



LED Retrofit Lamps

Approved for Hazardous Locations

GE current
a Daintree company

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

LED technology has fundamentally transformed the lighting industry in the past two decades. It brings unprecedented energy efficiency, significantly reduces operating and maintenance costs while vastly improving the color and quality of light in virtually any setting—commercial, industrial, office, retail and outdoor. Most recently, LED retrofit lamps have been developed to replace the High Intensity Discharge (HID) lamps used in hazardous location fixtures, which has accelerated the adoption of LED technology in this unique application. These lamps are purposefully designed and are qualified through vigorous UL testing to be used in the most popular hazardous location fixtures.

The LED hazardous location retrofit lamps offer simple field installation and compelling return on investment (ROI). They provide industrial facility operators in hazardous rated areas an easy upgrade to LED technology that saves 40% or more in energy costs while reducing maintenance and carbon emissions. As these lamps gain popularity in the market, questions may arise about their safety, performance and reliability when used in hazardous locations. This paper will address the concerns regarding the use of these LED hazardous location retrofit lamps for HID.

LED Retrofit Lamp for HID

In its most basic form, an LED retrofit lamp for HID modifies an existing HID lighting fixture into an LED fixture. LED retrofit lamp kits for HID generally consist of a LED lamp, a re-lamp warning label, safety tethers (in some instances), an in-line fuse kit and mounting accessories. LED retrofit lamps for HID gives facility managers the fastest, most cost-effective means to replace outdated HID lamps with the efficiency and performance of LEDs. Why are so many facilities making the change from HID lamps to LED retrofit lamps? The numbers say it all. The key benefits of replacing a HID lamp with a LED retrofit lamp:

1. Save at least **50%** in energy usage.
2. Realize **2 to 3 times longer life**. LED HID retrofit lamp life is typically **50,000 hours**, while HID lamp life for a HPS lamp is typically 24,000 hours, and Metal Halide lamp is typically 10,000 to 20,000 hours¹.
3. Achieve payback generally in **< 1 year**.

LED HID retrofit lamps are designed to replace HID lamps. However, there are large variations in the luminous flux of different manufacturers' LED retrofit lamps that claim to be the equivalent of a particular HID lamp. These variations generate confusion for customers, and an uneven playing field for manufacturers. To address this issue, NEMA is working to establish Standard LL-10-202X (under consideration): LED Replacement Lamps for HID Lamps Light Output Equivalency Claims². End users, specifiers and entities establishing requirements will be able to use this proposed standard to ensure that enough light output is obtained to adequately cover the demands of their original HID applications.

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

Table-1 is a summary of the proposed NEMA standard on *Light output levels required for equivalency* versus GE Current, a Daintree company (“Current”)’s LED retrofit lamp offerings. Per NEMA Standard LL-10-202X a LED lamp must exceed the luminous flux in the third column in order to claim equivalency to the HID lamp in the same row. In the third column, NEMA included corrections for lumen maintenance and color rendering. The second column is the minimum initial light output from surveys NEMA conducted of online products of HID lamps in the North American market. Interpolated and extrapolated values for uncommon wattages are indicated by (I) and (E), respectively, in the first column. The lamps listed in the fourth column are Current’s standard LED retrofit lamp offerings that can claim equivalency to the HID lamp in the same row. The fifth column provides Current’s LED hazardous location retrofit lamp offerings that can claim equivalency to the HID lamp in the same row.

Metal Halide Lamp Wattage (W)	Metal Halide Initial Light Output (lm)	Minimum LED Lamp initial light output (lm)	Current standard LED retrofit lamps	Current LED hazardous location retrofit lamps
50	3200	2000	LED21ED17	LED21ED17/HAZ
70	5200	3000	LED21ED17;	LED21ED17/HAZ;
100	8100	5000	LED35ED17; LED45ED17	LED35ED17/HAZ; LED45ED17/HAZ
150	12000	7500	LED50ED23.5	LED50ED23.5/HAZ*
175	11000	7000	LED50ED23.5	LED50ED23.5/HAZ*
250	19100	12000	LED80ED23.5	LED80ED23.5/HAZ*
320 (I)	25600	16500	LED115ED28	LED115ED28/HAZ*
350 (I)	28400	18000	LED115ED28	LED115ED28/HAZ*
360 (I)	29400	19000		
400	33100	21500	LED150ED28	LED150ED28/HAZ*
750 (I)	72300	46500	LED360ED37	
1000	100280	65000	LED450BT56	

HPS Lamp Wattage (W)	HPS Initial Light Output (lm)	Minimum LED Lamp initial light output (lm)	Current standard LED retrofit lamps	Current LED hazardous location retrofit lamps
50 (E)	4500	2500	LED21ED17	LED21ED17/HAZ
70	6300	4000	LED35ED17	LED35ED17/HAZ
100	9500	6000	LED45ED17; LED50ED23.5	LED45ED17/HAZ
150	13000	8500		
200 (I)	19500	12500		
250	26000	17000	LED115ED28	LED115ED28/HAZ*
310 (I)	33200	21500	LED150ED28	LED150ED28/HAZ*
400	44000	29000	LED200ED37	
600 (I)	66000	42500	LED270BT56	
750 (I)	82500	53500		
1000	110000	73000		

**Available in 2021*

Table-1: Proposed NEMA Light output levels required for equivalency and Current’s LED retrofit lamp offerings.

