

# TÜV Rheinland Eye Comfort Certification Solution



# Major Drivers in Display Technology



## Growth in urbanization

Urbanization, responsible for generating more than 80% of the global GDP in cities, contributes to sustainable growth through increased productivity and innovation.



## Acceleration of digitalization

As online shopping becomes easier and more popular, simple and clear information must be provided to aid consumers in their purchasing decisions.



## Increasing awareness of product performance

Retailers and end consumers are increasingly focusing on product performance.



## Quest for health-related features

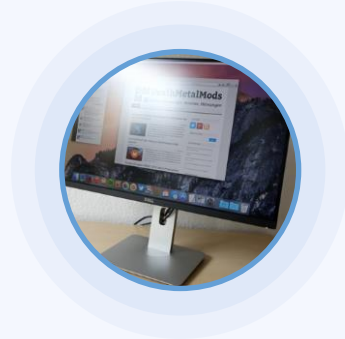
People are seeking ways to increase their longevity, and they are willing to purchase products that can help them achieve this.

# Key user pain points and expectation in digital times



## Image quality

- ❑ Enhanced resolution
- ❑ Increased refresh rate and reduced response time
- ❑ Uniform color and luminance
- ❑ Accurate color reproduction
- ❑ Wider color space



## Ambient light performance

- ❑ Improved daylight visibility
- ❑ Minimized distracting mirror-like reflection
- ❑ Reduced color washout
- ❑ Automatic adaptation of CCT and luminance



## Visual fatigue

- ❑ Mitigation of HEV blue light, reducing potential long-term risk to retinas
- ❑ Regulation of the screen to adapt to natural human alertness and sleep patterns
- ❑ Prevention of visible and non-visible flicker



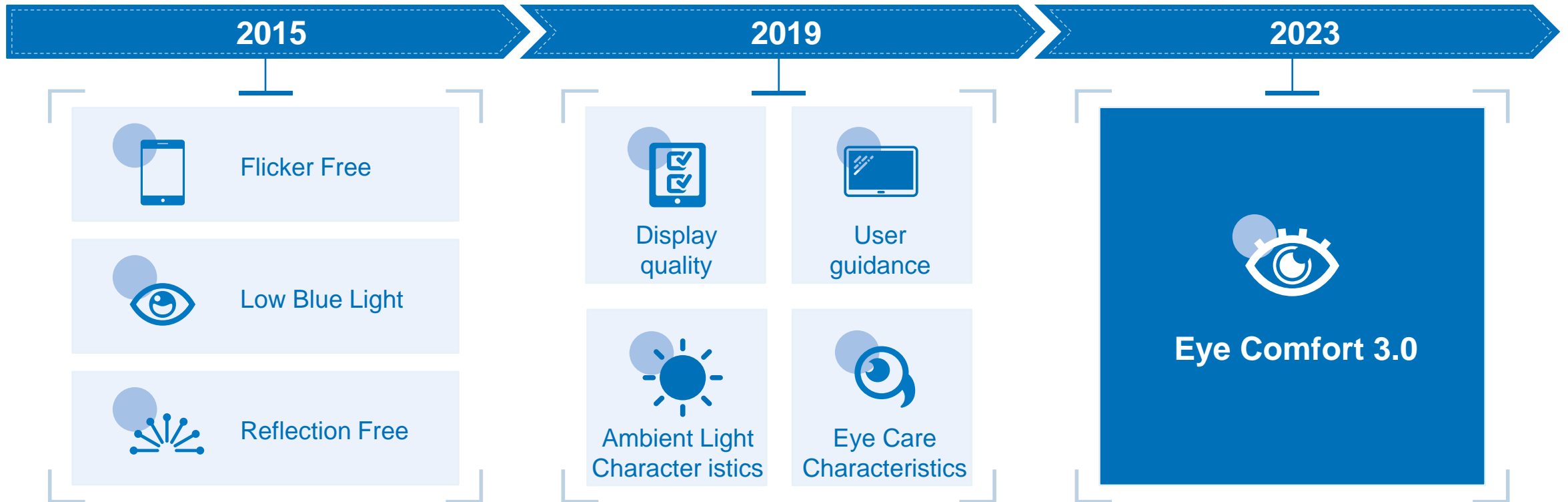
## Improper usage

- ❑ Excessive screen time
- ❑ Poor user habits
- ❑ Improper brightness settings
- ❑ Circadian rhythm disruption

# TÜV Rheinland Eye Comfort Certification Solution

In 2015, TÜV Rheinland introduced an eye comfort certification for the display industry. The first version incorporated the latest requirements in visual ergonomics, such as ISO 9241-307, reflection management, and user guidance.

