GUIDE TO LIGHTING BEST PRACTICE
FOR THE BRC GLOBAL STANDARD
FOR FOOD SAFETY

ISSUE 2
The Society of Light & Lighting (SLL) is the UK’s leading authority on interior lighting and produces the UK’s Code for Lighting as well as The Lighting Handbook and a series of Lighting Guides to specific building types and sectors.

The Society welcomes this BRC Global Standards guide as a way of promoting understanding of lighting technology and how it can be used to enhance the use of lighting for its Certificated Suppliers. Used correctly, lighting can enhance a space and improve productivity and safety; used badly it can lead to potential contamination and product recall, as well as increased energy and maintenance costs.

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GUIDE TO LIGHTING BEST PRACTICE FOR THE BRC GLOBAL STANDARD FOR FOOD SAFETY

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1.0 INTRODUCTION

The BRC Global Standard requires companies to ensure that there is adequate lighting throughout their sites so that staff can perform correct operations of processes as well as monitor quality and product defects. For details of recommended lighting levels please see page 24 of this guide.

Certificated sites must assess where light bulbs and strip lights pose a risk (e.g. where they are in close proximity to production, storage areas or staff facilities) as these will need to be protected against breakage. Consideration must be given to all types of lighting in order to minimise the likelihood of breakage and the spread of glass or brittle plastic.

The aim of these guidelines is to aid individuals and companies to develop robust systems and procedures which adequately meet the requirements of the Standard. However, the practical implementation of the Standard, and whether the resulting systems are deemed as conforming or non-conforming by the auditor carrying out a BRC Global Standards audit, is an objective judgement, based on the evidence collected and observations made during the audit.

2.0 AVOIDING GLASS AND PLASTIC CONTAMINATION - BEST PRACTICE

There are two key areas to consider when avoiding product contamination from lighting:

1) Lamps and glass covers
2) Removable plastic components

2.1 LAMPS AND GLASS COVERS

Routine maintenance when diffuser covers are removed and glass lamps are handled is the critical step in preventing product cross-contamination with broken lighting. A simple mishandling accident can result in potential widespread glass contamination and possible financial impact. Therefore, the use of fragment retention lamps (sometimes called shatter-proof lamps) is highly recommended wherever possible, to significantly reduce the risk to controllable levels. As a minimum, these should be installed in all areas where there is open product or the potential for contamination exists. Alternatively, an across site policy for fragment retention lamps is recommended as best practice.

Where glass covers are present, these should either be treated with a fragment retention film covering or replaced with plastic versions, if available. This should also be taken into account when purchasing new luminaires.

2.2 REMOVABLE PLASTIC COMPONENTS

Where diffuser covers are used with fluorescent lighting (IP65) and high bay / low bay high intensity discharge (HID) lighting, it is recommended, wherever possible, that metal retaining clips are used instead of plastic to hold them in place. This significantly increases detection levels of any lost clips through wear and tear (most sites have a metal detector checking products). Cracked or heavily discoloured diffuser covers can lead to water and dust ingress to the luminaire, significantly reducing light levels. These should be routinely replaced. This also reduces the shedding of brittle particles in situ and during periods of maintenance when handled.

Where applicable, open rated (batten or diffuser-less) luminaires with fragment retention lamps should be considered. This eliminates the use of small clips combined with minimal removable outer parts.
2.3 PRACTICAL CONSIDERATIONS WHEN CHANGING LIGHT BULBS

All maintenance should be carried out by a responsible, qualified person, or an outside contractor.

- Complete area re-lamping with planned maintenance can be more cost effective compared to continual spot replacement. A bulk re-lamping program prevents varied illuminance levels and also maximises lamp service life. For production areas, planned maintenance is recommended (where possible) during periods of shut down or when production has stopped. This reduces the risk of potential product contamination from falling debris.

- If operating with fluorescent switch start luminaires it is recommended that the electronic starter be replaced when new lamps are installed. This helps to maximise lamp service life and reduce further maintenance between re-lamps.

- Always ensure correct lifting equipment is used for elevated environments and operated by a qualified, responsible person.

- Where possible, transport all lamps in their original packaging and do not remove until installation.