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

The ANSI Profile and Why It Is Important for LED Retrofit Lamps

ANSI (American National Standards Institute) has published a series of specification standards for HID lamps^{3,4,5}. These standards set forth the physical and electrical characteristics for different shapes and styles of HID lamps to ensure interchangeability and safety. Figure-1 is an example of an ED23.5 Metal Halide Lamp Maximum Outline Drawing from ANSI C78.43-20173. The ANSI Maximum Outline Drawing is sometimes also referred to as an ANSI profile.

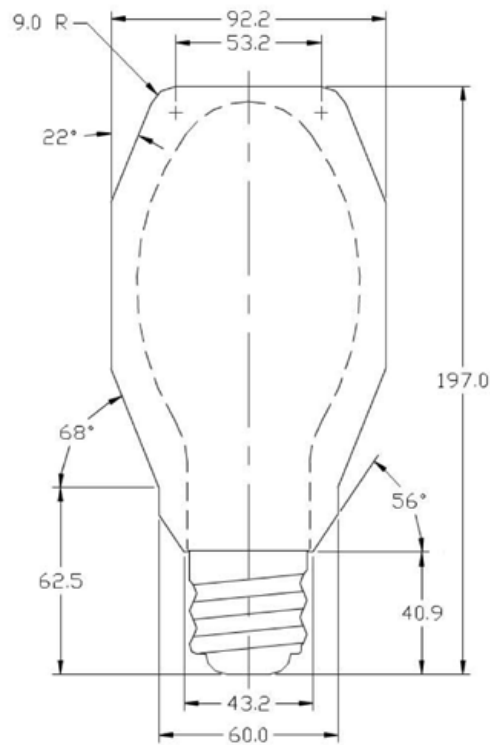


Figure 1: An example of ED23.5 Metal Halide Lamp Maximum Outline Drawing from ANSI C78.43-2017³

HID lamps, including Metal Halide lamps, High-Pressure Sodium lamps and High-Pressure Mercury lamps, from different lamp manufacturers are expected to conform to these ANSI standards. Luminaire manufacturers also design their fixtures according to these ANSI standards, so lamps that conform to the ANSI profile should not have problems fitting in those fixtures. Traditional HID lamp manufacturers and luminaire manufacturers are quite often different entities, but thanks to these ANSI standards, traditional lamp and fixture compatibility has not been an issue.

The emergence of many non-ANSI profile LED retrofit lamps breaks this established harmony. There are enormous technical challenges to design a LED retrofit lamp for HID that conforms to the ANSI profile without sacrificing reliability, light output, efficacy and cost. As a result, many companies have launched LED retrofit lamp that are bigger than the ANSI profile. Customers who purchase these non-ANSI profile LED retrofit lamps may face a fit challenge. Even when the fixtures can accommodate these larger lamps, the fixture light distribution will most likely be compromised because of the larger lamp size.

Current's LED retrofit lamps, both standard and hazardous location, are precision-engineered with our proprietary technologies (U.S. Patent 10788163) to fit within the ANSI profiles without sacrificing performance. This allows Current to bring reliable and long-lasting LED retrofit lamps into existing HID fixtures without compromising on fit.

LED Retrofit Lamps – APPROVED FOR HAZARDOUS LOCATIONS

What Constitutes a Hazardous Location?

The National Electrical Code (NEC) defines Hazardous locations in terms of **CLASS, DIVISION** and **GROUP**:

- **CLASS I** locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.
- **CLASS II** locations are those that are hazardous because of the presence of combustible dust.
- **CLASS III** locations are those that are hazardous because of the presence of easily ignitable fibers or flyings, but in which such fibers or flyings are not likely to be in suspension in the air in sufficient quantities to produce ignitable mixtures.

Each **CLASS** is further defined as either **DIVISION 1** or **DIVISION 2**.

- **DIVISION 1** is an environment that is normally hazardous.
- **DIVISION 2** is an environment that is not normally hazardous.

GROUP defines the specific hazardous material in the surrounding atmosphere.

- **CLASS I** areas common materials **GROUP** ratings: **GROUP A**—Acetylene; **GROUP B**—Hydrogen; **GROUP C**—Ethylene; **GROUP D**—Methane & Propane.
- **CLASS II** areas common materials **GROUP** ratings: **GROUP E**—Metal Dust; **GROUP F**—Carbon & Charcoal; **GROUP G**—Flour, Starch, Wood & Plastic.

