



U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

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Mr. Thomas L. Wollan
Managing Engineer, Engineering Services
Underwriters Laboratories Inc.
12 Laboratory Drive, P.O. Box 13995
Research Triangle Park, NC 27709-3995

Re: Recommendation for Changes to UL 507 - *Electric Fans*

Dear Mr. Wollan:

This letter presents recommendations from the staff of the U.S. Consumer Product Safety Commission (CPSC) for changes to UL 507, *Electric Fans*, to address the potential fire and shock hazards associated with power cords of portable electric fans.

From 1990 through 1998, there were an estimated 4,500 fires associated with portable electric fans. These fires resulted in more than 20 deaths, 270 injuries, and about \$55 million in property loss. Among 243 in-depth investigations (IDIs) conducted from January 1, 1990 through April 12, 2001, there were 63 incidents involving cord failure: 33 involved the power-supply cord (See Table 1 – IDIs Involving Power Supply Cord), 9 involved the cord that connects the motor and the base of an oscillating fan (See Table 2 – IDIs Involving Cords Connecting Motor and Base of Oscillating Fans), and the remaining 21 involved an extension cord or repaired cord.

Human Factors staff evaluated available IDIs in which the cord of a portable electric fan may have contributed to a fire or electrocution. In many cases, the fundamental cause of an incident was identified as a short circuit in the cord or fan. However, the resulting damage to the cord often made it difficult to assess possible reasons for these failures. The details of several investigations permitted staff to identify four general usage patterns that could have contributed to some fire incidents. Although there may be other potential ways in which consumers will use the fan and power cord such that the cord becomes damaged or fails, staff believes the following patterns may be representative of typical consumer behaviors:

- The consumer places the fan or some other object on top of the cord.
- The consumer pushes furniture against a wall, pinching a cord that runs between them.
- The consumer positions the fan such that the cord is exposed to pedestrian traffic.
- The consumer exposes the cord to damage during storage.

Staff believes consumers will use portable electric fans in ways that could damage the cord and lead to failure. Most consumers lack detailed knowledge of how electrical products work, so consumers simply may not realize that their behavior could be hazardous. In addition, repeated exposure to portable electric fans without incident further reinforces the perception that the products are safe and are being used in a safe manner, even if they are not. Consumers may not notice damage when not in view (e.g., if the location of the pinch point on a cord is behind furniture).

Portable electric fans may be used in children's rooms, and children are generally less knowledgeable about electrical products and their associated hazards than adults. Even consumers who are aware of the potential hazards associated with certain cord usage patterns may find it difficult to avoid situations that could damage the cord. For example, it is difficult to prevent the cord from being exposed to pedestrian traffic depending on the desired placement of the fan and the location of the electrical outlets. Consumers' efforts to prevent damage to the cord by wrapping the cord around the fan during storage could, in itself, damage the cord and lead to failure. In addition, there may be numerous opportunities for cord damage depending on how and where the fan is stored when not in use.

Based on this rationale, CPSC staff recommends that the minimum requirements for power supply cords in UL 507, *Electric Fans*, be upgraded to provide more rugged cord constructions such as those required for vacuum cleaners.

In addition to the power cord failures, there were nine IDIs, involving six different manufacturers, related to the internal wiring that connects the motor and the base of an oscillating fan. Although the standard requires that the internal wiring have an insulation thickness not less than 0.4 mm on each conductor, some IDIs indicated that the insulation on the internal wiring was abraded while oscillating causing sparking and arcing. Therefore, the staff recommends that the requirements in UL 507 for the internal wiring that runs between the motor and base of an oscillating fan should also be improved, such as a requirement for a protective jacket, to protect the wiring insulation from abrasion due to contact with rough edges and other mechanical damage during fan oscillation.

Thank you for the opportunity to make these recommendations. We look forward to participating in further discussions on this matter. The views expressed in this letter are those of the staff and have not been reviewed or considered by the Commission.

Sincerely,

Anna L. Luo
Electrical Engineer
Directorate for Engineering Sciences

cc: James R. Beyreis, UL/Northbrook
Gordon Gillerman, UL/Washington
Colin Church, CPSC Voluntary Standards Coordinator
Wayne Morris, AHAM

Table 1 – IDIs Involving Power Supply Cord

IDI	Incident Date	Type	Fan Age	Injury/ Death	Synopsis
900514CCC3423	04/26/90	16"-Oscillating	7 years	No	The plug of fan power cord was somewhat damaged. This caused the fan cord to short, and ignited a curtain.
900712CCC1548	07/03/90	Circulator (round shape)		84-year old female died	The fan power cord shorted and caused the carpet beneath it to smolder and smoke.
910508CCC1476	10/10/90	20" Box fan	2 years	2-year old female died	The insulation of the power cord was completely burned away from the fan to the receptacle.
910919CWE5013	08/21/91	Square-shape fan (box fan)	2 years	No	The consumer saw smoke coming from the side of the bed next to the wall at a point where an electric fan was plugged into an outlet. The power cord had been overstressed by being forced against the bedroom wall as the bed was shoved against the wall and caused the cord insulation to break down.
921021CCC2032	08/20/92	Oscillating	Unknown	3-year old male was electrocuted	Exposed bare wire on the power cord came in contact with an aluminum patio doorframe. The power cord had several cuts.
931027CCC1047	08/17/93	Oscillating	3-4 years	No	The fire began at point where the stress knot is positioned in the housing of the base. There was beading on the power cord conductors.
940630CCN1825	06/23/94	Oscillating	2 weeks	No	There was a break in the insulation of the power cord approximately 6 inches away from the power plug.
940726CCN2007	07/14/94	N/A	N/A	37-year old female died	The insulation of the power cord had been cut exposing both the hot and neutral conductors.
940916CCN2367	07/05/93	Box Fan	7 years	41-year old male, 33-year old male and his 12-month old twin daughters suffered burns to their feet	The carpet around and underneath the fan ignited. There was extensive arcing to the fan power supply cord.
950811CCC1917	06/19/95	N/A	10 years	No	The fan power cord overheated when it was wedged between a dresser and the wall. The rug caught fire and set fire to the dresser and other furniture.

IDI	Incident Date	Type	Fan Age	Injury/ Death	Synopsis
950906CCC2955	07/18/95	16"-Oscillating	1 year	No	The insulation of the power cord became frayed as a result of being stepped on. This caused the cord to short out and ignited the combustible materials.
950913CCC2993	07/28/95	Oscillating	20 years	No	The fan power cord overheated, shorted out, and ignited the newspaper pile underneath the fan.
950914CWE5008	08/10/95	12"-Oscillating	10-15 years	No	The power cord of the fan was frayed and shorted due to being pinched between the cabinet and the wall.
951129CCC1202	07/02/95	Box Fan	Unknown	79-year old female died	The fan was found in the center area of the burned carpet. The cord to the electric fan had overheated, ignited the carpet around the fan, and the fan was totally consumed.
960726CNE5188	08/03/95	Box Fan	1 year	No	The power supply cord was found to have beaded ends. This showed that an electrical arcing had occurred in the fan cord.
960827CCC7411	06/29/96	Window Fan	unknown	34-year, 5-year, and 3-year old females died	The fan power cord overheated, igniting combustible materials.
970616CNE5141	05/31/97	Pedestal Fan	Unknown	No	The fan cord shorted and ignited bedding materials.
980210CCC0046		20-inch Box Fan	Purchased August 1997	13-year old female died	The girl slept on the couch, which was 12 inches away from the fan in the basement. The fan cord had been burned off and showed signs of beading on the ends.
980629CCC5651	05/27/98		5-7 years		There was some evidence of the fan power cord shorting out where it was run beneath the fan housing. There was beading on the cord.
980729CNE5211	06/30/98	Floor Fan	Unknown		The fan power cord was damaged by either stepping on it or heavy boxes sitting on it. The cord overheated and ignited the cardboard boxes.
980824CMC8183	07/29/98	20-inch Box Fan	10 years	No	The metal box fan was in the attic bedroom. The homeowner saw flames on the rubber-backed area rug under the box fan. The power cord shorted out and ignited the rug under the fan.
981102HCC6040	06/13/98	Oscillating	2-3 months	Several children had minor burns	There was beading on the fan cord's conductors.

IDI	Incident Date	Type	Fan Age	Injury/ Death	Synopsis
991012CNE5309	08/30/99	Oscillating	2 months	Two females suffered smoke inhalation	There was an area where arcing had occurred between the neutral and the hot conductors of the fan cord.
990825CNE5260	08/09/99	20" Box Fan	2 1/2 years	A male had a minor burn to his finger	The fan was placed on the floor with the cord beneath it. The section of the cord that was beneath the fan was found frayed and split. This resulted in a short that ignited the carpet.
000606HCC2581	05/03/00	Box Fan	3 years	24-year old female suffered smoke inhalation, and 2 nd degree burn to arm	The fan cord shorted out and ignited the clothes lying on top of the cord.
000208CNE5422	10/23/99	Oscillating Fan	Unknown	No	Fan cord overheated and ignited combustible materials.
000711HCC2662	06/16/00	16" Pedestal Oscillating	2 years	No	The fan power cord was wrapped tightly around the stand. The cord overheated, dropped onto the carpet, and ignited the carpet and clothes on the bedroom floor.
000713HCC2672	08/03/99	Pedestal Fan	Unknown	No	The fan power cord was wrapped around the fan's leg, so it was resting on the cord. The cord had shorted and caused the fire.
000713HCC0827	09/28/99	Box Fan	8-9 years	62-year female sustained burns to her face, chest, arm, and smoke inhalation	There was evidence of an electric short in the fan cord.
001011HCC2027	08/26/00	Box Fan	Unknown	No	The cord probably was crimped by something sitting on it and caused the fire.
001227CNE5992	12/23/00	Box Fan	6 month	A female and a male sustained minor burns, and smoke inhalation	The consumer's son saw the sparks and fire from the power cord.
010323HCN0448	03/22/01	Oscillating Fan	Unknown	No	The power cord was crimped by something that was placed on it and overheated to the point of catching the drop cloth on fire.

Table 2 – IDIs Involving Cords Connecting Motor and Base of Oscillating Fans

IDI	Incident Date	Type	Fan Age	Injury/ Death	Synopsis
930910CWE7045	08/24/93	7"-Oscillating	Unknown	No	Three wires entering moving part of the oscillating fan became bare and short-circuited.
930916CCC1552	06/12/93	12"-Oscillating	2 years	No	The consumer noticed that the metal oscillating bar wore away the insulation of the electrical wire that connected to the motor.
931020CWE7122	09/30/93	12"-Oscillating Fan	2 Years	No	There was a burn mark at the point where the wires enter the moving part of the oscillating fan.
950705CCN2388	06/27/95	Oscillating	Unknown	No	The cord that connects to the fan motor was partially cut and arced.
951012CCC1087	07/14/95	Oscillating	Unknown	44-year old female died	There was 3-4 inches of beading on the conductors of the power cord where connected to the motor.
960730CWE5015	06/10/96	12"-Oscillating Fan	1 year	No	The cord that connected to the motor (where the fan oscillated) was cut.
980708CCC2683	06/22/98	12"-Oscillating	2 years	No	The metal arm of the oscillating fan rubbed off the insulation of the wire. This caused sparking and arcing.
990726CCC2560	07/05/99	12" Oscillating	1 year	A female had severe electric shock	While standing on the metal furnace grill in the floor, with one hand holding the fan plug, the other hand touching the back of the fan, the consumer received a severe electric shock, burning her finger. The source of the shock was attributed to damaged wiring (near the oscillating area).
000720HCC0839	05/11/00	Pedestal oscillating Fan	2 months	No	The fan revealed evidence of pinching and abrading of the wires that connected to the fan motor. The wiring rubbed against the metal fan motor and the plastic fan motor housing when it was oscillating. Arcing occurred and ignited the plastic motor housing.