2.4 MANAGING BREAKAGES

You should have a documented breakage procedure detailing the course of action to be taken when a breakage of glass, brittle or hard plastic occurs. This should be based on risk assessment, so the action taken may depend on the area in which the breakage occurs and should include:

- Isolation and inspection of potentially contaminated product (raw materials, packaging, final product, equipment)

- Isolation of potentially contaminated area (in the case of lighting it will be necessary to consider where it fell from)

- How to clear up the broken item

- How to clean the area and which cleaning equipment to use - this is important to ensure that glass particles are not transferred on equipment from one area to another

- How to dispose of debris

- Inspection of the area after cleaning and the authorisation to re-commence normal activities

- Inspection and changing of footwear and workwear of staff who have been in the implicated area since the breakage occurred

- Who to inform

- Records to keep

- Management of implicated product (e.g. product disposal)

- Identification of authorised staff to complete the above actions
3.0 DIFFERENT TYPES OF INDUSTRIAL LED LIGHTING

3.1 LED TUBES (FLUORESCENT RETRO-FIT)

Installing retro-fit LED tubes are a great way to save energy and can provide long term financial savings. The majority of LED retro-fit tubes will be manufactured from either plastic or glass and both designs in their standard form have some limitations. It is recommended that fragment retention (externally coated) versions are used which comply with Class A of IEC 61549 (EN61549) for the following reasons:

1). Glass versions on impact will cause widespread contamination similar to an unprotected fluorescent lamp.
2). Plastic versions on impact may cause the shedding of undetectable plastic parts.
3). Plastic versions operated in open batten configuration may deteriorate when subject to long term cleaning /chemical exposure.

Different types of LED retro-fit tubes

There are currently two different types of LED retro-fit tubes.

1). Direct mains voltage operation for magnetic ballast / control or no control gear.
2). High Frequency (HF) version for operation on electronic ballast / control gear.

3.2 INSTALLATION

When installing LED retro-fit tubes into fluorescent luminaires consideration should be given to the safety of the procedure. For starter-less magnetic control gear a wiring modification will be necessary by a suitably qualified person and care should be taken to avoid the shedding of particles. For magnetic control gear incorporating a starter, a simple change-over can be made by installing the tube and replacing the electronic starter with a dummy starter which is usually supplied with each tube. High Frequency retro-fit LED tubes can be installed directly without any modifications or parts to replace.

3.3 LUMEN OUTPUT AND SERVICE LIFE

When considering or installing LED retro-fit tubes in high risk areas first check that the Lumen output and light distribution pattern is compatible to the source that is being replaced. Consideration should be given to achieving acceptable lighting and distribution levels to avoid any Health & Safety issues.

Consideration should also be given to the Lumen maintenance (light reduction over time) as this performance will vary with different manufacturers. Fluorescent lamps, for example, will reduce in output by 10% over service life compared to 30% typically for LED tubes. It is therefore recommended that manufacturer’s specification data sheets are checked before any installation. In addition, temperature characteristics of the light source and environment will need to be matched. This is particularly relevant in cold room environments.

3.4 CE MARKING AND Fixture OWNERSHIP POST MODIFICATION

After completing any LED retro-fit tube installation the original equipment manufacturer of the luminaire will no longer be responsible for the performance and CE marking. Ownership will be automatically transferred to the user or the person making the modification.
3.5 LIGHT DISTRIBUTION

Most LED tubes emit light in one direction with a beam angle of typically 160°. When located in an existing fluorescent luminaire they may not provide the same light distribution over the working area below. This may lead to dark spots or stripes which could cause a potential safety hazard. It is therefore recommended that an assessment or trial is carried out before completing a full installation. LED retro-fit tubes manufactured with rotating end caps allow beam angle adjustment and can provide further flexibility to direct light where it is mostly required. This can be beneficial for inspection areas, above machinery and gangways.

3.6 LED LUMINAires

**IP65 enclosed and high and low bay luminaires with non-replaceable integrated board or driver**

There are many non-corrosive IP65 enclosed and high & low Bay luminaires currently on the market which are designed to replace conventional linear fluorescent, metal halide and sodium technology. However, some are designed and manufactured in such a way that the user cannot replace the drivers or LED boards (sealed unit or riveted LED boards). This means the complete luminaire has to be replaced and disposed of when the LED light source fails. While this may suit some users and applications, cost of ownership can be greatly impaired due to repetitive complete luminaire replacement and installation costs. It is therefore recommended that Certificated Sites check manufacturer’s specifications regarding the access of replacement LED boards and drivers. In typical moderate operating environments the majority of luminaire bodies and diffusers typically have a service life of 10 years or more, therefore a false economy can be experienced by the inability to replace spent LED boards and drivers (where as by comparison fluorescent and discharge lamps and ballasts can be replaced).

This picture shows the inside of a LED luminaire where the LED boards are not accessible. This LED luminaire therefore has a non-replaceable light source. Manufacturer’s product data sheets should confirm if the light source is replaceable or not.