An example description of a specific hazardous location is “**Class 1, Division 2, Groups A, B, C, D**”.

Please be aware that the classification of a given area as to **Class, Division** and **Group** is based on the judgment of **the owner, insurance company and the Authority Having Jurisdiction** taking into consideration many factors.

Hazardous Location Temperature Code and Why It Is Important

Hazardous flammable gases, vapors, combustible dust, ignitable fibers or flyings may auto-ignite if they encounter a surface that has a temperature above their auto-ignition temperature. Table-2 shows the auto-ignition temperatures of some substances that are common in **Class I, Division 2, Groups A, B, C, D** Hazardous locations.

NEC Class	Division	Group	Typical Atmospher and Autoignition Temperatures
1 Gases, Vapors	2 Not Normally Hazardous	A	Acetylene (305°C, 581°F)
		B	Hydrogen (502°C, 986°F) manufactured gases containing more than 30% hydrogen (by volume)
		C	Ethylene (450°C, 842°F) Cylopropane (503°C, 938°F)
			Hexane (225°C, 437°F) Butane (288°C, 550°F) Propane (450°C, 842°F) Acetone (465°C, 869°F) Benzene (420°C, 788°F) Gasoline (280°-471°C, 536°-880°F)

Table 2: Class I, Division 2, Group A, B, C, D Hazardous Substances Auto-ignition Temperatures

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

To mitigate the risk of hazardous substance auto-ignition, UL assigns a hazardous location temperature rating to each certified hazardous location luminaire. The temperature rating is based on the maximum temperature of the luminaire and the lamp within or retrofit lamp kit in a specified ambient temperature range, depending on its hazardous location classification.

- For **Class I, Division 1, All Groups**, and for all **Class II Divisions and Groups**, and for all **Class III Divisions**, the maximum temperature is measured on the exterior of the luminaire. The maximum temperature that a given combination of lamp wattage, optical configuration and ballast housing produces while operating in a specific ambient temperature environment **MUST BE LESS** than the temperature Limiting Value specified for that **Class, Division and Group**.
- For **Class I, Division 2, Groups A, B, C, and D**, the maximum temperature of the luminaire is measured inside the luminaire, if the luminaire contains a traditional HID lamp, usually on the lamp wall surface; for LED fixtures or LED retrofit lamps the maximum temperature is typically measured on the phosphor of the LED. The reason for measuring the maximum temperature inside the luminaire is because the gases in the area could infiltrate the luminaire, contact the lamp or LED surface, and ignite if their auto-ignition temperatures are below that of the lamp or LED surface.

UL844 "Luminaires for Use in Hazardous (Classified) Locations" use the Temperature Code Table in Table-3 to designate a maximum temperature range identification number for each tested hazardous location lamp or fixture. This code is called the Hazardous Locations Temperature Code, or Tcode. The Tcode matches the identification numbers with the maximum temperature range in degrees Celsius (C) that they represent. The codes are then placed on the hazardous locations luminaire's fixture label.

	Identification Number*	°C	Identification Number*	°C
Maximum Temperature Range Identification Number	T1	450	T3A	180
	T2	300	T3B	165
	T2A	280	T3C	160
	T2B	260	T4	135
	T2C	230	T4A	120
	T2D	215	T5	100
	T3	200	T6	85

*The higher the identification number, the lower the temperature of the fixture.

Table 3: Temperature Code Table (UL844)

Table-4 presents an example of Current's LED hazardous locations retrofit lamps Temperature Code. At the time this paper is written, these lamps are UL844 Listed for **Class I, Division 2, Groups A, B, C, D** hazardous locations. Per NEC Article 500-503, in **Class I, Division, 2, Groups A, B, C, and D** hazardous locations, the maximum luminaire temperature rating is not to exceed the auto-ignition temperature of the gases or vapors involved.

Therefore, LED21ED17/YXX/HAZ can be used at a hazardous atmosphere where ambient temperature of the fixture is below 65°C and the auto-ignition temperature of the gases or vapors involved is higher than 120°C (T4A).

LED35ED17/YXX/HAZ can be used at a hazardous atmosphere where ambient temperature of the fixture is below 55°C and the auto-ignition temperature of the gases or vapors involved is higher than 135°C (T4).

LED Retrofit Lamps – APPROVED FOR HAZARDOUS LOCATIONS

LED45ED17/YXX/HAZ can be used at a hazardous atmosphere where ambient temperature of the fixture is below 45°C and the auto-ignition temperature of the gases or vapors involved is higher than 135°C (T4). Note that **Class I, Division 2, Group A, B, C, D** Hazardous Substances presented above in Table-2 all have their auto-ignition temperature higher than T4 or T4A, therefore each of these lamps can be used in all those applications.

