The Society of
Light and Lighting

BRCGS

Guide to Lighting Best Practice for the Global Standard for Food Safety

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 BRCGS 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 Standard requires companies to ensure that there is adequate lighting throughout their sites so that staff are able to perform correct operations of processes as well as monitor quality and product defects.

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 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 shatterproof 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 diffuserless) 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 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.

3.1 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 = Two 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

Operation – open or enclosed luminaires
Check service life of coating and environment

Class B Compliance Marking

Operation – Open rated luminaires only

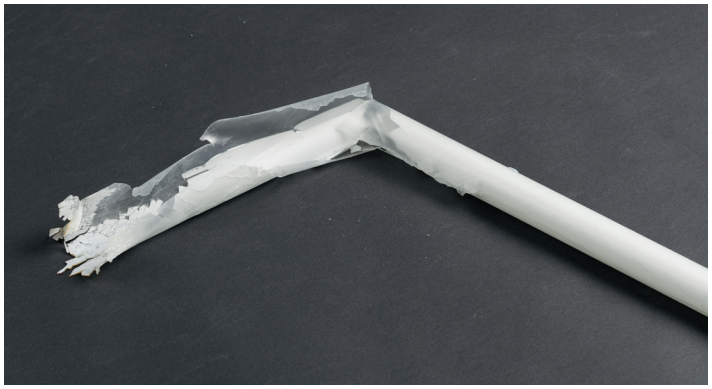
Both product classes meet a 4 metre impact test which is a requirement of IEC 61549 (EN 61549) Standard.

3.2 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)

3.3 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:

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

3.4 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

4.0 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 bulb 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).

4.1 Elliptical quartz metal halide lamps (white light)

Where possible, elliptical fragment retention (PFA coated) Quartz arc-tube metal 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). The majority of 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.

5.0 LED lighting

5.1 LED tubes (fluorescent retro-fit)

When considering energy saving LED retro-fit (fluorescent) tubes, seek expert advice to achieve safe, reliable performance. The majority of LED retro-fit tubes will have an outer sleeve manufactured from either plastic or glass. 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 (EN 61549) for the following reasons:

1) Glass versions on impact will cause widespread contamination similar to an unprotected fluorescent lamp.
2) Plastic versions may fail prematurely when installed into enclosed IP65 luminaires due to elevated temperatures. In open (batten) luminaire operation the resistance to long term chemical or cleaning exposure can be low.

5.1.1 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. Currently, most LED tubes will not provide the same light output and illumination level as fluorescent sources. Therefore, consideration should be given to achieving acceptable lighting and distribution levels to avoid any Health and 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% at the end of service life but the LED tube output will typically be reduced by 30%. Check the characteristics on lamp data sheet.

5.1.2 Installation

When installing LED retro-fit tubes into High Frequency fluorescent luminaires consideration should be given to the safety of the procedure. A wiring modification will be necessary by a suitably qualified person and care should be taken to avoid the shedding of parts.

5.1.3 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.

5.1.4 Distribution

Many LED tubes only emit light in one direction. Even when located in an existing fluorescent luminaire pointing directly downward, they may not provide the same light distribution over the working area below, leading to dark spots or stripes – a possible safety hazard. Where the luminaire uses reflectors to distribute the light, an LED tube with a complete circular distribution around the tube should be used to ensure that the light emitted from the luminaire matches that of the original fluorescent lamp.

5.2 LED luminaires

When considering or installing energy saving LED luminaires it is important to choose the correct IP rating for the application in which they will be used. Consideration should be given to the resistance to dust and water ingress. If cleaning chemicals or other chemicals are present, even in dilute form, check with the manufacturer's technical data sheet for suitability.

It is recommended that a light level and uniformity comparison is carried out against the current light sources that are being replaced. Reputable lighting manufacturers should be able to provide software lighting calculations to substantiate the performance of their proposed equipment against a professionally derived lighting scheme for the area to be lit. Any major reduction in floor level lighting or uniformity should be seriously considered to avoid any Health and 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 full service life whilst LED will be a greater amount, typically 30%.

More aggressive environments, where elevated ambient temperatures of over 25°C are present, can greatly reduce the life of the LEDs and their output. Always check the manufacturer's technical data sheet for performance at elevated temperatures.

The performance of LED luminaires improves in colder environments and is potentially a good solution in cold storage and freezer applications. Full service life can typically be achieved (50,000 hrs), providing a good cost of ownership with little or no maintenance costs.

6.0 Fluorescent luminaires

Fluorescent lighting technology is one of the most proven and reliable lighting sources and has been in service since the 1940s. Latest fluorescent luminaire technology incorporates high frequency ballasts that yield high efficiency. Extra controls via daylight dimming and motion sensor technology options are also available and can produce significant energy savings when applied in the correct applications.

With the latest T5 lamp (16mm diameter) technology, up to 45% energy savings can be achieved over T8 (26mm diameter) lamps, making them one of the most efficient proven and reliable lighting sources available today. Replacing old T8 luminaires with the latest T5 versions offers a fast payback with lower investment costs when compared to other lighting sources. When combined with long life lamps up to 42,000 hours service can also be achieved. T5 Tri Phosphor fluorescent lamps have a 90% lumen maintenance so will only drop in output by 10% throughout their useful life (identical to T8 Tri Phosphor).

