Raytec White-Paper

Hazardous Area Certification: The Basics

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Raytec is a world leader in LED lighting for hazardous area environments. SPARTAN is our range of globally certified Ex LED luminaires, delivering class-leading performance and reliability.

Whether you're new to specifying equipment for use in hazardous areas or simply looking to refresh your understanding, this White Paper will cover some of the fundamental considerations you should consider when handling a project which involves a potentially explosive atmosphere. While Raytec, and some of the content within this White Paper, is focused on lighting equipment, much of the same consideration should be given to any electrical equipment being used in a hazardous area.

The contents of this paper will cover:

1. What is a Hazardous Area?

A hazardous area can be defined as any location where there is a risk of an explosion. It is important to know that they can exist in any workplace. Typically, this includes oil rigs, refineries, chemical production facilities, and food production sites to name just a few, but there are other less obvious applications that require hazardous area equipment. Raytec have been involved in projects requiring hazardous area lighting from football clubs to cemeteries!

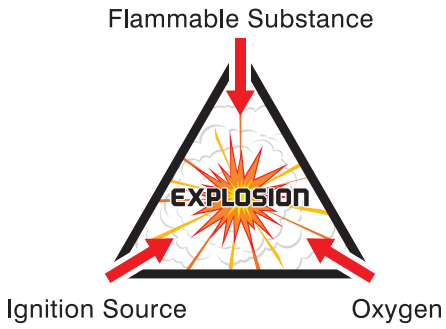
Specialist lighting plays an important role in the safety and efficiency for many businesses where hazardous areas are present, so it is important to know when and why this type of lighting is required.

2. Why is Hazardous Area Lighting Required?

Where there is potential for an explosive atmosphere, special precautions are needed to prevent fires and explosions. Lighting, as well as other electronic equipment, needs to be purpose-designed for use in hazardous areas to prevent a spark from occurring and igniting any flammable substances.

For an explosion to occur, there are three components that need to be present;

1. Flammable Substance – this needs to be present in a relatively high quantity to produce an explosive mixture (e.g. gas, vapours, mists, and dusts).
2. Oxygen – oxygen is required in high quantities and in combination with the flammable substance to produce an explosive atmosphere.
3. Ignition Source – a spark or high heat must also be present.



All electrical equipment used needs to be specially designed and tested to avoid igniting an explosion. Explosion-proof LED lighting is a must in areas where these components exist. This means the luminaire will be able to either prevent sparks from occurring, or to contain them, in order to ensure it cannot be exposed to the flammable substance in the air, and to prevent an explosion.

One example where gases and dusts can be dangerous in the workplace is in pharmaceutical manufacturing. Although it may not be one of the first industries which come to mind when thinking about typical uses for hazardous area equipment, large parts of modern pharmaceutical facilities are classified as zoned hazardous areas. This is due to;

- Raw solvents, chemicals and gases which are used during the manufacturing process
- Powders, dusts, and gases produced as a by-product of manufacturing
- Storage of materials and gases on-site for use in manufacturing

This means Ex lighting is often required for many areas throughout the site, including internal manufacturing areas, clean rooms, internal and external access as well as storage areas.

If you would like to explore some of the other interesting hazardous area applications that Raytec have been involved in, explore our **'EX Lighting Guides'**.

