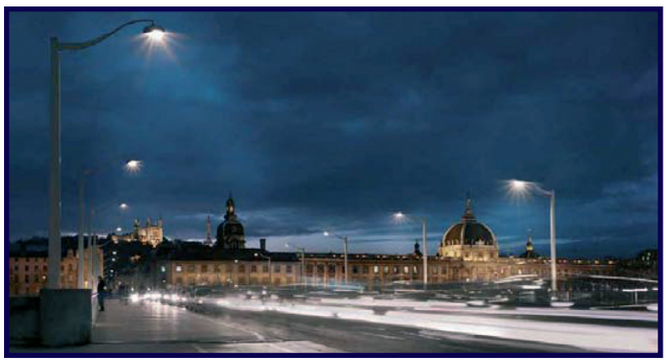
Key Aspects of LEDs

Seeing the lighting through the LED MAZE

Q & A

QUESTIONS AND ANSWERS



AIE Technical Task Force

The Key aspects of LEDs_Q and A.indd 1 11/8/2011 4:19:54 PM

Lamps already in use

In order to properly understand when to use Light Emitting Diodes technology (LEDs), it is important to take a quick look at lamps that are already commonplace.

Filament lamps

When a current is applied to a specially constructed filament, light is created. The addition of halogen gasses improve life and allow the filament to glow brighter.
These lamps are easily dimmed by simply reducing the voltage available to the lamp.
Typical efficacies sit at around 18 lumens/watt.

Fluorescent lamps

The lamp contains a mixture of gasses held at low pressure; the internal surface of the lamp is coated with phosphor. When a current is applied to the gas, a plasma is formed as the energy moves through the tube, and blue light is created. The phosphor receives the blue light, becomes energised and emits white light. These lamps run on control gear and are generally dimmed using an additional control circuit. Typical efficacies are at around 50 lumens/watt.

High Pressure Discharge lamps

The lamp has a central arc tube containing gasses at high pressure. A 4.5kV strike voltage is applied across two contacts causing a spark which excites the gas. Once up to temperature, the lamp runs on a voltage of around 100V. Typical efficacies are at around 90 lumens/watt.

So what is happening to filament lamps?

Due to their poor efficacy, filament lamps are being progressively banned within the European Union (EU). Eventually only filament lamps for specialist applications will remain.

What are they being replaced with?

Non-directional lamps such as general use tungsten filament lamps are being replaced with retrofit compact fluorescent lamps (CFLs). LED technology is increasingly being used in place of non-directional and directional filament and halogen lamps.

Are all LEDs the same?

Absolutely not! On the following pages we will look at some of the things you should be looking for from your LED if it is to do the same job as the halogen lamp you would have previously used.

So what is an LED?

There are two primary ways of producing high intensity white-light using LEDs. One is to use individual LEDs that emit three primary colours – red, green, and blue - and then mix all the colours to form white light. The other is to use a phosphor material to convert monochromatic light from a blue or UV LED to broad-spectrum white light, much in the same way a fluorescent light bulb works.

Colour temperature

The colour temperature is the measure of the ‘coolness’ or ‘warmth’ of the colour of a light source. Typically halogen lamps are regarded as 2900k. As this measurement is taken across the full spectrum of visible light, care should be taken when considering two different methods: a 3000k fluorescent lamp will often appear warmer than a 3000k Ceramic Metal Halide Lamp, for example.

The Key aspects of LEDs_Q and A.indd 2 11/8/2011 4:19:54 PM

An LED will also have a lower output at 3000k than the same wattage chip at 4200k (Cold White). However 3000k will be necessary if you are to achieve a similar lighting effect to halogen.

Colour Rendering Index

This is a measurement of the colour quality of light, done by assessing how far an object's colours under the test lamp conform to those under a CIE reference illuminant.

Originally there were eight reference colours, in categories 1A, 1B etc, with results expressed in Ra. There are now 14 colours, with results expressed in CRI and the percentage achieved. Typically, incandescent and halogen sources achieve CRI 100; a Ceramic Metal Halide Lamp will achieve CRI 85-92 and fluorescents CRI 75-85.
The higher the CRI, the lower the lumen output from an LED. It is however possible to achieve CRI of 85-95 from a good quality LED.

Heat Dissipation

The heat sink is of paramount importance, in order to obtain optimum performance from the LED chip. The heat sink will need to be integrated into the luminaire or replacement lamp unit and thermally tested to ensure that the chip runs at the design temperature.

Lumen Package

While it is now possible to achieve 3000 lumen packages within an LED luminaire, the biggest issue remains the size of the heat sink required to maintain the junction temperature of the LED chip. This is the biggest enemy of the replacement lamp market. The size of the lamp that is being replaced limits the size of the heat sink available. This in turn limits the performance of the LED chip, if it is going to last the course.

Standards of Test

The LED market remains largely unregulated with respect of life and photometric performance. There are, however, two voluntary standards LM79 & LM80.

LM80 deals with issues of lumen maintenance and life, and requires that the LEDs are tested in status attached to their final heat sink or luminaire.

LM79 has similar test requirements and covers how the initial photometric test is completed and how the performance is measured over life.

Why are these standards important?

One of the key reasons for the development of these standards is due to differences in measuring LED performance criteria.

LED manufacturers typically measure LEDs in pulse mode operation with no heat sink. The pulse is very short – typically 10 or 20 milliseconds (that is, thousandths of a second) – which will not heat up the LED; therefore no heat sink is required and TJ can be assumed to be equal to ambient temperature TA (typically held constant at 25°C). This is useful for doing high yield LED measurements quickly. This also explains why LED manufacturer data sheets typically show LED performance for TJ = 25°C.

Many manufacturers of LED products will simply quote these theoretical figures, when in fact the reality could be much different. As the temperature rises at the junction, the performance of the LED will fall. Once it exceeds the stated maximum, the chip will begin to fail.

The Key aspects of LEDs_Q and A.indd 3 11/8/2011 4:19:54 PM

What are the key benefits of LED?

- **No mercury in the light source**
- **No ultraviolet radiation**
- **No efficiency loss due to filtering**
- **Dynamic colour control**
- **Fully dimmable**
- **Instantly on**
- **Cold start capable (-40°C)**
- **Low voltage DC operation**

Is it possible to dim CFLs and LEDs?

Well, in short 'yes'. However, there is a big BUT in this simple answer; there are a few variables that could turn the 'yes' to a 'no'. Here are some things that need to be considered when looking to dim CFLs and LEDs:

• Are the fittings and lamps dimmable?
Some are, but some aren't.

• The definition of dimmable can be interpreted in many ways: Is a lamp classed as dimmable if it can be adjusted between 80% and 30% or should it be between 100% an 0%?
This definition is not always clear, so when installing a lamp it is worth checking with lamp fitting providers as to what they expect. Customers will associate dimmable with what they have come to expect from tungsten light sources, so clarity on the dimming potential of the lamp from the outset is essential.

Can halogen lamps be directly replaced with LED light sources and still be able to be dimmed?

Again, there is no simple answer to this question! The first thing to check is whether the LED light source that you are using to replace the halogen lamp is dimmable. If this is a 'yes', then you will need to take into account the minimum and maximum power handling of the dimmer, which should be marked on the outer casing of the dimmer itself. A word of advice is, if you are unsure, then check with the lamp manufacturer which light control systems they recommend for dimming the lamp in question.

What are LED drivers and how easy are they to install?

LED drivers are very similar to low voltage transformers. The 230V side is the same as traditional transformers. However, the output side can differ. Some LED drivers require the fittings to be connected in series, rather than the traditional individual cable per lamp or lamps and the LED driver itself may have control cables as well as a 230V feed. Dependent on the control method used (0-10 V, DMX or DALI), a different control cabling will be required in conjunction with the usual 230V feed.

What are some of the things to look out for when installing a lighting control system that controls LEDs?

Well for a start, look at the maximum and minimum loads on the system and ensure that they are within suitable tolerances for the LEDs you want to use. Also, think through which control method you want to use. You will also need to take into account what dimming performance the lamp and fitting provide and whether they will meet customers' expectations. It is also worth noting that LEDs & CFLs have different light characteristics to low voltage lamps, so even if the light level is stated as the same on the fitting, it may give a different perception to the end user compared to the original lamp source.

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The Key aspects of LEDs_Q and A.indd 4 11/8/2011 4:19:54 PM