The second version was built upon research related to human visual health, encompassing four key dimensions: image quality, ambient light, eye care, and user guidance.



# TÜV Rheinland Eye Comfort Certification Solution

## “ Introduction of Star Rating Scheme



Under this program, products are evaluated and assigned an Eye Comfort rating on a scale of 1 to 5 stars.



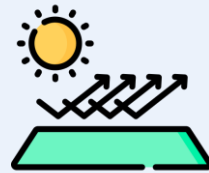
The new Star Rating certification mark can be used to distinguish different product functions in the market, thereby simplifying purchase decision making based on quality.



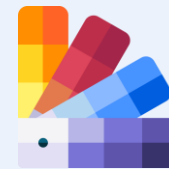
The eye wellness factors being considered remain the same. However, the criteria for attaining 3, 4, or 5 stars differ, with higher star ratings indicating more stringent standards.

# TÜV Rheinland Eye Comfort Certification Solution

The Eye Comfort Certification Solution is an all-inclusive certification scheme that considers major eye wellness factors.



> 01 Ambient Light Management



> 02 Color Accuracy



> 03 Color Gamut



> 04 Flicker Free



> 05 Low Blue Light



> 06 Refresh rate

Ergonomics Engineering Research + Academy Partnership + User Experience Research

## > 01 Ambient Light Management

**Ambient Light Management** is a feature that adjusts screen brightness and correlated color temperature (CCT) based on the surrounding lighting conditions.

This feature plays a significant role in reducing eye strain and fatigue, thereby contributing to a healthier and more comfortable visual experience for individuals



### Brightness control:

Excessively bright lighting may lead to discomfort and glare, which can result in eye strain.



### Contrast enhancement:

Adjusting the ambient light to minimize contrast imbalances makes it easier for your eyes to perceive images and text on a screen.



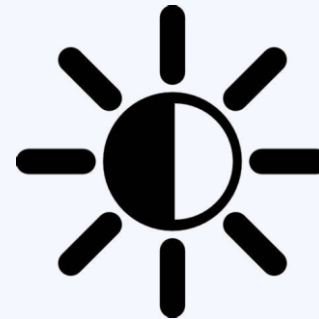
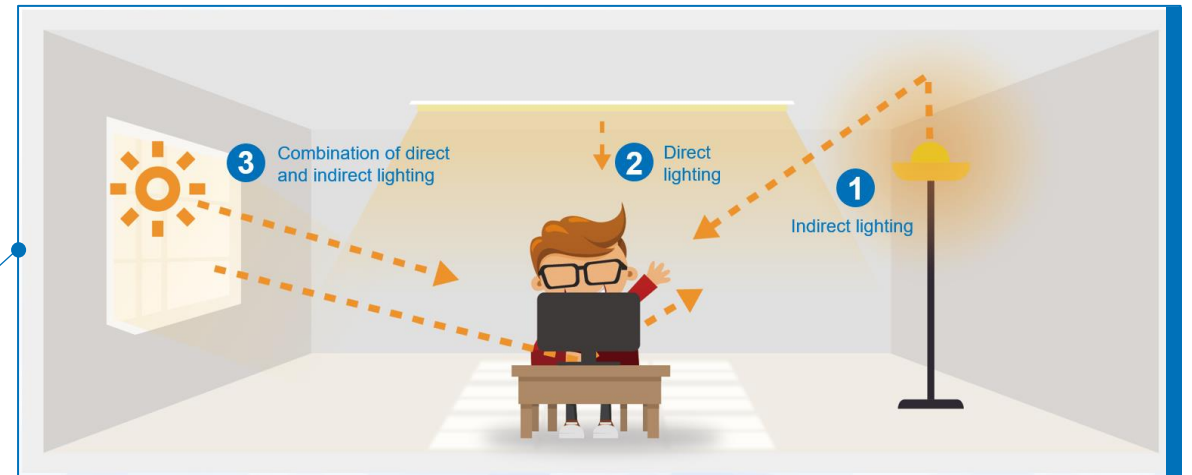
### Glare reduction:

Glare occurs when light reflects off a surface, and excessive glare can strain your eyes as you try to focus on the screen through the reflected light.

