LED T8 replacement tubes

Safety issues observed in market surveillance tests

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SAFETY TECHNOLOGY AUTHORITY (TUKES)
FINLAND

Outline

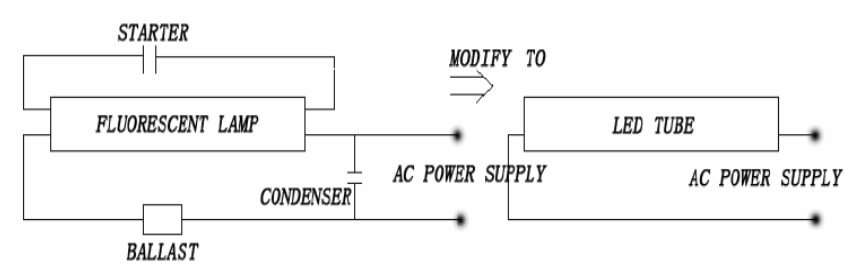
- Introduction – LED T8 replacement tubes
- Tests by Tukes (Finland)
  - Reactions given
- Defects found in the tests
  - Safety during the lamp replacement
  - Other safety issues
- Responsibility issues with the LED tubes
- How to deal with the LED tubes ?

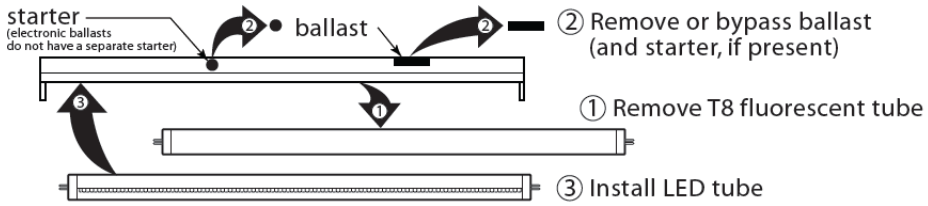
LED T8 replacement tubes

- LED T8 tubes are intended to be replacements for traditional T8 fluorescent tubes in the original (existing) luminaires.
- LED T8 replacement tubes have been intensively marketed all over the world due to their claimed energy savings (up to 70%) and long life times (>50 000 h).
- So far most of the LED tubes have emerged from the factories (unknown brands) in China (e.g. Osram just released their version in April).
- For example in Finland, there are already dozens of importers for LED tubes and the installation base is well over 10000.
- So far the tubes have been mainly marketed for institutional customers (many installations are still in testing phase).

LED T8 replacement tubes

- Even commonly marketed as “drop-in replacements”, installation of the LED T8 tubes in traditional fluorescent fixtures will, however, require normally some modification of “the original fluorescent luminaire” (removal or bypass of the ballast and starter).
- Required modifications depend on the type of the light fixture and that of the LED tube.





LED T8 replacement tubes

- There is no knowledge about the behavior of LED-tubes in long term (e.g. possible failure mechanisms) as the electronic LED drivers are packaged in a very small room in the LED tubes.
- Questions of the responsibilities in connection with the new lightning fixtures (modified luminaries with LED tubes) have been raised up. The original manufacturer of the luminaire obviously cannot anymore take the responsibility for the modified new light fixture, but the one who has performed the modification should now verify and guarantee the electrical and fire safety, EMC compatibility etc.
- There could be potential EMC compatibility issues with the LED tubes.
- As there are no direct standards for the LED tubes, the LVD conformity assessment have been made by adopting various (depending on the test laboratory used) luminaries and LED standards. Often no risk analyses have been performed by LED tube manufacturers.

Market surveillance tests in Finland

- We (Tukes) have been continuously asked about the issues with LED tubes (for about a year):
  - Installation instructions
  - How to guarantee the safety
  - What are the responsibilities
  - What is the quality of the tubes on the market

→ Some tubes (importers) were selected for further testing

- According to test laboratories **all the tested LED tubes** did not fulfill all the relevant safety requirements of LVD.
- Many serious defects (that endanger the safety) were found in the performed partial tests to fulfill the market surveillance needs.

Reactions given in Finland

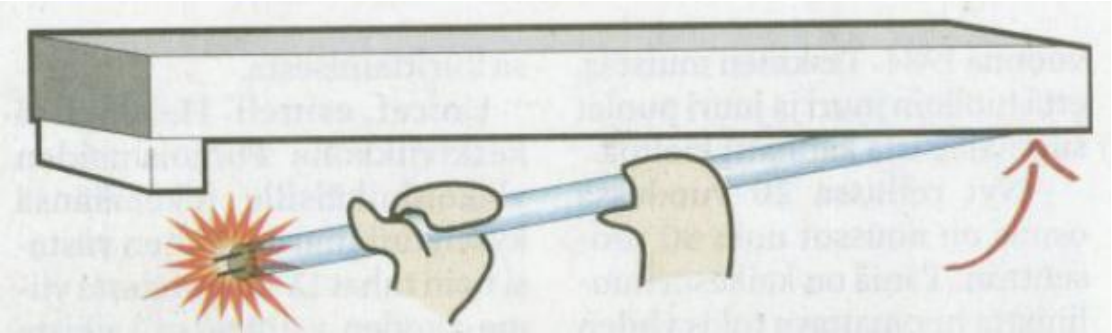
Company	Model	Case #	Test laboratory	Test result*	Reaction
Ledikor Oy	25W, AC 85 - 265 V	AKA-20091118-02	SGS Fimko	211	Recall
Finntology Oy	T8 LED Lamp 20 W (1720022 M3)	TEH-20091201-01	SGS Fimko	201	Sales ban
Verkkokauppa.com Oy	PowerLed 528 SKU 1086 (32W, 150 cm)	TEH-20091201-03	SGS Fimko	112	Sales ban
Valtavalo Oy	18W-G13, 230V, T8	TEH-20091201-04	SGS Fimko	212	Sales ban
Valtavalo Oy	22SW5009110044	MTO-20100122-01	SGS Fimko	201	Recall
Oversol Oy	11409072	HAK-20091109-02	SGS Fimko Intertek Semko	212 120	Recall
Juha-Elektro Oy	LED48T8-288-TPW-001W	HAK-20091109-01	SGS Fimko Intertek Semko	212 132	Recall

Sales ban includes the obligation of the importer to inform all the customers about the potential risks involved with usage of the LED tubes.

***(XYZ)**
Defects that endanger the safety (X)
Defects that may endanger the safety (Y)
Defect s that does not significantly endanger the safety (Z)

Safety during the lamp replacement

- Protection against electric shock in the case of one-sided insertion (EN 60598-1, 8.2.1 and Annex A) was missing in all of the **tested** led T8 tubes.
- During mounting the free end connector of the led tube might be live. A normal size fluorescent tube will not ignite until both ends are connected to the mains.



Safety during the lamp replacement

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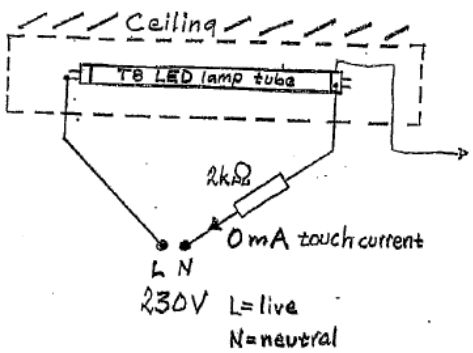
Normal operation



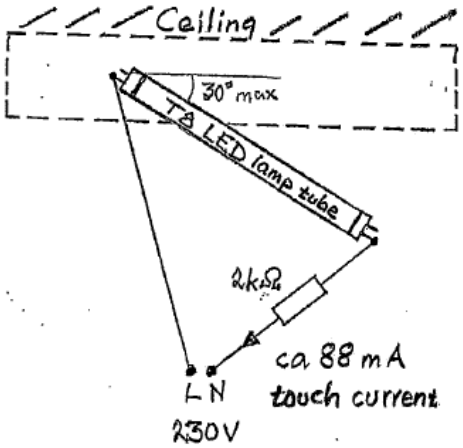
The T8 LED lamp tube mounted in a luminare modified acc. to the operating instructio

Metal cap, insulated from current pa

Touch current measured to 0 mA with the T8 LED lamp tube mounted in a modified luminair (the touch current measured according to standard).

Max 0,7 mA is allowed to clause 10.3, EN 60598-1:2008+

Lamp replacement



One end of the T8 LED lamp tube taken out of the luminare for a lamp replacement, while the other end is still connected to the mains supply.

