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**ELECTRICAL FIRES AND THE SAFETY  
OF ELECTRICAL EQUIPMENT AND MATERIALS  
IN FINLAND**

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## **1. Safety and fire safety requirements**

Safety standards and the levels of safety requirements differ throughout the world. In Finland, the safety requirements for electrical equipment and materials are based on EU directives and related harmonized European standards. In this report, a comparison is made between the fire safety requirements of UL (Underwriters Laboratories Inc.), which are mainly applied in the USA, and global IEC (International Electrotechnical Commission) standards. Harmonized European standards for electrical goods are mainly based on global IEC standards.

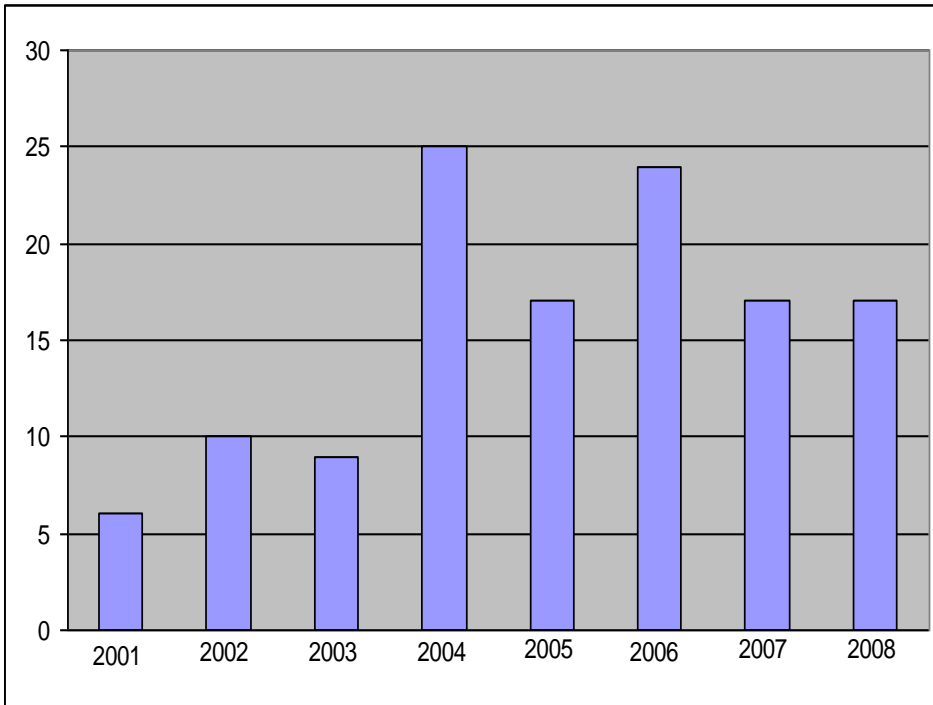
With regard to the standards, it was found that there are differences between the requirements of different standardisation systems. For example, UL standard safety requirements for plastic parts are more rigorous than IEC standards. According to the available information, this has a certain effect on the safety of products. In addition, it was found that in the development and updating work carried out on UL standards the information received about product surveillance, fires and accidents is better taken into account and the UL standards are continuously being developed on the basis of information received.

Testing of the product according to the requirements of the relevant safety standard is a way to clarify whether the product fulfils the requirements. Certification bodies can, on the basis of test reports, grant the right to use their certification mark on the product. Certification of a product also requires production surveillance in accordance with the requirements of the certification body. IEC-based surveillance methods put more emphasis on the quality control of the production, whereas the main emphasis for UL surveillance is on the certified product. In other words, the emphasis is on how precisely the construction, components and materials comply with the tested and approved sample.

## **2. Electrical fire safety in Finland**

According to the statistics (Figure 1), the number of fatal electrical fires has increased during recent years. There are various reasons for this. According to previous studies conducted by Tukes, about 50% of electrical fires are caused by technical faults and the other 50% by human error. On the basis of this present study, it seems that electrical fires could be decreased by reducing the flammability risk of the products. It is possible to influence a product's non-flammability by taking into account electrical fire safety requirements in product design as well as in material and component selection.

Figure 1 shows the development of fatal electrical fires in Finland. An average of 20 people a year lost their lives during the five years between 2004 and 2008.

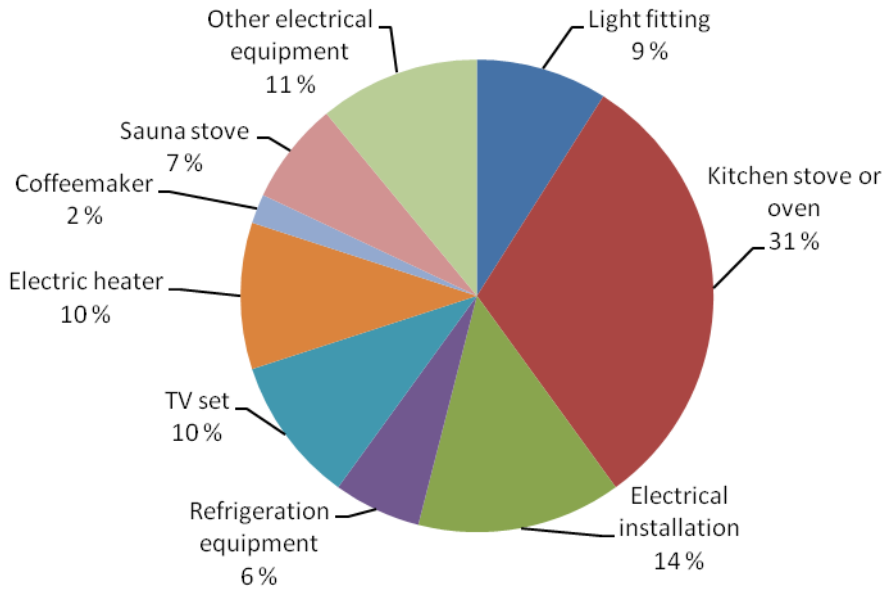


**Figure 1: Electrical fire fatalities in Finland 2001-2008.**

Table 1 and Figure 2 show electrical appliances that have caused fatal electrical fires in Finland during 2001-2008.

**Table 1: Electrical fire fatalities/appliance in Finland 2001-2008.**

Appliance/Year	2001 (pcs)	2002 (pcs)	2003 (pcs)	2004 (pcs)	2005 (pcs)	2006 (pcs)	2007 (pcs)	2008 (pcs)	Total (pcs)
Coffeemaker	0	0	0	1	0	1	0	0	2
Sauna stove	0	2	0	1	0	2	0	4	9
Refrigeration equipment	1	2	1	1	1	0	1	0	7
Kitchen stove or oven	1	2	1	9	7	7	8	4	39
Electrical installation	0	1	2	1	3	4	4	2	17
Electric heater	1	1	1	3	1	2	2	1	12
TV set	2	0	1	3	1	4	1	1	13
Light fitting	0	2	2	5	1	2	0	0	12
Other electrical equipment	1	0	1	1	3	2	1	5	14
<b>Total</b>	<b>6</b>	<b>10</b>	<b>9</b>	<b>25</b>	<b>17</b>	<b>24</b>	<b>17</b>	<b>17</b>	<b>125</b>



**Figure 2: Fatal electrical fire caused by electric appliances (2001-2008).**

### 3. Examples of fire-damaged electrical products

Figures 3-7 below show examples of fire-damaged electrical appliances.



**Figure 3: TV set destroyed by fire**



***Figure 4: Installation box destroyed due to loose connections or a worn component***



***Figure 5: Floodlight damaged due to defect in compensation capacitor***





**Figure 6: Fire-damaged refrigeration equipment**



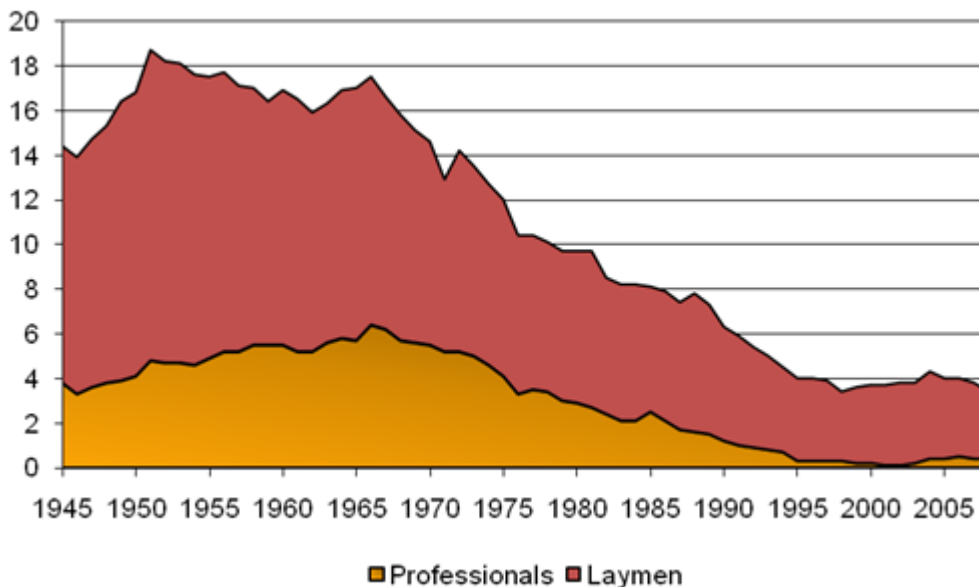
**Figure 7: Compensation capacitor damaged due to defect**