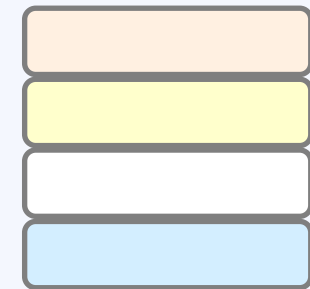


### Blue light exposure:

Prolonged exposure to blue light can disrupt sleep patterns and cause eye fatigue.



Automatic brightness adjustment

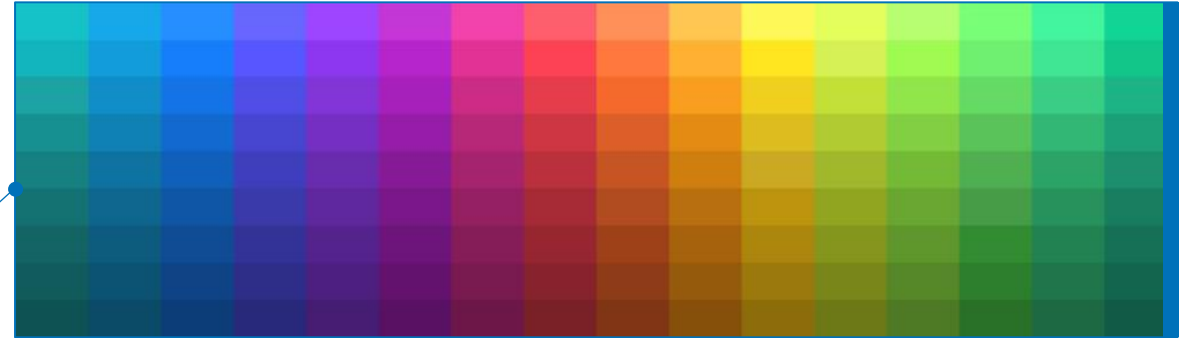


Automatic CCT adjustment

## > 02 Color Accuracy

**Color accuracy** refers to how precisely a display represents the original content or intended color values.

Monitoring eye comfort is important because our eyes are sensitive to variations in color and can perceive even slight discrepancies.



### • **Natural perception:**

Inaccurate colors can strain our eyes as we try to reconcile the discrepancies between what we expect to see and what is actually displayed.



### • **Visual consistency:**

If colors are displayed inconsistently or inaccurately, eye strain may occur, rendering it challenging to accurately evaluate and edit visual content.



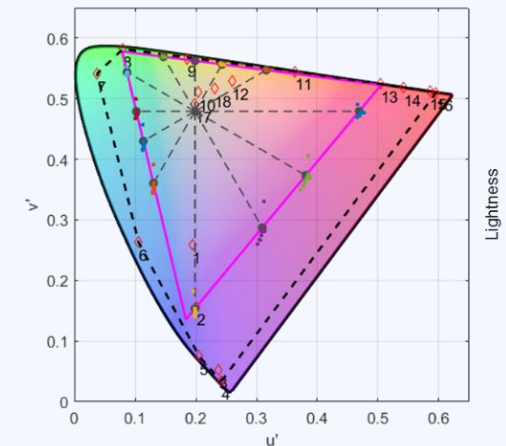
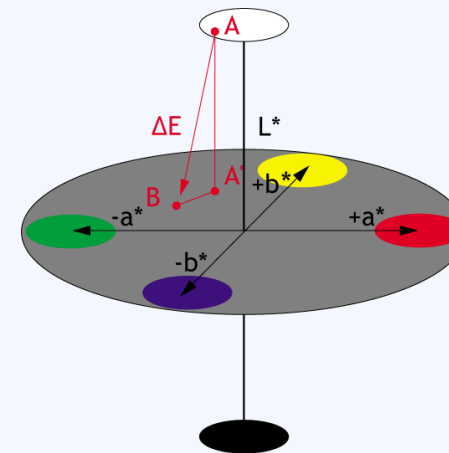
### • **Color contrast and readability:**

Inaccurate colors can impact the visibility and clarity of content, leading to eye strain as we strain to decipher text or distinguish details.



