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Electrical Fires in Finland

Summary of the results of the follow-up study 2003–2004

The Safety Technology Authority (TUKES) conducted a one-year follow-up study on electrical fires between 1 September 2003 and 31 August 2004 in cooperation with the rescue and police authorities. The last such large-scale study on electrical fires was completed between 1998 and 1999. This summary presents the main results of the study and compares them with the results of the study completed five years ago.

Study material and summary

ELECTRICAL FIRE

An electrical device or installation starts a fire in such a way that the energy source needed for the fire to burn is electricity. Electrical fires may also be caused by faults or misuse of devices or installations.

The study concentrated on fires that were suspected to have been caused by electrical equipment, its installation or incorrect use. The object of the study was to define the equipment groups which caused major electrical fires, their causes and damage in different types of buildings, to suggest the most advisable preventive actions, and to recognise possible development trends in the field.

The causes for suspected electrical fires were examined during 1 September 2003 – 31 August 2004 in Vantaa and the Kymenlaakso Region. Outside the research area, all fatal electrical fires were investigated, as well as major fires that were suspected to have been caused by electricity. In addition, reference information on electrical fires that occurred in Finland during the study period was collected from all rescue teams and police departments and analysed. The conflagration statistics of the Finnish Federation of Insurance Companies from 1980–2003 were also utilised.

Summary of the results

In the first follow-up study during 1 September 1998 – 31 August 1999, 1760 electrical fires occurred in Finland. In the current follow-up period, five years later, there were 245 fewer fires, i.e. a total of 1515 electrical fires.

In other words, the total number of electrical fires has dropped by approximately two hundred fires per year.

In the one-year reference period between 2003 and 2004, information was found on 14 deaths caused by electrical fires (in the previous follow-up study between 1998 and 1999, the number had been 7). Most electrical fires and a very significant proportion of damage caused by them still occur in the home environment. Health care buildings were found to have the greatest frequency of electrical fires in relation to the number of buildings and the size of the floor area. The fire-causing equipment and causes for fires were very different there, compared to other buildings with public and business premises. The most common fire-causing group of devices in health care buildings was stoves and ovens.

Typical damages caused by electrical fires were greatest in agricultural buildings and traffic constructions. The conflagration risk was clearly greatest in agricultural buildings. The time of day and the density of the municipality's population had a significant effect on the risk of electrical fires. Fewer electrical risks occurred in the small hours and early in the morning (between midnight and 08.00) and in sparsely populated (< 20 inhabitants/km^2) municipalities but, compared to other places, these municipalities had more major fires, and the typical damages were greater.

Fires by device group

In the new follow-up study, the most common device groups that caused electrical fires were, in order of frequency, stoves, electrical installations, light fittings, washing machines and dish washers, televisions, various electrical devices used in production, refrigeration equipment and electrical sauna stoves *(table 1)*.

There has been some reduction in the number of fires in nearly all groups. Television fires in particular, but also those of washing machines, sauna stoves, light fittings and electrical installations have clearly decreased during the last five years *(picture 1)*. It seems that the number of television fires has dropped by as much as 50%. Fires caused by stoves or ovens and refrigeration equipment have increased, on the other hand, contrary to the common trend in the number of electrical fires.

The most common cause for fires started by **stoves and ovens** (approximately 95% of all cases) was incorrect use. Food was left on the stove or in the oven for too long. Sometimes a child or a pet, typically a dog, had switched on the stove. In these cases, objects left on the stove or in its immediate vicinity, such as oven gloves or plastic bowls, had helped ignite the fire.

More than two thirds of all **sauna stove** fires were due to incorrect use. Typically, washing had been left drying in the steam room with the sauna stove switched on. Textiles placed too close to the hot sauna stove or hung carelessly and dropped on the stove had caught fire. In some cases, the heat in the steam room had softened a plastic clothes-hanger or clothes line, causing the clothes to fall on the sauna stove.

Almost all **television** fires were caused by a technical fault in the device, mostly a defective solder joint in a circuit card.