The use of fire-retardant substances in plastic materials for electrical fittings may be a challenge for environmental protection, but it is obvious that using such materials may prevent fatal electrical fire accidents and property damage. Furthermore, depending on the circumstances, a fire in and of itself can naturally be a significant cause of environmental damage.

It is obvious that the appliances above were not damaged due to the carelessness of the user or some other external factor. ***It is equally obvious that these fires could have been prevented by the use of non-flammable materials and components in the appliances concerned.***

#### 4. Electrical safety of products

The statistics on fatal electrical accidents (Figure 8) show that they decreased in number in Finland during the period of obligatory pre-approvals (1980-1993) below the level of five accidents per year, a level which has been maintained, discounting the deviations that occurred at the turn of the millennium. The low accident level after 1995 can also be explained by an improvement in the way in which market surveillance is carried out in Finland.



**Figure 8: Fatal electrical accidents in Finland 1945-2008 (ten-year average).**

It is a challenge for authorities in every country to maintain a consistently low level of electrical accidents. The surveillance of electrical safety requires decision-makers in authorities to have a deep and comprehensive knowledge of safety requirements, and field inspectors to have the necessary know-how to detect dangerous products on the market. In addition, good co-operation between EU countries is necessary in order to attain a high level of electrical safety throughout the Union.



## 5. Market surveillance activities

The main purpose of market surveillance is to detect electrical products on the market which pose a risk. The effectiveness of market surveillance in controlling the fire safety of products could be enhanced if the requirements of valid directives and harmonized standards were better taken into account in the fire safety features of the product.

Market surveillance activities differ from country to country. Information concerning dangerous products has been compiled in the Commission's CIRCA register since 2001 and the results registered by the countries vary considerably. As far as Finland is concerned, one can say that the number of dangerous products has not decreased during this period. Table 2 shows the number of dangerous electrical products detected on the EU market during 2001-2007.

**Table 2: Number of dangerous electrical products on EU market during 2001-2007.**

Country/Year	2001 (pcs)	2002 (pcs)	2003 (pcs)	2004 (pcs)	2005 (pcs)	2006 (pcs)	2007 (pcs)
Austria	71	79	28	20	2	12	22
Belgium	6	17	31	22	5	0	11
Bulgaria	-	-	-	-	-	-	0
Cyprus	-	-	-	0	0	8	1
Czech Republic	0	0	0	0	0	0	1
Denmark	24	45	24	12	0	0	1
Estonia	-	-	-	0	0	0	0
Finland	20	39	32	75	75	145	138
France	5	4	5	0	6	5	8
Germany	14	13	22	15	16	7	4
Greece	0	0	1	0	3	3	0
Hungary	0	3	6	2	73	97	42
Iceland	13	8	2	2	4	6	9
Ireland	0	0	1	0	0	0	0
Italy	20	0	0	0	0	0	0
Latvia	-	-	-	0	0	0	0
Lithuania	-	-	-	0	0	0	0
Luxembourg	4	5	2	22	7	12	0
Malta	-	-	-	0	0	0	0
Netherlands	5	11	6	6	17	11	15
Norway	2	0	0	5	0	8	5
Poland	-	-	-	0	0	3	2
Portugal	1	0	0	0	44	0	0
Romania	-	-	-	-	-	-	0
Slovakia	-	-	-	0	0	0	0
Slovenia	-	-	3	6	4	16	3
Spain	27	12	9	31	30	35	29
Sweden	85	93	85	71	89	73	75
United Kingdom	12	4	2	1	42	15	8
<b>Total</b>	<b>309</b>	<b>333</b>	<b>259</b>	<b>290</b>	<b>417</b>	<b>456</b>	<b>374</b>

Surveillance by authorities is targeted at products on the market. In the EU, one purpose of the CE marking is to show that the product is in accordance with the requirements, but according to the reports on dangerous products this assumption is false in practice. The CE marking on the dangerous product would appear to indicate that the marking and the manufacturer's declaration are not always reliable indicators of the product's compliance with the requirements.

Furthermore, according to Table 2, market surveillance activities are not at the same level in every EU country. If there is no active market surveillance in every EU country, it means that all dangerous products imported into a country without such surveillance can be distributed quite easily throughout the whole EU.

***Dangerous electrical products notified by Finland to the CIRCA Register 2004-2007***

In Finnish market surveillance, the majority of problems (table 3) have been detected in light fittings, power supply units and electronic equipment used for entertainment purposes. In the long term, it is obvious that the arrival of unacceptable products on the market could be avoided if the safety and authority requirements could be better taken into account in technical and commercial training.

Furthermore, EU regulations should put more emphasis on the responsibility of EU importers to ensure that the products fulfil the technical safety requirements.

***Table 3: Dangerous electrical products notified by Finland***

<b>Product group</b>	<b>Dangerous electrical products (2004-2007) (pcs)</b>	<b>Dangerous electrical products (2004-2007) (%)</b>
Installation materials, wiring and cables	41	9
Computers and office equipment	16	4
Kitchen appliances, heaters, pumps	44	10
Electric tools	37	9
Light fittings	148	34
Adapters, recharging equipment	62	14
Home entertainment equipment	48	11
Others	37	9
<b>Total</b>	<b>433</b>	<b>100</b>

Typical defects in products:

- The live parts in the appliance are not adequately protected against accessibility
- Too short distances and clearances between conductive parts of different polarity or between hazardous live parts and accessible metal parts in the appliance
- The cord anchorage is missing from the flexible supply cord of the appliance
- Plastic enclosure material does not fulfil the flammability requirements
- The cross-sectional areas of wires are too small
- Dimensioning of connectors and terminals is not in accordance with the requirements
- The protection against too high a temperature rise during normal use of the appliance is not in accordance with the requirements
- The insulation of wiring materials and/or the current-carrying parts of the appliance do not fulfil the requirements
- Construction of the appliance does not fulfil the moisture resistance requirements (e.g. outdoor use of appliance does not pass the splash-proof test)
- The metal enclosures of the appliances are not reliably earthed.

Furthermore, the necessary information about the product, such as the manufacturer’s name, country of manufacture, user’s manual, installation guides, and manufacturer’s declaration was quite often missing. In addition, the CE marking was in many cases illegally used on the dangerous products.

## 6. Development and training needs

In light of the above results, the development of fire safety requirements for IEC standards should be taken into account more effectively. Training in safety standards should be better integrated into the training programmes of technical and commercial universities and schools. Both designers and importers should be very aware of the safety regulations of the products. If the safety requirements of the product are not taken into account, it may turn out to be defective and this may result in a significant economic risk for the manufacturer or importer and pose a safety risk for the user.

## 7. Conclusions

### Safety and fire safety requirements

There are differences in the safety and fire safety requirements between IEC and UL standards. For example, the UL standard safety requirements for plastic parts are more rigorous than IEC standards.

### Fatal electrical accidents in Finland

According to the statistics, fatal electrical accidents decreased in number in Finland during the period of obligatory pre-approvals (1980-1993) below the level of five accidents per year, a level that has been maintained during Tukes' time.

### Examples of fire-damaged electrical products

It is patently obvious in many cases that the fire has been caused by the use of flammable plastic materials in the appliance. ***Many fatal electrical fires could be prevented by the use of non-flammable materials and components in the appliances.***

### Electrical fire fatalities in Finland

It would appear that electrical fires could be decreased by reducing the flammability risk of the products. It is possible to influence a product's non-flammability by taking into account electrical fire safety requirements in product design as well as in material and component selection.

### Market surveillance activities

Market surveillance activities are not at the same level in every EU country. If there is no active market surveillance in every EU country, it means that all dangerous products imported into a country without such surveillance can be distributed quite easily throughout the whole EU.

### Development and training needs

Harmonization development is needed when it comes to the requirements for safety standards. In particular, it is apparent that the fire safety requirements are not rigorous enough in many IEC standards. Training in safety standards should be better integrated into the training programmes of technical and commercial universities and schools.

### Source

Simonen Seppo, Sähkölaitteiden ja tarvikkeiden turvallisuus Suomessa. (Safety of electrical equipment and materials in Finland). Tukes Publication 4/2009.