### • **Visual harmony:**

Our eyes are naturally drawn to well-balanced and pleasing color combinations. Inaccurate colors can lead to visual discomfort and fatigue as our eyes work harder to adjust to and accommodate the irregularities.



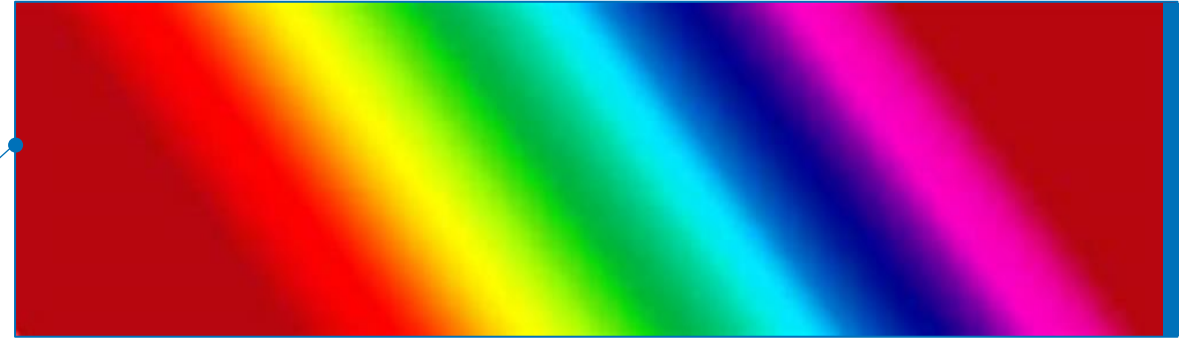
**5 star requirement:** The average value of 41 standard color difference  $\Delta E_{2000} \leq 1.5$



## > 03 Color Gamut

**Color gamut** refers to the range of colors that a monitor can display.

Monitoring color gamut is important because it directly affects the range and accuracy of colors that can be displayed on a screen or in a visual medium.



### Realism and immersion:

A wide color gamut allows for the reproduction of a broader range of colors, enabling more realistic and immersive visual experiences.



### Accuracy of color representation:

Fidelity in color reproduction reduces visual inconsistencies and helps your eyes perceive the content as intended. Inaccurate color reproduction can lead to eye strain and visual discomfort as your eyes try to make sense of the discrepancies.



### Contrast and visual hierarchy:

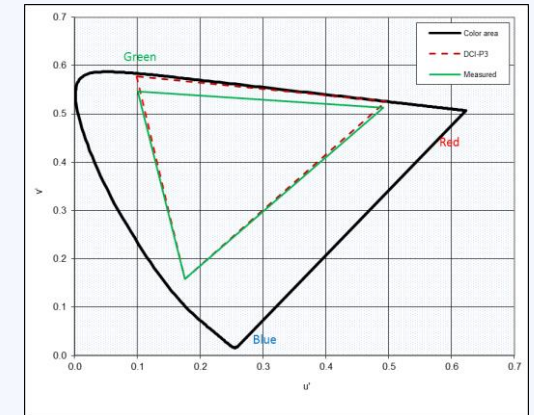
Different colors have varying levels of brightness and saturation, and accurate color reproduction enables proper differentiation and balance. This can enhance visual clarity and reduce the strain on your eyes as you view and interpret the content.



### Color harmony and aesthetics:

Accurate color reproduction ensures that colors interact in a balanced and cohesive manner.

Color	Color Gamut Coverage					
	DCI-P3 Reference color			Measured		
	u'	v'	CCT	u'	v'	CCT
D65	0.1978	0.4683	6500	0.1978	0.4683	6523
R	0.4964	0.5255		0.4914	0.5125	
G	0.0986	0.5777		0.1006	0.5467	
B	0.1754	0.1579		0.1754	0.1579	
Gamut Ratio%				91.65%		
Gamut Coverage %				75.50%		
				23		



### 5 star requirement:

DCI-P3 Min. 95% (CIE 1976) & sRGB Min. 95% (CIE 1931); or  
 Adobe RGB Min. 95% (CIE 1931) & sRGB Min. 95% (CIE 1931)

## > 04 Refresh Rate

**Refresh rate** is the number of times per second the monitor updates the image on the screen, measured in hertz (Hz).

Monitoring the refresh rate is crucial because it affects the smoothness and stability of visuals on a display



### • **Reduced eye strain:**

A higher refresh rate can reduce eye strain and fatigue, especially when viewing fast-paced content such as action-packed movies or video games. A low refresh rate can cause motion blur or judder, requiring additional effort from the eyes to track and process the visuals.



### • **Flicker reduction:**

A higher refresh rate can reduce perceived flicker on the screen. With a higher refresh rate, the time between screen updates decreases, resulting in less noticeable flickering.



### • **Improved motion clarity:**

When the refresh rate is too low, fast-moving objects or scrolling text can appear blurry or smeared, rendering it challenging for your eyes to track and read the content.

**5 star requirement:** refresh rate  $\geq$  120Hz



### • **Gaming and responsiveness:**

For gamers, a higher refresh rate can offer benefits such as improved responsiveness and reduced input lag.



### • **Eye comfort customization:**

Some displays offer variable refresh rate technologies, such as AMD FreeSync or NVIDIA G-SYNC. These technologies synchronize the refresh rate of the display with tearing and stuttering.

## > 05 Flicker Free

**Flicker** is rapid and repeated changes in brightness, typically caused by modulation of the backlight intensity.

Monitoring flicker is important to reduce eye strain and fatigue caused by the perception of flickering light.



### Minimized eye strain:

Flickering can strain your eyes as they continuously adjust to changes in brightness.



### Prevention of headaches and migraines:

Flickering can trigger headaches and migraines, particularly for individuals who are sensitive to rapid changes in light intensity.



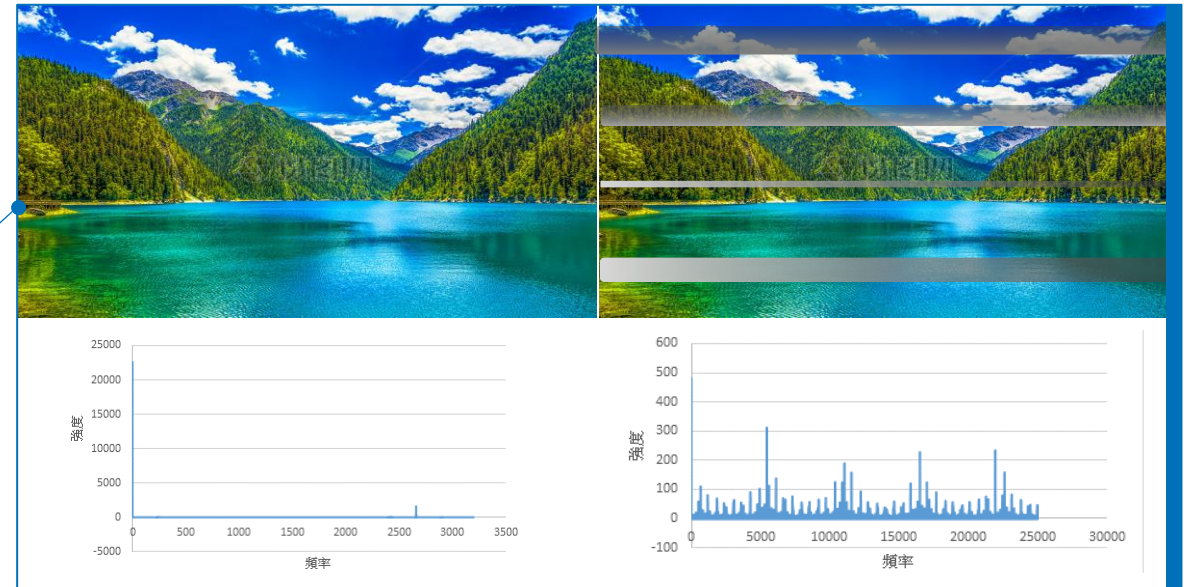
### Improved visual stability:

Flicker-free displays provide a stable and consistent light source, allowing for smoother visual perception



### Enhanced readability:

Flickering light can cause text and images to appear blurry or distorted, making it more difficult to read and comprehend information.



