

Industrial LED lighting solutions

Small to large scale industrial environments

Energise your industrial lighting, maximise the value of your investment



Powering Business Worldwide



Energizing a world that demands more.

We deliver:

- **Electrical solutions** that use less energy, improve power reliability and make the places we live and work safer and more comfortable
- **Hydraulic and electrical solutions** that enable machines to deliver more productivity without wasting power
- **Aerospace solutions** that make aircraft lighter, safer and less costly to operate, and help airports operate more efficiently
- **Vehicle drivetrain and powertrain solutions** that deliver more power to cars, trucks and buses, while reducing fuel consumption and emissions

Discover today's Eaton.

Powering business worldwide

Eaton is a power management company with 2016 sales of \$19.7 billion. We provide energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably.

Eaton is dedicated to improving the quality of life and the environment through the use of power management technologies and services. Eaton has approximately 95,000 employees and sells products to customers in more than 175 countries. For more information, visit Eaton.com

EATON

Powering Business Worldwide

Eaton has over 100 years' experience in providing lighting solutions for commercial buildings and is a market leader in emergency lighting.

Our industrial LED lighting solutions brochure provides a guide to the many challenges and considerations required when deploying a low energy lighting solution in an industrial facility, the solutions that Eaton can offer, and how partnering with us can benefit your application.

We understand that optimising a building can positively affect operating costs, productivity, and the well-being of those who use the space. Eaton can help you design and build for a lower carbon footprint and plan for future needs and regulations. This protects the future value of your investment and ensures that your business runs more productively.

Our global business footprint also means we can partner with your business – wherever it operates – offering local support and custom solutions.

Let Eaton maximise your investment and allow you to achieve your potential.





Your low energy LED lighting solution

Your building infrastructure is the foundation of your business. To be more productive, you need to maximise the functional use of your space and increase energy efficiency, all while keeping people safe. Therefore, you need expert support to manage risk and increase operational effectiveness.

You need Eaton to help you:

Increase operational efficiencies by

- Reducing energy consumption and maintenance requirements to improve your bottom line
- Lowering your total cost of ownership by up to 50%
- Reducing your carbon footprint to improve your environmental credentials

Design and build lit environments optimised for comfort and aesthetics, leading to

- Improved staff wellbeing
- Reduction in absenteeism
- Higher productivity
- Improved safety

Lower risk with on-time project execution and expertise due to

- Experienced, dedicated sales, project management and customer service teams
- Accurate and timely information, helping you stay on-schedule and on-budget
- Site surveys and scheme design for turnkey solution

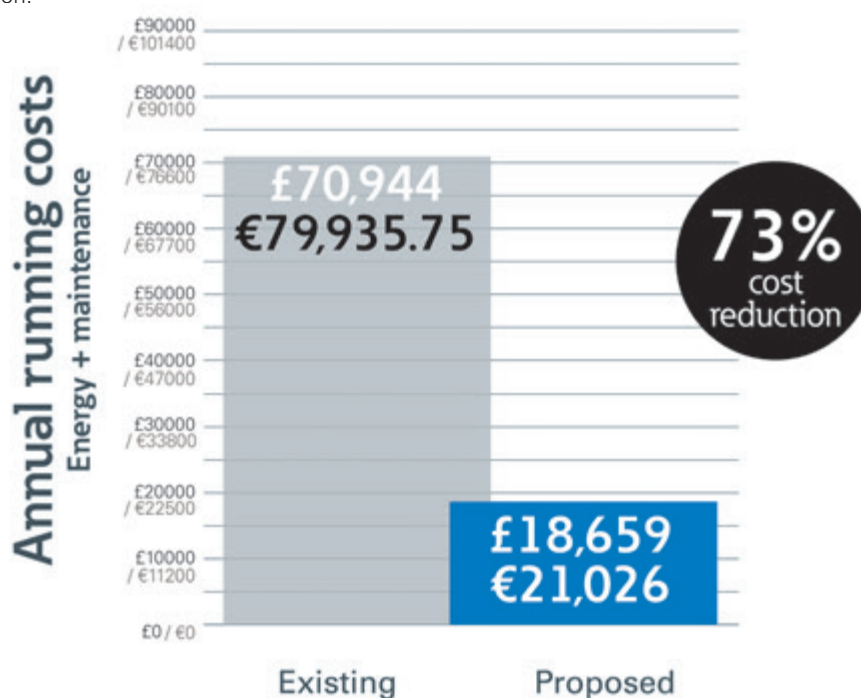
Protect people, assets and reputation for business continuity with

- Emergency lighting systems to ensure compliance with regulations
- Depth of expertise to support compliance with the codes and standards
- A wide range of support services to ensure your lighting installation not only meets basic operational and safety requirements on day one, but will continue to do so throughout its lifetime

Project example

Below is a real life project example of the energy and cost savings achievable from an LED lighting solution – as well as a projected carbon footprint reduction.

This is a cold storage application.

