WHITE PAPER

SAFETY COMPLIANCE OF LUMINAIRE RETROFITS

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Luminaire retrofits kits are simple in concept but complicated in practice, due to variable luminaire and kit designs as well as safety considerations. This white paper will provide an overview of UL's certification programs for luminaire retrofit kits, as well as guidance on the steps that facility owners and operators can take to ensure an efficient and safe luminaire retrofit program.

The What and Why of Luminaire Retrofits

As innovation brings new technologies to market, it is often necessary or advisable to introduce retrofit programs as a cost-efficient method of extending the useful life of previously installed equipment. This adaptive approach is exemplified by the emergence of new lighting technologies and the introduction of retrofit kits to upgrade existing lighting fixtures and luminaires.

For example, exit signs have evolved from incandescent to fluorescent lighting technology and then to light-emitting diodes (LEDs), the current dominant technology for most electrical exit signs. The same evolution can be found in fluorescent luminaires, which have been through three retrofit cycles, including the transition to improved optics/reflectors, the transition from magnetic to electronic ballasts, and finally the transition from T12 to T8 to T5. In each of these cases, retrofit kits have provided facility owners and operators with a path to upgrade lighting technologies through these transitions without the need to abandon existing lighting infrastructure investments.

Predictably, participants in the lighting industry have different points of view regarding the advantages and disadvantages of lighting and luminaire retrofit kits and programs. Original equipment manufacturers (OEMs) may prefer to sell new equipment rather than having original equipment modified taking into account rapid advancement in LED lighting capabilities. On the other hand, independent electrical contractors like retrofit programs since it provides customers access to reliable and efficient LED lighting technologies at lower costs. Facility owners like retrofit programs since it gives them flexibility in upgrading their properties with minimal workspace disruption. And authorities having jurisdiction (AHJs), such as local building and electrical inspectors, may prefer simpler retrofit programs that offer fewer variables that require fewer modifications to existing equipment and limit the number of responsible parties involved.

But overall, retrofitting can be an effective method to obtain more time and value out of the existing infrastructure, to save

on energy costs and to reduce the impact on the environment. Retrofitting existing fixtures also provides an opportunity to evaluate the potential benefits of a new technology prior to making a more substantial investment. While changing over from one technology to another can introduce compatibility issues between drivers, arrays and controls, the savings that can be achieved make retrofit programs worthwhile for many facility owners and operators.

Certification of Luminaire Retrofit Kits

One of the most common questions related to the retrofitting of installed luminaires has to do with the UL Listing status of previously installed equipment, and whether the process of retrofitting an existing fixture voids its prior Listing. Retrofitting an installed luminaire with an appropriate UL-Certified Retrofit Kit does not impact the original luminaire's UL Listing. The original UL Listing Mark was applied by the luminaire manufacturer (OEM) as their attestation that the product met the appropriate UL Standard when it was shipped. The UL certification mark on the retrofit kit indicates that a representative sample of the kit (including its components and the accompanying installation instructions) has been tested and certified against the correlating UL standard for use with the identified luminaires. It also indicates that when the kit is installed in accordance with its markings and instructions, the converted luminaire

complies with the UL standard for luminaires. In other words, a lighting retrofit essentially "refreshes" the certification status of a luminaire, since any retrofit kit that is installed must be compliant with the current set of applicable product safety requirements and standards.

The more important question to ask is whether a retrofitted product complies with the applicable product safety standards and provisions of the local electrical code. Even the simplest modification to an installed luminaire can create potential non-compliance issues that can significantly affect safety.

Table 1 provides details on UL's existing retrofit certification programs for the lighting industry. Note that some retrofit kits are evaluated to the same standard that is applicable to the original lighting product, while others are evaluated according to the requirements of different standards. However, all retrofit kit certification programs take into account compatibility with an installed luminaire, the interoperability of controls, the reuse of existing components, ongoing maintenance of the retrofitted product, and the approval of the retrofitted luminaire by the AHJ.

TABLE 1

Product	Listing Standard	Listing Category	Retrofit Standard	Retrofit Category
Electric Signs	UL48	UXYT	UL 879A	UYWU
Exit Signs	UL924	FTBR	UL 924	GGET
Luminaires	UL1598	IEUZ, IEVV, IEZR, IEZX	UL 1598B	IEUQ
Luminaires, SSL	UL1598, UL8750	IFAM, IFAO	UL 1598C	IFAR
Refrigeration Luminaires, SSL	UL471, UL8750	SOSR	UL 1598C	IFAS
Self-Ballasted Lamps, SSL	UL1993, UL8750	OOLV, OOLV2	UL 1598C	IFAR, IFAS
Luminaires for Hazardous Locations, SSL	UL1598, UL8750	IHTF	UL 1598C	IFUL

Although retrofit kits and certification programs have been available for a number of years, the National Electric Code® (NEC) has only recently adopted a formal definition for retrofit kits, and a requirement that retrofit kits for lighting equipment be listed. It is important to note that the NEC definition of the term "listing" is different from that used by UL and other certification organizations. The NEC definition of the term means that an independent agency or testing laboratory has put the product on a "list" that can be referenced as a means of validating a product's compliance with applicable safety standards. Although almost every product that UL certifies fits within this NEC definition of "listed," not every product that qualifies under this expansive definition meets the requirements for UL certification. This is because UL certification (or "Listing") also involves oversight of the product's ongoing production.