### 5 star requirement:

DCI-P3 Min. 95% (CIE 1976) & sRGB Min. 95% (CIE 1931); or  
Adobe RGB Min. 95% (CIE 1931) & sRGB Min. 95% (CIE 1931)



### Suitability for sensitive individuals:

Some individuals are more sensitive to flickering light than others. In particular, people with certain visual conditions, such as photophobia (light sensitivity), may find flickering light bothersome.

## > 06 Low Blue Light

Blue light is a short-wavelength, high energy light that is part of the visible light spectrum.

It is important to ensure low **blue light** to reduce eye strain, minimize potential sleep disruptions, and mitigate the potential negative effects of blue light exposure.



### Reduced eye strain:

Prolonged exposure to blue light has been associated with symptoms such as dry eyes, blurred vision, and general discomfort.



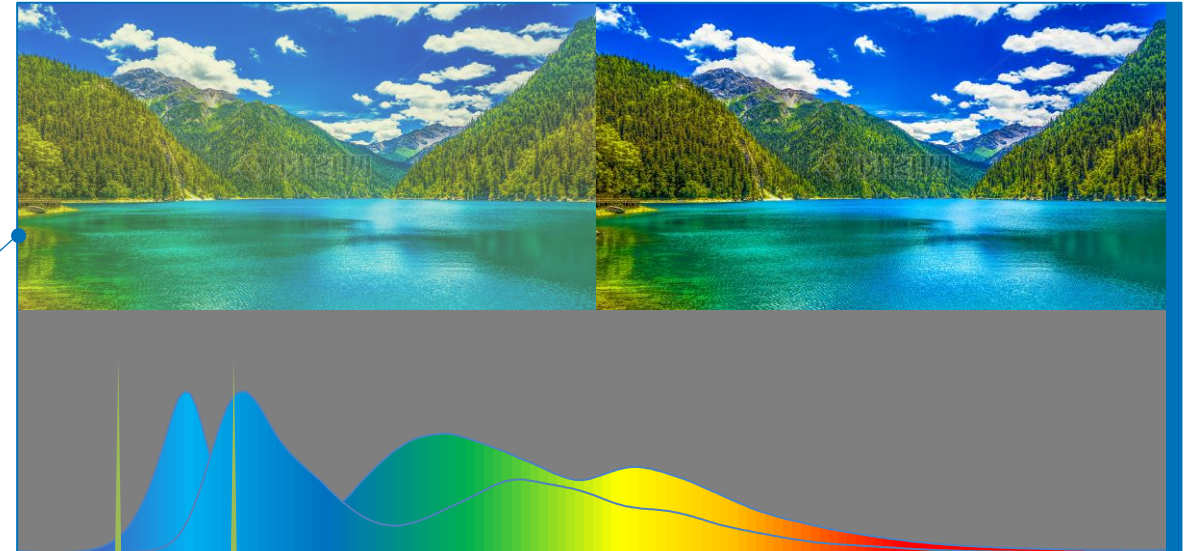
### Sleep regulation:

Blue light exposure, particularly in the evening or at night, can interfere with the natural sleep-wake cycle. In particular, blue light suppresses the production of melatonin, a hormone that helps regulate sleep.



### Protection against potential risks:

While more research is needed, some studies suggest that excessive blue light exposure may have long-term effects on eye health and increase the risk of conditions such as age-related macular degeneration.



**5 star requirement:** TÜV Hardware LBL Category II ( $\leq 35\%$ ) or Category I



### Visual comfort and clarity:

Blue light can cause visual glare and reduce contrast, making it more challenging to perceive details accurately.

# TÜV Rheinland Eye Comfort Certification Solution

“ Certipedia: TÜV Rheinland’s online database for all certificates and test scores. ”

Summaries of valid certificates are shown, including the certificate number, license holder, product identification, standard, issue date, and certificate type.