Go to Lighting Guides

3. Zone Classifications

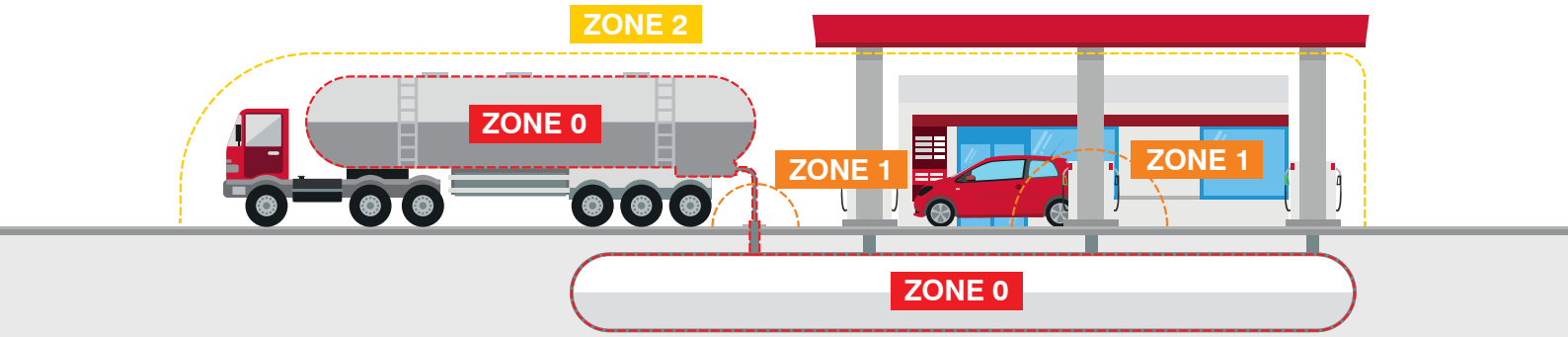
Although every application is different, for the ease of monitoring and specification each hazardous area is classified as a particular level or “zone”. Zones define the type of explosive atmosphere, as well as the likelihood of an explosive atmosphere being present. The risk also depends on how long the hazard is present.

As a result, all hazardous area equipment must be designed with hazardous area zone classifications in mind, as the “zone” governs the level of protection and precaution required. It is essential to know which zone you are working in so that you can specify the most appropriate equipment.

For gases, vapours, mists, and dusts there are three zones.

Gas	Dust	Hazardous Area Zone Characteristics
Zone 0	Zone 20	Explosive atmosphere present continuously or for long periods
Zone 1	Zone 21	Explosive atmosphere likely to occur in normal operation
Zone 2	Zone 22	Explosive atmosphere not likely to occur in normal operation but may be present for short periods

To make this even easier to understand, take a look at the diagram of a typical petrol station below where we have identified the areas that are classified as Zone 0, Zone 1 and Zone 2. However, it’s important to note that this is solely an indicative example and will not necessarily apply to all applications. The Zone classification depends on many factors, such as the level of ventilation.



3.a How do I Know What Zone I Need?

Knowing which Zone you need can be a challenge. This is because every application is different and the site needs to be independently classified to determine things such as the types of gas and dust present and in what volume, plus the level of ventilation on site. Ultimately, it is always recommended that hazardous area classification needs to be done on-site by qualified personnel and applying the standard 60079-10.

4. Product Certification

The high-risk nature of a hazardous area means that strict certification requirements exist for any electrical equipment being installed in these locations. This ensures lighting, and other equipment, do not present a safety risk and is compliant with the necessary regulations. To obtain this certification, the luminaire must generally be tested and approved by an independent third party called a 'notified body'.

There are several different certification authorities that exist in relation to hazardous equipment, and those relevant to you will depend on where the products are being installed. In this section, we look at some of the most widely known and used certification markings for hazardous area equipment.

4.a Certification Standards

IEC 60079 is a series of standards relating to explosive atmospheres as set out by the International Electrotechnical Commission. These standards define how electrical equipment must be designed, constructed, tested, and marked in order to be used in an explosive atmosphere. IEC 60079 is used by certification authorities across Europe as well as internationally.

In North America, a different set of standards are used, although there are many similarities to IEC 60079.

Several certification authorities exist to enforce the relevant standards;

IECEx (International) – IEC 60079

IECEx is the certification system based on the IEC 60079 standards for equipment use in hazardous areas. IECEx is an internationally accepted means of proving compliance with IEC standards.

Look out for the Ex, CE and UKCA logo, along with the IECEx certification data which the manufacturer should publish on their website.

Given that the IEC standards are used in many national approval schemes, IECEx certification can often be used to support any specific national compliance which is required, negating the need for additional testing in most cases.

What is the IEC Database?

The IEC Ex database is used by many as it allows you to public view the certificates of any product registered for use, not just light fittings. It includes a variety of products with a hazardous certification, such as a power supply or stopper plug for example. This means that customers can corroborate the certifications given to them by a supplier.

ATEX (Europe) – EN 60079

The ATEX directive is the European certification that is mandatory across Europe and based on the IEC 60079 series of standards. Like IECEx, ATEX involves all stages from the manufacture, through to the installation and use of the equipment. Companies must fulfil the ATEX requirements to be able to manufacture, import or distribute Ex equipment within the EU.