**IP65 enclosed and high and low bay luminaires with replaceable boards and drivers**

Luminaires designed with simple user access to replace end of life LED boards and drivers offer an effective solution with an improved cost of ownership. Components can be replaced, similar to that of conventional lighting technology, and can offer longer term savings by not requiring a complete fixture replacement. This is particularly relevant with expensive stainless steel luminaires. There are specialist luminaire supplier’s that can offer a LED board and driver refurbishment service.
It is recommended that manufacturer’s specifications are thoroughly checked with regard to access and maintenance as sometimes special fasteners are used by the manufacturer which prohibits removal of LED boards and drivers using standard tooling. It is also recommended that Certificated Sites choose luminaires from reputable well established manufacturers or importers. Risk of replacement components becoming obsolete or the supplier ceasing to trade post installation should be considered and taken into account before purchase.
IP65 open rated luminaires with Fragment Retention Coated LED tubes

Open Rated IP65 luminaires with Fragment Retention Coated LED Tubes offer an effective lighting solution for many production areas and cold rooms. They are simple to maintain and offer excellent cost of ownership with no diffuser, clips and separate LED boards or drivers to replace. As direct mains voltage LED tubes also house the driver, only simple tube replacements are required at end of life. Due to the open rated configuration of the fixture, instant access to the LED tube is straight forward. LED tube versions with rotating end caps (ROT) can also benefit users as the beam angle can be adjusted to direct light where it is required. Applications include elevated walkways over machinery, gangways, inspection stations and quality control areas. It is recommended that manufacturer’s specifications are checked, including the Fragment Retention Coating, as some plastics may not be suited to aggressive environments or where chemicals are present. Fragment Retention LED tubes carrying a single black band ring comply with IEC- 62776 Industry Standard. It is also recommended that Certificated Sites choose luminaires from reputable well established manufacturers or importers. Risk of replacement components becoming obsolete or the supplier ceasing to trade post installation should be considered and taken into account before purchase.
3.7 CONSTRUCTION AND PERFORMANCE OF LED LUMINAIRES

For production and high risk areas choose luminaires that are fit for purpose and will meet the operating conditions of the environment. Luminaires should be easy to clean and not harbour dirt or dust.

Where possible choose luminaires with minimal working parts (no clips or diffusers). Open rated IP65 luminaires with fragment retention coated LED tubes or fluorescent lamps manufactured to IEC 61549 (EN 61549) are a good solution for many applications. Where enclosed (diffused) luminaires are chosen, they should be fitted with stainless steel and not plastic clips.

Both open and enclosed linear fluorescent and LED tube luminaires should incorporate fragment retention coated lamps manufactured to IEC 61549 (EN 61549).

Standard plastic bodied luminaire designs based around linear fluorescent, and now LED boards or retrofit tubes, manufactured from GRP perform better in demanding or corrosive environments. For extremely aggressive environments luminaire bodies manufactured from stainless steel will offer the best performance.

316L food grade stainless steel luminaires offer the best protection against chemical cleaning regimes and or corrosive atmospheric vapours caused during food processing. Unlike plastic or painted steel bodied luminaires risk of particle shedding is also significantly reduced ensuring audit compliance. Certificated Sites are recommended to install stainless steel fixtures with a Fluoro Polymer (FEP or PFA) treated diffuser or cover.

Whilst initial upfront costs can be higher than plastic bodied luminaires, stainless steel products offer significant savings due to extended life and minimal maintenance.

For warehouse and storage areas consideration should be given to light distribution, especially between aisles where there is fork truck operation and movement of personnel. Choose luminaires that will provide even collimated light at the correct beam angle. Most reputable manufacturers will offer a lighting design service to ensure correct light levels are achieved without compromising Health & Safety issues.
3.8 LIGHTING CONTROLS - MOTION AND DAYLIGHT SENSORS

Further energy reductions can be achieved with the introduction of motion and daylight sensors. For example in applications such as storage rooms or warehousing where staff are not present for extended periods the installation of motion sensors can provide further savings and automatically switch off luminaires when staff are not present. Delay times can be programmed to as little as a few seconds or up to several hours after the area becomes vacant.

Note: the system must be carefully designed so that the light source cannot be suddenly extinguished whilst people are present.

For applications where natural daylight is present, the introduction of dimming sensors can produce further energy savings. Daylight dimming sensors increase and decrease the output of the luminaire automatically as natural light increases and decreases. These sensors can be programmed to maintain a designated task lighting level and will automatically compensate for dirt build-up on windows or skylights. Energy savings of 30% are possible in some installations.