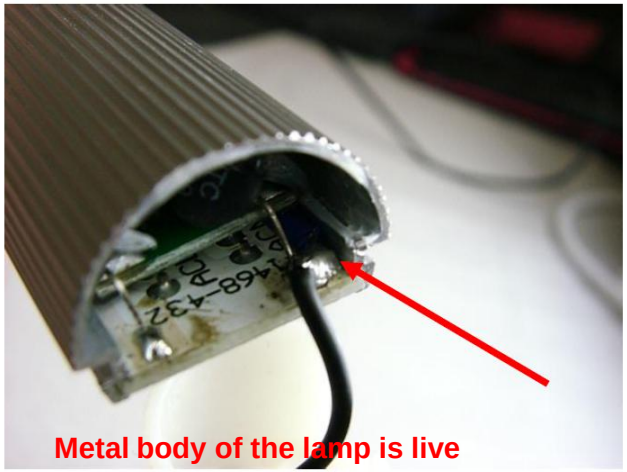
At lamp replacement, with one end of the T8 LED lamp tube taken out of the modified luminaire at angle of max 30° to the horizontal, a touch current of ca 88 mA has been measured at a mains supply of 230 V.

At an angle of more than 30° to the horizontal the touch current has been measured to 0 mA.

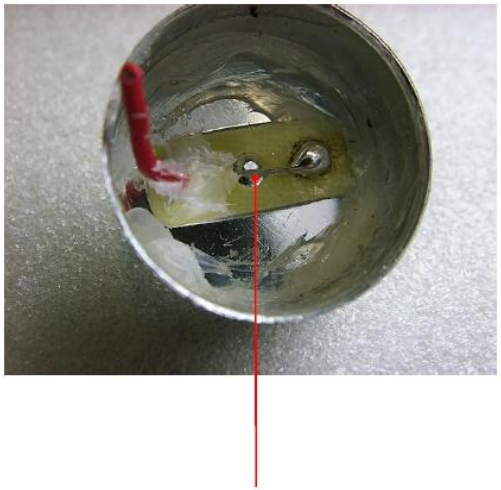
Touch current not measured according to standard, as the T8 LED lamp tube is not mounted and ready to operate as in normal use.

Other defects found in the tests

Kuva vakavasta puutteesta
Picture of defect

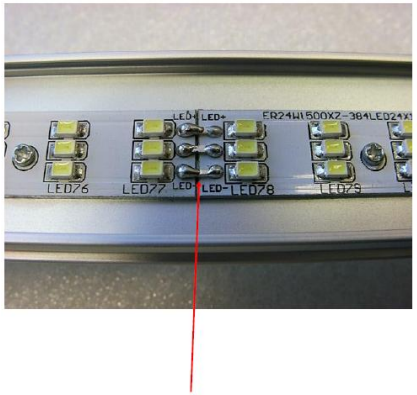


Kuva vakavasta puutteesta
Picture of serious defect



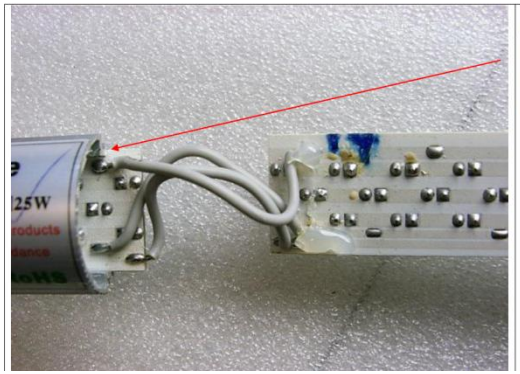
Eristämätön jännitteinen yhdysjohdin koskettaa metallihelaa
Bare live connecting conductor is in contact with the metal cap

Kuva vakavasta puutteesta
Picture of serious defect



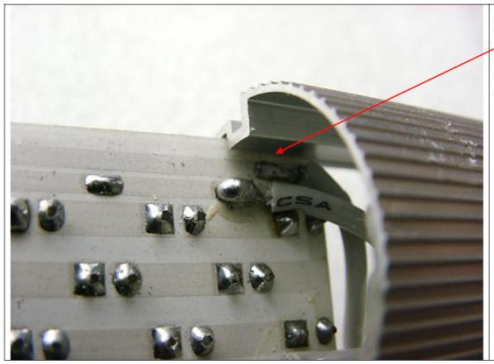
Jännitteiset juotoskohdat ovat lähes kiinni rungossa (<0,1mm).
Live solder contact are almost in contact with the body (<0,1mm).