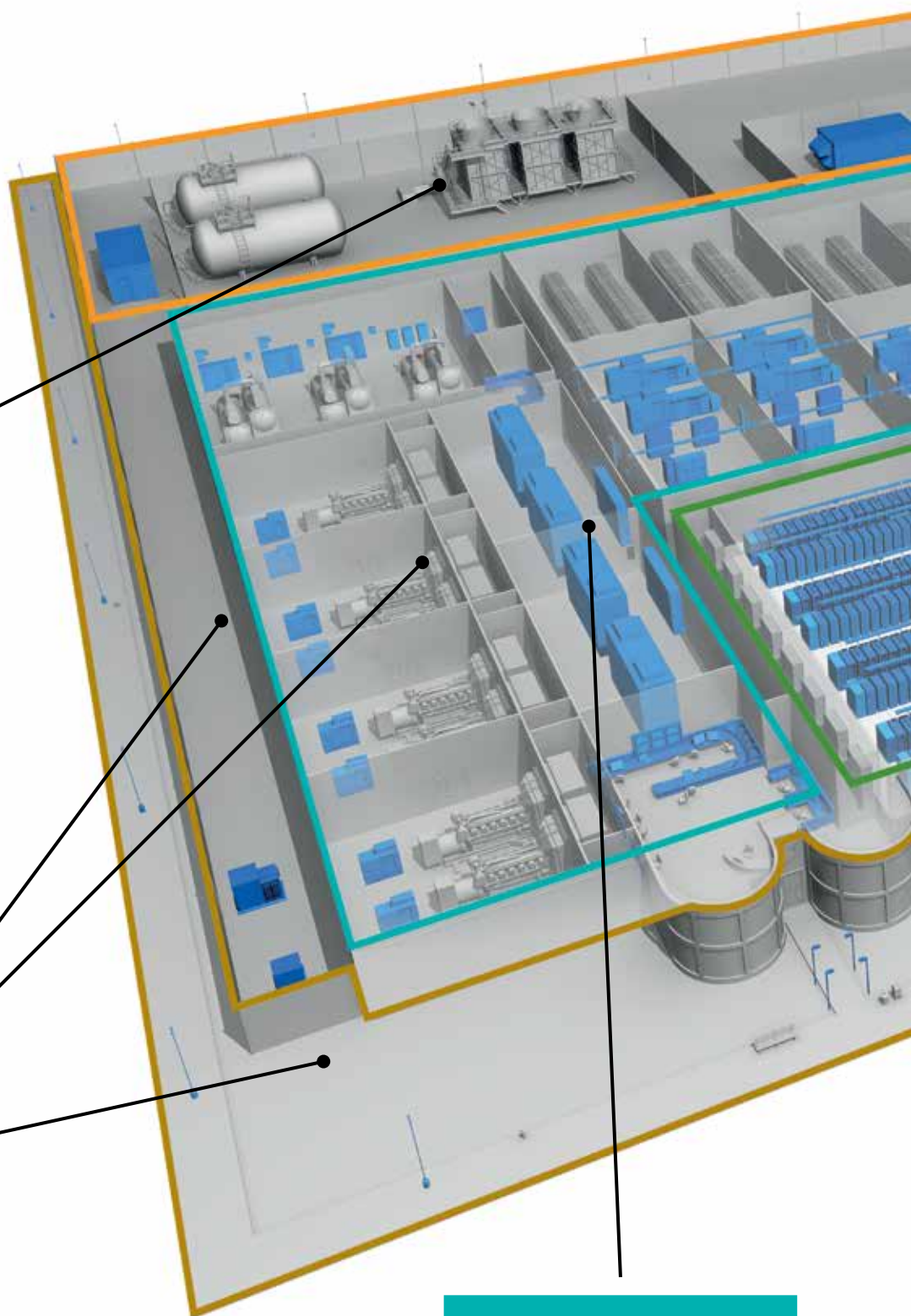


Summary	Litex Elite Industrial LED	Fluorescent HID Metal Halide luminaire
Number of luminaires	150	150
Wattage per luminaire	142	460
Total Wattage	21300	69000
Watts per day (24 hrs usage)	51,1200	165,6000
Annual energy cost -based on £0.10p KWhr	£18,659 / €21,026.83	£60,444 / €68,102.25
Maintenance		
Average lamp life (hours)	80,000	10,000
Annual operating hours	8760	8760
Replacement time (years)	9.13	1.14
Lamp cost (based on £20 per)	£0	£3,000 / €3381
Lamp change cost (based on £50 per)	£0	£7,500 / €8,452.50
Maintenance cost	£0	£10,500 / €11,833.50
Total annual operating cost	£18,659 / €21,028.69	£70,944 / €79953.89
Total annual saving	-	£52,285 / €58909.51
10 Year savings		£522,850 / € 589092.16

Note: Sterling to Euro conversion rate of £1 to €1.13 - correct at time of publication.

Lighting for industry

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Harsh industrial environments

Maintaining a safe working environment is a priority in spaces with harsh working conditions. This may be a process or material driven area. Suitable and compliant lighting helps to safeguard people and property.