Where motion sensor and daylight dimming can be combined, significant energy savings are achievable with relatively low-cost investment.

3.9 PERFORMANCE OF LED BASED LUMINAIRES

Rated life and light level depreciation claims by some LED manufacturers have been varied since the technology was introduced. This has caused uncertainty for users in how to evaluate true luminaire performance and reliability.

However, leading manufacturers have now published a technical standard to assist users in making the correct choice. This is in conjunction with the IEC standards who recently developed and published specific performance standards for LED based luminaires.

An example is a White Paper from Philips Lighting: Evaluating Performance of LED Based Luminaires. The following text is based on the standards and information given in the Philips Lighting White Paper.


You may see such published statements such as L80 B50 and wonder what this means. Below is a simple guide to understanding the performance and service life of LED luminaires.

The gradual light output degradation of a LED luminaire at a certain point in time is called Useful Life and is generally expressed as LxBy. Useful Life describes the lumen maintenance of an LED luminaire over time.

LxBy means the length of time during which y% of the population of operating LED luminaires of the same type fail to provide at least x% of the initial luminous flux. ‘Lx’ describes lumen maintenance: L80 means that these specific luminaires still give 80% of their initial lighting output.
‘By’ describes for what percentage of the population that is true. For example L80 B50 reflects the age (in hours) at which 50% of the population have failed parametrically. Parametrically is defined as a luminaire producing less than 80% of its initial flux but still operating.

Below is a typical example of performance information found on a product datasheet and what it means.

• Luminous flux: 5,000 lumen
• Median Life: 50,000 hours
• L80 B50

Luminous flux is the initial light output expressed in lumen.

Median Life is the point at which we have as many luminaires with light level degradation below 20% (L80) as we do above it. In this example median life is 50,000 hours.

L80 B50 means that at 50,000 hours (median life) 50% of the luminaires have greater than 80% of their initial light output (5,000 lumen) and 50% have less than 80% of their initial light output.

Therefore, at 50,000 hours 50% of the luminaires will have >4,000 lumen and 50% will have less than <4,000 lumen.

Within the IEC standards the above is defined as Useful Life.

Note: L70 to L90 without a quoted B rating are all B50 by definition.

Before choosing LED based luminaires or tubes, Certificated Sites are recommended to check the manufacturer’s technical specifications for the L & B ratings. Care should be taken with manufacturers who have no, or only partial supporting data.
3.10 ENVIRONMENT & TEMPERATURE

The performance and service life of LED Lighting can be affected by the environment that they are operated in. Manufacturer’s specifications are typically written with reference to testing in +25°C ambient conditions which covers many general applications. However, in applications where ambient temperatures exceed +40°C, a reduction in service life and output can be experienced. Manufacturers published operating temperature ranges do not always make reference to ambient temperature. It is therefore recommended that Certificated Sites thoroughly check specification data sheets when choosing LED lighting in elevated temperature applications. For low ambient temperature applications the performance of LED technology remains very stable. Service life is not impaired and it remains a good choice of lighting.

3.11 GLARE & OPTICAL PERFORMANCE

Glare is the sensation produced by luminance within the visual field that is sufficiently greater than the luminance to which the eyes are adapted. This can cause annoyance, discomfort or loss in visual performance and visibility. As the output from LED’s are very directional and often high intensity, choosing lighting fixtures without the presence of optical control could result in problems with ‘discomfort’ glare in the workplace.

It is recommended that Certificated Sites choose fit for purpose LED luminaires and tubes with adequate optical control to reduce the risk of excess glare. Responsible manufacturers will offer lighting design schemes which are designed to meet industry standards and will be able to select appropriate designs suitable for specific applications.

Above are examples of LED luminaires incorporating different methods of light and glare control.

The left hand image shows the use of a high quality mirror finish reflector to efficiently manage light output.

Luminaires with high quality reflectors will generate better light output and distribution than those without. It should be noted that when choosing a LED luminaire and comparing different products that lumen efficacy (lumens/watt) should be judged on the actual luminance generated by the luminaire, not by the LED light source as these will always be different.

The right hand image shows a ‘Diamond’ prism controller used to control and reduce glare.

Both a high quality reflector and prismatic controller can be employed to effectively manage light output and glare.
3.12 Cleaning and Performance

The IP rating performance of lighting fixtures are based on industry tests within IEC 60529 Standard. Products which pass the relevant test rating to which they were tested to are then published to allow end users to select the correct product for the application.