Certified equipment must be marked with the Ex logo, as shown to the left. The logo should be included on the product name plates of the physical product, and the manufacturer should publish ATEX certification data on their website.

QAN / QAR

To manufacture products intended for use in potentially explosive atmospheres, manufacturers must be ATEX/ IECEx compliant. Compliance issued by a notified body is required to ensure the manufacturer is authorised to produce and sell hazardous equipment.

UKCA / UKEX (United Kingdom) - BS 60079

UKCA stands for the 'United Kingdom Conformity Assessment' and was introduced in January 2021 following the UK's exit from the EU. The UKCA mark is used to declare that all products conform to the applicable UK legislation.

In the case of hazardous area equipment being installed in the UK, the ATEX directive has now been replaced by UKCA and the UK directive SI 2016: 1107 – a UKCA Ex scheme known as UKEX.

Like ATEX, the UKEX scheme is also based on the IEC 60079 series of standards. The UKCA mark must be placed on the goods themselves and replaces the CE mark for products being placed on the market in Great Britain. Look for the UKCA mark on product nameplates and the UKCA certification on the manufacturer's website.

In addition to the Notified Body and QAN issued under the ATEX Directive, a separate UK based Approved Body and UK QAN must be applied to products under the UKEX scheme.

C1D1 & C1D2 (North America)

Unlike most countries, Canada and the United States do not base national compliance for hazardous area products on the IEC 60079 series of standards. Instead, a separate range of UL (or CSA for Canada) standards exist which the equipment must comply with.

The UL listed mark indicates that products comply with the requirements of the standard and have been tested according to Canadian or US standards. Look out for the UL markings on the nameplates of the physical product and on any product literature shared by the manufacturer.

Other Countries

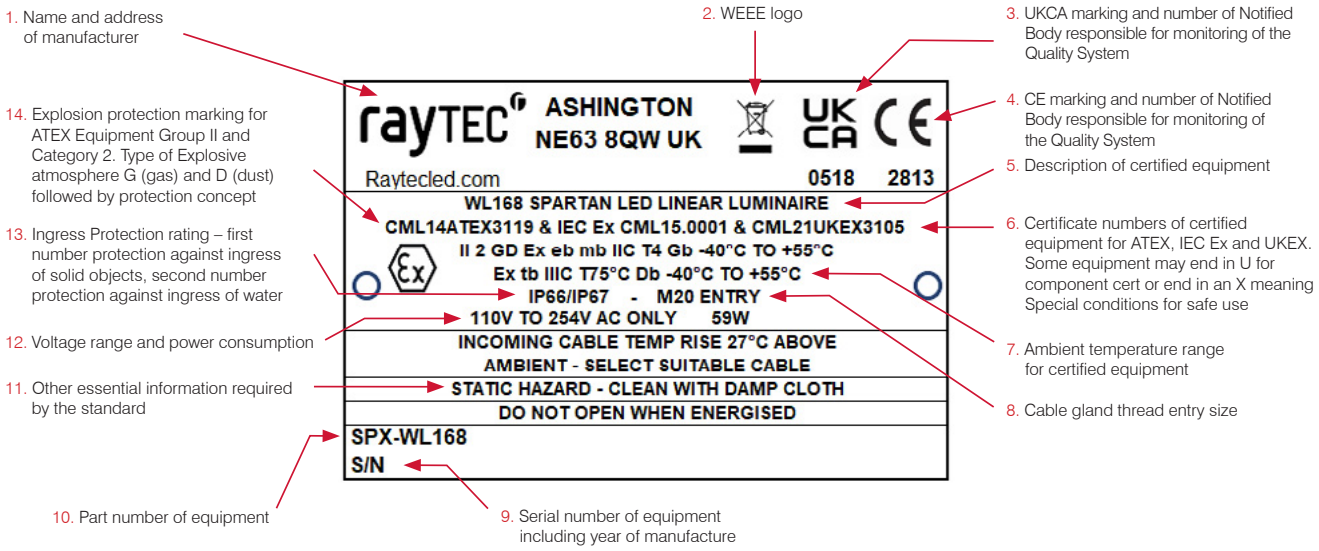
For other countries outside of the jurisdiction of the above covered regions, additional local requirements may also apply. However, in most cases these tend to be based on the IEC Ex certificate and is unlikely to require further testing.