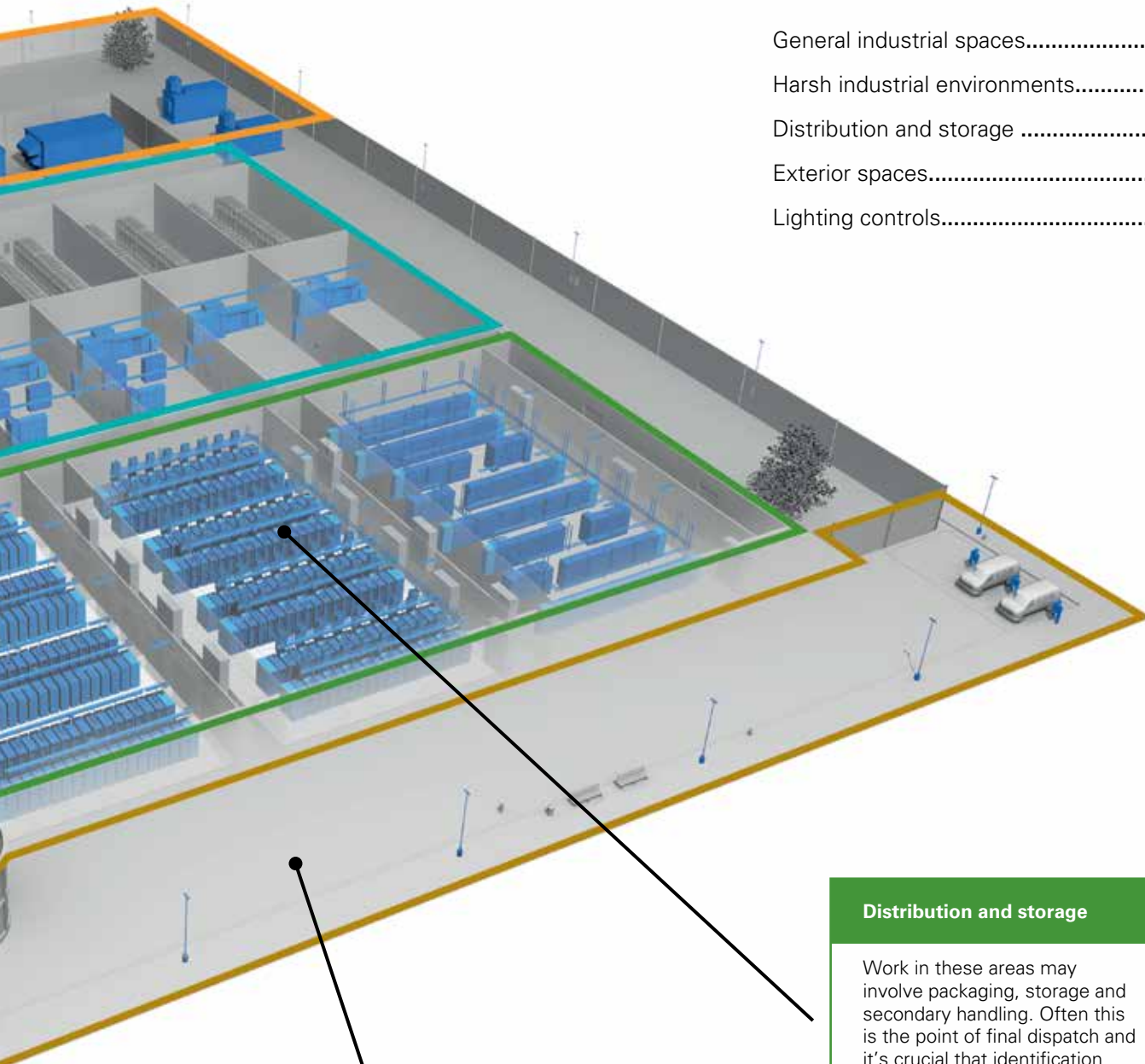
Lighting controls

A vital component in any lighting philosophy is the controls strategy. Lighting controls can enhance the space, save vital energy and prolong the life of the lighting installation. All areas in this guide benefit from the correct selection and use of lighting controls.

General industrial spaces

The wide diversity of industrial process and manufacturing requirements mean that the choice of appropriate lighting is crucial.

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Distribution and storage

Work in these areas may involve packaging, storage and secondary handling. Often this is the point of final dispatch and it's crucial that identification of packages is accurate. Good lighting is part of this process.

Exterior spaces

Many tasks related to the industrial environment take place exterior to buildings. Good lighting is essential to the safe and efficient operation for staff and other users of the area.



General industrial areas

General industrial areas cover the majority of spaces found in the industrial environment. These may be as diverse as heavy manufacture, to final assembly of finished goods and precise inspection of materials. The provision of adequate lighting to industrial work and process spaces is essential to the successful outcome and safety of those involved. The ability to carry out a task quickly and accurately increases productivity and benefits all concerned. In planning effective lighting there are many points to consider.



- **The task** – the correct level of illuminance and quality of light allows people to perform the task correctly and safely. Every effort should be made to identify what the task involves prior to considering lighting design. Also consider the stakeholders needs and expectations of the space.

- **Legal requirements** - many situations in industrial lighting will be covered by local legal requirements. Often these requirements are prescriptive as to illuminance levels and other considerations such as glare, colour temperature and the colour rendering properties of the luminaires being considered. Adopting these requirements demonstrates commitment to people and the quality of their working environment.

- **Energy efficiency and sustainability** – using the energy available to us wisely is a must in the modern world. Understanding the task and lighting needs can help in the selection of the most efficient and suitable lighting products. Using the latest technology, in this case LED lighting, has proven to show energy and therefore cost savings in excess of 80% in some cases. If the task involves some periods of inactivity or absence, selecting controls to manage the space can further reduce energy consumption. (See lighting controls on page 15).



- **Tasks with special consideration** – where rotating or reciprocating machinery is in close proximity to people, it may present a stroboscopic effect. This means people may not fully see moving parts. A method to inhibit this is to have the local lighting powered from more than one phase of the electrical supply. Other operations are subject to extra care particularly in situations where the safe evacuation of people would be required in an emergency. Checking whether the process can be left running or needs to be shut down will dictate what emergency and / or standby lighting system should be selected. Local legislation may also cover these requirements. Emergency directional signage may also be required.

- **Localised lighting** – the diversity of tasks within the environment often means that the general lighting is not specific enough. Supplementary and dedicated lighting may be required immediately adjacent to the task, such as final inspection of goods, precise work on a bench etc.