The commonly used IP65 rated range of lighting fixtures are known to be waterproof and dust proof. However, it is important to understand that there are limitations to the level of protection against water ingress when deep cleaning. For example, the IP65 industry standard water test is carried out using a jet nozzle that splashes a volume flow of 12.5 litres per minute. This is from a distance of 2.5 - 3 metres onto the housing from all directions for at least 3 minutes.

Lighting Industry Acceptance conditions:

Water that may have penetrated may not be present to a level that the good working order of the operating material or the safety is impaired. Also, it may not be deposited on insulating parts where it could lead to creep currents, or come into contact with live parts or coils that are unsuitable for operation in wet conditions or collect near the line end or possibly penetrate into the lines.

Advice to Certificated Sites

The use of pressurized water, especially at close range, to deep clean standard IP65 rated luminaires could cause premature failure due to water ingress. It is therefore recommended that IP rated luminaires matched to the environment and cleaning regime are used. Your lighting manufacturer representative can advise the most appropriate luminaire.

Please see our guide to luminaire ratings in section 7 later in this publication.
4.0 FLUORESCENT LAMPS

IEC 61549 (EN 61549) Standard for fragment retention lamps (FRLs) has been in effect since April 2013. The Standard is designed to assist electrical contractors, distributors, end users and certification bodies in identifying and choosing fit for purpose products that will provide a level of performance which satisfies the requirements for glass fragment retention, in applications where risk of contamination from accidental breakage requires control.

4.1 IDENTIFICATION AND PRODUCT CLASSES – IEC 61549 (EN 61549) STANDARD

There are two product classes within IEC 61549 (EN 61549) Standard for fragment retention fluorescent lamps. Class A = Single Band and Class B = Double Bands. Class A has a higher performance over Class B and can be operated in both open and totally enclosed luminaires, while Class B products can only be operated in open rated (batten) luminaires.

Observation of the band type is therefore important when considering the application and environment. Single band fragment retention lamps (FRLs) will typically perform better in more demanding industrial applications such as bakeries and cooked foods areas where elevated ambient temperatures can be experienced and totally enclosed luminaires are installed.

Class B products typically have a lower thermal threshold and should only be considered for open rated luminaire operation. If an application does have elevated ambient temperatures check the manufacturer’s technical data sheet for suitability.

Class A compliance marking

Class B compliance marking

Both product classes meet a 4 metre impact test which is a requirement of IEC 61549 (EN 61549) Standard.

4.2 NON-COMPLIANT PRODUCTS

- Products with no visible lamp band
- Less than 8,000 hours coating service life
- No supporting performance data
Examples of poor quality performance

Split coating upon impact, caused by the plastic being too thin and becoming brittle when operated in an enclosed IP65 fitting

Split coating and ejection of cap upon impact, caused by the plastic being unable to withstand the higher temperatures experienced at the lamp end caps

Poor thermal stability, caused by the plastic being unable to withstand the higher temperatures experienced when operated on switch start fittings (lamps flashing at end of life)
4.3 INCORRECT INSTALLATION

Incorrect product installation can lead to premature failure and potential Health and Safety issues for the user. In severe cases this can also cause the shedding of plastic particles and be a potential fire risk.

An example of rapid polymer deterioration due to excessive heat:

![Image of polymer deterioration]

It is important to select the correct product class with the application. Always check the manufacturer’s technical data sheet for use in demanding environments.

Incorrect product installation can potentially lead to:

- Ineffective glass fragment retention on impact
- Contamination issues through the shedding of particles
- Fire risk

4.4 KEY POINT SUMMARY

- Fragment retention lamps (FRLs) manufactured to IEC 61549 (EN 61549) Standard offer an optimum level of performance
- Mark of compliance demonstrated by either single or twin band lamp marking at one end
- Single or twin band determines level of performance and suitability for application
- Meet 4 metre impact test onto a flat surface
- Coating life can vary. Check manufacturers data sheet before installation
- Be wary of products not carrying official markings or backed up with any technical data sheets

5.0 HIGH INTENSITY DISCHARGE LAMPS (HID) METAL HALIDE, SODIUM AND MERCURY

HID lamps are designed to provide high light output from a compact single source and are typically used in warehousing and distribution applications for ceiling heights over 6 metres. When incorporated into high bay and low bay luminaires they can offer a good solution, for example, for aisle area illumination and areas between storage racking.