5. Understanding Nameplates for Ex Luminaires

An Ex luminaire's nameplate provides valuable information about the equipment. It allows you to identify the manufacturer, the areas in which it's safe to be used, as well as information about the luminaire's specification, such as input voltage, ingress protection rating and much more. For installers and end-users, this information is critical to ensuring the luminaire is installed correctly and safety on-site is maintained.

To understand the different information a nameplate tells us, we'll look at an example of the nameplate that would be fitted to Raytec's SPARTAN WL168 Linear luminaire. The look and layout of a nameplate will vary between the manufacturer; however, this is a typical example of the markings you should expect to see from a luminaire that has been certified for use in a hazardous area.

Raytec Nameplate Example



For manufacturers that are developing products specifically for hazardous locations, nameplates are a necessity to showcase the latest and appropriate certification standards. It is important that manufacturers keep their nameplates up to date with the correct information. If not, unclear markings can lead to incorrect equipment being purchased and installed on-site which can lead to a critical safety issue.

5.a Presence of an 'X' on the Certificate

Have you ever seen an 'X' on an Ex-certificate? It's important to know why an 'X' might be used and to look out for the 'X' symbol. It identifies that there is a specific condition, whether that is to do with installation, use or maintenance of the equipment, that should be considered when using the equipment in hazardous areas.

Look out for an 'X' at the end of the certificate number of the certified equipment.

Certificates, as well as installation guides and manuals, must include explanations of what the X conditions are. An X-symbol does not automatically mean something bad; it could be something as simple as how to clean the equipment safely, but it is important that this information is shared to ensure that the equipment is safe to install, use and maintain in a hazardous area.

6. Protection Methods

We have already covered the importance of approving a luminaire to the appropriate level, based on the environment in which it is being installed. For example, if the site has been designated as a Zone 1 hazardous area, you will need to specify a luminaire that is approved to Zone 1 standards.

In addition to this, it is also important to look at the method of protection used during certification as this can have a significant impact on how the luminaire has been designed and will need to be maintained. While there are various protection methods, two are particularly common in Ex luminaires; Ex e 'increased safety', and Ex d 'flameproof'.

	Ex Code	Description	Standard	Location
Flameproof	d	Ex d or Flameproof luminaires approved to this standard must be able to safely contain an explosion, and the accompanying pressure that develops. They must prevent any fire or sparks from escaping the enclosure and into the surrounding explosive environments. This protection method is therefore focused on containment rather than prevention.	IEC/EN 60079-1	Zone 1 if gas group and temp. class correct
Increased Safety	e	Ex e luminaires approved to this standard are designed to be cool running and prevent arcs, sparks and hotspots from occurring. In short, this protection method is focused on preventing the risk of explosion by ensuring an ignition source cannot arise.	IEC/EN 60079-7	Zone 1 or Zone 2

With a basic understanding of the principles behind these protection methods, we can consider how this impacts the way a luminaire can be designed and how that impacts an end user.

There are other protection methods that you may want to be aware of. See Appendix A for more information on these additional Ex protection methods and the basic concepts of protection.

7. Ex e vs Ex d

Ease of Maintenance

One of the main differences between luminaires certified using Ex e or Ex d standards is how easy they are to maintain. This is due to the design and use of flamepaths in an Ex d luminaire which can make maintenance more time-consuming and complicated. With Ex e protection there is no requirement to use a flamepath, making maintenance easier.

Ease of Installation

An Ex d luminaire tends to be bigger, bulkier, and heavier than a comparable Ex e fitting. By being lighter and more compact, Ex e luminaires are easier to install and maintain. When designed using strong materials, such as aluminium or stainless steel, they can still retain high levels of durability and robustness too.

Temperature Ratings & Gas Groups

Due to changes in the property of a gas or vapour at low temperatures, most Ex d luminaires are not suitable for installation in areas below -20°C. Because Ex e luminaires are designed to prevent an ignition source from occurring (rather than preventing gases from entering or escaping), they are likely to have a much wider temperature rating.

To find out more information on the main benefits of Ex e over Ex d, watch our '**Ex e vs Ex d**' webinar.