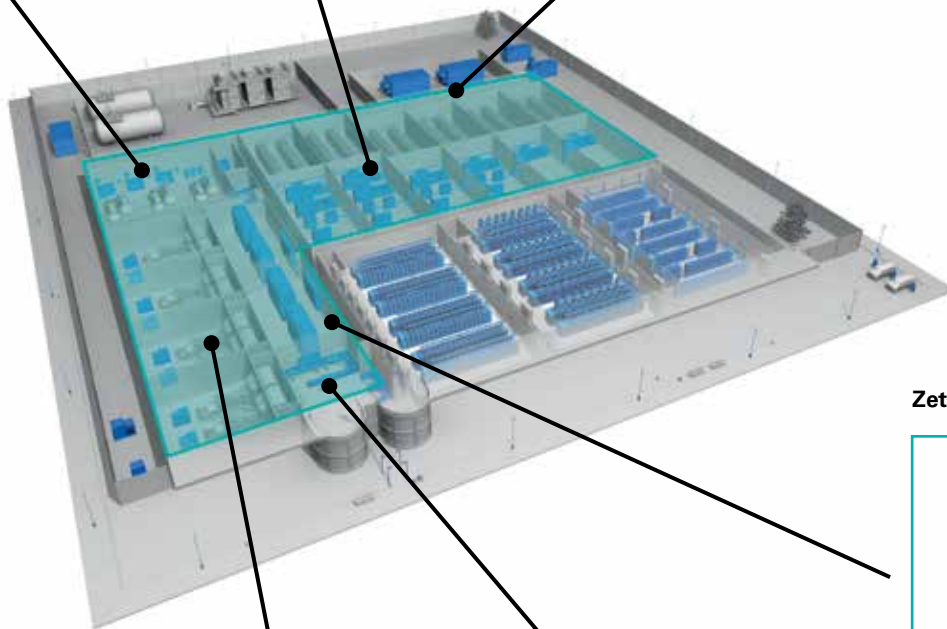
Litex Elite



Linery LED / LED+



Crompack LED / LED+



Zeta 4



Caius



Tufflite LED / LED+



Harsh industrial environments

Harsh industrial environments may occur when processes are subject to materials or activities that may be considered hostile or hazardous. Hostile environments are ones in which there may be damage to the lighting equipment from extreme cold, heat, vibration or a corrosive atmosphere. Hazardous environments are ones in which the lighting equipment itself may pose a risk of causing a fire or explosion. Clearly in these situations, the correct choice of suitable lighting equipment is vital. Eaton has considerable expertise in this area and has developed approved, compliant lighting and safety products to deal with these challenging environments.

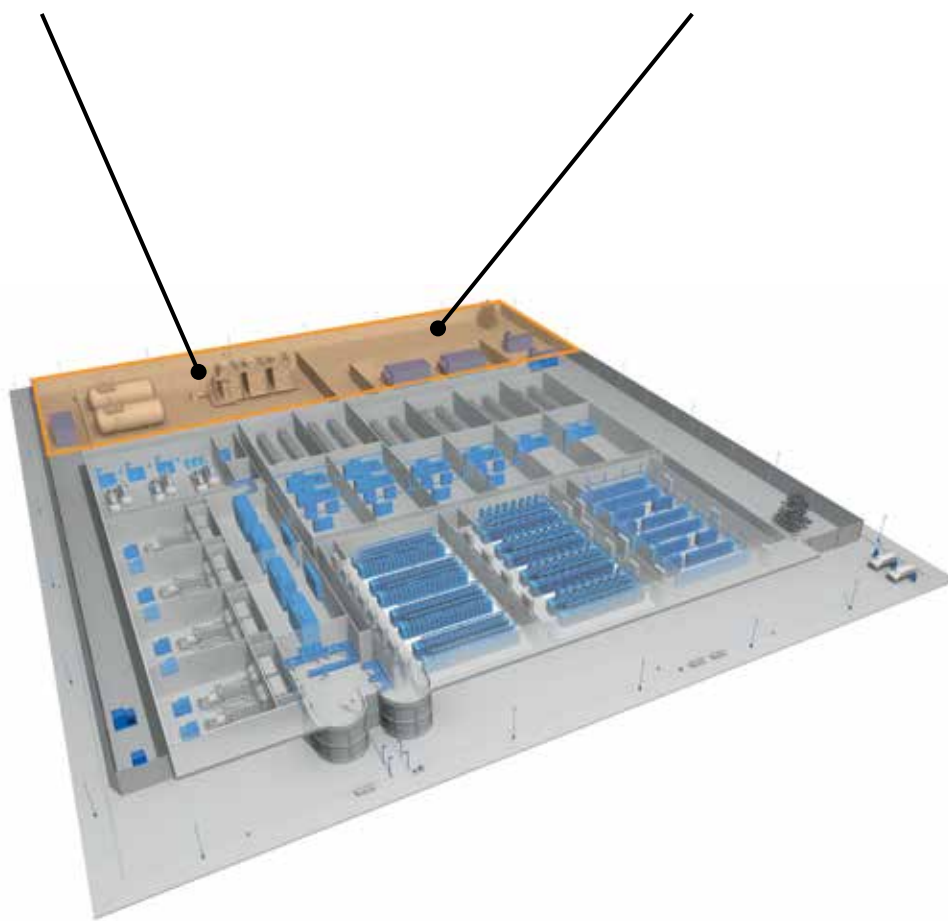
The general considerations for these spaces are broadly in line with those of general industrial areas. In addition to these, there are specific points which need to be considered at the design stage.

- **Category of environment** – the level of luminaire protection and robustness within the space needs to be established with the owner and user of the process. Without this, the selection of luminaires and other life safety products cannot be carried out correctly.
- **Tasks with special consideration** - by its very nature, in a harsh environment the operations performed need special consideration in the way that they are carried out. Lighting of the task needs to be in keeping with safety procedures and the safeguarding of people is paramount. Emergency and standby lighting needs to be of a suitable and consistent construction with the rest of the approved luminaires. Emergency directional signage may also be required.
- **Suitability of luminaires** – as well as being suitable for the purpose in these spaces, other considerations need to be made. Can the luminaire be maintained safely while the processes are ongoing? Are the materials used for construction suitable in terms of resistance to corrosion, chemically resistant and correctly sealed for ingress protection? Can the product be cleaned effectively in-situ? Is vibration present in the installation and does the luminaire have an inbuilt design resistance?
- **Legal requirements** – this is an area where the legal requirements for lighting and its suitability in use is well documented. Local and global standards apply to luminaires and life safety equipment construction. Correct selection of equipment must follow these guidelines.
- **Power management** – the processes and operations in harsh environments mean that in the event of a power outage, some processes need to remain running and monitored, requiring a safely lit environment allowing staff to remain. Selecting a suitable backup power supply can not only safeguard the process but can also allow operatives to continue to work effectively until the resumption of normal power.

Litex Elite



i-P65+





Distribution and storage

A large proportion of most industrial production and manufacturing facilities is given over to distribution and storage. Storage encompasses both raw materials and finished goods. Distribution is concerned with storage, sorting and dispatch of goods. This may be finished goods in a manufacturing environment or selection and repacking of stored goods in a distribution warehouse.

Regardless of the operation, there are some key lighting design elements to consider.

- **Open or racked areas** – lighting selection in these areas can vary by the task due to be performed. An open area benefits from a lighting contribution from numerous sources in a regular array, this assists with modelling and the reduction of shadowing associated with working under a few large output light sources.

In closely racked areas, the availability of light sources is limited to those in direct sight, other sources might be concealed by the height of the racking. In these areas, luminaires with high vertical illuminance properties are recommended. These aid in visual acuity and task recognition. Multiple lower powered sources are preferred to small numbers of high powered luminaires. These areas are often used by fork trucks and this method of illumination also reduces glare to operators where the task repeatedly involves looking up.

- **Colour and task recognition** – a large proportion of the activity in these spaces is labour intensive and relies heavily on recognition. Visual acuity is a vital component of the task where the immediate correct identification of goods is crucial. Luminaires which display a good CRI rating (colour rendering) have been shown to improve operator performance accuracy.
- **Special considerations** – due to the confined conditions associated with racked areas, emergency lighting and signage need to be designed to be visible regardless of where people are located. In some instances, additional provision should be made to aid in the event of an emergency or evacuation. Viewing distances for signage also needs to be adequate for the large continuous spaces associated with warehousing.
- **Lighting controls** – due to the work patterns in distribution and storage areas, they benefit immensely from lighting controls. Absence detection, combined with any available daylight harvesting can reduce energy consumption dramatically. Unoccupied spaces lit by LED solutions offer a rapid on-off switching cycle due to the LED's ability to reach full output in milliseconds, compared to a cold fluorescent which has to 'warm up'.



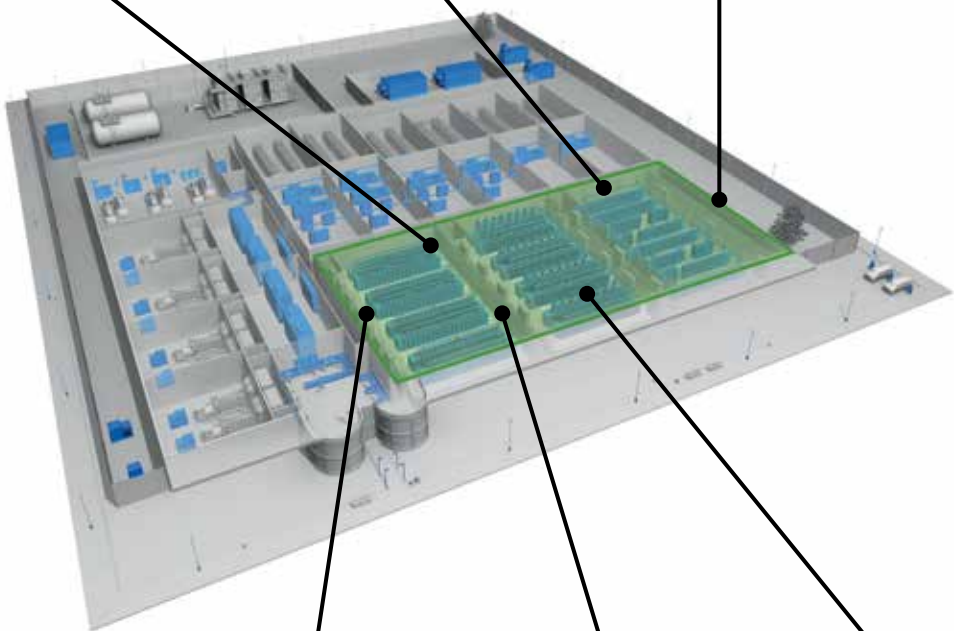
Litex Elite



Linergy LED / LED+



Zeta 4



Crompack LED / LED+



Tufflite LED / LED+



i-P65+



Exterior spaces

Utilising the exterior spaces adjacent to and around an industrial site is crucial to the efficient operation of the site. Access for both vehicular and pedestrian traffic should be managed carefully with particular attention to the safety of all users. Well planned and adequate lighting provision helps to maintain awareness and the safe segregation of activity.

Exterior spaces may include loading docks, bulk storage facilities, marshalling yards, car parks and footpaths.

Some of the key lighting design elements to consider are.

- **Modelling** – good modelling in lighting terms is the balance between a mostly diffuse light source and a directional one. Exterior lighting by its very nature does not have large surfaces to aid this, therefore a completely singularly directional design should be avoided. Directional lighting also can cast shadows, hindering the ability to work effectively. Even and uniformly lit exteriors also function more effectively than areas with high contrast.
- **Obtrusive light** – care should be given to design a solution that is sympathetic to the environment and the surroundings of the site. Poorly placed and aimed exterior lighting is wasteful of energy and can distract from the safe and efficient running of the site.
- **Special considerations** – egress from a building in an emergency situation should take into account the points at which people leave a space. There should be adequate lighting to allow for the safe transition from a highly lit interior to a potentially dark exterior area.

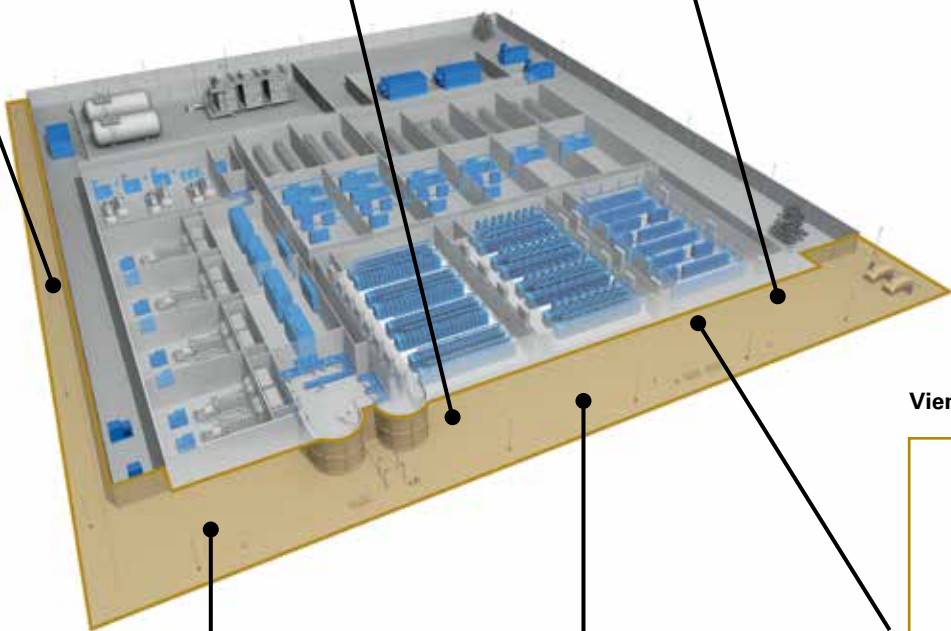
Aethon



Caius



Chatham



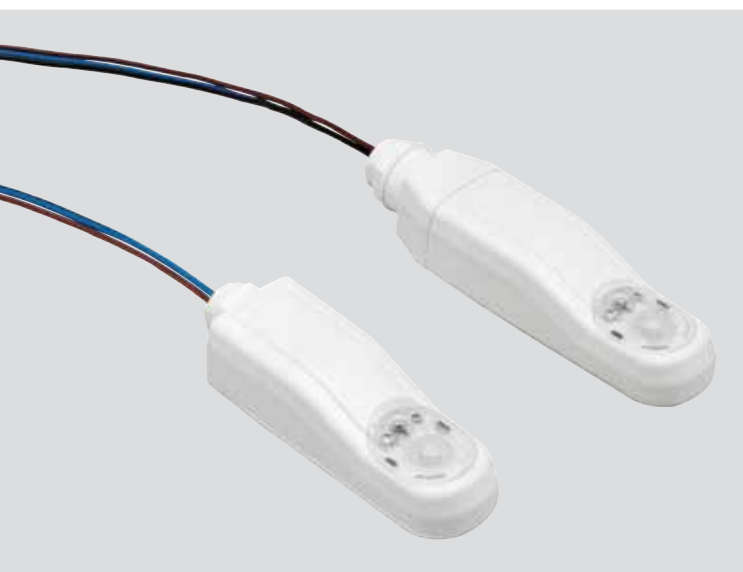
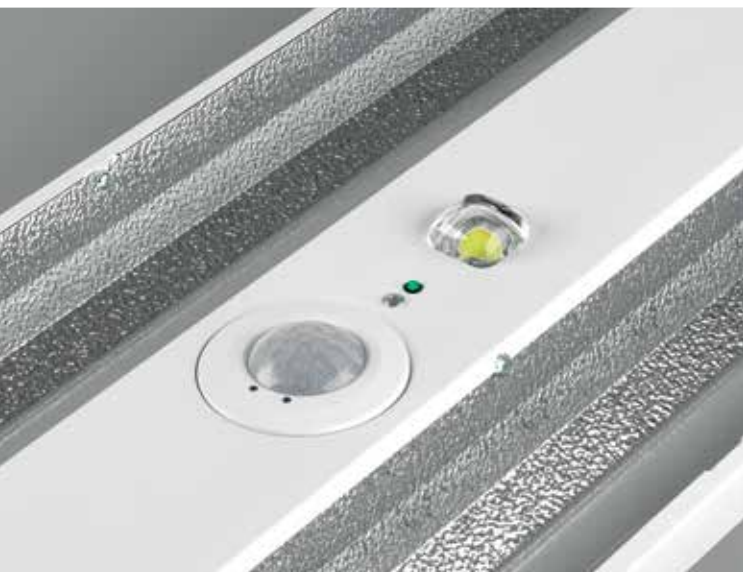
Vienza / LED



i-P65+



Galaxy LED



Lighting controls

Energy costs are one of the most significant factors for an operation. Whilst LED lighting is inherently low energy when compared to many other forms of illumination, combining LED luminaires with a well-designed lighting control strategy may reap the highest benefits.

- **Presence / Absence detection** – automatically determining whether a space is occupied and, therefore, should be lit is a minimum standard in any energy efficient lighting scheme. Care should be taken not to have the effect of continually switching on and off adjacent areas to the detriment of visual comfort.
- **Luminaire communication system** – many systems are available that allow a group of luminaires to be controlled from a single point of detection. Designers should work with the site owners to establish an effective strategy for each space on an individual basis.
- **Daylight linking** – perhaps the easiest and most obvious energy saving strategy is to use available daylight to light a space where appropriate. Modern lighting can be designed to supplement, rather than replace, the natural light levels throughout the day by allowing luminaires to dim up or down dependent on levels of natural light. A study of the site should be undertaken at design stage to evaluate the practicality and savings potential of this technology.
- **Constant illumination** – some systems offer the ability to maintain a strict illumination level which allows for the natural deterioration and environmental condition which would reduce the illumination in normal conditions. This compensating feature can be a benefit to certain critical processes and continuity of work.
- **Reconfigure the space** – controls offer a multitude of advantages to any organisation. Work patterns do change and any control system design should have flexibility designed in to allow for the reconfiguration of a space post completion.





Emergency lighting

Emergency lighting is required when the power to the regular mains lighting in an area fails. There are many types and methods of achieving emergency lighting, the choice of which depends on the function and occupancy of a space. Emergency lighting should offer the means to evacuate a space safely, and in some instances allow high risk tasks to be shut down in a controlled manner for the safety of the operator and other occupants of the building. Luminaires which perform the emergency lighting function can be split into the following categories.

- **Combined emergency luminaire** – a luminaire containing a light source that can operate under normal mains conditions and can be energized from an alternative supply source under mains failure. This may be an inbuilt battery or alternate supply from a central battery, UPS or standby generator
- **Self-contained emergency** – this is a luminaire or sign which provides either maintained or non maintained emergency lighting only. All the elements of the product (light source, battery and the changeover device) are contained in one housing – or with 1 of the housing.

Choosing the right emergency lighting system will depend on the site, the process and the local legislation which applies. Eaton can help you decide which system is best for the application.



Central battery and UPS systems

Power management – the processes and operations in harsh environments mean that in the event of a power outage, some processes need to remain running and monitored, as well as safely lit, so that staff can remain. Selecting a suitable backup power supply can not only safeguard the process but can also allow operatives to continue to work effectively until the resumption of normal power.

Technical

Glossary of terms

Activity Area

Area within which a specific activity is carried out.

Anti-Panic (Open) Area Lighting

The part of Emergency Escape Lighting provided to avoid panic and provide illumination allowing people to reach a place where an escape route can be identified.

Background Area

Area adjacent to the immediate surrounding area.

Driver

The component that controls the operation of an LED source from a specified low or high voltage AC or DC source (Typically between 12 and 240 volts).

Ballast Lumen Factor

The ratio of the light output of the LED in emergency operation compared with the light output of the same LED operated by a reference ballast at its rated voltage and frequency.

Battery

Secondary cells providing the source of power during mains failure.

Battery - Recombination

A battery that is designed to recombine the electrolyte, constructed so that no provision is made for replacement of electrolyte (sometimes called sealed).

Battery - Vented

A battery that requires replacement of electrolyte at regular intervals.

Battery Capacity

The discharge capability of a battery, being a product of average current and time, expressed as Ampere-hours (Ah) over a stated duration.

Note: At fast rates of discharge the full ampere hour capacity of the battery is not available.

Candela (cd)

The unit of luminous intensity.

Central Battery System

A system in which the batteries for a number of emergency luminaires are housed in one location. Usually for all the emergency luminaires on one lighting sub-circuit, but sometimes for all emergency luminaires in a complete building.

Colour Rendering Index (CRI)

A measure of the degree to which the appearance of a surface colour under a given light source compares to the same surface under a CIE reference source. The index has a maximum value of 100.

Colour Temperature (CCT)

All materials emit light when heated (e.g., metal glows red through to white as the temperature increases). The temperature to which a full radiator (or 'black body') would be heated to achieve the same chromaticity (colour quality) of the light source being considered, defines the correlated colour temperature of the lamp, quoted in degrees Kelvin.

Combined Emergency Luminaire

A luminaire containing two or more lamps, at least one of which is energised from the emergency supply and the remainder from the normal supply (If the emergency lamp is only illuminated in a mains failure condition this luminaire is regarded for fire authority approval as non-maintained).

Design Voltage

The voltage declared by the manufacturer to which all the ballast characteristics are related.

Disability Glare

Glare produced directly or by reflection, that obscures or impairs vision of an object, but does not necessarily cause any discomfort.

Discomfort Glare

Glare which causes visual discomfort.

Downward Light Output Ratio (DLOR)

The ratio of luminaire light output below the horizontal, compared with total lamp light output.

Emergency Lighting

The lighting provided for use when the supply to the normal mains lighting installation fails.

Escape Route Lighting

Lighting provided to ensure that the means of escape can be effectively identified and safely used when a location is occupied.

Emergency Exit

The way out of a building, which is intended to be used at any time whilst the premises are occupied.

Final Exit

The terminal point of an escape route, beyond which point persons are no longer in danger from fire or any other hazard requiring evacuation of the building.

Glare

The discomfort or disability that occurs when there is an excessive change of luminance in the field of vision.

High Risk Task Area Lighting

Emergency lighting provided to ensure the safety of people involved in a potentially dangerous process or situation and to enable proper shut down procedures for the safety of the operator and other occupants of the premises.

Housing 850°C Test

Mandatory test for emergency luminaires used on escape routes, to establish that materials do not burn at given temperature. Self-extinguishing grades of plastic must be used, or alternatively glass and/or steel.

Impact Protection (IK) Number

Number classification of the degree of protection a luminaire provides against mechanical impact.

Immediate Surrounding Area

Band surrounding the task area within the field of visual field.

Ingress Protection (IP) Number

Number Classification of the degree of protection a luminaire provides against the entry of solid foreign bodies and moisture.

Isolux Diagram

Diagram showing contours of equal illuminance.

K Factor

The ratio of the light output from the light source in its worst condition, normally at end of discharge and with any cable volt drop, to the output at nominal voltage.

Lamp Lumen Maintenance Factor (LLMF)

The proportion of light output of a lamp after a stated period, compared with initial lumen output.

Lamp Survival Factor (LSF)

The proportion of functioning lamps in an installation after a stated period.

LENI

Lighting Energy Numeric Indicator (EN15193) standard for determining the energy requirements for lighting.

Light Loss Factor (LLF)

See Maintenance Factor

Light Output Ratio (LOR)

The ratio of the total light output of a luminaire, compared with total lamp light output.

Lumen (lm)

The unit of luminous flux used to describe the quantity of light emitted by a source or received by a surface.

Luminaire

Apparatus which distributes the light given by a lamp or lamps, including all the items necessary for fixing and protecting the lamps and for connecting them to the electrical supply.

Luminaire Maintenance Factor (LMF)

The proportion of light output from a luminaire with dirt deposition after a stated period, compared with the initial light output when clean.

Luminance (cd/m²)

The perceived brightness of a surface, measured by the intensity of light emitted or reflected from a surface area in a given direction.

Luminous Efficacy (lm/W)

The ratio of light emitted, to the power consumed by a lamp.

Luminous Flux (lm)

The total light emitted by a lamp, measured in lumens.

Luminous Intensity (cd)

The power of a light source or illuminated surface to emit light in a given direction, measured in candela.

Lux

The unit of illuminance, equal to one lumen per square metre (lm/m²).

Maintained Emergency Luminaire

A luminaire containing one or more light sources, all of which operate from the normal supply or from the emergency supply at all material times.

