various lightings colours temperature of LED lights (3000K, 4000K & 6500K).



## Testing Condition

Test was performed in accordance to clause 5.2.2.1 Standard radiance measurement method of IEC 62471:2006 and conducted based on the test conditions as follows:

1. LED luminaire at standard measurement distance of 20cm
2. LED luminaire at measurement distance of 80cm
3. LED luminaire with diffuser removed at standard measurement distance of 20cm
4. LED luminaire with diffuser removed at measurement distance of 80cm

## Results

With the report from TÜV SÜD PSB, it shows that the LED lighting installed in public housing is classified under “Exempt” Risk group (RG0), which is safe for public usage. The results had proven that the different colours of LED lightings **has little blue light hazard impact on public**. Under most use cases, LED lighting do **not present greater risk** for blue light hazard than other sources such as fluorescent lamp.

Test Report No. 7191181027-EEC18-CMF  
dated 2 Mar 2018



### Appendix I Summary of results

CCT	Diffuser removed	Measurement distance	$L_b, W/(m^2 \cdot sr)$	$L, cd/m^2$	Risk Group
3000K	<input type="checkbox"/> Yes, <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> 20 cm, <input type="checkbox"/> 80 cm	4.558E+00	1.459E+04	RG0 unlimited
	<input type="checkbox"/> Yes, <input checked="" type="checkbox"/> No	<input type="checkbox"/> 20 cm, <input checked="" type="checkbox"/> 80 cm	4.741E+00	1.474E+04	RG0 unlimited
	<input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No	<input checked="" type="checkbox"/> 20 cm, <input type="checkbox"/> 80 cm	5.077E+02	1.788E+06	RG1 unlimited
	<input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No	<input type="checkbox"/> 20 cm, <input checked="" type="checkbox"/> 80 cm	4.496E+01	1.338E+05	RG0 unlimited
4000K	<input type="checkbox"/> Yes, <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> 20 cm, <input type="checkbox"/> 80 cm	6.377E+00	1.397E+04	RG0 unlimited
	<input type="checkbox"/> Yes, <input checked="" type="checkbox"/> No	<input type="checkbox"/> 20 cm, <input checked="" type="checkbox"/> 80 cm	6.368E+00	1.352E+04	RG0 unlimited
	<input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No	<input checked="" type="checkbox"/> 20 cm, <input type="checkbox"/> 80 cm	7.474E+02	1.822E+06	RG1 unlimited
	<input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No	<input type="checkbox"/> 20 cm, <input checked="" type="checkbox"/> 80 cm	6.287E+01	1.278E+05	RG0 unlimited
6500K	<input type="checkbox"/> Yes, <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> 20 cm, <input type="checkbox"/> 80 cm	1.330E+01	1.622E+04	RG0 unlimited
	<input type="checkbox"/> Yes, <input checked="" type="checkbox"/> No	<input type="checkbox"/> 20 cm, <input checked="" type="checkbox"/> 80 cm	1.323E+01	1.580E+04	RG0 unlimited
	<input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No	<input checked="" type="checkbox"/> 20 cm, <input type="checkbox"/> 80 cm	1.683E+03	1.830E+06	RG1 unlimited
	<input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No	<input type="checkbox"/> 20 cm, <input checked="" type="checkbox"/> 80 cm	9.457E+01	1.112E+05	RG0 unlimited

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