Elliptical lamps with Quartz arc-tube metal halide in fragment retention versions for high bay applications (vertical burning) should be used, where possible, over sodium or mercury types. Elliptical metal halide lamps will provide white light compared to high pressure sodium types which emit golden yellow light but have longer operational life. In the EU, mercury lamps will be banned from 2015 under the Energy Related Products Directive and should not be used.
Example of elliptical lamp in base up (BU) position

Note: Where possible, the use of tubular lamps should be avoided due to outer jacket glass temperatures reaching up to 400°C when operated in the horizontal burning position. Current fragment retention technology allows up to 270°C continuous service. This allows the use of elliptical lamps in the base up (BU) vertical burning position for high bay luminaires (elliptical lamps typically operate at 220°C).

5.1 ELLIPTICAL QUARTZ METAL HALIDE LAMPS (WHITE LIGHT)

Where possible, elliptical fragment retention (PFA coated) Quartz arc-tubemetal halide lamps should be used to reduce the risk of glass contamination in the event of accidental breakage. All lamps should be operated in the vertical burning position (lamp base up). Most high bay luminaires offer this lamp position and provide a good source of light for warehousing applications.

Fragment retention elliptical metal halide lamps provide a good high colour rendering index utilising a crisp white light and some can be directly retro-fitted into some luminaires designed to use a high pressure sodium lamp. It is essential to check that the circuit is compatible with the lamp operation. Do not operate fragment retention elliptical metal halide lamps in a horizontal position as this will generate a high temperature hotspot on the top side of the outer glass envelope in excess of 270°C causing premature coating failure.
6.0 INVESTING IN NEW LIGHTING

In section three we discussed the different types of industrial LED lighting. It may be that you are now thinking about investing in new lighting. Below is some guidance on what should be considered before embarking on any new lighting installation.

What is the objective?
If your lighting objective consists of all of the below, and it should, the starting point should be assessing what is taking place in the current environment and what changes, if any are on the horizon.
- Achieving optimum lighting for the environment
- Energy reduction
- Maintenance reduction
- Health and Safety
- Productivity

Alternatively you may be commencing a ‘new build’ and the above will apply.

A well-defined objective and plan supported by a reputable lighting supplier will help ensure a quality lighting scheme.

Environment
Below are some example considerations.
- What are (or will be) the tasks being performed and conditions of the environment?
- How well does my existing lighting enable staff to perform tasks safely and productively and what, if any, lighting improvements could be made?
- What, if any planned changes are there to the environment?
- Warehouse – Racking upgrade or re-positioning?
- Production Hall – Machinery upgrade?

Energy
A lot of emphasis is put on the energy consumption of one luminaire compared to another as this is the simplest comparison to make.

In reality, energy is one element of a quality lighting scheme and should be treated as such.

For example, your current lighting consists of 400w metal halide high bays operating five days a week at twelve hours a day.

You are offered a 235w LED alternative offering a 41% energy cost reduction.

However, this environment is not occupied much of the time and the reason you leave the lighting on is because of the long re-strike times associated with these types of lamp.

An alternative could be a luminaire with lighting controls which would further reduce energy consumption, improve payback period and offer increased service life.
**Maintenance**
Luminaire maintenance is a consequence of its design and operating environment.

A luminaire with a replaceable light source will likely incur fewer costs throughout its service life than one with non-replaceable parts.

In addition, a luminaire with fewer replaceable components will be easy to diagnose and reduce maintenance costs.

Critically important is to match the luminaire to its operating environment. Frequent intense or chemical cleaning regimes can significantly shorten the life of an ill-matched luminaire.

Ingress protection (IP) ratings and luminaire materials should be correctly matched to the operating environment.

**Light quality**
In section 3.9 the performance of LED based luminaires was discussed, in particular rated life and light level depreciation. In essence, a luminaire of good design with quality components offers the best chance of a quality optimised lighting scheme.

In addition and just as important is a detailed survey of the environment and the tasks being performed within it? It might be that whilst the majority of the environment, for example a production hall requires 500 lux, there may be some specific areas requiring greater lighting levels. An example could be an inspection area where a light level nearer to 1,000 lux is required.

More on light source and its effects on well-being and productivity are covered in the ‘Productivity’ section.

It is your opportunity when investing in new lighting to be specific about your needs. Many environments change over their life and it may be that the current floor arrangement does not match the existing lighting. This is particularly common in industrial environments where either machinery or storage racking has been changed to accommodate business needs.
Health and Safety
A good starting point for identifying potential health and safety issues is assessing existing light levels. Whilst there are no current legally required lighting levels, the Society of Light & Lighting (SLL), which is part of the Chartered Institute of Building Services Engineers (CIBSIE), publishes The SLL Code of recommended light levels. These can be found in section nine of this guide.