Watch Webinar

8. Temperature Classifications

When specifying lighting for hazardous areas, another thing to consider is the temperature classification given to the luminaire. The T-Class classifications run from T1 to T6 and are used to identify the minimum auto-ignition temperature the equipment would need to be subjected to for it to ignite. It is important that equipment is tested and classified so that you can determine if the product is going to be suitable for the required application.

The table below shows the T-Class ratings used when specifying Ex lighting and the minimum ignition temperature the equipment would need to be subjected to for it to ignite.

T-Class Rating	Minimum Ignition Temperature	Suitable Equipment
T1 Class	450°C	T1, T2, T3, T4, T5, T6
T2 Class	300°C	T2, T3, T4, T5, T6
T3 Class	200°C	T3, T4, T5, T6
T4 Class	135°C	T4, T5, T6
T5 Class	100°C	T5, T6
T6 Class	85°C	T6

9. Gas & Dust Groups

Gases and dusts are grouped so that end users can identify the risks of ignition and identify the severity of an explosion. The likelihood and severity of an explosion is determined by a variety of factors including the presence of a flammable substance (gases, vapours, mists and dusts), oxygen and ignition source. The flame temperature and minimum ignition energy also need to be considered here.

Testing is done on the atmosphere to determine the gas and/or dust group the area falls into to allow the end-user to select the correct equipment for their hazardous area.

Gas Groups

Area	Group	Representative Gas
Zone 0, 1 & 2	IIC	Acetylene & Hydrogen
	IIB+H2	Hydrogen
	IIB	Ethylene
	IIA	Petrol, Propane, Industrial Methane
	I	Firedamp (Methane) and coal dust

Dust Groups

Area	Group	Representative Gas
Zone 20, 21 & 22	IIIC	Combustible and conductive dusts, such as magnesium
	IIIB	Combustible but non-conductive dusts, such as flour, grain, wood & plastic
	IIIA	Ignitable fibers/flyings, such as cotton lint, flax and rayon

10. IP Ratings

IP (also known as “Ingress Protection”) ratings are used to measure protection from intrusion (e.g. dust) and moisture. All hazardous area luminaires must carry a minimum IP rating, which will depend on the level and method of protection.

An IP rating has two digits (e.g. IP67), the first of which (the 6 in this example) denotes the luminaires protection against dust ingress. A rating of 6 is the highest level of protection which means a luminaire with this rating has complete protection against dust. The second (7 in this example) denotes the luminaires protection against moisture. A rating of 7 means that the luminaire is protected against full immersion for up to 30 minutes at depths between 15cm and 1m with no harmful effects.

Raytec luminaires are either IP66 or IP67 rated, these are defined below:

IP66 – IP rated as “dust tight” and protected against heavy seas or powerful jets of water.
IP67 – IP rated as “dust tight” and protected against immersion for 30 minutes at depths of 15cm – 1m.

11. Specifying Lighting for Hazardous Areas

11.a Lighting Technology

Selecting a luminaire that uses LEDs rather than conventional lighting technology, such as high-pressure sodium or fluorescent, should be considered essential when specifying lighting for hazardous areas.

Fluorescent lighting is used extensively across the world in a wide range of applications and for many years was the only option that was considered – the chances are that if your site has a requirement for hazardous area or industrial lighting, then a large proportion of these will be fluorescent luminaires. Furthermore, if you work closely with lighting, you’ll most likely be aware of some of the issues which can occur with fluorescent technology; look around a site and you will probably see a number of fluorescents that are no longer working - or if they are all still running, frequent maintenance will be required to ensure they are operating correctly.

LED linear luminaires provide a solution to many of the problems which exist with traditional fluorescent fittings. It is useful to highlight the advantages of LED luminaires when specifying, as they provide a solution to many of the problems which exist with traditional fluorescent fittings. If you haven’t already then you should really be considering upgrading your site to LED to take advantage of these benefits.

11.b The Benefits of Hazardous Area Lighting

Longer Life – fluorescent luminaires are more prone to failure compared to LEDs which are unlikely to fail completely.

Lower maintenance with no need for relamping – the long-life LEDs means, that unlike fluorescent fittings, there is no requirement for ongoing lamp changes over the course of the product lifetime.

More consistent light output – over time a fluorescent luminaire will lose almost 40% of its initial lumens, compared to an LED fitting which will lose just a fraction of this figure.

Better performance under higher temperatures – unlike fluorescent luminaires, LED equivalents are largely unaffected by extreme hot or cold temperatures.

Summary

To recap, when specifying equipment for use in hazardous areas, end-users should choose equipment based on the specific requirements of the site. It is important that end-users are aware of these key considerations when specifying:

1. The Zone you are specifying in, so you can specify the most appropriate equipment
2. Where the products are being installed and the certification requirements, to ensure the product is compliant with the necessary regulations
3. The method of protection used during certification, so you are clear how the luminaire has been designed and will need to be maintained
4. The temperature classification given to the luminaire, to identify the minimum auto-ignition temperature the equipment would need to be subjected to for it to ignite
5. The type of hazard, to identify the risks of ignition and the severity of an explosion. Allowing the correct selection of equipment for that specific hazardous area

Follow this general rule of thumb when specifying your hazardous area equipment, and you can rest assured that the site is protected to the highest standards.

Raytec SPARTAN LED Luminaires

Typically, you will find that hazardous area lighting is housed in a solid frame like steel or aluminium. Additionally, for hazardous area products, the nameplate is a critical component and must always be easily legible. Using the wrong equipment could result in a critical safety issue.

Raytec offers a full range of LED luminaires suitable for hazardous areas. Our SPARTAN range of luminaires are encased in marine-grade aluminium for guaranteed reliability, and every luminaire is fitted with a laser engraved, stainless-steel certification nameplate permanently riveted in place to guarantee longevity and durability (and the information contained within it). Most commonly, nameplates found on Ex luminaires consist of a printed, self-adhesive, polyester label.

The lenses are another essential component and need to be extremely durable to withstand the harsh conditions they are often exposed to, to prevent cracks, which can result in leaks. Raytec lenses are UV stabilised polycarbonate, making them extremely durable and able to withstand these harsh conditions.

For more information about specifying equipment for use in hazardous areas or if you have any questions regarding anything covered in this White Paper, call us on **+44 (0) 1670 520 055**, or email Raytec Global at **sales@raytecled.com**.

Appendix A: Ex Protection Methods for Electrical Equipment

Enclosure Type	Ex Code	Description	Standard	Location
Oil Filled	o	Ex o equipment approved to this standard must be able to be completely submerged in oil. The equipment is protected by using a liquid (or oil) in which the electrical equipment is immersed so that an explosive gas atmosphere which may be above the liquid or outside the enclosure cannot access the electrical source of energy and be ignited.	IEC/EN 60079-6	Zone 1 or Zone 2
Intrinsic Safety	i (ia, ib and ic)	Ex i equipment is the 'limitation of energy by electronic circuit design' when all parts of the electrical circuits have been designed to have spark and thermal energy lesser than that required for ignition of the explosive atmosphere, with up to two faults applied for "ia", or one fault for "ib" or no fault but subject to the most onerous conditions for "ic".	IEC/EN 60079-11	All Zones
Pressurised	p (px, py and pz)	Ex p equipment uses the principle of gas exclusion so that there is no explosive atmosphere in the enclosure.	IEC/EN 60079-2	Zone 1 or Zone 2
Powder Filled	q	Ex q equipment approved to this standard are designed to be completely covered with a layer of sand, powder or quartz. This method protects the equipment by quenching of the flame.	IEC/EN 60079-5	Zone 1 or Zone 2
Protection by Enclosure	t (ta, tb and tc)	Ex t equipment prevents the entry of dust inside enclosures where electrical energy may be released by preventing entry of dust and fibres.	IEC/EN 60079-31	Zone 20, Zone 21 or Zone 22
Encapsulation	m (ma, mb and mc)	The components of Ex m equipment are usually encased in a resin type material and designed to keep flammable substances out.	IEC/EN 60079-18	All Zones
Non-sparking	n	Similar to Increased Safety 'e', Ex n equipment is designed to be cool running and prevent arcs, sparks and hotspots from occurring to prevent the risk of explosion by ensuring an ignition source cannot arise.	IEC/EN 60079-15	Zone 2
Optical Radiation	Op (Op pr, Op sh and Op is)	Ex op equipment addresses the ignition hazards caused by optical energy to prevent an ignition caused by energy from light.	IEC/EN 60079-28	Zone 0, Zone 1 and Zone 2

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