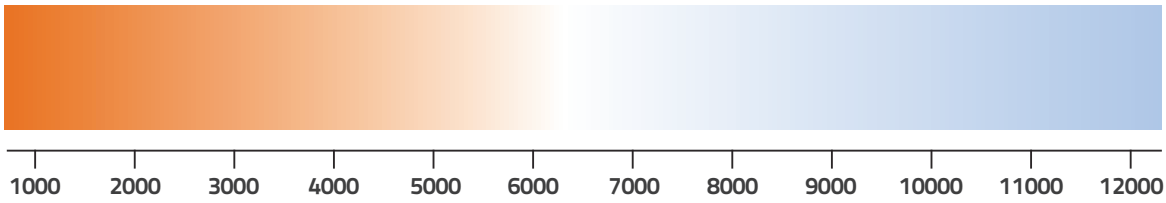
COLOUR TEMPERATURE, COLOUR RENDERING AND R VALUES

Colour temperature and rendering are key considerations when specifying your lighting installation and substantially effect both the look and feel of an area and the accuracy with which colours can be identified. Colour temperature and rendering must therefore be selected correctly in all applications whether that is to create a warm and enticing atmosphere in hospitality applications, to allow products to be highlighted to maximum effect in retail applications or most importantly to ensure that colours can be accurately identified in critical applications such as healthcare where skin and blood tones can assist accurate diagnosis. Colour rendering can also be an important consideration in maximising the efficiency of your installation.

CCT Correlated Colour Temperature

Correlated Colour Temperature or CCT is used to determine how warm or cool the lighting effect is, the lower the value the warmer the colour temperature produced. Correlated Colour Temperature is specified in degrees Kelvin, the colour of the light is equated to the colour of light produced by a black body emitter when heated to the specified temperature. Flames demonstrate this effectively where a relatively cool flame such as a match or candle produces a warm colour of light and a hot flame such as a welding torch produces a white or blue colour of light. The sun produces a colour temperature of approximately 6000 Kelvin when viewed without atmospheric interference however when viewed from earth the geographical location, time of day and atmospheric effects can cause substantial shifts in this colour temperature.

Lighting is typically offered in several fixed colour temperature options in order to manage the number of LED types that are produced, although tunable white luminaires can produce a wide range of colour temperatures by mixing two or more colour temperatures. The most commonly available colour temperatures in the UK are 3000 Kelvin, 4000 Kelvin, 5000 Kelvin, 5700 kelvin and 6500 Kelvin. The following is intended to act as a guide to typical applications in which such colour temperatures might be commonly specified:



Hues of the Planckian locus on a linear scale (values in kelvin)

3000 Kelvin:
Most commonly used where a warm environment needs to be created, 3000 Kelvin is typically used in hospitality applications such as hotels and restaurants as well as some retail applications, particularly in fashion. It is also more commonly being used in external spaces where warmer colour temperatures reduce the impact of lighting on wildlife and the human circadian rhythm. It is generally not suitable for applications such as offices, academia or healthcare where cooler temperatures are needed. Retailers may wish to consider their product range and tailor their colour temperature selection to suit, a bakery or cheese retailer for example may enhance the product appearance through the use of warmer colour temperatures.

4000 Kelvin:
The most commonly used colour temperature in the UK, 4000 Kelvin is specified in BSEN 12464 as the default colour temperature for the majority of internal workspaces. Offices, academia and most healthcare installations, indoors industrial, manufacturing, logistics applications and many retailers commonly use 4000 Kelvin colour temperatures.

5000, 5700 and 6500 Kelvin:
The cooler colour temperatures are rarely used in the UK and tend to give a bluer colouration of light, some applications in healthcare or graphics may specify these higher colour temperatures to give a closer parallel to natural daylight, usually combined with a higher Colour Rendering Index. Some retailers may have a preference for higher colour temperatures, for example pharmaceutical, to create a clean and energetic environment.

CRI Colour Rendering Index

Colour Rendering Index or CRI is entirely separate to colour temperature but is an equally important factor that must be specified when selecting your light source. Colour Rendering Index defines how effectively the human eye can define colours using natural daylight as a base line for perfect colour rendering. The Colour Rendering Index is a determined on a scale up to 100, the higher the value the better colour rendering a light source provides with 100 being the equivalent of natural daylight. It is possible for some light sources to give a negative CRI value, such as low pressure sodium where the yellow and orange colouration of the light makes accurate colour identification impossible.

It is necessary in most applications to make some compromise with Colour Rendering Index for the sake of energy efficiency, perfect colour rendition is not required in most instances and the better the colour rendering index of an LED source the lower the energy efficiency given the additional wavelengths of light that need to be produced. As with Correlated Colour Temperature, Colour Rendering Index is usually available in a fixed number of increments for the sake of manufacturing efficiency, the most common of which are below:

CRI 70:
Most suited to external applications, CRI 70 sacrifices colour accuracy for improved energy efficiency. Colour rendering is not critical for roadways, car parks and similar applications so reduced colour rendering index is used in these areas to ensure efficiency is maximised.

CRI 80:
The most commonly used Colour Rendering Index in the UK, CRI 80 is deemed acceptable for most internal applications where accurate definition of colours is not critical for users of the space. CRI 80 provides a good compromise between colour identification and energy efficiency and is used widely throughout applications such as academia and office spaces as well as many retail applications.

CRI 90:
CRI 90 is commonly used where excellent colour rendition is more important than energy consumption, such applications may be healthcare, high end retail, graphics design or displays in art galleries and museums.

CRI 95+:
Very high colour rendering index LED sources are available on the market in CRI 95 or CRI 98 at a further cost to efficiency. These would commonly be used in similar applications to CRI 90 where the best possible colour rendition is required.

R Value

More commonly R values are published in place of Colour Rendering Index. Colour Rendering Index is calculated as an average of the spectrum of light produced, therefore it is possible for a light source with a high Colour Rendering Index value to be very strong in some wavelengths and weak in others which may be problematic if specific colours need to be identified accurately. This can be especially problematic with high colour temperature luminaires such as 6500 Kelvin where the red content is lower and the blue content higher to produce the cooler colour temperature required. R values score the individual colour wavelengths allowing each part of the spectrum that the LED source produces to be fully understood. R9 is most commonly requested as this confirms the red content which is sometimes absent from cool white luminaires. The Ra value is the average of the score across each of the colour wavelengths. In the example diagram the source would still achieve an Ra value greater than 80 despite the very low red content, by using the R9 value in conjunction with Ra this can be easily identified: