

## LIF Technical Statement No. 41

### T5 and T8 Fluorescent Lamp and LED Lamp/Module Adaptors "Retrofit Conversion Units" for T8, T10 & T12 Luminaires

#### Introduction:

If you want to improve the energy efficiency of your lighting installations, the most effective way, which will also improve the lighting quality whilst reducing maintenance and operating costs, is by the installation of a new high efficiency lighting installation.

However, there may be reasons\* why the lighting installation is not replaced with a new high efficiency installation on every occasion when some upgrading is necessary. Therefore when existing luminaires have their lives extended e.g. by the fitting of new control gear and lamps, considerations need to be made as to how these modifications are made to the existing luminaires.

\*Note: These may include: luminaires which are installed in hard-to-access ceilings where the cost of replacement would be excessive; or upgrading the control gear to reduce energy consumption in luminaires that have some design features that particularly suit the space; or to change the light distribution to suit new task requirements in the space and hence, extend the life of the installation.

Changes to the existing luminaires may be simple "add-ons" (adaptors) which allow the fitting of a low energy control gear and a new light source, through to complete replacement of the internal components of the luminaire. Sometimes these modifications would be made off site but more often they are made in situ. The simple "add-ons" create great concern with regard to the safety and product performance.

The Low Voltage Directive Administrative Cooperation of the European Commission has seen reason to produce safety advice on the use of T8 LED tubes. This is given in the following document, a copy of which is appended in the Annex of this Technical Statement:

## LVD ADCO

Recommendation

Adopted: February 2011

Safety of LED T8 replacement tubes and modified luminaires

**For further details, see LIF Technical Statement No. 51**

This LIF document further highlights the risks and gives recommendations to avoid any danger.

### Original Luminaire

A new luminaire will have been designed and manufactured to meet the safety and performance requirements of the relevant standards and will have been photometrically tested to enable the lighting scheme designer to calculate the correct number of luminaires and their location to meet the task requirement. In addition, each and every luminaire will have been tested at the end of the production line to ensure that it is electrically safe. The manufacturer then affixes the CE mark to the luminaire to confirm that this product meets the essential requirements of the relevant Directives. This is a legal requirement!

### Adaptors

These types of adaptors replace the original T8, T10 or T12 fluorescent lamps operated by switch start or SRS magnetic control gear or high frequency electronic control gear in an already installed luminaire. They are marketed on the basis that they reduce the energy consumption of the installed luminaire. There are a number of different versions of such adaptors including the following:

- 1) Replacement of the existing lamp with a new “luminaire” which may use a T5 lamp or LED lamp/module that plugs into the existing lamp holders. Some versions provide alternative fixings in case the original lampholders cannot cope with the weight of the adaptor. The existing luminaire is then re-wired to provide mains voltage onto the original lamp holders or via a cable passed through the vacant starter switch hole in the body of the original luminaire to the adaptor. With respect to some types of fluorescent and LED lamp/module adaptors, it is known that the bi-pin at the end of the “adaptor” may be “live” when the other end is inserted into the lamp holder. This is not covered by the safety standards – only under the LVD which requires products to be “SAFE”. This means that there is an “unsafe” situation can occur at the time when these fluorescent and LED lamp/modules are installed. LVD AdCo has issued a safety guidance covering LED lamp/module used to retrofit or modify a luminaire – See Annex A for a reproduction of their advice;

OR

- 2) By the addition of an electronic control gear that plugs onto one end of the new T5 lamp whilst a spacer plugs onto the other end of the lamp. This trio of components plugs into the existing lamp holders.

The existing starter has to be removed and a bridging device installed. In addition, the power factor correcting capacitor and RF capacitor (if fitted) have to be removed from the circuit;

OR

- 3) By the addition of a very long electronic control gear that plugs onto one end of the new 6 ft T8 lamp to fill the space between the lamp holders of 8ft T12 lamped luminaires;

OR

- 4) Other adaptor type products not referred to here that may be on the market today or come onto the market in the future.

These modifications to the original luminaire may compromise the safety and performance of the original luminaire and concerns have been raised in many quarters (internationally and domestically) as to how to address the safety and performance aspects of the adapted luminaires.

*NOTE: Similar problems affecting safety and performance may apply to other types of lamp adaptor not considered here.*

### **International Considerations**

*“The international committee of IEC SC34D MT LUMEX confirms that there are NO component standards by which these components can be tested to ensure their safety or performance in use. It is only possible to ensure the safety and performance in use of the components when they are tested with the luminaires they are intended to convert and comply fully with the requirements of IEC 60598-1 and any other relevant standards.”<sup>\*1</sup>*

<sup>\*1</sup> See IEC document 34D/891/INF

The reasons behind this decision were based on the following safety and other concerns:

Experts examined a number of "retro-fit conversion units" (referred to in future as "adaptors") which are intended to be retro-fitted to existing T8, T10 or T12 fluorescent lamp luminaires and found the following safety and other concerns regarding the samples examined:

### **Safety**

- There may be adverse changes to the thermal characteristics of the original luminaire?
- Are the lamp holders of the original luminaire over stressed by the weight of the adaptor units?

- Do the dimensional tolerances of the “plug on” adaptors exceed the tolerances permitted between the original lamp holders?
- Do the converted luminaires comply with the requirements of the luminaire safety standard BSEN 60598-1?
- Most components used in luminaires are able to be tested to their own standards. In the case of these adaptors, there are no specific standards covering their safety or performance?
- As a result of the above points there is a possibility that the converted luminaires may not comply with the requirements of the luminaire safety standard BSEN 60598-1. The only way to confirm their safety in use is to fully comply with the requirements of BSEN 60598-1. This must be carried out for each type of luminaire to be converted – not generically.
- For these types of adaptors, there are currently no product safety standards and the compatibility with the luminaire has to be checked against the essential requirements of the Low Voltage Directive (LVD). One example of a requirement not covered by any standard is the risk of electric shock in case of insertion of only one end of a lamp into the lampholder. EN 60598-1 does not assure protection against electric shock in case of insertion of one end of the lamp into a G5/G13 lampholder leaving the other accessible because this is not a problem when inserting a normal fluorescent lamp. In the case of an adaptor with electrical continuity between the two ends the risk of electric shock may easily occur. Another requirement to be evaluated according to LVD is the possibility that the user can insert again a tubular fluorescent lamp in a converted luminaire. In some cases this can cause short circuits or a dangerous situation.

#### **Compatibility with Maintained Emergency Lighting Luminaires**

- Are the adaptor units suitable for fitting to emergency lighting versions of mains luminaires?
- The adaptors are not suitable for fitting to maintained emergency lighting versions of mains luminaires. Reason: The new electronic components are placed between the new lamp and the original lamp holders i.e. directly in the circuit between the emergency lighting control gear and the lamp. The emergency lighting control gear is designed to operate directly to the T8, T10 or T12 lamp, for which they were designed, and not through an additional electronic circuit and new lamp(s) of different circuit characteristics.
- Many lighting installations utilise one of the lamps in a luminaire to operate in an emergency when the normal mains supply fails. If this lamp has been replaced by one of the adapted units, they will not operate in an emergency when:

- 1) The emergency luminaire is self-contained i.e. the battery and emergency control gear are inside the luminaire
- 2) The emergency supply is from a central supply and it is not 230V ac sinusoidal. (Central supplies may be dc or 110V ac in which case the lamp will not work).

Under the Regulatory Reform Order, the new Fire Safety Legislation came into force during 2006. This law places the responsibility for fire safety of the premises with the “responsible person”. **In the workplace, this is the employer or any other person who may have control of any part of the premises, for example, the occupier or owner.** Contractors could also be held accountable for the areas outlined in the terms of their contract.