Kuva erittäin vakavasta puutteesta
Picture of defect that endangers the safety



Kuva 1 Pintaväli juotosnastasta runkoon

Picture 1
Creepage distance between solder connection and the metal body



Kuva 1 Pintaväli juotosnastasta runkoon

Picture 1
Creepage distance between solder connection and the metal body

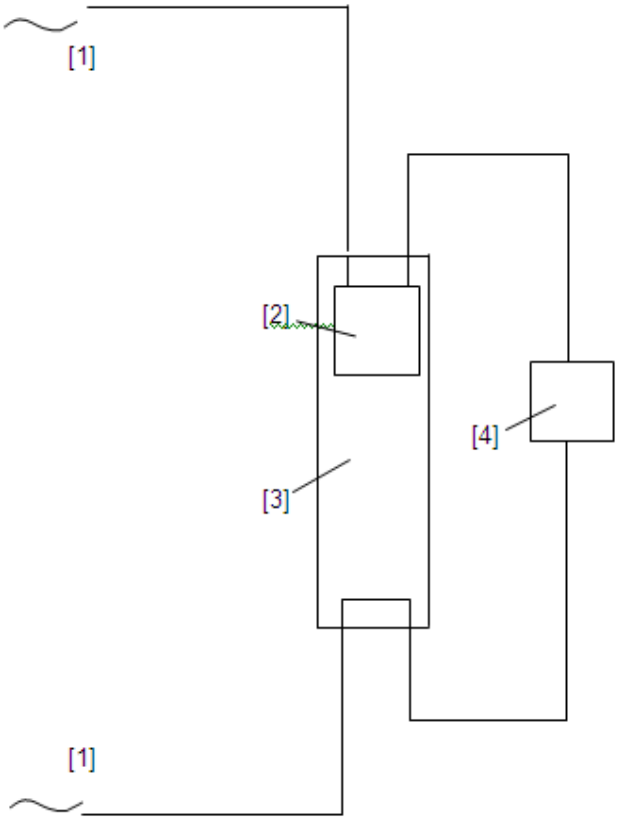
Other defects found in the tests

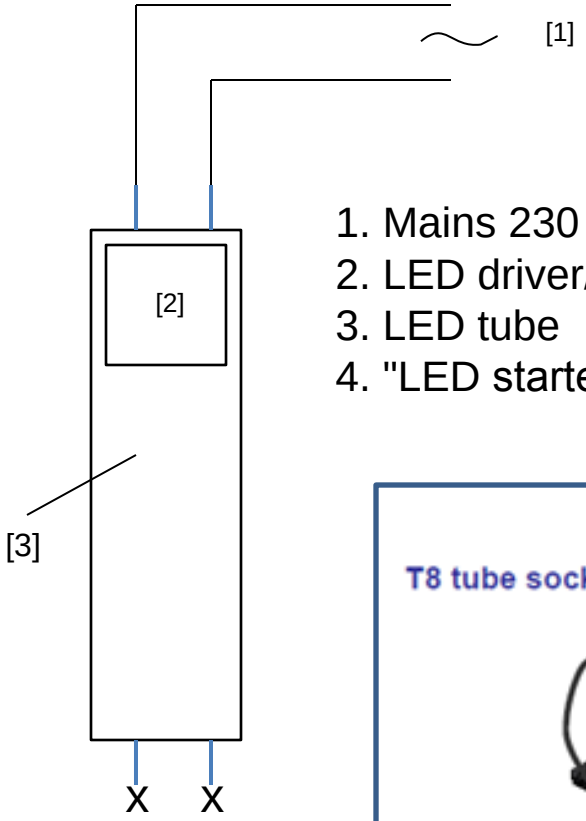
- Led-lamp (rectifying diode short-circuited) caused a rapid temperature rise during fault condition test (led-lamp was installed in a luminaire with a magnetic ballast). Test was interrupted before break down of the ballast and the luminaire. (3,4A current flowed through the ballast. Current during abnormal heating test is about 1,1A for a fluorescent lamp.) (EN 60598-1/12.7 and EN 60968/12) F