6.1 Construction and design

For production and high risk areas choose fluorescent luminaires that are fit for purpose and will meet the requirements of the application and environment. For installations where white ceilings and walls are present, diffuserless (open rated) IP65 battens fitted with fragment retention fluorescent lamps to IEC 61549 (EN 61549) are beneficial and can provide cost savings in maintenance as well as improve light levels and overall safety. There are fewer working parts and no plastic clips or diffuser covers to replace.

Traditional enclosed IP65 luminaires with diffusers are a good option for lighting at low mounting heights where risks from lift truck impact or potential flying objects are present. Where possible, choose enclosed IP65 luminaires with metal clips over plastic versions due to the increased chance of detectability if lost.

All fluorescent luminaires should be easy to clean and not harbour dirt or dust. Bodies manufactured from GRP perform better in demanding environments where corrosive chemicals are present.

All fluorescent luminaires should incorporate fragment retention lamps manufactured to IEC 61549 (EN 61549) Standard.

7.0 Luminaire ratings

Opposite 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 Electrotechnical 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.

FIRST DIGIT	MECHANICAL PROTECTION	SECOND DIGIT	WATER INGRESS PROTECTION
0	No protection	**0**	No protection
1	Protected against solid foreign objects of 50mm Ø and greater	**1**	Protected against vertically falling drops of water
2	Protected against solid foreign objects of 12.5mm Ø and greater	**2**	Protected against vertically falling water drops when enclosure tilted 15°
3	Protected against solid foreign objects of 2.5mm Ø and greater	**3**	Protected against spraying water
4	Protected against solid foreign objects of 1mm Ø and greater	**4**	Protected against splashing water
5	Dust-protected	**5**	Protected against water jets
6	Dust-tight	**6**	Protected against powerful water jets
		7	Protected against the effects of temporary immersion in water
		8	Protected against the effects of continuous immersion in water

7.1 Guide to markings used on luminaires

IP NUMERAL	DEGREE OF PROTECTION	SYMBOL
5x	Dust-protected	
6x	Dust-tight	
x1	Protected against dripping water / Drip-proof	
x3	Protected against spraying water / Rain-proof	
x4	Protected against splashing water / Splash-proof	
x5	Protected against water jets / Jet-proof	
x7	Protected against the effects of immersion / Watertight (immersible)	

8.0 Efficiency and energy saving

Saving energy reduces operating costs and CO_2 emissions, which positively impacts on any business and the environment. There are many ways in which this can be achieved. From making small step changes with existing lighting to new installations, significant savings can be achieved. Payback periods should always be considered for new installations within the calculations so that total cost of ownership can be seen, as well as the ongoing savings provided.

For example a new lighting fixture giving a 50% energy saving over an existing installation but paying back over 5 years may be less attractive in the short term than a cheaper product offering 35% energy savings and paying back in 2 years. In this particular example, though, if the life of the installation was 12 years or more, the first product would ultimately give net financial savings compared with the cheaper one.

Long payback periods are more suited to difficult access environments and where maintenance costs are extremely high. However, this will depend on the service life of the new source and lumen maintenance factor. It is advisable to compare the luminaire manufacturer's data sheet calculations of access equipment hire and any outside contracting (if applicable) to be used within the payback period and savings.

Major energy savings typically result in a reduction in light level. When considering any new lighting installation it is advisable to compare the manufacturer's technical data sheet for Lumens per Watt ratio and Lumen Maintenance curve (light drop off over time).

8.1 Upgrading T8 fluorescent lighting

For main plant lighting where existing T8 fluorescent lighting is used in installations up to 6 metres in height, an economical fit for purpose solution offering up to a 45% energy saving with a fast payback period is an equivalent T5 (16mm diameter) fluorescent luminaire. Latest T5 lamp technology can also offer up to 42,000 hours life and be highly efficient. For offices and storage rooms, LED retro-fit tubes or complete LED luminaires are a good solution. These can offer increased energy savings typically up to 60%. However, payback periods can significantly increase where lights are not in use 24 hours.

8.2 Upgrading metal halide, sodium and mercury lighting

Metal halide technology has consistently improved, which has allowed significant benefits in increased lumens per watt and higher quality Colour Rendering Index (CRI). In addition, there is now a much greater choice available in lower wattage energy saving versions to replace older traditional 250w and 400w installations. For example, a 400w sodium, mercury or metal halide lamp can now be replaced using a 320w metal halide providing an instant energy saving of 20%. 250w versions can also be replaced using a 200w metal halide providing an identical saving. To convert to lower wattage metal halide lamps it will be necessary to change the control ballast inside the luminaire and this should be carried out by a qualified person before lamp installation. This type of upgrade can be very cost effective with a fast payback period as it negates the purchase of a complete new luminaire.

For some applications, such as illumination between storage racking and aisles, the characteristic tighter beam control of LEDs would make them a good replacement for HID units, leading to a useful energy saving.

8.3 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.

Note: When using fluorescent lamp technology on dimming circuits always burn new lamps in for 100 hours prior to dimming to prevent premature lamp failure.

9.0 Light levels – production, storage, warehouse and office environments

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

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

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.

10.0 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 on escape areas. 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 Construction Products Directive (89/106/EEC)
- 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 work places 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 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. LEDs can be used, particularly for safety signs where long lamp life is a priority. They are also very efficient at low temperatures.

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 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

Glossary

- 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 parabolic reflector
- Low bay - High intensity discharge luminaire using tubular lamp horizontally
- LED - Light emitting diodes

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