### Lamp Operation

- Are the new lamps operated in accordance with the safety and performance standards relevant to the lamp type?
- Are the end-of-life conditions of the lamp safeguarded by the new adaptors?
- Operation of the new lamp in accordance with its safety and performance standards can only be assured when fully tested in the luminaires in which they will be used. The lamp manufacturer’s warranty will be void if the adapted luminaires do not comply with lamp safety and performance standards.

### EMC

- What are the EMC characteristics of the converted luminaire? Do they comply with the limits of electromagnetic compatibility specified in BSEN 55015 and required by the EMC Directive?
- It is not possible to measure the EMC compliance of the “adaptors” independently from the luminaire. Therefore, the only way to confirm that they comply with the limits of electromagnetic compatibility of the relevant IEC standards is to test each type of luminaire converted.

### OTHER CONSIDERATIONS

#### Environmental Considerations

- Waste Electrical and Electronic Equipment Legislation (WEEE). It is possible that the legal obligation of the original producer under WEEE may be moved to the converter of the luminaires following any modification to the original luminaires. Only a test case in law will prove this.

- Restriction of Hazardous Substances (RoHS). The adaptor will need to comply with the National requirements of this legislation.

### **Legal Marking**

- Legal liabilities are placed on the manufacture of the original luminaire (CE Marking) which will become void when an adaptor is fitted. The original manufacturer's mark should be removed or obliterated and new markings applied to identify the converter company who now takes on the legal responsibilities for the converted luminaires.

### **Illuminance**

- The original lighting installation should have been designed to comply with the lighting specification to meet the demands of the visual task. There may be legal requirements covering the lighting design of the original installation. These should be met by the converted installation unless there is a change of use and the "new" installation designed to meet these new requirements.
- The lumen output of the luminaire may change. The replacement T5, T8 or LED lamp(s) may have a lower lumen output than the T8, T10 or T12 lamp it replaces. Therefore, the converted installation may not provide the same level of maintained illuminance as the designed installation.

### **Light Distribution**

- Has the converted luminaire been photometrically tested? This will be required in order to calculate the illuminance distribution of the converted installation and compare it with the original design.
- Will the installation still provide the required maintained illuminance for the tasks?
- Will the installation comply with BSEN 12464-1 Lighting of indoor workplaces and/or CIBSE Lighting Code?
- The lumen output will change. Have additional luminaires been added to the installation to ensure that there is sufficient illuminance for the visual tasks?
- The light centre of the lamp may be displaced. Some units move the lamp axis and this will affect the light distribution. Those units retaining the same axis will still have a modified light distribution when used with specular reflector systems due to the change in diameter of the lamp in the case of T5 fluorescent lamps, but will be totally different in the case of LED units using multiple LEDs.
- Will the original Glare Index (and currently the Unified Glare Rating) still comply for the installation? The Unified Glare Rating may not now comply for the installation.

- The T5 lamp has a higher luminance (surface brightness of the lamp) than the T8, T10 or T12 lamp it replaces. It is questionable whether the luminance limits of the luminaire will still comply for usage with Display Screen Equipment. Similar considerations would also cover LED units.
- It is questionable whether the installation will continue to meet its original design parameters.

### **Energy Efficiency**

- Do the adaptors comply with the requirements of the Ballast Directive which was implemented in the UK as Statutory Instrument 2001 No 3316: The Energy Efficiency (Ballasts for Fluorescent Lighting) Regulations 2001?
- Has the energy efficiency of the adaptor been measured in compliance with BSEN 50294 which can only be carried out in the luminaire when it is being converted?
- The Ballast Directive specifies energy efficiency requirements for lighting control gear. The only way to confirm that the adaptors comply with the requirements of this legislation is to test the converted luminaires.

### **SUMMARY AND CONCLUSION**

In assessing the suitability of any specific product or installation the user must make his own judgement and/or take appropriate advice. Whilst it is the responsibility of each individual organization or person converting luminaires by incorporating these adaptors, to determine how best to do that, the opinion of LIF based on the points identified above is that best practice should at least incorporate the following:

The post modification of installed luminaires should be carried out by a competent engineer. The original installation should be surveyed to ensure that the luminaires to be converted are suitable i.e. no emergency luminaires.

A selection of each type of luminaire should be modified and tested to all relevant safety and performance standards. This includes the photometric tests.

The original lighting design parameters need to be determined and compared with the planned modifications to ensure that the original lighting design is maintained. Any shortfall in the lighting requirements should be corrected to meet the requirements of the work places.

Only when compliance is achieved in all respects should the modifications proceed.

Following modification of a luminaire, it should be tested for electrical safety equivalent to the “end of line test” for a new one.

All relevant information related to the above should be kept in a Technical File for the required period of at least 10 years following modification of the original luminaire.

It should be noted that the organisation modifying a luminaire by the use of these types of adaptors will normally be taking over the full future responsibility for the luminaire with respect to Safety, EMC, Photometric, Environmental, and other Legal Responsibilities. This responsibility remains even if the luminaire is subsequently returned to its original condition (removal of the adaptor), since damage to the original luminaire may have occurred.

# TECHNICAL STATEMENT

**Neither the Lighting Industry Federation Ltd, nor any person acting on its behalf, makes any warranty of representation, expressed or implied with respect to the information contained in this report, or assumes any liability with respect to the use of, or damages resulting from, the use of this information. In assessing the suitability of any specific product or installation the user must make his own judgement and/or take appropriate advice.**

## ANNEX

Low Voltage Directive Administrative Cooperation of the European Commission:

### **LVD ADCO**

#### **Recommendation**

**Adopted: February 2011**

Safety of LED T8 replacement tubes and modified luminaires Introduction:

LED T8 tubes are extensively marketed in the EU. These are intended to be replacements for traditional T8 Fluorescent tubes either in existing luminaires or in modified luminaires.

EU Market surveillance Authorities have expressed serious concerns with both the LED replacement tubes and with modifications carried out to existing luminaires. These concerns are in respect to their safety and many present an unacceptable risk to consumers and professionals.

This Recommendation is within the framework of the current Directive and as such is intended to provide clarification for particular products. It does not represent any change in the Directive.

#### **Discussion:**

Recent enforcement actions on the LED T8 replacement tubes by countries in the EEA have revealed that many of these products do not comply with safety requirements, e.g. protection against electric shock. A common failure is access to live parts e.g. with one end of the tube inserted in the luminaire the other end presents an easily accessible electric shock hazard.

As these products are within the scope of the Directive 2006/95/EC (the Low Voltage Directive (LVD)), these concerns were discussed at the LVD ADCO 26th Meeting on 17 & 18 Nov 2010, which concluded that generally economic operators (manufacturer, importer, distributor and retailer) are not fully aware of the safety risks relevant to the LED replacement tubes they manufacture, import or supply. It was also recognised that guidance, in the form of an ADCO Recommendation, would be helpful to assist the economic operators in understanding these risks and also the actions required to meet the requirements of the LVD.

#### **LED T8 tubes**

Economic operators placing on the market LED T8 tubes which are intended as either direct replacement in the original luminaire (retrofit type) or for use in a modified luminaire are responsible for ensuring that these products are safe and comply with the safety requirements of the LVD.

Modification kits and modified luminaires. For a modified luminaire, the manufacturer of the original luminaire will generally no longer be seen as responsible for the safety of the product. Any modifications made to the original

luminaire may alter the characteristics of the original product e.g. safety aspects of the original luminaire, and hence risk assessment of hazards posed by the original luminaire may no longer be applicable to the modified luminaire. In this case, the modified luminaire would be considered as a new product.