- Two out of four metal caps (end parts) of the lamp were insufficiently fixed. The metal cap detaches easily by pulling it (fixing of the lamp in a luminaire might be in danger). (EN 60598-1 / 4.12.4) S / Lamp cap is not fixed reliably to the lamp as the metal cap detached easily from the lamp part with slight pull. (EN 60598-1, 8.2.1) S

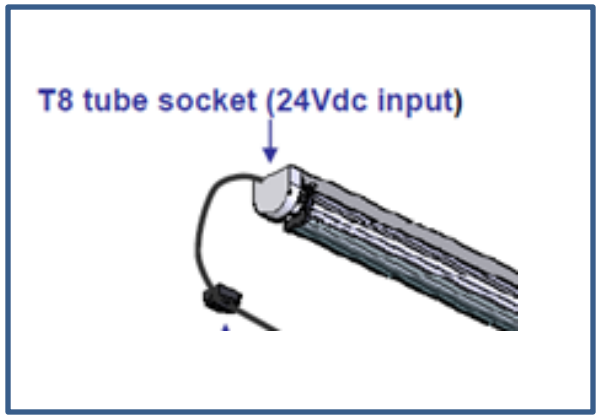
- All markings required by the standard are missing from the lamp (mark of origin, type and voltage were marked on the package). (EN 60968, 4.1)

LED tube wiring(s) to circumvent ”one sided insertion” defect





1. Mains 230 VAC
2. LED driver/controlgear
3. LED tube
4. "LED starter“ (short-circuit)



Responsibility issues

- Original (fluorescent) luminaires are meant/designed to be used only with standardized fluorescent tubes.
- If modifications have been performed into the luminaire, the original manufacturers' third party certification mark (if any) and the technical file as well as the DoC will not cover the modified construction of the luminaire.
- The person/organization carrying out the modification of the luminaire will have full responsibility for safety, EMC compatibility environmental features, markings, legal issues for the new light fixture.
- Existing markings on the luminaire should be removed as it is now giving misleading information and that new labeling should be the added to the luminaire.

Summary

How to deal with LED T8 replacement tubes ?

- Many recent LED replacement tubes do not have protection against electrical shock in the case of one-sided insertion.
  - Can such tubes be allowed ? How big is the real risk ?
- Modification of the existing luminaires (originally meant to be used with standardized fluorescent tubes) is often considered necessary with the LED replacement tubes.
  - How to guarantee safety ? How to deal with the responsibilities ?
- It might be that many LED T8 replacement tubes have been placed on the market without proper procedures.
  - Required tests, risk analyses
  - In order to ensure the safety the replacement LED tubes should be tested together with each modified luminaire ?

CTL PROVISIONAL DECISION SHEET

Supplement 1

Standard(s): IEC 60598-1/2003 A1/2006 EN 60598-1/2004 A1/2006	Subclause(s): General 1.2.60 2.2	No. PDSH 0702	Year 2008
Category: LITE		Developed by: ETF5 OSM/LUM	
Subject: T8 to T5, T8 to T8 and similar lamp adaptors (including ditto with LED)	Key words: - Retro-fit conversion units - Semi luminaires - Lamp adaptors	*To be approved at the 46th CTL Plenary Meeting, in 2009*	

Question:

In respect of document 34D/891/INF, how do we deal with the units in question?
This issue has been dealt with earlier, before the SC 34D document was issued. The SC 34D document was developed by experts. The outcome is that the products of this kind cannot ensure safety of the converted luminaire without a retest of the converted luminaire.
Moreover, other features, such as EMC, compability with Emergency Lighting Luminaires, lamp operation, marking, legal, illuminance, environmental, light distribution, energy efficiency etc. is not properly covered and must consequently be carefully considered.

Decision:

Due to the fact that the organisation modifying a luminaire with this type of products has full responsibility for the converted luminaire with respect to safety, EMC compability, lamp operation, marking, illuminance, environmental features, lighting distribution and legal responsibilities. This product can only be certified together with the converted luminaire, in other words complete recertification must be done. Moreover, this responsibility remains even if the converted luminaire is subsequently returned to its original condition (i.e. removal of the conversion unit), since damage to the original luminaire may have occurred.
This is also applicable to similar products containing LEDs.

Safety

- 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.
- Therefore, the converted luminaires may not comply with the requirements of the luminaire safety standard IEC 60598-1. The only way to confirm their safety in use is to fully comply with the requirements of IEC 60598-1. This must be carried out for each type of luminaire to be converted – not generically.