Device causing the fire	Study 1998–99	2003–04	Total
Washing machine (dish + clothes)	171	120	291
Television	210	92	302
Stove or oven	309	431	740
Light fitting	191	150	341
Electrical installations	319	274	593
Sauna stove	94	59	153
Electric heater	81	72	153
Production device	105	83	188
Cooker hood	21	13	34
Refrigeration equipment	54	75	129
Central vacuum cleaner	17	9	26
Microwave oven	19	24	43
Other household appliance	49	31	80
Car heater	30	18	48
Other device or apparatus	90	47	137
Deep fat fryer	0	8	8
Computer	0	9	9
	1 760	1 515	3 275

Table 1.
Device groups causing electrical fires

Most **washing machines** fires were caused by technical faults (approximately 97% of all fires). In more than 60% of all cases, the defective component was a program mechanism. Other components that caused fires included the engines of cleaning drums or water pumps, heating resistors and contact plugs.

More than two thirds of fires caused by **electric heaters** were started by technical faults, whereas the reasons for fires were previously divided fairly evenly between technical faults and the user's incorrect operation. As previously, typical incorrect operation included covering the equipment or placing particularly portable heaters in an unstable manner or too close to flammable materials. This time around, the most common technical reason turned out to be a defective heating resistor, whereas in the previous study the defective component was typically a thermostat.

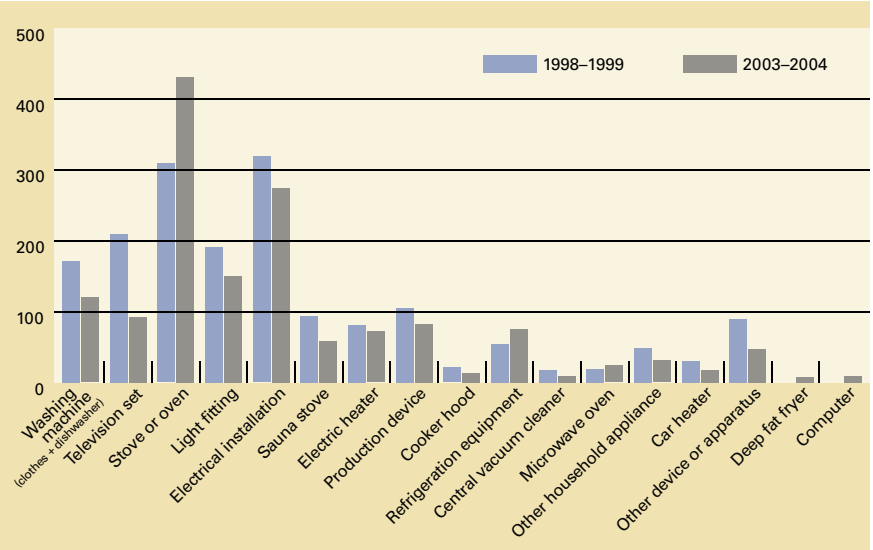
In 99% of fires caused by **refrigeration equipment**, the fire was caused by a technical fault in the equipment. The fault was mostly found in the compressor or its start relay.

The most important causes for fires in **electrical installations** were technical faults. Their share of all fires was more than 90%, just as in the previous study. A little less than a half of fires caused by electrical installations were started by bad joints in distribution joints or main exchanges, branch boxes or mounting boxes. Approximately 80% of the fires that started from distribution joints or main exchanges occurred in industrial, residential or business buildings or meeting rooms.

The **light fitting** that caused the most fires was fluorescent lights. Approximately two thirds of all fires caused by light fittings involved fluorescent lights, with incandescent lights accounting for approximately one third. In 80% of the cases, fires in light fittings were caused by technical faults. Most fires that started from fluorescent lights occurred as a result of a defective choke coil or condenser. In incandescent lights, the fires were typically caused by incorrect operation. Particular attention should be paid to the stability of portable **incandescent and fluorescent lights**. For safety's sake, halogen lights used on building sites should be replaced by fluorescent lights with lower surface temperatures.

