Lighting ....

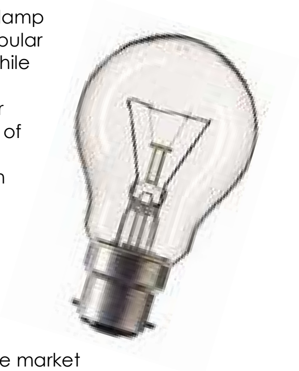
What are the options?

(Making sense of the changing lighting landscape)

With so many lighting options available it is not surprising that many people find it all rather confusing.

To best solve the question of what type of lighting best suits a particular application an understanding of the technology as well as few basic concepts are helpful.

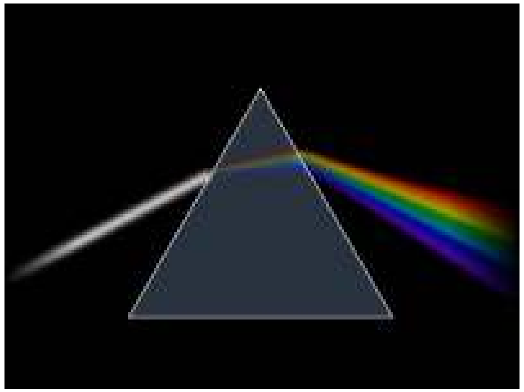
Luminaires (light fittings) will have been designed to accommodate particular lamp types – typically using a variety of standardised lamp holders – eg Bayonet Cap (BC), Small Bayonet Cap (SBC), Edison Screw (ES) and Small Edison Screw (SES). Other lamp types that have been developed include Low Voltage Bi-pin, GU10 (240v), G9 (240v), and linear halogen R7s (240v). In more recent times GX53 lamp holders have been developed specifically for compact fluorescent applications. Some luminaires have been specifically designed for fluorescent and metal halide discharge lighting applications, and have appropriate integral control gear.



The standard GLS lamp type has been popular for generations. While being cheap to manufacture, their efficiency in terms of light output is relatively poor with only 5-10% of the energy consumed being emitted as visible light. These - by and large have been withdrawn from the market as a result of the Australian Government's decision to phase out many less efficient lamp types, creating a strong demand for alternative lamp types with improved efficiency.

Self ballasted **compact fluorescent lamps** (CFLs) have become popular as a consequence as they are adaptable to most of the lamp holder types mentioned above. In most cases efficiencies are up to 5-6 times that of an incandescent lamp of same output. A high quality 20w CFL will give a similar output as a 100w GLS incandescent lamp.

A compact fluorescent lamp is best thought of as an electronic appliance. The "light bulb moment" in the development of these items was to include the ballast within the lamp. Each one therefore includes the electronic components necessary to ionise the gases within the tube which in turn activates the phosphorous lining of the tube. This helps us understand why CFLs are typically non dimmable, unless the electronics in the ballast is compatible with the electronics of the dimmer. Dimmable CFLs tend to be more expensive, as the quality of the electronic components tends to be better.



It is useful to understand that a fluorescent tube will glow at a fixed rate per centimetre. In order to get more light output a longer tube is needed. With the invention of spiral CFLs, brighter (higher output) lamps have been developed that can still be accommodated within most common luminaires.

Many people are critical of CFLs because of their slow start up time. This is a function of the electronics and the fact that the ionisation process needs to "build up". It is just what fluorescent lamps do! First impressions are not always good, but if you think to check out the lamp after a minute or two it will have improved! Generally speaking, CFLs with longer start up times will have better expected lamp lives. Fluorescent lighting is best suited for applications where lights tend to stay on for longer periods.