Once a recommended lighting level has been established and agreed your preferred quality lighting supplier can advise the best luminaire for the environment and its tasks.

Productivity
When considering LED lighting it is important to factor in how it will affect staff well-being and productivity.

A well-lit working environment will invariably produce better working conditions and productivity.

An integral part of a well-lit environment is what is known as ‘uniformity’. In its simplest terms, uniformity is how evenly the light is spread over the environment, not only over the ‘working plane’ (desk, workbench or machinery), but also over the walls and ceiling.

Good uniformity over all surfaces offers the most comfortable and productive lighting.

When considering new LED lighting, a good practice is to trial a small area to assess its suitability.

Summary
Changing your lighting is a big investment. Not only are there potential significant material costs, there are also installation costs, future maintenance costs and the possible costs caused by disruption.

To ensure these costs, now and in the future are minimized it is recommended that you solicit the services of a reputable and experienced lighting supplier.

These suppliers will offer the best in product quality and advice supported by after-sales and product warranty.
7.0 LUMINAIRE RATINGS

Below is a guide to luminaire performance ratings. This can be very helpful when choosing the correct or best source for an application.

Ingress Protection Rating (IP)

The IP Code, Ingress Protection Rating, sometimes also interpreted as International Protection Rating, classifies and rates the degree of protection provided against the intrusion of body parts such as hands and fingers, and dust and water into mechanical casings and electrical enclosures. It is published by the International Electro technical Commission (IEC).

The first digit represents protection against penetration by solid objects accessing hazardous parts. The second digit describes the enclosure’s protection against the ingress of water.

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<th>FIRST DIGIT</th>
<th>MECHANICAL PROTECTION</th>
<th>SECOND DIGIT</th>
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<td>Dust-tight</td>
<td>6</td>
<td>Protected against powerful water jets</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>7</td>
<td>Protected against the effects of temporary immersion in water</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>8</td>
<td>Protected against the effects of continuous immersion in water</td>
</tr>
</tbody>
</table>
## 8.0 GUIDE TO MARKINGS USED ON LUMINAIRES

<table>
<thead>
<tr>
<th>IP NUMERAL</th>
<th>DEGREE OF PROTECTION</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>5x</td>
<td>Dust-protected</td>
<td>🌴</td>
</tr>
<tr>
<td>6x</td>
<td>Dust-tight</td>
<td>🌴</td>
</tr>
<tr>
<td>x1</td>
<td>Protected against dripping water / Drip-proof</td>
<td>🌴</td>
</tr>
<tr>
<td>x3</td>
<td>Protected against spraying water / Rain-proof</td>
<td>🌴</td>
</tr>
<tr>
<td>x4</td>
<td>Protected against splashing water / Splash-proof</td>
<td>🌴</td>
</tr>
<tr>
<td>x5</td>
<td>Protected against water jets / Jet-proof</td>
<td>🌴</td>
</tr>
<tr>
<td>x7</td>
<td>Protected against the effects of immersion / Watertight (immersible)</td>
<td>🌴</td>
</tr>
</tbody>
</table>
### 9.0 LIGHT LEVELS - PRODUCTION, STORAGE, WAREHOUSE AND OFFICE ENVIRONMENTS

Below is a recommended guide to Illuminance or Lux Levels for various environments.

<table>
<thead>
<tr>
<th>ILLUMINANCE (LUX)</th>
<th>ACTIVITY</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>Some perception of detail</td>
<td>Loading bays, switch rooms, plant rooms</td>
</tr>
<tr>
<td>200</td>
<td>Continuously occupied with little</td>
<td>Foyers &amp; entrance halls</td>
</tr>
<tr>
<td></td>
<td>perception of detail</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>Continuously occupied areas with</td>
<td>Storage, warehousing, canteens &amp; kitchens</td>
</tr>
<tr>
<td></td>
<td>perception of detail</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>Visual tasks with perception of detail</td>
<td>Factory production, general offices, laboratories</td>
</tr>
<tr>
<td>750</td>
<td>Difficult visual tasks with higher</td>
<td>Quality control, visual inspection, grading</td>
</tr>
<tr>
<td></td>
<td>level perception of detail</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>Very difficult visual tasks with high</td>
<td>Precise assembly</td>
</tr>
<tr>
<td></td>
<td>level perception of detail</td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td>Extremely difficult visual tasks with</td>
<td>Fine work inspection, precision assembly</td>
</tr>
<tr>
<td></td>
<td>extreme level of perception detail</td>
<td></td>
</tr>
</tbody>
</table>

The Society of Light & Lighting (SLL), which is part of the Chartered Institution of Building Services Engineers (CIBSE), publishes The SLL Code for Lighting as well as a useful range of lighting guides which provide detailed guidance and recommendations on lighting for a wide range of tasks and applications. To find out more about these publications go to www.sll.org.uk.
10. EMERGENCY LIGHTING

Emergency lighting is a legal requirement in most countries. Details of emergency lighting systems can be found in SLL Lighting Guide 12: Emergency Lighting Design Guide.