Model	Ambient Temperature Range	Operating Temperature Code
LED45ED17/YXX/HAZ	-40°C to +45°C	T4
LED35ED17/YXX/HAZ	-40°C to +55°C	T4
LED21ED17/YXX/HAZ	-40°C to +65°C	T4A

Table 4: Current LED Hazardous Location Retrofit Lamps Temperature Code

How to Select the Right LED Retrofit Lamp for a Hazardous Location Luminaire

To satisfy the lighting needs of an area having a hazardous or potentially hazardous environment, **The owner, responsible insurance company and the Authority Having Jurisdiction** must have certain knowledge of the environment to define the needs of the area before specifying a luminaire or lamp in the luminaire. Included in this knowledge should be a full understanding of National Electrical Code® (NEC®), National Fire Protection Association (NFPA), Factory Mutual (FM), Underwriters Laboratories Listings (UL Listing), National Electrical Manufacturers Association (NEMA), and other governing body codes, standards and testing procedures. This knowledge must also include an awareness and understanding of local codes, the physical and chemical properties of the environments, and the testing procedures applicable to the application and product. With this knowledge, a qualified individual can then begin to determine the proper code(s) and code requirements that a luminaire system or a retrofit lamp for a hazardous location must meet.

For hazardous locations, NEC Articles 500-517 and the UL844 are particularly relevant to lamp or luminaire selection. The National Electrical Code (NEC) Articles 500-517 define, categorize and provide the basic ground rules of the application and installation of lighting fixtures in hazardous locations. UL844 "Luminaires for Use in Hazardous (Classified) Locations" is the UL standard for hazardous locations lighting (CSA C22.2 No. 137 – "Electric luminaires for use in hazardous locations" is used in Canada).

Here's a step-by-step guide that the qualified individual should use to select a UL844 certified LED retrofit lamp for an existing hazardous location luminaire.

Step 1. Determine the hazardous location NEC Class, Division and Group.

At the time of this paper's publishing, Current's LED hazardous locations retrofit lamps are UL844 certified for **Class I, Division 2, Groups A, B, C, and D**. **Proceed to Step 2 only if the hazardous locations fixture belongs to this category.**

Step 2. Check the to be retrofitted fixture label and record the manufacturer name, model number, UL844 certified **Class, Division and Groups**, lamp type and wattage.

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

Figure-2 shows an example of a GE Filtr-Gard™ fixture label. From the label, we can see this fixture model number is GE Filtr-Gard™ H210M, UL844 certified for **Class I, Division 2, Groups A, B, C, D** for all configurations, and **Class II, Division 2, Group G** and **Class II, Division 1, Group E, F, G** for some configurations. The fixture temperature codes are listed on the label for a 100W M90/E metal halide lamp.

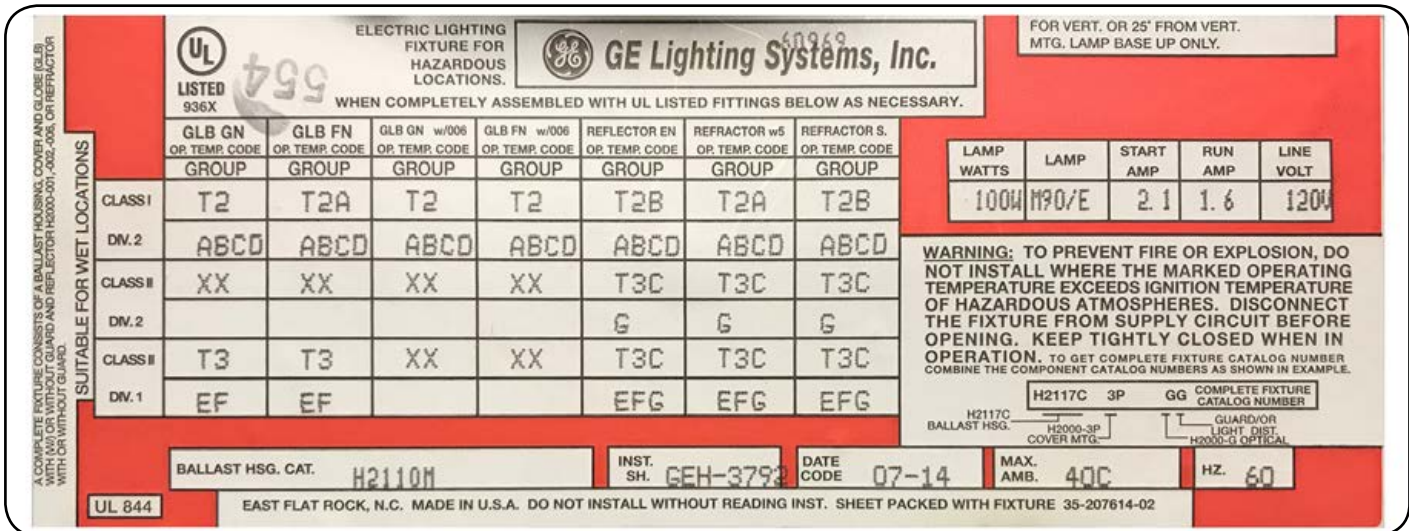


Figure 2: An example of GE Filtr-Gard™ fixture label

At the time this paper is written, Current's LED hazardous location retrofit lamps are UL844 certified for **Class I, Division 2, Groups A, B, C, and D** for the following four fixtures only:

- GE Filtr-Gard™
- Crouse-Hinds Champ® VMV
- Appleton™ Mercmaster™ II Series
- Appleton™ Mercmaster™ III Series

(**Note:** Current will announce more UL approved fixtures in the near future).

Even though the fixture above may carry other ratings such as **Class II, Division 1**, retrofitting of our lamps are only fully approved in the area with **Class I, Division 2, Groups A, B, C, and D** ratings. Proceed to Step 3 only if the luminaire is one of these four types and the fixture is UL844 listed for **Class I, Division 2, Groups A, B, C, and D**.

Step 3. Determine the LED hazardous location retrofit lamp type and wattage

We recorded the lamp type and wattage in the to be retrofitted fixture in Step 2. In the example above, GE Filtr-Gard™ H2 fixture contains a 100W Metal Halide lamp. Consult Table 1: NEMA Light output levels required for equivalency and Current's product offering, we see that both LED35ED17/HAZ and LED45ED17/HAZ will meet or exceed the minimum light output equivalency. There are six models that we can choose from: two light output levels (5000lm or 6000lm) and three CCTs (3000K, 4000K, 5000K). The customer would choose based on their preference. For example, our customer may prefer a higher light output and the metal halide lamp to be replaced has a CCT of 4000K, in which case the choice would be LED45ED17/740/HAZ.

Step 4. Determine the hazardous atmosphere temperature Limiting Value and maximum ambient temperature in the area to be lighted.

As an example, suppose we will light a storage shed containing propane tanks. This area fits the **NEC Class I, Division 2, Group D** with a maximum ambient temperature of 40°C. Auto-ignition temperature of propane is 450°C. For **Class I, Division 2** hazardous locations, the temperature Limiting Value is equal to the auto-ignition temperature of the hazardous substance. In this case it is 450°C.

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

Step 5. Verify the LED hazardous locations retrofit lamps' temperature code can meet the hazardous location temperature requirements in **Step 4**.

Consult Current's LED hazardous location retrofit lamps specification sheet online for the UL approved fixtures temperature profile data. Table-5 presents an example. From Table-5, the LED45ED17/740/HAZ lamp Temperature Code is T4 (in red box) with a maximum fixture ambient temperature of 45°C. The temperature requirements for a storage shed containing propane tanks have a maximum ambient temperature of 40°C. Therefore, LED45ED17/740/HAZ is a good choice for this application.

UL Fixture	HID Lamp Wattage	OEM Fixture Max Ambient Temp. 40°C**	OEM Fixture Max Ambient Temp. 55°C**	OEM Fixture Max Ambient Temp. 65°C**	Current LED Recommended Hazardous Replacement Wattage	LED Replacement Temperature Code
Classification Class 1, Division 2 - Groups A, B, C & D						
GE Filtr-Gard™	50	T3A	T3	T3	21	T4A
GE Filtr-Gard™	70	T3A	T3	T3	35	T4A
GE Filtr-Gard™	100	T2B	T2C	T2C	35/45	T4A/T4
GE Filtr-Gard™	150	T2A	T2	T2	45	T4
GE Filtr-Gard™	250	N/A	N/A	N/A	45	T4
Appleton™ Mercmaster™	50	T3	N/A	N/A	21	T4A
Appleton™ Mercmaster™	70	T3	N/A	N/A	35	T4A
Appleton™ Mercmaster™	100	T2C	N/A	N/A	35/45	T4A/T4
Appleton™ Mercmaster™	150	T2A	N/A	N/A	45	T4
Appleton™ Mercmaster™	175	T2B	N/A	N/A	45	T4
Appleton™ Mercmaster™	50	T3B	T3A	T3	21	T4A
Appleton™ Mercmaster™	70	T3A	T3A	N/A	35	T4A
Appleton™ Mercmaster™	100	T2D	T2D	N/A	35/45	T4A/T4
Appleton™ Mercmaster™	150	T2B	T2A	N/A	45	T4
Appleton™ Mercmaster™	175	T2B	T2A	N/A	45	T4
Appleton™ Mercmaster™	250	T2	T2	N/A	45	T4
Crouse-Hinds Champ™ VMV	50	T3A	T3A	T3	21	T4A
Crouse-Hinds Champ™ VMV	70	T3	T3	N/A	35	T4A
Crouse-Hinds Champ™ VMV	100	T2C	T2B	N/A	35/45	T4A/T4
Crouse-Hinds Champ™ VMV	150	T2A	T2	N/A	45	T4
Crouse-Hinds Champ™ VMV	250	N/A	N/A	N/A	45	T4**

**Max ambient temperature equals the air temperature around the fixture.

Table 5: Current LED Hazardous Location Retrofit lamps UL approved fixtures temperature profile data

Is It Safe to Retrofit a Hazardous Location Fixture with a LED Lamp?