Persons placing on the market modification kits for incorporation into an existing luminaire must ensure that the modified luminaire is safe when the kit is installed in accordance with the instructions.

A modified product when placed on the market is likely to need to comply with the safety requirements and conformity assessment procedures of the LVD as it would to a new product. Therefore, the economic operator responsible for placing such product on the market has the full responsibility for ensuring its safety and compliance with the LVD and any other applicable Directives. He is required to carry out all of those responsibilities of an original manufacturer including conformity assessment, drawing up of Technical Documentation, Declaration of Conformity and affixing of CE marking.

Where a luminaire is modified to use a LED T8 tube, the luminaire must still be safe if a T8 fluorescent lamp is installed, though they do not have to function.

Harmonised Standards. Currently, there are no specific standards for LED replacement tubes. However, the economic operators should be aware that a standardisation activity is ongoing for "double capped retrofit LED lamps" 1.

Once the standard is published it will provide a presumption of conformity with the Directive, (limited to its scope and the relevant requirements that are covered).

#### **1 Provisions under consideration include:**

- Safety of the LED lamp in case a wrong starter-lamp combination is used.
- Safety of the LED lamp/Luminaire with different type of control gears (EM/HF);
- Safety of the lamp in case the luminaire control gear short circuits;
- Safety of user against accidental contact with live parts.

#### **Recommendation:**

##### **a) General**

- It is important that the economic operators fully understand their responsibility with respect to compliance requirements of these products with the LVD and its safety objectives.
- The manufacturers, importer and distributors are responsible for ensuring that only those products that fulfil the LVD safety objectives (i.e. products are safe) are placed on the EEA market.
- The Directive requires that all products placed on the market meet the safety requirements; the conformity assessment demonstrates how these requirements have been met. A manufacturer may use harmonized standards to provide a presumption of conformity with the LVD, however, currently there are no specific standards for these products. Economic operators will need to use other means to assess the safety risks. For example, the standard EN 60598-1:2008, clause 8 could be used to form the basis of assessing risk of access to live parts.

- Thus, the Technical Documentation must contain, among others, an assessment of the risks, a description of the technical solutions adopted, and the procedures used for verification, providing a detailed explanation as to how the safety objectives and requirements of the Directive have been achieved.

#### **b) Modification of luminaires**

- The person who places a modification kit on the market to modify an existing luminaire must ensure that incorporation of the kit does not render the luminaire unsafe. Besides providing conforming components, this might require a precise definition of the types of luminaires suitable for conversion, clear instructions, and procedures on how to check the modified luminaire. If the modified product is placed on the market, it will be subject to the requirements of the LVD as though it were a new products being placed on the market for the first time, and the conformity assessment procedure, drawing up of relevant documentation and markings as described in the Directive all need to be complied with.

#### **c) Replacement tubes**

- Those LED T8 replacement tubes that are intended for use as replacements in standard fluorescent luminaires i.e. where no modification of the original luminaire is required (retrofit type)<sup>2</sup> must meet the applicable specifications for a standard fluorescent tube; e.g. must not exceed the dimensions and operating parameters related to the safety of the original fluorescent tube (e.g. weight, power, temperature rise, electrical properties)

<sup>2</sup> The replacement of a glow starter compliant with IEC 60155 with other devices does not constitute a modification of the luminaire itself, however, the use of such a starter needs to be safe when used in luminaires.

- Conformity assessment of the retrofit LED replacement tube and its starter replacement must take any combination of original and replacement components into account.
- LED tubes, which when one end of the tube is inserted into a luminaire expose a hazard caused by direct contact with live parts (e.g. contact pins) at the other end of the tube do not fulfil the safety objectives of the LVD.

#### **Additional considerations:**

This recommendation is made by LVD AdCo as such only the implications with regard to the LVD are considered. For many products other Directives (such as EMC, WEEE, RoHS, etc.) are also applicable. Economic operators are advised to consider their obligations with regard to the requirements of any other applicable Directive.