When normal mains lighting fails in areas without natural light, it is necessary to evacuate the premises, move people to a place of safety or allow essential processes to continue or be shut down. During this period, emergency lighting should be provided from a source independent of that supplying normal lighting. The system should provide illumination on the floor of 1 lux on the centre line of the escape route and 0.5 lux in open areas across which people might need to move. Signs indicating emergency exits and directions to exits have to be visible (Illuminated) at all material times. A number of European Union Directives have implications for emergency lighting. They are:

- The Workplace Directive (89/654/EEC)
- The Signs Directive (92/58/EEC)

10.1 SCHEME PLANNING – RISK ASSESSMENT

The first step in planning an emergency lighting installation is to carry out a fire risk assessment. In workplaces where five or more people are employed this assessment is a legal requirement.

A fire risk assessment includes the following steps:

- Identify potential fire hazards in the workplace: sources of ignition, fuels, and work processes
- Identify the location of people at significant risk in case of fire: who might be in danger (employees, visitors) and why
- Evaluate the risks: are safety measures adequate or does more need to be done (fire detection, warning, means of fighting fire, means of escape, fire safety training of employees, maintenance and testing of fire precautions)
- Carry out improvements
- Record findings and actions taken: prepare emergency plans, inform, instruct and train employees
- Keep assessment under review: revise it when situation changes

10.2 HIGH RISK LIGHTING AREAS

A high-risk lighting area is defined as one where hazardous activity occurs that has to be made safe or terminated before leaving or where people passing may be exposed to the hazard, e.g. moving machinery.

The lighting requirements for high-risk areas are as follows:

- Minimum illuminance on the task: 10% of the maintained illuminance on the reference plane of the task, but at least 15 Lux
- Minimum/average illuminance uniformity on the reference plane for the task 0.1
- Maximum response time: 100% of minimum illuminance within 0.5s of supply failing
- Minimum duration: 1 hour
10.3 LUMINAIRES - SELF-CONTAINED

Self-contained emergency luminaires contain a battery to provide power and may be of three types: maintained, non-maintained or combined. A maintained luminaire is where the emergency lighting lamps are operating when the normal lighting is on and when there is a failure of mains electricity supply. A non-maintained luminaire is where all the emergency lighting lamps are in operation only when the electricity supply to the normal lighting fails. A combined (or sustained) luminaire contains at least two lamps: one of which is energised from the normal lighting supply and the other from the emergency lighting supply.

Self-contained luminaires may be dedicated or may be converted from normal luminaires by adding an emergency conversion unit. If the work is not carried out by the original equipment manufacturer, the person who does it must have relevant training and experience.

10.4 LIGHT SOURCES

To be suitable for use in emergency lighting luminaires, light sources need to have fast run-up and re-strike times, and preferably a long life. Lamps with internal starters should not be used. Care must also be taken when using amalgam versions of fluorescent lamps as these have slow run-up characteristics. High-Pressure discharge lamps are not normally suitable for emergency lighting due to their extended run-up and re-strike times. LED Technology can be used, particularly for safety signs where long lamp life is a priority. They are also very efficient at low temperatures.

GLOSSARY

- BRC - BRC Global Standards
- Efficacy - Lumens per watt. E.G. 7,354 lumens divided by 48w equals an efficacy of 153 lumens per watt.
- FRL - Fragment retention lamp (A fluorescent lamp which has been externally polymer coated directly onto the glass, including the metal end caps, forming a seal. A loose plastic sleeve which slips over the lamp and with push on end caps to hold in place does not constitute a fragment retention lamp
- High bay - High intensity discharge luminaire using elliptical lamp vertically inside a parabolic reflector
- LED Driver - An electrical device which regulates the power to an LED or a string (or strings) of LEDs
- Low bay - High intensity discharge luminaire using tubular lamp horizontally
- LED - Light emitting diodes
- Lumen Maintenance - compares the amount of light produced from a light source or from a luminaire when it is brand new to the amount of light output at a specific time in the future
- ROT – Rotating end caps