UL has a category (IFUL) to address the safety aspects of hazardous location retrofit kits or retrofit lamps. **For hazardous locations, using a UL844 certified LED hazardous location lamp is the key to ensure safety.**

The UL requirements and definition for LED hazardous location retrofit kits (or lamps) are best illustrated by citing the UL IFUL guide for LED retrofit luminaire conversion kits for use in hazardous locations. This category covers LED retrofit kits intended for field installation in luminaires. The retrofit kits consist of LED light sources, installation instructions, subassemblies, luminaire marking labels and assembly aids (where appropriate) to facilitate the replacement of the existing light source in complete luminaires. The retrofit installation will require modifications to the luminaire in accordance with the manufacturer's installation instructions. UL certified LED retrofit kits have been investigated and determined that, when installed in accordance with the manufacturer's instructions, they do not affect the operation of the luminaire and maintain the original Safety rating.

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

To be UL-certified for use in a hazardous location, a retrofit LED lamp must be tested for compliance to UL844, Standard for Luminaires for Use in Hazardous (Classified) Locations, and certified for use with a specific manufacturer and luminaire model. Included in this certification is the established hazardous location temperature codes (Tcode), which are critical to verifying product suitability for a hazardous location environment. These retrofit kits are supplied with new labels. The new label cites the lamp manufacturer and model certified, and the new lower Tcode as well as indicating the maximum ambient fixture temperature.

To verify UL certification, examine the LED retrofit lamp cartons for the UL Certified Mark as shown in Figure-3. UL844 certified safety mark indicates the lamp is fully accepted and certified for use in the U.S. and Canada for hazardous locations. UL Safety on the retrofitted luminaire is maintained when the manufacturer's installation instructions enclosed with the lamp are followed.



Figure 3: UL Certified Safety Mark

UL also maintains a comprehensive on-line database that allows visitors to search for UL-certified luminaire retrofit kits. The easiest way to verify that a LED retrofit lamp is suitable for hazardous locations is to conduct a search on the UL Online Certification Directory for CCN IFUL, then look for GE Lighting Solutions, LLC. Table 6 shows an example of UL database search results of Current's LED hazardous location lamps on Nov. 17, 2020.

Class 1, Division 2, Groups A, B, C and D Hazardous Locations

Retrofit Kit Cat. No. +	Retrofitted Luminaire Fittings Assembly Model/Cat. No.	Light Source	Rating
Current Fittings:			
LED45ED17/835/HAZ LED45ED17/750/HAZ LED45ED17/740/HAZ LED45ED17/730/HAZ LED35ED17/750/HAZ LED35ED17/740/HAZ LED35ED17/730/HAZ LED21ED17/750/HAZ LED21ED17/740/HAZ LED21ED17/730/HAZ	Ballast Housing	H2 Series Ballast Housings	LED ++
Cooper Crouse-Hinds Fittings:			
	Ballast Housing	VMVC75, VMVC100 and VMVC175 Series Mercury Vapor housings VMVS Series High Pressure Sodium housings VMVM Series Metal Halide housings	
Appleton Fittings:			
	Ballast Housing	LPB Series High Pressure Sodium Housings MLBG, MLBR, KPBR and KPBR Series High Pressure Sodium Lamp Housings	

++ Refer to the markings on the retrofit kits for ratings

Last updated on 11/17/2020

Table 6: UL database search results of Current's LED Hazardous Location Lamps

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

When a hazardous location retrofit lamp meets UL844, UL1598C and UL1993 and is installed per the manufacturer's UL-approved instructions, the system will maintain the UL hazardous location certification of the fixture, with no compromise to safety.

