



UNITED STATES  
CONSUMER PRODUCT SAFETY COMMISSION  
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**Memorandum**

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SUBJECT : Final Report on Portable Electric Fans – Fires

An estimated 20,000 residential structure fires (excluding incendiary and suspicious fires) associated with all electric fans, were attended by fire departments from 1990 through 1998. These fires resulted in an estimated 920 civilian injuries, 100 civilian deaths, and \$228 million in property loss. By using methods consistent with those used to estimate losses associated with all electric fans, the Directorate for Epidemiology estimated that, between 1990 and 1998, about 4,500 (23 percent) of these fires were associated with portable electric fans. These fire incidents related to portable fans resulted in about 270 civilian injuries, more than 20 deaths, and about \$55 million property loss in the United States during this time period (Table 1)<sup>1</sup>.

The voluntary standard for fans (UL 507) generally recognizes some of the more obvious failure modes of portable fans (i.e. stalled motor, power cord insulation, switch endurance, etc.) and addresses these with performance tests. However, the standard does not account for all reasonably foreseeable failure modes, contributing factors and use patterns. In order to obtain this information, CPSC staff reviewed all 255 follow-up investigations of portable fan related incidents<sup>2</sup> (out of the total reported 506 incidents between January 1, 1990 and April 12, 2001). Two hundred forty three of these incidents were associated with structure fires, potential fires<sup>3</sup>, electrocutions, electric shocks, or electrical hazards. The remaining 12 incidents involved hazards from the fan blades coming apart or loose. Since the emphasis in this memo is on fires, potential fires, electrocutions, electric shocks, and electrical hazard, only information from the 243 incidents was used. This information and the results of limited testing of portable fans by CPSC engineering staff will be used to make recommendations for upgrading the voluntary standard for fans, UL 507.

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<sup>1</sup> CPSC, Directorate for Epidemiology, Hazard Analysis Division, U.S. Fire Administration/NFIRS, and the National Fire Protection Association (NFPA).

<sup>2</sup> While they are not a statistical sample of all incidents that may have occurred between January 1990 and April 2001, they provide useful information on the incident scenarios and fan characteristics.

<sup>3</sup> Smoke, sparks, or burning odor.

Table 1  
Estimated Residential Structure Fires, Deaths, Injuries, and Property Loss  
Associated with Portable Electric Fans  
1990-1998

<b>Year</b>	<b>Fire Estimates<sup>4</sup></b>	<b>Death Estimates<sup>5</sup></b>	<b>Injury Estimates<sup>6</sup></b>	<b>Loss Estimates</b>
1990	500	*	30	\$4.0 million
1991	600	10	40	\$9.2 million
1992	500	*	30	\$4.3 million
1993	500	10	40	\$4.2 million
1994	500	*	30	\$6.5 million
1995	400	*	20	\$5.4 million
1996	400	*	20	\$4.4 million
1997	500	*	30	\$8.6 million
1998	600	*	30	\$8.6 million
<b>Total</b>	<b>4,500</b>		<b>270</b>	<b>\$55.2 million</b>

Source: U.S. Consumer Product Safety Commission, EPHA, U.S. Fire Administration, and NFPA.

### Product Description

A portable fan is a cord-connected appliance capable of being easily moved by hand from place to place. Portable fans consist of box fans, window box fans, dual window fans, window fans, desk/table fans, pedestal/floor fans, clip-on fans, and hassock fans. Based on 243 incidents, information concerning fan type, failure mode, fan age, fan material, manufacturer and safety standard, and incident scenario is presented in Table 2 through Table 10.

### Fan Type.

Based on a review of 243 portable fan-related incidents, five hazards were identified as follows: (1) fire (210 incidents), (2) potential fire (16 incidents), (3) electrocution (12 incidents), (4) electric shock (3 incidents), and (5) electrical hazard (2 incidents). Box fans, desk/table fans, and pedestal/floor fans were involved in about 65 percent of the total incidents. The distribution of portable fans classified by the hazards is presented in Table 2.

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<sup>4</sup> Rounded to nearest 100.

<sup>5</sup> Rounded to nearest 10 and \* denotes the estimate is less than 5.

<sup>6</sup> Rounded to nearest 10.

Table 2  
Distribution of Portable Fans Classified by Hazards  
January 1, 1990 – April 12, 2001

<b>Fan Type</b>	<b>Total</b>	<b>Hazard</b>
Box Fans	<b>67</b>	Fire (61), Potential Fire(3), Electrocution (1), Electrical Hazard (2)
Desk/Table Fans	<b>47</b>	Fire (39), Potential Fire (6), Electrocution (1), Electrical Shock (1)
Pedestal/Floor Fans	<b>45</b>	Fire (32), Potential Fire (4), Electrocution (8), Electrical Shock (1)
Window Fans	<b>22</b>	Fire (20), Electrocution (1), Electrical Shock (1)
Dual Window Fans	<b>16</b>	Fire (15), Potential Fire (1)
Window box Fans	<b>8</b>	Fire (8)
Clip-On Fans	<b>7</b>	Fire (6), Potential Fire (1)
Antique Small Fans	<b>1</b>	Fire (1)
Hassock Fans	<b>1</b>	Fire (1)
Portable Fans <sup>7</sup> (Not Specified)	<b>18</b>	Fire (17), Potential Fire (1)
Electric Fans <sup>8</sup> (Not Specified)	<b>10</b>	Fire (9), Electrocution (1)
Electrical Product <sup>9</sup>	<b>1</b>	Fire (1)
<b>Total</b>	<b>243</b>	<b>Fire (210), Potential Fire (16), Electrocution (12), Electrical Shock (3), Electrical Hazard (2)</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

### Failure Modes

Based on a review of 243 portable fan-related incidents, the failure modes associated with portable fans which resulted in fires, potential fires, electrocutions, electric shocks, or electrical hazards were motors, power appliance cords, or switches (Table 3). The problems of a failed motor (110 incidents), a failed appliance cord (63 incidents), or a failed switch (8 incidents) were identified as follows:

- (1) One hundred ten motor-related incidents occurred when a motor was overheated because the fan blade ceased to turn (28), a motor seized up and was overheated (55), or a motor was reported to have a wiring problem or to have a short circuit (27).
- (2) Sixty-three appliance cord related-incidents occurred when a cord had a short circuit or an insulation breakdown (33), the fan oscillating motion caused a sharp edge on the fan to rub off the cord insulation (9), or a cord had been repaired/replaced by owners or attached to an extension cord (21).
- (3) Eight switch-related incidents were associated with electrical fault in a switch (5) or bare/damaged switch wires (3).

<sup>7</sup> The type of these portable fans could not be determined because of severe fire damage.

<sup>8</sup> Could not determine if the fans were portable because the damage was total.

<sup>9</sup> Could not determine if the incident was related to the fan.

Table 3  
Distribution of Failure Modes Classified by Hazard  
January 1, 1990 – April 12, 2001

Failure Mode	Total	Hazard				
		Fire	Potential Fire	Electrocution	Electrical Shock	Electrical Hazard
<b>Motor</b>	<b>110</b>					
1. Overheated/Blade Blocked <sup>10</sup>		27	1	0	0	0
2. Overheated/Seized Up		49	6	0	0	0
3. Wiring/Shorted Out		25	2	0	0	0
<b>Appliance Fan Cord</b>	<b>63</b>					
1. Cord Failed <sup>11</sup>		31	0	2	0	0
2. Oscillating Motion		3	5	0	1	0
3. Repaired/Replaced/ Extension Cord		17	0	4	0	0
<b>Switch</b>	<b>8</b>					
1. Electrical Fault		5	0	0	0	0
2. Bare/Damaged Wire		0	0	1	1	1
<b>Undetermined</b>	<b>62</b>	53	2	5	1	1
<b>Total</b>	<b>243</b>	<b>210</b>	<b>16</b>	<b>12</b>	<b>3</b>	<b>2</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

Failed motors occurred most often in a box fan (35 incidents), a desk/table fan (23 incidents), and a pedestal/floor fan (13 incidents); the remaining 39 incidents of failed motors were attributed to other portable fans (such as antique fans, clip-on fans, dual window fans, window fans, window box fans, etc.). Failed cords occurred most often in a desk/table fan (11 incidents), a box fan (10 incidents), and a pedestal/floor fan (7 incidents); the remaining 5 failed-cord incidents were to a dual window fan, a window fan, a window box fan, or a not specified electric fan. Failed switches occurred in a dual window fan (4 incidents), a pedestal/floor fan (3 incidents), and a box fan (1 incident).

<sup>10</sup> When the fans fell from furniture or were jammed by curtains, bedding, etc.

<sup>11</sup> From shorting out, braking down of insulation, being stepped on, being wedged between objects, etc.

## Fan Age

According to trade experts as reported in *Appliance*, a trade publication, average life expectancy of an electric fan is 12 years. This is considered “first use”, after which the product may be replaced, given away, or discarded<sup>12</sup>.

Based on a review of 243 portable fan-related incidents, 113 incidents involved a fan that was less than 10 years old while 47 incidents involved a fan that was 10 years or older, and the remaining 83 incidents had no information on the ages of the fans (Table 4). Further review of the 243 incidents indicated that almost half of the involved fans had been purchased new or had been considered as the “first use”.

Table 4  
Distribution of Portable Fans  
Classified by Fan Type and Fan Age  
January 1, 1990-April 12, 2001

Portable Fan	Fan Age				
	< 1 yr.	1yr.≤Age<5 yrs.	5yrs.≤Age<10 yrs.	≥10 yrs. <sup>13</sup>	Unk
Box Fan	15	11	5	13	23
Desk/Table Fan	7	17	9	4	11
Pedestal/Floor Fan	5	15	4	11	10
Window Fan	1	2	1	11	7
Dual Window Fan	5	7	0	1	2
Window Box Fan	0	2	1	2	3
Clip-On Fan	1	2	0	1	3
Antique Small Fan	0	0	0	1	0
Hassock Fan	0	0	0	1	0
Portable Fan (Not Specified)	1	2	0	2	13
Electric Fan (Not Specified)	0	0	0	0	10
Electrical Product	0	0	0	0	1
<b>Total</b>	<b>35</b>	<b>58</b>	<b>20</b>	<b>47</b>	<b>83</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

## Fan Materials

In general, the contributing factor to the portable fan related fires or potential fires was the presence of plastic materials. When a fan with plastic blades, motor housing, or enclosure overheats or catches on fire, the plastic usually melts, and drips onto combustible materials such as carpet, clothing, bedding, paper, etc. Table 5 shows that of the 226 fires or potential fires, 174 of these incidents (or 3 out of every 4 incidents) were related to a fan with the presence of plastic materials.

<sup>12</sup> Karels, Terrance R., CPSC, Directorate for Economic Analysis, “Electric Fans”, Memorandum to Anna L. Luo, November 29, 2000.

<sup>13</sup> Included older type fans or very old fans.

Table 5  
Distribution of Hazards Associated with Portable Fans  
Classified by Fan Materials  
January 1, 1990 – April 12, 2001

Hazard	Fan Material				
	Total	Plastic & Metal	Plastic	Metal	Unknown
Fire	<b>210</b>	124	37	13	36
Potential Fire	<b>16</b>	7	6	0	3
Electrocution	<b>12</b>	2	2 <sup>14</sup>	7 <sup>15</sup>	1
Electrical Shock	<b>3</b>	1	0	2	0
Electrical Hazard	<b>2</b>	1	1	0	0
<b>Total</b>	<b>243</b>	<b>135</b>	<b>46</b>	<b>22</b>	<b>40</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

#### Manufacturers and UL Listed<sup>16</sup>

The Association of Home Appliance Manufacturers (AHAM) stated that six member firms account for 75 percent or more of sales of portable fans in the U.S. market. These firms produce portable fans under a variety of brands<sup>17</sup>. AHAM reported that the major U.S. manufacturers also produce portable fans in overseas facilities, or purchase fans produced by overseas firms. According to AHAM, imported portable fans represent more than 75 percent of all portable fans sold in the U.S., and China is the major exporting country of these products<sup>18</sup>.

Loss of information on the characteristics of the fans or cords most often occurred when the fans or cords were completely destroyed or discarded by the fire departments or by the owners. Based on a review of 243 portable fan-related incidents, the manufacturer or the brand of the involved fans could be identified in only 104 incidents. Information concerning safety standards on the fans, cords, or plugs was also very limited. For example, only 63 involved fans or cords were identified as UL Listed; and only 89 involved fans were identified as equipped with a cord with a 2-prong plug (37 fans), a 2-prong polarized plug (39 fans), or a 3-prong grounded plug (13 fans).

<sup>14</sup> One case involved a fan with plastic blades (the other parts were unknown)

<sup>15</sup> Two cases involved a fan with metal stand (the other parts were unknown)

<sup>16</sup> UL Standard for Safety for Electric Fans, UL 507.

<sup>17</sup> The market distribution of these brands is not available according to the Directorate for Economic Analysis.

<sup>18</sup> Karels, Terrance R., CPSC, Directorate for Economic Analysis, "Electric Fans", Memorandum to Anna L. Luo, November 29, 2000.

Information concerning the incident scenarios such as (1) the dwelling types, (2) the presence or absence of safety devices (smoke alarms, fire alarms, or sprinklers), (3) the rooms where the incidents occurred, (4) the fan locations<sup>19</sup> at the time of the incidents, and (5) the previous problems prior to the incidents are summarized in the following tables.

### Dwellings

Table 6  
Distribution of Dwellings  
January 1, 1990 – April 12, 2001

<b>Dwelling Type</b>	<b>Number of Incidents</b>
Single Family Home	139
Apartment, Duplex, Townhouse, Condominium	53
Mobile Home/Motor Home	23
Place of Business	19
Boat, Dormitory, or Low-Income Housing	4
Not Stated	5
<b>Total</b>	<b>243</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

### Safety Fire Devices (in the Dwellings)

Table 7  
Distribution of Safety Fire Devices  
January 1, 1990 – April 12, 2001

<b>Safety Device</b>	<b>Number of Incidents</b>
Operating Smoke Detectors/Fire Alarms/Sprinklers	66
No Smoke Detectors/Alarms/Sprinklers or Not Operating Detectors/Alarms/Sprinklers	66
Unknown if Detectors/Alarms/Sprinklers Worked	18
Not Stated or Not Available <sup>20</sup>	93
<b>Total</b>	<b>243</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

<sup>19</sup> On the floor, on top of a chair, a table, a dresser, a bed, or in a window.

<sup>20</sup> Safety system is not available in the case of potential fire, electrocution, electrical shock, or electrical hazard.

## Rooms of the Incidents

Table 8  
Distribution of Rooms of the Incidents  
January 1, 1990 – April 12, 2001

Room	Number of Incidents
Bedroom	126
Living Room or Family Room	40
Office	18
Kitchen	12
Basement	7
Attic (living areas)	5
Dining Room	4
Bathroom	2
Hallway	1
Other (computer room, porch, deck, garage, etc.)	12
Not Stated	16
<b>Total</b>	<b>243</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

## Fan Placement

Location of the fan played a very significant part in the fire incidents. An overheated fan on top of a carpeted floor or on a pile of papers/clothing would ignite these combustible objects. A fan mounted in a window or on a window sill with curtains or a window blind could cause a fan motor to stall (from jamming curtains or a blind in the fan blades). Placing an unstable fan on a table/desk or clipped to a desk or to a foot board of a bed could cause the fan to fall face down and stop the oscillating function of the fan. The distribution of the incidents by placement of the involved fans is presented in Table 9.

Table 9  
Distribution of Fan Placements  
January 1, 1990 – April 12, 2001

Placement	Number of Incidents
In the Window or Window Sill	54
On Vinyl Floor, Floor (Not Specified)	50
On Carpeted Floor	43
On Top of Piles of Papers/Clothing	39
On Top of Table/Desk/Chair	24
Clipped on Desk/Bed, Hung in Attic	10
Not Stated	23
<b>Total</b>	<b>243</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.



## Previous Problems

Table 10  
Distribution of Previous Problems  
January 1, 1990 – April 12, 2001

<b>Previous Problem</b>	<b>Number of Incidents</b>
No Previous Problems	90
Trouble Getting Fan Blade Moving	12
Cord/Plug/Switch Not Properly Function	15
Emitting Odor/Smoke/Flames/Humming Noise	12
Fan Had Been Repaired	8
Short Circuit when Oscillating	2
Problems (not specified)	5
Not Stated	99
<b>Total</b>	<b>243</b>

Source: U.S. Consumer Product Safety Commission (CPSC), Death Certificate and Injury and Potential Injury Incident Files, Directorate for Epidemiology, Hazard Analysis Division.

## Conclusion

An estimated 4,500 of the residential structure fires attended by fire departments from 1990 through 1998 were associated with portable electric fans. These fires resulted in about 270 civilian injuries, more than 20 deaths, and about \$55 million in property loss. Based on 243 follow-up investigations of portable fan-related incidents, fire was the major hazard and accounted for about 80 percent of the total incidents. About half of the fire incidents occurred in a single-family home and most often in a bedroom. An overheated fan on top of a carpeted floor or on a pile of papers or clothing would ignite this combustible object, especially for fans with plastic material where the plastic melts and drips on the object.

The failure modes associated with the portable fan-related hazards were the fan motors, powered appliance cords, or switches. The motors failed when they were overheated (because the blades jammed or the motors seized up) or when there were problems with the wiring and the fans shorted out. The appliance fan cords failed when a cord had a short circuit or an insulation breakdown; the oscillating motion caused a sharp edge on the fan to rub off the cord insulation; or when the cords were crushed, damaged, exposed, repaired, or attached to an extension cord. The switches failed when there was an electrical fault in the switches or when the switch wires were bare or damaged.

Box fans, desk/table fans, and pedestal/floor fans were involved in over half of the total incidents.