Valid test scores can be searched using the ID number, which provides access to the associated keywords, their explanations, and details of the certificate that the scores pertain to.

Although the basic entry is automatically created, additional information can be supplemented upon request, such as product pictures.



The Certipedia website in classic desktop version



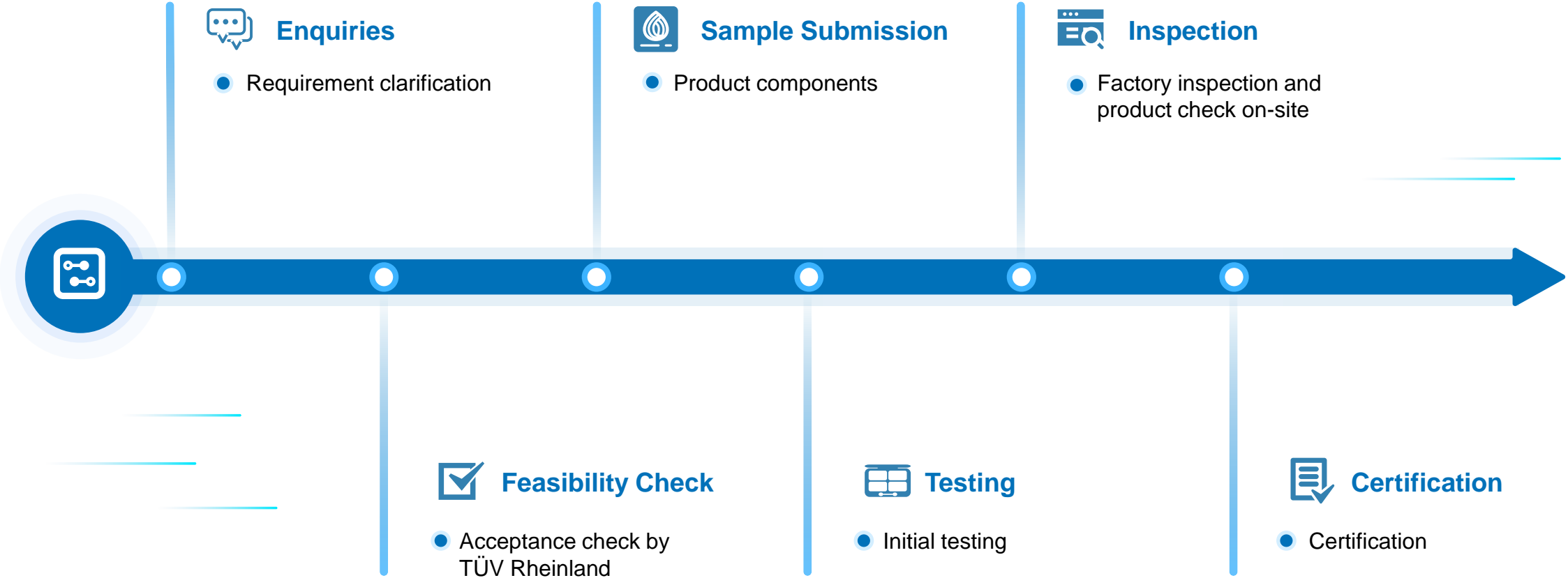
Mobile view of a Certipedia Premium entry



Mobile view of a Certipedia Basic or Plus entry

Further information about Certipedia can be found [here](#).

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“ Academic papers or research referenced for the development of standards

- ▣ Joint Research on High Refresh Rate Performance – China National Institute of Standardization, National Key Laboratory of Human Factors and Ergonomics & TÜV Rheinland
- ▣ TÜV Rheinland White Paper on Display Device Ambient Light Management
- ▣ TÜV Rheinland White Paper on Color Vision Accessibility – in Partnership with Accessibility Research Association & Chinese PLA General Hospital
- ▣ TÜV Rheinland Flicker Free Certification Solution
- ▣ TÜV Rheinland Hardware Low Blue Light Certification Solution



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# TÜV Rheinland Eye Comfort Certification Solution

Contact us now to receive a quote

<https://www.tuv.com/world/en/eye-comfort.html>



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