Please be aware that fixture manufacturers tend to push back on ideas that may cost them the sale of a new fixture. They may raise concerns and allege safety issues trying to stop any possibility of using LED retrofit lamps in conventional HID fixtures. It is important to note that the conventional hazardous location fixtures are designed to allow replacement of failed lamps or ballasts periodically as well as continue to meet UL requirements specific to the application and location. In many regards, it is better to retrofit a hazardous location fixture with a UL844 certified LED hazardous location lamp rather than a traditional HID lamp for the following reasons:

1. Conventional metal halide lamps last about 10,000 to 15,000 hours, while Current's LED hazardous location lamps have a life rating of 50,000 hours. This provides three to five times of life over traditional metal halide lamps. Additionally, the fixture needs to be opened much less frequently to replace the LED lamps than failed metal halide lamps, so the wear and tear on the fixture gaskets and seals as well as the maintenance costs are reduced.
2. The lower heat profile of the LED lamp will also help mitigate safety risks. As can be seen in Table-5, hazardous location fixtures retrofitted with Current's UL844 certified LED lamps have a much lower temperature profile than a traditional HID lamp. In typical cases, temperature codes are improved from T2 (300°C) to T4 (135°C); in the worst cases, temperature codes are improved from T3A (180°C) to T4A (120°C). This lowered temperature profile helps reduce safety risks and prolong the life of the gaskets and seals.
3. Retrofitting with Current's UL844 certified LED lamps will remove the aging HID lamp ballasts from the circuit. This permanently eliminates another failure point while reducing safety risks and thermal loading on the fixture.

Performance of LED Retrofit Lamps Inside a Hazardous Location Fixture

To ensure a satisfactory retrofit experience, LED hazardous location lamps are carefully engineered so that the luminaire will produce equivalent lumen output, similar light distribution and good illuminance levels in the targeted application areas. In this section, we will discuss performance of LED retrofit lamps in hazardous location fixtures including light output under room temperature and elevated temperature, light distribution and surge protections.

Light output example in a hazardous location fixture under room temperature

We seasoned a 70W metal halide lamp for 100 hours, then installed the lamp into an Appleton Mercmaster III 70W fixture and measured its total light output and system power. The fixture comes with an old and inefficient magnetic ballast, which is typical in most retrofit situations. The measured fixture total system power is 94W and light output is 4730 lumens. We then bypassed the ballast and retrofitted the fixture with a LED 35W hazardous location lamp. Total system power reduced to 39W and light output measured at 4643 lumens. By retrofitting a 70W metal halide hazardous location fixture with a LED 35W hazardous location lamp, you will get similar total initial light output while saving >57% of energy.

Traditional HID lamps have poor lumen maintenance. Per IES RP-36-151 and NEMA LL-102, lumen maintenance of metal halide lamp at 40% rated life (typically 4,000 hours) is 65% of its 100 hours lumens, lumen maintenance of HPS lamps at 50% rated life (typically 12,000 hours) is 87%, and lumen maintenance of LED at 50% of rated life is 84% (typical LED L70 life is 50,000 hours). Therefore, retrofitting an old HID fixture with an equivalent LED retrofit lamp would produce increased maintained light levels in most cases.

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

Light distribution in a hazardous location fixture

We measured the light distribution of the Appleton Mercmaster III fixture with a seasoned 70W metal halide lamp and a LED lamp (LED35ED17/HAZ) under photometric laboratory conditions. Figure-4 illustrates the polar plot comparison, where the green line is the polar plot with LED35ED17/HAZ lamp and the red line is the polar plot with 70W metal halide lamp. Table-7 provides the photometric zonal lumen property comparison. The results indicate the hazardous location fixture with the 70W metal halide lamp and the LED 35W hazardous location lamp produces similar zonal lumen distributions, and the polar plots are also similar. Based on the similarity in spatial distribution of lumens, we can expect them to produce similar illuminance levels in the targeted application areas.

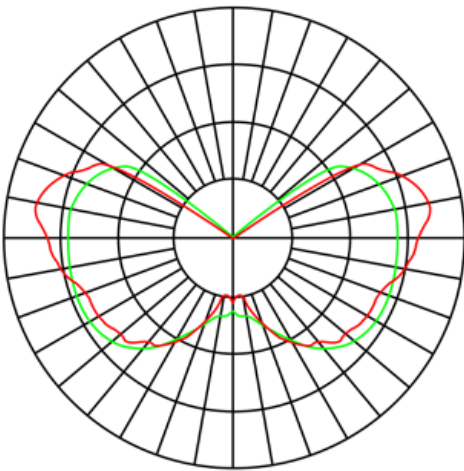


Figure 4: Polar plot LED35W lamp versus 70W metal halide lamp in an Appleton Mercmaster III fixture

Zone	70W Metal halide lamp		LED35ED17/HAZ	
	Lumens	% Luminaire	Lumens	% Luminaire
0-30	263	5.6%	250	5.4%
0-40	529	11.2%	505	10.9%
0-60	1316	27.8%	1315	28.3%
60-90	1651	34.9%	1576	33.9%
90-120	1674	35.4%	1461	31.5%
0-90	2967	62.7%	2892	62.3%
90-180	1763	37.3%	1751	37.7%
0-180	4730	100%	4643	100%
Total luminaire watts	94		39	
Luminaire efficacy rating (LER)	50		118	

Table 7: Zonal lumens of LED35W lamp and 70W MH lamp in an Appleton Mercmaster III fixture

Light output in a fixture at elevated temperature

In some hazardous location applications, the fixtures must operate under elevated ambient temperatures. It is well known that the light output of an LED chip decreases as operating temperature rises. Therefore, all LED hazardous location fixtures, including the ones that are retrofitted with a LED hazardous location lamp, will have reduced light output at an elevated temperature.

