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CONSUMER PRODUCT SAFETY COMMISSION
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Memorandum

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SUBJECT : Hazards Related to Electric Lighting Products *

An estimated 8,780 residential structure fires (excluding incendiary and suspicious fires) associated with all electric lighting products, were attended by fire departments annually from 1995 through 1999. These fires resulted in an estimated 310 civilian injuries, 40 civilian deaths, and $119.2 million in property loss, annually (Table 1). According to the latest report available, an estimated 6% of all consumer product-related electrocutions in 2001 were attributable to electric lighting products. [1]

In order to obtain information about hazards related to lighting products, CPSC staff identified and reviewed 402 follow-up investigations of incidents [2] occurring between October 1, 2002 and September 30, 2004. Of interest were portable products such as floor/table/desk/clip-on lamps, and work/rope/night lights, as well as permanent products such as all mounted/hanging/recessed lighting fixtures. The focus of this data review was on structure fires, potential fires[3], electrocutions, electric shocks, or electrical hazards. After screening the investigation reports to retain only the in-scope cases, 374 incidents were classified into three distinct groups. One group involved the malfunction of portable products (150 incidents), while another group involved malfunction of installed products (145 incidents). A third group

*The views expressed here are those of the CPSC staff. They have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

[1] Chowdhury, Risana T.; 2001 Electrocutions Associated With Consumer Products, June 2004, Directorate for Epidemiology, Division of Hazard Analysis, U.S. Consumer Product Safety Commission.

[2] While they are not a statistical sample of all incidents that may have occurred between October 2002 and September 2004, they provide useful information on the incident scenarios.

[3] Flames, sparks, smoke, overheating, or burning odor.

consisted of 79 incidents where factors other than product failures created the hazard. A discussion of this last group is considered beneficial since many of the scenarios illustrate common, preventable human errors which created the hazardous conditions that led to the subsequent chain of events. Analysis of each of these groups is presented separately below.

Table 1
Estimated Residential Structure Fires, Deaths, Injuries, and Property Loss Associated with All Electrical Lighting Products
1995-1999

Year	Fire Estimates[4]	Death Estimates[5]	Injury Estimates[6]	Property Loss Estimates(millions)[7]
1995	8,800	50	310	$120.3
1996	9,000	60	330	$103.2
1997	9,600	30	340	$142.8
1998	8,000	60	250	$102.5
1999†	8,500	20	310	$127.0
Total	43,900	220	1,540	$595.8
Annual Average	**8,780**	**40**	**310**	**$119.2**

Sources: Smith, L., and Mah J., Revised Residential Fire Loss Estimates 1980-1998, Division of Hazard Analysis, Directorate for Epidemiology, U.S. Consumer Product Safety Commission.
Miller, D., Smith, L., and Greene, M., 1999 Residential Fire Loss Estimates, Division of Hazard Analysis, Directorate for Epidemiology, U.S. Consumer Product Safety Commission.
† Due to change in data structure, use of 1999 data with earlier data for trend comparison is not recommended.

I: Failure of Portable Products

Product Description

A portable lighting product is an appliance (usually cord-connected) capable of being easily moved by hand from place to place. This category includes table lamps (including touch or clap on-clap off types), desk lamps, reading lamps, floor lamps (including torchiere or pole types), night lights (usually cordless, plug-in style), work/trouble lights, decorative rope lights, and specialty lamps like lava lamps, among others. Information concerning the product type, failure mode, product age, manufacturer and safety listing is presented below.

[4] Rounded to nearest 100.
[5] Rounded to nearest 10 .
[6] Rounded to nearest 10.
[7] Rounded to nearest tenth of a million.

Product Type

Based on a review of 150 portable lighting product-related incidents, 5 hazards were identified as follows: potential fire (78 incidents), fire (60 incidents), explosions (7 incidents), electrocutions (3 incidents), and electrical shocks (2 incidents). Among the 78 potential fires, the eruption of a small flame in the product was reported in 20 incidents and smoke was reported to be emanating from the product in 19 others. In 17 other cases, the product was discovered by the consumer to have sustained some sort of fire/heat damage, although the consumer was not aware of it at the time of the incident. The remaining cases involved sparks, overheating, and burning odor in the product. Table/desk lamps, floor lamps, and night lights accounted for 86% of the total incidents. The distribution of portable lighting products classified by hazards is presented in Table 2.

Table 2
Distribution of Portable Lighting Products Classified by Hazards
October 1, 2002 – September 30, 2004

Lighting Product Type	Total	Hazard
Table/Desk lamps	**55**	Fire (30), Potential Fire (20), Explosion (4), Electrocution (1)
Floor lamps	**41**	Potential Fire (20), Fire (19), Explosion (1), Electrical Shock (1)
Night lights	**33**	Potential Fire (28), Fire (2), Explosion (2), Electrical Shock (1)
Work lights	**6**	Fire (2), Potential Fire (2), Electrocution (2)
Decorative rope lights	**4**	Potential Fire (4)
Clip-on lights	**4**	Fire (3), Potential Fire (1)
Specialty lamps	**3**	Fire (2), Potential Fire (1)
Unspecified lamps	**4**	Fire (2), Potential Fire (2)
Total	**150**	**Potential Fire (78), Fire (60), Explosion (7), Electrocution (3), Electrical Shock (2)**

Source: U.S. Consumer Product Safety Commission (CPSC), In-Depth Investigation Reports File, Directorate for Epidemiology, Hazard Analysis Division.

Sources of Failure

Based on a review of 150 portable lighting product-related incidents, the known failure sources associated with these products were mainly bulbs (21%) and power cords (19%). When more specific information was unavailable, "fixtures" were generally identified in another 19% of the incidents. Occasionally more than one component was cited as the source of failure. For instance, bulb/ballast, bulb/cord, bulb/socket, bulb/wiring, or cord/plug combinations made up another 6% of the failure sources. For a large proportion (21%) of the incidents, the extent of the damage made it impossible to identify the source of failure. The remaining incidents (15%) involved a variety of failure sources such as malfunction of the switch, screen/shade, socket, plug, housing, and sensor, among others. Table 3 below illustrates the distribution of failure mode by hazards.

Failed bulbs occurred most frequently in table lamps (13 incidents) and floor lamps (7 incidents); failed power cords occurred most often in table lamps (16 incidents) and floor lamps (10 incidents). General fixture failures were cited most often in night lights (15 incidents). Beside the fact that most (65%) of the involved products were switched on at the time of the incident, very little additional detail was available on the exact nature of failure.

For the 38 incidents where bulbs were found to be the source of failure (either alone or in combination with some other product component), the most common bulb types identified were fluorescent (15 cases) and incandescent, including black incandescent (14 cases). The ratings of the bulbs varied greatly from 0.03 watts (in electro-luminescent bulbs) to 1000 watts (in halogen bulbs). Very sketchy information was available on the ratings of the power cords or extension cords. No power cord information was available for 90 of the 150 incidents, while it was reported that no power cord was being used in another 30 incidents. In the latter cases, the products were plugged directly into the outlet. For the remaining 30 cases, the ratings of the power cords varied between 16-18 AWG and 110-300 volts. An extension cord was known to be present in only 5 incidents, but scarcely any information was available on the rating or length. For the rest of the incidents, either no extension cord was being used or no information was available.

Table 3
Distribution of Sources of Failure Classified by Hazards
Among Portable Lighting Products
October 1, 2002 – September 30, 2004

	Hazard					
Source of Failure	Potential Fire	Fire	Explosion	Electrocution	Electrical Shock	**Total (Percent)**
Bulb	19	8	4	0	0	**31 (21%)**
Power cord	3	24	0	1	1	**29 (19%)**
Fixture, no further detail available	24	2	1	1	0	**28 (19%)**
Combination of components	6	3	0	0	0	**9 (6%)**
Other (switch, shade, socket, etc.)	13	6	2	0	1	**22 (15%)**
Unknown	13	17	0	1	0	**31 (21%)**
Total	**78**	**60**	**7**	**3**	**2**	**150 (100%)**

Source: U.S. Consumer Product Safety Commission (CPSC), In-Depth Investigation Reports File, Directorate for Epidemiology, Hazard Analysis Division.

Product Age and History

A review of the 150 portable lighting product related-incidents showed that over 71% of the products were purchased new. For 22% of the cases, this information was unavailable and for the remaining 7%, it was reported that the product was bought "used". Fifty-four of the 150

failed product-components were under one year old. Forty were between 1 and 5 years old, and 10 were over 5 years old. In a few (7) cases the product was described very generally as being "a few years/ fairly/ very" old. No information was available on the age of the remaining 39 failed product-components.

For a majority (64%) of the cases, the consumers reported no prior problem with the product. For another 25%, no information was available. In 11% of the incidents the consumer reported experiencing some sort of problem with the product, or with another similar product. Repair or modification of the product was rare. Only 2 consumers reported repairing the product prior to the incident. For the vast majority (70%), no product repair had taken place, while for 29% of the cases, no such information was available.

Manufacturer and Safety Listing

Loss of information on the characteristics of the lighting products occurred most often when the products were completely destroyed in a fire or discarded by the fire departments or the owners. The manufacturer or the brand of the failed lighting product (or the relevant component) could be identified in 60% of the incidents. No information was available for the rest. Information concerning safety standards on the lighting products and the components was also limited. About 54% of the products were identified as UL/CSA listed, while no information could be obtained for 42% of them. For the remaining 4%, no safety label was visible.

Of the 150 products, 57 were identified as being equipped with a 2-prong polarized plug, 39 were equipped with a 2-prong plug (polarization was unknown for a good proportion of these), and 8 were with a 3-prong grounded plug. No information was available for the remaining 46 products.

II: Failure of Installed Products

Product Description

A permanently installed lighting product is a stationary fixture that cannot be easily moved from place to place. Installed lighting products can be mounted on or hanging from surfaces such as ceilings, walls, furniture, or under-the-counter, among other locations. The mounted fixtures may be either surface-mounted or recessed.

Product Type

A review of 145 installed lighting products shows fires (74 incidents), potential fires (57 incidents), explosions (11 incidents), electrical shocks (2 incidents) and electrocution (1 incident) to be the hazards involved. Surface mounted fixtures on ceilings and walls were responsible for

64% of the incidents. The distribution of permanently installed lighting products classified by hazards is presented in Table 4.

Table 4
Distribution of Installed Lighting Products Classified by Hazards
October 1, 2002 – September 30, 2004

Lighting Product Type	Total	Hazard
Surface mounted, ceiling fixtures	**60**	Potential Fire (32), Fire (22), Explosion (5), Electrical Shock (1)
Surface mounted, wall fixtures	**33**	Fire (18), Potential Fire (11), Explosion (4)
Recessed, ceiling fixtures	**19**	Fire (14), Potential Fire (5)
Hanging, ceiling fixtures	**13**	Potential Fire (6), Fire (5), Explosion (2)
Surface mounted fixtures on furniture, under-counter, shelf, closet, etc.	**8**	Fire (4), Potential Fire (3), Electrical Shock (1)
Fixtures on ceiling, no further detail available	**5**	Fire (5)
Other (swimming pool and emergency exit lighting)	**2**	Fire (1), Electrocution (1)
Unknown installed lighting	**5**	Fire (5)
Total	**145**	**Fire (74), Potential Fire (57), Explosion (11), Electrical Shock (2), Electrocution (1)**

Source: U.S. Consumer Product Safety Commission (CPSC), In-Depth Investigation Reports File, Directorate for Epidemiology, Hazard Analysis Division.

Sources of Failure

A review of the 145 installed lighting product-related incidents revealed that the known failure sources associated with these products were mainly bulbs (30%) and wiring (17%). As seen for portable products, often (in 17% of the incidents) the "fixture" was generally cited as the source of failure when more precise information was unavailable. For a large proportion (17%) of the incidents, no source of failure could be determined. Failures in the ballast, connections, switch, housing, cord, circuit board, or sensor made up another 15% of the incidents. For the remaining 3%, a combination of components such as bulb/ballast, bulb/wiring, or connections/wiring was cited as the source of failure. Table 5 below illustrates the distribution of failure mode by hazards.

All of the major problems such as failed bulbs, wiring, or fixtures, occurred disproportionately more often in surface mounted ceiling fixtures (20 incidents involved bulbs, 12 involved fixtures, and 9 involved wiring). Surface mounted wall fixtures ranked second both in bulb failures (9 incidents) and wiring failures (6 incidents). Recessed ceiling products ranked second in fixture failures (8 incidents). In cases of fixture failure, the specific component of the fixture was not identifiable. Other than the fact that the product was turned on in most cases (61%), very little detail was available on exactly how each failure occurred.

There were 47 incidents where either the bulb alone or some combination of components including the bulb malfunctioned. In 33 of the 47 incidents, the bulb type was fluorescent. Seven cases involved incandescent bulbs, 4 involved halogen bulbs, and 1 involved a multi-vapor metal bulb. No bulb information was available for the remaining 2 incidents.

Table 5
Distribution of Sources of Failure Classified by Hazards
Among Installed Lighting Products
October 1, 2002 – September 30, 2004

		Hazard				
Source of Failure	Fire	Potential Fire	Explosion	Shock	Electrocution	**Total (Percent)**
Bulb	4	30	10	0	0	**44 (30%)**
Wiring	19	4	0	1	0	**24 (17%)**
Fixture, no further detail available	11	13	1	0	0	**25 (17%)**
Other (ballast, connection, switch, housing, etc.)	16	5	0	1	0	**22 (15%)**
Combination of components	5	0	0	0	0	**5 (3%)**
Unknown	19	5	0	0	1	**25 (17%)**
Total	**74**	**57**	**11**	**2**	**1**	**145 (100%)**

Source: U.S. Consumer Product Safety Commission (CPSC), In-Depth Investigation Reports File, Directorate for Epidemiology, Hazard Analysis Division.

Of the 145 products, 96 were reported to have "on-off" switches (among them, 4 had pull chains, 1 was rocker-type, and 1 was touch-type). Only 4 cases reported the presence of a "dimmer" switch, and 5 cases reported no switches. For the "no-switch" scenario, a key or motion-detector activated the lights. For the remaining 40 incidents, no information on switch was reported. The time that the product was in use, immediately prior to the incident, varied from "not in use" to "continuously".

While the bulbs ranged anywhere from 2 to 400 watts, very scant information was available on wiring or switch specifics such as wire gauge, voltage, wattage, etc.

Product Age and History

A review of 145 installed lighting product related-incidents showed that around 59% of the products were purchased new. No information was available for another 39%, while only 2% reported the product to have been bought "used". Twenty-eight of the 145 malfunctioning products (or components) were under one year old, 35 were between 1 and 5 years old, and 22 were over 5 years old. In 20 cases the product was described in very general terms as being "old" or "very old". In 2 cases, where a combination of components was cited as the source of failure, the age of the one component was under 18 months while the other component was more

than 5 years old. In contrast to portable lighting products, a sizeable fraction (29%) of the permanent products was over 5 years old. No information was available on the age of the remaining 38 failed product components.

For a majority (85) of the cases, the consumers reported no prior problem with the product. For another 37 cases, no information was available. In 23 of the incidents the consumer reported experiencing some sort of problem with the product, or with another similar product. Repair or modification of the product was again rare. Only 7 consumers reported repairing the product prior to the incident. For the vast majority (99 cases), no product repair had taken place, while for 39 cases, no information was available on repair history.

Manufacturer and Safety Listing

As was the case for portable lighting products, the manufacturer or the brand of the failed lighting product (or the relevant component) could be identified only part of the time (58% of the incidents); no such information was available for 42% of the cases. Information concerning safety standards on the lighting products and the components was also limited. For 62 of the 145 cases, the products were identified as being UL listed (with one product reported as being HVI certified) and 5 products had no safety labels whatsoever. No information was reported for the remaining 77 cases.

