SUMMARY

LED

LEDs have exceeded the majority of traditional lighting sources with regard to power consumption and lifetime running costs. With efficiency increases arriving with each new generation, which are released every 6-9 months, lumens/Watt figures have risen dramatically and continue to increase.

Colour rendering has also been improved, with LED modules now available with CRI 97+, as well as having a strong R9 value, which is the saturated red colour that was a weakness of LEDs previously, which can still be an issue in cheaper modules and luminaires.

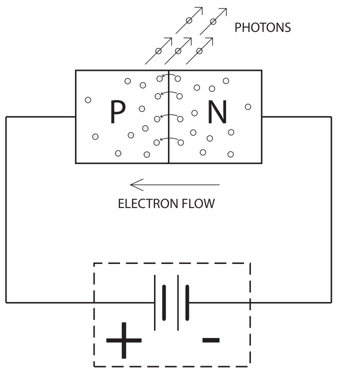
Due to their much higher luminance than traditional sources, glare is also a factor with LEDs and has to be considered during the luminaire design phase. ITAB Prolight continues to develop bespoke reflector optics, heat sinks and diffuser materials specifically designed for use with our LED luminaires. Despite the improvements in LED technology, it isn't the case the LEDs can simply be retrofitted into existing luminaires with no thought or attention to design.

How an LED works

An LED is made up of a piece of silicon, of which half has been mixed (or 'doped') with another material to become negatively charged, and the other half has been doped to create a positively charged half.

Once the voltage across the LED reaches the activation voltage (known as 'forward voltage') then current will start to flow through the LED. As electrons cross the junction between the two halves, energy is released in the form of photons.

The wavelength, i.e. colour of these photons, will depend on what material the silicon has been doped with.



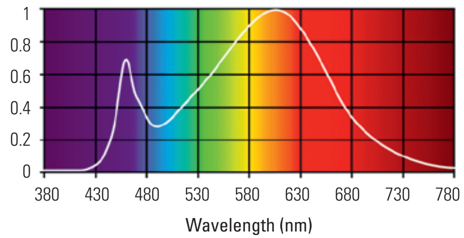
NEGATIVE HALF – Doped with impurities to give an excess of electrons

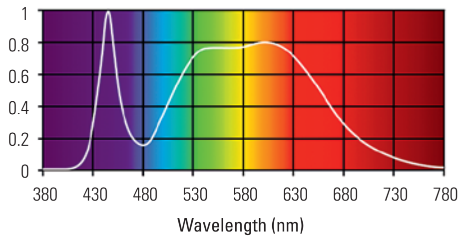
POSITIVE HALF – Doped with impurities to give an excess of holes

When current flows across the junction from the negative side to the positive, electrons recombine with holes and energy is released as photons of light.

LED manufacturers have realized the most efficient way of creating white light is to have the LED produce a very rich blue colour, and then pass this through a phosphor (the yellow coating on the top of LEDs) to create a wide spectrum white light that we can use for general lighting.

Warmer colour temperatures give less lumens per watt than cooler colour temperatures. This is because the phosphor has to be denser to convert more of the light from the original blue up to the red end of the spectrum:

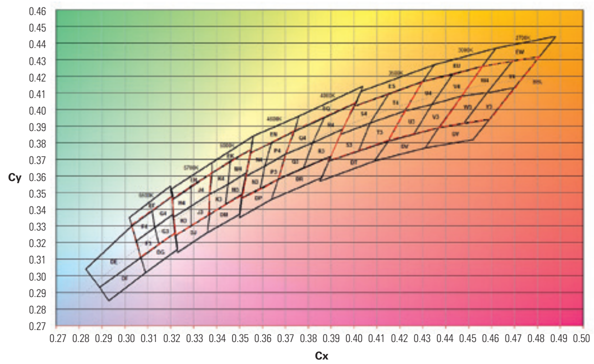




LED Binning

During the manufacture of LEDs the silicon wafer has to be cooked at 850°C with a tolerance of only +/– 0.5°C. Because of this it is incredibly difficult to ensure all LEDs have exactly the same performance and characteristics – there are still significant variations in colour temperature, lumen output and forward voltage between LEDs from the same wafer. After manufacture, all individual LEDs are tested for their variations and are grouped or 'binned' together accordingly.

From a general lighting perspective the most important way of binning is for colour temperature. The ANSI standard for a certain colour temperature allows a +/– 175 Kelvin tolerance; this equates to a 7 step MacAdams ellipse. A colour variation of this extent would be clearly visible to the human eye.



In the diagram the red dashed line shows the extent of the ANSI standard for that particular colour temperature. They are shown as being broken down into 4 bins. Most LED manufacturers will sub divide each of those by 4 again, making 16 bins/ANSI quandrangle.

Modern fluorescent lamps have a tolerance of 4 step ellipse, which is +/-100 Kelvin. Two sources at the extremes of tolerance may just be perceptible as different to the human eye.

All LEDs used in our products have a tolerance of 4 step MacAdams ellipse or less.

Colour Rendering

The current standard measurement of colour rendering (CRI) takes an average of the first 8 colour selections (as shown below), but does not take into account saturated colours, specifically R9 – red. Due to the fact that LEDs are manufactured by producing light in the blue end of the spectrum, which is then passed through a phosphor to create a broader spectrum of usable light, the R9 value can be low, yet the CRI value can be high – rendering it meaningless.

If LEDs have a low value for R9 saturated red, R11 saturated green and R12 saturated blue then installations can be left looking pale and washed out.

LEDs have improved in this regard and luminaires are available, such as our high CRI OWL panel, which has strong colour rendition throughout all samples ensuring accurate and high quality reproduction of colour:

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
High CRI OWL Panel	95	96	94	94	93	92	98	94	85	89	93	70	96	96

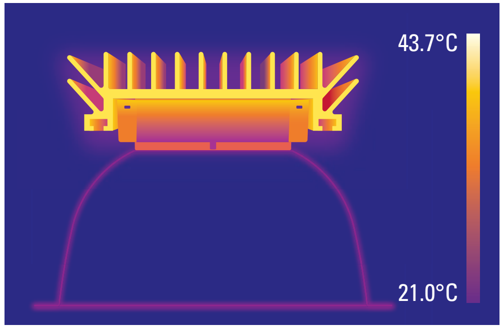
A new metric for colour rendering from the Illuminating Engineering Society, TM-30, has just been taken on board as a standard measure by the Department of Energy in the USA. TM-30 relies on separate fidelity and gamut metrics, as well as using a much larger set of colour samples that is more representative of real-world objects. TM-30 uses 99 colour samples as opposed to the 8 used for CRI.

Heat Management

Heat can affect many of the performance characteristics of LEDs. Light output of an LED will reduce as the junction temperature of the LED increases. All of our luminaires have been photometrically tested in a thermally stable state – i.e. the fitting has been turned on long enough to warm up and reach an equilibrium with the ambient air.

As the junction temperature in an LED increases, there is also a shift in the colour temperature of all LEDs. Using trusted manufacturers such as Philips, Tridonic and Samsung, we can ensure that this is kept to such a small degree as to be imperceptible.

However, overheating can cause an irreparable reduction to the lifetime of an LED and so it is critical that this aspect of luminaire design is not overlooked.



LED Warranty

1. **Products**
   This warranty applies to the LED components of luminaires supplied by ITAB Prolight UK Ltd.
2. **Duration of the guarantee**
   The guarantee period is for two years (parts and labour) from delivery to site.
3. **Extended warranty**
   The extended warranty period for LED components is for a further three years (parts only).
4. **Guarantee conditions**
   - Products have to be used according to the product and application specifications e.g. temperature or voltage limits must not be exceeded.
   - Products have to be installed by a qualified electrician, adhering to any instruction leaflets that are sent with the luminaires.
   - No modifications or alterations in any way are allowed to the luminaires.
5. **Execution of the guarantee**
   During the period of the guarantee, ITAB Prolight will endeavour to dispatch an engineer to site within five working days of receiving a fault report to repair, or replace free of charge, either the luminaire in its entirety, or any part of the product that ITAB Prolight accepts to be defective as a result of material malfunction. If the defective product is no longer available, then ITAB Prolight will provide an alternative product of similar specification and quality.
6. **Execution of the extended warranty**
   During the extended warranty, ITAB Prolight will deliver to site either a replacement luminaire, or component parts that ITAB Prolight accepts to be defective as a result of material malfunction, for a qualified engineer to replace or rework the defective luminaire on site. If the defective product is no longer available, then ITAB Prolight will provide an alternative product of similar specification and quality.
   Any costs e.g. transport for return of faulty products and costs of labour to remove existing and replace with new, are not covered by this guarantee. Replacement products or parts are supplied to the customer or to the end user free of charge.

Special warranty extensions can be agreed on a project by project basis.