Colour temperature: Another aspect about fluorescent lighting (and LED's for that matter – more about these later) is the character of the light. Typically fluorescents are available in warm white (colour temperature 2700-3000K), cool white (4000K), "natural" (5000K) and daylight (6400K). The essential difference is the colour make up of the light. "Pure" white light doesn't really exist! White light when shone through a lead prism separates into the colours of the rainbow. Warm white light will have proportionally more red, while the "cooler" whites have proportionally more blue in their colour spectra. What is sometimes perceived as **brightness** is probably better thought of as **starkness**. In deciding which colour temperature is most suitable for a given application, it is useful to consider the décor, or the subject being lit. Materials of intrinsically warm colour characters structures – for example timbers, leathers, brass, and walls painted with beiges, ochres, etc will look much better when lit with warm light. Items of intrinsically cool characters, blues, greens, steel, glass etc will look cleaner when lit with cooler coloured light.

Fluorescent lamps do have limitations! The light output is very dependant on temperature. The optimum temperature for T8 fluoro tubes is 24°C while T5 tubes work best at 28°C. Luminaries for these lamp types will have been designed with this in mind. Diffusers should not be removed to "improve" light output. In many cases the performance of such fittings reduces if the tubes end up running at a sub-optimal temperature. Light output will also fall with age!

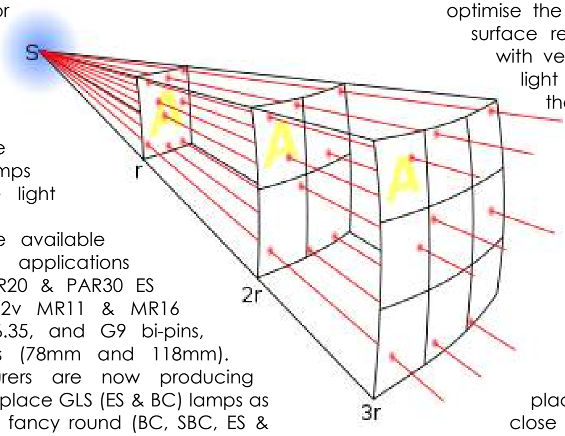
Fluorescent tubes (and several other lamp types) contain trace levels of mercury. Care should be taken therefore when disposing of old tubes. These can (and should) be recycled. When dealing with breakages, particular care should be taken, washing hands thoroughly afterwards. Ventilate affected areas thoroughly.

The quality of the ballasts will also have a big impact on the overall efficiency of a fluorescent lamp. Electronic ballasts should be selected over magnetic ballast for fittings with integral "control gear". Lamp life and light output is much improved for luminaries with electronic ballasts. Efficiency of the control gear is often referred to in terms of power factors. Electricity utilities have been keen to enforce the use of high power factor capacitors for fixed T8 fluorescent fittings. Without these capacitors, the utilities have to provide extra capacity for which they cannot charge the customer. Research shows that many CFLs also have poor power factors, in the range of 0.55 – 0.6. Dimmable CFLs it seems – due perhaps to the better quality of the electronic components – have much improved power factors around 0.9.

Halogen lamps were developed as an improvement on the basic incandescent globe. By using a halide gas in the capsule around the tungsten filament rather than a vacuum, 30% extra light output is achieved for a given wattage lamp. The filament is able to glow hotter, so the light generated has greater intensity as well as a slightly elevated colour temperature. By reducing the voltage (and increasing the current) even greater output is achieved, by virtue of the fact that in order to accommodate the increased current, the gauge of the filament has to be substantially increased. The lamp then is better built, more robust and hence longer life.

Dichroic filters were developed and incorporated into what has become the standard low voltage down light lamp of choice. Dichroic filters are able to filter out some parts of the colour spectrum – particularly infra red - while reflecting the rest. The light output from a dichroic MR16 low voltage reflector lamp will then appear clearer due to the absence of the infrared part of the spectrum which has been allowed to pass through the reflector behind the lamp. The more recent development of **infrared coated** (IRC) lamps uses the same idea, but in this case the infrared output is blocked and remains within the capsule with a resultant 60% increase in visible output.

IRC lamps are becoming more widely available in 12v MR16 format in 20w, 35w and 50w options. Wide beam spread 60° and narrower 36° beam spread options are also available. If an application calls for very high levels of light, 50w IRC lamps provide a good solution. In many applications the use of 20w IRC lamps provides adequate light output.