Safety Standards for Luminaire Retrofit Kits

The first step in helping to ensuring that a retrofit installation is compliant with applicable codes and standards is to make sure that the existing luminaire, as installed, complies with the applicable requirements of UL 1598, *the Standard for Luminaires*. Some retrofit kit installation instructions guide an installer through a basic inspection of a luminaire to determine if there has been any modifications to the fixture or damage that could compromise the compliance of the retrofitted product. In most cases, the presence of an appropriate UL certification mark on the luminaire is sufficient to establish that the luminaire has been evaluated for compliance with UL 1598 and incorporates the basic safeguards required for protection against fire, electric shock and mechanical hazards.

The primary standard for LED luminaire retrofit kits, UL 1598C, was published in January 2014. It details the safety requirements for a variety of LED luminaire conversion retrofit kits, including retrofit kits for recessed or can lights, and fluorescent luminaires. UL 1598C also identifies other standards applicable to components used in LED retrofit kits.

The LED lamps included in UL Certified luminaire retrofit kits are evaluated to UL 1993, *the Standard for Self-Ballasted Lamps and Lamp Adapters*. The 4th edition of this standard, published in December 2012, includes requirements specific to LED

tubular lamps. This standard differentiates among three different types of LED tube lamps (Types A, B and C).
Type A lamps are the most versatile, since they are rigorously tested to determine their compatibility with a wide range of installed fluorescent ballasts (which vary in output voltage and frequency). Because this type of lamp does not require any modification to the installed luminaire, it is not a "kit" but instead a Listed device suitable for field installation. However, one downside of Type A lamps is that they are powered from the luminaire's existing ballast. The age and electrical design of the ballast can lower the potential energy efficiency and reliability of the system.

Type B lamps are very common, and retrofitting them typically involve simply bypassing the existing fluorescent ballast and connecting the branch circuit to the existing lamp holders. These lamps are certified as a component only and certain restrictions regarding their general suitability may exist.

Type C lamps are powered from an external LED driver which is installed in the luminaire as part of its conversion. Type C lamps are also certified as components only, and there are typically some restrictions on their use.

Certified Retrofit Kit Selection and Installation

UL maintains a comprehensive on-line database (at: http://iq.ul.com/ssl) that allows visitors to search for UL-certified luminaire retrofit kits. Searches can be qualified based on various luminaire features, such as electrical ratings, install location (e.g., dry, damp, etc.), and whether the luminaire is dimmable. Currently, the database lists over 700 companies offering UL-certified luminaire retrofit kits, with each company providing detailed information about available retrofit kits and their intended applications.

In addition to the database of UL-certified luminaire retrofit kits, UL also provides additional guidance on luminaire retrofit kits at http://bit.ly/retrofitkits. The guide information available at this link describes the scope and requirements applicable to the retrofit certification category, as well as the certification mark requirements that identify the types of luminaires for which a given retrofit kit is intended.

Once a visitor has identified specific retrofit kits, it is advisable to visit the website of the manufacturer(s) to obtain more detailed information about specific retrofit kits, including access to the installation instructions. Reviewing the installation instructions for a retrofit kit can prove to be an invaluable exercise, since it can provide insight into how simple or complex the retrofit installation process may be. This is especially important since differences in the time required to retrofit an existing luminaire can be significant in retrofit projects involving dozens or hundreds of luminaires.

Under UL 1598C, installation instructions must address the following requirements:

QUALIFIED INSTALLER—Installation instructions accompanying a retrofit kit must include a specific declaration that the retrofit kit is intended to be installed only by a "qualified" installer.

LIMITS OF APPLICABILITY—Installation instructions must state that the retrofit kit is intended for use only with those luminaires described in the installation instructions and that have an electrical rating not less than the retrofit kit itself. This requirement helps to prevent installations in which the original branch circuit is overloaded by the change in the electrical load.

SHUNTED LAMP HOLDERS—Installation instructions must specify when the retrofit kit is not intended for use with luminaires with shunted lamp holders.

ILLUSTRATIONS—UL 1598C requires that installation instructions include step-by-step descriptions and illustrations and/or pictures where appropriate.

PARTS LIST—Installation instructions must include a complete list of the parts required to install the retrofit kit.

EXAMINATION OF ORIGINAL FIXTURE— Finally, installation instructions accompanying luminaire retrofit kits must advise the installer to carefully examine the original fixture and any remaining parts for signs of damage or excessive wear, and to replace those parts as needed.

In addition to evaluating a kit's retrofit instructions, it is also advisable to consider the impact of current and planned lighting controls on a retrofitted fixture. Most lighting technologies subject to retrofitting are designed to support the lighting controls in place at the time of their installation. Therefore, it's important to verify that a prospective retrofit kit is compatible with the currently installed or planned daytime controls, dimmers, and other devices. Look for specific claims of compatibility, known as a "matched pair" relationship, in which the manufacturer and model number of the luminaire, the controller, or both are specifically referenced in the retrofit specification sheet.

One final consideration in the selection of an appropriate retrofit kit is the required or preferred lighting performance of the retrofitted fixtures. In addition to improving overall energy efficiency or allowing the use of more sophisticated lighting controls, retrofitting luminaires presents an ideal opportunity to balance overall lighting of a given space. This could mean having a broader light beam spread to provide more balanced and even illumination throughout, or a narrower beam spread that can help to reduce light leakage into areas that don't require illumination. Therefore, it's important to evaluate whether a given retrofit kit will provide the required photometric performance. (Note that UL safety certification of luminaire retrofit kits does not include an evaluation of its photometric performance.)

UL retrofit certification programs do not include specific requirements regarding the qualifications of the electrician or technician who is installing a retrofit. Instead, the programs assume that the installer is able to: 1) read and follow instructions accompanying the retrofit kit; 2) follow guidelines established by the National Electrical Contractors Association (NECA) to protect themselves from injury during the installation process; and 3) understand and apply as appropriate the applicable provisions of the NEC. Therefore, although some locations do impose specific requirements regarding an installer's qualifications, the qualifications of a retrofit installer are usually self-declared.

In the end, the proper and safe installation and operation of a luminaire retrofit kit is primarily a function of following a three-pronged approach that includes: 1) the safety of the original luminaire as verified by its UL 1598 certification; 2) the safety of the retrofit kit as verified by its UL 1598C certification; and 3) the installer's compliance with the instructions accompanying

the retrofit kit, knowledge and application of provisions of the NEC, and appropriate practices for de-energizing and locking out lighting circuits before beginning kit installation.

Field-applied Markings for Retrofitted Luminaires using types B & C lamps

There are important safety markings that are required to be placed on a retrofitted luminaire so that they are readily observable during maintenance. The first is a label that clearly states that the luminaire "has been modified to operate LED lamps." The purpose of this label is to reduce the likelihood of a user installing a non- LED lamp into a converted luminaire. While such a possibility is not likely to result in a serious electrical incident, it could produce a noise or burst of light that could startle the person installing the incorrect replacement lamp, potentially leading to a secondary injury such as a fall from a ladder.

The second required label must provide information on the specific type and model of the replacement lamp that has been installed, as well as the manufacturer of the lamp and information on how to obtain lamp replacements.

In addition to these safety markings, instructions are provided that describe the correct electrical supply connections for the lamp holders. These instructions can be provided on an instruction sheet or on a tag affixed to the lamp for use by the installer, and are intended to ensure that the converted luminaire has the correct electrical connections to properly power the new LED light source.

The Final Step: AHJ Approval

Commercial retrofit projects are usually subject to a local or state permitting process which involves an inspection by an AHJ, typically a local electrical inspector. This inspection usually involves checking for the use of appropriately certified electrical equipment, and whether this equipment has been installed in accordance with its ratings and instructions. The use of a UL-certified luminaire retrofit kit will meet the expectations of most parties conducting an inspection. And the use of retrofit kits that have been UL-certified also provides the installer and the AHJ with direct access to UL to answer any questions or resolve any uncertainties in connection with their installation.

Alternatives to Using Certified Retrofit Kits

In some cases, the permitting of luminaire retrofits may be delayed due to the use of a non-certified kit or unaddressed concerns on the part of the AHJ. In these cases, UL can provide a field evaluation of the installed retrofits to assess overall safety or to address AHJ concerns. Luminaire retrofits that successfully undergo field evaluation are labeled with a special Field Evaluated Product mark as evidence of compliance with all applicable safety requirements.

UL also offers manufacturers that are authorized to produce UL-certified fluorescent luminaires the option of using all or part of a UL-certified retrofit kit to produce certified LED luminaries without the need for additional testing. This option provides luminaire manufacturers with an efficient and cost-effective path to entering the LED luminaire market, and provides retrofit kit manufacturers with an additional base of potential customers.

Summary and Conclusion

The market for luminaire retrofits will continue to grow as facility owners and operators seek ways to leverage LED lighting technologies to reduce energy and maintenance costs. The use of certified luminaire retrofit kits in retrofit projects is required to meet the requirements of AHJs and to help ensure the continuing safety of retrofitted luminaires. UL maintains a comprehensive publicly available database of luminaire retrofit kits that have been evaluated and found compliant with the requirements of UL 1598C, easing the process of identifying retrofit kits appropriate for specific applications that will also address the requirements of AHJs.

UL also publishes a number of quarterly newsletters designed to provide the lighting industry with up-to-date news and information. To subscribe to The Code Authority or Lumen Insights, visit http://industries.ul.com/subscription; to download copies of recent issues, go to www.ul.com/library, and then select the "Newsletters" option.

For further information about UL's lighting standards or our certification programs for luminaire retrofit kits, visit http://www.ul.com/lighting or contact the UL lighting team at http://contact.ul.com/contact-ul-lighting.

UL LLC
333 Pfingsten Road
Northbrook, IL 60062-2096 USA

UL.com