More than 67% of fires caused by **production equipment** were started by electric motors or machines operated with electric motors. In 96% of cases, production equipment fires were caused by a technical fault in a device. This time, the proportion of fires caused by incorrect operation was only about 2%, whereas in the previous study its proportion was around 20%.

Typically, technical faults that caused fires in electrical devices or equipment are often connected to inadequate or totally neglected maintenance. Technical faults causing an electrical fire are apparently often caused by operating methods, and design or manufacturing defaults do not seem to have a significant role in the ignition of electrical fires.



Picture 1.
The fire frequency of a single piece of equipment in some groups of electrical equipment

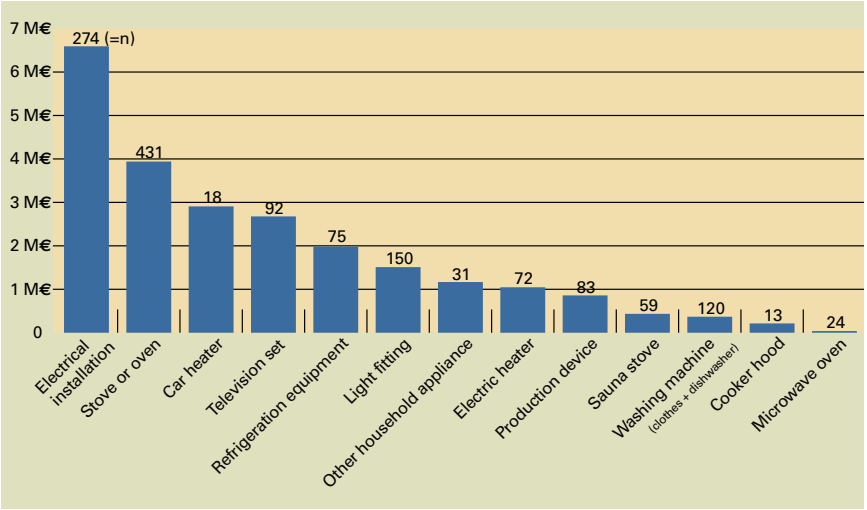
Fire damage

Various device groups can be compared to each other using computational total loss sums *(picture 2)*. Based on this way of thinking, the most damage is caused by electrical installations, stoves, car heaters, television sets, refrigeration equipment and light fittings. Furthermore, the risk of death caused by a fire is magnified in fires started by stoves and television sets.

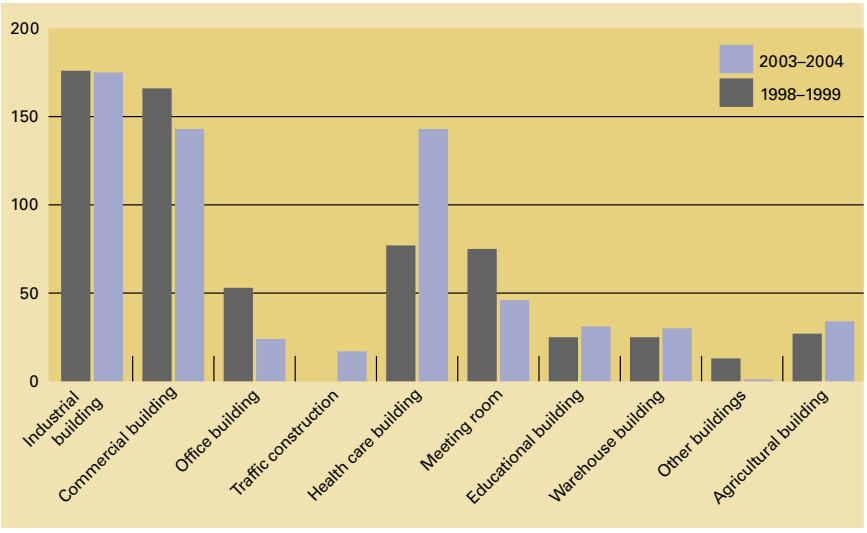
During the year under consideration, 29 major electrical fires occurred in Finland (direct damage of more than 200 000 euros). In the previous data collection period, there were 24 major electrical fires. The device groups that caused the most fires included electrical installations, refrigeration equipment and car heaters *(table 2)*.

Device causing the fire	Study 1998–99	2003–04	Total
Washing machine (dish + laundry)	0	1	1
Television	0	2	2
Stove or oven	0	2	2
Light fitting	3	0	3
Electrical installations	9	10	19
Electric heater	1	0	1
Production device	9	2	11
Refrigerating device	1	4	5
Other household appliance	0	2	2
Car heater	1	4	5
Other device or apparatus	0	2	2
Total	24	29	53

Table 2.
Device groups causing major electrical fires



Picture 2.
Computational sum of total loss of the various device groups per year



Picture 3.
Number of electrical fires by building type in the various study periods (residential buildings excluded)

Fires by building type

Building type	Study 1998–99	2003–04	Total
Residential building	1 123	871	1 994
Industrial building	176	175	351
Commercial building	166	143	309
Office building	53	24	77
Traffic construction	0	17	17
Health care building	77	143	220
Meeting room	75	46	121
Educational building	25	31	56
Warehouse building	25	30	55
Other building	13	1	14
Agricultural building	27	34	61
Total	1 760	1 515	3 275

Table 3. Numbers of electrical fires by building type in various studies

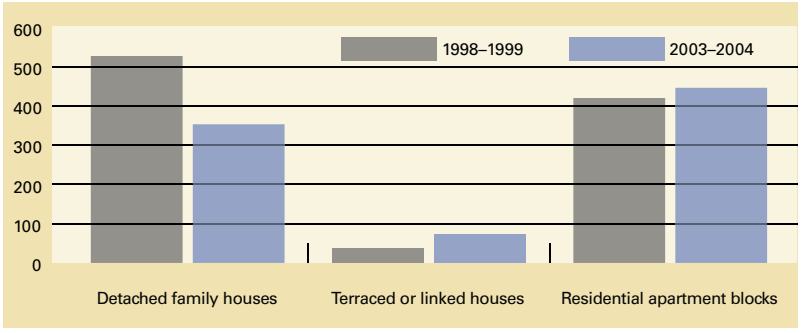
Clearly the largest number of electrical fires occurred in residential buildings. They represent the most common building type both by the number of buildings and by the floor area. Other major building types for electrical fires include industrial buildings, commercial buildings, health care buildings and meeting rooms. In total, more than 90% of all electrical fires occurred in these five building type groups *(table 3)*.

Compared to the previous study, the number of electrical fires had clearly decreased in commercial buildings, office buildings and meeting rooms *(picture 3, on the previous page)*. The change in the number of fires in industrial, educational and agricultural buildings was negligent. However, the number of electrical fires in health care buildings had almost doubled in this study.

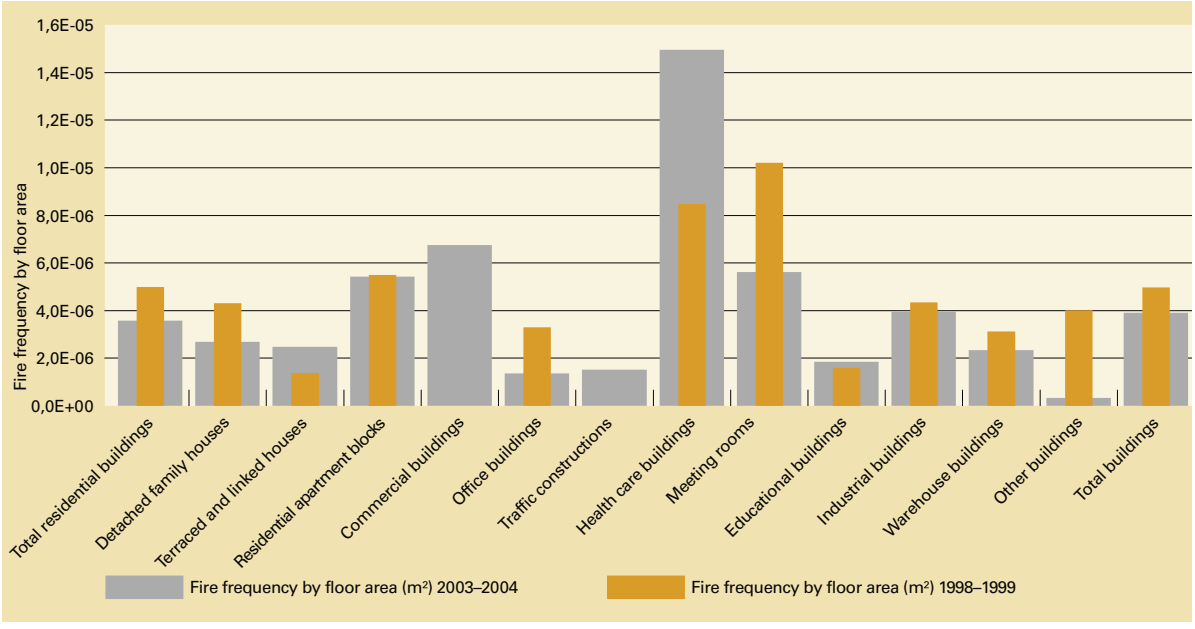
As a whole, the number of electrical fires in residential buildings had decreased. When reviewing the changes in the various types of residential buildings, it can be seen that the decrease is due to there being fewer electrical fires in detached family houses *(picture 4)*.

There was no significant change in the number of fires in residential apartment blocks, but in terraced and linked houses electrical fires seem to have increased to some extent.

When reviewed by floor area, electrical fires have decreased particularly in commercial and office buildings, meeting rooms and warehouse buildings and in residential buildings as a whole, due to the decreasing number of electrical fires in detached family houses. Electrical fires have increased considerably, above all, in health care buildings *(picture 5)*. The electrical fire frequency of these buildings corresponds with one electrical fire per 50 health care buildings per year, when seen in the context of the number of buildings. Considered in these terms, the changes are very similar to the results achieved when comparing the floor area.



Picture 4. The number of electrical fires in various residential building types in various studies



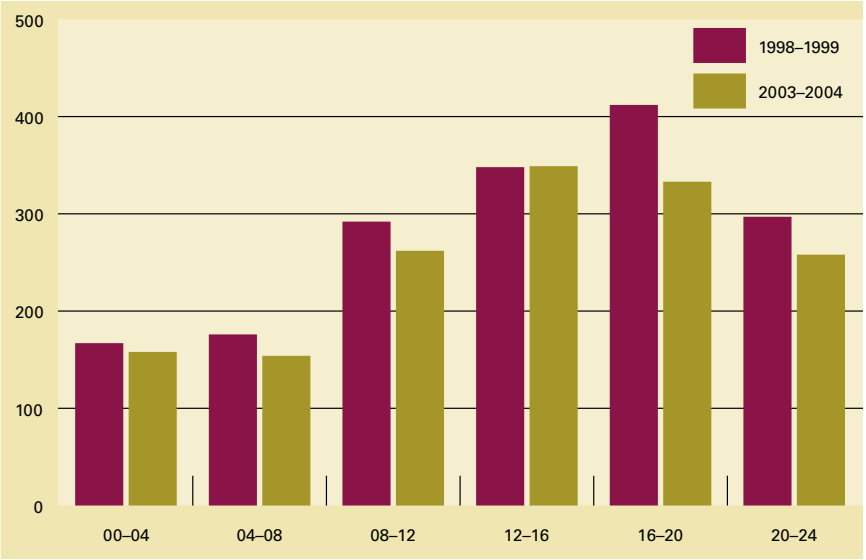
Picture 5. Electrical fire frequencies by floor area

Electrical fires in different seasons

As in the previous study, the least number of electrical fires occurred in the small hours between midnight and 08.00, when most people were asleep and the social activity at its lowest. The most electrical fires occurred in the afternoon and early evening between 12.00 and 20.00 *(picture 6)*.

In the small hours and in the morning between midnight and 08.00, the typical damages directly contributable to electrical fires were considerably higher than at other times of the day *(table 4)*. In the computational sums of total loss, the damage suffered during early morning period between midnight and 04.00 is highlighted as being more severe than at other times.

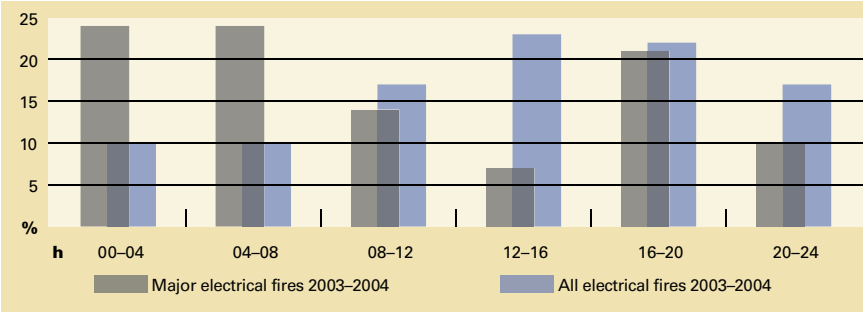
Approximately 40% of all electrical fires occurred during the daytime hours between 08.00 and 16.00 *(picture 7)*. However, approximately half of the major electrical fires occurred in the small hours between midnight and 08.00, even though only a fifth of all electrical fires occurred during that period.



Picture 6.
Electrical fires at different times of the day

Time class	n	5% adjusted average of the amount of loss	Total amount of loss
00–04	158	45 929 €	7 256 782 €
04–08	154	31 163 €	4 799 102 €
08–12	262	19 011 €	4 980 882 €
12–16	349	8 828 €	3 080 972 €
16–20	333	13 062 €	4 349 646 €
20–24	258	16 153 €	4 167 474 €
Total	1 514		28 634 858 €

Table 4.
The 5% adjusted average of direct damages and the computational total amount of loss at different times of the day.



Picture 7.
The distribution of electrical fires between different times of the day

Conclusions

Based on the follow-up study, it can be estimated that the number of electrical fires has decreased on a computational basis, by 160 to 330 fires per year. Losses caused by typical fire damage have remained unchanged during the past few years, with the reduction in the number of electrical fires leading to millions of euros of savings in damages per year. Whilst the number of electrical fires has decreased, they seem to have become more dangerous: the number of deaths caused by fires has not dropped, but rather on the contrary.

Information on the safe use of equipment should continue, in order to influence consumers' attitudes and operating methods in relation to fire safety. It is also important to develop fire investigation, so as to learn from the fires that have occurred.

Information on the safe use of equipment should continue, in order to influence consumers' attitudes and operating methods in relation to fire safety. It is also important to develop fire investigation, so as to learn from the fires that have occurred. Fire inspection activity should be expanded to cover not only the review of buildings and technical solutions, but also the promotion of safe operating methods among the people operating at the target.

The results of the study reflect a wider social phenomenon: the aging of the population and the increase in the number of old people living alone. That creates certain fire safety risks, regardless of the form of housing that the old people live in. An important method is to adapt the technology available to the operating ability of the elderly. Old people cannot always operate conventional electric stoves and ovens, for example. It is more cost effective to compensate by utilising the characteristics of the technology than to try and eliminate the fundamental reasons for the incorrect use of such equipment by trying to remove all individual defaults. At the end of the day, technology and people's living conditions should be developed in such a way that no one has to die or be injured in a fire.

The development in different device groups has been very positive, particularly with fires caused by television sets, but also with regard to washing machines, light fittings, sauna stoves, electrical installations and production equipment. However, there has been some increase in fires caused by stoves, in particular. In order to reduce damage, the protection level should be decisively developed everywhere in Finland for all building types, particularly for health care and agricultural buildings. Increasing the use of automatic fire detectors and extinguishers in high risk buildings makes it possible to detect fires more quickly and reduce both personal and property damage.

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Source material

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