III: Incidents Caused by Factors Other Than Product Malfunction

There were 79 cases where factors other than product malfunction played the key role in triggering the incident. The most common scenario (40 cases) was when the heat from the bulb ignited nearby combustibles. For a majority of these instances, a bare bulb (with no shade or guard) was placed very close to or in contact with curtains, clothes in a closet, or stacks of paper. In other instances, clothing articles or the lampshade ignited because the consumer either had placed clothes on top of the shade or had pushed the shade to one side. In several other instances, children, pets, or adults knocked over lamps onto combustible material (usually a mattress, blanket, rug, or newspapers) which in turn ignited. In a handful of cases, faulty installation such as insufficient clearance between the light fixture and insulation caused the problem. Another common scenario was the location of the power cord such that it got pinched by large furniture pieces. In a few cases, there was the presence of gasoline/solvent fumes, or even gas leaks in the surrounding environment; the subsequent accidental shattering of a light bulb or a spark from a light-switch ignited a flash fire and explosion. A few cases were the result of overheating due to excessive wattage, or melting due to using rope lights before uncoiling. In the remaining cases, the cause was either not a component of a lighting product (such as a faulty transformer used for outdoor lighting, a consumer contacting live wiring while working on a lighting product, or a faulty switch which was part of a separate cord kit) or could not be determined with certainty to be related to a lighting product.

Presence of Safety Devices

Whether the fire incident was a direct result of a lighting product malfunction or not, the presence and effectiveness of a safety device such as a smoke alarm, heat detector, or sprinkler system, is of interest because of the degree to which it can affect the severity of the outcome. Table 6 below presents the distribution of safety device status by disposition of the victim(s) in all 374 incidents. Except for one case with a heat detector and one with a sprinkler system, in the vast majority of the incidents, the safety device refers to a smoke alarm.

Table 6
Distribution of Safety Device Status by Victim Disposition
October 1, 2002 – September 30, 2004

Safety Device	No Injury	Treated and Released	Dead on Arrival	Transferred to Another Hospital	Unknown	Total
No safety devices or safety devices not operating	45	3	7	1	0	56
Operating safety device	55	14	5	3	0	77
Unknown if safety device present or worked	53	11	16	4	1	85
Not applicable[8]	133	19	4	0	0	156
Total	**286**	**47**	**32**	**8**	**1**	**374**

Source: U.S. Consumer Product Safety Commission (CPSC), In-Depth Investigation Reports File, Directorate for Epidemiology, Hazard Analysis Division.

A circuit breaker or a fuse can be a different type of safety device. They detect the presence of excessive current flow in the branch circuit and automatically shut it off before an electrical fire can start. For the most part (205 of the 374 incidents) no information was available on any breakers or fuses; in 118 incidents, no circuit breaker tripped; in 40 cases, the breaker was reported to have tripped, and in 3 cases, a fuse blew. In 2 additional cases, the circuit breaker was intentionally shut off by the consumer or reset after it had tripped. There was no electrical incident in the remaining 6 cases; hence, the tripping of a circuit breaker was not applicable.

Conclusion

An estimated annual average of 8,780 residential structure fires attended by fire departments from 1995 through 1999 were associated with electrical lighting products. These fires resulted in an estimated annual average of 310 civilian injuries, 40 civilian deaths, and over $119 million in property loss.

Based on 150 follow-up investigations of portable lighting product-related incidents occurring between October, 2002 and September, 2004, fire and potential fire (small flames,

[8] Safety system is considered not applicable in cases of potential fire, electrocution, or electrical shock.

sparks, smoke, overheating, or burning odor) were the major hazards and accounted for over 92% of the total incidents. Table/desk lamps, floor lamps, and night lights were the most frequently involved product types with power cord and bulb malfunctions, the most common identifiable failure sources. Most of these incidents occurred while the product was switched on for varying lengths of time (anywhere from "moments" to "continuously"). Most of the products were bought new, less than 5 years of age at the time, with no problem or repair history.

Based on 145 follow-up investigations of installed lighting product-related incidents occurring between October, 2002 and September, 2004, fire and potential fire were the major hazards once again, accounting for over 90% of the total incidents. Surface mounted fixtures, on ceilings and walls, were the most frequently involved product types, with most failures occurring in the bulb or wiring components. Similar to portable products, most of the installed products were also purchased new, less than 5 years of age, with no prior problem or repair reported.

The 79 incidents with no lighting product malfunction demonstrate a lack of consumer awareness of preventive measures that may have mitigated the hazardous conditions that triggered the incidents.