Maintenance Factor (MF)

The ratio of the illuminance provided by an installation at a stated period, compared to the installation when new. Calculated as a product of lamp lumen, lamp survival, luminaire and room surface maintenance factors.

Mounting Height

The vertical distance between the luminaire and the working plane.

Note: For emergency lighting the floor is always taken to be the working plane.

Non-Maintained Emergency Luminaire

A luminaire containing one or more light sources, which operate from the emergency supply only upon failure of the normal mains supply.

Place of Safety

Place in which persons are in no danger.

Rated Duration

The manufacturers declared duration for a battery operated emergency lighting unit, specifying the time for which it will operate after mains failure. This may be for any reasonable period, but is normally one or three hours (when fully charged).

Rated Load

The maximum load which may be connected to the system which will be supplied for the rated duration.

Re-charge Period

The time necessary for the batteries to regain sufficient capacity to achieve their rated duration.

Responsible Person

Delegated individual who is responsible for provision and operation of appropriate emergency escape lighting.

Room Index

Index defining the relationship between the height, length and width of a room. Used for illuminance calculations.

Room Surface Maintenance Factor (RSMF)

The proportion of illuminance provided by a lighting installation with dirt deposition on the room surfaces after a stated period, compared with the illuminance when the room was clean.

Self Contained Emergency Luminaire

A luminaire or sign providing Maintained or Non-Maintained emergency lighting, in which all the elements such as battery, the lamp and the control unit are contained within the housing or within 1 metre of the housing.

Slave Luminaire

An emergency luminaire without its own batteries, which is designed to work in conjunction with a central battery system.

Spacing to Height Ratio (SHR)

The ratio of the distance between luminaire centres in relation to their height above the working plane. Maximum spacing to height ratio (SHR_{max}) is the maximum spacing of an array of luminaires that will achieve a ratio of min/max direct illuminance of at least 0.7.

Standby Lighting

The part of emergency lighting which may be provided to enable normal activities to continue in the event of a mains supply failure.

Sustained Emergency Luminaire

See combined emergency luminaire.

Uniformity

The ratio between minimum illuminance (or luminance) to average illuminance (or luminance), usually measured at the working plane.

Upward Light Output Ratio (ULOR)

The ratio of luminaire light output above the horizontal, compared with total lamp light output.

Utilance (U)

The proportion of luminous flux emitted by a luminaire which reaches the working plane.

Utilisation Factor (UF)

The proportion of luminous flux emitted by a lamp (or lamps) which reaches the working plane.

Visual acuity

A measure of the ability to distinguish details and shapes of objects.

Product selection

Other areas

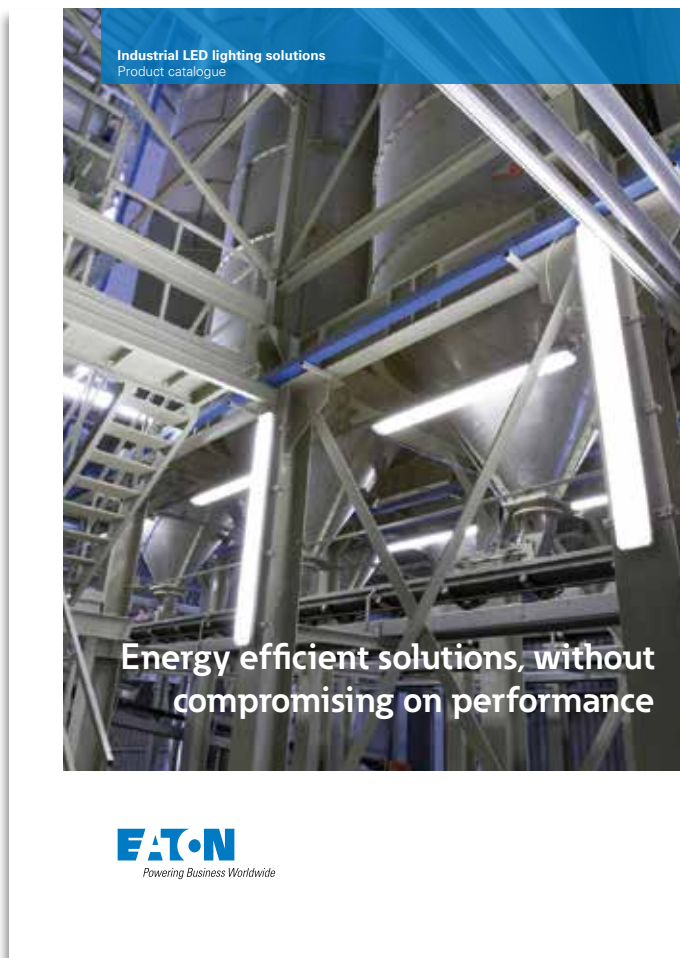
Eaton can also supply lighting products to ancillary areas often found in and around industrial sites. Most sites will contain offices, transitory spaces, control rooms, bathrooms and other welfare areas.

For advice on lighting solutions for these areas, contact your local sales representative.

Product selection

This guide has provided a brief outline of the issues surrounding lighting for industrial facilities. The Eaton products mentioned here are fully explored in our accompanying industrial LED lighting product catalogue.

A PDF version is available online.



Industrial LED lighting product catalogue

Contact details

Eaton products are available through a network of stockists, backed up by extensive stocks held at our Doncaster site. For assistance in specifying and ordering products, or to obtain further information, please contact the UK sales office below:

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Eaton's electrical business is a global leader with expertise in power distribution and circuit protection; backup power protection; control and automation; lighting and security; structural solutions and wiring devices; solutions for harsh and hazardous environments; and engineering services. Eaton is positioned through its global solutions to answer today's most critical electrical power management challenges.

Eaton is a power management company with 2016 sales of \$19.7 billion. We provide energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. Eaton is dedicated to improving the quality of life and the environment through the use of power management technologies and services. Eaton has approximately 95,000 employees and sells products to customers in more than 175 countries. For more information, visit Eaton.com.

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