Halogen lamps are available for a range of applications including 240v (PAR20 & PAR30 ES and GU10) and 12v MR11 & MR16 spotlights, G4, GY6.35, and G9 bi-pins, linear halogen R7s (78mm and 118mm). Several manufacturers are now producing halogen lamps to replace GLS (ES & BC) lamps as well as candle and fancy round (BC, SBC, ES & SES configurations). In addition to producing a high quality light, they are dimmable which will save energy consumption as well as extending lamp life.

The efficacy of any source of light can be described by the **inverse square law** - which describes dissipation of intensity with distance. The tyranny of distance (i.e. high ceilings) is hugely important in deciding what type of luminaire will provide adequate lighting. For every doubling of the distance light travels, its intensity will reduce by a factor of four.
Spot lights and recessed down lights should be thought of as task lights where the light output from the lamp is directed at a certain subject or to illuminate a particular work surface. Because of the effects of the inverse square law the greater the distance between the light source and the illuminated subject, the less effective the light will seem. This problem can be solved in several ways:

- The light source can be brought closer to the subject
- A lamp with a more focused beam can be used
- A lamp of greater output can be used

When a space is illuminated with a series of down lights, the lighting task has been divided into a number of separate components. In designing a lighting plan involving extensive use of such light fittings, care should be taken to highlight the various subjects that will optimise the effect. A well lit dark surface remains a dark surface with very little of the incident light reflecting and filling in the other parts of the space. Directing spotlights on to highly reflective surfaces, by for example deliberately placing them close to light coloured walls, will create a better effect. It may then prove possible to light a space with fewer well chosen light sources, rather than slavishly creating a grid pattern on the ceiling.

When considering LED (**light emitting diode**) technology, many of the same considerations apply. The output from an LED chip is a point source, and as such can be focused well so becomes a useful alternative to other point sources of light, for example halogen spotlights. Low powered LED chips can be presented in an array (hedgehog effect), or incorporated into strip lighting – to good effect.

In contrast to other lighting technologies, LEDs run on DC (direct current) drivers or power sources. Unlike fluorescent lighting options, LED light output is less affected by extremes in ambient temperature operating reliably in a range of -20°C to 80°C.

High powered LEDs, as with all light sources, generate significant amounts of heat in addition to light. This heat is proportionately less than for incandescent and halogen lamps, but is significant never the less. The problem is solved by engineering heat sinks into the lamp module. Higher output chips require larger and more complex heat sink design, so applications such as replacing a standard MR16 halogen will have limited output. Typically these MR16 (low voltage) replacement lamps will have a power draw of 3 – 5watts. The capacity of the transformer may become an issue when re-lamping an existing installation. Many electronic transformers will have an operating range of 20-60vA. The low current draw from an LED may not be enough for the transformer to work.

Voltage driven LED devices are a compromise. They have simple inbuilt drivers and have been adapted to a wide range of lamp holder types for existing fittings. Such lamps will not have the capacity for dimming. To achieve the most from an LED system a sperate suitably matched constant current driver needs to be utilised. Such a system can then have much increased output as well as the option of being dimmable.

LEDs are electronic products, so there is great potential for special effects, particularly in changing colour. By controlling the levels of the primary colours – red, green and blue (RGB) an infinite variety of colour can be achieved which can be projected into a space.

White light options are typically high colour temperature 6000K, though warmer whites (3400K) are also available. They are well suited to landscape lighting applications. The driver can be at some distance from the lamp assembly. Unlike constant voltage (12v) systems where voltage drop becomes a restricting factor with long cable runs, constant current systems are designed to maintain the current flow regardless of the length of run. Installation costs are much less, negating the need to run heavy gauge cables.

Still confused?

Contact Design Lighting (info@designlighting.com.au, ph 03 6334 1092, or fax 03 6334 2657) for more information, and we can also help you with the next step, which is in selecting your light fittings!

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