LED Retrofit Lamps - APPROVED FOR HAZARDOUS LOCATIONS

LED hazardous location lamps are sometimes designed with a thermal protection mechanism called “thermal foldback.” This feature will begin to reduce the power supplied to the LED chips when the lamp temperature reaches a pre-determined thermal set-point. This feature provides additional protection for safety and reliability; however, it will reduce fixture light output under elevated temperatures. Table-8 shows Current hazardous location lamp in-fixture performance at elevated temperatures. The 21W hazardous location lamp (LED21ED17/HAZ) will operate at full power from 25°C to 65°C. The thermal foldback feature will not be triggered; the light output reduction and the slight lamp power reduction is typical LED chip behavior under elevated temperatures. The 35W and 45W hazardous location lamps (LED35ED17/HAZ and LED45ED17/HAZ) will trigger the thermal foldback feature at 45°C ambient temperature and therefore have reduced light output (9% reduction for 35W lamps and 21% reduction for 45W lamps at 45°C ambient temperature). Any selection of LED hazardous location lamps for elevated ambient locations must keep this light output derating factor in mind.

Ambient Temperature (°C)	LED21ED17/XXY/HAZ		LED35ED17/XXY/HAZ		LED45ED17/XXY/HAZ	
	Light Output (%)	Input Power (W)	Light Output (%)	Input Power (W)	Light Output (%)	Input Power (W)
25	100%	20.9	100%	35	100%	42.5
45	96.2%	20.3	91%	32	79%	33.5
50	95.7%	20.2	83%	29		
55	94.7%	20.0	77%	27		
60	94%	19.9				
65	92.5%	19.7				

Table 8: Current hazardous location lamp in fixture performance at elevated temperature

LED retrofit lamp surge protection

Electrical surges and transients are common in industrial environments. Traditional HID luminaires, welding machines, pumps and compressors, and even lightning strikes can induce surges and transients in the AC power lines. This could damage any lighting system, including LEDs, if they are not properly designed with surge protection. The ANSI C136.2-2018 standard⁶ defines performance requirements and test procedures for evaluating luminaire and control devices for dielectric withstand and electrical transient immunity. This standard divides luminaires into three risk categories: typical, enhanced and extreme, with requirements of 6kV/3kA, 10kV/5kA, and 20kV/10kA respectively. Current’s LED hazardous location lamps include integrated 6KV/3KA surge protection directly onboard the lamp to protect against power surges and transients. This level of surge protection is consistent with typical industrial and many outdoor LED luminaires.

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Summary and Takeaways

LED hazardous location lamps have made it easy for customers to keep their existing hazardous location fixtures, replace the old HID lamp, bypass the ballast and get the benefits of LED systems at an affordable cost. If you want better ROI and an easy upgrade to aging, costly hazardous location fixtures, UL844 certified LED retrofit lamps are your best choice. They offer equivalent light output, superior efficiency, versatility and durability in places where flammable vapors and gases are present. Most importantly, they allow hazardous location facilities to save on energy costs and improve light quality and reliability without compromising safety.

Current's robust design and expansive portfolio based on extensive market research provides customers a new and innovative lighting solution. By offering an ANSI-shaped LED HID retrofit lamp approved for hazardous locations, users will not have any fit issues compared to others in the marketplace. Current also includes an E39 socket adapter in the kit for mogul base applications. This eliminates the possibility of ordering a lamp with the wrong base and an installer having to come back at a later date at an additional charge. Customers can increase energy savings while lowering the heat profile of the lamp, which equates to a lower overall temperature code. The ambient temperature can be very high in these locations and the lamps contribute as a heat source. Fixtures retrofitted with LED replacement lamps run much cooler, so using LED HID replacement lamps means that fixtures that once were only considered for 40°C or 55°C locations may now be used in 65°C locations giving facility managers greater flexibility. It also allows customers to install higher lumen lamps in locations that were previously only able to use low wattage/low lumen lamps.

References

1. IES RP-36-15 Recommended Practice for Lighting Maintenance, 2015 Edition
2. NEMA Standards Publication LL-10-202X, LED Replacements for HID Lamps: Equivalency Claims
3. ANSI C78.43-2017 American National Standard for Electric Lamps – Single-Ended Metal Halide Lamps
4. ANSI C78.42-2007 American National Standard for Electric Lamps – High Pressure Sodium Lamps
5. ANSI C78.40-2016 American National Standard for Electric Lamps – Specifications for Mercury Lamps
6. ANSI C136.2-2018 American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirement.