March 19, 2013

Supplemental Information for Proposals under Consideration by the Codes and Standards Committee at the meeting to be held on March 25, 2013.

1. ACCA letter- (see proposals for Equipment Sizing) Page 2
2. ACCA response to letter - (see proposals for Equipment sizing) Page 6
3. AFCI literature(NEMA)- (see proposals for arc-fault circuit interrupters) Page 8
4. CSST literature- (see proposal for CSST Arc-Resistant jacket) Page 233

ACCA
Air Conditioning Contractors of America
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22 February 2013

Workgroup Members,

ACCA, the Air Conditioning Contractors of America, strongly oppose the changes to the VECC R403.6 and VRC M1401.3 proposed by Mr. Tomberlin, which seek to make exceptions to the Manual S (*Residential Equipment Selection*) sizing requirements for HVAC systems. **The proposed change should not be accepted due to the following reasons:**

Reason 1: Degrades Humidity Control

The rationale for making the change completely ignores the primary reason for limiting excess cooling capacity for buildings located in humid climates, which is:

Over-size limits are designed to assure adequate indoor humidity control for seasonal occupant health and comfort, and to minimize the possibility of mold and mildew on interior surfaces.

This is especially important as the entire state of Virginia is classified as a 4A Climate Zone, i.e., Mixed – Humid (CDD50°F ≤ 4500 and 3600 < HDD65°F ≤ 5400). **[A brief narrative that summarizes the physics of this issue is proved in the Appendix to this letter]**

Reason 2: Ignores Installation, Maintenance & Operational Costs

The wording of the proposed change essentially says, if the available sizes for a particular product class are not compatible with the dwelling's cooling and heating loads, ignore the problem, and use the smallest size that has capacity that exceeds the load. This implies that there is no official limit on excess capacity because these products are magic, so there is no down-side to having capacity that will never be used.

a. This is a double standard, contrived to benefit sales for a particular product class.
b. The suggestion that there is no down-side to installing equipment that has capacity that will never be used, is misleading and incorrect.
    - Cooling season humidity control is a fundamental concern, per Reason 1.
    - Installed cost, repair and maintenance cost is an issue. (Does a cab driver in New York, New York, need an 800 HP, 200 MPH Ferrari?)
    - Energy use, operating cost and pay-back are relevant issues.

Reason 3: Focuses Primarily on Dry-Bulb Conditions (While Virginia is Mixed-Humid)

Rule-making, whether a code or standard, must be based on a rationale. The rationale defines the performance variables of interest, and establishes the need for limits on the performance envelope (i.e., indoor humidity control concerns translate to a need for equipment capacity limits). The rational and the limits of the performance envelope must be defended by credible knowledge.

The wording of the proposed change essentially says that the only variable of interest is the indoor dry-bulb temperature, and that there are no limits on excess capacity because motor speed control can satisfy the needs of the indoor dry-bulb thermostat.

a. This ignores the indoor humidity issue; the comparative installed cost, repair and maintenance cost issues; the comparative op-cost issue, and the comparative return-on-investment issue.
b. A credible defense of the proposed size limit for this class of equipment is not required because fundamental issues are ignored (all over-sized equipment, whether single speed, multi-speed, or variable-speed can satisfy the needs of an indoor dry-bulb thermostat).
c. If all the variables are considered (especially the humidity control issue), the limits for equipment size must be defended by unbiased industry knowledge, and/or research (i.e., must be based on an investigation and report produced by credentialed people that do not have a vested interest in product promotion and sales).

Reason 4: Newer Construction (Tighter Envelopes) Makes Right-Sizing Even More Important

Current dwelling construction practices are trending to increasingly efficient envelopes, and a need for continuous engineered ventilation. This makes it increasingly difficult to control indoor humidity for very efficient dwellings located in humid climates.

HVAC equipment OEMs are behind the curve on this issue. High efficiency dwellings need small equipment (say ½ nominal ton, to 1-1/2 nominal tons), and for humid climate dwellings, this equipment should have an indoor coil operating temperature that provides adequate latent capacity.

Consider the following:

a. Duct runs in a conditioned space are not a load issue.
b. Efficient fenestration assemblies and shading practices reduce the sensible load on equipment.
c. Envelope insulation and tightness reduces the sensible load on equipment.
d. Envelope tightness reduces the latent load on equipment.
e. Outdoor air for engineered ventilation increases the sensible and latent loads on equipment.
f. For humid climates, the trend is for more latent load per unit of sensible load, which make it more difficult to control indoor humidity.
g. As equipment ft^2/ton of cooling capacity increases, blower Cfm/ft^2 and air distribution effectiveness decrease (common supply outlet hardware is inadequate, using bypass air conflicts with SEER requirements, and product cost).

Reason 5: Code Officials Are Being Asked To Compensate For Lack Of OEM Product Offerings

Advanced split-coil heat pump equipment may not have an electric heating coil option for supplemental heat when it is noticeably cold outdoors. Some OEM deal with this issue by promoting equipment size based on winter heating load. This is incorrect, for all the reasons stated above. Essentially this boils down to: the OEM's product does not have the feature needed for the application. It is not the purpose of the building codes to make exceptions for these shortcomings.

It is thus, with the grave concern, that ACCA opposes the code change proposal set forth.

Sincerely,

Luis Romeo Escobar

Appendix: Why Humidity Control Is Important In Virginia

a. For human health, indoor humidity should be in the 40% H to 60% RH range; this is compatible with acceptable indoor humidity for human comfort. Indoor humidity above 60% RH provides an opportunity for mold and mildew blooms.

b. Indoor air moisture depends on outdoor air moisture, and on how much outdoor moisture enters the conditioned space by infiltration (leakage through structural cracks, and duct work installed in an unconditioned space), and engineered ventilation (outdoor air purposely routed to the conditioned space). It also depends on the amount of moisture released by people and appliances (ignoring occasional problems caused by things like indoor plants, and fish tanks). In general this moisture load (as far as the cooling equipment is concerned) is proportional to the summer humidity of the climate (no problem at all in place like Denver, CO; a serious concern for locations that have significant summer humidity).

c. The indoor cooling coil removes indoor moisture (controls indoor humidity). However, this only occurs when the effective temperature of the indoor coil is colder than the dew-point of the indoor air (when this is true, moisture condenses on coil surfaces, is collected in the drip pan, then goes down the drain).

d. The equipment does no moisture removal when the equipment is not running. Equipment run time per hour depends on the sensible cooling load (this is the load that the thermostat on the wall responds to), vs. the sensible cooling capacity of the equipment (which depends on mostly on equipment size, and some technical caveats and details).

e. When the equipment starts, it takes something like 5 to 15 minutes for the indoor coil to provide its full moisture removal capacity. When the sensible load is small, the equipment may shut down before this happens (because the thermostat on the wall is satisfied, and it cares nothing about indoor moisture).

f. The sensible cooling load is at the value for the summer outdoor design condition for only a few hours per season. The average sensible cooling load for the whole season is about half the summer design condition value, and there are 1,000s of hours when the sensible load is less than half of the summer design condition value (it goes all the way to zero, then heating is required). So there are 1,000s of hours per season when the equipment cycles on and off, and only operates for a small number of minutes per hour.

g. The moisture load is decoupled from the sensible load. This is because outdoor air moisture (as indicated by its dew-point temperature) can be just as high for a cool cloudy day or night (little or no heat from the sun), as it is for the summer design condition. Therefore, the less the equipment runs, the higher the indoor humidity.

h. Equipment that has no excess capacity for the summer design condition has 50%, or more, excess capacity for 1,000s of cooling season hours. And there are hundreds of hours when it hardly runs at all. So indoor humidity is more than desired (50% to 55% RH) for a significant number of hours, and it may be more than 60% RH some of the time.

i. The number of hours when indoor humidity is more than desired, or is excessive, is proportional to the amount of excess cooling capacity for the summer design condition. For example, the hourly run-time for equipment that has twice more capacity that it needs for the summer design

condition, is about half of the run-time for equipment that has no excess capacity. This principle applies to every cooling season hour.

j. Two speed and variable speed equipment improves the situation, because moisture is removed at reduced speed vs. no removal for single speed equipment that has cycled off. However, moisture removal at reduced speed is less than moisture removal at full speed. When the cooling load is less than the equipment capacity for minimum speed, advanced equipment cycles off-on, just like single speed equipment.

k. For example, there have been cases where two-speed equipment never operates at high speed (low speed is about correct for the summer design condition). So as far is moisture removal is concerned, two speed equipment that only operates at low speed may be no better than single speed equipment that is correctly sized; or may be not as good if the latent capacity of the single speed unit is more than the latent capacity of the two-speed unit operating at low speed.

l. Therefore it would be correct to say; ton-for-ton, advanced equipment manages indoor humidity better than single speed equipment, but this does not mean that there are no limits to over-sizing advanced equipment.

m. At present, a committee of 34 industry stakeholders has reviewed this issue, and as a result the latest version of Manual S (going out for Public review in April 2013) has an upper limit established by the committee at 120% of the Manual J load (1.20 factor) for this equipment type.

n. Going forward, research is needed to determine the over-size limit for advanced equipment, as far as indoor moisture control is concerned. For now, setting generous over-size limits that are not defended by consensus industry knowledge (based on ASHRAE research or equivalent) ignores the due-diligence aspect of rule-making.

Country Heating & Cooling, Inc

3/15/13

To whom it may concern;

The following letter is a collection of my thoughts as they relate to the proposed changes to VECC R403.6 and VRC M1401.3 proposed by Mr. Tomberlin. I am a Master Tradesman, (2710-034751) and I own and operate a small HVAC/R installation and service company. I have 18 years in the field, and have had hands on experience in our industry as we have gone through the changes of the last 10 years. I am NATE certified, and have continued my education both at the code level, and with OEM training for the equipment in question. I also teach HVAC at Richmond Tech in the adult night school program.

I would like to address the 5 concerns listed in the ACCA letter dated 2/22/13 submitted by Luis Romeo Escobar. Although Mr. Escobar's facts are 100% correct, I feel that they do not apply to the actual proposed changes, as the change relates to the type of equipment that it will effect. All five points that Mr. Escobar brings up would be true if the machinery was single stage, fixed capacity equipment. The proposed change will only relate to multi-stage, or modulating equipment. As long as the space load falls somewhere in between the equipment's operational parameter's the unit will operate to match the load, and not exceed it. This is especially true of systems that employ a variable speed rotary compressor, as many ductless mini split systems do.

The multi-stage equipment is reacting to the actual load in the space and deciding based upon that exact need, how much heat energy the system needs to remove. This operational system alone addresses reasons 1, 3, 4, and 5 in Mr. Escobar's letter. The real world end result of this type of system while its running is increased runs times. I have actually had customers call me to "complain" after installing a new, high SEER multi-stage central heat pump to say that the system was running too long. This longer run time gives the system the ability to remove more latent heat than a single speed, or single stage machine. Many of these systems are actually tracking and have the ability to react to the space humidity as well as the sensible heat loads. This feature is built into to comfort control that drives the system.

18064 Jefferson Highway • Montpelier, VA 23192 • Office (540) 872-4379 • (540) 872-4362 Fax

I would now like to address reason #2 as a separate issue. The first item that I would like to mention is the comment about the NYC cab driver not needing an 800hp or 200mph Ferrari. Although this is an analogy, the concept lends to the idea that the CODE / STATE should decide what car should be used by a cab driver. In this country, if a guy has the resources to use a Ferrari as a cab, and is following the traffic laws, then it is no business of the CODE / STATE to say otherwise. The proposed change to the code gives the contractor the ability to install LOWER SEER machinery in small dwellings. Under the current CODE, we would be oversizing a system in a small house when the smallest available HVAC system made in the convention split or packaged system is 18,000 BTU/H. The customer might not have the financial ability to purchase the higher SEER multi-stage equipment that will modulate down to the smaller real world load of the house. This is particularly true of the older houses in Richmond, VA that had older oil fired floor furnaces that have died, and the home owner is replacing the dead floor furnace with a central ducted heat pump. Not allowing this modification to the code actually singles out the person with lower financial resources and prevents them from installing a central heat pump.

As a mechanical contractor, HVAC service and installation provider, I fully support the proposed change to the code submitted by Mr. Tomberlin. I feel that it a relevant change that adapts to the changes made in system manufacturing, and helps with furthering our industries' quest for improved indoor environmental quality.

Thank you for your time and consideration.

Kenneth M. Marolla

Country Heating & Cooling

18064 Jefferson Highway • Montpelier, VA 23192 • Office (540) 872-4379 • (540) 872-4362 Fax

VIRGINIA DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
DIVISION OF BUILDING AND FIRE REGULATION

Code Change Form for the 2012 Code Change Cycle

Code Change Number:_____

Proponent Information (Check one): ☐Individual ☐Government Entity ☒Association

Name: Paul Wilson Abernathy Representing: National Electrical Manufacturers Association

Mailing Address: 1300 North 17th Street, Rosslyn, Virginia 22209

Email Address: Paul.Abernathy@nema.org Telephone Number: 703-825-5235

Proposal Information

Code(s) and Section(s): Virginia Construction Code, Part I - Section E3902.11

Proposed Change (including all relevant section numbers, if multiple sections):

Delete the entire amendment to Section E3902.11 as written in the 2009 Virginia Construction Code.

Supporting Statement (including intent, need, and impact of the proposal):

The intent of this proposal is to restore the requirements of section E3902.11 as it is stated in the 2009 International Residential Code and 2012 International Residential Code. The need is reflective on the reduced safety due to an arc-fault condition that could result in a fire, loss of life and loss of property. Detailed studies have been posted on www.AFCISAFETY.ORG and recent notices posted by the Consumer Product Safety Commission are factual statistics and results showing the importance of this technical advancement. The impact is minimal in terms of economic costs but high on establishing a safer one and two family dwelling. The average cost of an AFCI Device is $ 42.00, subtract the $ 6.00 for a standard circuit breaker and you are left with a cost of $36.00 per device. The average home will need between 8-10 AFCI Devices to comply with the code standards. The added cost to the consumer is $360.00, less than ½ of 1 percent of the cost of a typical $250,000.00 home. Virginia is well behind on removing this amendment as the vast majority of states have adopted the full use of Arc Fault Circuit Interrupters without amendment.

Documentation, Studies and Fire Reports will be provided with this proposal for review and consideration

Submittal Information

Date Submitted: 11/25/2012

The proposal may be submitted by email as an attachment, by fax, by mail, or by hand delivery.

Please submit the proposal to:

DHCD DBFR SBCO (State Building Codes Office)
600 East Main Street
Suite 300
Richmond, VA 23219

Email Address: Vernon.hodge@dhcd.virginia.gov
Fax Number: (804) 371-7092
Phone Numbers: (804) 371-7150

National Fire Protection Association
National Electrical Code®

Fact Sheet

Arc-Fault Circuit Interrupters

What are Arc-Fault Circuit Interrupters (AFCIs)?
The 2008 *National Electrical Code® (NEC®)* requirement for AFCI protection considerably expands this fire prevention technology to the majority of circuits installed in new and renovated homes. The type of AFCI currently available commercially is a next-generation circuit breaker that not only provides the conventional safety functions, but its advanced design also rapidly detects potentially dangerous arcs and disconnects power in the circuit before a fire can start. Fire safety officials throughout the U.S. endorse AFCIs as a significant step forward in electrical fire safety.

Why should they be installed in homes?
AFCIs will save lives and make homes safer. According to the U.S. Fire Administration, each year home electrical problems cause about 70,000 fires, resulting in 485 deaths and $868 million in property loss.

Why mandate AFCIs for newer homes when statistics show the majority of problems have occurred in older homes?
Fire safety officials recommend the use of AFCIs in all dwellings. While it is true that fire statistics in many cases are derived from older dwellings, damage to appliance cords or to wires hidden in a wall can occur regardless of the home's age. In addition, incorrectly performed electrical installations can occur in both new and old homes. As technology evolves and the *NEC* is revised, the enhanced level of safety is typically required only in new construction that is subject to the latest adopted edition. Homes wired per the 2008 *NEC* will have the majority of their circuits protect by AFCIs for the life of the electrical system.

How do you know AFCIs will prevent fires and save lives?
Since 1999, AFCIs have been thoroughly field-tested. Underwriters Laboratories, the National Association of State Fire Marshals (NASFM), the U.S. Consumer Product Safety Commission, and many other experts have found AFCIs to be reliable and effective. By eliminating a significant source of electrically related fires, future statistics will demonstrate a reduction in fires of electrical origin.

Are AFCIs expensive?
The cost of the enhanced protection is directly related to the size of the dwelling and the number of circuits installed. Current retail prices of AFCI-type circuit breakers at several national building supply chains are in the range of $35 to $40 per unit. Even for larger homes with more circuits, the cost increase is insignificant compared to the total cost of the home, particularly when the increased level of safety is factored.

Do AFCIs interfere with smoke alarms and appliances, and trip unnecessarily?
AFCIs do not interfere with power supply reliability. These state-of-the-art devices identify problems that current circuit breakers are not designed to protect against, which can result in what appears to be an unexplained circuit breaker trip. By actually identifying these problems, residents are safer.

What is the *NEC*?
The *NEC* is the *National Electrical Code*. The *NEC's* mission is to provide practical safeguards from the hazards that arise from using electricity. It is the most widely adopted safety code in the United States and the world, and it is the benchmark for safe electrical installations. The *NEC* is an evolving document, developed through an open consensus process. A new edition is issued every three years.

For more information, visit www.nfpa.org.

National Fire Protection Association
National Electrical Code®
Fact Sheet

Tamper-Resistant Electrical Receptacles

What are tamper-resistant electrical receptacles and what is the new requirement?
The 2008 *National Electrical Code® (NEC®)* will require new and renovated dwellings to have tamper-resistant (TR) receptacles. These receptacles have spring-loaded shutters that close off the contact openings, or slots, of the receptacles. When a plug is inserted into the receptacle, both springs are compressed and the shutters then open, allowing for the metal prongs to make contact to create an electrical circuit. Because both springs must be compressed at the same time, the shutters do not open when a child attempts to insert an object into only one contact opening, and there is no contact with electricity. Tamper-resistant receptacles are an important next step to making the home a safer place for children.

Why require tamper-resistant electrical receptacles?
Each year, approximately 2,400 children suffer severe shock and burns when they stick items into the slots of electrical receptacles. It is estimated that there are six to 12 child fatalities a year related to this.

If homeowners do not have children, are TR receptacles required?
Yes. Owners or tenants of homes and apartments change frequently. In addition, exposure to electrical shock and burn accidents are not limited to a child's own home. Children visit homes of relatives and friends who don't have children of their own. This requirement ensures all new homes and apartments are safe for children, whether the home is their own or they are there on a temporary basis.

Do TR receptacles require greater insertion strength than standard receptacles?
TR receptacles require comparable force to other receptacles. The insertion force may vary depending on the newness of the device to the shape or style of the plug being inserted.

Are TR receptacles costly?
No. The projected cost of a TR receptacle adds about $0.50 to the cost of an unprotected receptacle. Based on current statistics, the average home has about 75 receptacles resulting in an overall added cost of under $40. This amount may vary slightly based on the type and style of TR receptacle used. This minimal increase in cost buys a significant increase in electrical safety for children.

Shouldn't people accept responsibility for their children and teach their children not to stick items in receptacles?
Accidents involving children and receptacles cannot be blamed entirely on poor parenting. They involve people who look away for a moment, only to face undue tragedy and pain as the result of a child's curiosity. The *NEC's* mission is to provide electrical safety in the home. TR receptacles are a simple and easy way to protect children from serious injuries that continue to happen every year.

Why are TR receptacles preferred over products such as receptacles with caps or with sliding receptacle covers?
Receptacle caps may be lost and also may be a choking hazard for some ages. Children can learn to defeat sliding receptacle covers when they watch their parents. TR receptacles provide security against the insertion of objects other than cord plugs into the energized parts.

What is the *NEC*?
The *NEC* is the *National Electrical Code*. The *NEC's* mission is to provide practical safeguards from the hazards that arise from using electricity. It is the most widely adopted safety code in the United States and the world, and it is the benchmark for safe electrical installations. The *NEC* is an evolving document, developed through an open consensus process. A new edition is issued every three years.

For more information, visit www.nfpa.org.

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U.S. Consumer Product Safety Commission

Office of Communications Washington, D.C.

FOR IMMEDIATE RELEASE
November 15, 2012
Release #13-039

Firm's Recall Hotline: (888) 213-5758
CPSC Recall Hotline: (800) 638-2772
CPSC Media Contact: (301) 504-7908

Ceiling-Mounted Light Fixtures Recalled by Dolan Northwest Due to Fire and Shock Hazards

WASHINGTON, D.C. - The U.S. Consumer Product Safety Commission, in cooperation with the firm named below, today announced a voluntary recall of the following consumer product. Consumers should stop using recalled products immediately unless otherwise instructed. It is illegal to resell or attempt to resell a recalled consumer product.

Name of Product: Ceiling-Mounted Light Fixture

Units: About 8,000

Importer: Dolan Northwest LLC, of Seattle d/b/a Seattle Lighting, Globe Lighting, Builders Lighting and Destination Lighting

Manufacturer: Dongguan Young Long Electric Co. Ltd.

Hazard: The fixture's socket wire insulation can degrade, leading to charged wires becoming exposed, causing electricity to pass to the metal canopy of the fixture. This poses a fire and electric shock hazard to consumers.

Incidents/Injuries: The firm has received two reports of defective fixtures which resulted in the home's Arc Fault Circuit Interrupter (AFCI) tripping. No injuries have been reported to the firm.

Description: This recall involves round ceiling-mounted light fixtures, satin nickel or bronze in color with a domed alabaster glass shade. The light fixture is 14 inches in diameter and 5.5 inches high and has two sockets marked “BO AN” that take 75 watt bulbs. The light fixtures were sold as Design Classics Model 562-09 and 562-30. The brand name and model number are on the inside of the fixture pan.

Sold at: Builders Lighting, Globe Lighting, Seattle Lighting and online at DestinationLighting.com from September 2008 through September 2009 for about $32.

Manufactured in: China

Remedy: Consumers should immediately stop using the recalled light fixtures and return them to the place of purchase to obtain a free replacement fixture and a $50 voucher, or contact the firm to schedule a free home repair.

Consumer Contact: Dolan Northwest LLC; toll-free at (888) 213-5758, from 9 a.m. to 5 p.m. PT Monday through Friday; or e-mail flushmountrecall@seattlelighting.com, flushmountrecall@globelighting.com, flushmountrecall@builderslighting.com, or flushmountrecall@destinationlighting.com; or online at

www.seattlelighting.com, www.globelighting.com, www.builderslighting.com, or www.destinationlighting.com

Design Classic Model 562-09

Design Classic Model 562-30

The U.S. Consumer Product Safety Commission (CPSC) is still interested in receiving incident or injury reports that are either directly related to this product recall or involve a different hazard with the same product. Please tell us about your experience with the product on SaferProducts.gov

CPSC is charged with protecting the public from unreasonable risks of injury or death associated with the use of the thousands of consumer products under the agency's jurisdiction. Deaths, injuries, and property damage from consumer product incidents cost the nation more than $900 billion annually. CPSC is committed to protecting consumers and families from products that pose a fire, electrical, chemical, or mechanical hazard. CPSC's work to ensure the safety of consumer products - such as toys, cribs, power tools, cigarette lighters, and household chemicals - contributed to a decline in the rate of deaths and injuries associated with consumer products over the past 30 years.

Under federal law, it is illegal to attempt to sell or resell this or any other recalled product.

To report a dangerous product or a product-related injury, go online to: SaferProducts.gov, call CPSC's Hotline at (800) 638-2772 or teletypewriter at (301) 595-7054 for the hearing and speech impaired. Consumers can obtain this news release and product safety information at www.cpsc.gov. To join a free e-mail subscription list, please go to www.cpsc.gov/cpsclist.aspx.

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NASFM Science Advisory Committee Recommendations
Regarding Arc-Fault Circuit Interrupters
to Prevent Fires Originating in Electrical Wiring

The Board of Directors of the National Association of State Fire Marshals (NASFM) has asked the NASFM Science Advisory Committee (SAC) to assist in offering guidance on the use of arc-fault circuit interrupters (AFCIs) in residential housing. This guidance, in part, is derived from the NASFM Consumer Product Safety Task Force Report on AFCIs issued August 1, 2002.

Function and Purpose of AFCIs: While conventional circuit breakers only respond to overloads and short circuits AFCIs continuously monitor the electrical current in a circuit, recognizing unique current and/or voltage signatures associated with arcing faults, and de-energizing the current when unintended arcing conditions occur. Once an unwanted arcing condition is detected, the control circuitry trips the internal contacts, thus de-energizing the circuit and reducing the potential for a fire to occur.

Typical conditions where arc faults may occur include damaged wires by carelessly nailed walled studs, damaged or misapplied equipment, and overheating from excessive current flow. Other common causes for arcing include:

- Cracked insulation on wire or cords from age, heat, chemical erosion or bending stress.
- Loose or improper connections, such as electrical wires to outlets and switches.
- Frayed or ruptured extension or appliance cords.
- Moisture or contaminants between conductors of different voltage.
- Electrical wire insulation chewed by rodents.

The most serious of these conditions (in terms of arc-fault related fire risk) occurs behind walls and under floors. By mitigating the unwanted effects of arcing, AFCIs reduce the risk of electrical fires, thereby safeguarding persons and property.

Installation: As of 2002, the installation of AFCIs is required by the National Electrical Code ® (NEC) in new construction of branch circuits providing power to outlets in dwelling unit bedrooms. AFCIs can also be easily retrofitted into existing structures. The NEC requirement

addresses the new home market, but the biggest potential for home electrical wiring system failures is in existing homes. The quality and safety of electrical wire systems deteriorates over time. As the home building stock increases in age, there is increased likelihood of home electrical wire systems failing, which creates a life safety issue. Whether new home or older home, installation should be performed by a licensed electrician or capable experienced individual.

Impact: Studies by both the National Fire Protection Association (NFPA) and U.S. Consumer Product Safety Commission (CPSC) underscore the significant impact of the use of AFCIs on the frequency of damage, injury, and deaths caused by residential electrical fires. Data from the National Fire Incident Reporting System (NFIRS) and the NFPA indicate that electrical arcing was the cause of approximately 48,800 fires annually in one and two family dwellings between 1994-1998. The use of AFCIs in residences may significantly decrease the frequency of such fires.

Additionally, the US Consumer Product Safety Commission technical staff, after conducting a great deal of independent research on AFCIs, estimates that 50-75% of residential electrical fires can be prevented by employing AFCI technology. [1]That means that of the 73,500 electrical fires annually, AFCIs could potentially prevent 55,125 fires and save more than 440 lives, 1,685 injuries, and $785,925,000 in property damage, when AFCIs work their way into electrical codes for installation throughout the house.

Standards and Testing: AFCIs have undergone rigorous testing by UL and CPSC and have been in production since 1997, and readily available in stores since 2001. AFCIs are tested to decrease the risk of fire from various types of arcing in accordance with the UL Safety Standard. The UL 1699 Standard addresses several types of AFCIs, each intended for different applications and/or protection of the branch circuit and extension wiring. The performance requirements for these devices include the arc-fault detection tests as described in Section 56 of that standard. All manufacturers' AFCI breaker devices pass all of the tests required for branch/feeder AFCIs.

Some critics refer to a UL study for the CPSC, which involved research on five different technologies designed to detect and monitor conditions that could lead to residential electrical wiring fires. One of those technologies was AFCIs. However, not all of the 14 experimental tests described in the CPSC's report were intended for AFCI technology.[2]

Cost: Once criticized for their high cost (originally in excess of $125 per unit), AFCIs have recently become more affordable due to increased production. The added first cost to install AFCI circuit breakers in a new home is approximately $100. This cost estimate is based on replacing two conventional circuit breakers with an AFCI circuit breaker. While the code requirement is to apply the AFCI to only the bedroom circuits, consideration should be made to include AFCI protection to other circuits as well.

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[1] King, William H., Jr., Chief Engineer for Electrical and Fire Safety, Division of Electrical Engineering, US Consumer Product Safety Commission, in discussion with the NASFM Science Advisory Committee, July 14, 2002.
[2] Dini, David, "Arc Fault Circuit Interrupters," *IAEI News*, September/October 2001.

The SAC agrees that the AFCI technology is sound and should seek continuing and expanded usage in residences, AFCIs can also be applied on a voluntary basis to other high risk applications such as: historic or older buildings, public housing, military installations, assisted living facilities, child care centers, schools, churches, dormitories, etc.

In determining this opinion, the SAC noted that AFCI technology:

- Increases early detection and prevention of arc-faults, reducing property losses, injuries, and loss of life;
- Is simple and affordable to install in new and pre-existing electrical distribution systems;
- Continues to undergo rigorous testing by public and private standards and testing laboratories;
- Is based upon recognized and thoroughly developed scientific methodologies.

Links to Background on NASFM report on AFCI technology, use, and authoritative testing.

http://www.firemarshals.org/issues/home/electrical_fires.html

Residential Structure Fire Causes

Created by: Dwight Crews (VA)

Report Parameters:

Report Period: From 01/01/2011 to 12/31/2011

State: VA **Version:** All **Status:** All **Released:** All

Report Filters:

NOTE: Report Filter Groups are applied to the report SQL as "AND" conditions (i.e. Group 1 AND Group2 and Group 3 etc...)

Report FDIDs*: All

*Data from deactivated fire depts within the list was not included in the report.

Residential Structure Fire Causes

State: VA ***Report Period:*** From 01/01/2011 to 12/31/2011

CODE	Category	FREQ	FREQ %	CIV DTHS	CIV DTHS %	CIV INJS	CIV INJS %	FF DTHS	FF DTHS %	FF INJS	FF INJS %	PROP LOSS	PROP LOSS %	CONT LOSS	CONT LOSS %	TOTAL LOSS	TOT LOSS %
01	Incendiary, Suspicious	418	5.40 %	3	7.50 %	37	9.71 %	0	0.00 %	20	13.99 %	9,677,597	9.65 %	2,468,037	7.89 %	12,145,634	9.23 %
02	Children Playing	26	0.34 %	0	0.00 %	4	1.05 %	0	0.00 %	0	0.00 %	785,261	0.78 %	142,240	0.45 %	927,501	0.70 %
03	Smoking	156	2.02 %	2	5.00 %	9	2.36 %	0	0.00 %	5	3.50 %	1,693,250	1.69 %	470,660	1.50 %	2,163,910	1.64 %
04	Heating	1,123	14.51 %	0	0.00 %	20	5.25 %	0	0.00 %	10	6.99 %	2,550,696	2.54 %	850,945	2.72 %	3,401,641	2.58 %
05	Cooking	2,622	33.87 %	1	2.50 %	128	33.60 %	0	0.00 %	13	9.09 %	4,594,929	4.58 %	1,954,612	6.25 %	6,549,541	4.98 %
06	Electrical Distribution	103	1.33 %	0	0.00 %	7	1.84 %	0	0.00 %	7	4.90 %	1,904,147	1.90 %	528,272	1.69 %	2,432,419	1.85 %
07	Appliances, AC	204	2.64 %	0	0.00 %	22	5.77 %	0	0.00 %	5	3.50 %	3,635,552	3.62 %	1,103,254	3.53 %	4,738,806	3.60 %
08	Open Flame, Ember,	345	4.46 %	1	2.50 %	18	4.72 %	0	0.00 %	8	5.59 %	8,532,508	8.51 %	1,985,827	6.35 %	10,518,335	7.99 %
09	Other Heat, Flame,	242	3.13 %	5	12.50 %	13	3.41 %	0	0.00 %	4	2.80 %	3,555,117	3.54 %	812,383	2.60 %	4,367,500	3.32 %
10	Other Equipment	51	0.66 %	0	0.00 %	7	1.84 %	0	0.00 %	3	2.10 %	813,002	0.81 %	282,201	0.90 %	1,095,203	0.83 %
11	Natural	153	1.98 %	0	0.00 %	3	0.79 %	0	0.00 %	3	2.10 %	4,408,871	4.39 %	2,372,311	7.58 %	6,781,182	5.15 %
12	Exposure	95	1.23 %	1	2.50 %	6	1.57 %	0	0.00 %	2	1.40 %	6,634,836	6.61 %	1,888,537	6.04 %	8,523,373	6.48 %
13	Unknown	2,203	28.46 %	27	67.50 %	107	28.08 %	0	0.00 %	63	44.06 %	51,533,116	51.37 %	16,418,884	52.49 %	67,952,000	51.64 %
	Totals:	7,741	100.00 %	40	100.00 %	381	100.00 %	0	0.00 %	143	100.00 %	100,318,882	100.00 %	31,278,163	100.00 %	131,597,045	100.00 %

Residential Structure Fire Causes

Report Parameters:

Report Period: 1/1/09 - 12/31/09 **Version:** Both **Status:** All **Released:** All

Report Filters: No Filters Applied

NOTE: Report Filter Groups are applied to the report SQL as "AND" conditions (i.e. Group 1 AND Group 2 AND Group 3 etc...)

State: VA

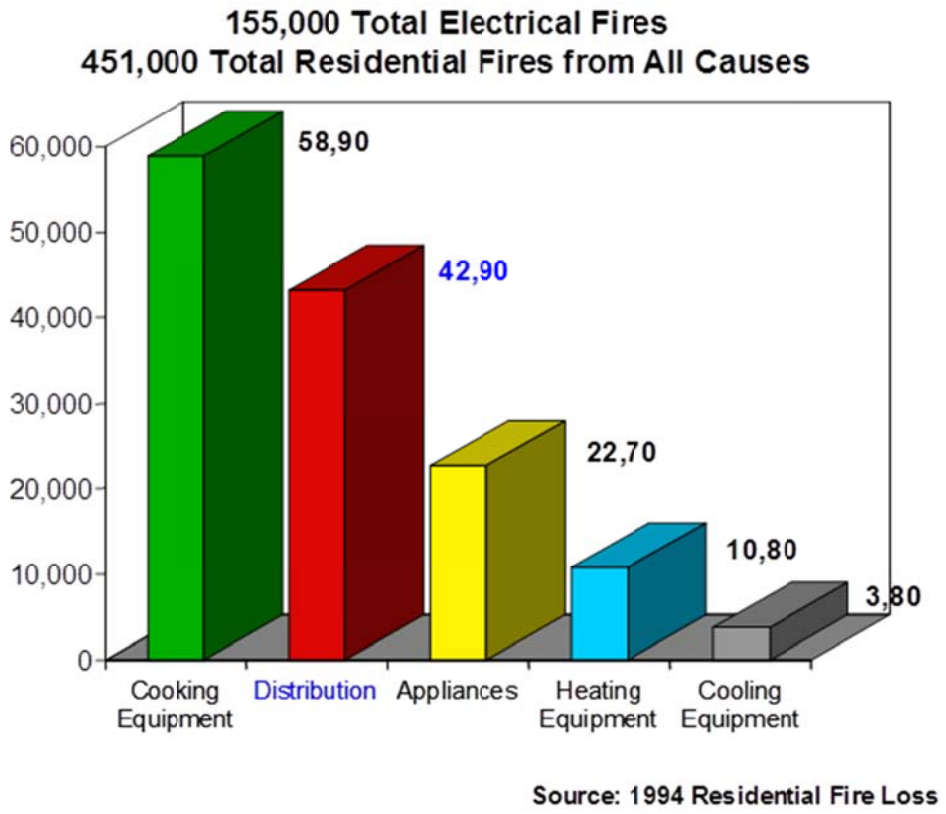
Report FDIDs: All

Residential Structure Fire Causes

State: VA **Report Period:** 1/1/09 - 12/31/09

CODE	CATEGORY	FREQ	FREQ %	CIV DTHS	CIV DTHS %	CIV INJS	CIV INJS %	FF DTHS	FF DTH %	FF INJS	FF INJS %	PROP LOSS	PROP LOSS %	CONT LOSS	CONT LOSS %	TOTAL LOSS	TOT LOSS %
01	Incendiary, Suspicious	350	4.33%	11	20.37%	17	5.65%	0	0.00%	21	18.26%	11,169,471	8.48%	3,729,396	9.51%	14,898,867	8.72%
02	Children Playing	22	0.27%	0	0.00%	3	1.00%	0	0.00%	1	0.87%	571,950	0.43%	140,866	0.36%	712,816	0.42%
03	Smoking	143	1.77%	4	7.41%	14	4.65%	0	0.00%	3	2.61%	4,781,422	3.63%	1,515,053	3.86%	6,296,475	3.68%
04	Heating	1,279	15.81%	3	5.56%	17	5.65%	0	0.00%	4	3.48%	3,081,466	2.34%	748,471	1.91%	3,829,937	2.24%
05	Cooking	2,672	33.04%	3	5.56%	81	26.91%	0	0.00%	2	1.74%	4,300,675	3.26%	1,446,538	3.69%	5,747,213	3.36%
06	Electrical Distribution	112	1.38%	0	0.00%	5	1.66%	0	0.00%	9	7.83%	3,864,186	2.93%	1,277,879	3.26%	5,142,065	3.01%
07	Appliances, Air Conditioning	206	2.55%	0	0.00%	7	2.33%	0	0.00%	4	3.48%	2,222,927	1.69%	664,848	1.70%	2,887,775	1.69%
08	Open Flame, Ember, Torch	378	4.67%	2	3.70%	18	5.98%	0	0.00%	3	2.61%	10,656,339	8.09%	3,746,425	9.55%	14,402,764	8.43%
09	Other Heat, Flame, Spark	266	3.29%	2	3.70%	13	4.32%	0	0.00%	8	6.96%	6,388,395	4.85%	1,803,760	4.60%	8,192,155	4.79%
10	Other Equipment	57	0.70%	0	0.00%	2	0.66%	0	0.00%	2	1.74%	729,105	0.55%	568,647	1.45%	1,297,752	0.76%
11	Natural	124	1.53%	0	0.00%	1	0.33%	0	0.00%	3	2.61%	2,861,025	2.17%	968,940	2.47%	3,829,965	2.24%
12	Exposure	269	1.50%	2	3.70%	5	1.66%	0	0.00%	3	2.61%	10,237,141	7.77%	2,969,111	7.57%	13,206,252	7.73%
13	Unknown Cause	2,359	29.15%	27	50.00%	118	39.20%	1	100.00%	52	45.22%	70,872,018	53.80%	19,629,353	50.06%	90,501,371	52.94%
Totals		8,237	100.00%	54	100.00%	301	100.00%	1	100.00%	115	100.00%	131,736,120	100.00%	39,209,287	100.00%	170,945,407	100.00%

Chart 1



Source: 1994 Residential Fire Loss

Chart 2

Electrical Distribution Equipment Fires in U.S. Homes - 1994 CPSC Estimates

Equipment	Fires	Civilian Deaths	Civilian Injuries
Fixed wiring	**15,200**	**140**	**380**
Cords and plugs	6,400	90	400
Light fixtures	5,300	40	140
Switches, receptacles and outlets	5,300	40	140
Lamps and light bulbs	3,400	20	160
Fuses, circuit breakers and other overcurrent protection devices	3,200	10	80
Meters or meter boxes	900	—	10
Transformers	500	—	20
Unknown or unclassified electrical distribution equipment	2,700	30	110
Total	**42,900**	**370**	**1,440**

Source: 1994 Residential Fire Loss Estimates,

Chart 3

Electrical Distribution Equipment Fires in U.S. Homes

Category	Number	Percent
Service equipment	21	14%
Branch circuit wiring	**50**	**34%**
Receptacle outlets and switches	**29**	**19%**
Cords and plugs	**29**	**19%**
Lighting fixtures and lamps	**19**	**13%**
Transformers (improperly installed)	1	1%
Total	**149**	

Source: "What Causes Wiring Fires in Residences?" by Smith and McCoskrie
Data from 149 fire investigations in 16 cities, 1984 and 1985 *Fire Journal*. Jan/Feb 1990

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U.S. Consumer Product Safety Commission

Office of Communications Washington, D.C.

FOR IMMEDIATE RELEASE
June 19, 2012
Release #12-197

Firm's Recall Hotline: (800) 764-0756
CPSC Recall Hotline: (800) 638-2772
CPSC Media Contact: (301) 504-7908

Ceiling Mounted Light Fixtures Recalled by Thomas Lighting Due to Fire and Shock Hazards

WASHINGTON, D.C. - The U.S. Consumer Product Safety Commission, in cooperation with the firm named below, today announced a voluntary recall of the following consumer product. Consumers should stop using recalled products immediately unless otherwise instructed. It is illegal to resell or attempt to resell a recalled consumer product.

Name of product: Thomas Lighting ceiling flush mount light fixtures

Units: About 83,750

Manufacturer: Thomas Lighting, of Elgin, Ill; part of Philips Consumer Luminaires Corporation, of Elgin, Ill.

Hazard: The fixture's socket wire insulation can degrade, leading to charged wires becoming exposed, causing electricity to pass to the metal canopy of the fixture. This poses a fire and electric shock hazard to consumers.

Incidents/Injuries: Thomas Lighting has received 11 reports of defective fixtures which resulted in the home's Arc Fault Circuit Interrupter (AFCI) tripping. No injuries have been reported to the firm.

Description: This recall involves 28 different models of ceiling flush-mounted light fixtures manufactured between June 1, 2010 through November 25, 2010 with a diameter ranging from 7.5" to 13". All affected fixtures have a round base or canopy affixed to the ceiling and a dome- or cylindrical-shaped cover. The recalled fixtures have a variety of finishes including metal and/or clear or frosted glass and contain one, two or three light bulbs. Canopies are a range of colors including white, bronze, brass (gold) and nickel. Most models have a nib in the center of the dome cover in the same color as the canopy. Although the manufacturer's name, the fixture model number and production date can be found on a printed label on the ceiling-side of the fixture's metal canopy, consumers are advised not to remove the metal canopy from the ceiling in order to access this label.

Sold at: Electrical distributors and lighting wholesalers nationwide from July 2010 through July 2011 for between $19 and $50 as Thomas Lighting products.

Manufactured in: China

Remedy: Consumers should immediately stop using the light fixture, avoid direct contact with the fixture and contact Thomas Lighting to arrange for a free in-home repair of the fixtures by a qualified electrician.

Consumer Contact: For additional information, contact Thomas Lighting at (800) 764-0756 between 9 a.m. and 5 p.m. ET Monday through Friday, or visit the firm's website at www.thomaslighting.com

SL325-8: White 7-1/2" dia.	SL8691-78: Brushed Nickel 11" dia.	SL8771-63: Painted Bronze 11" dia.

1-light White glass	1-light Etched alabaster style glass	1-light Golden cream swirl glass
SL326-8: White 9-1/2" dia. 2-light White glass	SL8691-81: Tile Bronze 11" dia. 1-light Etched alabaster style glass	SL8772-63: Painted Bronze 13" dia. 2-light Golden cream swirl glass
SL458-8: White 9-1/2" dia. 2-light Clear glass	SL8692-1: Polished Brass 13" dia. 2-light Etched alabaster style glass	SL8781-15: Oiled Bronze 11" dia. 1-light Etched glass
SL8652-1: Polished Brass 13" dia. 2-light Etched swirl glass	SL8692-18: Textured White 13" dia. 2-light Etched alabaster style glass	SL8781-23: Colonial Bronze 11" dia. 1-light Etched glass
SL8683-81: Tile Bronze 15" dia. 3-light Etched melon glass	SL8692-68: Burnished Bronze 13" dia. 2-light Etched alabaster style glass	SL8781-78: Brushed Nickel 11" dia. 1-light Etched glass
SL8691-1: Polished Brass 11" dia. 1-light Etched alabaster style glass	SL8692-78: Brushed Nickel 13" dia. 2-light Etched alabaster style glass	SL8782-15: Oiled Bronze 13" dia. 2-light Etched glass
SL8691-11: Bronze Florentine 11" dia. 1-light Etched alabaster style glass	SL8693-1: Polished Brass 15-1/2" dia. 3-light Etched alabaster style glass	SL8782-23: Colonial Bronze 13" dia. 2-light Etched glass
SL8691-18: Textured White 11" dia. 1-light Etched alabaster	SL8693-78: Brushed Nickel 15-1/2" dia. 3-light Etched alabaster	SL8782-78: Brushed Nickel 13" dia. 2-light Etched glass

style glass	style glass	
SL8691-63: Painted Bronze 11" dia. 1-light Etched alabaster style glass	SL8761-1: Polished Brass 11" dia. 1-light Clear swirl glass	
SL8691-68: Burnished Bronze 11" dia. 1-light Etched alabaster style glass	SL8761-78: Brushed Nickel 11" dia. 1-light Clear swirl glass	

Representative photos of the main affected products:

Model number SL326-8

Model number SL8691-78 (11" 1-light),
or SL8692-78 (13" 2-light),
or SL8693-78 (15-1/2" 3-light)

The U.S. Consumer Product Safety Commission (CPSC) is still interested in receiving incident or injury reports that are either directly related to this product recall or involve a different hazard with the same product. Please tell us about your experience with the product on SaferProducts.gov

CPSC is charged with protecting the public from unreasonable risks of injury or death associated with the use of the thousands of consumer products under the agency's jurisdiction. Deaths, injuries, and property damage from consumer product incidents cost the nation more than $900 billion annually. CPSC is committed to protecting consumers and families from products that pose a fire, electrical, chemical, or mechanical hazard. CPSC's work to ensure the safety of consumer products - such as toys, cribs, power tools, cigarette lighters, and household chemicals - contributed to a decline in the rate of deaths and injuries associated with consumer products over the past 30 years.

Under federal law, it is illegal to attempt to sell or resell this or any other recalled product.

To report a dangerous product or a product-related injury, go online to: SaferProducts.gov, call CPSC's Hotline at (800) 638-2772 or teletypewriter at (301) 595-7054 for the hearing and speech impaired. Consumers can obtain this news release and product safety information at www.cpsc.gov. To join a free e-mail subscription list, please go to www.cpsc.gov/cpsclist.aspx.

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Introducing the SmartlockPro® Outlet Branch Circuit AFCI Receptacle

Advanced technology helps protect against electrical fires resulting from arc-faults.

The U.S. Fire Administration (USFA) National Fire Incident Reporting System estimates that between 2006 and 2010 there were an average of approximately 28,000 electrical residential building fires, causing nearly 300 deaths per year as well as average property damage of almost $1 billion annually. According to the National Fire Protection Association (NFPA), arc-faults are "the principle electrical failure mode resulting in fire."

Arc Fault Circuit Interrupters (AFCI) were developed to help combat the problems associated with arc-faults. AFCI's are devices designed to detect a wide range of arc-faults to help reduce the likelihood of the electrical system being an ignition source of a fire. They function by de-energizing the circuit downstream of the device upon which an arc-fault is detected; ideally preventing ignition and a resultant fire. AFCIs are now required by the National Electrical Code in many areas throughout the home.

Whole house electrical safety is a tall order, but with the new SmartlockPro Outlet Branch Circuit (OBC) AFCI Receptacle Leviton has developed a device to offer added protection from arc-faults. Often unseen, arc-faults can occur anywhere in the home's electrical system including within walls, at loose electrical connections or within electrical cords accidently damaged by impinging furniture. Leviton OBC AFCI Receptacles are designed to identify arc-faults and respond by interrupting power to help prevent arc-faults that may lead to a fire.

To date, the only available option for providing the required AFCI protection against electrical fire hazards was through the use of AFCI breakers. And, even though there were some exceptions to the Code that would allow for the use of an AFCI receptacle with prescribed wiring techniques, there were no AFCI receptacles available on the market. That has recently changed.

Leviton's OBC AFCI Receptacle addresses the dangers associated with both types of potentially hazardous arcing – parallel and series arcing. Similar to GFCIs, AFCI receptacles provide feed-through protection and are able to detect downstream arc-faults, both parallel and series, as well as upstream series arc-faults. Utilizing an AFCI receptacle offers homeowners the benefit of localized TEST and RESET, providing a convenient alternative to AFCI breakers.

National Electrical Code

The 2011 National Electrical Code® (NEC) (210.12) addresses the use of AFCIs in residences:

"**Dwelling Units**. (A) Where required. All 15A or 20A, 120V branch circuits in dwelling units supplying outlets in family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas must be protected by a listed AFCI device of the combination type.

Exception 1: AFCI protection can be of the branch-circuit type located at the first outlet if the circuit conductors are installed in RMC, IMC, EMT or Type MC or steel armored Type AC cable meeting requirements of 250.118, and the AFCI device is contained in a metal outlet or junction box.

Exception 2: Where a listed metal or nonmetallic conduit or tubing is encased in not less than 2 in. of concrete for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, an outlet branch-circuit AFCI at the first outlet is permitted to provide protection for the remaining portion of the branch circuit.

(B) Branch-Circuit Extensions or Modifications – Dwelling Units. Where branch-circuit wiring is modified, replaced, or extended in any of the areas specified in 210.12(A), the branch circuit must be protected by:

(1) A listed combination AFCI located at the origin of the branch circuit; or
(2) A listed outlet branch circuit AFCI located at the first receptacle outlet of the existing branch circuit."

In accordance with the cited exceptions, Leviton's SmartlockPro OBC AFCI Receptacles can be used to meet the requirements of the Code.

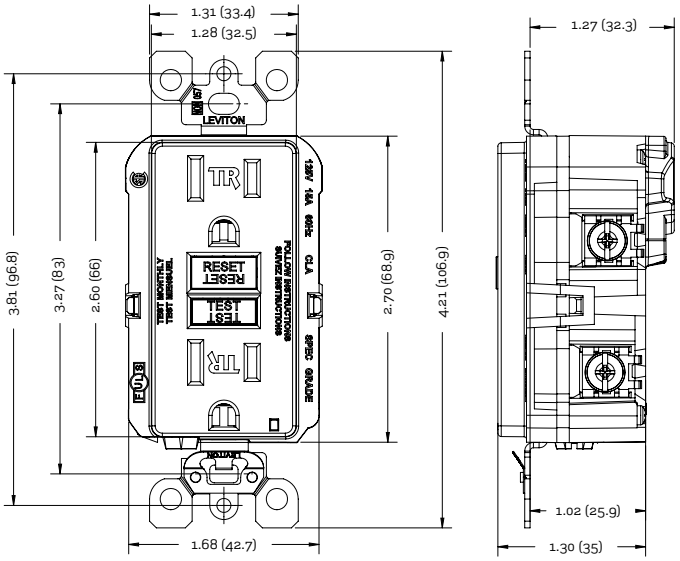
Leviton's SmartlockPro OBC AFCI receptacle can also be used to meet the NEC requirements for replacement receptacles that take effect in 2014.

NEC 406.4(D) states, "**Arc-Fault Circuit-Interrupter Protection**. Effective January 1, 2014, where a receptacle outlet is supplied by a branch circuit that requires arc-fault circuit interrupter protection [210.12(A)], a replacement receptacle at this outlet must be one of the following:

(1) A listed outlet branch circuit type arc-fault circuit interrupter receptacle
(2) A receptacle protected by a listed outlet branch circuit type arc-fault circuit interrupter type receptacle
(3) A receptacle protected by a listed combination type arc-fault circuit interrupter type circuit breaker."

Meeting all of the requirements for an outlet branch-circuit type AFCI, Leviton's new OBC AFCI Receptacle provides protection to both branch circuit wiring as well as extensions to branches such as appliances and cord sets.

Dimensional Drawings



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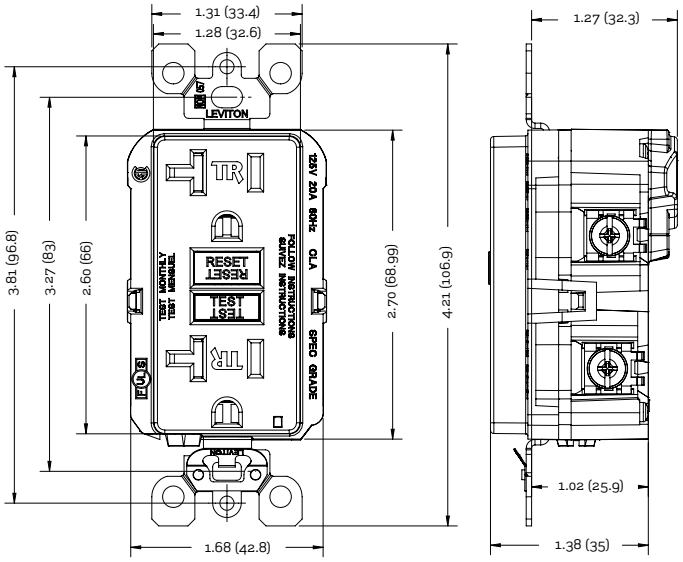

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Features and Benefits

General

- Use of TEST and RESET buttons is similar to traditional GFCI receptacles of which consumers have become familiar with. This translates into greater acceptance of the technology and a more user-friendly platform
- Meets or exceeds UL requirements for tripping time on both series and parallel arcs
- Device design reduces nuisance tripping
- Impact-resistant thermoplastic cover and body
- Superior resistance to electrical surges and over-voltages
- Expanded wiring options with nine back-wire holes (two for each line and load connection plus one for ground with an internal clamp)
- Silver alloy contacts
- Compatible with all Decora® devices and wallplates; available in select colors
- Packed with coordinating wallplate
- Backed by Leviton's Limited Two-Year Warranty

Tamper-Resistant

- TR symbol indicates the device's compliance with the latest NEC® requirements for tamper-resistant receptacles in residences and childcare facilities

Lockout Action

- Automatically tests the AFCI every time the RESET button is depressed; the AFCI will not reset if the AFCI circuit is not functioning properly
- By blocking reset of the AFCI if protection has been compromised, the SmartlockPro OBC AFCI reduces the possibility of end-users incorrectly assuming that a reset AFCI is providing protection when its functionality has been compromised
- A line-load reversal diagnostic feature is provided which prevents the AFCI from being reset and stops power from being fed to the AFCI receptacle face or through to down-stream devices; a green LED indicator on the AFCI's face also illuminates to alert the installer to a line-load wiring reversal when the device is in the tripped state
- The trip latching mechanism in the SmartlockPro OBC AFCI is a one-piece "T" design for efficient operation
- There are 4 sets of contacts for load terminals and face; the SmartlockPro OBC AFCI uses a patented bifurcated bridge contact for efficient operation

Agency Standards

- Leviton AFCI UL file - E342815
- Meets UL Standard 1699A (Arc-Fault Circuit-Interrupters, Outlet Branch Circuit Type) for AFCI
- Meets UL Standard 498 for receptacle
- Requirements in UL1998 and UL1699 were applied based on reference in UL1699A

Ordering Information:

SmartlockPro Consumer Product Safety Commission Outlet Branch Circuit AFCI Receptacles

Description	Rating	Cat. No.	Color
Tamper-Resistant Outlet Branch Circuit AFCI Receptacle with LED Indicator	15A-120V @ Receptacle, 20A-125V Feed-Through NEMA 5-15R	AFTR1-W AFTR1-I AFTR1-T AFTR1-GY AFTR1-E AFTR1	White Ivory Light Almond Gray Black Brown
Tamper-Resistant Outlet Branch Circuit AFCI Receptacle with LED Indicator	20A-120V @ Receptacle, 20A-125V Feed-Through NEMA 5-20R	AFTR2-W AFTR2-I AFTR2-T AFTR2-GY AFTR2-E AFTR2	White Ivory Light Almond Gray Black Brown

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ISO 9001 REGISTERED Quality Manufacturer

HOME ELECTRICAL FIRES

John R. Hall, Jr.

January 2012

National Fire Protection Association
Fire Analysis and Research Division

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Abstract

Home electrical fires
In 2009, an estimated 44,800 home structure fires reported to U.S. fire departments involved some type of electrical failure or malfunction as a factor contributing to ignition. These fires resulted in 472 civilian deaths, 1,500 civilian injuries, and $1.6 billion in direct property damage.

Home electrical distribution or lighting equipment fires
In 2009, an estimated 21,000 reported U.S. non-confined home structure fires involving electrical distribution or lighting equipment resulted in 320 civilian deaths, 1,000 civilian injuries, and $935 million in direct property damage.

These estimates are based on data from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey.

Keywords: Electrical fire, wiring, lamp, light, cord, plug, fuse, circuit breaker, transformer, outlet, receptacle, switch, generator, battery, fire statistics, home fires, residential fires.

Acknowledgements

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

For more information about the National Fire Protection Association, visit www.nfpa.org or call 617-770-3000. To learn more about the One-Stop Data Shop go to www.nfpa.org/osds or call 617-984-7443.

Copies of this analysis are available from:

National Fire Protection Association
One-Stop Data Shop
1 Batterymarch Park
Quincy, MA 02169-7471

NFPA No. USS37

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Executive Summary

Home electrical fires

The most inclusive and direct interpretation of "electrical fire" is a fire involving some type of electrical failure or malfunction. In 2009, an estimated 44,800 home structure fires reported to U.S. fire departments involved some type of electrical failure or malfunction as a factor contributing to ignition. These fires resulted in 472 civilian deaths, 1,500 civilian injuries, and $1.6 billion in direct property damage. In 2005-2009, home electrical fires represented 13% of total home structure fires, 17% of associated civilian deaths, 11% of associated civilian injuries, and 21% of associated direct property damage.

These statistics include fires reported as "confined fires," for which detailed reporting is not required. Estimates of detailed characteristics for confined fires require statistical allocation of a large share of unknowns and so involve less confidence.

Half (49%) of 2005-2009 reported non-confined U.S. home structure fires involving electrical failure or malfunction had some type of electrical distribution or lighting equipment as equipment involved in ignition. The leading other types of equipment involved in ignition were washer or dryer (6%), fan (6%), space heater (4%), air conditioning equipment (4%), water heater (3%), and range (3%).

Home electrical distribution or lighting equipment fires

In 2009, an estimated 21,000 reported U.S. non-confined home structure fires involving electrical distribution or lighting equipment resulted in 320 civilian deaths, 1,000 civilian injuries, and $935 million in direct property damage. Fires reported as confined fires would add only 1.8% to the estimated non-confined fires and less than 1.0% to associated losses. Therefore, they are not included in this analysis.

The national estimates in this report are derived from data reported to the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS). Fires declined by about one-third from 1980 to 1998. Version 5.0 of NFIRS, introduced in 1999, contained numerous changes in data categories, definitions, and rules. After the transition period of 1999-2001, when NFIRS Version 5.0 was being phased in, the estimates settled into a level about one-half lower than the levels of the late 1990s, a much larger decline than would have been expected if the 1980-1998 trend had continued unchanged. Associated losses also showed large declines coinciding with the shift to NFIRS Version 5.0.

As with other types of equipment cited as equipment involved in ignition, all that we know from this designation is that the equipment provided the heat leading to ignition. That does not mean that there was electrical or any other type of failure or malfunction. For example, a hot light bulb might have been too close to combustibles.

Electrical distribution or lighting equipment accounted for 6% of 2005-2009 home structure fires, ranking fourth among major causes behind cooking equipment, heating equipment, and intentional. Electrical distribution or lighting equipment also accounted for 15% of associated civilian deaths (ranking behind smoking materials, heating equipment, and tied with cooking equipment), 8% of associated civilian injuries (ranking fifth), and 12% of associated direct property damage (ranking third).
Wiring and related equipment accounted for the largest share (61%) of 2005-2009 home structure fires involving electrical distribution

or lighting equipment, followed by lamps, light fixtures, and light bulbs (21%), cords and plugs (12%), and transformers and power supplies (6%). Cords and plugs accounted for larger shares of civilian deaths (34%) and injuries (24%) than of fire incidents (12%) associated with home electrical distribution or lighting equipment fires.

Three-fourths (73%) of 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment cited some type of electrical failure or malfunction as a factor contributing to ignition.

The majority of 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment began with ignition of products and materials often found in structural areas, including wire or cable insulation (31%), structural member or framing (15%), insulation within structural area (6%), and exterior wall covering and finish (5%).

One-third (31%) of deaths in 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment resulted from fires that began in a living room, family room, or den.

Three out of five (60%) deaths in 2005-2009 home structure fires involving electrical distribution or lighting equipment involved victims who were outside the area of origin when injured. By comparison 46% of fatal victims for all home structure fires were outside the area of origin when injured.

Home structure fires involving electrical distribution or lighting equipment, in 2005-2009, show a winter peak similar to that for heating equipment but less pronounced. Based on special reports by the U.S. Consumer Product Safety Commission, analyzing data from the death certificate data base, in 1999 to 2010, 49 people died per year of injuries from unvented carbon monoxide from generators. Fueled equipment to generate electricity is the only type of electrical distribution or lighting equipment that can produce carbon monoxide.

Safety Tips

- Home electrical safety begins with NFPA 70, *National Electrical Code®*, and related documents with special relevance to homes, notably NFPA 73, *Electrical Inspection Code for Existing Dwellings*. However, work on home electrical distribution or lighting equipment should only be conducted by someone qualified as an electrician. When you are buying, selling or remodeling a home, have it inspected by a professional electrician.

- Call a qualified electrician or landlord if you have
  - recurring problems with blowing fuses or tripping circuit breakers,
  - a tingling feeling when you touch an electrical appliance,
  - discolored or warm wall outlets,
  - a burning smell or rubbery odor coming from an appliance,
  - flickering lights,
  - sparks from an outlet.
  - cracked or broken outlets
- Arc fault circuit interrupters (AFCIs) are a type of circuit breaker that shuts off electricity when a dangerous arcing condition occurs. Consider having them installed in your home. Use a qualified electrician.
- Use extension cords for temporary wiring only. Consider having additional circuits or outlets added by a qualified electrician.

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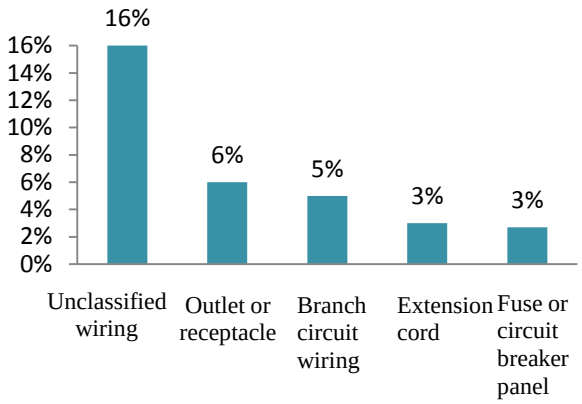
Email: osds@nfpa.org
www.nfpa.org

Home Electrical Fires Fact Sheet

U.S. fire departments responded to an estimated average of 43,900 reported U.S. home[1] structure fires involving electrical failure or malfunction in 2005-2009. These fires resulted in 438 civilian deaths, 1,430 civilian injuries and $1.47 billion in direct property damage.

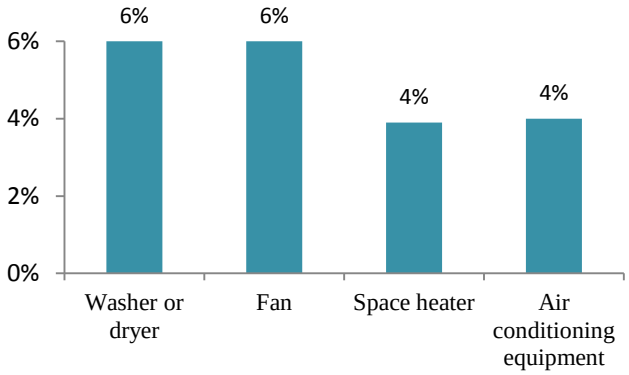
Roughly half of home electrical fires involved electrical distribution or lighting equipment in 2005-2009.

Leading Types of Electrical Distribution or Lighting Equipment Involved in Home Electrical Fires, 2005-2009



Nearly half of home electrical fires involved other known types of equipment in 2005-2009.

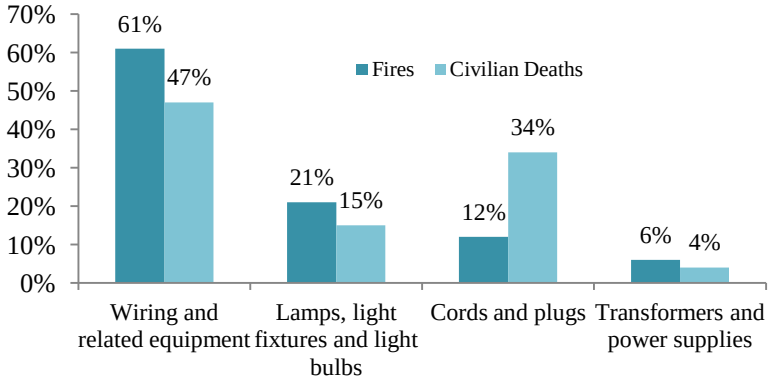
Leading Other Types of Equipment Involved in Home Electrical Fires, 2005-2009



Home Fires Involving Electrical Distribution or Lighting Equipment

U.S. fire departments responded to an estimated average of 23,400 reported U.S. non-confined home structure fires involving electrical distribution or lighting equipment in 2005-2009. These fires resulted in 392 civilian fire deaths, 970 civilian fire injuries, and $820 million in direct damage.

Home Fires Involving Electrical Distribution or Lighting Equipment, by Major Equipment Group 2005-2009



In 2005-2009:
Some type of electrical failure or malfunction was cited as factor contributing to ignition for 73% of electrical distribution or lighting equipment home structure fires.

One-third (31%) of civilian deaths in these incidents began in the living room, family room or den.

Wire or cable insulation is what ignited first in 31% of electrical distribution or lighting equipment home structure fires.

[1]Homes are dwellings, duplexes, manufactured homes, apartments, townhouses, and rowhouses.

NFPA's Fire Safety Resources

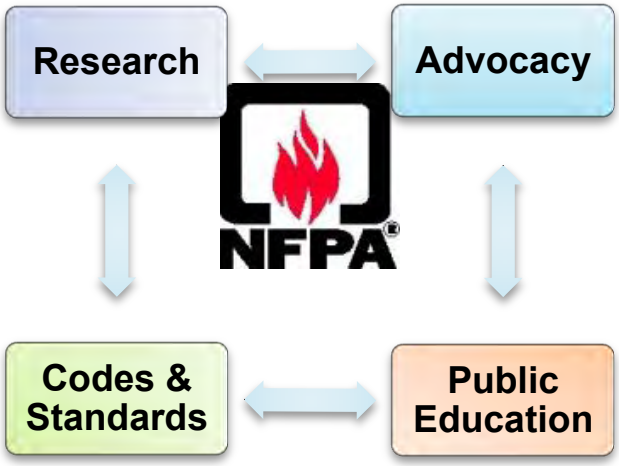
NFPA´s wealth of fire-related research includes investigations of technically significant fire incidents, fire data analysis, and the Charles S. Morgan Technical Library, one of the most comprehensive fire literature collections in the world. In addition, NFPA´s Fire Protection Research Foundation is a source of independent fire test data. Find out more at:

www.nfpa.org/research

Properly installed and maintained smoke alarms are necessary to provide a warning of any fire to all occupants. You can find out more information about smoke alarms here: NFPA Smoke Alarm Information

Home fire sprinkler systems provide even greater protection. These systems respond quickly to reduce the heat, flames, and smoke from a fire until help arrives. More information about home fire sprinklers may be found at www.firesprinklerinitiative.org

Simply put, smoke alarms and fire sprinklers save lives.



NFPA also develops, publishes, and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. Home electrical safety begins with:

NFPA1: Fire Code

NFPA 101 Life Safety Code®

NFPA 70: National Electrical Code®:

For consumers: NFPA has consumer safety information regarding causes, escape planning, fire & safety equipment, and many other topics.

For Kids : Sparky.org has important information for kids delivered via fun games, activities, and cartoons.

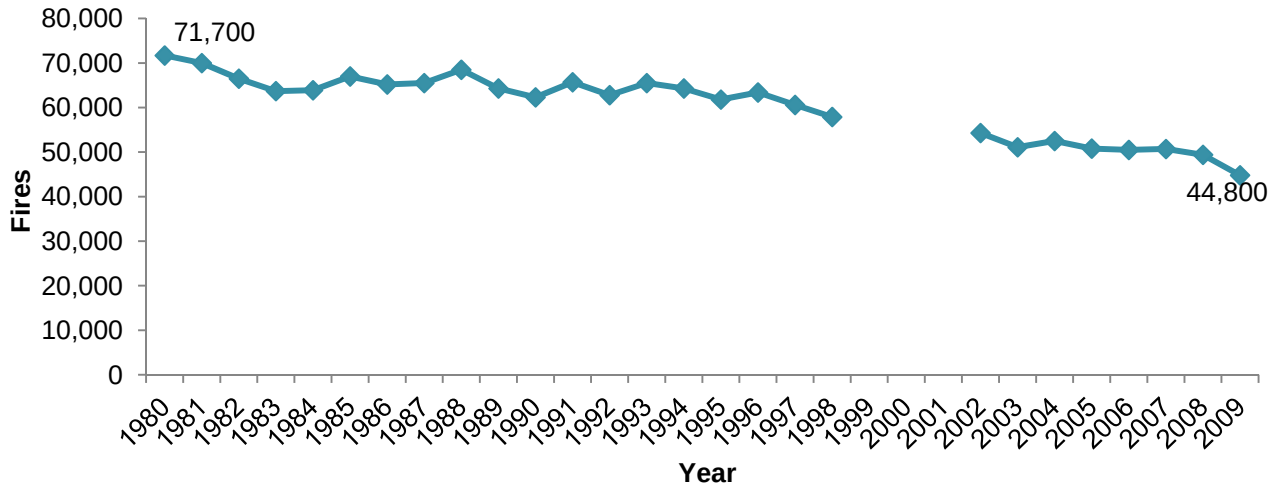
For public educators: Resources on fire safety education programs, educational messaging, grants & awards, and many other topics.

Section 1. Electrical Fires

In 2009, an estimated 44,800 home electrical fires were reported to U.S. fire departments. "Electrical fire" is defined as structure fire that involved some type of electrical failure or malfunction as a factor contributing to ignition.
These fires resulted in 472 civilian deaths, 1,500 civilian injuries, and $1.6 billion in direct property damage.

Home electrical fires represented 13% of total 2005-2009 home structure fires, 17% of associated civilian deaths, 11% of associated civilian injuries, and 21% of associated direct property damage.

Figure 1.1. Home Fires Involving Electrical Failure or Malfunction as Factor Contributing to Ignition, by Year Structure Fires Reported to U.S. Fire Departments



Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey. Note: See Note in Table 1.1.

Figure 1.1 and Table 1.1 show that there has been a fairly steady and substantial downward trend, with the 2009 total being roughly one-third less than the size of the 1980 estimated total of 71,700 fires. However, most of that decline occurred between 1980 and 1998, with long periods of slow or no decline after the introduction of NFIRS Version 5.0 in 1999, except for the most recent year. Civilian deaths and direct property damage (adjusted for inflation) have not shown a consistent decline from 1980 to the present.

These statistics *include* fires reported as "confined fires," for which detailed reporting is not required. Estimates of detailed characteristics for confined fires require statistical allocation of a large share of unknowns and so involve less confidence. In this analysis, fires reported as confined fires added an average of 12% to the non-confined fire estimates in 2005-2009. They added at most 1% to civilian deaths and injuries and to direct property damage. Most of the confined fires (64%) were fires confined to a cooking vessel, and most of the rest (25% of the total) were fires confined to fuel burner, boiler, chimney or flue. The rest were fires confined to

trash (4%), fires confined to an incinerator (4%), fires confined to chimney or flue (2%), and fires confined to commercial compactor (1%).

Most (76%) reported home structure fires involving electrical failure or malfunction were reported with few or no details on failure mode.
Table 1.A shows the estimates for different types of electrical failure or malfunction. The two leading types were unclassified electrical failure or malfunction (49%) and unspecified short circuit arc (27%). The leading factor with specific details was short circuit arc from defective or worn insulation (13%).

Table 1.A. Home Fires Involving Electrical Failure or Malfunction as Factor Contributing to Ignition, by Factor Contributing to Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Type of Electrical Failure or Malfunction	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	23,920	(49%)	218	(50%)	664	(46%)	$770	(52%)
Unspecified short circuit arc	13,110	(27%)	108	(25%)	422	(29%)	$440	(30%)
Short circuit art from defective or worn insulation	6,310	(13%)	49	(11%)	151	(10%)	$151	(10%)
Arc or spark from operating equipment	2,510	(5%)	26	(6%)	96	(7%)	$60	(4%)
Arc from faulty contact or broken conductor	2,250	(5%)	18	(4%)	55	(4%)	$49	(3%)
Short circuit arc from mechanical damage	2,040	(4%)	33	(8%)	50	(3%)	$43	(3%)
Water caused short circuit arc	710	(1%)	0	(0%)	13	(1%)	$10	(1%)
Fluorescent light bulb	190	(0%)	0	(0%)	4	(0%)	$11	(1%)
Total fires	49,080	(100%)	438	(100%)	1,445	(100%)	$1,476	(100%)
Total factors	51,030	(104%)	452	(103%)	1,455	(101%)	$1,534	(104%)

Note: Figures *include* confined fires, which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and civilian injuries are expressed to the nearest one, and property damage is rounded to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank, with allocations done separately for non-confined and confined fires. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Arcing appears to account for most home electrical fires, as compared with overheating due to overcurrent.

It is useful to estimate the relative frequency of arcing vs. overheating as the mechanism of ignition, because different fire prevention devices (e.g., arc-fault circuit interrupter) or strategies may be more effective on one ignition mechanism than the other.

If electrical failure or malfunction is defined by Factor Contributing to Ignition, then the relative roles of arcing and overheating can be examined using Heat Source. Arcing should be the mode of ignition if Heat Source refers to arcing or sparks. Overheating should be the mode of ignition if Heat Source refers to radiated or conducted heat or to molten or hot material. Here are the leading Heat Source entries and their respective shares of fires with known Heat Source, from all home fires involving electrical failure or malfunction:

- Arcing – 63%, definitely arcing;
- Unclassified heat from powered equipment – 13%, could be either;
- Unclassified heat source – 6%, could be either;
- Radiated or conducted heat from operating equipment – 5%; should be overheating;
- Spark, ember or flame from operating equipment – 5%, could be either;
- Unclassified hot or smoldering object – 5%, probably overheating;
- Heat or spark from friction – 1%, could be either;
- Molten or hot material – 1%, very probably overheating.

These statistics suggest a 6-to-1 ratio of arcing fires to overheating fires based on heat sources that appear likely to be one or the other. If everything that is not specifically arcing is overheating, then the ratio is still 3-to-2 arcing versus overheating.

Fires due to overheating caused by overcurrent can be prevented by overcurrent protection devices, principally circuit breakers and fuses, while fires due to arcing can be prevented by arc fault circuit interrupters (AFCIs). The former has been present in all, or nearly all, homes with electrical service since electrical service has been available. The latter is a technology developed more recently and is still in very limited use.

A 1983 special study by the National Institute of Standards and Technology (then still called the National Bureau of Standards) examined 80 cases of one- and two-family dwelling electrical distribution or lighting equipment fires for which the type and performance of overcurrent protection was known and reported.[1] None of the 43 cases with circuit breakers and 11% of the cases with fuses were deemed to involve circumstances where the overcurrent protection device should have operated to prevent ignition.

The U.S. Consumer Product Safety Commission which had arranged and sponsored the collection of the data analyzed by NIST, arranged and sponsored a second phase of data collection in the late 1980s and performed the analysis themselves. One finding was a strong relationship between age of dwelling and the rate of electrical distribution and lighting equipment fires per million dwellings, as shown in Table 1.B.

The two analyses identified three primary factors in relationship between age of dwelling and risk.

- In the 1990 CPSC analysis, no dwelling built later than 1965 used fuses rather than circuit breakers, whereas about half the dwellings built before 1965 used fuses. As of

[1] CPSC analysis of 141 fires, as reported in Linda E. Smith and Dennis McCoskrie, "What Causes Wiring Fires in Residences?," *Fire Journal*, January/February 1990, pp. 19-24, 69; NIST analysis of 101 fires, as reported in John R. Hall, Jr., Richard Bukowski, and Alan Gomberg, *Analysis of Electrical Fire Investigations in Ten Cities*, NBSIR 83-2803, National Bureau of Standards, December 1983.

2007, roughly 42% of the nation occupied detached single-family dwellings had been built before 1965, which suggests dwellings with fuses now account for at most one-fifth of total dwellings.

- In the 1983 NIST analysis, no dwelling built later than 1950 used knob and tube wiring whereas about one-third of dwellings built before 1950 used knob and tube wiring. As of 2007, 23% of the nation's occupied detached single-family dwellings were built before 1950, which suggests dwellings with knob and tube wiring now account for less than one-tenth of total dwellings. [2]
- In the 1983 NIST analysis, 63% of fire cases involving dwellings built before 1960 found electrical systems in need of repair, compared to only 27% of fire cases involving dwellings built after 1960 (at most 20 years old).

Table 1.B. Risk Ratios for Rate of Electrical Distribution or Lighting Equipment per Million Dwellings, by Age of Dwelling

Age of Dwelling	Risk Ratio	
	1990 CPSC Study	1983 NIST Study
0-10 years	0.3	0.3
11-20 years	0.5	0.3
21-40 years	1.0	1.1
More than 40 years	1.6	1.9
All ages	1.0	1.0

Note: The risk ratio is defined as the ratio of the fire rate for dwellings of that age to the fire rate for all dwellings.

Source: CPSC analysis of 141 fires, as reported in Linda E. Smith and Dennis McCoskrie, "What Causes Wiring Fires in Residences?," *Fire Journal*, January/February 1990, pp. 19-24, 69; NIST analysis of 101 fires, as reported in John R. Hall, Jr., Richard Bukowski, and Alan Gomberg, *Analysis of Electrical Fire Investigations in Ten Cities*, NBSIR 83-2803, National Bureau of Standards, December 1983.

Of these three factors, the first two – use of fuses and use of knob and tube wiring – are clearly much less common today than they were at the time of the NIST and CPSC studies. However, age may still be a factor in the risk of home electrical fires. In the CPSC study, one-sixth (17%) of the fires were in dwellings that showed equipment deterioration due to aging.

The Fire Protection Research Foundation sponsored a project in 2002-2008 to take an updated look at the issue of aging electrical distribution and lighting equipment in dwellings.[3] The methodology consisted of a detailed examination of 30 homes that were 30 to 110 years old. They identified a number of system problems, which may correlate with system age for different reasons. Here are some examples:

(1) Physical deterioration due to age alone.
Pre-1950 wiring often used conductors with thermoset rubber insulation, and rubber is known to become brittle with age. This general potential was confirmed to have occurred in some of the

[2] *American Housing Survey 2007*, U.S. Department of Commerce and U.S. Department of Housing and Urban Development, September 2008, Tables 1A-1 and 2-25.
[3] David A. Dini, *Residential Electrical System Aging Research Project*, Fire Protection Research Foundation, Quincy, MA, July 1, 2008.

sample homes. Ground fault circuit interrupters (GFCIs) were cited as an example of an electrical product that in several cases were left in place past their design product life. Like non-operational smoke alarms, these products include test features and/or external indicators of non-operationality but may still be left in place without needed maintenance or replacements.

(2) Deterioration as a possible or likely cumulative result of repeated impacts in normal use. Receptacle outlets receive repeated impacts from the insertion and removal of plugs. Some of these insertions or removals are rough enough to constitute abuse, but even normal use creates the potential for product deterioration over time.

(3) Products that, even though they may not deteriorate with age, no longer provide as much fire protection as alternative products now widely used. Age is indirectly related because it correlates with the degree of usage of these alternative products.
Circuit breakers and fuses are always cited as an example, but the FPRF study, like the NIST and CPSC studies, did not find a clear difference in performance between fuses and circuit breakers. All those studies tend to indicate that old fuses and old circuit breakers work well if not abused or misused. Fuses are easier to defeat through tampering, and this appears to be the key to any statistical difference in performance.

(4) Misuse of products, often products used because appropriate equipment is considered too costly, do not provide as much fire protection as appropriate products. Age is indirectly related because poor and other high-risk households are more likely to live in older homes.[4]
The principal example was the use of extension cords as permanent wiring instead of adding more outlets. There was also a general reference to the failure to replace worn-out electrical devices. At the same time, some problems – such as improper installation, poor product choices, and inadequate electrical capacity – can arise in new homes as easily as in older homes. For example, in 2009, the American Housing Survey asked whether fuses or circuit breakers had "blown" in the previous three months.[5] The overall average was 9% of households said yes. The response was the same for new construction (housing units no more than four years old) as for older housing.

Half (49%) of 2005-2009 reported U.S. home structure fires involving electrical failure or malfunction had some type of electrical distribution or lighting equipment as equipment involved in ignition.
The leading other types of equipment involved in ignition were washer or dryer (6%), fan (6%), portable or stationary space heater (4%), air conditioning equipment (4%), water heater (3%), and range (3%). See Table 1.2, which does not include confined fires. If confined fires were included, the share for ranges would be considerably larger.

Lamps, light bulbs, and light fixtures rank lower in Table 1.2 than they do on any list of all home fires by equipment involved in ignition. This is because the percentage of lamp, light fixture, or light bulb non-confined fires involving electrical failure or malfunction (37%) is much lower

[4] For example, in 2007, 50% of poor households lived in a housing unit built before 1970 compared to 44% of all households, and 37% of poor households lived in a housing unit built before 1960 compared to 32% of all households. (*American Housing Survey 2007*, U.S. Department of Commerce and U.S. Department of Housing and Urban Development, September 2008, Table 2-25.) The 2009 survey report did not include an update of this table.
[5] *American Housing Survey 2009*, U.S. Department of Commerce and U.S. Department of Housing and Urban Development, March 2011, Table 2-6.

than the corresponding percentages for transformers and power supplies (59%), for cords and plugs (75%), and for wiring and related equipment (86%). (These percentages are shown in tables in Sections 3-6 of this report.) For lamp, light fixture, or light bulb fires, the leading factor contributing to ignition is not a type of electrical failure but is heat source too close to combustible.

Tables 1.3 to 1.8 also exclude confined fires.

Nearly half (47%) of 2005-2009 non-confined home electrical fires (structure fires involving electrical failure or malfunction) began with ignition of products often found in concealed spaces – wire or cable insulation (31%) or structural member or framing (16%).
Other leading items first ignited were insulation within structural areas (7%), interior wall covering (6%), appliance housing or casing (5%), and exterior wall covering (4%). Leading items first ignited for fire deaths were wire or cable insulation (24%), structural member or framing (17%), upholstered furniture (9%), and interior wall covering (8%). (See Table 1.3.)

Half (53%) of 2005-2009 home electrical fire deaths resulted from fires that began in the principal occupiable spaces of the home – living room, family room, or den (22%), bedroom (20%), or kitchen (11%).
Leading areas of origin for non-confined fire incidents were bedroom (14%), attic or ceiling/roof assembly or concealed space (11%), kitchen (11%), wall assembly or concealed space (7%), and living room, family room or den (6%). (See Table 1.4.)

Most fatal victims (59%) of home electrical fires were not in the area of fire origin when injured.
The share outside the area of origin is higher than for fatal home fires in general (47%). (See Table 1.5 for victim location when fire began.)

Most (73%) fatal victims of home electrical fires were attempting to escape (39%) or sleeping (34%) when fatally injured.
Fatal victims of home electrical fires were more likely than victims of home fires in general to be attempting escape (39% vs. 35%) and less likely to be unable to act (9% vs. 11%) or acting irrationally (2% vs. 6%). (See Table 1.6.)

Home electrical fire deaths show a peak in the early morning hours (42% in midnight to 6 am) and in winter (44% in December through March). (See Tables 1.7 and 1.8.)

Other reports provide statistics on non-fire incidents and harm due to electricity.
See the following reports:

- Jennifer D. Flynn, *Non-Fire Electrical Wiring and Equipment Problem Incidents Reported to U.S. Fire Departments*, NFPA Fire Analysis and Research Division, Quincy, MA, August 2007 – Analyzes 316,000 reported 2003 incidents, such as power line down, that did not involve fire or rescue.
- Jennifer D. Flynn, *Non-Fire Electrical Rescue Incidents Reported to Fire Departments in 2003*, NFPA Fire Analysis and Research Division, Quincy, MA, August 2007 – Analyzes 2,800 reported incidents, including electrocutions and people trapped by power lines.

- John R. Hall, Jr., *Deaths and Injuries Due to Non-Fire Burns*, NFPA Fire Analysis and Research Division, Quincy, MA, March 2009 – Estimates 1991-2007 electrical burn injuries reported to U.S. hospital emergency rooms and 1980-2005 unintentional-injury deaths by electrical current, including deaths specifically attributable to electric transmission lines or to lightning.

Also of interest is the following:

- Robert Garrett and Susan B. Kyle, *An Evaluation of the U.S. Consumer Product Safety Commission's Electrocution Reduction Program*, CPSC Office of Planning and Evaluation, Bethesda, MD, November 2002.

Safety Tips

- Home electrical safety begins with NFPA 70, *National Electrical Code*® and related documents with special relevance to homes, notable NFPA 73, *Electrical Inspection Code for Existing Dwellings*. However, work on home electrical distribution or lighting equipment should only be conducted by someone qualified as an electrician. When you are buying, selling or remodeling a home, have it inspected by a professional electrician.

- Call a qualified electrician or landlord if you have
  - recurring problems with blowing fuses or tripping circuit breakers,
  - a tingling feeling when you touch an electrical appliance,
  - discolored or warm wall outlets,
  - a burning smell or rubbery odor coming from an appliance,
  - flickering lights,
  - sparks from an outlet,
  - cracked or broken outlets.

- Arc fault circuit interrupters (AFCIs) are a type of circuit breaker that shuts off electricity when a dangerous arcing condition occurs. Consider having them installed in your home. Use a qualified electrician.

Table 1.1. Home Fires Involving Electrical Failure or Malfunction as Factor Contributing to Ignition, by Year Structure Fires Reported to U.S. Fire Departments

Year	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions) As Reported		In 2009 Dollars	
1980	71,700		471		1,503		$426		$1,111	
1981	70,000		477		1,665		$409		$963	
1982	66,500		405		1,762		$450		$1,000	
1983	63,700		463		1,778		$530		$1,140	
1984	63,960		328		1,442		$551		$1,137	
1985	67,000		451		1,603		$603		$1,201	
1986	65,200		639		1,636		$600		$1,175	
1987	65,500		562		1,884		$616		$1,164	
1988	68,500		545		2,187		$745		$1,352	
1989	64,300		590		2,000		$693		$1,200	
1990	62,300		435		1,999		$737		$1,212	
1991	65,700		393		2,367		$981*		$1,545*	
1992	62,800		486		2,271		$727		$1,113	
1993	65,500		485		2,536		$936		$1,390	
1994	64,300		518		2,160		$835		$1,210	
1995	61,800		582		2,113		$867		$1,220	
1996	63,400		593		2,067		$1,031		$1,412	
1997	60,600		380		1,794		$980		$1,310	
1998	57,900		479		1,816		$943		$1,241	
1999	46,000	(44,300)	387	(387)	1,618	(1,618)	$917	($917)	$1,181	($1,180)
2000	49,200	(46,400)	348	(348)	1,673	(1,673)	$1,085	($1,082)	$1,353	($1,349)
2001	53,600	(49,200)	548	(548)	1,676	(1,635)	$1,237	($1,235)	$1,500	($1,497)
2002	54,300	(49,300)	278	(278)	1,286	(1,286)	$1,183	($1,181)	$1,411	($1,409)
2003	51,100	(45,200)	639	(639)	1,350	(1,349)	$1,283	($1,281)	$1,495	($1,492)
2004	52,500	(46,400)	614	(614)	1,501	(1,490)	$1,360	($1,357)	$1,543	($1,541)
2005	50,100	(44,500)	444	(444)	1,362	(1,345)	$1,530	($1,522)	$1,681	($1,672)
2006	50,500	(45,100)	333	(333)	1,367	(1,356)	$1,390	($1,389)	$1,480	($1,479)
2007	50,700	(45,500)	451	(451)	1,641	(1,633)	$1,228	($1,227)	$1,271	($1,270)
2008	49,400	(44,800)	519	(519)	1,351	(1,324)	$1,633	($1,632)	$1,626	($1,625)
2009	44,800	(39,500)	472	(472)	1,500	(1,471)	$1,644	($1,643)	$1,644	($1,643)

* All 1991 home fire property damage figures are inflated by estimation problems related to the handling of the Oakland fire storm.

Note: Figures in parentheses exclude confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Figures for 1980-1998 are based on ignition factor 54-55 and reflect a proportional share of home fires with ignition factor unknown, unreported, or blank. Figures for 1999 and later years reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for these years are highly uncertain and must be used with caution*. Inflation adjustment to 2009 dollars is done using the consumer price index.

Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey.

Table 1.2. Home Fires Involving Electrical Failure or Malfunction, by Equipment Involved in Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Equipment Involved in Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Electrical distribution or lighting equipment	21,300	(49%)	300	(68%)	661	(46%)	$834	(57%)
Unclassified wiring	6,800	(16%)	79	(18%)	161	(11%)	$247	(17%)
Outlet or receptacle	2,600	(6%)	21	(5%)	74	(5%)	$105	(7%)
Branch circuit wiring	2,100	(5%)	15	(4%)	43	(3%)	$100	(7%)
Extension cord	1,400	(3%)	82	(19%)	108	(8%)	$62	(4%)
Fuse or circuit breaker panel	1,400	(3%)	19	(4%)	24	(2%)	$41	(3%)
Service supply wiring from utility	700	(2%)	3	(1%)	22	(2%)	$25	(2%)
Unclassified lamp, light fixture or sign	600	(1%)	7	(2%)	9	(1%)	$24	(2%)
Meter or meter box	600	(1%)	4	(1%)	7	(1%)	$16	(1%)
Incandescent light fixture	600	(1%)	6	(1%)	11	(1%)	$18	(1%)
Wiring from meter box to circuit breaker	500	(1%)	3	(1%)	5	(0%)	$27	(2%)
Surge protector	500	(1%)	8	(2%)	18	(1%)	$22	(2%)
Permanently attached power cord or plug	500	(1%)	11	(3%)	29	(2%)	$15	(1%)
Unclassified cord or plug	400	(1%)	6	(1%)	29	(2%)	$22	(1%)
Electrical power (utility) line	400	(1%)	6	(1%)	12	(1%)	$13	(1%)
Table or floor lamp	400	(1%)	4	(1%)	20	(1%)	$17	(1%)
Detachable power cord or plug	300	(1%)	9	(2%)	20	(1%)	$11	(1%)
Fluorescent light fixture or ballast	300	(1%)	3	(1%)	14	(1%)	$13	(1%)
Wall switch	200	(1%)	0	(0%)	11	(1%)	$4	(0%)
Other known electrical distribution or lighting equipment	900	(2%)	11	(2%)	42	(3%)	$52	(4%)
Equipment other than electrical distribution or lighting equipment	20,100	(46%)	126	(29%)	702	(49%)	$543	(37%)
Washer or dryer	2,700	(6%)	0	(0%)	66	(5%)	$52	(4%)
Fan	2,700	(6%)	10	(2%)	79	(6%)	$79	(5%)
Portable or stationary space heater	1,800	(4%)	34	(8%)	69	(5%)	$58	(4%)
Air conditioning equipment	1,700	(4%)	3	(1%)	64	(4%)	$43	(3%)
Water heater	1,500	(3%)	0	(0%)	18	(1%)	$18	(1%)
Range	1,500	(3%)	12	(3%)	37	(3%)	$24	(2%)
Refrigerator, freezer or ice maker	1,000	(2%)	0	(0%)	35	(2%)	$36	(2%)
Entertainment equipment other than television	700	(2%)	0	(0%)	43	(3%)	$27	(2%)
Television	700	(2%)	0	(0%)	35	(2%)	$25	(2%)
Dishwasher	700	(1%)	0	(0%)	14	(1%)	$16	(1%)
Microwave oven	600	(1%)	0	(0%)	42	(3%)	$16	(1%)
Furnace or other central heating unit	600	(1%)	11	(3%)	19	(1%)	$9	(1%)
Computer or other office equipment	500	(1%)	0	(0%)	37	(3%)	$27	(2%)
Portable cooking or warming device	400	(1%)	3	(1%)	22	(2%)	$15	(1%)
Oven or rotisserie	400	(1%)	0	(0%)	2	(0%)	$3	(0%)

Table 1.2. Home Fires Involving Electrical Failure or Malfunction, by Equipment Involve in Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Equipment Involved in Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Other known equipment other than electrical distribution or lighting equipment	2,700	(6%)	52	(12%)	122	(9%)	$96	(7%)
No equipment involved	2,000	(5%)	0	(0%)	35	(2%)	$81	(5%)
Unclassified equipment involved in ignition	**500**	**(1%)**	**6**	**(1%)**	**28**	**(2%)**	**$16**	**(1%)**
Total	43,900	(100%)	438	(100%)	1,426	(100%)	$1,474	(100%)

Note: Figures *exclude* confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank. Figures reflect a proportional share of home fires with factor contributing to ignition coded as electrical failure or malfunction and equipment involved with ignition shown as unknown or blank or as "no equipment" without a confirming heat source (codes 40-99 under heat source), with allocations done separately for non-confined and confined fires. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 1.3. Home Fires Involving Electrical Failure or Malfunction, by Item First Ignited
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	13,390	(31%)	103	(24%)	390	(27%)	$344	(23%)
Structural member or framing	7,020	(16%)	75	(17%)	148	(10%)	$330	(22%)
Insulation within structural area	2,880	(7%)	7	(2%)	37	(3%)	$77	(5%)
Interior wall covering	2,650	(6%)	36	(8%)	88	(6%)	$99	(7%)
Appliance housing or casing	2,130	(5%)	13	(3%)	88	(6%)	$45	(3%)
Exterior wall covering	1,910	(4%)	9	(2%)	26	(2%)	$58	(4%)
Unclassified item	1,840	(4%)	9	(2%)	39	(3%)	$42	(3%)
Unclassified structural component or finish	1,650	(4%)	20	(4%)	45	(3%)	$75	(5%)
Mattress or bedding	1,180	(3%)	19	(4%)	121	(8%)	$42	(3%)
Ceiling covering	1,110	(3%)	6	(1%)	17	(1%)	$40	(3%)
Floor covering	990	(2%)	28	(6%)	47	(3%)	$34	(2%)
Unclassified furniture or utensil	840	(2%)	9	(2%)	41	(3%)	$39	(3%)
Clothing	750	(2%)	3	(1%)	34	(2%)	$23	(2%)
Upholstered furniture	750	(2%)	41	(9%)	92	(6%)	$42	(3%)
Cabinetry	750	(2%)	14	(3%)	32	(2%)	$30	(2%)
Multiple items first ignited	560	(1%)	6	(1%)	29	(2%)	$34	(2%)
Unclassified soft goods or clothing	390	(1%)	4	(1%)	22	(2%)	$11	(1%)
Curtain or drape	260	(1%)	4	(1%)	27	(2%)	$11	(1%)
Exterior roof covering	230	(1%)	0	(0%)	2	(0%)	$11	(1%)
Other known item first ignited	2,590	(6%)	0	(7%)	102	(7%)	$86	(6%)
Total fires	43,870	(100%)	438	(100%)	1,426	(100%)	$1,474	(100%)

Note: Figures exclude confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank. Figures reflect a proportional share of home fires with factor contributing to ignition coded as electrical failure or malfunction and item first ignited shown as unknown or blank, with allocations done separately for non-confined and confined fires. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 1.4. Home Fires Involving Electrical Failure or Malfunction, by Area of Origin
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	6,250	(14%)	89	(20%)	403	(28%)	$236	(16%)
Attic or ceiling/roof assembly or concealed space	4,960	(11%)	8	(2%)	61	(4%)	$167	(11%)
Kitchen	4,910	(11%)	49	(11%)	141	(10%)	$134	(9%)
Wall assembly or concealed space	3,270	(7%)	30	(7%)	66	(5%)	$105	(7%)
Living room, family room, or den	2,710	(6%)	98	(22%)	196	(14%)	$122	(8%)
Laundry room or area	2,350	(5%)	14	(3%)	56	(4%)	$54	(4%)
Bathroom	1,940	(4%)	3	(1%)	47	(3%)	$40	(3%)
Unclassified function area	1,860	(4%)	41	(9%)	109	(8%)	$71	(5%)
Crawl space or substructure space	1,650	(4%)	19	(4%)	39	(3%)	$57	(4%)
Exterior wall surface	1,620	(4%)	5	(1%)	25	(2%)	$32	(2%)
Ceiling/floor assembly or concealed space	1,600	(4%)	26	(6%)	29	(2%)	$63	(4%)
Garage*	1,560	(4%)	4	(1%)	66	(5%)	$95	(6%)
Unclassified area of origin	910	(2%)	3	(1%)	10	(1%)	$24	(2%)
Heating equipment room or area	910	(2%)	4	(1%)	21	(1%)	$18	(1%)
Unclassified structural area	900	(2%)	16	(4%)	14	(1%)	$40	(3%)
Closet	750	(2%)	2	(0%)	18	(1%)	$23	(2%)
Unclassified storage area	570	(1%)	0	(0%)	10	(1%)	$17	(1%)
Unclassified equipment or service area	460	(1%)	3	(1%)	5	(0%)	$8	(1%)
Duct for cable, exhaust, heating, or air conditioning	420	(1%)	0	(0%)	9	(1%)	$6	(0%)
Exterior balcony or unenclosed porch	410	(1%)	4	(1%)	12	(1%)	$21	(1%)
Unclassified outside area	380	(1%)	0	(0%)	4	(0%)	$6	(0%)
Conduit, pipe, utility, or ventilation shaft	330	(1%)	0	(0%)	0	(0%)	$5	(0%)
Lobby or entrance way	310	(1%)	4	(1%)	6	(0%)	$11	(1%)
Storage room, area, tank, or bin	280	(1%)	0	(0%)	10	(1%)	$10	(1%)
Hallway or corridor	230	(1%)	3	(1%)	10	(1%)	$5	(0%)
Office	220	(1%)	2	(1%)	8	(1%)	$14	(1%)
Other known area of origin	2,090	(5%)	10	(2%)	50	(4%)	$87	(6%)
Total fires	43,870	(100%)	438	(100%)	1,426	(100%)	$1,474	(100%)

* Excludes garage reported as separate property.

Note: Figures exclude confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank. Figures reflect a proportional share of home fires with factor contributing to ignition coded as electrical failure or malfunction and area of origin shown as unknown or blank, with allocations done separately for non-confined and confined fires Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 1.5. Civilian Deaths and Injuries in Home Fires Involving Electrical Failure or Malfunction, vs. All Home Fires, by Victim Location
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

	Home Electrical Fires				All Home Fires	
A. Victim Location When Injured	**Civilian Deaths**		**Civilian Injuries**		**Civilian Deaths**	**Civilian Injuries**
In area of origin	180	(41%)	748	(52%)	53%	66%
Not in area of origin but in building of origin	250	(57%)	545	(38%)	46%	28%
Not in building of origin	9	(2%)	133	(9%)	1%	6%
Total	438	(100%)	1,426	(100%)	100%	100%

	Home Electrical Fires				All Home Fires	
B. Victim Location at Ignition	**Civilian Deaths**		**Civilian Injuries**		**Civilian Deaths**	**Civilian Injuries**
In area of origin and not involved	82	(19%)	369	(26%)	2%	24%
Not in area of origin and not involved	170	(39%)	453	(32%)	21%	24%
Not in area of origin but involved	88	(20%)	258	(18%)	39%	14%
In area of origin and involved	98	(22%)	346	(24%)	39%	38%
In area of origin	180	(41%)	716	(50%)	40%	25%
Not in area of origin	258	(59%)	711	(50%)	60%	75%
Involved in ignition	186	(42%)	604	(42%)	78%	63%
Not involved in ignition	252	(58%)	822	(58%)	22%	27%
Total	438	(100%)	1,426	(100%)	100%	100%

Note: Figures exclude confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are rounded to the nearest one. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank. Figures reflect a proportional share of home fires with factor contributing to ignition coded as electrical failure or malfunction and victim location at ignition unknown or blank, with allocations done separately for non-confined and confined fires Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 1.6. Civilian Deaths and Injuries in Home Fires Involving Electrical Failure or Malfunction, vs. All Home Fires, by Victim Activity When Injured
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

	Home Electrical Fires				All Home Fires	
Activity	Civilian Deaths		Civilian Injuries		Civilian Deaths	Civilian Injuries
Attempting to escape	169	(39%)	472	(33%)	35%	25%
Sleeping	149	(34%)	178	(12%)	35%	12%
Unable to act	41	(9%)	25	(2%)	11%	2%
Attempting to fight fire	30	(7%)	389	(27%)	3%	36%
Returning to vicinity of fire	16	(4%)	121	(9%)	3%	7%
Attempting rescue	15	(3%)	126	(9%)	2%	7%
Irrational act	11	(2%)	11	(1%)	6%	3%
Unclassified activity	8	(2%)	93	(7%)	5%	8%
Total	438	(100%)	1,426	(100%)	100%	100%

Note: Figures exclude confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are rounded to the nearest one. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank. Figures include a proportional share of home fires with factor contributing to ignition coded as electrical failure or malfunction and victim activity unknown or blank, with allocations done separately for non-confined and confined fires. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 1.7. Home Fires Involving Electrical Failure or Malfunction, by Time of Day
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Time	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Midnight – 1:59 am	2,890	(7%)	60	(14%)	126	(9%)	$116	(8%)
2:00 – 3:59 am	2,510	(6%)	61	(14%)	135	(9%)	$120	(8%)
4:00 – 5:59 am	2,260	(5%)	61	(14%)	133	(9%)	$93	(6%)
6:00 – 7:59 am	2,730	(6%)	47	(11%)	124	(9%)	$92	(6%)
8:00 – 9:59 am	3,350	(8%)	28	(6%)	107	(7%)	$108	(7%)
10:00 – 11:59 am	3,910	(9%)	19	(4%)	121	(9%)	$132	(9%)
Noon – 1:59 am	4,320	(10%)	31	(7%)	121	(9%)	$145	(10%)
2:00 – 3:59 pm	4,430	(10%)	22	(5%)	110	(8%)	$146	(10%)
4:00 – 5:59 pm	4,710	(11%)	15	(3%)	106	(7%)	$145	(10%)
6:00 – 7:59 pm	4,810	(11%)	32	(7%)	126	(9%)	$135	(9%)
8:00 – 9:59 pm	4,420	(10%)	20	(5%)	99	(7%)	$130	(9%)
10:00 – 11:59 pm	3,550	(8%)	41	(9%)	118	(8%)	$113	(8%)
Total	43,870	(100%)	438	(100%)	1,426	(100%)	$1,474	(100%)

Note: Figures exclude confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank, with allocations done separately for non-confined and confined fires. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 1.8. Home Fires Involving Electrical Failure or Malfunction, by Month
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Month	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
January	4,640	(11%)	47	(11%)	159	(11%)	$156	(11%)
February	3,770	(9%)	38	(9%)	136	(10%)	$125	(9%)
March	3,730	(9%)	54	(12%)	129	(9%)	$139	(9%)
April	3,230	(7%)	25	(6%)	109	(8%)	$117	(8%)
May	3,100	(7%)	36	(8%)	98	(7%)	$106	(7%)
June	3,440	(8%)	21	(5%)	120	(8%)	$130	(9%)
July	3,710	(8%)	27	(6%)	104	(7%)	$123	(8%)
August	3,440	(8%)	35	(8%)	105	(7%)	$98	(7%)
September	2,990	(7%)	17	(4%)	90	(6%)	$99	(7%)
October	3,320	(8%)	40	(9%)	108	(8%)	$107	(7%)
November	3,660	(8%)	46	(10%)	108	(8%)	$114	(8%)
December	4,850	(11%)	52	(12%)	160	(11%)	$160	(11%)
Total	43,870	(100%)	438	(100%)	1,426	(100%)	$1,474	(100%)

Note: Figures exclude confined fires which are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Figures reflect a proportional share of home fires with factor contributing to ignition listed as unknown, unreported, none, or blank, with allocations done separately for non-confined and confined fires. Totals may not equal sums because of rounding error.

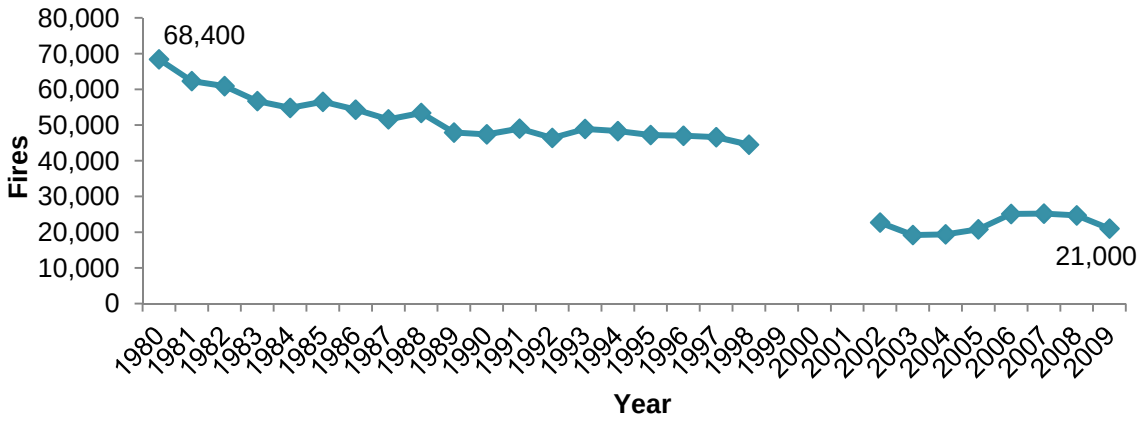
Source: Data from NFIRS Version 5.0 and NFPA survey.

Section 2. Electrical Distribution or Lighting Equipment

In 2009, an estimated 21,000 reported U.S. non-confined home structure fires involving electrical distribution or lighting equipment resulted in 320 civilian deaths, 1,000 civilian injuries, and $935 million in direct property damage.
As with other types of equipment cited as equipment involved in ignition, all that we know from this designation is that the equipment provided the heat leading to ignition. That does not mean that there was electrical or any other type of failure or malfunction. For example, a hot light bulb might have been too close to combustibles.

Electrical distribution or lighting equipment accounted for 6% of 2005-2009 home structure fires, ranking fourth among major causes behind cooking equipment, heating equipment, and intentional. Electrical distribution or lighting equipment also accounted for 15% of associated civilian deaths (ranking behind smoking materials and heating equipment, and tied with cooking equipment), 8% of associated civilian injuries (ranking fifth), and 12% of associated direct property damage (ranking third).

Figure 2.1. Home Fires Involving Electrical Distribution or Lighting Equipment, by Year Structure Fires Reported to U.S. Fire Departments



Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey. Note: See Note in Table 2.1.

The national estimates in this report are derived from data reported to the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS). Fires declined by about one-third from 1980 to 1998. (See Figure 2.2 and Table 2.1.) Version 5.0 of NFIRS, introduced in 1999, contained numerous changes in data categories, definitions, and rules. After the transition period of 1999-2001, when Version 5.0 of the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) was being phased in, the estimates settled into a level about one-half lower than the levels of the late 1990s, a larger decline than would have been expected if the 1980-1998 trend had continued unchanged. Associated losses also showed large declines coinciding with the shift to NFIRS Version 5.0.

NFIRS Version 5.0 introduced six types of "confined fires" – fires confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor – for which

detailed reporting is not required. Estimates of detailed characteristics for confined fires involve a large share of unknowns and so involve less confidence. In 2005-2009, an average of 400 home structure confined fires per year involved electrical distribution or lightning equipment. They add only 1.8% to non-confined fires and less than 1.0% to any measure of associated loss. Therefore, no analyses in this section include confined fires.

The report is organized around four major sub-groups of electrical distribution or lighting equipment:

- Wiring and related equipment from power supply to outlet or switch. The following types of equipment are included:
  - Wiring
  - Meters and meter boxes
  - Overcurrent protection equipment
  - Outlets, receptacles, and switches
- Lamps, light fixtures, light bulbs, and signs
- Cords and plugs
- Transformers and power supplies, including surge protectors

There are also two minor equipment groups, which account for too few fires to support more detailed analysis:

- Electric fences
- Lightning rods and lightning arresters (normally called surge arresters)

Table 2.A. Home Fires Involving Electrical Distribution or Lighting Equipment, by Major Equipment Group
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments
(Excluding Fires Reported as Confined Fires)

Major Equipment Group	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wiring and related equipment	14,320	(61%)	186	(47%)	389	(40%)	$463	(56%)
Lamps, light fixtures, and light bulbs	5,000	(21%)	57	(15%)	254	(26%)	$199	(24%)
Cords and plugs	2,710	(12%)	134	(34%)	228	(24%)	$100	(12%)
Transformers and power supplies	1,360	(6%)	15	(4%)	95	(10%)	$59	(7%)
Electric fences	10	(0%)	0	(0%)	1	(0%)	$1	(0%)
Lightning rods and arresters	10	(0%)	0	(0%)	0	(0%)	$0	(0%)
Total	23,420	(100%)	392	(100%)	967	(100%)	$822	(100%)

Note: Figures exclude fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Totals may not equal sums because of rounding error.

Source: Data from NFIRS and NFPA survey.

Wiring and related equipment accounted for most (61%) 2005-2009 home structure fires involving electrical distribution or lighting equipment.
See Table 2.A. Lamps, light fixtures, and signs accounted for 21% of these fires. Cords and plugs accounted for only 12% of the fires but for 34% of associated deaths (and 24% of injuries), compared to 47% of deaths associated with wiring and related equipment.

Nearly three-fourths (73%) of 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment cited factors contributing to ignition that are electrical failures or malfunctions.
Leading mechanical or electrical factors with specific detail include short circuit arc from defective or worn insulation (10% of fires), arc from faulty contact or broken conductor (4%), and short circuit arc from mechanical damage (3%). (See Table 2.2.)

The majority of 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment began with ignition of products and materials often found in structural areas, including wire or cable insulation (31%), structural member or framing (15%), insulation within structural area (6%), and exterior wall covering (5%).
Leading items first ignited for fire deaths involving these types of equipment were wire or cable insulation (25%), upholstered furniture (12%), structural member or framing (8%), mattress or bedding (8%), floor covering (5%), and unclassified furniture or utensil (5%). (See Table 2.3.)

One-third (31%) of deaths in 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment resulted from fires that began in a living room, family room, or den.
Leading areas of origin for fire incidents include both those identified with specific living areas – e.g., bedroom (18%), living room, family room, or den (9%), kitchen (6%), and unclassified function area (4%) – and those identified as structural or exterior areas – e.g., attic or ceiling/roof assembly or concealed space (10%), wall assembly or concealed space (8%), exterior wall surface (5%), ceiling/floor assembly or concealed space (4%), crawl space or substructure space (4%), and garage (4%). (See Table 2.4.)

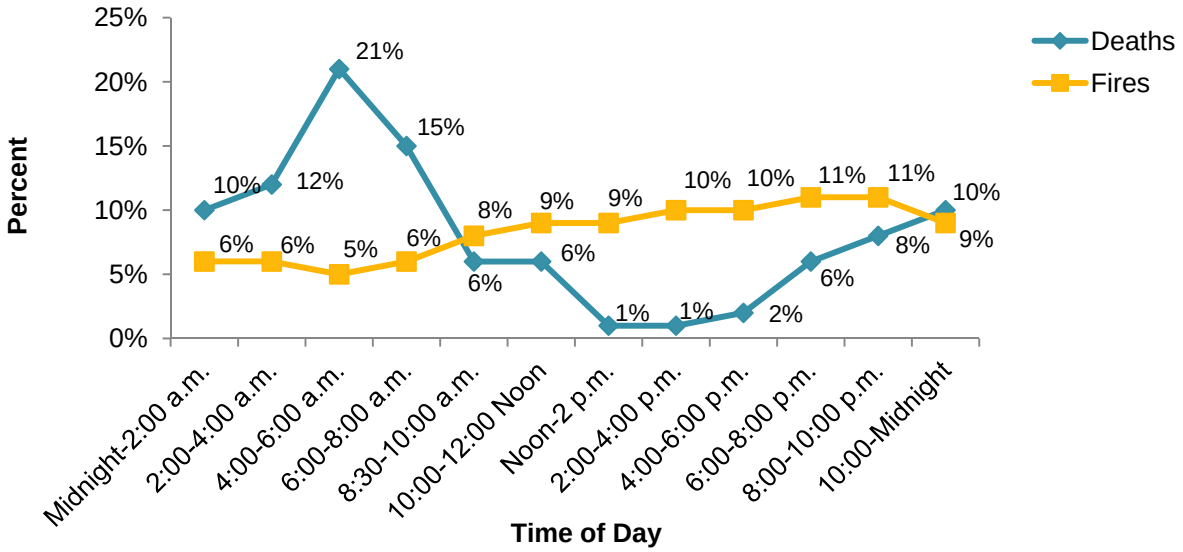
Three out of five (60%) deaths in 2005-2009 home structure non-confined fires involving electrical distribution or lighting equipment involved victims who were outside the area of origin when injured.
This compares to 46% of the fatal victims being outside the area of origin when injured for all home structure fire deaths. Table 2.5 provides details on victim location when injured and when fire began.[6]

Table 2.6 provides an overview of victim activity when injured. Relative to all 2005-2009 home structure fire deaths, the fatal victims of 2005-2009 home structure fires involving electrical distribution or lighting equipment were more likely to be attempting to escape (41% vs. 35%), more likely to be attempting to fight the fire (9% vs. 3%), and less likely to have been sleeping (30% vs. 35%).

[6] For more information on victim characteristics for home fires in general, see Jennifer D. Flynn, *Characteristics of Home Fire Victims*, NFPA Fire Analysis and Research Division, March 2010.

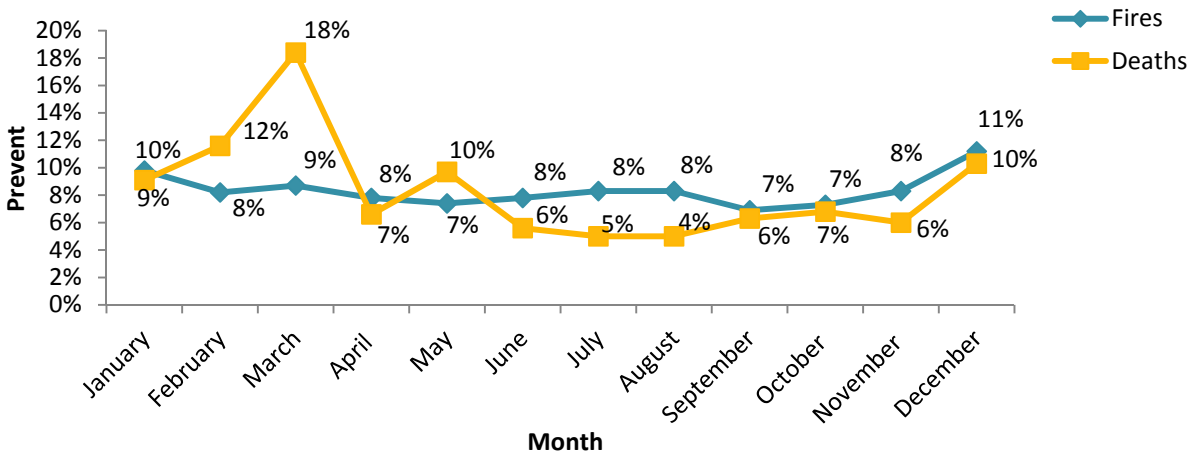
This is despite the fact that 2005-2009 home structure fire deaths involving electrical distribution or lighting equipment show the same kind of night time peak as do 2005-2009 home structure fire deaths of all causes. (See Figure 2.2 and Table 2.7.)

Figure 2.2. Non-Confined Home Fires and Deaths Involving Electrical Distribution or Lighting Equipment, by Time of Day, 2005-2009



Source: Data from NFIRS Version 5.0 and NFPA survey. Note: See Note on Table 2.8.

Figure 2.3. Non-Confined Home Fires and Deaths Involving Electrical Distribution or Lighting Equipment, by Month, 2005-2009



Source: Data from NFIRS Version 5.0 and NFPA survey. Note: See Note on Table 2.9.

Home structure fires involving electrical distribution or lighting equipment, in 2005-2009, showed a winter peak similar to that for heating equipment but less pronounced.
Figure 2.3 and Table 2.8 show this pattern. Note that in winter, not only are the days and nights colder, but also more of the day is dark. A longer period of time requiring lighting each day, combined with increased demands from heating equipment, some of which are electric-powered, all help to explain this peak.

Electrical distribution and lighting equipment dwelling fires have been shown to increase in frequency with increasing dwelling age.[7]
When studies show higher fire risk generally for older homes, it is usually because the studies have not controlled for the risk levels associated with occupants. Statistically, older homes have a higher proportion of occupants who are poor or have other risk factors. NFPA's annual study of variations in state fire death rates is one of the few studies of risk factors where the statistical link between older homes and higher-risk occupants is broken.[8] This is because several states (like Vermont and Connecticut) have large shares of older, expensive homes with affluent occupants. In that study, age of housing has a small or no statistical correlation with fire death risk. See a more extended and detailed discussion about the age of home and its electrical system vs. fire risks in the electrical failure or malfunction section of this report.

In 1999 to 2010, 589 people died of non-fire injuries from unvented carbon monoxide from generators, or 49 deaths per year.[9]
Fueled equipment to generate electricity is the only type of electrical distribution or lighting equipment that can produce carbon monoxide. (Fueled lighting devices are not included in the scope of this report.)

The death toll from carbon monoxide produced by generators has increased sharply in recent years until 2007, from less than 10 per year on average in 1999 and prior years to 19 per year in 2000-2001, 47 per year in 2002-2004, peaking at 89 per year in 2005-2006, then falling to 52 per year in 2007-2009, and down to 29 in 2010.

The large jump in deaths involving generators in 2000 may reflect the fact that roughly half the total generators in use in 2000 had been purchased in 1999 because of concerns over Y2K (year 2000) problems with the nation's power grid.[10] This meant a large number of generator users had no experience in safe generator use. Disasters like Hurricane Katrina and a series of Florida hurricanes have added to the demand for generators and probably added to the number of inexperienced users.

The U.S. Consumer Product Safety Commission examined the circumstances of the 591 non-fire carbon monoxide generator deaths (including two deaths where other equipment was being used as a generator) in 1999-2010. One-eighth (76 deaths) occurred in temporary shelters.

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[7] Linda E. Smith and Dennis McCoskrie, "What causes wiring fires in residences?" *Fire Journal*, January/February 1990, Volume 84, Number 1. The title cites wiring, but the study includes the other major types of electrical distribution and lighting equipment.
[8] John R. Hall, Jr., *U.S. Unintentional Fire Death Rates, by State*, NFPA Fire Analysis and Research Division, Quincy, MA, October 2011.
[9] Matthew V. Hnatov, *Incidents, deaths and in-depth investigations associated with non-fire carbon monoxide from engine-driven generators and other engine-driven tools, 1999-2010*, U.S. Consumer Product Safety Commission, July 2011, accessed at www.cpsc.gov.
[10] *Portable Generators*, U.S. Consumer Product Safety Commission, May 20, 2004, accessed at www.cpsc.gov.

Of the 503 deaths where the reason for generator use was known:

- 35% involved generator usage because of a weather-related power outage (34%) or because of preparation for a coming storm (1%),
- 34% involved generator usage because power had been shut off because of non-payment (21%) or because power had not been turned on in a building still under construction (13%),
- 27% involved generator use in either a building that does normally have power (8%) or a property separate from the main housing unit (20%), such as a storage shed, trailer, boat, camper, cabin, or campsite, and
- 4% involved generator use in a power outage due to unknown reasons.

In 2003-2007, eight types of electrical distribution or lighting equipment accounted for an average of 13.8 electrocution deaths per year.[11]
Two types of lighting equipment averaged 4.8 electrocution deaths. Two types of cords averaged 3.8 electrocution deaths. Three types of wiring averaged 3.6 electrocution deaths per year. Electric fences averaged 1.6 deaths.

In 2010, an estimated 78,130 injuries involving electrical distribution or lighting equipment were reported to hospital emergency rooms.[12]
Half of these injuries involved lamps, light fixtures, or light bulbs. See Table 2.B. Note that thermal burns can result from contact with hot objects as well as from fires.

Of the equipment groups identified in fire incident data, meters and meter boxes, transformers, and electric fences do not appear to be identified separately in the coding of products involved in hospital emergency room injuries. The injuries reported under the transformer and power supplies category specifically involved batteries (86%), generators (11%), and battery chargers (3%).

Table 2.B. Injuries Involving Electrical Distribution or Lighting Equipment, Reported to Hospital Emergency Rooms, 2010

Equipment	Type of Injury							
	Total		Laceration		Contusion or Abrasion		Thermal Burn	
Lamps, light fixtures, and light bulbs	39,220	(50%)	17,950	(77%)	5,560	(50%)	2,400	(89%)
Transformers and power supplies	14,990	(19%)	990	(4%)	1,430	(13%)	220	(8%)
Cords and plugs	14,180	(18%)	1,860	(8%)	3,300	(30%)	80	(3%)
Wiring and related equipment	9,530	(12%)	2,620	(11%)	790	(7%)	10	(0%)
Lightning rods and arresters	210	(0%)	0	(0%)	10	(0%)	0	(0%)
Total electrical distribution and lighting equipment	78,130	(100%)	23,410	(100%)	11,090	(100%)	2,700	(100%)

Source: CPSC's National Electronic Injury Surveillance System.

[11] Matthew V. Hnatov, 2007 *Electrocutions Associated with Consumer Products*, U.S. Consumer Product Safety Commission, November 2010, accessed at www.cpsc.gov.
[12] "Statistics from National Electronic Injury Surveillance System (NEISS) data obtained from the U.S. Consumer Product Safety Commission (CPSC) website, www.cpsc.gov.

Safety Tips

- Home electrical safety begins with NFPA 70, *National Electrical Code*® and related documents with special relevance to homes, notably NFPA 73, *Electrical Inspection Code for Existing Dwellings*. However, work on home electrical distribution or lighting equipment should only be conducted by someone qualified as an electrician. When you are buying, selling or remodeling a home, have it inspected by a professional electrician.

- Call a qualified electrician or landlord if you have
  - recurring problems with blowing fuses or tripping circuit breakers,
  - a tingling feeling when you touch an electrical appliance,
  - discolored or warm wall outlets,
  - a burning smell or rubbery odor coming from an appliance,
  - flickering lights,
  - sparks from an outlet,
  - cracked or broken outlets.

- Keep lamps, light fixtures, and light bulbs away from anything that can burn, including lamp shades, furniture, bedding, curtains, clothing, and flammable or combustible gases and liquids.
- Never place clothing over a lamp or a cloth over a light bulb.
- Place lamps away from where people and pets walk or where things might fall against them.
- Use light bulbs that match the recommended wattage on the lamp or fixture.

- If a fuse blows or a circuit breaker trips often, find out why and correct the problem.
- Replace fuses with the proper rating for the circuit they protect.
- Never replace a fuse with a higher rated fuse.
- If the problem continues, call an electrician.

- Only plug one heat-producing appliance (such as a coffee maker, toaster, space heater, etc.) into a receptacle outlet at a time.
- Never plug a major appliance into an extension cord.
- Buy only appliances that have the label of a recognized testing laboratory.
- Replace cracked electrical cords. If you have older cords with cloth covering, check for fraying as well, and replace any frayed cords.
- Pinching cords against walls or furniture or running them under carpets or across doorways can cause a fire.
- Use extension cords for temporary wiring only.
- Consider having additional circuits or receptacles added by a qualified electrician.
- Receptacle outlets and switches should have wall plates to prevent shocks.
- Homes with young children should have tamper-resistant electrical receptacles.

- If an appliance is malfunctioning, unplug it if it is safe to do so. If necessary, cut off power by unscrewing a fuse or turning off the circuit breaker.

- Arc fault circuit interrupters (AFCIs) are a type of circuit breaker that shuts off electricity when a dangerous arcing condition occurs. Consider having them installed in your home. Use a qualified electrician.
- Ground fault circuit interrupters (GFCIs) reduce the risk of shock.
- Test AFCIs and GFCIs once a month to make sure they are working properly.

- Keep ladders at least 10 feet away from overhead power lines including the electrical service into your home.
- Never touch a power line. Stay at a safe distance – you could be electrocuted.
- Report downed power lines to authorities.
- Some power lines are underground. Call your local utility before digging.

Table 2.1. Home Fires Involving Electrical Distribution or Lighting Equipment, by Year
Structure Fires Reported to U.S. Fire Departments
(Excluding Fires Reported as Confined Fires)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions) As Reported	In 2009 Dollars
1980	68,400	520	1,650	$493	$1,286
1981	62,300	550	1,500	$459	$1,082
1982	60,900	410	1,820	$519	$1,153
1983	56,700	500	1,570	$548	$1,180
1984	54,800	440	1,520	$549	$1,132
1985	56,500	470	1,400	$720	$1,435
1986	54,300	720	1,420	$597	$1,170
1987	51,600	520	1,580	$512	$967
1988	53,400	440	1,720	$715	$1,298
1989	47,900	610	1,500	$642	$1,112
1990	47,400	440	1,540	$683	$1,123
1991	49,000	350	1,890	$958*	$1,508*
1992	46,400	400	1,770	$617	$944
1993	48,900	420	1,900	$818	$1,215
1994	48,300	460	1,640	$714	$1,034
1995	47,200	490	1,650	$775	$1,091
1996	47,000	470	1,560	$839	$1,149
1997	46,600	350	1,580	$865	$1,156
1998	44,500	360	1,370	$843	$1,111
1999	34,800	180	530	$806	$1,038
2000	26,600	120	1,130	$631	$786
2001	26,200	440	1,030	$717	$869
2002	22,700	170	700	$593	$708
2003	19,200	320	600	$698	$815
2004	19,400	290	840	$623	$708
2005	20,800	500	1,060	$858	$943
2006	25,100	370	840	$776	$826
2007	25,200	270	1,050	$663	$685
2008	24,700	510	880	$964	$960
2009	21,000	320	1,000	$935	$935

* All 1991 home fire property damage figures are inflated by estimation problems related to the handling of the Oakland fire storm.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten, and property damage is rounded to the nearest million dollars. *Fires, deaths, and injuries are rounded more on this table than on any other in the report, because otherwise, most of the entries shown would have four significant places, and that would suggest an unreasonably high degree of precision*. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or reported as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution*. Inflation adjustment to 2009 dollars is done using the consumer price index.
Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey.

Table 2.2. Home Fires Involving Electrical Distribution or Lighting Equipment, by Factor Contributing to Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	6,980	(30%)	99	(25%)	229	(24%)	$293	(36%)
Unspecified short circuit arc	5,790	(25%)	83	(21%)	211	(22%)	$215	(26%)
Short circuit arc from defective or worn insulation	2,410	(10%)	49	(13%)	99	(10%)	$57	(7%)
Heat source too close to combustibles	2,110	(9%)	11	(3%)	126	(13%)	$80	(10%)
Arc from faulty contact or broken conductor	1,000	(4%)	8	(2%)	40	(4%)	$28	(3%)
Equipment overloaded	820	(3%)	26	(7%)	52	(5%)	$28	(3%)
Unclassified mechanical failure or malfunction	730	(3%)	11	(3%)	28	(3%)	$22	(3%)
Short circuit arc from mechanical damage	680	(3%)	40	(10%)	22	(2%)	$21	(3%)
Arc or spark from operating equipment	560	(2%)	9	(2%)	36	(4%)	$26	(3%)
Unclassified misuse of material	470	(2%)	9	(2%)	39	(4%)	$16	(2%)
Installation deficiency	410	(2%)	21	(5%)	20	(2%)	$19	(2%)
Worn out	360	(2%)	4	(1%)	16	(2%)	$8	(1%)
Unclassified factor	310	(1%)	20	(5%)	7	(1%)	$16	(2%)
Equipment unattended	280	(1%)	3	(1%)	15	(2%)	$17	(2%)
Storm	280	(1%)	3	(1%)	6	(1%)	$11	(1%)
Water caused short circuit arc	270	(1%)	0	(0%)	7	(1%)	$7	(1%)
Collision, knockdown, or turnover	230	(1%)	6	(2%)	26	(3%)	$8	(1%)
Unintentionally turned on or not turned off	170	(1%)	0	(0%)	6	(1%)	$7	(1%)
Animal	170	(1%)	0	(0%)	3	(0%)	$3	(0%)
Equipment not being operated properly	160	(1%)	6	(2%)	11	(1%)	$9	(1%)
High wind	130	(1%)	0	(0%)	3	(0%)	$7	(1%)
Fluorescent light ballast	130	(1%)	0	(0%)	3	(0%)	$3	(0%)
Unclassified operational deficiency	130	(1%)	0	(0%)	10	(1%)	$4	(0%)
Other known factor contributing to ignition	930	(4%)	40	(10%)	73	(8%)	$35	(4%)
Total fires	23,420	(100%)	392	(100%)	967	(100%)	$822	(100%)
Total factor entries	25,480	(109%)	447	(114%)	1,091	(113%)	$937	(114%)
All electrical failures or malfunction	17,180	(73%)	277	(71%)	615	(64%)	$615	(75%)

* The leading factor contributing to ignition for fire deaths not shown above is construction deficiency (7% of deaths).

Note: Multiple entries are allowed, resulting in more factor entries than fires. Figures exclude combined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as “no equipment” but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and factor contributing to ignition listed as unknown, unreported, none, or blank have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5. and NFPA survey.

Table 2.3. Home Fires Involving Electrical Distribution or Lighting Equipment, by Item First Ignited
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	7,380	(31%)	98	(25%)	255	(26%)	$189	(23%)
Structural member or framing	3,580	(15%)	33	(8%)	78	(8%)	$174	(21%)
Insulation within structural area	1,360	(6%)	13	(3%)	11	(1%)	$30	(4%)
Exterior wall covering	1,190	(5%)	6	(1%)	23	(2%)	$60	(7%)
Interior wall covering	1,030	(4%)	18	(5%)	45	(5%)	$33	(4%)
Mattress or bedding	960	(4%)	30	(8%)	79	(8%)	$35	(4%)
Unclassified item first ignited	770	(3%)	3	(1%)	18	(2%)	$24	(3%)
Clothing	750	(3%)	3	(1%)	48	(5%)	$24	(3%)
Unclassified structural component or finish	740	(3%)	18	(5%)	13	(1%)	$21	(3%)
Floor covering	680	(3%)	20	(5%)	38	(4%)	$25	(3%)
Upholstered furniture	520	(2%)	49	(12%)	75	(8%)	$28	(3%)
Ceiling covering	460	(2%)	5	(1%)	16	(2%)	$19	(2%)
Appliance housing or casing	440	(2%)	0	(0%)	13	(1%)	$12	(1%)
Unclassified furniture or utensil	430	(2%)	20	(5%)	22	(2%)	$18	(2%)
Cabinetry	290	(1%)	5	(1%)	19	(2%)	$13	(2%)
Multiple items first ignited	280	(1%)	3	(1%)	22	(2%)	$15	(2%)
Unclassified soft goods or clothing	270	(1%)	3	(1%)	28	(3%)	$9	(1%)
Curtain or drape	220	(1%)	3	(1%)	12	(1%)	$10	(1%)
Linen other than bedding	190	(1%)	5	(1%)	12	(1%)	$3	(0%)
Flammable or combustible gas or liquid	180	(1%)	16	(4%)	48	(5%)	$9	(1%)
Light vegetation including grass	180	(1%)	0	(0%)	0	(0%)	$7	(1%)
Box or bag	170	(1%)	3	(1%)	21	(2%)	$12	(1%)
Papers	150	(1%)	3	(1%)	15	(2%)	$8	(1%)
Exterior roof covering	130	(1%)	0	(0%)	0	(0%)	$6	(1%)
Other known item	1,090	(5%)	36	(9%)*	57	(6%)	$39	(5%)
Total fires	23,420	(100%)	392	(100%)	967	(100%)	$822	(100%)

* The leading item first ignited for fire deaths not shown above is Christmas tree (6% of deaths).

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and item first ignited unknown have also been allocated proportionally. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 2.4. Home Fires Involving Electrical Distribution or Lighting Equipment, by Area of Origin
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	4,310	(18%)	75	(19%)	283	(29%)	$159	(19%)
Attic or ceiling/roof assembly or concealed space	2,410	(10%)	32	(8%)	17	(2%)	$85	(10%)
Living room, family room, or den	2,050	(9%)	123	(31%)	186	(19%)	$82	(10%)
Wall assembly or concealed space	1,800	(8%)	21	(5%)	30	(3%)	$47	(6%)
Kitchen	1,400	(6%)	16	(4%)	56	(6%)	$40	(5%)
Exterior wall surface	1,230	(5%)	2	(1%)	25	(3%)	$25	(3%)
Ceiling/floor assembly or concealed space	1,010	(4%)	11	(3%)	18	(2%)	$41	(5%)
Unclassified function area	980	(4%)	35	(9%)	57	(6%)	$36	(4%)
Crawl space or substructure space	950	(4%)	11	(3%)	38	(4%)	$36	(4%)
Garage*	890	(4%)	2	(1%)	38	(4%)	$80	(10%)
Laundry room	760	(3%)	13	(3%)	18	(2%)	$17	(2%)
Bathroom	690	(3%)	2	(1%)	34	(4%)	$13	(2%)
Closet	580	(2%)	6	(2%)	25	(3%)	$20	(2%)
Unclassified structural area	370	(2%)	9	(2%)	7	(1%)	$17	(2%)
Exterior balcony or unenclosed porch	360	(2%)	2	(1%)	8	(1%)	$16	(2%)
Unclassified storage area	340	(1%)	0	(0%)	14	(1%)	$12	(1%)
Unclassified equipment or service area	280	(1%)	6	(1%)	7	(1%)	$8	(1%)
Unclassified outside area	270	(1%)	2	(1%)	4	(0%)	$6	(1%)
Conduit, pipe, utility, or ventilation shaft	240	(1%)	0	(0%)	3	(0%)	$3	(0%)
Unclassified area	240	(1%)	4	(1%)	7	(1%)	$5	(1%)
Heating equipment room	230	(1%)	0	(0%)	7	(1%)	$5	(1%)
Storage room, area, tank, or bin	190	(1%)	0	(0%)	18	(2%)	$5	(1%)
Lobby or entrance way	160	(1%)	2	(1%)	4	(0%)	$4	(0%)
Courtyard, terrace or patio	150	(1%)	4	(1%)	7	(1%)	$10	(1%)
Office	140	(1%)	0	(0%)	5	(1%)	$8	(1%)
Exterior roof surface	140	(1%)	0	(0%)	3	(0%)	$4	(0%)
Hallway or corridor	130	(1%)	2	(1%)	5	(1%)	$2	(0%)
Switchgear area or transformer vault	120	(1%)	0	(0%)	0	(0%)	$3	(0%)
Tool or supply storage room or area	120	(1%)	0	(0%)	3	(0%)	$4	(0%)
Other known area of origin	890	(4%)	11	(3%)	40	(4%)	$29	(4%)
Total fires	23,420	(100%)	392	(100%)	967	(100%)	$822	(100%)

* Excludes garage reported as separate property.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and area of origin unknown have also been allocated proportionally. Totals may not equal sums because of rounding error.
Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 2.5. Civilian Deaths and Injuries in Home Fires Involving Electrical Distribution or Lighting Equipment, vs. All Home Fires by Victim Location Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. Victim Location When Injured

Victim Location When Injured	Home Electrical Distribution or Lighting Equipment Fires: Civilian Deaths		Home Electrical Distribution or Lighting Equipment Fires: Civilian Injuries		All Home Fires: Civilian Deaths	All Home Fires: Civilian Injuries
In area of origin	154	(39%)	529	(55%)	53%	66%
Outside area of origin but n building of origin	234	(60%)	358	(37%)	46%	28%
Outside building of origin	4	(1%)	80	(8%)	1%	6%
Total	392	(100%)	967	(100%)	100%	100%

B. Victim Location at Ignition

Victim Location When Injured	Home Electrical Distribution or Lighting Equipment Fires: Civilian Deaths		Home Electrical Distribution or Lighting Equipment Fires: Civilian Injuries		All Home Fires: Civilian Deaths	All Home Fires: Civilian Injuries
In area of origin and not involved	50	(13%)	218	(23%)	2%	24%
Not in area of origin and not involved	138	(35%)	307	(32%)	21%	24%
Not in area of origin but involved	110	(28%)	175	(18%)	39%	14%
In area of origin and involved	94	(24%)	268	(28%)	39%	38%
In area of origin	144	(37%)	486	(50%)	40%	25%
Not in area of origin	248	(63%)	482	(50%)	60%	75%
Involved in ignition	204	(52%)	443	(46%)	78%	63%
Not involved in ignition	188	(48%)	524	(54%)	22%	27%
Total	392	(100%)	967	(100%)	100%	100%

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Home fire casualties involving indicated equipment with victim location unknown have been proportionally allocated. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Casualties with this equipment involved in ignition but victim location unknown have been proportionally allocated. Totals may not equal sums because off rounding error. Civilian deaths and injuries are estimated to the nearest one.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 2.6. Civilian Deaths and Injuries in Home Fires Involving Electrical Distribution or Lighting Equipment, vs. All Home Fires, by Victim Activity When Injured Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

	Home Electrical Distribution or Lighting Equipment Fires				All Home Fires	
Victim Location When Injured	Civilian Deaths		Civilian Injuries		Civilian Deaths	Civilian Injuries
Attempting to escape	160	(41%)	285	(30%)	35%	25%
Sleeping	116	(30%)	129	(13%)	35%	12%
Attempting to fight fire	33	(9%)	306	(32%)	3%	36%
Unable to act	32	(8%)	16	(2%)	11%	2%
Attempting rescue	30	(8%)	70	(7%)	2%	7%
Irrational act	9	(2%)	11	(1%)	6%	3%
Returning to vicinity of fire	6	(2%)	88	(9%)	3%	7%
Unclassified activity	5	(1%)	62	(6%)	5%	8%
Total	392	(100%)	967	(100%)	100%	100%

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Fires with this equipment involved but activity unknown have been proportionally allocated. Totals may not equal sums because off rounding error. Civilian deaths and injuries are estimated to the nearest one.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 2.7. Home Fires Involving Electrical Distribution or Lighting Equipment, by Time of Day
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Time	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Midnight – 1:59 am	1,510	(6%)	41	(10%)	87	(9%)	$62	(8%)
2:00 – 3:59 am	1,350	(6%)	47	(12%)	88	(9%)	$62	(8%)
4:00 – 5:59 am	1,200	(5%)	82	(21%)	80	(8%)	$49	(6%)
6:00 – 7:59 am	1,500	(6%)	58	(15%)	78	(8%)	$59	(7%)
8:00 – 9:59 am	1,760	(8%)	25	(6%)	85	(9%)	$70	(8%)
10:00 – 11:59 am	2,050	(9%)	24	(6%)	79	(8%)	$69	(8%)
Noon – 1:59 pm	2,190	(9%)	4	(1%)	61	(6%)	$68	(8%)
2:00 – 3:59 pm	2,350	(10%)	2	(1%)	56	(6%)	$82	(10%)
4:00 – 5:59 pm	2,420	(10%)	9	(2%)	76	(8%)	$65	(8%)
6:00 – 7:59 pm	2,580	(11%)	25	(6%)	97	(10%)	$75	(9%)
8:00 – 9:59 pm	2,530	(11%)	33	(8%)	90	(9%)	$95	(12%)
10:00 – 11:59 pm	1,990	(9%)	41	(10%)	89	(9%)	$66	(8%)
Total	23,420	(100%)	392	(100%)	967	(100%)	$822	(100%)

Note: Figures exclude combined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires are rounded to the nearest hundred and civilian deaths to the nearest one. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 2.8. Home Fires Involving Electrical Distribution or Lighting Equipment, by Month
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Month	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
January	2,290	(10%)	36	(9%)	109	(11%)	$82	(10%)
February	1,920	(8%)	46	(12%)	76	(8%)	$69	(8%)
March	2,040	(9%)	72	(18%)	96	(10%)	$67	(8%)
April	1,820	(8%)	26	(7%)	71	(7%)	$65	(8%)
May	1,730	(7%)	38	(10%)	59	(6%)	$62	(8%)
June	1,820	(8%)	22	(6%)	77	(8%)	$56	(7%)
July	1,940	(8%)	22	(6%)	57	(6%)	$63	(8%)
August	1,940	(8%)	14	(4%)	80	(8%)	$57	(7%)
September	1,630	(7%)	25	(6%)	76	(8%)	$51	(6%)
October	1,700	(7%)	27	(7%)	90	(9%)	$79	(10%)
November	1,950	(8%)	26	(7%)	82	(9%)	$67	(8%)
December	2,630	(11%)	40	(10%)	94	(10%)	$104	(13%)
Total	23,420	(100%)	392	(100%)	967	(100%)	$822	(100%)

Note: Figures exclude combined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Fires reported as “no equipment” but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Section 3. Wiring and Related Equipment

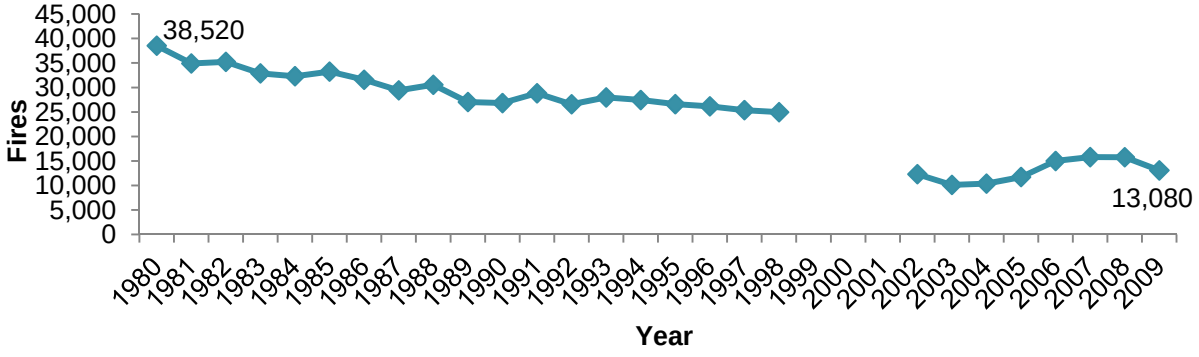
In 2009, an estimated 13,080 reported U.S. non-confined home structure fires involving wiring and related equipment resulted in 113 civilian deaths, 438 civilian injuries, and $558 million in direct property damage.

Wiring and related equipment include the following groups and types of electrical distribution equipment located after power supplies through the outlet, receptacle or switch that channels power to an appliance or other powered device:

- Wiring
  - Branch circuit wiring
  - Power (utility) wiring
  - Electrical service supply wiring
  - Wiring from meter box to service
- Outlets, receptacles, and switches
  - Outlet or receptacle
  - Wall switch
- Panelboard or switchboard for circuit breakers or fuses
- Meter or meter box
- Ground fault circuit interruptor (GFCI)

The newest type of protection device – arc fault circuit interrupter (AFCI) – is not separately identified among the choices for equipment involved in ignition. GFCIs and AFCIs are triggered by different conditions from those that activate conventional circuit breakers. Conventional fuses and circuit breakers activate when too much current is flowing through the circuit. AFCIs activate when they detect a low but irregular electrical current, indicating current is leaking out of the circuit, possibly into adjacent combustible material. AFCIs have more of an effect in preventing fire ignitions, while GFCIs have more of an effect in preventing electric shock.

Figure 3.1. Home Fires Involving Wiring and Related Equipment, by Year
Structure Fires Reported to U.S. Fire Departments



Source: Data from NFIRS Version 5.0 and NFPA survey. Note: See Note on Table 3.1.

Fires involving wiring and related equipment declined by more than one-third from 1980 to 1998. After the transition period of 1999-2001, when NFIRS Version 5.0 was being phased in, the estimates for 2003-2005 were roughly one-half lower than the levels of the late 1990s, a much larger decline than would have been expected if the 1980-1998 trend had continued unchanged. Some of the sharp decline after 1998 may be due to the changes in data categories, definitions, and rules introduced in NFIRS Version 5.0 rather than a decline in the real size of this fire problem. (See Figure 3.1 and Table 3.1.)

Wiring and related equipment accounted for 61% of 2005-2009 non-confined structure fires involving electrical distribution or lighting equipment, as well as 47% of associated civilian deaths, 40% of associated civilian injuries, and 56% of associated direct property damage.

Two-fifths (43%) of the 2005-2009 reported non-confined home structure fires involving wiring and related equipment involved unclassified wiring.
Because such a large share of these fires and associated losses are unclassified, the numbers and percentages for every specific type of equipment are probably severely understated. Comparisons within a group are not a problem. For example, note that the number of fires declines for wiring as one moves from inside the house along the wiring network toward the connections to the utility poles outside the house.

Table 3.A. Home Fires Involving Wiring and Related Equipment, by Specific Type of Equipment
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments
(Excluding Fires Reported as Confined Fires)

Type of Equipment	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified wiring	6,100	(43%)	93	(50%)	165	(42%)	$192	(41%)
Outlet or receptacle	2,500	(17%)	15	(8%)	86	(22%)	$78	(17%)
Branch circuit wiring	1,910	(13%)	41	(22%)	42	(11%)	$74	(16%)
Panelboard or switchboard for fuses or circuit breakers	1,280	(9%)	20	(11%)	30	(8%)	$34	(7%)
Electrical service supply wiring	740	(5%)	5	(3%)	22	(6%)	$23	(5%)
Meter or meter box	580	(4%)	3	(2%)	8	(2%)	$13	(3%)
Wiring from meter box to service	490	(3%)	5	(3%)	11	(3%)	$29	(6%)
Power (utility) line	470	(3%)	5	(2%)	15	(4%)	$12	(3%)
Wall switch	210	(1%)	0	(0%)	10	(2%)	$5	(1%)
Ground fault circuit interrupter (GFCI)	30	(0%)	0	(0%)	1	(0%)	$3	(1%)
Total	14,320	(100%)	186	(100%)	389	(100%)	$463	(100%)

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Damage has not been adjusted for inflation. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Six of seven (86%) of 2005-2009 non-confined home structure fires involving wiring and related equipment involved electrical failures or malfunctions as a factor contributing to ignition.
The two leading specific factors contributing to ignition were unclassified electrical failure or malfunction (33%) and unspecified short circuit arc (30%). These two leading factors lack details on the nature of the failure. The leading mechanical or electrical factors contributing to ignition with details were short circuit arc from defective or worn insulation (13%), arc from faulty contact or broken conductor (6%), and short circuit arc from mechanical damage (4%). Factors contributing to ignition are shown in the tables for all wiring and related equipment and for leading specific types of equipment. (See Table 3.2.)

Nearly two-fifths (37%) of 2005-2009 non-confined home structure fires involving wiring and related equipment began with ignition of wire or cable insulation.
Other leading items first ignited were structural member or framing (21%), insulation within structural area (7%), exterior wall covering (5%), and interior wall covering (5%). (See Table 3.3.)

The areas of origin for 2005-2009 non-confined home structure fires involving wiring and related equipment are fairly evenly divided between concealed or exterior spaces and normally occupied spaces.
The leading areas of origin that are concealed or exterior spaces were attic or ceiling/roof assembly or concealed space (14%), wall assembly or concealed space (12%), exterior wall surface (6%), crawl space or substructure space (5%), and ceiling/floor assembly or concealed space (5%). The leading areas of origin that are normally occupied spaces were bedroom (13%), kitchen (7%), living room, family room, or den (6%), laundry room or area (4%), unclassified function area (3%), garage (3%), and bathroom (3%).

In 2010, an estimated 9,530 injuries involving wiring and related equipment were reported to hospital emergency rooms.[13]
This group of equipment specifically accounted for 2,620 laceration injuries and 1,470 electrical burn injuries. (See Table 3.B.)

Table 3.B. Injuries Involving Wiring and Related Equipment Reported to Hospital Emergency Rooms, 2008

	Type of Injury		
Equipment	**Total**	**Laceration**	**Electric Burn**
Outlet, receptacle, or switch	4,500	660	1,190
Wiring	4,130	1,520	270
Panelboard or switchboard for circuit breakers or fuses	910	430	20
Total	9,530	2,620	1,470

Source: CPSC's National Electronic Injury Surveillance System.

In 2003-2007, three types of wiring averaged 3.6 electrocution deaths per year.[14]

[13] Statistics from National Electronic Injury Surveillance System (NEISS) data obtained from the U.S. Consumer Product Safety Commission (CPSC) website, www.cpsc.gov.

Household wiring averaged 1.8 deaths, outdoor wiring averaged 0.6 deaths, and miscellaneous wiring averaged 1.2 deaths.

Safety Tips

- Home electrical safety begins with NFPA 70, *National Electrical Code®*, and related documents with special relevance to homes, notably NFPA 73, *Electrical Inspection Code for Existing Dwellings*. However, work on home electrical distribution or lighting equipment should only be conducted by someone qualified as an electrician. When you are buying, selling, or remodeling a home, have it inspected by a professional electrician.
- Call a qualified electrician or your landlord if you have
  - recurring problems with blowing fuses or tripping circuit breakers,
  - a tingling feeling when you touch an electrical appliance,
  - discolored or warm wall outlets,
  - a burning smell or rubbery odor coming from an appliance,
  - flickering lights,
  - sparks from an outlet,
  - cracked or broken outlets.

Outlets, Receptacles, and Switches

- Consider having additional circuits or receptacles added by a qualified electrician.
- Receptacle outlets and switches should have wall plates to prevent shocks.
- Homes with young children should have tamper-resistant electrical receptacles.

Circuit Breakers, Fuses, Overcurrent Protection, GFCIs, AFCIs

- Replace fuses with the proper rating for the circuit they protect.
- Never replace a fuse with a higher rated fuse.
- Only plug one heat-producing appliance (such as a coffee maker, toaster, space heater, etc.) into a receptacle outlet at a time.
- If an appliance is malfunctioning, unplug it if it is safe to do so. If necessary, cut off power by unscrewing a fuse or turning off the circuit breaker.
- Arc fault circuit interrupters (AFCIs) are a type of circuit breaker that shuts off electricity when a dangerous arcing condition occurs. Consider having them installed in your home. Use a qualified electrician.
- Ground fault circuit interrupters (GFCIs) reduce the risk of shock.
- Test AFCIs and GFCIs once a month to make sure they are working properly.

Power Lines

- Keep ladders at least 10 feet away from overhead power lines including the electrical service into your home.
- Never touch a power line. Stay at a safe distance – you could be electrocuted.
- Report downed power lines to authorities.
- Some power lines are underground. Call your local utility before digging.

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[14] Matthew V. Hnatov, *2007 Electrocutions Associated with Consumer Products*, U.S. Consumer Product Safety Commission, November 2010, accessed at www.cpsc.gov.

Table 3.1. Home Fires Involving Wiring and Related Equipment, by Year
Structure Fires Reported to U.S. Fire Departments
(Excluding Fires Reported as Confined Fires)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions) As Reported	In 2009 Dollars
1980	38,520	265	673	$307	$802
1981	34,900	317	666	$261	$615
1982	35,220	161	721	$316	$702
1983	32,880	268	683	$330	$710
1984	32,300	173	659	$338	$696
1985	33,230	272	604	$385	$768
1986	31,570	325	554	$365	$716
1987	29,410	296	734	$295	$557
1988	30,550	257	725	$439	$798
1989	27,030	343	564	$393	$680
1990	26,820	149	594	$391	$643
1991	28,820	130	701	$568*	$894*
1992	26,580	205	762	$363	$555
1993	27,970	138	726	$402	$597
1994	27,440	255	652	$409	$593
1995	26,600	301	685	$449	$632
1996	26,150	206	634	$495	$677
1997	25,380	177	709	$484	$647
1998	24,960	190	577	$485	$639
1999	18,950	61	105	$416	$536
2000	14,260	41	243	$308	$385
2001	14,750	174	507	$411	$498
2002	12,310	45	254	$314	$374
2003	10,120	124	183	$354	$414
2004	10,380	117	360	$331	$376
2005	11,730	190	381	$452	$497
2006	15,000	135	392	$448	$476
2007	15,790	143	446	$328	$340
2008	15,760	390	285	$595	$593
2009	13,080	113	438	$558	$558

* All 1991 home fire property damage figures are inflated by estimation problems related to the handling of the Oakland fire storm.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and civilian injuries are expressed to the nearest one, and property damage is rounded to the nearest million dollars. *Fires, deaths, and injuries are rounded more on this table than on any other in the report, because otherwise, most of the entries shown would have four significant places, and that would suggest an unreasonably high degree of precision*. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or reported as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution*. Inflation adjustment to 2009 dollars is done using the consumer price index.

Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Wiring and Related Equipment

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	4,780	(33%)	53	(29%)	125	(32%)	$185	(40%)
Unspecified short circuit arc	4,350	(30%)	33	(18%)	116	(30%)	$152	(33%)
Short circuit arc from defective or worn insulation	1,790	(13%)	24	(13%)	53	(14%)	$41	(9%)
Arc from faulty contact or broken conductor	850	(6%)	8	(4%)	29	(8%)	$21	(5%)
Short circuit arc from mechanical damage	510	(4%)	20	(11%)	9	(2%)	$14	(3%)
Unclassified mechanical failure or malfunction	430	(3%)	11	(6%)	12	(3%)	$10	(2%)
Arc or spark from operating equipment	330	(2%)	0	(0%)	14	(4%)	$17	(4%)
Equipment overloaded	320	(2%)	6	(3%)	10	(3%)	$9	(2%)
Installation deficiency	260	(2%)	18	(10%)	15	(4%)	$9	(2%)
Storm	250	(2%)	3	(2%)	6	(2%)	$9	(2%)
Worn out	240	(2%)	0	(0%)	8	(2%)	$6	(1%)
Water caused short circuit arc	210	(1%)	0	(0%)	7	(2%)	$5	(1%)
Heat source too close to combustibles	160	(1%)	0	(0%)	5	(1%)	$9	(2%)
Unclassified misuse of material	140	(1%)	0	(0%)	7	(2%)	$4	(1%)
Unclassified factor	140	(1%)	0	(0%)	2	(0%)	$6	(1%)
High wind	110	(1%)	0	(0%)	3	(1%)	$6	(1%)
Leak or break	90	(1%)	0	(0%)	7	(2%)	$2	(0%)
Other known factor contributing to ignition	480	(3%)	32	(17%)*	14	(3%)	$14	(3%)
Total fires	14,320	(100%)	186	(100%)	389	(100%)	$463	(100%)
Total factor entries	15,440	(108%)	208	(112%)	442	(114%)	$521	(113%)
All electrical failures or malfunctions	12,360	(86%)	133	(72%)	331	(85%)	$410	(89%)

* The leading factor contributing to ignition for fire deaths not shown above is construction deficiency (15% of deaths).

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Unclassified Wiring

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	2,340	(38%)	24	(26%)	60	(36%)	$84	(44%)
Unspecified short circuit arc	1,640	(27%)	7	(8%)	52	(31%)	$57	(30%)
Short circuit arc from defective or worn insulation	920	(15%)	15	(16%)	25	(15%)	$22	(12%)
Arc from faulty contact or broken conductor	250	(4%)	5	(5%)	8	(5%)	$5	(3%)
Unclassified mechanical failure or malfunction	230	(4%)	0	(0%)	3	(2%)	$7	(3%)
Short circuit arc from mechanical damage	190	(3%)	13	(14%)	0	(0%)	$6	(3%)
Arc or spark from operating equipment	120	(2%)	0	(0%)	5	(3%)	$3	(2%)
Worn out	100	(2%)	0	(0%)	2	(1%)	$4	(2%)
Equipment overloaded	100	(2%)	0	(0%)	2	(1%)	$2	(1%)
Installation deficiency	90	(2%)	5	(6%)	0	(0%)	$4	(2%)
Heat source too close to combustibles	80	(1%)	0	(0%)	3	(2%)	$2	(1%)
Storm	60	(1%)	0	(0%)	5	(3%)	$1	(1%)
Unclassified factor	60	(1%)	0	(0%)	2	(1%)	$3	(2%)
Unclassified misuse of material	60	(1%)	0	(0%)	4	(2%)	$2	(1%)
Water caused short circuit arc	60	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known factor contributing to ignition	230	(4%)	27	(29%)*	6	(4%)	$9	(5%)
Total fires	6,100	(100%)	93	(100%)	165	(100%)	$192	(100%)
Total factor entries	6,530	(107%)	96	(103%)	175	(106%)	$212	(110%)
All electrical failures and malfunctions	5,310	(87%)	64	(69%)	144	(87%)	$168	(88%)

* The leading factor contributing to ignition for fire deaths not shown above is construction deficiency (26% of deaths).

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Outlet or Receptacle

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unspecified short circuit arc	810	(33%)	9	(60%)	21	(25%)	$28	(37%)
Unclassified electrical failure or malfunction	740	(30%)	8	(54%)	22	(25%)	$31	(39%)
Short circuit arc from defective or worn insulation	210	(9%)	0	(0%)	10	(11%)	$6	(7%)
Arc from faulty contact or broken conductor	210	(8%)	0	(0%)	7	(8%)	$6	(7%)
Equipment overloaded	100	(4%)	0	(0%)	6	(7%)	$3	(4%)
Arc or spark from operating equipment	60	(2%)	0	(0%)	0	(0%)	$1	(1%)
Water caused short circuit arc	60	(2%)	0	(0%)	0	(0%)	$1	(1%)
Short circuit arc from mechanical damage	50	(2%)	0	(0%)	2	(2%)	$1	(1%)
Heat source too close to combustibles	50	(2%)	0	(0%)	1	(2%)	$6	(7%)
Unclassified mechanical failure or malfunction	50	(2%)	0	(0%)	3	(3%)	$1	(2%)
Worn out	40	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified misuse of material	40	(2%)	0	(0%)	3	(3%)	$2	(2%)
Installation deficiency	30	(1%)	0	(0%)	1	(2%)	$1	(1%)
Storm	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Leak or break	20	(1%)	0	(0%)	2	(2%)	$0	(0%)
Unclassified factor	20	(1%)	0	(0%)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	60	(3%)	0	(0%)	5	(6%)	$1	(1%)
Total fires	2,500	(100%)	15	(100%)	86	(100%)	$78	(100%)
Total factor entries	2,560	(103%)	17	(114%)	83	(97%)	$88	(113%)
All electrical failures and malfunctions	2,070	(83%)	13	(100%)	61	(72%)	$68	(88%)

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Branch Circuit Wiring

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unspecified short circuit arc	750	(39%)	7	(17%)	16	(37%)	$31	(41%)
Unclassified electrical failure or malfunction	420	(22%)	0	(0%)	10	(24%)	$25	(33%)
Short circuit arc from defective or worn insulation	320	(17%)	7	(17%)	5	(12%)	$6	(8%)
Arc from faulty contact or broken conductor	110	(6%)	3	(8%)	12	(27%)	$5	(7%)
Installation deficiency	80	(4%)	17	(40%)	11	(26%)	$4	(5%)
Short circuit arc from mechanical damage	80	(4%)	3	(8%)	0	(0%)	$3	(4%)
Equipment overloaded	60	(3%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified mechanical failure or malfunction	40	(2%)	14	(34%)	3	(7%)	$1	(1%)
Arc or spark from operating equipment	30	(2%)	0	(0%)	3	(7%)	$1	(1%)
Worn out	30	(2%)	0	(0%)	0	(0%)	$0	(0%)
Storm	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Water caused short circuit arc	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Construction deficiency	10	(1%)	4	(9%)	0	(0%)	$1	(1%)
Heat source too close to combustibles	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Other known factor contributing to ignition	70	(4%)	0	(0%)	2	(4%)	$3	(4%)
Total fires	1,910	(100%)	41	(100%)	42	(100%)	$74	(100%)
Total factor entries	2,060	(108%)	55	(134%)	62	(146%)	$81	(109%)
All electrical failures and malfunctions	1,690	(89%)	18	(43%)	37	(88%)	$69	(93%)

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Panelboard or Switchboard for Fuses or Circuit Breakers

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	460	(36%)	13	(66%)	12	(39%)	$14	(42%)
Unspecified short circuit arc	430	(34%)	7	(34%)	8	(26%)	$13	(40%)
Arc from faulty contact or broken conductor	100	(8%)	0	(0%)	0	(0%)	$1	(3%)
Short circuit arc from defective or worn insulation	70	(6%)	0	(0%)	2	(7%)	$1	(3%)
Unclassified mechanical failure or malfunction	50	(4%)	0	(0%)	2	(6%)	$1	(3%)
Arc or spark from operating equipment	40	(3%)	0	(0%)	0	(0%)	$1	(4%)
Water caused short circuit arc	30	(2%)	0	(0%)	4	(15%)	$2	(5%)
Installation deficiency	30	(2%)	0	(0%)	0	(0%)	$0	(1%)
Equipment overloaded	30	(2%)	7	(34%)	2	(6%)	$1	(3%)
Short circuit arc from mechanical damage	20	(2%)	0	(0%)	0	(0%)	$1	(2%)
Storm	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified factor	10	(1%)	0	(0%)	0	(0%)	$1	(3%)
Leak or break	10	(1%)	0	(0%)	2	(7%)	$0	(0%)
Worn out	10	(1%)	0	(0%)	0	(0%)	$1	(2%)
High wind	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	30	(3%)	0	(0%)	0	(0%)	$1	(3%)
Total fires	1,280	(100%)	20	(100%)	30	(100%)	$34	(100%)
Total factor entries	1,380	(107%)	27	(134%)	32	(106%)	$39	(115%)
All electrical failures and malfunctions	1,130	(88%)	20	(100%)	26	(87%)	$31	(91%)

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

F. Electrical Service Supply Wiring

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	190	(26%)	0	(0%)	2	(8%)	$7	(29%)
Unspecified short circuit arc	180	(24%)	0	(0%)	7	(34%)	$6	(27%)
Short circuit arc from defective or worn insulation	80	(10%)	2	(51%)	9	(43%)	$3	(11%)
Short circuit arc from mechanical damage	70	(10%)	0	(0%)	4	(17%)	$2	(10%)
Arc from faulty contact or broken conductor	60	(9%)	0	(0%)	2	(8%)	$2	(7%)
Storm	40	(6%)	2	(49%)	2	(8%)	$3	(13%)
High wind	30	(5%)	0	(0%)	4	(17%)	$2	(8%)
Exposure fire	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified mechanical failure or malfunction	20	(2%)	0	(0%)	0	(0%)	$0	(2%)
Worn out	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified factor	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Collision, knock down, or turn over	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Arc or spark from operating equipment	10	(1%)	0	(0%)	0	(0%)	$1	(2%)
Equipment overloaded	10	(1%)	0	(0%)	0	(0%)	$1	(3%)
Leak or break	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified natural condition	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Water caused short circuit arc	10	(1%)	0	(0%)	4	(16%)	$1	(5%)
Installation deficiency	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified misuse of material	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Heat source too close to combustibles	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Total fires	740	(100%)	5	(100%)	22	(100%)	$23	(100%)
Total factor entries	830	(111%)	5	(100%)	33	(150%)	$29	(123%)
All electrical failures and malfunctions	570	(77%)	2	(51%)	22	(100%)	$18	(77%)

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

G. Meter or Meter Box

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	220	(39%)	3	(100%)	0	(0%)	$7	(56%)
Unspecified short circuit arc	180	(32%)	0	(0%)	6	(73%)	$5	(35%)
Short circuit arc from defective or insulation	30	(6%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified mechanical failure or malfunction	30	(5%)	0	(0%)	0	(0%)	$0	(2%)
Short circuit arc from mechanical damage	30	(5%)	0	(0%)	2	(27%)	$0	(1%)
Arc from faulty contact or broken conductor	30	(5%)	0	(0%)	0	(0%)	$0	(1%)
Arc or spark from operating equipment	20	(4%)	0	(0%)	0	(0%)	$0	(1%)
Water caused short circuit arc	10	(2%)	0	(0%)	0	(0%)	$0	(4%)
Storm	10	(2%)	0	(0%)	0	(0%)	$0	(4%)
Other known factor contributing to ignition	50	(8%)	0	(0%)	0	(0%)	$1	(9%)
Total fires	580	(100%)	3	(100%)	8	(100%)	$13	(100%)
Total factor entries	620	(107%)	3	(100%)	8	(100%)	$15	(113%)
All electrical failures and malfunctions	510	(88%)	3	(100%)	8	(100%)	$11	(86%)

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

H. Wiring From Meter Box

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unspecified short circuit arc	150	(31%)	5	(100%)	5	(47%)	$6	(20%)
Unclassified electrical failure or malfunction	150	(30%)	0	(0%)	0	(0%)	$6	(20%)
Short circuit arc from defective or worn insulation	70	(14%)	0	(0%)	3	(27%)	$1	(5%)
Arc from faulty contact or broken conductor	30	(7%)	0	(0%)	0	(0%)	$0	(1%)
Short circuit arc from mechanical damage	20	(4%)	0	(0%)	0	(0%)	$0	(0%)
Storm	20	(3%)	0	(0%)	0	(0%)	$2	(7%)
Arc or spark from operating equipment	10	(3%)	0	(0%)	0	(0%)	$12	(42%)
Worn out	10	(3%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified natural condition	10	(2%)	0	(0%)	0	(0%)	$1	(3%)
Water caused short circuit arc	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Installation deficiency	10	(2%)	0	(0%)	3	(27%)	$0	(2%)
Leak or break	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified misuse of material	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Other known factor contributing to ignition	40	(8%)	0	(0%)	0	(0%)	$1	(4%)
Total fires	490	(100%)	5	(100%)	11	(100%)	$29	(100%)
Total factor entries	540	(111%)	5	(100%)	11	(100%)	$31	(107%)
All electrical failures and malfunctions	420	(86%)	5	(100%)	8	(73%)	$25	(88%)

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

I. Power (Utility) Line Wiring

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	120	(26%)	2	(50%)	7	(50%)	$5	(41%)
Unspecified short circuit arc	80	(17%)	0	(0%)	0	(0%)	$2	(14%)
Short circuit arc from defective or worn insulation	60	(12%)	0	(0%)	0	(0%)	$1	(7%)
Arc from faulty contact or broken conductor	40	(8%)	0	(0%)	0	(0%)	$1	(12%)
Storm	40	(8%)	0	(0%)	0	(0%)	$1	(5%)
High wind	40	(8%)	0	(0%)	0	(0%)	$2	(17%)
Short circuit arc from mechanical damage	30	(7%)	2	(50%)	1	(9%)	$1	(7%)
Arc or spark from operating equipment	20	(4%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified factor	10	(3%)	0	(0%)	0	(0%)	$0	(2%)
Worn out	10	(3%)	0	(0%)	5	(33%)	$0	(0%)
Unclassified natural condition	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified mechanical failure or malfunction	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Exposure fire	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified misuse of material	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	40	(8%)	0	(0%)	1	(9%)	$1	(5%)
Total fires	470	(100%)	5	(100%)	15	(100%)	$12	(100%)
Total factor entries	530	(112%)	5	(100%)	15	(100%)	$13	(115%)
All electrical failures and malfunctions	340	(72%)	5	(100%)	9	(59%)	$9	(74%)

Note: See detailed notes and source information at end of table.

Table 3.2. Home Fires Involving Wiring and Related Equipment, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

J. Wall Switch

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unspecified short circuit arc	80	(38%)	0	(NA)	1	(14%)	$2	(37%)
Unclassified electrical failure or malfunction	70	(31%)	0	(NA)	6	(60%)	$2	(38%)
Arc or spark from operating equipment	10	(6%)	0	(NA)	4	(43%)	$0	(8%)
Arc from faulty contact or broken conductor	10	(6%)	0	(NA)	0	(0%)	$0	(2%)
Short circuit arc from defective or worn insulation	10	(5%)	0	(NA)	0	(0%)	$0	(1%)
Worn out	10	(3%)	0	(NA)	0	(0%)	$0	(0%)
Water caused short circuit arc	10	(3%)	0	(NA)	0	(0%)	$0	(6%)
Unclassified mechanical failure or malfunction	10	(3%)	0	(NA)	0	(0%)	$0	(0%)
Short circuit arc from mechanical damage	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	20	(11%)	0	(NA)	1	(13%)	$1	(13%)
Total fires	210	(100%)	0	(NA)	10	(100%)	$5	(100%)
Total factor entries	230	(109%)	0	(NA)	12	(129%)	$5	(106%)
All electrical failures and malfunctions	180	(86%)	0	(NA)	8	(87%)	$4	(90%)

NA – Not applicable because total is zero.

Note: Multiple entries are allowed, resulting in more factor entries than fires. "All electrical failures and malfunctions" is a multi-factor group that has been analyzed to eliminate double-counting of fires. Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and factor contributing to ignition listed as unknown, unreported, none, or blank have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 3.3. Home Fires Involving Wiring and Related Equipment, by Item First Ignited
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Wiring and Related Equipment

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	5,260	(37%)	71	(38%)	118	(30%)	$124	(27%)
Structural member or framing	3,040	(21%)	36	(19%)	59	(15%)	$152	(33%)
Insulation within structural area	1,050	(7%)	12	(6%)	9	(2%)	$22	(5%)
Exterior wall covering	780	(5%)	7	(4%)	14	(4%)	$24	(5%)
Interior wall covering	760	(5%)	3	(2%)	25	(6%)	$24	(5%)
Unclassified structural component or finish	540	(4%)	6	(3%)	9	(2%)	$15	(3%)
Unclassified item	440	(3%)	3	(2%)	1	(0%)	$10	(2%)
Mattress or bedding	280	(2%)	17	(9%)	33	(8%)	$11	(2%)
Ceiling covering	270	(2%)	0	(0%)	6	(2%)	$10	(2%)
Upholstered furniture	200	(1%)	3	(2%)	19	(5%)	$11	(2%)
Clothing	170	(1%)	0	(0%)	11	(3%)	$7	(1%)
Appliance housing or casing	160	(1%)	0	(0%)	3	(1%)	$3	(1%)
Floor covering	160	(1%)	3	(2%)	6	(1%)	$6	(1%)
Unclassified furniture or utensil	160	(1%)	7	(4%)	6	(2%)	$7	(2%)
Multiple items first ignited	130	(1%)	0	(0%)	12	(3%)	$8	(2%)
Cabinetry	110	(1%)	0	(0%)	11	(3%)	$4	(1%)
Exterior roof covering	90	(1%)	0	(0%)	0	(0%)	$5	(1%)
Other known item	730	(5%)	19	(10%)	49	(12%)	$20	(4%)
Total fires	14,320	(100%)	186	(100%)	389	(100%)	$463	(100%)

Note: See detailed notes and source information at end of table.

Table 3.3. Home Fires Involving Wiring and Related Equipment, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Unclassified Wiring

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	1,940	(32%)	23	(25%)	50	(30%)	$54	(28%)
Structural member or framing	1,450	(24%)	28	(30%)	20	(12%)	$55	(29%)
Insulation within structural area	550	(9%)	0	(0%)	3	(2%)	$12	(6%)
Unclassified structural component or finish	320	(6%)	0	(0%)	3	(2%)	$9	(5%)
Interior wall covering	290	(5%)	4	(4%)	11	(6%)	$9	(5%)
Exterior wall covering	180	(3%)	0	(0%)	1	(1%)	$5	(3%)
Unclassified item	170	(3%)	3	(4%)	1	(1%)	$5	(2%)
Ceiling covering	160	(3%)	0	(0%)	2	(1%)	$6	(3%)
Mattress or bedding	110	(2%)	15	(16%)	16	(10%)	$6	(3%)
Floor covering	100	(2%)	4	(4%)	4	(3%)	$4	(2%)
Appliance housing or casing	100	(2%)	0	(0%)	1	(1%)	$1	(1%)
Upholstered furniture	100	(2%)	3	(4%)	2	(1%)	$3	(2%)
Unclassified furniture or utensil	90	(2%)	7	(8%)	5	(3%)	$4	(2%)
Clothing	90	(1%)	0	(0%)	3	(2%)	$3	(1%)
Multiple items first ignited	70	(1%)	0	(0%)	9	(5%)	$4	(2%)
Cabinetry	60	(1%)	0	(0%)	8	(5%)	$3	(1%)
Unclassified soft goods or clothing	40	(1%)	0	(0%)	2	(1%)	$2	(1%)
Other known item	280	(5%)	6	(7%)*	25	(15%)	$9	(5%)
Total fires	6,100	(100%)	93	(100%)	165	(100%)	$192	(100%)

The leading item first ignited for fire deaths not shown above is trash or waste (7% of deaths).

Note: See detailed notes and source information at end of table.

Table 3.3. Home Fires Involving Wiring and Related Equipment, by Item First Ignited (Continued)
Annual Average of 2005-2009 Fires Reported to U.S. Fire Departments

C. Outlet or Receptacle

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	1,020	(41%)	13	(85%)	32	(38%)	$22	(28%)
Structural member or framing	290	(12%)	0	(0%)	6	(7%)	$15	(19%)
Interior wall covering	260	(10%)	0	(0%)	8	(9%)	$9	(11%)
Mattress or bedding	140	(6%)	2	(15%)	10	(12%)	$5	(6%)
Exterior wall covering	100	(4%)	0	(0%)	1	(2%)	$3	(4%)
Insulation within structural area	90	(4%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified item	80	(3%)	0	(0%)	0	(0%)	$1	(1%)
Upholstered furniture	80	(3%)	0	(0%)	6	(7%)	$6	(8%)
Unclassified structural component or finish	70	(3%)	0	(0%)	1	(2%)	$2	(2%)
Unclassified furniture or utensil	50	(2%)	0	(0%)	2	(2%)	$3	(4%)
Clothing	50	(2%)	0	(0%)	6	(8%)	$2	(2%)
Appliance housing or casing	40	(1%)	0	(0%)	1	(2%)	$1	(2%)
Floor covering	30	(1%)	0	(0%)	0	(0%)	$1	(2%)
Curtain or drape	30	(1%)	0	(0%)	2	(2%)	$0	(1%)
Cabinetry	30	(1%)	0	(0%)	0	(0%)	$1	(1%)
Multiple items first ignited	20	(1%)	0	(0%)	3	(3%)	$1	(1%)
Unclassified soft goods or clothing	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Flammable or combustible gas or liquid	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Ceiling covering	10	(1%)	0	(0%)	1	(2%)	$0	(0%)
Box or bag	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	70	(3%)	0	(0%)	6	(7%)	$3	(4%)
Total fires	2,500	(100%)	15	(100%)	86	(100%)	$78	(100%)

D. Branch Circuit Wiring

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Structural member or framing	700	(37%)	7	(16%)	14	(33%)	$34	(46%)
Wire or cable insulation	560	(29%)	18	(45%)	5	(11%)	$17	(24%)
Insulation within structural area	280	(14%)	9	(22%)	5	(12%)	$6	(8%)
Interior wall covering	60	(3%)	0	(0%)	2	(4%)	$3	(4%)
Unclassified structural component or finish	50	(3%)	0	(0%)	0	(0%)	$2	(3%)
Ceiling covering	50	(3%)	0	(0%)	0	(0%)	$1	(2%)
Exterior wall covering	50	(2%)	4	(9%)	1	(4%)	$2	(3%)
Unclassified item	30	(2%)	0	(0%)	0	(0%)	$2	(2%)
Upholstered furniture	10	(1%)	0	(0%)	9	(21%)	$1	(2%)
Pipe, duct, conduit, or hose covering	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Floor covering	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	100	(5%)	3	(8%)*	6	(15%)	$5	(7%)
Total fires	1,910	(100%)	41	(100%)	42	(100%)	$74	(100%)

*The leading item first ignited for fire deaths not shown above is unclassified storage supplies (8% of deaths).
Note: See detailed notes and source information at end of table.

Table 3.3. Home Fires Involving Wiring and Related Equipment, by Item First Ignited (Continued)
Annual Average of 2005-2009 Fires Reported to U.S. Fire Departments

E. Panelboard or Switchboard for Fuses or Circuit Breakers

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	790	(62%)	14	(71%)	15	(49%)	$15	(45%)
Structural member or framing	150	(12%)	0	(0%)	6	(20%)	$8	(23%)
Interior wall covering	70	(6%)	0	(0%)	3	(9%)	$3	(8%)
Unclassified item	50	(4%)	0	(0%)	0	(0%)	$1	(4%)
Exterior wall covering	50	(4%)	0	(0%)	0	(0%)	$1	(4%)
Unclassified structural component or finish	40	(3%)	6	(29%)	4	(13%)	$1	(4%)
Insulation within structural area	30	(2%)	0	(0%)	1	(5%)	$1	(3%)
Clothing	20	(2%)	0	(0%)	1	(4%)	$1	(2%)
Ceiling covering	20	(1%)	0	(0%)	0	(0%)	$1	(3%)
Pipe, duct, conduit, or hose covering	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Floor covering	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	50	(4%)	0	(0%)	0	(0%)	$1	(4%)
Total fires	1,280	(100%)	20	(100%)	30	(100%)	$34	(100%)

F. Electrical Service Supply Wiring

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	230	(31%)	0	(0%)	5	(24%)	$5	(19%)
Structural member or framing	140	(19%)	0	(0%)	1	(7%)	$10	(42%)
Exterior wall covering	130	(18%)	2	(51%)	8	(39%)	$4	(19%)
Insulation within structural area	40	(5%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified item	30	(4%)	0	(0%)	0	(0%)	$1	(2%)
Exterior roof covering	30	(4%)	0	(0%)	0	(0%)	$1	(3%)
Unclassified structural component or finish	20	(3%)	0	(0%)	0	(0%)	$0	(1%)
Interior wall covering	20	(2%)	0	(0%)	0	(0%)	$0	(2%)
Flammable or combustible gas or liquid	10	(1%)	0	(0%)	1	(6%)	$0	(0%)
Multiple items first ignited	10	(1%)	0	(0%)	0	(0%)	$1	(2%)
Ceiling covering	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Light vegetation including grass	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Exterior trim including doors	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Cabinetry	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Mattress or bedding	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	50	(7%)	2	(49%)*	5	(24%)	$1	(4%)
Total fires	740	(100%)	5	(100%)	22	(100%)	$23	(100%)

* The leading item first ignited for fire deaths not shown above is fence or pole (49% of deaths).
Note: See detailed notes and source information at end of table.

Table 3.3. Home Fires Involving Wiring and Related Equipment, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

G. Meter or Meter Box

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	270	(47%)	0	(0%)	4	(52%)	$2	(18%)
Exterior wall covering	110	(20%)	0	(0%)	0	(0%)	$4	(34%)
Structural member or framing	70	(11%)	3	(100%)	4	(48%)	$4	(30%)
Unclassified item	20	(4%)	0	(0%)	0	(0%)	$0	(2%)
Interior wall covering	20	(4%)	0	(0%)	0	(0%)	$0	(2%)
Insulation within structural area	20	(3%)	0	(0%)	0	(0%)	$0	(1%)
Pipe, duct, conduit, or hose covering	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified structural component or finish	10	(2%)	0	(0%)	0	(0%)	$0	(3%)
Pipe, duct, conduit or hose	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Multiple items first ignited	10	(1%)	0	(0%)	0	(0%)	$0	(4%)
Exterior trim including doors	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	20	(4%)	0	(0%)	0	(0%)	$1	(5%)
Total fires	580	(100%)	3	(100%)	8	(100%)	$13	(100%)

H. Wiring From Meter Box

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	200	(41%)	0	(0%)	3	(31%)	$5	(16%)
Structural member or framing	120	(25%)	0	(0%)	4	(41%)	$21	(72%)
Exterior wall covering	50	(11%)	0	(0%)	0	(0%)	$1	(2%)
Insulation within structural area	20	(5%)	5	(100%)	0	(0%)	$1	(2%)
Interior wall covering	20	(4%)	0	(0%)	2	(14%)	$0	(1%)
Unclassified item	20	(3%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified structural component or finish	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Ceiling covering	10	(2%)	0	(0%)	2	(14%)	$0	(1%)
Other known item first ignited	30	(7%)	0	(0%)	0	(0%)	$1	(3%)
Total fires	490	(100%)	5	(100%)	11	(100%)	$29	(100%)

Note: See detailed notes and source information at end of table.

Table 3.3. Home Fires Involving Wiring and Related Equipment, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

I. Power (Utility) Line Wiring

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	140	(30%)	0	(0%)	0	(0%)	$2	(13%)
Exterior wall covering	100	(21%)	0	(0%)	0	(0%)	$2	(20%)
Structural member or framing	50	(11%)	0	(0%)	0	(0%)	$2	(20%)
Exterior roof covering	30	(7%)	0	(0%)	0	(0%)	$2	(16%)
Unclassified item	20	(5%)	0	(0%)	0	(0%)	$0	(2%)
Light vegetation including grass	10	(3%)	0	(0%)	0	(0%)	$0	(1%)
Flammable or combustible gas or liquid	10	(2%)	5	(100%)	2	(15%)	$1	(8%)
Multiple items first ignited	10	(2%)	0	(0%)	0	(0%)	$1	(5%)
Unclassified structural component or finish	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Ceiling covering	10	(2%)	0	(0%)	2	(15%)	$1	(5%)
Appliance housing	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Insulation within structural area	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Fence or pole	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Floor covering	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Exterior trim including doors	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	30	(7%)	0	(0%)	11	(70%)	$1	(5%)
Total fires	470	(100%)	5	(100%)	15	(100%)	$12	(100%)

J. Wall Switch

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	100	(47%)	0	(NA)	0	(0%)	$1	(16%)
Structural member or framing	50	(24%)	0	(NA)	4	(45%)	$3	(55%)
Interior wall covering	20	(10%)	0	(NA)	0	(0%)	$0	(8%)
Insulation within structural area	10	(6%)	0	(NA)	0	(0%)	$0	(7%)
Unclassified item	10	(5%)	0	(NA)	0	(0%)	$0	(1%)
Other known item first ignited	20	(8%)	0	(NA)	5	(55%)	$1	(14%)
Total fires	210	(100%)	0	(NA)	10	(100%)	$5	(100%)

NA – Not applicable because total is zero.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and item first ignited unknown have also been allocated proportionally. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Wiring and Related Equipment

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Attic or ceiling/roof assembly or concealed space	2,000	(14%)	32	(17%)	12	(3%)	$69	(15%)
Bedroom	1,800	(13%)	24	(13%)	96	(25%)	$77	(17%)
Wall assembly or concealed space	1,650	(12%)	22	(12%)	23	(6%)	$45	(10%)
Kitchen	950	(7%)	7	(4%)	33	(9%)	$26	(6%)
Living room, family room, or den	900	(6%)	39	(21%)	45	(11%)	$32	(7%)
Exterior wall surface	830	(6%)	2	(1%)	16	(4%)	$16	(3%)
Crawl space or substructure space	720	(5%)	9	(5%)	17	(4%)	$32	(7%)
Ceiling/floor assembly or concealed space	700	(5%)	12	(6%)	11	(3%)	$25	(5%)
Laundry room or area	540	(4%)	11	(6%)	14	(3%)	$11	(2%)
Unclassified function area	500	(3%)	7	(4%)	26	(7%)	$14	(3%)
Garage*	450	(3%)	0	(0%)	14	(4%)	$29	(6%)
Bathroom	380	(3%)	0	(0%)	7	(2%)	$8	(2%)
Closet	270	(2%)	7	(4%)	12	(3%)	$8	(2%)
Unclassified structural area	250	(2%)	0	(0%)	4	(1%)	$9	(2%)
Unclassified equipment or service area	220	(2%)	0	(0%)	5	(1%)	$4	(1%)
Conduit, pipe, utility, or ventilation shaft	220	(2%)	0	(0%)	3	(1%)	$3	(1%)
Unclassified storage area	200	(1%)	0	(0%)	3	(1%)	$8	(2%)
Heating equipment room or area	190	(1%)	0	(0%)	4	(1%)	$4	(1%)
Unclassified area	150	(1%)	0	(0%)	1	(0%)	$4	(1%)
Unclassified outside area	140	(1%)	2	(1%)	3	(1%)	$1	(0%)
Exterior balcony or unenclosed porch	140	(1%)	0	(0%)	1	(0%)	$4	(1%)
Storage room, area, tank, or bin	120	(1%)	0	(0%)	9	(2%)	$3	(1%)
Exterior roof surface	100	(1%)	0	(0%)	3	(1%)	$3	(1%)
Switchgear area or transformer vault	80	(1%)	0	(0%)	0	(0%)	$1	(0%)
Supply or tool storage room or area	80	(1%)	0	(0%)	1	(0%)	$3	(1%)
Hallway or corridor	70	(1%)	0	(0%)	0	(0%)	$1	(0%)
Unclassified service facility	70	(1%)	0	(0%)	0	(0%)	$1	(0%)
Other known area of origin	570	(4%)	11	(6%)	26	(7%)	$23	(5%)
Total fires	14,320	(100%)	186	(100%)	389	(100%)	$463	(100%)

* Excludes garage coded as separate property.

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Unclassified Wiring

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Attic or ceiling/roof assembly or concealed space	1,150	(19%)	21	(23%)	8	(5%)	$34	(18%)
Bedroom	790	(13%)	19	(21%)	43	(26%)	$31	(16%)
Wall assembly or concealed space	570	(9%)	5	(5%)	10	(6%)	$15	(8%)
Kitchen	430	(7%)	0	(0%)	10	(6%)	$10	(5%)
Living room, family room, or den	430	(7%)	13	(14%)	25	(15%)	$15	(8%)
Ceiling/floor assembly or concealed space	420	(7%)	4	(5%)	3	(2%)	$14	(7%)
Crawl space or substructure space	310	(5%)	5	(5%)	8	(5%)	$9	(5%)
Unclassified function area	230	(4%)	5	(5%)	12	(7%)	$8	(4%)
Bathroom	210	(3%)	0	(0%)	3	(2%)	$4	(2%)
Exterior wall surface	180	(3%)	0	(0%)	0	(0%)	$4	(2%)
Laundry room	170	(3%)	12	(13%)	5	(3%)	$3	(2%)
Garage*	160	(3%)	0	(0%)	6	(3%)	$9	(5%)
Unclassified structural area	130	(2%)	0	(0%)	1	(1%)	$5	(3%)
Unclassified storage area	100	(2%)	0	(0%)	0	(0%)	$4	(2%)
Closet	100	(2%)	0	(0%)	5	(3%)	$4	(2%)
Heating equipment room or area	80	(1%)	0	(0%)	3	(2%)	$1	(1%)
Unclassified area	60	(1%)	0	(0%)	0	(0%)	$3	(1%)
Exterior balcony or unenclosed porch	50	(1%)	0	(0%)	1	(1%)	$2	(1%)
Storage room, area, tank, or bin	40	(1%)	0	(0%)	0	(0%)	$2	(1%)
Unclassified outside area	40	(1%)	0	(0%)	1	(1%)	$1	(0%)
Unclassified equipment or service area	40	(1%)	0	(0%)	0	(0%)	$1	(0%)
Lobby or entrance way	40	(1%)	0	(0%)	2	(1%)	$1	(0%)
Interior stairway or ramp	40	(1%)	5	(5%)	0	(0%)	$2	(1%)
Hallway or corridor	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Conduit, pipe, utility, or ventilation shaft	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	280	(5%)	4	(5%)**	18	(11%)	$10	(5%)
Total fires	6,100	(100%)	93	(100%)	165	(100%)	$192	(100%)

* Excludes garage reported as separate property.

** Leading area of origin for fire deaths not shown above is multiple areas of origin (5% of fire deaths).

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Outlet or Receptacle

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	660	(27%)	2	(15%)	33	(39%)	$28	(36%)
Wall assembly or concealed space	420	(17%)	0	(0%)	1	(2%)	$10	(13%)
Living room, family room, or den	310	(12%)	10	(69%)	16	(19%)	$11	(14%)
Kitchen	300	(12%)	2	(15%)	10	(11%)	$7	(9%)
Unclassified function area	120	(5%)	0	(0%)	7	(8%)	$3	(4%)
Laundry room or area	110	(4%)	0	(0%)	3	(3%)	$2	(2%)
Exterior wall surface	90	(4%)	0	(0%)	1	(2%)	$2	(2%)
Bathroom	80	(3%)	0	(0%)	1	(2%)	$0	(1%)
Garage*	70	(3%)	0	(0%)	3	(3%)	$5	(7%)
Crawl space or substructure space	30	(1%)	0	(0%)	0	(0%)	$2	(3%)
Attic or ceiling/roof assembly or concealed space	30	(1%)	0	(0%)	0	(0%)	$1	(1%)
Exterior balcony or unenclosed porch	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified structural area	30	(1%)	0	(0%)	1	(2%)	$1	(1%)
Closet	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified area	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Storage room, area, tank, or bin	20	(1%)	0	(0%)	8	(9%)	$1	(1%)
Ceiling/floor assembly or concealed space	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	120	(5%)	0	(0%)	1	(2%)	$4	(6%)
Total fires	2,500	(100%)	15	(100%)	86	(100%)	$78	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Branch Circuit Wiring

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Attic or ceiling/roof assembly or concealed space	610	(32%)	11	(27%)	0	(0%)	$26	(35%)
Wall assembly or concealed space	250	(13%)	13	(31%)	3	(6%)	$8	(11%)
Ceiling/floor assembly or concealed space	190	(10%)	4	(11%)	8	(19%)	$8	(11%)
Bedroom	150	(8%)	2	(6%)	3	(6%)	$5	(7%)
Crawl space or substructure space	110	(6%)	0	(0%)	1	(3%)	$6	(8%)
Kitchen	90	(5%)	5	(12%)	7	(16%)	$4	(6%)
Exterior wall surface	50	(3%)	0	(0%)	1	(3%)	$1	(2%)
Living room, family room, or den	50	(3%)	6	(14%)	3	(7%)	$2	(2%)
Unclassified function area	40	(2%)	0	(0%)	7	(17%)	$2	(2%)
Bathroom	40	(2%)	0	(0%)	0	(0%)	$1	(1%)
Laundry room or area	40	(2%)	0	(0%)	0	(0%)	$1	(1%)
Garage*	40	(2%)	0	(0%)	1	(3%)	$2	(3%)
Heating equipment room or area	30	(2%)	0	(0%)	1	(3%)	$1	(1%)
Closet	30	(1%)	0	(0%)	3	(7%)	$1	(1%)
Unclassified structural area	20	(1%)	0	(0%)	1	(3%)	$1	(1%)
Unclassified storage area	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Exterior balcony or unenclosed porch	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Storage room, area, tank, or bin	10	(1%)	0	(0%)	1	(3%)	$0	(1%)
Hallway or corridor	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Tool or supply storage room or area	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Lobby or entrance way	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	70	(4%)	0	(0%)	1	(3%)	$2	(3%)
Total fires	1,910	(100%)	41	(100%)	42	(100%)	$74	(100%)

* Excludes garage coded as separate property.

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Panelboard or Switchboard for Fuses or Circuit Breakers

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wall assembly or concealed space	130	(10%)	2	(12%)	3	(9%)	$4	(11%)
Laundry room or area	130	(10%)	0	(0%)	1	(5%)	$3	(9%)
Crawl space or substructure space	110	(9%)	4	(21%)	8	(27%)	$3	(7%)
Garage*	90	(7%)	0	(0%)	1	(5%)	$5	(15%)
Closet	90	(7%)	7	(33%)	3	(9%)	$2	(6%)
Unclassified equipment or service area	80	(6%)	0	(0%)	4	(13%)	$1	(4%)
Bedroom	80	(6%)	0	(0%)	3	(9%)	$3	(8%)
Exterior wall surface	70	(5%)	0	(0%)	0	(0%)	$1	(3%)
Kitchen	50	(4%)	0	(0%)	6	(19%)	$1	(2%)
Unclassified function area	50	(4%)	2	(11%)	0	(0%)	$1	(3%)
Heating equipment room or area	50	(4%)	0	(0%)	0	(0%)	$1	(4%)
Living room, family room, or den	30	(3%)	5	(23%)	0	(0%)	$1	(4%)
Storage room, area, tank, or bin	30	(3%)	0	(0%)	0	(0%)	$0	(1%)
Switchgear area or transformer vault	30	(2%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified storage area	30	(2%)	0	(0%)	0	(0%)	$1	(2%)
Conduit, pipe, utility, or ventilation shaft	30	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified structural area	30	(2%)	0	(0%)	0	(0%)	$1	(2%)
Attic or ceiling/roof or concealed space	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified service facility	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Ceiling/floor assembly or concealed space	20	(2%)	0	(0%)	0	(0%)	$1	(3%)
Unclassified area	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Tool or supply storage room or area	20	(1%)	0	(0%)	0	(0%)	$1	(4%)
Hallway or corridor	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Bathroom	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified outside area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Exterior balcony or unenclosed porch	10	(1%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified means of egress	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Interior stairway	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Duct for cable, exhaust, heating, or air conditioning	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	20	(2%)	0	(0%)	1	(5%)	$1	(3%)
Total fires	1,280	(100%)	20	(100%)	30	(100%)	$34	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

F. Electrical Service Supply Wiring

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Exterior wall surface	120	(17%)	2	(51%)	8	(37%)	$2	(9%)
Attic or ceiling/roof assembly or concealed space	80	(11%)	0	(0%)	1	(7%)	$4	(16%)
Wall assembly or concealed space	60	(8%)	0	(0%)	1	(6%)	$2	(8%)
Conduit, pipe, utility, or ventilation shaft	60	(8%)	0	(0%)	1	(6%)	$1	(3%)
Crawl space or substructure space	40	(6%)	0	(0%)	0	(0%)	$2	(8%)
Ceiling/floor assembly or concealed space	40	(6%)	0	(0%)	0	(0%)	$1	(4%)
Exterior roof surface	40	(5%)	0	(0%)	1	(6%)	$0	(2%)
Unclassified equipment or service area	30	(4%)	0	(0%)	1	(6%)	$0	(1%)
Unclassified outside area	30	(4%)	2	(49%)	0	(0%)	$0	(1%)
Bedroom	30	(4%)	0	(0%)	3	(13%)	$1	(5%)
Garage*	20	(3%)	0	(0%)	0	(0%)	$3	(11%)
Laundry room or area	20	(3%)	0	(0%)	1	(7%)	$1	(2%)
Living room, family room, or den	20	(3%)	0	(0%)	0	(0%)	$1	(5%)
Kitchen	20	(3%)	0	(0%)	0	(0%)	$1	(6%)
Unclassified function area	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Switchgear area or transformer vault	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Exterior surface of vehicle	10	(2%)	0	(0%)	1	(6%)	$1	(4%)
Unclassified area of origin	10	(1%)	0	(0%)	0	(0%)	$1	(5%)
Heating equipment room or area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified structural area	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Exterior balcony or unenclosed porch	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Storage room, area, tank, or bin	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified service facility	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	40	(6%)	0	(0%)	1	(7%)	$2	(7%)
Total fires	740	(100%)	5	(100%)	22	(100%)	$23	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

G. Meter or Meter Box

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Exterior wall surface	170	(29%)	0	(0%)	3	(31%)	$4	(30%)
Wall assembly or concealed space	60	(10%)	0	(0%)	1	(18%)	$1	(11%)
Conduit, pipe, utility, or ventilation shaft	40	(8%)	0	(0%)	0	(0%)	$1	(7%)
Crawl space or substructure space	30	(6%)	0	(0%)	0	(0%)	$1	(4%)
Unclassified equipment or service area	30	(5%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified outside area	20	(4%)	0	(0%)	0	(0%)	$0	(1%)
Laundry room or area	20	(3%)	0	(0%)	1	(16%)	$0	(3%)
Bedroom	20	(3%)	0	(0%)	0	(0%)	$1	(7%)
Garage*	20	(3%)	0	(0%)	1	(18%)	$1	(7%)
Unclassified area	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Kitchen	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Attic or ceiling/roof assembly or concealed space	10	(2%)	0	(0%)	0	(0%)	$1	(4%)
Closet	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified service facility	10	(2%)	0	(0%)	0	(0%)	$0	(3%)
Switchgear area or transformer vault	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Exterior balcony or unenclosed porch	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified function area	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Living room, family room, or den	10	(2%)	0	(0%)	0	(0%)	$0	(3%)
Unclassified storage area	10	(2%)	0	(0%)	1	(17%)	$0	(1%)
Unclassified structural area	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Exterior surface of vehicle	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Bathroom	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	30	(5%)	3	(100%)**	0	(0%)	$2	(12%)
Total fires	580	(100%)	3	(100%)	8	(100%)	$13	(100%)

* Excludes garage as separate property.

** The leading area of origin for deaths not shown above is ceiling/floor assembly or concealed space (100% of deaths).

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

H. Wiring From Meter Box

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wall assembly or concealed space	80	(15%)	2	(50%)	1	(13%)	$2	(6%)
Exterior wall surface	60	(12%)	0	(0%)	1	(13%)	$1	(2%)
Crawl space or substructure space	60	(12%)	0	(0%)	0	(0%)	$10	(34%)
Attic or ceiling/roof assembly or concealed space	40	(7%)	0	(0%)	2	(23%)	$2	(6%)
Laundry room or area	40	(7%)	0	(0%)	1	(13%)	$0	(1%)
Unclassified equipment or service area	20	(5%)	0	(0%)	0	(0%)	$1	(4%)
Garage*	20	(5%)	0	(0%)	0	(0%)	$2	(6%)
Bedroom	20	(4%)	0	(0%)	0	(0%)	$7	(26%)
Conduit, pipe, utility, or ventilation shaft	20	(3%)	0	(0%)	1	(14%)	$1	(2%)
Closet	10	(3%)	0	(0%)	1	(12%)	$0	(1%)
Kitchen	10	(3%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified structural area	10	(2%)	0	(0%)	0	(0%)	$1	(3%)
Supply or tool storage room or area	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified function area	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified service facility	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Ceiling/floor assembly or concealed space	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Heating equipment room or area	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified outside area	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified storage area	10	(1%)	0	(0%)	1	(12%)	$0	(0%)
Living room, family room, or den	10	(1%)	2	(50%)	0	(0%)	$1	(2%)
Other known area of origin	30	(6%)	0	(0%)	0	(0%)	$1	(2%)
Total fires	490	(100%)	5	(100%)	11	(100%)	$29	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

I. Power (Utility) Line Wiring

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Exterior wall surface	80	(18%)	0	(0%)	1	(9%)	$1	(11%)
Attic or ceiling/roof assembly or concealed space	40	(9%)	0	(0%)	0	(0%)	$1	(12%)
Exterior roof surface	30	(7%)	0	(0%)	1	(9%)	$2	(17%)
Conduit, pipe, utility, or ventilation shaft	30	(5%)	0	(0%)	0	(0%)	$0	(1%)
Bedroom	30	(5%)	0	(0%)	11	(73%)	$1	(5%)
Unclassified outside area	20	(5%)	0	(0%)	0	(0%)	$0	(3%)
Living room, family room, or den	20	(5%)	2	(50%)	0	(0%)	$0	(4%)
Wall assembly or concealed space	20	(5%)	0	(0%)	0	(0%)	$0	(4%)
Garage*	20	(4%)	0	(0%)	0	(0%)	$1	(4%)
Crawl space or substructure space	20	(3%)	0	(0%)	0	(0%)	$0	(3%)
Exterior surface of vehicle	10	(3%)	0	(0%)	0	(0%)	$1	(5%)
Unclassified structural area	10	(3%)	0	(0%)	0	(0%)	$1	(5%)
Unclassified area	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Laundry room or area	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified equipment or service area	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Kitchen	10	(2%)	0	(0%)	0	(0%)	$0	(3%)
Unclassified storage area	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Exterior balcony or unenclosed porch	10	(2%)	0	(0%)	0	(0%)	$0	(3%)
Heating equipment room or area	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Awning	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Ceiling/floor assembly or concealed space	10	(1%)	0	(0%)	0	(0%)	$0	(2%)
Switchgear area or transformer vault	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified function area	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Supply or tool storage room or area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	30	(7%)	2	(50%)**	1	(9%)	$1	(11%)
Total fires	470	(100%)	5	(100%)	15	(100%)	$12	(100%)

* Excludes garage reported as separate property.

** The leading area of origin for fire deaths not shown above is on or near highway or public way (50% of deaths).

Note: See detailed notes and source information at end of table.

Table 3.4. Home Fires Involving Wiring and Related Equipment, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

J. Wall Switch

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wall assembly or concealed space	60	(28%)	0	(NA)	3	(29%)	$2	(41%)
Kitchen	30	(13%)	0	(NA)	1	(13%)	$1	(18%)
Bedroom	30	(12%)	0	(NA)	1	(14%)	$0	(10%)
Bathroom	20	(9%)	0	(NA)	3	(29%)	$0	(6%)
Living room, family room, or den	10	(7%)	0	(NA)	0	(0%)	$0	(7%)
Unclassified function area	10	(6%)	0	(NA)	0	(0%)	$0	(7%)
Other known area of origin	50	(25%)	0	(NA)	1	(15%)	$1	(20%)
Total fires	210	(100%)	0	(NA)	10	(100%)	$5	(100%)

NA – Not applicable because total is zero.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and area of origin unknown have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Section 4. Lamps, Light Fixtures, and Light Bulbs

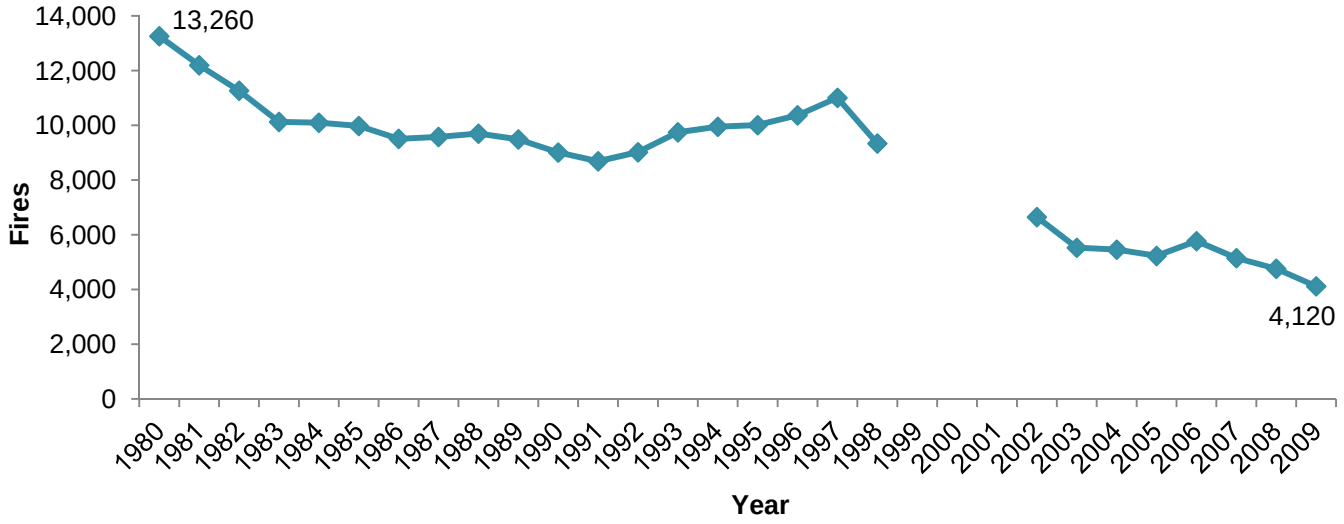
In 2009, an estimated 4,120 reported U.S. non-confined home structure fires involving lamps, light fixtures, or light bulbs resulted in 61 civilian deaths, 243 civilian injuries, and $192 million in direct property damage.

Lamps, light fixtures, and light bulbs include the following specific types of equipment:

- Incandescent light fixtures
- Halogen light fixtures and lamps
- Fluorescent light fixtures
- Sodium or mercury vapor lights
- Decorative lights on line voltage
- Decorative or landscape lighting
- Unclassified lamp, light fixture, or light bulb
- Table or floor lamps
- Light bulbs
- Lanterns and flashlights
- Nightlights
- Work lights and trouble lights
- Signs

Fires involving lamps, light fixtures, or light bulbs declined by nearly one-third from 1980 to 1998. After the transition period of 1999-2001, when NFIRS Version 5.0 was being phased in, the estimates for 2005-2009 have been fairly consistently about one-half lower than the levels of the late 1990s, a much larger decline than would have been expected if the 1980-1998 trend had continued unchanged. Associated losses also showed large declines coinciding with the shift to NFIRS Version 5.0. Some of the decline after 1998 may be due to the changes in data categories, definitions, and rules introduced in NFIRS Version 5.0 rather than a decline in the real size of this fire problem. (See Figure 4.1 and Table 4.1.)

Figure 4.1. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Year Structure Fire Reported to U.S. Fire Departments



Source: Data from NFIRS Version 5.0 and NFPA survey. Note: See Note on Table 4.1.

Lamps, light fixtures, and light bulbs accounted for 21% of 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment, as well as 15% of associated civilian deaths, 26% of associated civilian injuries, and 24% of associated direct property damage.

Table and floor lamps (22%) and incandescent light fixtures (19%) accounted for the largest shares of the 2005-2009 non-confined home structure fires involving lamps, light fixtures, and light bulbs of detailed types. (See Table 4.A.)

Because of the large share (28%) coded as unclassified light fixture, lamp, or light bulb, it is likely that the numbers and percentages are substantially understated for all of the specific types of equipment. Also, there is no category identified for compact fluorescent light bulbs, which might be recorded as fluorescent light fixture, light bulb, or unclassified light fixture, lamp, or light bulb. The U.S. Consumer Product Safety Commission (CPSC) analyzed 402 of their in-depth investigations of lighting-product-related incidents from 2002-2004. That report provides examples of fires, burns, and electric shock involving several types of specialty lighting products that are not specifically identified in the NFIRS categories, including clip-on lamps, lava lamps, rope lights, ceiling-hanging lights, and furniture- or cabinet-mounted light fixtures.[15]

Table 4.A. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Specific Type of Equipment
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments
(Excluding Fires Reported as Confined Fires)

Type of Equipment	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified light fixture, lamp or light bulb	1,420	(28%)	7	(13%)	56	(22%)	$53	(27%)
Table or floor lamp	1,090	(22%)	24	(42%)	82	(32%)	$55	(28%)
Incandescent light fixture	940	(19%)	7	(12%)	24	(10%)	$26	(13%)
Light bulb	380	(8%)	0	(0%)	14	(5%)	$7	(4%)
Halogen light fixture or lamp	380	(8%)	2	(4%)	19	(8%)	$20	(10%)
Fluorescent light fixture	290	(6%)	4	(8%)	22	(9%)	$14	(7%)
Work light or trouble light	190	(4%)	0	(0%)	11	(4%)	$9	(5%)
Decorative light on line voltage	150	(3%)	8	(14%)	14	(5%)	$8	(4%)
Decorative or landscape light	50	(1%)	0	(0%)	0	(0%)	$2	(1%)
Nightlight	50	(1%)	0	(0%)	8	(3%)	$1	(1%)
Lantern or flashlight	30	(1%)	5	(8%)	3	(1%)	$1	(0%)
Sodium or mercury vapor light	20	(0%)	0	(0%)	1	(1%)	$1	(0%)
Sign	10	(0%)	0	(0%)	0	(0%)	$0	(0%)
Total	5,000	(100%)	57	(100%)	254	(100%)	$199	(100%)

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compacter. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Totals may not equal sums because of rounding.
Source: Data from NFIRS Version 5.0 and NFPA survey.

[15] Anna Luo, *Evaluation of Electric Lighting Products*, U.S. Consumer Product Safety Commission, Division of Electrical Engineering, Bethesda, MD, December 2007.

Halogen lights have a higher risk of fire than regular incandescent lights or fluorescent lights. Halogen lights are a type of incandescent light that provides 8% more lumens (more light) per watt than regular incandescent lights. Fluorescent lights are much more efficient but have until recently been much more expensive as well.

Incandescent light fixtures accounted for more 2005-2009 non-confined home structure fires than halogen light fixtures (by a factor of 2.5-to-1) and fluorescent light fixtures (by a factor of 3.2-to-1). If the fires attributed to table or floor lamps and to light bulbs were all incandescent lighting equipment, then the ratio of fires involving incandescent lighting equipment to fires involving other types of lighting equipment could rise as high as 6.3-to-1 for halogen lights and 8.3-to-1 for fluorescent lights. Even if all the fires attributed to unclassified light fixture, lamp, or light bulb are also assigned to incandescent lighting equipment, the ratio of incandescent to halogen lighting equipment would only rise to 10.0-to-1.

Usage estimates are available for 1993 and 2001. The 1993 usage ratio for incandescent vs. halogen lights ranges from 153-to-1 for all bulbs down to 72-to-1 for the bulbs with heaviest use.[16] The 2001 usage ratio for incandescent vs. halogen lights ranges from 120-to-1 for lamps per building to 44-to-1 for installed wattage and electricity consumed per building.[17] Even the lowest usage ratio is roughly four times higher than the highest incandescent vs. halogen fire incident ratio of 10.0-to-1. Therefore, the fire incident risk with halogen lights is estimated to be several times the fire incident risk with incandescent lights.

The 1993 usage ratio for incandescent vs. fluorescent lights ranges from 10-to-1 for all bulbs down to 5-to-1 for the bulbs with heaviest use. The 2001 usage ratio for incandescent vs. fluorescent lights ranges from 10-to-1 for installed wattage and electricity consumed per building to 6-to-1 for lamps per building. (It is not surprising that usage of the more cost-efficient fluorescent lights increases in applications where bulbs are in use for long periods.) This range of usage ratios overlaps the range in ratios of fire incidents, and it seems likely that the fluorescent share has increased considerably since 2001. Therefore, no conclusions can be made about relative fire risk between incandescent and fluorescent lights.

It is also worth noting that incandescent light bulbs are being phased out over the next few years in favor of energy-saving alternatives such as compact fluorescent light bulbs.

More than one-third (36%) of 2005-2009 non-confined home structure fires involving lamps, light fixtures, or light bulbs cited heat source too close to combustibles as a factor contributing to ignition.
This is a much higher percentage share for heat source too close to combustibles than is seen with wiring and related equipment (1%) and cords and plugs (3%). See Table 4.2. The percentage share for heat source too close to combustibles was:

- 34% for unclassified light fixture, lamp, or light bulb fires,
- 45% for table or floor lamp fires,
- 21% for incandescent light fixture fires,

[16] *Residential Lighting Use and Potential Savings*, U.S. Department of Energy, Energy Information Administration, September 1996, accessed at www.cia.doe.gov/cmcu/lighting.
[17] Navigant Consulting, Inc., *U.S. Lighting Market Characterization*, Volume 1, U.S. Department of Energy, September 2002.

- 57% for light bulb fires,
- 58% for halogen light fixture fires,
- 5% for fluorescent light fixture fires,
- 61% for work lights and trouble light fires, and
- 15% for decorative lights on line voltage fires.

The low percentage for fluorescent light fixtures probably reflects the fact that fluorescent lights emit only about 30% of their energy as heat compared to about 90% for halogen lights and regular incandescent lights.[18] The low percentage for decorative lights probably reflects the low wattage, hence low heat, associated with such lights.

Halogen lights are hotter than comparable regular incandescent lights because the smaller bulbs concentrate heat on a smaller surface and place the bulb surface closer to the filament. This means there is a larger volume of space around a halogen light in which combustibles can be ignited and that would be considered too close to heat source.

Half (50%) of civilian fire deaths in 2005-2009 non-confined home structure fires involving lamps, light fixtures, or light bulbs resulted from fires that started with ignition of upholstered furniture (24%), unclassified furniture or utensil (15%), or Christmas tree (11%).
See Table 4.3. Other items first ignited accounting for civilian fire deaths in fires involving this equipment were:

- Linen other than bedding (10%), and
- Mattress or bedding (6%).

Christmas trees also accounted for 17% of fires and 69% of civilian fire deaths involving decorative lights on line voltage. The other deaths involving decorative lights on line voltage were in fires that began with ignition of decorations.

Two out of five (38%) 2005-2009 non-confined home structure fires involving lamps, light fixtures, or light bulbs began in a bedroom (27%) or a living room, family room, or den (11%).
See Table 4.4. These two areas of origin combined also accounted for:

- 36% for unclassified light fixture, lamp, or light bulb fires,
- 76% for table or floor lamp fires,
- 14% for incandescent light fixture fires,
- 21% for light bulb fires,
- 32% for halogen light fixture fires,
- 22% for fluorescent light fixture fires,
- 15% for work light or trouble light fires, and
- 42% for decorative light (on line voltage) fires,

The leading area of origin for light bulb was closet (18% of fires). The 2008 and later editions of the *National Electrical Code* do not allow "open or partially open incandescent type light fixtures" in closets. In this context, "open" would mean an exposed, unenclosed light bulb.

[18] "FAQs – Halogen," accessed at http://gelighting.com/na/business.lighting/faqs.

In 2005-2009, two types of lamp, light fixture, or light bulb accounted for an average of 4.8 electrocution deaths per year.[19]
Holiday lighting accounted for 0.8 deaths per year, and other lighting equipment accounted for 4.0 deaths per year.

In 2010, an estimated 39,220 injuries involving lamps, light fixtures, or light bulbs were reported to hospital emergency rooms.[20]
See Table 4.B. Note that thermal burns can result from contact with a hot object as well as from fires.

Note the large share of injuries involving Christmas tree lights, even though such lights are in heavy and widespread use only about one month out of 12 per year. If adjusted for usage, the Christmas tree light injury total would likely be a much larger share of the injuries. NFPA publishes a separate study of fires involving Christmas trees and related decorative lights and decorations.[21]

Table 4.B. Injuries Involving Lamps, Light Fixtures, and Light Bulbs Reported to Hospital Emergency Rooms, 2010

	Type of Injury			
	Total	Laceration	Contusion or abrasion	Thermal burn
Light bulb	13,330	5,920	1,830	1,530
Table or floor lamp, excluding halogen	10,000	5,520	1,050	820
Light fixture	6,670	4,100	880	0
Christmas tree lights	3,830	270	720	0
Flashlight or lantern	2,540	870	620	0
Other or unknown electric lighting equipment	1,550	770	140	0
Outdoor electric lighting equipment	630	150	240	40
Night light	480	250	90	10
Halogen floor or table lamp	190	90	0	0
Total	39,220	17,950	5,560	2,400

Source: CPSC's National Electronic Injury Surveillance System

No injuries were reported involving trouble or work lights.

The injuries shown above do not include 3,280 injuries involving electric Christmas decorations other than tree lights, because the definition of the category allows for many decorations that are not lights. However, a review of a non-random sample of the injuries showed nearly all of them to be falls sustained while putting up or taking down Christmas lights.

[19] Matthew V. Hnatov, *2007 Electrocutions Associated with Consumer Products*, U.S. Consumer Product Safety Commission, November 2010, accessed at www.cpsc.gov.
[20] Statistics from National Electronic Injury Surveillance System (NEISS) data obtained from the U.S. Consumer Product Safety Commission website, www.cpsc.gov.
[21] Marty Ahrens, *Home Christmas Tree and Holiday Light Fires*, NFPA Fire Analysis and Research Division, November 2011.

Similarly, the month from December 16 through January 15 accounts for 8% of the days but for 34% of the 2005-2009 non-confined home structure fires involving decorative lights on line voltage, 60% of associated civilian injuries, and all the associated civilian deaths.

Safety Tips

- Home electrical safety begins with NFPA 70, *National Electrical Code®*, and related documents with special relevance to homes, notably NFPA 73, *Electrical Inspection Code for Existing Dwellings*. However, work on home electrical distribution or lighting equipment should only be conducted by someone qualified as an electrician.

- When you are buying, selling, or remodeling a home, have it inspected by a professional electrician.

- Call a qualified electrician or landlord if you have flickering lights.

- Keep lamps, light fixtures, and light bulbs away from anything that can burn, including lamp shades, furniture, bedding, curtains, clothing, and flammable or combustible gases and liquids.

- Never place clothing over a lamp or a cloth over a light bulb.

- Place lamps away from where people and pets walk or where things might fall against them.

- Buy only appliances that have the label of a recognized testing laboratory.

- Use light bulbs that match the recommended wattage on the lamp or fixture.

Table 4.1. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Year
Structure Fires Reported to U.S. Fire Departments

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions) As Reported	In 2009 Dollars
1980	13,260	48	455	$71	$186
1981	12,200	81	347	$70	$165
1982	11,270	69	367	$77	$172
1983	10,130	73	324	$79	$169
1984	10,100	96	262	$78	$160
1985	9,980	48	282	$88	$175
1986	9,510	126	237	$80	$156
1987	9,580	36	279	$69	$130
1988	9,700	56	308	$90	$162
1989	9,490	36	272	$88	$152
1990	9,010	87	285	$126	$207
1991	8,690	59	301	$139*	$219*
1992	9,020	39	323	$89	$136
1993	9,750	88	367	$109	$162
1994	9,950	70	344	$123	$178
1995	10,010	61	349	$146	$206
1996	10,370	80	362	$135	$185
1997	11,010	43	378	$179	$239
1998	9,340	89	271	$134	$177
1999	9,510	61	210	$228	$293
2000	7,610	41	243	$208	$260
2001	7,050	87	332	$177	$215
2002	6,650	30	221	$159	$190
2003	5,530	124	210	$136	$159
2004	5,460	15	272	$154	$175
2005	5,230	59	241	$210	$231
2006	5,770	87	186	$181	$193
2007	5,150	36	325	$214	$221
2008	4,760	28	272	$191	$190
2009	4,120	61	243	$192	$192

* All 1991 home fire property damage figures are inflated by estimation problems related to the handling of the Oakland fire storm.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and civilian injuries are expressed to the nearest one, and property damage is rounded to the nearest million dollars. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or reported as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.* Inflation adjustment to 2009 dollars is done using the consumer price index.

Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Lamps, Light Fixtures, and Light Bulbs

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	1,830	(36%)	15	(27%)	99	(39%)	$70	(35%)
Unclassified electrical failure or malfunction	760	(15%)	4	(7%)	24	(9%)	$40	(20%)
Unspecified short circuit arc	550	(11%)	17	(29%)	20	(8%)	$20	(10%)
Short circuit arc from defective or worn insulation	250	(5%)	5	(9%)	15	(6%)	$5	(3%)
Equipment unattended	200	(4%)	4	(7%)	11	(4%)	$10	(5%)
Collision, knock down, or turn over	200	(4%)	9	(15%)	28	(11%)	$9	(4%)
Unintentionally turned on or not turned off	150	(3%)	0	(0%)	3	(1%)	$8	(4%)
Unclassified misuse of material	140	(3%)	0	(0%)	12	(5%)	$5	(2%)
Animal	140	(3%)	0	(0%)	2	(1%)	$3	(2%)
Unclassified factor	130	(3%)	0	(0%)	5	(2%)	$6	(3%)
Fluorescent light ballast	120	(2%)	0	(0%)	4	(1%)	$4	(2%)
Unclassified mechanical failure or malfunction	110	(2%)	0	(0%)	5	(2%)	$8	(4%)
Installation deficiency	110	(2%)	0	(0%)	2	(1%)	$6	(3%)
Arc or spark from operating equipment	100	(2%)	12	(22%)	7	(3%)	$5	(2%)
Equipment not being operated properly	70	(1%)	0	(0%)	7	(3%)	$2	(1%)
Worn out	60	(1%)	0	(0%)	7	(3%)	$1	(0%)
Abandoned or discarded material	60	(1%)	0	(0%)	2	(1%)	$0	(0%)
Short circuit arc from mechanical damage	50	(1%)	0	(0%)	2	(1%)	$2	(1%)
Equipment overloaded	50	(1%)	0	(0%)	0	(0%)	$2	(1%)
Arc from faulty contact or broken conductor	50	(1%)	0	(0%)	4	(1%)	$3	(2%)
Unclassified operational deficiency	40	(1%)	0	(0%)	6	(2%)	$1	(1%)
Equipment used for not intended purpose	40	(1%)	0	(0%)	4	(1%)	$4	(2%)
Unclassified design, manufacturing, or installation deficiency	40	(1%)	0	(0%)	2	(1%)	$0	(0%)
Failure to clean	30	(1%)	0	(0%)	0	(0%)	$2	(1%)
Playing with heat source	30	(1%)	0	(0%)	2	(1%)	$0	(0%)
Other known factor contributing to ignition	160	(3%)	5	(9%)*	18	(7%)	$10	(5%)
Total fires	5,000	(100%)	57	(100%)	254	(100%)	$199	(100%)
Total factor entries	5,480	(110%)	71	(124%)	287	(113%)	$227	(114%)
All electrical failures and malfunctions	1,830	(37%)	38	(67%)	72	(28%)	$77	(39%)

* The leading factor contributing to ignition for fire deaths not shown above is unclassified fire spread (9% of deaths).

Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Unclassified Lamp, Light Fixture, or Light Bulb

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	480	(34%)	2	(29%)	24	(43%)	$22	(40%)
Unclassified electrical failure or malfunction	250	(18%)	0	(0%)	3	(5%)	$11	(20%)
Unspecified short circuit arc	170	(12%)	2	(31%)	1	(3%)	$4	(7%)
Equipment unattended	80	(5%)	2	(31%)	2	(3%)	$4	(7%)
Short circuit arc from defective or worn insulation	60	(4%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified mechanical failure or malfunction	50	(4%)	0	(0%)	5	(8%)	$1	(2%)
Unclassified misuse of material	50	(3%)	0	(0%)	2	(3%)	$2	(4%)
Collision, knock down, or turn over	40	(3%)	0	(0%)	6	(11%)	$2	(4%)
Unclassified factor	40	(3%)	0	(0%)	2	(3%)	$2	(5%)
Animal	30	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unintentionally turned on or not turned off	30	(2%)	0	(0%)	0	(0%)	$2	(4%)
Arc or spark from operating equipment	30	(2%)	3	(40%)	2	(3%)	$1	(1%)
Installation deficiency	20	(2%)	0	(0%)	0	(0%)	$3	(5%)
Abandoned or discarded material	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Short circuit arc from mechanical damage	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Worn out	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Arc from faulty contact or broken conductor	20	(1%)	0	(0%)	2	(3%)	$1	(3%)
Equipment overloaded	20	(1%)	0	(0%)	0	(0%)	$1	(2%)
Equipment used for not intended purpose	10	(1%)	0	(0%)	2	(3%)	$2	(3%)
Flourescent light ballast	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Equipment not being operated properly	10	(1%)	0	(0%)	2	(3%)	$0	(0%)
Flammable liquid or gas spilled	10	(1%)	0	(0%)	7	(12%)	$1	(2%)
Unclassified design, manufacturing or installation deficiency	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified operational deficiency	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known factor contributing to ignition	50	(3%)	3	(40%)*	2	(3%)	$1	(2%)
Total fires	1,420	(100%)	7	(100%)	56	(100%)	$53	(100%)
Total factor entries	1,540	(109%)	13	(171%)	59	(106%)	$61	(114%)
All electrical failures and malfunctions	530	(38%)	5	(71%)	8	(14%)	$18	(33%)

* The leading factor contributing to ignition for fire deaths not shown above is unclassified fire spread (40%).
Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Table or Floor Lamp

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	490	(45%)	11	(47%)	25	(31%)	$19	(34%)
Unclassified electrical failure or malfunction	120	(11%)	0	(0%)	5	(6%)	$14	(26%)
Collision, knock down, or turn over	110	(10%)	6	(23%)	17	(20%)	$9	(16%)
Unspecified short circuit arc	80	(7%)	0	(0%)	5	(6%)	$4	(7%)
Short circuit arc from defective or worn insulation	60	(6%)	7	(30%)	7	(9%)	$4	(7%)
Equipment unattended	60	(5%)	0	(0%)	9	(11%)	$6	(10%)
Unintentionally turned on or not turned off	50	(4%)	0	(0%)	3	(4%)	$1	(2%)
Unclassified misuse of material	40	(4%)	0	(0%)	7	(8%)	$1	(2%)
Unclassified factor	30	(3%)	0	(0%)	0	(0%)	$0	(1%)
Equipment not being operated properly	20	(2%)	0	(0%)	3	(4%)	$1	(2%)
Arc or spark from operating equipment	20	(1%)	0	(0%)	2	(2%)	$1	(1%)
Animal	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified operational deficiency	20	(1%)	0	(0%)	6	(7%)	$0	(0%)
Short circuit arc from mechanical damage	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Arc from faulty contact or broken conductor	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Worn out	10	(1%)	0	(0%)	3	(4%)	$0	(1%)
Unclassified mechanical failure or malfunction	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Abandoned or discarded material	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Playing with heat source	10	(1%)	0	(0%)	2	(2%)	$0	(1%)
Equipment used for not intended purpose	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Other known factor contributing to ignition	30	(3%)	0	(0%)	2	(2%)	$2	(4%)
Total fires	1,090	(100%)	24	(100%)	82	(100%)	$55	(100%)
Total factor entries	1,220	(112%)	24	(100%)	96	(116%)	$64	(117%)
All electrical failures and malfunctions	310	(28%)	7	(30%)	19	(23%)	$23	(41%)

Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Incandescent Light Fixture

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	190	(21%)	2	(34%)	12	(48%)	$5	(20%)
Unspecified short circuit arc	170	(18%)	2	(34%)	3	(13%)	$3	(13%)
Unclassified electrical failure or malfunction	170	(18%)	0	(0%)	0	(0%)	$7	(25%)
Short circuit arc from defective or worn insulation	80	(8%)	0	(0%)	5	(19%)	$1	(5%)
Animal	50	(5%)	0	(0%)	0	(0%)	$2	(9%)
Installation deficiency	40	(4%)	0	(0%)	2	(6%)	$2	(7%)
Arc or spark from operating equipment	30	(3%)	2	(31%)	0	(0%)	$1	(4%)
Unclassified factor	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unintentionally turned on or not turned off	20	(2%)	0	(0%)	0	(0%)	$1	(5%)
Unclassified mechanical failure or malfunction	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Equipment overloaded	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified misuse of material	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Arc from faulty contact or broken conductor	10	(2%)	0	(0%)	2	(7%)	$1	(5%)
Worn out	10	(1%)	0	(0%)	3	(13%)	$0	(1%)
Failure to clean	10	(1%)	0	(0%)	0	(0%)	$2	(6%)
Equipment unattended	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Water caused short circuit arc	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Equipment not being operated properly	10	(1%)	0	(0%)	1	(6%)	$0	(0%)
Unclassified operational deficiency	10	(1%)	0	(0%)	0	(0%)	$1	(3%)
Unclassified design, manufacturing, or installation deficiency	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Equipment used for not intended purpose	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Short circuit arc from mechanical damage	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Storm	10	(1%)	0	(0%)	0	(0%)	$1	(2%)
Other known factor contributing to ignition	20	(3%)	0	(0%)	0	(0%)	$1	(4%)
Total fires	940	(100%)	7	(100%)	24	(100%)	$26	(100%)
Total factor entries	960	(102%)	7	(100%)	27	(113%)	$30	(113%)
All electrical failures and malfunctions	470	(50%)	4	(66%)	9	(39%)	$13	(48%)

Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Light Bulb

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	220	(57%)	0	(NA)	11	(78%)	$5	(70%)
Animal	30	(8%)	0	(NA)	0	(0%)	$0	(2%)
Unintentionally turned on or not turned off	20	(6%)	0	(NA)	0	(0%)	$1	(10%)
Unclassified misuse of material	20	(5%)	0	(NA)	0	(0%)	$0	(0%)
Installation deficiency	20	(5%)	0	(NA)	0	(0%)	$1	(9%)
Unclassified factor	20	(5%)	0	(NA)	0	(0%)	$1	(7%)
Equipment unattended	10	(4%)	0	(NA)	0	(0%)	$0	(0%)
Collision, knock down, or turn over	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Unclassified electrical failure or malfunction	10	(3%)	0	(NA)	3	(22%)	$0	(5%)
Unclassified mechanical failure or malfunction	10	(2%)	0	(NA)	0	(0%)	$0	(0%)
Abandoned or discarded material	10	(2%)	0	(NA)	0	(0%)	$0	(0%)
Failure to clean	10	(2%)	0	(NA)	0	(0%)	$0	(0%)
Equipment not being operated	10	(2%)	0	(NA)	0	(0%)	$0	(0%)
Construction deficiency	10	(1%)	0	(NA)	0	(0%)	$0	(2%)
Other known factor contributing to ignition	20	(6%)	0	(NA)	0	(0%)	$1	(8%)
Total fires	380	(100%)	0	(NA)	14	(100%)	$7	(100%)
Total factor entries	420	(110%)	0	(NA)	14	(100%)	$9	(115%)
All electrical failures and malfunctions	20	(5%)	0	(NA)	3	22%)	$0	(6%)

NA – Not applicable because total is zero.

Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

F. Halogen Light Fixture or Lamp

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	220	(58%)	0	(*)	15	(79%)	$10	(51%)
Unclassified electrical failure or malfunction	30	(8%)	0	(*)	0	(0%)	$1	(5%)
Unspecified short circuit arc	20	(6%)	0	(*)	0	(0%)	$1	(4%)
Equipment unattended	20	(5%)	0	(*)	0	(0%)	$1	(4%)
Collision, knock down, or turn over	20	(4%)	0	(*)	2	(10%)	$0	(0%)
Unintentionally turned on or not turned off	10	(3%)	0	(*)	0	(0%)	$0	(1%)
Installation deficiency	10	(3%)	0	(*)	0	(0%)	$0	(0%)
Unclassified misuse of material	10	(2%)	0	(*)	2	(10%)	$0	(1%)
Animal	10	(2%)	0	(*)	2	(10%)	$0	(0%)
Unclassified factor	10	(2%)	0	(*)	0	(0%)	$0	(2%)
Unclassified design, manufacturing or installation deficiency	10	(2%)	0	(*)	0	(0%)	$0	(0%)
Short circuit arc from defective or worn insulation	10	(2%)	0	(*)	0	(0%)	$0	(1%)
Exposure fire	10	(2%)	0	(*)	0	(0%)	$0	(1%)
Equipment used for not intended purpose	10	(2%)	0	(*)	0	(0%)	$1	(3%)
Playing with heat source	10	(1%)	0	(*)	0	(0%)	$0	(0%)
Arc or spark from operating equipment	10	(1%)	0	(*)	0	(0%)	$1	(3%)
Unclassified mechanical failure or malfunction	10	(1%)	0	(*)	0	(0%)	$5	(24%)
Equipment not being operated properly	10	(1%)	0	(*)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	30	(7%)	0	(*)	6	(30%)	$1	(6%)
Total fires	380	(100%)	2	(100%)	19	(100%)	$20	(100%)
Total factor entries	430	(114%)	2	(100%)	27	(139%)	$21	(109%)
All electrical failures and malfunctions	70	(18%)	0	(0%)	0	(0%)	$3	(13%)

* Percents not available because all deaths have factor contributing to ignition unknown.

Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

G. Fluorescent Light Fixture

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Fluorescent light ballast	110	(39%)	0	(0%)	5	(24%)	$4	(31%)
Unclassified electrical failure or malfunction	90	(30%)	0	(0%)	7	(32%)	$5	(32%)
Unspecified short circuit arc	30	(11%)	0	(0%)	0	(0%)	$2	(14%)
Heat source too close to combustibles	10	(5%)	0	(0%)	0	(0%)	$1	(8%)
Short circuit arc from defective or worn insulation	10	(4%)	0	(0%0	0	(0%)	$0	(2%)
Unclassified mechanical failure or malfunction	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Arc or spark from operating equipment	10	(3%)	4	(100%)	5	(22%)	$1	(5%)
Worn out	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Installation deficiency	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Other known factor contributing to ignition	30	(10%)	0	(0%)	5	(23%)	$2	(12%)
Total fires	290	(100%)	4	(100%)	22	(100%)	$14	(100%)
Total factor entries	320	(109%)	4	(100%)	22	(100%)	$15	(107%)
All electrical failures and malfunctions	240	(82%)	4	(100%)	20	(88%)	$12	(82%)

Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

H. Work Light or Trouble Light

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	110	(61%)	0	(NA)	4	(41%)	$5	(50%)
Equipment unattended	20	(10%)	0	(NA)	0	(0%)	$1	(7%)
Unintentionally turned on or not turned off	10	(7%)	0	(NA)	0	(0%)	$2	(17%)
Unspecified short circuit arc	10	(5%)	0	(NA)	0	(0%)	$1	(8%)
Unclassified misuse of material	10	(4%)	0	(NA)	2	(15%)	$0	(2%)
Other known factor contributing to ignition	40	(21%)	0	(NA)	5	(44%)	$3	(34%)
Total fires	190	(100%)	0	(NA)	11	(100%)	$9	(100%)
Total factor entries	200	(108%)	0	(NA)	11	(100%)	$11	(118%)
All electrical failures and malfunctions	20	(9%)	0	(NA)	0	(0%)	$1	(9%)

NA – Not applicable because total is zero.

Note: See detailed notes and source information at end of table.

Table 4.2. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Factor Contributing to Ignition (Continued) Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

I. Decorative Light on Line Voltage

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	40	(30%)	2	(31%)	4	(29%)	$3	(34%)
Unspecified short circuit arc	30	(22%)	5	(69%)	7	(52%)	$3	(37%)
Heat source too close to combustibles	20	(15%)	0	(0%)	1	(9%)	$0	(6%)
Short circuit arc from defective or worn insulation	20	(12%)	0	(0%)	1	(10%)	$0	(0%)
Unclassified factor	10	(5%)	0	(0%)	1	(10%)	$1	(6%)
Collision, knock down, or turn over	10	(4%)	3	(38%)	1	(11%)	$0	(3%)
Arc or spark from operating equipment	10	(4%)	0	(0%)	0	(0%)	$1	(9%)
Other known factor contributing to ignition	30	(19%)	0	(0%)	0	(0%)	$1	(9%)
Total fires	150	(100%)	8	(100%)	14	(100%)	$8	(100%)
Total factor entries	160	(111%)	11	(138%)	17	(121%)	$9	(104%)
All electrical failures and malfunctions	100	(68%)	8	(100%)	11	(81%)	$7	(82%)

Note: Multiple entries are allowed, resulting in more factor entries than fires. "All electrical failures and malfunctions" is a multi-factor group that has been analyzed to eliminate double-counting of fires. Figures exclude confined fires which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and factor contributing to ignition listed as unknown, unreported, none, or blank have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Lamps, Light Fixtures, and Light Bulbs

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	550	(11%)	0	(0%)	23	(9%)	$11	(6%)
Mattress or bedding	460	(9%)	3	(6%)	30	(12%)	$17	(8%)
Clothing	450	(9%)	0	(0%)	28	(11%)	$12	(6%)
Structural member or framing	400	(8%)	0	(0%)	12	(5%)	$17	(8%)
Insulation within structural area	310	(6%)	0	(0%)	0	(0%)	$9	(4%)
Exterior wall covering	260	(5%)	0	(0%)	3	(1%)	$31	(16%)
Ceiling covering	190	(4%)	3	(5%)	9	(3%)	$8	(4%)
Floor covering	180	(4%)	0	(0%)	6	(2%)	$6	(3%)
Unclassified item	180	(4%)	0	(0%)	9	(4%)	$7	(3%)
Upholstered furniture	170	(3%)	14	(24%)	32	(13%)	$8	(4%)
Unclassified furniture or utensil	160	(3%)	9	(15%)	7	(3%)	$7	(3%)
Linen other than bedding	150	(3%)	6	(10%)	9	(4%)	$2	(1%)
Unclassified soft goods or clothing	140	(3%)	3	(5%)	19	(8%)	$3	(2%)
Appliance housing or casing	140	(3%)	0	(0%)	3	(1%)	$3	(2%)
Curtain or drape	130	(3%)	0	(0%)	5	(2%)	$5	(2%)
Unclassified structural component or finish	120	(2%)	0	(0%)	3	(1%)	$3	(2%)
Light vegetation including grass	120	(2%)	0	(0%)	0	(0%)	$6	(3%)
Interior wall covering	90	(2%)	3	(4%)	9	(4%)	$5	(2%)
Cabinetry	90	(2%)	3	(5%)	2	(1%)	$3	(2%)
Unclassified organic materials	70	(1%)	0	(0%)	0	(0%)	$3	(2%)
Papers	60	(1%)	3	(5%)	3	(1%)	$3	(1%)
Box or bag	60	(1%)	0	(0%)	8	(3%)	$7	(3%)
Multiple items first ignited	50	(1%)	3	(4%)	4	(2%)	$2	(1%)
Decoration	50	(1%)	3	(5%)	3	(1%)	$1	(1%)
Flammable or combustible gas or liquid	40	(1%)	0	(0%)	15	(6%)	$3	(2%)
Transformer or transformer fluids	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Christmas tree	30	(1%)	6	(11%)	5	(2%)	$5	(2%)
Exterior roof covering	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Exterior trim including doors	30	(1%)	0	(0%)	0	(0%)	$4	(2%)
Toy or game	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	230	(5%)	0	(0%)	6	(2%)	$6	(3%)
Total fires	5,000	(100%)	57	(100%)	254	(100%)	$199	(100%)

Note: See detailed notes and source information at end of table.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Unclassified Lamp, Light Fixture, or Light Bulb

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	180	(12%)	0	(0%)	7	(12%)	$4	(7%)
Mattress or bedding	120	(9%)	0	(0%)	8	(14%)	$4	(7%)
Structural member or framing	110	(7%)	0	(0%)	0	(0%)	$7	(13%)
Clothing	100	(7%)	0	(0%)	5	(9%)	$5	(10%)
Exterior wall covering	70	(5%)	0	(0%)	0	(0%)	$0	(1%)
Insulation within structural area	70	(5%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified item	70	(5%)	0	(0%)	5	(9%)	$1	(3%)
Unclassified soft goods or clothing	60	(4%)	0	(0%)	15	(27%)	$1	(2%)
Unclassified structural component or finish	60	(4%)	0	(0%)	3	(6%)	$2	(3%)
Floor covering	50	(4%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified furniture or utensil	50	(3%)	5	(69%)	2	(3%)	$2	(4%)
Ceiling covering	40	(3%)	0	(0%)	0	(0%)	$0	(1%)
Upholstered furniture	40	(3%)	0	(0%)	0	(0%)	$2	(5%)
Linen other than bedding	40	(3%)	0	(0%)	3	(6%)	$0	(0%)
Interior wall covering	40	(3%)	0	(0%)	0	(0%)	$1	(2%)
Cabinetry	30	(2%)	2	(31%)	0	(0%)	$2	(3%)
Appliance housing or casing	30	(2%)	0	(0%)	0	(0%)	$1	(1%)
Curtain or drape	30	(2%)	0	(0%)	2	(3%)	$3	(5%)
Unclassified organic material	30	(2%)	0	(0%)	0	(0%)	$2	(3%)
Box or bag	20	(2%)	0	(0%)	2	(3%)	$5	(9%)
Light vegetation including grass	20	(1%)	0	(0%)	0	(0%)	$4	(7%)
Multiple items first ignited	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Papers	20	(1%)	0	(0%)	0	(0%)	$0	(1%)
Decoration	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Flammable or combustible gas or liquid	10	(1%)	0	(0%)	3	(6%)	$1	(1%)
Exterior roof covering	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Transformer or transformer fluids	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified storage supplies	10	(1%0	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	70	(5%)	0	(0%)	2	(3%)	$3	(5%)
Total fires	1,420	(100%)	7	(100%)	56	(100%)	$53	(100%)

Note: See detailed notes and source information at end of table.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Table or Floor Lamp

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Mattress or bedding	200	(18%)	3	(14%)	14	(17%)	$7	(13%)
Clothing	190	(17%)	0	(0%)	9	(11%)	$2	(4%)
Upholstered furniture	90	(8%)	13	(54%)	23	(28%)	$5	(9%)
Wire or cable insulation	80	(8%)	0	(0%)	4	(5%)	$3	(5%)
Unclassified furniture or utensil	70	(7%)	0	(0%)	3	(3%)	$3	(5%)
Floor covering	70	(6%)	0	(0%)	6	(7%)	$2	(4%)
Curtain or drape	60	(5%)	0	(0%)	0	(0%)	$1	(2%)
Appliance housing or casing	50	(5%)	0	(0%)	1	(2%)	$2	(3%)
Linen other than bedding	40	(4%)	5	(22%)	2	(2%)	$1	(2%)
Unclassified soft goods or clothing	40	(3%)	3	(11%)	1	(2%)	$0	(0%)
Unclassified item	20	(2%)	0	(0%)	3	(3%)	$0	(1%)
Papers	20	(2%)	0	(0%)	1	(2%)	$1	(2%)
Cabinetry	20	(2%)	0	(0%)	0	(0%)	$1	(1%)
Interior wall covering	20	(2%)	0	(0%)	1	(2%)	$1	(1%)
Ceiling covering	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Toy or game	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Box or bag	10	(1%)	0	(0%)	3	(3%)	$0	(1%)
Decoration	10	(1%)	0	(0%)	1	(2%)	$0	(0%)
Structural member or framing	10	(1%)	0	(0%)	1	(2%)	$0	(1%)
Household utensil	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Multiple items first ignited	10	(1%)	0	(0%)	3	(3%)	$0	(0%)
Unclassified structural component or finish	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Trash or waste	10	(1%)	0	(0%)	2	(2%)	$0	(0%)
Other known item first ignited	30	(3%)	0	(0%)	4	(5%)	$24	(44%)
Total fires	1,090	(100%)	24	(100%)	82	(100%)	$55	(100%)

Note: See detailed notes and source information at end of table.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Incandescent Light Fixture

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Structural member or framing	170	(18%)	0	(0%)	6	(24%)	$5	(20%)
Wire or cable insulation	130	(14%)	0	(0%)	2	(9%)	$1	(4%)
Insulation within structural area	120	(12%)	0	(0%)	0	(0%)	$4	(16%)
Ceiling covering	70	(7%)	2	(34%)	0	(0%)	$4	(16%)
Exterior wall covering	60	(7%)	0	(0%)	0	(0%)	$3	(11%)
Clothing	40	(5%)	0	(0%)	0	(0%)	$1	(3%)
Light vegetation including grass	40	(4%)	0	(0%)	0	(0%)	$1	(5%)
Mattress or bedding	30	(3%)	0	(0%)	0	(0%)	$1	(5%)
Appliance housing or casing	30	(3%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified structural component or finish	30	(3%)	0	(0%)	0	(0%)	$0	(1%)
Linen other than bedding	30	(3%)	0	(0%)	2	(8%)	$0	(2%)
Unclassified item	30	(3%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified organic material	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Exterior trim including doors	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified soft goods or clothing	10	(1%)	0	(0%)	5	(21%)	$1	(6%)
Curtain or drape	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified furniture or utensil	10	(1%)	2	(34%)	0	(0%)	$0	(2%)
Floor covering	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Multiple items first ignited	10	(1%)	2	(31%)	0	(0%)	$0	(2%)
Upholstered furniture	10	(1%)	0	(0%)	6	(24%)	$0	(1%)
Packing or wrapping material	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Interior wall covering	10	(1%)	0	(0%)	2	(7%)	$1	(3%)
Rolled or wound material	10	(1%)	0	(0%)	0	(0%)	$0	(2%)
Box or bag	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	40	(4%)	0	(0%)	2	(7%)	$0	(1%)
Total fires	940	(100%)	7	(100%)	24	(100%)	$26	(100%)

Note: See detailed notes and source information at end of table.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Light Bulb

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Clothing	60	(15%)	0	(NA)	4	(29%)	$2	(27%)
Mattress or bedding	40	(11%)	0	(NA)	1	(11%)	$1	(16%)
Light vegetation including grass	30	(8%)	0	(NA)	0	(0%)	$0	(3%)
Exterior wall covering	20	(6%)	0	(NA)	0	(0%)	$0	(2%)
Linen other than bedding	20	(5%)	0	(NA)	0	(0%)	$0	(2%)
Insulation within structural area	20	(5%)	0	(NA)	0	(0%)	$0	(3%)
Structural member or framing	20	(5%)	0	(NA)	0	(0%)	$1	(13%)
Unclassified item	20	(4%)	0	(NA)	0	(0%)	$0	(0%)
Unclassified organic materials	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Unclassified soft goods or clothing	10	(3%)	0	(NA)	0	(0%)	$0	(2%)
Floor covering	10	(3%)	0	(NA)	0	(0%)	$1	(9%)
Wire or cable insulation	10	(3%)	0	(NA)	0	(0%)	$0	(0%)
Cabinetry	10	(3%)	0	(NA)	0	(0%)	$0	(2%)
Unclassified furniture or utensil	10	(2%)	0	(NA)	0	(0%)	$0	(1%)
Unclassified structural component or finish	10	(2%)	0	(NA)	0	(0%)	$0	(3%)
Papers	10	(1%)	0	(NA)	1	(11%)	$0	(3%)
Box or bag	10	(1%)	0	(NA)	1	(9%)	$0	(1%)
Other known item first ignited	70	(19%)	0	(NA)	5	(40%)	$1	(13%)
Total fires	380	(100%)	0	(NA)	14	(100%)	$7	(100%)

NA – Not applicable because total is zero.

Note: See detailed notes and source information at end of table.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

F. Halogen Light Fixture or Lamp

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Exterior wall covering	50	(12%)	0	(0%)	0	(0%)	$1	(7%)
Clothing	30	(8%)	0	(0%)	7	(36%)	$0	(1%)
Structural member or framing	30	(8%)	0	(0%)	1	(7%)	$1	(3%)
Insulation within structural area	30	(7%)	0	(0%)	0	(0%)	$1	(4%)
Floor covering	20	(6%)	0	(0%)	0	(0%)	$1	(5%)
Wire or cable insulation	20	(5%)	0	(0%)	0	(0%)	$0	(2%)
Curtain or drape	20	(5%)	0	(0%)	0	(0%)	$0	(1%)
Interior wall covering	20	(5%)	0	(0%)	6	(30%)	$2	(9%)
Mattress or bedding	20	(4%)	0	(0%)	0	(0%)	$2	(9%)
Unclassified item	10	(4%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified soft goods or clothing	10	(4%)	0	(0%)	0	(0%)	$0	(1%)
Ceiling covering	10	(3%)	0	(0%)	0	(0%)	$0	(1%)
Linen other than bedding	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Multiple items first ignited	10	(3%)	0	(0%)	1	(7%)	$1	(3%)
Light vegetation including grass	10	(3%)	0	(0%)	0	(0%)	$1	(3%)
Exterior roof covering or finish	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Upholstered furniture	10	(2%)	0	(0%)	1	(7%)	$0	(1%)
Papers	10	(2%)	2	(100%)	0	(0%)	$0	(2%)
Unclassified furniture or utensil	10	(2%)	0	(0%)	3	(13%)	$1	(7%)
Appliance housing or casing	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Box or bag	10	(2%)	0	(0%)	0	(0%)	$1	(3%)
Other known item first ignited	40	(11%)	0	(0%)	0	(0%)	$7	(34%)
Total fires	380	(100%)	2	(100%)	19	(100%)	$20	(100%)

NA – Not applicable because total is zero.

Note: See detailed notes and source information at end of table.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

G. Fluorescent Light Fixture

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	80	(27%)	0	(0%)	6	(25%)	$3	(18%)
Ceiling covering	40	(13%)	0	(0%)	9	(39%)	$3	(17%)
Structural member or framing	30	(10%)	0	(0%)	5	(21%)	$1	(10%)
Transformer or transformer fluids	20	(8%)	0	(0%)	0	(0%)	$0	(1%)
Cabinetry	20	(7%)	0	(0%)	2	(7%)	$1	(4%)
Unclassified item	20	(6%)	0	(0%)	0	(0%)	$4	(26%)
Appliance housing or casing	20	(6%)	0	(0%)	2	(7%)	$1	(4%)
Insulation within structural area	10	(5%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified structural component	10	(3%)	0	(0%)	0	(0%)	$0	(3%)
Other known item first ignited	40	(15%)	4	(100%)*	0	(0%)	$2	(15%)
Total fires	290	(100%)	4	(100%)	22	(100%)	$14	(100%)

* The leading item first ignited for fire deaths not shown above is interior wall covering (100% of deaths).

H. Work Light or Trouble Light

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Insulation within structural areas	50	(25%)	0	(NA)	0	(0%)	$1	(14%)
Structural member or framing	20	(11%)	0	(NA)	0	(0%)	$0	(4%)
Flammable or combustible gas or liquid	10	(7%)	0	(NA)	7	(64%)	$2	(25%)
Wire or cable insulation	10	(6%)	0	(NA)	0	(0%)	$0	(4%)
Clothing	10	(6%)	0	(NA)	0	(0%)	$0	(3%)
Floor covering	10	(5%)	0	(NA)	0	(0%)	$1	(10%)
Mattress or bedding	10	(4%)	0	(NA)	0	(0%)	$1	(8%)
Linen other than bedding	10	(4%)	0	(NA)	1	(13%)	$0	(4%)
Unclassified structural component or finish	10	(3%)	0	(NA)	0	(0%)	$0	(2%)
Upholstered furniture	10	(3%)	0	(NA)	0	(0%)	$0	(2%)
Unclassified item	10	(3%)	0	(NA)	0	(0%)	$0	(0%)
Box or bag	10	(3%)	0	(NA)	2	(23%)	$1	(8%)
Other known item first ignited	40	(19%)	0	(NA)	0	(0%)	$2	(17%)
Total fires	190	(100%)	0	(NA)	11	(100%)	$9	(100%)

NA – Not applicable because total is zero.

Note: See detailed notes and source information at end of table.

Table 4.3. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

I. Decorative Light on Line Voltage

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Christmas tree	20	(17%)	5	(69%)	4	(30%)	$3	(31%)
Wire or cable insulation	20	(15%)	0	(0%)	1	(10%)	$1	(6%)
Decoration	20	(11%)	2	(31%)	1	(10%)	$1	(6%)
Exterior wall covering	10	(9%)	0	(0%)	3	(20%)	$1	(11%)
Mattress or bedding	10	(6%)	0	(0%)	0	(0%)	$0	(0%)
Curtain or drape	10	(5%)	0	(0%)	1	(9%)	$0	(4%)
Structural member or framing	10	(4%)	0	(0%)	0	(0%)	$0	(4%)
Light vegetation including grass	10	(4%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	40	(29%)	0	(0%)	3	(21%)	$3	(37%)
Total fires	150	(100%)	8	(100%)	14	(100%)	$8	(100%)

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming heat source (codes 40-99) are also treated as unknown equipment and allocated. Home fires with this equipment and item first ignited unknown have also been allocated proportionally. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 4.4. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Area of Origin
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Lamps, Light Fixtures, and Light Bulbs

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	1,350	(27%)	18	(32%)	95	(38%)	$42	(21%)
Living room, family room, or den	530	(11%)	22	(38%)	63	(25%)	$23	(11%)
Attic or ceiling/roof assembly or concealed space	400	(8%)	0	(0%)	1	(1%)	$15	(8%)
Bathroom	270	(5%)	2	(4%)	16	(6%)	$5	(3%)
Exterior wall surface	270	(5%)	0	(0%)	1	(1%)	$6	(3%)
Closet	260	(5%)	0	(0%)	10	(4%)	$8	(4%)
Ceiling/floor assembly or concealed space	260	(5%)	0	(0%)	4	(2%)	$12	(6%)
Kitchen	230	(5%)	7	(12%)	12	(5%)	$9	(5%)
Unclassified function area	220	(4%)	5	(9%)	13	(5%)	$11	(6%)
Exterior balcony or unenclosed porch	170	(3%)	0	(0%)	3	(1%)	$6	(3%)
Garage*	130	(3%)	0	(0%)	8	(3%)	$30	(15%)
Laundry room or area	90	(2%)	0	(0%)	0	(0%)	$3	(1%)
Crawl space or substructure space	80	(2%)	0	(0%)	4	(2%)	$1	(1%)
Courtyard, terrace or patio	80	(2%)	0	(0%)	2	(1%)	$3	(1%)
Wall assembly or concealed space	70	(1%)	0	(0%)	3	(1%)	$2	(1%)
Unclassified outside area	70	(1%)	0	(0%)	0	(0%)	$3	(2%)
Lobby or entrance way	60	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified structural area	60	(1%)	0	(0%)	0	(0%)	$5	(3%)
Unclassified storage area	50	(1%)	0	(0%)	0	(0%)	$3	(1%)
Exterior stairway, ramp, or fire escape	30	(1%)	0	(0%)	3	(1%)	$0	(0%)
Hallway or corridor	30	(1%)	0	(0%)	0	(0%)	$1	(0%)
Exterior surface of vehicle	30	(1%)	0	(0%)	0	(0%)	$1	(0%)
Storage room, area, tank, or bin	30	(1%)	0	(0%)	2	(1%)	$1	(0%)
Office	30	(1%)	0	(0%)	1	(0%)	$1	(0%)
Unclassified means of egress	30	(1%)	0	(0%)	1	(1%)	$0	(0%)
Exterior roof surface	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Interior stairway	30	(1%)	0	(0%)	1	(1%)	$0	(0%)
Unclassified area	30	(1%)	2	(4%)	1	(1%)	$0	(0%)
Other known area of origin	120	(2%)	0	(0%)	5	(2%)	$5	(2%)
Total fires	5,000	(100%)	57	(100%)	254	(100%)	$199	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 4.4. Home Fires Involving Lamps, Light Fixture, and Light Bulbs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Unclassified Lamp, Light Fixture, or Light Bulb

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	360	(25%)	2	(29%)	25	(44%)	$12	(22%)
Living room, family room, or den	160	(11%)	3	(40%)	16	(29%)	$6	(11%)
Attic or ceiling/roof assembly or concealed space	100	(7%)	0	(0%)	0	(0%)	$4	(8%)
Bathroom	90	(6%)	0	(0%)	1	(2%)	$1	(3%)
Exterior wall surface	80	(5%)	0	(0%)	0	(0%)	$1	(1%)
Kitchen	70	(5%)	2	(31%)	4	(8%)	$2	(4%)
Unclassified function area	60	(5%)	0	(0%)	3	(5%)	$4	(7%)
Closet	60	(4%)	0	(0%)	0	(0%)	$2	(3%)
Ceiling/floor assembly or concealed space	60	(4%)	0	(0%)	0	(0%)	$2	(4%)
Exterior balcony or unenclosed porch	50	(3%)	0	(0%)	0	(0%)	$2	(4%)
Garage*	40	(3%)	0	(0%)	1	(3%)	$3	(5%)
Unclassified outside area	30	(2%)	0	(0%)	0	(0%)	$3	(5%)
Lobby or entrance way	30	(2%)	0	(0%)	0	(0%)	$0	(1%)
Courtyard, terrace or patio	30	(2%)	0	(0%)	2	(4%)	$2	(4%)
Unclassified structural area	30	(2%)	0	(0%)	0	(0%)	$4	(8%)
Wall assembly or concealed space	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified storage area	20	(2%)	0	(0%)	0	(0%)	$2	(4%)
Laundry room or area	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Crawl space or substructure space	20	(1%)	0	(0%)	1	(2%)	$1	(1%)
Unclassified area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified means of egress	10	(1%)	0	(0%)	1	(2%)	$0	(0%)
Supply or tool storage room or area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Exterior stairway, ramp, or fire escape	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Storage room, area, tank, or bin	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Other known area of origin	50	(3%)	0	(0%)	0	(0%)	$1	(3%)
Total fires	1,420	(100%)	7	(100%)	56	(100%)	$53	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 4.4. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Table or Floor Lamp

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	640	(59%)	16	(68%)	36	(43%)	$17	(31%)
Living room, family room, or den	180	(17%)	0	(0%)	28	(33%)	$8	(15%)
Unclassified function area	70	(6%)	5	(22%)	4	(5%)	$4	(8%)
Closet	30	(2%)	0	(0%)	4	(5%)	$0	(1%)
Laundry room or area	20	(2%)	0	(0%)	0	(0%)	$1	(1%)
Office	20	(1%)	0	(0%)	1	(1%)	$0	(1%)
Bathroom	20	(1%)	0	(0%)	3	(4%)	$0	(0%)
Kitchen	10	(1%)	2	(10%)	0	(0%)	$0	(1%)
Garage*	10	(1%)	0	(0%)	0	(0%)	$22	(40%)
Crawl space or substructure space	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Wall assembly or concealed space	10	(1%)	0	(0%)	1	(2%)	$1	(2%)
Attic or ceiling/roof assembly or concealed space	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified area	10	(1%)	0	(0%)	1	(2%)	$0	(0%)
Exterior wall surface	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Ceiling/floor assembly or concealed space	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified structural area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	40	(4%)	0	(0%)	4	(5%)	$0	(1%)
Total fires	1,090	(100%)	24	(100%)	82	(100%)	$55	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 4.4. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Incandescent Light Fixture

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Attic or ceiling/roof assembly or concealed space	140	(15%)	0	(0%)	0	(0%)	$5	(20%)
Ceiling/floor assembly or concealed space	130	(14%)	0	(0%)	1	(6%)	$3	(13%)
Bathroom	100	(10%)	2	(34%)	3	(12%)	$2	(8%)
Bedroom	90	(10%)	0	(0%)	5	(30%)	$2	(9%)
Exterior wall surface	80	(8%)	0	(0%)	0	(0%)	$2	(7%)
Closet	70	(7%)	0	(0%)	1	(5%)	$3	(11%)
Kitchen	60	(7%)	0	(0%)	3	(11%)	$1	(6%)
Exterior balcony or unenclosed porch	60	(6%)	0	(0%)	3	(12%)	$2	(9%)
Living room, family room, or den	40	(4%)	2	(31%)	4	(18%)	$1	(4%)
Unclassified function area	20	(2%)	0	(0%)	3	(11%)	$0	(0%)
Laundry room or area	20	(2%)	0	(0%)	0	(0%)	$1	(3%)
Courtyard, terrace or patio	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Lobby or entrance way	10	(2%)	0	(0%)	0	(0%)	$1	(3%)
Exterior stairway, ramp, or fire escape	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Hallway or corridor	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified outside area	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Wall assembly or concealed space	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified means of egress	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Interior stairway	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified area	10	(1%)	2	(34%)	0	(0%)	$0	(0%)
Crawl space or substructure space	10	(1%)	0	(0%)	1	(6%)	$0	(1%)
Garage*	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	30	(3%)	0	(0%)	0	(0%)	$1	(5%)
Total fires	940	(100%)	7	(100%)	24	(100%)	$26	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 4.4. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Light Bulb

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Closet	70	(18%)	0	(NA)	5	(38%)	$2	(33%)
Bedroom	70	(17%)	0	(NA)	6	(40%)	$1	(20%)
Exterior wall surface	30	(8%)	0	(NA)	0	(0%)	$0	(1%)
Attic or ceiling/roof assembly or concealed space	30	(7%)	0	(NA)	0	(0%)	$0	(6%)
Bathroom	30	(7%)	0	(NA)	0	(0%)	$0	(1%)
Exterior balcony or unenclosed porch	20	(6%)	0	(NA)	0	(0%)	$0	(1%)
Living room, family room, or den	10	(4%)	0	(NA)	0	(0%)	$1	(12%)
Unclassified function area	10	(4%)	0	(NA)	0	(0%)	$0	(1%)
Ceiling/floor assembly or concealed space	10	(3%)	0	(NA)	0	(0%)	$0	(7%)
Crawl space or substructure space	10	(2%)	0	(NA)	0	(0%)	$0	(0%)
Exterior surface of vehicle	10	(2%)	0	(NA)	0	(0%)	$0	(2%)
Wall assembly or concealed space	10	(2%)	0	(NA)	0	(0%)	$0	(1%)
Garage*	10	(2%)	0	(NA)	1	(10%)	$0	(5%)
Exterior stairway, ramp, or fire escape	10	(2%)	0	(NA)	0	(0%)	$0	(0%)
Unclassified storage area	10	(2%)	0	(NA)	0	(0%)	$0	(1%)
Kitchen	10	(2%)	0	(NA)	0	(0%)	$0	(2%)
Other known area of origin	50	(13%)	0	(NA)	1	(11%)	$1	(9%)
Total fires	380	(100%)	0	(NA)	14	(100%)	$7	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 4.4. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

F. Halogen Light Fixture or Lamp

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	90	(25%)	0	(0%)	14	(71%)	$5	(25%)
Exterior wall surface	40	(12%)	0	(0%)	0	(0%)	$3	(14%)
Attic or ceiling/roof assembly or concealed space	30	(8%)	0	(0%)	0	(0%)	$1	(7%)
Living room, family room, or den	30	(7%)	2	(100%)	3	(14%)	$1	(4%)
Ceiling/floor assembly or concealed space	20	(5%)	0	(0%)	0	(0%)	$5	(24%)
Closet	20	(5%)	0	(0%)	0	(0%)	$1	(3%)
Unclassified function area	20	(5%)	0	(0%)	0	(0%)	$2	(9%)
Kitchen	20	(5%)	0	(0%)	0	(0%)	$0	(1%)
Garage*	10	(4%)	0	(0%)	0	(0%)	$1	(3%)
Exterior roof surface	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Wall assembly or concealed space	10	(2%)	0	(0%)	1	(7%)	$0	(1%)
Bathroom	10	(2%)	0	(0%)	1	(8%)	$0	(1%)
Crawl space or substructure space	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Exterior surface of vehicle	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Exterior balcony or unenclosed porch	10	(1%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified structural area	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified storage area	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Other known area of origin	40	(9%)	0	(0%)	0	(0%)	$1	(3%)
Total fires	380	(100%)	2	(100%)	19	(100%)	$20	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 4.4. Home Fires Involving Lamps, Light Fixtures, and Light Bulbs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

G. Fluorescent Light Fixture

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Kitchen	50	(16%)	2	(52%)	5	(24%)	$5	(34%)
Living room, family room, or den	40	(14%)	2	(48%)	1	(6%)	$2	(11%)
Ceiling/floor assembly or concealed space	20	(9%)	0	(0%)	3	(12%)	$1	(5%)
Bedroom	20	(8%)	0	(0%)	1	(6%)	$1	(5%)
Unclassified function area	20	(6%)	0	(0%)	2	(11%)	$1	(5%)
Garage*	20	(6%)	0	(0%)	0	(0%)	$1	(6%)
Attic or ceiling/roof assembly or concealed space	20	(6%)	0	(0%)	0	(0%)	$2	(10%)
Laundry room or area	10	(5%)	0	(0%)	0	(0%)	$1	(9%)
Closet	10	(4%)	0	(0%)	0	(0%)	$0	(2%)
Crawl space or substructure space	10	(4%)	0	(0%)	1	(6%)	$0	(2%)
Bathroom	10	(4%)	0	(0%)	8	(35%)	$0	(3%)
Hallway or corridor	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Exterior balcony or unenclosed porch	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Supply or tool storage room or area	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Other known area of origin	30	(10%)	0	(0%)	0	(0%)	$1	(6%)
Total fires	290	(100%)	4	(100%)	22	(100%)	$14	(100%)

* Excludes garage reported as separate property.

NA – Not applicable because total is zero.

Note: See detailed notes and source information at end of table.

Table 4.4. Home Fires Involving Lamps Light Fixtures, and Light Bulbs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

H. Work Light or Trouble Light

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Attic or ceiling/roof assembly or concealed space	50	(27%)	0	(NA)	0	(0%)	$2	(18%)
Garage*	20	(13%)	0	(NA)	4	(38%)	$3	(28%)
Bedroom	20	(13%)	0	(NA)	3	(27%)	$2	(19%)
Crawl space or substructure space	10	(6%)	0	(NA)	0	(0%)	$0	(3%)
Unclassified function area	10	(4%)	0	(NA)	0	(0%)	$0	(1%)
Storage room, area, tank, or bin	10	(4%)	0	(NA)	2	(23%)	$0	(2%)
Laundry room or area	10	(4%)	0	(NA)	0	(0%)	$0	(0%)
Bathroom	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Exterior wall surface	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Other known area of origin	40	(24%)	0	(NA)	1	(12%)	$3	(28%)
Total fires	190	(100%)	0	(NA)	11	(100%)	$9	(100%)

* Excludes garage reported as separate property.
NA – Not applicable because total is zero.
Note: See detailed notes and source information at end of table.

I. Decorative Light on Line Voltage

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Living room, family room, or den	50	(35%)	8	(100%)	11	(80%)	$4	(44%)
Exterior balcony or unenclosed porch	10	(9%)	0	(0%)	0	(0%)	$1	(9%)
Bedroom	10	(7%)	0	(0%)	0	(0%)	$0	(4%)
Unclassified outside area	10	(6%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified function area	10	(6%)	0	(0%)	0	(0%)	$0	(2%)
Courtyard, terrace or patio	10	(5%)	0	(0%)	0	(0%)	$0	(0%)
Bathroom	10	(4%)	0	(0%)	0	(0%)	$0	(4%)
Unclassified structural area	10	(4%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	40	(25%)	0	(0%)	3	(20%)	$3	(35%)
Total fires	150	(100%)	8	(100%)	14	(100%)	$8	(100%)

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and area of origin unknown have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Section 5. Cords and Plugs

In 2009, an estimated 2,490 reported U.S. non-confined home structure fires involving cords or plugs resulted in 133 civilian deaths, 201 civilian injuries, and $134 million in direct property damage.

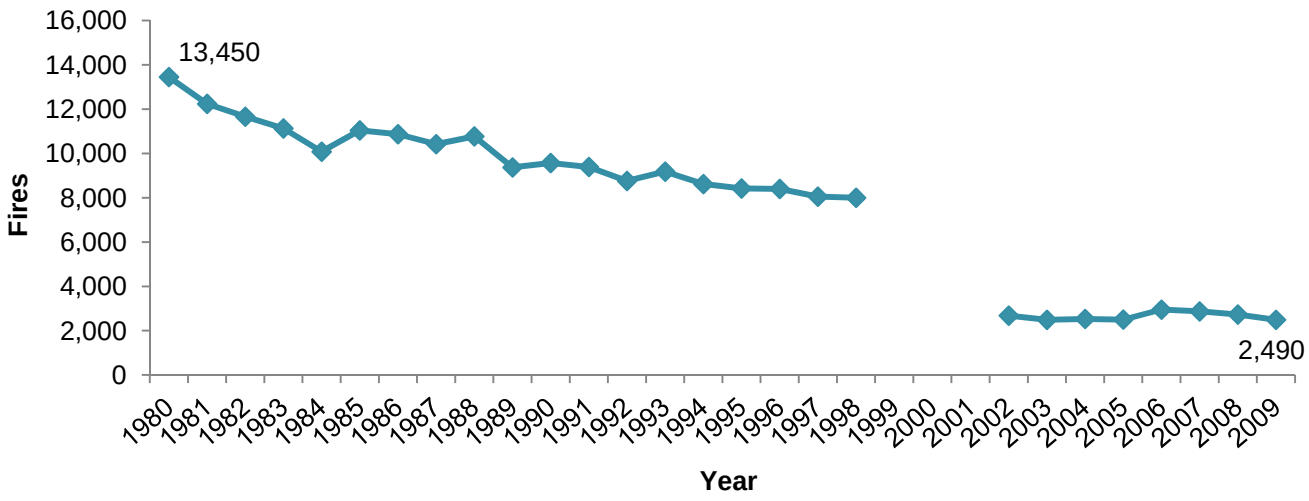
Cords and plugs include the following specific types of equipment:

- Extension cord
- Permanent power cord or plug
- Detachable power cord or plug

It is possible that some fires involving a power cord are coded in terms of the appliance or equipment powered by that power cord.

Fires involving cords or plugs declined by more than one-third from 1980 to 1998. After the transition period of 1999-2001, when NFIRS Version 5.0 was being phased in, the estimates for 2005-2009 are lower by about two-thirds than the levels in the late 1990s and are much lower than what would have been projected from the trend of the late 1990s. Trends for associated losses have yet to stabilize. Some of the sharp decline after 1998 may be due to the changes in data categories, definitions, and rules introduced in NFIRS Version 5.0 rather than a decline in the real size of this fire problem. (See Table 5.1 and Figure 5.1.)

Figure 5.1. Home Fires Involving Cords and Plugs, by Year
Structure Fires Reported to U.S. Fire Departments



Source: Data from NFIRS Version 5.0 and NFPA survey. Note: See Note in Table 5.1.

Cords and plugs accounted for 12% of 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment, as well as 34% of associated civilian deaths, 24% of associated civilian injuries, and 12% of associated direct property damage.

Extension cords accounted for more than half (55%) of the 2005-2009 non-confined home structure fires involving cords or plugs.
Permanent and detachable power cords are the other well-defined types of cords distinguishable in the fire incident data. Because one-sixth of cord and plug fires are coded as unclassified cord or plug, the numbers and percentages for the other, more specifically defined types are probably understated. (See Table 5.A.)

Table 5.A. Home Fires Involving Cords and Plugs, by Specific Type of Equipment
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Type of Equipment	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Extension cord	1,500	(55%)	96	(71%)	140	(61%)	$60	(59%)
Permanent power cord or plug	460	(17%)	11	(8%)	29	(13%)	$13	(13%)
Unclassified cord or plug	440	(16%)	18	(14%)	34	(17%)	$16	(16%)
Detachable power cord or plug	320	(12%)	9	(7%)	25	(11%)	$12	(12%)
Total	2,710	(100%)	134	(100%)	228	(100%)	$100	(100%)

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Three out of four (75%) 2005-2009 non-confined home structure fires involving cords or plugs cited some type of electrical failure or malfunction as a factor contributing to ignition.
See Table 5.2. Leading electrical factors with details on the nature of the failure were short circuit arc from defective or worn insulation (13%), short circuit arc from mechanical damage (4%), and arc from faulty contact or broken conductor (3%).

Nearly two of five (38%) of 2005-2009 non-confined home structure fires involving cords or plugs began with ignition of wire or cable insulation.
See Table 5.3. Other leading items first ignited – which suggest unsafe locations for cords and plugs – include floor covering, where cords might run under rugs or through high traffic areas (9%), mattress or bedding (8%), interior wall covering (5%), upholstered furniture (5%), and clothing (5%).

Half (52%) of 2005-2009 non-confined home structure fires involving cords or plugs began in a bedroom (35%) or a living room, family room or den (17%).
See Table 5.4. Other leading areas of origin were kitchen (7%), unclassified function area (7%), garage (4%), and laundry room (4%). The shares are larger for kitchen (16%) and laundry room (8%) for fires involving permanent power cords.

In 2010, an estimated 14,180 injuries involving electrical cords were reported to hospital emergency rooms.[22]
These consisted of 4,100 extension cord injuries and 10,080 injuries involving other or unknown-type electrical cords. The largest shares of the 14,180 injuries were 3,570 injuries involving fractures and 3,300 contusion or abrasion injuries.

In 2003-2007, two types of cords and plugs accounted for an average of 3.8 electrocution deaths per year.[23]
Extension cords accounted for 1.6 deaths per year, and unspecified electrical cords accounted for 2.2 deaths per year.

Safety Tips:

- Home electrical safety begins with NFPA 70, *National Electrical Code®*, and related documents with special relevance to homes, notably NFPA 73, *Electrical Inspection Code for Existing Dwellings*. However, work on home electrical distribution or lighting equipment should only be conducted by someone qualified as an electrician. When you are buying, selling, or remodeling a home, have it inspected by a professional electrician.

- Never plug a major appliance into an extension cord.

- Buy only appliances that have the label of a recognized testing laboratory.

- Replace cracked electrical cords. If you have older cords with cloth covering, check for and replace frayed cords.

- Pinching cords against walls or furniture or running them under carpets or across doorways can cause a fire.

- Use extension cords for temporary wiring only. Consider having additional circuits or outlets added by a qualified electrician.

[22] Statistics from National Electronic Injury Surveillance System (NEISS) data obtained from the U.S. Consumer Product Safety Commission (CPSC) website, www.cpsc.gov.
[23] Matthew V. Hnatov, *2007 Electrocutions Associated with Consumer Products*, U.S. Consumer Product Safety Commission, November 2010, accessed at www.cpsc.gov.

Table 5.1. Home Fires Involving Cords and Plugs, by Year
Structure Fires Reported to U.S. Fire Departments

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions) As Reported	In 2009 Dollars
1980	13,450	193	496	$98	$255
1981	12,240	155	445	$113	$265
1982	11,660	172	667	$108	$240
1983	11,130	133	467	$114	$246
1984	10,080	172	569	$106	$218
1985	11,040	151	467	$228	$453
1986	10,870	258	581	$120	$236
1987	10,420	168	512	$104	$196
1988	10,770	117	641	$147	$267
1989	9,370	211	598	$121	$209
1990	9,570	198	613	$142	$233
1991	9,390	148	788	$207*	$325*
1992	8,760	155	610	$141	$216
1993	9,180	175	718	$154	$229
1994	8,620	134	544	$143	$207
1995	8,420	117	554	$142	$200
1996	8,400	160	522	$165	$226
1997	8,050	132	420	$152	$203
1998	8,000	78	477	$178	$234
1999	4,980	61	105	$115	$148
2000	3,660	41	647	$96	$119
2001	3,380	44	142	$89	$108
2002	2,680	76	177	$89	$106
2003	2,490	71	192	$156	$182
2004	2,530	131	149	$96	$109
2005	2,500	220	303	$121	$133
2006	2,950	135	193	$98	$104
2007	2,870	83	250	$61	$63
2008	2,730	83	195	$111	$111
2009	2,490	133	201	$134	$134

* All 1991 home fire property damage figures are inflated by estimation problems related to the handling of the Oakland fire storm.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and civilian injuries are expressed to the nearest one, and property damage is rounded to the nearest million dollars. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or reported as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.* Inflation adjustment to 2009 dollars is done using the consumer price index.

Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey.

Table 5.2. Home Fires Involving Cords and Plugs, by Factor Contributing to Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Cords and Plugs

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	850	(31%)	26	(19%)	61	(27%)	$30	(30%)
Unspecified short circuit arc	630	(23%)	29	(21%)	54	(24%)	$28	(28%)
Short circuit arc from defective or worn insulation	350	(13%)	18	(13%)	32	(14%)	$10	(10%)
Equipment overloaded	340	(13%)	19	(14%)	35	(16%)	$13	(13%)
Unclassified misuse of material	140	(5%)	8	(6%)	16	(7%)	$6	(6%)
Short circuit arc from mechanical damage	100	(4%)	19	(15%)	12	(5%)	$4	(4%)
Heat source too close to combustibles	80	(3%)	0	(0%)	15	(6%)	$7	(7%)
Arc from faulty contact or broken conductor	80	(3%)	0	(0%)	8	(4%)	$3	(3%)
Arc or spark from operating equipment	60	(2%)	0	(0%)	7	(3%)	$2	(2%)
Unclassified mechanical failure or malfunction	60	(2%)	0	(0%)	2	(1%)	$1	(1%)
Equipment not being operated properly	50	(2%)	6	(5%)	2	(1%)	$5	(5%)
Equipment used for not intended purpose	40	(1%)	0	(0%)	7	(3%)	$3	(3%)
Worn out	40	(1%)	3	(3%)	2	(1%)	$1	(1%)
Unclassified factor	30	(1%)	19	(14%)	0	(0%)	$1	(1%)
Installation deficiency	30	(1%)	3	(2%)	3	(1%)	$1	(1%)
Water caused short circuit arc	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Equipment unattended	20	(1%)	0	(0%)	2	(1%)	$1	(1%)
Unclassified operational deficiency	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known factor contributing to ignition	70	(3%)	2	(2%)	3	(1%)	$3	(3%)
Total fires	2,710	(100%)	134	(100%)	228	(100%)	$100	(100%)
Total factor entries	3,020	(111%)	153	(114%)	259	(114%)	$117	(117%)
All electrical failures or malfunctions	2,040	(75%)	90	(67%)	167	(73%)	$72	(72%)

Note: See detailed notes and source information at end of table.

Table 5.2. Home Fires Involving Cords and Plugs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Extension Cord

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	440	(29%)	22	(23%)	42	(30%)	$17	(29%)
Unspecified short circuit arc	330	(22%)	19	(20%)	33	(24%)	$15	(26%)
Equipment overloaded	260	(17%)	15	(16%)	33	(24%)	$10	(17%)
Short circuit arc from defective or worn insulation	190	(13%)	6	(6%)	14	(10%)	$4	(7%)
Unclassified misuse of material	90	(6%)	5	(5%)	3	(2%)	$3	(6%)
Short circuit arc from mechanical damage	50	(3%)	15	(16%)	9	(7%)	$2	(4%)
Heat source too close to combustibles	50	(3%)	0	(0%)	12	(8%)	$6	(9%)
Arc from faulty contact or broken conductor	40	(3%)	0	(0%)	0	(0%)	$1	(1%)
Equipment not being operated properly	40	(3%)	6	(6%)	2	(1%)	$4	(7%)
Arc or spark from operating equipment	40	(2%)	0	(0%)	5	(4%)	$1	(1%)
Equipment used for not intended purpose	30	(2%)	0	(0%)	5	(4%)	$2	(3%)
Unclassified mechanical failure or malfunction	20	(1%)	0	(0%)	2	(1%)	$0	(1%)
Worn out	20	(1%)	3	(3%)	2	(1%)	$0	(0%)
Unclassified factor	10	(1%)	13	(13%)	0	(0%)	$1	(1%)
Installation deficiency	10	(1%)	3	(3%)	0	(0%)	$0	(1%)
Unclassified operational deficiency	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Water caused short circuit arc	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Equipment unattended	10	(1%)	0	(0%)	2	(1%)	$0	(0%)
Other known factor contributing to ignition	30	(2%)	2	(2%)	0	(0%)	$1	(2%)
Total fires	1,500	(100%)	96	(100%)	140	(100%)	$60	(100%)
Total factor entries	1,680	(113%)	109	(113%)	163	(117%)	$69	(116%)
All electrical failures and malfunctions	1,070	(71%)	62	(65%)	98	(70%)	$40	(68%)

Note: See detailed notes and source information at end of table.

Table 5.2. Home Fires Involving Cords and Plugs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Permanent Cord or Plug

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	130	(28%)	0	(0%)	2	(6%)	$3	(22%)
Unspecified short circuit arc	120	(27%)	3	(26%)	8	(27%)	$4	(29%)
Short circuit arc from defective or worn insulation	90	(19%)	8	(74%)	8	(29%)	$3	(20%)
Heat source too close to combustibles	20	(5%)	0	(0%)	1	(5%)	$1	(8%)
Short circuit arc from mechanical damage	20	(5%)	0	(0%)	0	(0%)	$1	(9%)
Arc from faulty contact or broken conductor	20	(4%)	0	(0%)	8	(27%)	$1	(10%)
Unclassified mechanical failure or malfunction	20	(4%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified misuse of material	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Installation deficiency	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Worn out	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Water caused short circuit arc	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	30	(7%)	0	(0%)	2	(6%)	$2	(14%)
Total fires	460	(100%)	11	(100%)	29	(100%)	$13	(100%)
Total factor entries	490	(106%)	11	(100%)	29	(100%)	$15	(116%)
All electrical failures and malfunctions	380	(82%)	11	(100%)	26	(89%)	$10	(76%)

Note: See detailed notes and source information at end of table.

Table 5.2. Home Fires Involving Cords and Plugs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Unclassified Cord or Plug

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	190	(44%)	5	(25%)	13	(38%)	$8	(49%)
Unspecified short circuit arc	90	(21%)	5	(25%)	2	(5%)	$5	(33%)
Equipment overloaded	40	(10%)	0	(0%)	3	(10%)	$1	(6%)
Short circuit arc from defective or worn insulation	30	(8%)	5	(25%)	6	(19%)	$2	(12%)
Unclassified misuse of material	20	(5%)	0	(0%)	3	(10%)	$1	(4%)
Arc from faulty contact or broken conductor	20	(4%)	0	(0%)	0	(0%)	$1	(4%)
Arc or spark from operating equipment	20	(3%)	0	(0%)	2	(5%)	$0	(2%)
Short circuit arc from mechanical damage	10	(3%)	0	(0%)	3	(10%)	$0	(1%)
Unclassified factor	10	(2%)	9	(50%)	0	(0%)	$0	(3%)
Unclassified mechanical failure or malfunction	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Heat source too close to combustibles	10	(2%)	0	(0%)	2	(5%)	$0	(1%)
Other known factor contributing to ignition	30	(6%)	0	(0%)	3	(10%)	$1	(3%)
Total fires	440	(100%)	18	(100%)	34	(100%)	$16	(100%)
Total factor entries	490	(110%)	23	(125%)	37	(110%)	$19	(120%)
All electrical failures or malfunctions	350	(80%)	9	(50%)	26	(76%)	$14	(91%)

Note: See detailed notes and source information at end of table.

Table 5.2. Home Fires Involving Cords and Plugs, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Detachable Power Cord or Plug

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	100	(32%)	0	(0%)	5	(19%)	$2	(19%)
Unspecified short circuit arc	90	(28%)	2	(24%)	11	(42%)	$4	(32%)
Short circuit arc from defective or worn insulation	40	(11%)	2	(26%)	3	(12%)	$1	(9%)
Equipment overloaded	30	(10%)	2	(25%)	0	(0%)	$2	(16%)
Unclassified misuse of material	20	(6%)	2	(25%)	9	(35%)	$1	(11%)
Short circuit arc from mechanical damage	10	(3%)	2	(25%)	0	(0%)	$0	(2%)
Worn out	10	(3%)	0	(0%)	0	(0%)	$0	(4%)
Unclassified mechanical failure or malfunction	10	(3%)	0	(0%)	0	(0%)	$0	(2%)
Heat source too close to combustibles	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Arc or spark from operating equipment	10	(2%)	0	(0%)	0	(0%)	$0	(3%)
Unclassified factor	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Equipment unattended	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	30	(10%)	0	(0%)	3	(12%)	$2	(18%)
Total fires	320	(100%)	9	(100%)	25	(100%)	$12	(100%)
Total factor entries	360	(113%)	11	(125%)	30	(118%)	$15	(119%)
All electrical failures and malfunctions	240	(77%)	7	(75%)	17	(66%)	$8	(64%)

Note: Multiple entries are allowed, resulting in more factor entries than fires. "All electrical failures and malfunctions" is a multi-factor group that has been analyzed to eliminate double-counting of fires. Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and factor contributing to ignition listed as unknown, unreported, none, or blank have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 5.3. Home Fires Involving Cords and Plugs, by Item First Ignited
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Cords and Plugs

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	1,040	(38%)	34	(25%)	82	(36%)	$33	(33%)
Floor covering	240	(9%)	16	(12%)	20	(9%)	$9	(9%)
Mattress or bedding	220	(8%)	11	(8%)	19	(8%)	$7	(7%)
Interior wall covering	140	(5%)	3	(2%)	11	(5%)	$3	(3%)
Upholstered furniture	140	(5%)	30	(23%)	21	(9%)	$8	(8%)
Clothing	130	(5%)	3	(2%)	9	(4%)	$6	(6%)
Unclassified furniture or utensil	90	(3%)	5	(4%)	7	(3%)	$3	(3%)
Structural member or framing	80	(3%)	0	(0%)	7	(3%)	$3	(3%)
Appliance housing or casing	70	(3%)	0	(0%)	3	(1%)	$2	(2%)
Unclassified item	70	(2%)	0	(0%)	4	(2%)	$2	(2%)
Multiple items first ignited	60	(2%)	0	(0%)	6	(3%)	$1	(1%)
Unclassified soft goods or clothing	60	(2%)	0	(0%)	8	(4%)	$2	(2%)
Box or bag	40	(2%)	3	(2%)	6	(3%)	$3	(3%)
Papers	40	(1%)	0	(0%)	6	(3%)	$3	(3%)
Exterior wall covering	40	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified structural component or finish	40	(1%)	5	(4%)	0	(0%)	$1	(1%)
Cabinetry	40	(1%)	3	(2%)	0	(0%)	$3	(3%)
Curtain or drape	30	(1%)	3	(2%)	3	(1%)	$4	(4%)
Insulation within structural area	30	(1%)	3	(2%)	3	(1%)	$0	(0%)
Linen other than bedding	20	(1%)	0	(0%)	3	(1%)	$1	(1%)
Exterior trim including doors	10	(1%)	0	(0%)	3	(1%)	$0	(0%)
Other known item first ignited	110	(4%)	15	(12%)*	8	(4%)	$4	(4%)
Total fires	2,710	(100%)	134	(100%)	228	(100%)	$100	(100%)

* The leading item first ignited for fire deaths not shown above is Christmas tree (12% of deaths).

Note: See detailed notes and source information at end of table.

Table 5.3. Home Fires Involving Cords and Plugs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Extension Cord

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	570	(38%)	23	(24%)	47	(34%)	$18	(31%)
Floor covering	150	(10%)	0	(0%)	12	(9%)	$5	(9%)
Mattress or bedding	120	(8%)	11	(12%)	13	(9%)	$4	(6%)
Clothing	100	(7%)	0	(0%)	9	(6%)	$5	(8%)
Upholstered furniture	70	(5%)	22	(23%)	10	(7%)	$5	(8%)
Interior wall covering	70	(5%)	3	(3%)	5	(3%)	$2	(3%)
Structural member or framing	40	(3%)	0	(0%)	3	(2%)	$2	(3%)
Unclassified furniture or utensil	40	(3%)	5	(6%)	1	(1%)	$2	(3%)
Unclassified soft goods or clothing	40	(2%)	0	(0%)	9	(6%)	$2	(3%)
Unclassified item	30	(2%)	0	(0%)	3	(2%)	$1	(2%)
Multiple items first ignited	30	(2%)	0	(0%)	5	(3%)	$1	(1%)
Exterior wall covering	30	(2%)	0	(0%)	0	(0%)	$1	(1%)
Box or bag	30	(2%)	3	(3%)	5	(3%)	$1	(2%)
Papers	20	(2%)	0	(0%)	4	(3%)	$2	(3%)
Curtain or drape	20	(1%)	3	(3%)	3	(2%)	$4	(7%)
Unclassified structural component or finish	20	(1%)	5	(5%)	0	(0%)	$1	(2%)
Insulation within structural area	20	(1%)	3	(3%)	3	(2%)	$0	(0%)
Cabinetry	10	(1%)	3	(3%)	0	(0%)	$3	(4%)
Appliance housing or casing	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Linen other than bedding	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Exterior trim including doors	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	50	(4%)	15	(16%)*	7	(5%)	$2	(3%)
Total fires	1,500	(100%)	96	(100%)	140	(100%)	$60	(100%)

* The leading item first ignited for fire deaths not shown above is Christmas tree (16% of deaths).

Note: See detailed notes and source information at end of table.

Table 5.3. Home Fires Involving Cords and Plugs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Permanent Cord or Plug

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	180	(38%)	5	(46%)	13	(46%)	$4	(31%)
Floor covering	40	(9%)	6	(54%)	1	(5%)	$2	(19%)
Mattress or bedding	30	(7%)	0	(0%)	3	(10%)	$1	(7%)
Interior wall covering	30	(6%)	0	(0%)	6	(20%)	$1	(8%)
Appliance housing or casing	20	(5%)	0	(0%)	0	(0%)	$0	(3%)
Clothing	20	(5%)	0	(0%)	0	(0%)	$0	(3%)
Upholstered furniture	20	(4%)	0	(0%)	0	(0%)	$1	(6%)
Unclassified furniture or utensil	20	(4%)	0	(0%)	0	(0%)	$0	(4%)
Structural member or framing	10	(3%)	0	(0%)	0	(0%)	$1	(5%)
Unclassified item	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Cabinetry	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified structural component or finish	10	(1%)	0	(0%)	0	(0%)	$0	(2%)
Curtain or drape	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	50	(12%)	0	(0%)	5	(18%)	$1	(11%)
Total fires	460	(100%)	11	(100%)	29	(100%)	$13	(100%)

Note: See detailed notes and source information at end of table.

Table 5.3. Home Fires Involving Cords and Plugs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Unclassified Cord or Plug

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	160	(35%)	3	(15%)	12	(35%)	$4	(27%)
Mattress or bedding	50	(11%)	0	(0%)	2	(5%)	$2	(12%)
Floor covering	40	(8%)	12	(63%)	3	(9%)	$1	(6%)
Unclassified furniture or utensil	20	(5%)	0	(0%)	6	(17%)	$1	(5%)
Interior wall covering	20	(4%)	0	(0%)	0	(0%)	$0	(3%)
Unclassified item	20	(4%)	0	(0%)	1	(4%)	$1	(7%)
Upholstered furniture	20	(4%)	4	(21%)	7	(21%)	$1	(8%)
Appliance housing or casing	20	(4%)	0	(0%)	2	(5%)	$1	(6%)
Multiple item first ignited	20	(4%)	0	(0%)	2	(5%)	$0	(0%)
Unclassified structural component or finish	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Structural member or framing	10	(2%)	0	(0%)	0	(0%)	$0	(3%)
Unclassified soft goods or clothing	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Papers	10	(1%)	0	(0%)	0	(0%)	$1	(6%)
Clothing	10	(1%)	0	(0%)	0	(0%)	$0	(3%)
Cabinetry	10	(1%)	0	(0%)	0	(0%)	$0	(2%)
Curtain or drape	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Other known item first ignited	30	(8%)	0	(0%)	0	(0%)	$2	(10%)
Total fires	440	(100%)	18	(100%)	34	(100%)	$16	(100%)

Note: See detailed notes and source information at end of table.

Table 5.3. Home Fires Involving Cords and Plugs, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Detachable Power Cord or Plug

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	140	(44%)	2	(25%)	10	(38%)	$7	(59%)
Mattress or bedding	30	(8%)	0	(0%)	1	(6%)	$0	(4%)
Upholstered furniture	20	(7%)	4	(49%)	4	(15%)	$1	(9%)
Floor covering	20	(7%)	0	(0%)	3	(11%)	$0	(4%)
Interior wall covering	20	(5%)	0	(0%)	0	(0%)	$0	(1%)
Appliance housing or casing	20	(5%)	0	(0%)	0	(0%)	$1	(8%)
Structural member or framing	10	(3%)	0	(0%)	4	(14%)	$0	(2%)
Unclassified furniture or utensil	10	(3%)	0	(0%)	0	(0%)	$0	(1%)
Cabinetry	10	(3%)	0	(0%)	0	(0%)	$0	(2%)
Clothing	10	(2%)	2	(26%)	0	(0%)	$0	(2%)
Unclassified soft goods or clothing	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Box or bag	10	(2%)	0	(0%)	0	(0%)	$1	(4%)
Multiple items first ignited	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Other known item first ignited	20	(7%)	0	(0%)	4	(16%)	$0	(3%)
Total fires	320	(100%)	9	(100%)	25	(100%)	$12	(100%)

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported to confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and item first ignited unknown have also been allocated proportionally. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 5.4. Home Fires Involving Cords and Plugs, by Area of Origin
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Cords and Plugs

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	940	(35%)	31	(23%)	74	(32%)	$31	(31%)
Living room, family room, or den	450	(17%)	57	(42%)	65	(28%)	$23	(23%)
Kitchen	190	(7%)	3	(2%)	9	(4%)	$4	(4%)
Unclassified function area	180	(7%)	22	(17%)	13	(6%)	$8	(7%)
Garage*	120	(4%)	2	(2%)	9	(4%)	$8	(8%)
Laundry room or area	110	(4%)	0	(0%)	4	(2%)	$3	(3%)
Crawl space or substructure space	90	(3%)	0	(0%)	5	(2%)	$3	(3%)
Exterior wall surface	50	(2%)	0	(0%)	3	(1%)	$0	(0%)
Wall assembly or concealed space	50	(2%)	0	(0%)	4	(2%)	$1	(1%)
Ceiling/floor assembly or concealed space	50	(2%)	0	(0%)	1	(1%)	$2	(2%)
Unclassified structural area	40	(1%)	10	(7%)	1	(1%)	$3	(3%)
Attic or ceiling/roof assembly or concealed space	40	(1%)	0	(0%)	0	(0%)	$1	(1%)
Closet	40	(1%)	0	(0%)	3	(1%)	$3	(3%)
Bathroom	40	(1%)	0	(0%)	5	(2%)	$0	(0%)
Unclassified storage area	40	(1%)	0	(0%)	9	(4%)	$1	(1%)
Exterior balcony or unenclosed porch	30	(1%)	0	(0%)	4	(2%)	$1	(1%)
Unclassified area	30	(1%)	2	(2%)	4	(2%)	$1	(1%)
Office	30	(1%)	0	(0%)	0	(0%)	$1	(1%)
Lobby or entrance way	20	(1%)	2	(2%)	1	(1%)	$1	(1%)
Storage room, area, tank, or bin	20	(1%)	0	(0%)	1	(1%)	$0	(0%)
Courtyard, terrace or patio	20	(1%)	5	(3%)	0	(0%)	$1	(1%)
Unclassified means of egress	20	(1%)	0	(0%)	3	(1%)	$0	(0%)
Hallway or corridor	20	(1%)	0	(0%)	4	(2%)	$0	(0%)
Unclassified outside area	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Heating equipment room or area	20	(1%)	0	(0%)	1	(1%)	$0	(0%)
Other known area of origin	70	(3%)	0	(0%)	3	(1%)	$3	(3%)
Total fires	2,710	(100%)	134	(100%)	228	(100%)	$100	(100%)

* Excludes garage coded as separate property.

Note: See detailed notes and source information at end of table.

Table 5.4. Home Fires Involving Cords and Plugs, by Area of Origin
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Extension Cord

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	520	(35%)	25	(26%)	49	(35%)	$19	(32%)
Living room, family room, or den	270	(18%)	47	(50%)	47	(34%)	$14	(24%)
Unclassified function area	110	(7%)	5	(5%)	5	(4%)	$5	(8%)
Garage*	80	(6%)	2	(2%)	6	(5%)	$6	(10%)
Crawl space or substructure space	70	(4%)	0	(0%)	5	(4%)	$3	(4%)
Kitchen	60	(4%)	0	(0%)	5	(4%)	$1	(2%)
Laundry room or area	50	(3%)	0	(0%)	1	(1%)	$1	(2%)
Exterior wall surface	30	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified storage space	20	(2%)	0	(0%)	0	(0%)	$1	(2%)
Exterior balcony or unenclosed porch	20	(2%)	0	(0%)	1	(1%)	$0	(0%)
Closet	20	(2%)	0	(0%)	3	(2%)	$2	(4%)
Ceiling/floor assembly or concealed space	20	(1%)	0	(0%)	0	(0%)	$1	(2%)
Wall assembly or concealed space	20	(1%)	0	(0%)	4	(3%)	$1	(2%)
Unclassified structural area	20	(1%)	7	(8%)	0	(0%)	$1	(2%)
Attic or ceiling/roof assembly or concealed space	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Lobby or entrance way	20	(1%)	2	(3%)	1	(1%)	$0	(0%)
Unclassified outside area	20	(1%)	2	(2%)	1	(1%)	$0	(1%)
Storage room, area, tank, or bin	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Courtyard, terrace or patio	10	(1%)	5	(5%)	0	(0%)	$1	(1%)
Bathroom	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified means of egress	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Heating equipment room or area	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Unclassified outside area	10	(1%).	0	(0%)	0	(0%)	$0	(1%)
Tool or supply storage room or area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	40	(3%)	0	(0%)	6	(5%)	$1	(1%)
Total fires	1,500	(100%)	96	(100%)	140	(100%)	$60	(100%)

* Excludes garage coded as separate property.

Note: See detailed notes and source information at end of table.

Table 5.4. Home Fires Involving Cords and Plugs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Permanent Power Cord or Plug

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	150	(33%)	2	(19%)	14	(48%)	$4	(28%)
Kitchen	70	(16%)	3	(27%)	3	(10%)	$1	(10%)
Living room, family room, or den	60	(12%)	0	(0%)	0	(0%)	$4	(27%)
Laundry room or area	30	(8%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified function area	20	(5%)	6	(54%)	0	(0%)	$1	(7%)
Ceiling/floor assembly or concealed space	20	(4%)	0	(0%)	0	(0%)	$0	(3%)
Bathroom	10	(3%)	0	(0%)	4	(14%)	$0	(1%)
Crawl space or substructure space	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Garage*	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Wall assembly or concealed space	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Attic or ceiling/roof assembly or concealed space	10	(2%)	0	(0%)	0	(0%)	$1	(4%)
Office	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified storage area	10	(1%)	0	(0%)	8	(28%)	$0	(2%)
Other known area of origin	50	(11%)	0	(0%)	0	(0%)	$2	(14%)
Total fires	460	(100%)	11	(100%)	29	(100%)	$13	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 5.4. Home Fires Involving Cords and Plugs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Unclassified Cord or Plug

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	170	(38%)	2	(11%)	6	(16%)	$5	(33%)
Living room, family room or den	70	(15%)	9	(51%)	11	(32%)	$4	(25%)
Unclassified function area	30	(7%)	7	(37%)	4	(12%)	$1	(7%)
Kitchen	20	(6%)	0	(0%)	1	(4%)	$1	(4%)
Garage*	20	(4%)	0	(0%)	1	(4%)	$1	(6%)
Laundry room or area	10	(3%)	0	(0%)	0	(0%)	$0	(1%)
Bathroom	10	(3%)	0	(0%)	1	(4%)	$0	(0%)
Crawl space or substructure space	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified structural area	10	(2%)	0	(0%)	1	(4%)	$0	(0%)
Unclassified area	10	(2%)	0	(0%)	3	(8%)	$0	(1%)
Wall assembly or concealed space	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Office	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Exterior wall surface	10	(2%)	0	(0%)	3	(8%)	$0	(1%)
Attic or ceiling/roof/assembly or concealed space	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Other known area of origin	40	(9%)	0	(0%)	3	(8%)	$2	(16%)
Total fires	440	(100%)	18	(100%)	34	(100%)	$16	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 5.4. Home Fires Involving Cords and Plugs, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

E. Detachable Power Cord or Plug

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	100	(32%)	2	(25%)	5	(21%)	$3	(24%)
Living room, family room, or den	60	(18%)	0	(0%)	6	(25%)	$2	(14%)
Kitchen	30	(11%)	0	(0%)	0	(0%)	$0	(4%)
Unclassified function area	20	(7%)	4	(49%)	4	(15%)	$1	(7%)
Laundry room or area	10	(5%)	0	(0%)	3	(11%)	$1	(9%)
Garage*	10	(4%)	0	(0%)	1	(5%)	$1	(6%)
Wall assembly or concealed space	10	(3%)	0	(0%)	0	(0%)	$0	(0%)
Office	10	(3%)	0	(0%)	0	(0%)	$1	(5%)
Closet	10	(2%)	0	(0%)	0	(0%)	$0	(4%)
Unclassified structural area	10	(2%)	2	(26%)	0	(0%)	$2	(14%)
Exterior wall surface	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Exterior balcony or unenclosed porch	10	(2%)	0	(0%)	3	(12%)	$0	(4%)
Other known area of origin	30	(9%)	0	(0%)	3	(10%)	$1	(8%)
Total fires	320	(100%)	9	(100%)	25	(100%)	$12	(100%)

* Excludes garage reported as separate property.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and area of origin unknown have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Section 6. Transformers and Power Supplies

In 2009, an estimated 1,290 reported U.S. non-confined home structure fires involving transformers or power supplies resulted in 10 civilian deaths, 122 civilian injuries, and $50 million in direct property damage.

Transformers include the following specific types of equipment:

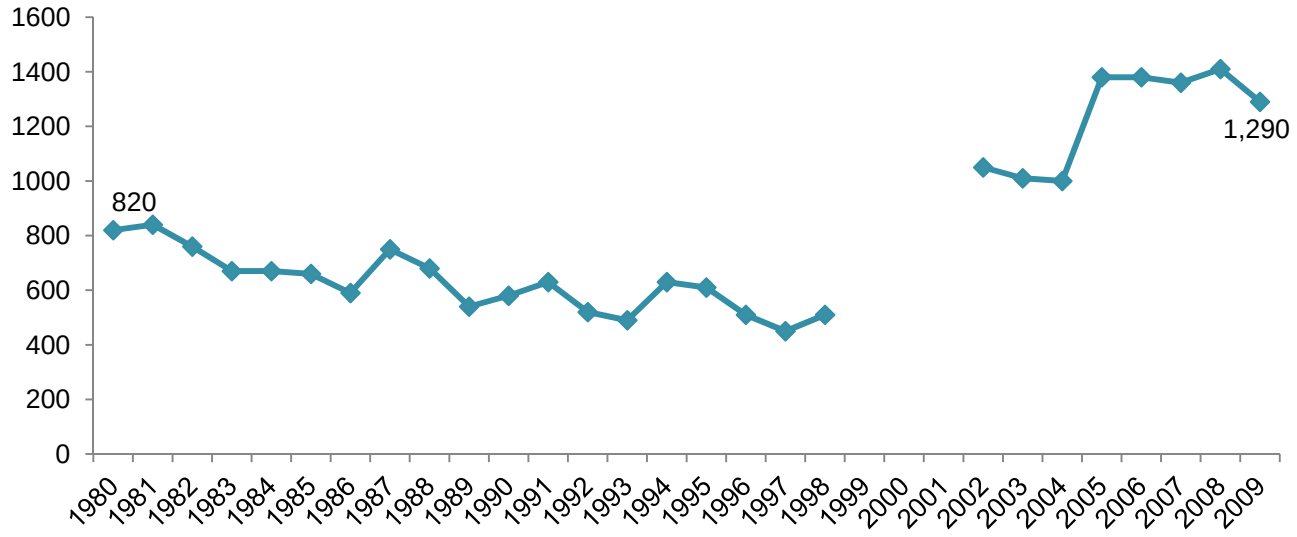
- Low voltage transformers
- Overcurrent or disconnect equipment associated with transformers
- Distribution type transformers

Power supplies (and related equipment) include the following specific types of equipment:

- Surge protectors
- Generators
- Batteries
- Battery chargers and rectifiers
- Inverters
- Uninterrupted power supplies

It is possible that some fires involving a battery are coded in terms of the appliance or equipment powered by the battery. Fires involving transformers, battery chargers, rectifiers, and inverters declined by more than one-third from 1980 to 1998. Fires involving surge protectors, generators, and batteries were given individual incident designations in NFIRS Version 5.0. Fires have continued to trend upwards from 2002 to 2009, perhaps in part because of increased usage of surge protectors and generators. (See Table 6.1 and Figure 6.1.) Also, there may be more battery-powered devices in use, including cell phones and old types of computer and other office equipment.

Figure 6.1 Home Fires Involving Transformers and Power Supplies, by Year
Structure Fires Reported to U.S. Fire Departments



Source: Data from NFIRS Version 5.0 and NFPA survey. Note: See Note on Table 6.1.

Transformers and power supplies accounted for 6% of 2005-2009 non-confined home structure fires involving electrical distribution or lighting equipment, as well as 4% of associated civilian deaths, 10% of associated civilian injuries, and 7% of associated direct property damage.

Surge protectors (37%) and generators (18%) accounted for over half of all home fires involving transformers or power supplies.
One-fifth (21%) of these fires involved one of three types of transformers. (See Table 6.A.)

Table 6.A. Home Fires Involving Transformers and Power Supplies, by Specific Type of Equipment
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments
(Excluding Fires Reported as Confined Fires)

Type of Equipment	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Surge protectors	500	(37%)	6	(39%)	32	(34%)	$17	(29%)
Generators	250	(18%)	9	(61%)	36	(38%)	$15	(25%)
Battery chargers and rectifiers	230	(17%)	0	(0%)	18	(19%)	$12	(20%)
Low voltage transformers	140	(10%)	0	(0%)	6	(16%)	$8	(14%)
Overcurrent or disconnect equipment associated with transformers	80	(6%)	0	(0%)	0	(0%)	$1	(2%)
Distribution type transformers	70	(5%)	0	(0%)	0	(0%)	$1	(3%)
Batteries	70	(5%)	0	(0%)	4	(4%)	$3	(6%)
Uninterrupted power supplies	20	(1%)	0	(0%)	0	(0%)	$1	(2%)
Inverters	10	(0%)	0	(0%)	0	(0%)	$0	(1%)
Total	1,360	(100%)	15	(100%)	95	(100%)	$59	(100%)

Note: Figures include confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Three of five (59%) 2005-2009 non-confined home structure fires involving transformers or power supplies cited some type of electrical failure or malfunction as a factor contributing to ignition.
One out of eight (13%) home generator fires involved a spill of flammable or combustible gas or liquid. (See Table 6.2.)

One-third (33%) of 2005-2009 non-confined home structure fires involving transformers or power supplies began with ignition of wire or cable insulation.
Other leading items first ignited were floor covering (7%), exterior wall covering (6%), flammable or combustible gas or liquid (6%), unclassified item (6%), appliance housing or casing (5%), and structural member or framing (5%). (See Table 6.3.)

One-third (34%) of 2005-2009 non-confined home structure fires involving transformers or power supplies began in a bedroom (20%) or living room, family room, or den (14%).
One in seven (14%) began in a garage, most of which were battery chargers or rectifiers (42% of these fires began in a garage). (See Table 6.4.)

In 2010, an estimated 14,990 injuries involving transformers or power supplies were reported to hospital emergency rooms.[24]
These consisted of 12,830 battery injuries, 1,980 generator injuries, and 500 battery charger injuries. The largest share of the 14,990 injuries was 4,690 injuries due to ingested object, followed by 1,430 contusions and abrasions and 1,270 strains and sprains.

In 1999 to 2010, 589 people died of non-fire injuries from unvented carbon monoxide from generators, or 49 deaths per year.[25]
Fueled equipment to generate electricity is the only type of electrical distribution or lighting equipment that can produce carbon monoxide. (Fueled lighting devices are not included in the scope of this report.)

The death toll from carbon monoxide produced by generators has increased sharply in recent years until 2007, from less than 10 per year on average in 1999 and prior years to 19 per year in 2000-2001, 47 per year in 2002-2004, 89 per year in 2005-2006, down to 52 per year in 2007-2009, and down to 29 in 2010.

The large jump in deaths involving generators in 2000 may reflect the fact that roughly half the total generators in use in 2000 had been purchased in 1999 because of concerns over Y2K (year 2000) problems with the nation's power grid.[26] This meant a large number of generator users had no experience in safe generator use. Disasters like Hurricane Katrina and a series of Florida hurricanes have added to the demand for generators and probably added to the number of inexperienced users.

The U.S. Consumer Product Safety Commission examined the circumstances of the 591 non-fire carbon monoxide generator deaths (including two deaths where other equipment was being used as a generator) in 1999-2010. One-eighth (76 deaths) occurred in temporary shelters.

Of the 503 deaths where the reason for generator use was known:

- 35% involved generator usage because of a weather-related power outage (34%) or because of preparation for a coming storm (1%),
- 34% involved generator usage because power had been shut off because of non-payment (21%) or because power had not been turned on in a building still under construction (13%),

[24] Statistics from National Electronic Injury Surveillance System (NEISS) data obtained from the U.S. Consumer Product Safety Commission (CPSC) website, www.cpsc.gov.
[25] Matthew V. Hnatov, *Incidents, deaths and in-depth investigations associated with non-fire carbon monoxide from engine-driven generators and other engine-driven tools, 1999-2010*, U.S. Consumer Product Safety Commission, July 2011, accessed at www.cpsc.gov.
[26] *Portable Generators*, U.S. Consumer Product Safety Commission, May 20, 2004, accessed at www.cpsc.gov.

- 27% involved generator use in either a building that does normally have power (8%) or a property separate from the main housing unit (20%), such as a storage shed, trailer, boat, camper, cabin, or campsite, and
- 4% involved generator use in a power outage due to unknown reasons.

Safety Tips

Generators

- Use generators only in well-ventilated areas outdoors, away from all doors, windows, and vent openings. This is to avoid serious danger of carbon monoxide poisoning from exhaust fumes.
- Generators should be operated and refueled in accordance with manufacturer's instructions.
- Do not use a generator that is in poor condition.
- Make sure the equipment is not overloaded.
- Carefully follow manufacturer's instructions when using any of these devices.
- Install carbon monoxide alarms, powered by batteries or with battery back-up to a line voltage connection by hard-wiring or plug-in, in accordance with manufacturer's instructions.
- Backfeeding electrical systems can be dangerous. Use a suitable transfer switch that prevents the inadvertent interconnection of the normal and standby sources of supply.

Table 6.1. Home Fires Involving Transformers and Power Supplies
Structure Fires Reported to U.S. Fire Departments
(Excluding Fires Reported as Confined Fires)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions) As Reported	In 2009 Dollars
1980	820	16	9	$3	$8
1981	840	0	8	$4	$9
1982	760	0	15	$5	$11
1983	670	0	17	$4	$8
1984	670	0	8	$10	$20
1985	660	0	14	$6	$12
1986	590	0	0	$7	$14
1987	750	4	29	$5	$10
1988	680	0	8	$6	$12
1989	540	0	25	$14	$24
1990	580	0	8	$4	$7
1991	630	4	13	$12*	$19*
1992	520	0	18	$4	$7
1993	490	0	21	$10	$15
1994	630	0	39	$9	$12
1995	610	0	11	$7	$10
1996	510	19	11	$10	$13
1997	450	0	13	$10	$13
1998	510	0	4	$10	$13
1999	1,320	0	105	$43	$55
2000	1,100	0	0	$18	$23
2001	980	131	47	$40	$48
2002	1,050	15	44	$31	$37
2003	1,010	0	18	$52	$60
2004	1,000	29	61	$41	$47
2005	1,380	29	132	$75	$82
2006	1,380	10	66	$50	$53
2007	1,360	12	27	$58	$60
2008	1,410	14	130	$64	$64
2009	1,290	10	122	$50	$50

* All 1991 home fire property damage figures are inflated by estimation problems related to the handling of the Oakland fire storm.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and civilian injuries are expressed to the nearest one, and property damage is rounded to the nearest million dollars. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or reported as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.*
Inflation adjustment to 2009 dollars is done using the consumer price index.
Source: Data from NFIRS (Version 5.0 after 1998) and NFPA survey.

Table 6.2. Home Fires Involving Transformers and Power Supplies, by Factor Contributing to Ignition
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Transformers and Power Supplies

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	450	(33%)	11	(71%)	19	(20%)	$24	(42%)
Unspecified short circuit arc	240	(18%)	0	(0%)	12	(12%)	$7	(12%)
Heat source too close to combustibles	130	(10%)	0	(0%)	10	(11%)	$5	(9%)
Unclassified mechanical failure or malfunction	110	(8%)	0	(0%)	11	(11%)	$4	(7%)
Equipment overloaded	110	(8%)	0	(0%)	7	(7%)	$3	(6%)
Arc or spark from operating equipment	60	(5%)	0	(0%)	7	(7%)	$4	(7%)
Equipment unattended	40	(3%)	0	(0%)	2	(2%)	$6	(11%)
Unclassified misuse of material	40	(3%)	0	(0%)	5	(5%)	$2	(3%)
Flammable liquid or gas spilled	40	(3%)	4	(29%)	17	(18%)	$1	(2%)
Short circuit arc from defective or worn insulation	30	(2%)	0	(0%)	0	(0%)	$1	(2%)
Short circuit arc from mechanical damage	20	(2%)	0	(0%)	0	(0%)	$1	(2%)
Improper fueling technique	20	(2%)	0	(0%)	5	(5%)	$1	(1%)
Unclassified operational deficiency	20	(1%)	0	(0%)	2	(2%)	$2	(3%)
Installation deficiency	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Worn out	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Arc from faulty contact or broken conductor	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified factor	20	(1%)	0	(0%)	0	(0%)	$2	(4%)
Improper container or storage	10	(1%)	0	(0%)	2	(2%)	$0	(0%)
Storm	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Equipment not being operated properly	10	(1%)	0	(0%)	3	(4%)	$1	(1%)
Water caused short circuit arc	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Abandoned or discarded material	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Automatic control failure	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified natural condition	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Leak or break	10	(1%)	0	(0%)	2	(2%)	$0	(1%)
Other known factor contributing to ignition	60	(4%)	0	(0%)	3	(3%)	$1	(2%)
Total fires	1,360	(100%)	15	(100%)	95	(100%)	$59	(100%)
Total factor entries	1,520	(112%)	15	(100%)	105	(111%)	$70	(119%)
All electrical failures or malfunctions	810	(59%)	11	(71%)	33	(35%)	$38	(65%)

Note: See detailed notes and source information at end of table.

Table 6.2. Home Fires Involving Transformers and Power Supplies, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Surge Protector

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	210	(43%)	6	(100%)	15	(48%)	$9	(55%)
Unspecified short circuit arc	110	(22%)	0	(0%)	8	(26%)	$2	(15%)
Equipment overloaded	70	(15%)	0	(0%)	9	(28%)	$2	(14%)
Arc or spark from operating equipment	20	(4%)	0	(0%)	2	(7%)	$0	(1%)
Unclassified mechanical failure or malfunction	20	(4%)	0	(0%)	0	(0%)	$0	(3%)
Unclassified misuse of material	20	(4%)	0	(0%)	2	(6%)	$1	(6%)
Short circuit arc from mechanical damage	20	(3%)	0	(0%)	0	(0%)	$1	(5%)
Heat source too close to combustibles	10	(3%)	0	(0%)	2	(6%)	$0	(3%)
Arc from faulty contact or broken conductor	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Short circuit arc from defective or worn insulation	10	(2%)	0	(0%)	0	(0%)	$1	(5%)
Water caused short circuit arc	10	(1%)	0	(0%)	0	(0%)	$0	(2%)
Worn out	10	(1%)	0	(0%0	0	(0%)	$1	(4%)
Other known factor contributing to ignition	30	(6%)	0	(0%)	0	(0%)	$2	(9%)
Total fires	500	(100%)	6	(100%)	32	(100%)	$17	(100%)
Total factor entries	560	(111%)	6	(100%)	38	(121%)	$21	(122%)
All electrical failures or malfunctions	380	(76%)	6	(100%)	21	(67%)	$14	(82%)

Note: See detailed notes and source information at end of table.

Table 6.2. Home Fires Involving Transformers and Power Supplies, by Factor Contributing to Ignition (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Generator

Factor	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Heat source too close to combustibles	70	(27%)	0	(0%)	6	(16%)	$4	(26%)
Unclassified mechanical failure or malfunction	30	(14%)	0	(0%)	1	(4%)	$1	(9%)
Flammable liquid or gas spilled	30	(13%)	9	(100%)	14	(41%)	$1	(7%)
Unclassified electrical failure or malfunction	20	(8%)	0	(0%)	2	(4%)	$1	(10%)
Equipment unattended	20	(6%)	0	(0%)	0	(0%)	$2	(13%)
Improper fueling technique	20	(6%)	0	(0%)	3	(8%)	$1	(4%)
Unclassified operational deficiency	10	(5%)	0	(0%)	2	(4%)	$1	(8%)
Arc or spark from operating equipment	10	(4%)	0	(0%)	4	(12%)	$2	(16%)
Unclassified misuse of material	10	(4%)	0	(0%)	3	(7%)	$0	(1%)
Improper container or storage	10	(3%)	0	(0%)	2	(4%)	$0	(2%)
Equipment not being operated properly	10	(3%)	0	(0%)	2	(4%)	$1	(4%)
Installation deficiency	10	(3%)	0	(0%)	0	(0%)	$0	(1%)
Unspecified short circuit arc	10	(2%)	0	(0%)	0	(0%)	$1	(4%)
Backfire	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Equipment overloaded	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Other known factor contributing to ignition	30	(14%)	0	(0%)	3	(7%)	$2	(10%)
Total fires	250	(100%)	9	(100%)	36	(100%)	$15	(100%)
Total factor entries	290	(116%)	9	(100%)	40	(112%)	$17	(115%)
All electrical failures or malfunctions	30	(14%)	0	(0%)	6	(16%)	$4	(29%)

Note: See detailed notes and source information at end of table.

Table 6.2. Home Fires Involving Transformers and Power Supplies, by Factor Contributing to Ignition (Continued) Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Battery Charger or Rectifier

Factor Fires	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified electrical failure or malfunction	90	(37%)	0	(NA)	4	(23%)	$4	(31%)
Unspecified short circuit arc	40	(19%)	0	(NA)	3	(17%)	$2	(18%)
Unclassified mechanical failure or malfunction	30	(12%)	0	(NA)	8	(44%)	$1	(10%)
Heat source too close to combustibles	30	(11%)	0	(NA)	1	(8%)	$1	(6%)
Arc or spark from operating equipment	20	(7%)	0	(NA)	0	(0%)	$1	(11%)
Equipment unattended	10	(6%)	0	(NA)	1	(8%)	$2	(18%)
Short circuit arc from defective or worn insulation	10	(3%)	0	(NA)	0	(0%)	$0	(2%)
Equipment overloaded	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Other known factor contributing to ignition	20	(10%)	0	(NA)	0	(0%)	$1	(6%)
Total fires	230	(100%)	0	(NA)	18	(100%)	$12	(100%)
Total factor entries	250	(108%)	0	(NA)	18	(100%)	$12	(104%)
All electrical failures or malfunctions	130	(56%)	0	(NA)	5	(28%)	$7	(59%)

NA – Not applicable because total is zero.

Note: Multiple entries are allowed, resulting in more factor entries than fires. "All electrical failures and malfunctions" is a multi-factor group that has been analyzed to eliminate double-counting of fires. Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and factor contributing to ignition listed as unknown, unreported, none, or blank have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 6.3. Home Fires Involving Transformers and Power Supplies, by Item First Ignited
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Transformers and Power Supplies

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	450	(33%)	0	(0%)	28	(29%)	$17	(28%)
Floor covering	100	(7%)	0	(0%)	6	(6%)	$3	(5%)
Exterior wall covering or finish	80	(6%)	0	(0%)	4	(4%)	$3	(5%)
Flammable or combustible gas or liquid	80	(6%)	9	(61%)	25	(27%)	$3	(5%)
Unclassified item	80	(6%)	0	(0%)	3	(3%)	$4	(7%)
Appliance housing	60	(5%)	0	(0%)	3	(3%)	$3	(5%)
Structural member or framing	60	(5%)	0	(0%)	0	(0%)	$6	(10%)
Transformer or transformer fluids	50	(4%)	0	(0%)	1	(2%)	$1	(2%)
Cabinetry	50	(3%)	0	(0%)	5	(5%)	$2	(3%)
Multiple items first ignited	40	(3%)	0	(0%)	0	(0%)	$5	(8%)
Interior wall covering	30	(2%)	0	(0%)	0	(0%)	$2	(3%)
Upholstered furniture	30	(2%)	0	(0%)	6	(6%)	$1	(2%)
Mattress or bedding	30	(2%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified furniture or utensil	20	(2%)	0	(0%)	1	(2%)	$1	(1%)
Clothing	20	(1%)	0	(0%)	1	(2%)	$1	(1%)
Unclassified structural component or finish	20	(1%)	6	(39%)	2	(2%)	$1	(2%)
Exterior trim including doors	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Box or bag	10	(1%)	0	(0%)	0	(0%)	$0	(1%)
Papers	10	(1%)	0	(0%)	1	(1%)	$1	(2%)
Toy or game	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Curtain or drape	10	(1%)	0	(0%)	2	(2%)	$1	(1%)
Pipe, duct, conduit or hose	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Trash or waste	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Ceiling covering	10	(1%)	0	(0%)	2	(2%)	$0	(0%)
Other known item first ignited	70	(5%)	0	(0%)	5	(5%)	$2	(4%)
Total fires	1,360	(100%)	15	(100%)	95	(100%)	$59	(100%)

Note: See detailed notes and source information at end of table.

Table 6.3. Home Fires Involving Transformers and Power Supplies, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Surge Protector

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	240	(48%)	0	(0%)	13	(40%)	$6	(37%)
Floor covering	70	(14%)	0	(0%)	5	(16%)	$2	(10%)
Appliance housing or casing	40	(7%)	0	(0%)	3	(9%)	$2	(14%)
Cabinetry	30	(6%)	0	(0%)	4	(13%)	$1	(8%)
Unclassified item	20	(5%)	0	(0%)	0	(0%)	$0	(1%)
Interior wall covering	20	(3%)	0	(0%)	0	(0%)	$1	(5%)
Unclassified furniture or utensil	10	(2%)	0	(0%)	1	(4%)	$0	(1%)
Multiple items first ignited	10	(2%)	0	(0%)	0	(0%)	$1	(4%)
Clothing	10	(2%)	0	(0%)	1	(4%)	$1	(3%)
Mattress or bedding	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Structural member or framing	10	(2%)	0	(0%)	0	(0%)	$1	(5%)
Upholstered furniture	10	(2%)	0	(0%)	1	(4%)	$0	(1%)
Other known item first ignited	30	(6%)	6	(100%)*	3	(9%)	$2	(10%)
Total fires	500	(100%)	6	(100%)	32	(100%)	$17	(100%)

* The leading item first ignited for fire deaths not shown above is unclassified structural component or finish (100% of deaths).

Note: See detailed notes and source information at end of table.

Table 6.3. Home Fires Involving Transformers and Power Supplies, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Generator

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Flammable or combustible gas or liquid	70	(29%)	9	(100%)	26	(73%)	$3	(21%)
Exterior wall covering	50	(20%)	0	(0%)	5	(13%)	$2	(14%)
Wire or cable insulation	20	(9%)	0	(0%)	0	(0%)	$2	(16%)
Structural member or framing	20	(9%)	0	(0%)	0	(0%)	$3	(23%)
Exterior trim including doors	20	(6%)	0	(0%)	0	(0%)	$0	(3%)
Floor covering	10	(3%)	0	(0%)	0	(0%)	$1	(5%)
Unclassified structural component or finish	10	(3%)	0	(0%)	2	(5%)	$1	(7%)
Multiple items first ignited	10	(3%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified item	10	(3%)	0	(0%)	0	(0%)	$0	(2%)
Ceiling covering	10	(2%)	0	(0%)	2	(5%)	$0	(1%)
Other known item first ignited	30	(13%)	0	(0%)	2	(5%)	$1	(8%)
Total fires	250	(100%)	9	(100%)	36	(100%)	$15	(100%)

Note: See detailed notes and source information at end of table.

Table 6.3. Home Fires Involving Transformers and Power Supplies, by Item First Ignited (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Battery Charger or Rectifier

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	70	(31%)	0	(NA)	12	(68%)	$5	(43%)
Floor covering	20	(9%)	0	(NA)	0	(0%)	$1	(7%)
Unclassified item	20	(7%)	0	(NA)	0	(0%)	$1	(6%)
Multiple items first ignited	10	(5%)	0	(NA)	0	(0%)	$1	(7%)
Upholstered furniture	10	(5%)	0	(NA)	3	(17%)	$1	(8%)
Mattress or bedding	10	(5%)	0	(NA)	0	(0%)	$0	(2%)
Interior wall covering	10	(5%)	0	(NA)	0	(0%)	$1	(4%)
Appliance housing or casing	10	(4%)	0	(NA)	0	(0%)	$0	(1%)
Toy or game	10	(4%)	0	(NA)	0	(0%)	$0	(1%)
Flammable or combustible gas or liquid	10	(4%)	0	(NA)	1	(8%)	$0	(2%)
Cabinetry	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Structural member or framing	10	(2%)	0	(NA)	0	(0%)	$1	(6%)
Unclassified furniture or utensil	10	(2%)	0	(NA)	0	(0%)	$0	(2%)
Other known item first ignited	30	(14%)	0	(NA)	1	(7%)	$1	(10%)
Total fires	230	(100%)	0	(NA)	18	(100%)	$12	(100%)

NA – Not applicable because total is zero.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported to confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and item first ignited unknown have also been allocated proportionally. Totals may not equal sums because of rounding.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Table 6.4. Home Fires Involving Transformers and Power Supplies, by Area of Origin
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

A. All Transformers and Power Supplies

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	270	(20%)	0	(0%)	23	(24%)	$9	(16%)
Living room, family room, or den	190	(14%)	8	(54%)	17	(18%)	$6	(11%)
Garage*	190	(14%)	0	(0%)	8	(8%)	$15	(26%)
Unclassified function area	70	(5%)	0	(0%)	6	(6%)	$2	(4%)
Exterior wall surface	50	(4%)	0	(0%)	3	(3%)	$1	(2%)
Wall assembly or concealed space	40	(3%)	0	(0%)	0	(0%)	$1	(2%)
Unclassified storage area	40	(3%)	0	(0%)	3	(3%)	$1	(1%)
Office	40	(3%)	0	(0%)	4	(4%)	$1	(2%)
Crawl space or substructure space	40	(3%)	2	(16%)	12	(12%)	$1	(1%)
Kitchen	40	(3%)	0	(0%)	1	(2%)	$2	(4%)
Exterior balcony or unenclosed porch	30	(3%)	2	(14%)	0	(0%)	$6	(10%)
Unclassified outside area	30	(2%)	0	(0%)	1	(2%)	$0	(1%)
Unclassified equipment or service area	30	(2%)	0	(0%)	1	(2%)	$1	(1%)
Unclassified area	30	(2%)	0	(0%)	0	(0%)	$0	(0%)
Switchgear area or transformer vault	20	(2%)	0	(0%)	0	(0%)	$0	(0%)
Closet	20	(2%)	0	(0%)	0	(0%)	$0	(1%)
Laundry room or area	20	(1%)	2	(15%)	1	(1%)	$0	(1%)
Courtyard, terrace or patio	20	(1%)	0	(0%)	1	(1%)	$4	(6%)
Unclassified structural area	20	(1%)	0	(0%)	1	(1%)	$1	(1%)
Unclassified means of egress	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Ceiling/floor assembly or concealed space	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Attic or ceiling/roof assembly or concealed space	10	(1%)	0	(0%)	0	(0%)	$1	(2%)
Dining room	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Storage room, area, tank, or bin	10	(1%)	0	(0%)	3	(3%)	$0	(0%)
Bathroom	10	(1%)	0	(0%)	3	(3%)	$0	(1%)
Unclassified vehicle area	10	(1%)	0	(0%)	1	(1%)	$0	(1%)
Conduit, pipe, utility, or ventilation shaft	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Lobby or entrance way	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Computer room or center	10	(1%)	0	(0%0	0	(0%)	$0	(0%)
Exterior stairway, ramp, or fire escape	10	(1%)	0	(0%)	1	(2%)	$0	(1%)
Other known area of origin	70	(5%)	0	(0%)	4	(4%)	$2	(4%)
Total fires	1,360	(100%)	15	(100%)	95	(100%)	$59	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 6.4. Home Fires Involving Transformers and Power Supplies, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

B. Surge Protector

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	190	(37%)	0	(0%)	17	(55%)	$7	(41%)
Living room, family room, or den	130	(27%)	6	(100%)	6	(20%)	$4	(24%)
Unclassified function area	50	(9%)	0	(0%)	3	(9%)	$2	(12%)
Office	30	(6%)	0	(0%)	3	(8%)	$1	(5%)
Garage*	10	(3%)	0	(0%)	0	(0%)	$1	(3%)
Kitchen	10	(3%)	0	(0%)	0	(0%)	$1	(7%)
Wall assembly or concealed space	10	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified storage area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Computer room or center	10	(1%)	0	(0%)	0	(0%0	$0	(0%)
Unclassified structural area	10	(1%)	0	(0%)	1	(4%)	$0	(1%)
Laundry room or area	10	(1%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified area	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area of origin	30	(7%)	0	(0%)	1	(4%)	$1	(4%)
Total fires	500	(100%)	6	(100%)	32	(100%)	$17	(100%)

* Excludes garage reported as separate property.

Note: See detailed notes and source information at end of table.

Table 6.4. Home Fires Involving Transformers and Power Supplies, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

C. Generator

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Garage*	30	(14%)	0	(0%)	3	(8%)	$5	(35%)
Exterior wall surface	30	(12%)	0	(0%)	3	(7%)	$1	(7%)
Exterior balcony or unenclosed porch	20	(9%)	2	(23%)	0	(0%)	$2	(16%)
Unclassified storage area	10	(6%)	0	(0%)	3	(8%)	$0	(2%)
Unclassified outside area	10	(5%)	0	(0%)	1	(4%)	$0	(1%)
Unclassified means of egress	10	(5%)	0	(0%)	0	(0%)	$0	(1%)
Unclassified area	10	(5%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified equipment or service area	10	(4%)	0	(0%)	1	(4%)	$1	(5%)
Wall assembly or concealed space	10	(4%)	0	(0%)	0	(0%)	$0	(1%)
Living room, family room, or den	10	(4%)	2	(25%)	2	(7%)	$1	(4%)
Bedroom	10	(4%)	0	(0%)	1	(3%)	$0	(2%)
Exterior stairway, ramp, or fire escape	10	(3%)	0	(0%)	1	(4%)	$0	(3%)
Crawl space or substructure space	10	(3%)	2	(26%)	10	(29%)	$0	(2%)
Courtyard, terrace or patio	10	(3%)	0	(0%)	1	(3%)	$0	(3%)
Exterior surface of vehicle	10	(2%)	0	(0%)	0	(0%)	$0	(2%)
Unclassified function area	10	(2%)	0	(0%)	0	(0%)	$0	(1%)
Other known area of origin	40	(16%)	2	(25%)**	8	(22%)	$2	(14%)
Total fires	250	(100%)	9	(100%)	36	(100%)	$15	(100%)

* Excludes garage reported as separate property.

** The leading area of origin for fire deaths not shown above is laundry room or area (25% of deaths).

Note: See detailed notes and source information at end of table.

Table 6.4. Home Fires Involving Transformers and Power Supplies, by Area of Origin (Continued)
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

D. Battery Charger or Rectifier

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Garage*	100	(42%)	0	(NA)	3	(15%)	$6	(54%)
Bedroom	40	(16%)	0	(NA)	1	(7%)	$1	(9%)
Living room, family room, or den	20	(9%)	0	(NA)	7	(41%)	$1	(6%)
Crawl space or substructure space	10	(4%)	0	(NA)	1	(7%)	$0	(4%)
Unclassified function area	10	(3%)	0	(NA)	1	(8%)	$0	(1%)
Unclassified storage area	10	(3%)	0	(NA)	0	(0%)	$0	(2%)
Exterior balcony or unenclosed porch	10	(3%)	0	(NA)	0	(0%)	$1	(8%)
Storage room, area, tank, or bin	10	(3%)	0	(NA)	0	(0%)	$0	(2%)
Closet	10	(3%)	0	(NA)	0	(0%)	$0	(1%)
Other known area of origin	40	(15%)	0	(NA)	4	(21%)	$2	(14%)
Total fires	230	(100%)	0	(NA)	18	(100%)	$12	(100%)

* Excludes garage reported as separate property.

NA – Not applicable because total is zero.

Note: Figures exclude confined fires, which are not considered relevant to these types of equipment, because these are fires reported as confined to fuel burner or boiler, chimney or flue, cooking vessel, trash, incinerator, or commercial compactor. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage to the nearest million dollars. Damage has not been adjusted for inflation. Figures reflect a proportional share of home fires with equipment involved in ignition unknown or recorded as electrical distribution or lighting equipment of undetermined type. Fires reported as "no equipment" but lacking a confirming specific heat source (codes 40-99) are also treated as unknown equipment and allocated. Home structure fires with this equipment and area of origin unknown have also been allocated proportionally. Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 5.0 and NFPA survey.

Appendix A.
How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit http://www.nfirs.fema.gov/. Copies of the paper forms may be downloaded from http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf.

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is impossible to tell the portion of each from the coded data.

Methodology may change slightly from year to year.
NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

NFPA's fire department experience survey provides estimates of the big picture.
Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S.

population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; 3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf.

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database -- the NFPA survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

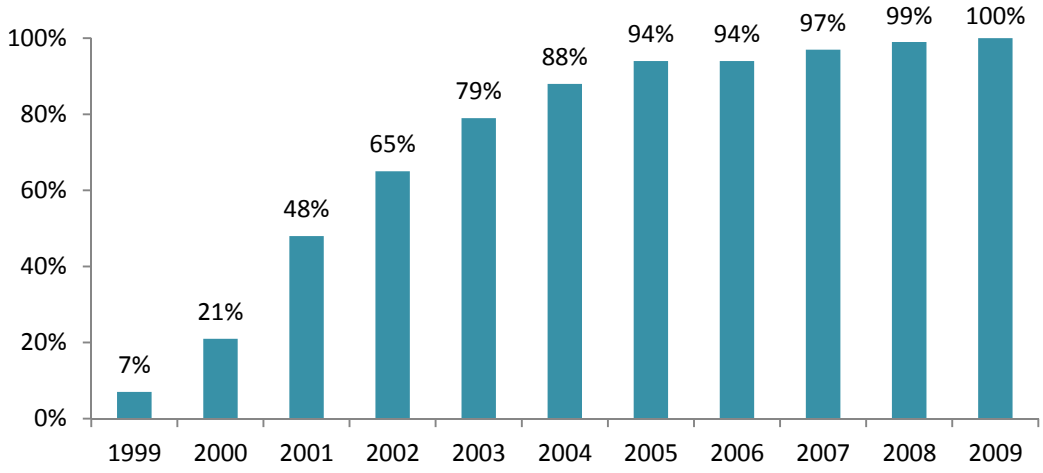
Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA's analyses.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic analytical rules used for this procedure. "The National Estimates Approach to U.S. Fire Statistics," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates. A copy of the article is available online at http://www.nfpa.org/osds or through NFPA's One-Stop Data Shop.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

Figure A.1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

Figure A.1. Fires Originally Collected in NFIRS 5.0, by Year



From 1999 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

<u>NFPA survey projections</u>
NFIRS totals (Version 5.0)

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

NFIRS 5.0 introduced six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases. Some analyses, particularly those that examine cooking equipment, heating equipment, fires caused by smoking materials, and fires started by playing with fire, may examine the confined fires in greater detail. Because the confined fire incident types describe certain scenarios, the distribution of unknown data differs from that of all fires. Consequently, allocation of unknowns must be done separately.

Some analyses of structure fires show only non-confined fires. In these tables, percentages shown are of non-confined structure fires rather than all structure fires. This approach has the advantage of showing the frequency of specific factors in fire causes, but the disadvantage of

possibly overstating the percentage of factors that are seldom seen in the confined fire incident types and of understating the factors specifically associated with the confined fire incident types.

Other analyses include entries for confined fire incident types in the causal tables and show percentages based on total structure fires. In these cases, the confined fire incident type is treated as a general causal factor.

For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

In the formulas that follow, the term "all fires" refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Cause of Ignition: This field is used chiefly to identify intentional fires. "Unintentional" in this field is a specific entry and does not include other fires that were not intentionally set: failure of equipment or heat source, act of nature, or "other" (unclassified)." The last should be used for exposures but has been used for other situations as well. Fires that were coded as under investigation and those that were coded as undetermined after investigation were treated as unknown.

Factor Contributing to Ignition: In this field, the code "none" is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for "not reported" when no factors are recorded. "Not reported" is treated as an unknown, but the code "none" is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.

In some analyses, all entries in the category of mechanical failure, malfunction (factor contributing to ignition 20-29) are combined and shown as one entry, "mechanical failure or malfunction." This category includes:

21. Automatic control failure;
22. Manual control failure;
23. Leak or break. Includes leaks or breaks from containers or pipes. Excludes operational deficiencies and spill mishaps;
25. Worn out;
26. Backfire. Excludes fires originating as a result of hot catalytic converters;
27. Improper fuel used; Includes the use of gasoline in a kerosene heater and the like; and
20. Mechanical failure or malfunction, other.

Entries in "electrical failure, malfunction" (factor contributing to ignition 30-39) may also be combined into one entry, "electrical failure or malfunction." This category includes:

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;
34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
30. Electrical failure or malfunction, other.

Heat Source. In NFIRS 5.0, one grouping of codes encompasses various types of open flames and smoking materials. In the past, these had been two separate groupings. A new code was added to NFIRS 5.0, which is code 60: "Heat from open flame or smoking material, other." NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette;
62. Pipe or cigar;
63. Heat from undetermined smoking material;
64. Match;
65. Lighter: cigarette lighter, cigar lighter;
66. Candle;
67 Warning or road flare, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by

$$\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}$$

The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping "smoking materials" includes codes 61-63 (cigarettes, pipes or cigars, and heat from undetermined smoking material, with a proportional share of the code 60s and true unknown data.

Equipment Involved in Ignition (EII). NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to "the piece of equipment that provided the principal heat source to cause ignition." However, much of the data predates the change. Individuals who have

already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.

To allocate unknown data for EII, the known data is multiplied by

$$\frac{\text{All fires}}{(\text{All fires} - \text{blank} - \text{undetermined} - [\text{fires in which EII} = \text{NNN and heat source} <> 40\text{-}99])}$$

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100 - heating, ventilation, and air conditioning, other; code 200 - electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach has the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together.

Code Grouping	**EII Co**	**NFIRS definitions**
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater
	143	Oil-filled heater
Fireplace or chimney	120	Fireplace or chimney
	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Fixed wiring and related equipment	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	213	Electric meter or meter box
	214	Wiring from meter box to circuit breaker
	215	Panel board, switch board or circuit breaker board
	216	Electrical branch circuit
	217	Outlet or receptacle

	218	Wall switch
	219	Ground fault interrupter
Transformers and power supplies	221	Distribution-type transformer
	222	Overcurrent, disconnect equipment
	223	Low-voltage transformer
	224	Generator
	225	Inverter
	226	Uninterrupted power supply (UPS)
	227	Surge protector
	228	Battery charger or rectifier
	229	Battery (all types)
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast
	235	Halogen light fixture or lamp
	236	Sodium or mercury vapor light fixture or lamp
	237	Work or trouble light
	238	Light bulb
	241	Nightlight
	242	Decorative lights – line voltage
	243	Decorative or landscape lighting – low voltage
	244	Sign
Cord or plug	260	Unclassified cord or plug
	261	Power cord or plug, detachable from appliance
	262	Power cord or plug- permanently attached
	263	Extension cord
Torch, burner or soldering iron	331	Welding torch
	332	Cutting torch
	333	Burner, including Bunsen burners
	334	Soldering equipment
Portable cooking or warming equipment	631	Coffee maker or teapot
	632	Food warmer or hot plate
	633	Kettle
	634	Popcorn popper
	635	Pressure cooker or canner
	636	Slow cooker

637	Toaster, toaster oven, counter-top broiler
638	Waffle iron, griddle
639	Wok, frying pan, skillet
641	Breadmaking machine

Equipment was not analyzed separately for confined fires. Instead, each confined fire incident type was listed with the equipment or as other known equipment.

Item First Ignited. In most analyses, mattress and pillows (item first ignited 31) and bedding, blankets, sheets, and comforters (item first ignited 32) are combined and shown as "mattresses and bedding." In many analyses, wearing apparel not on a person (code 34) and wearing apparel on a person (code 35) are combined and shown as "clothing." In some analyses, flammable and combustible liquids and gases, piping and filters (item first ignited 60-69) are combined and shown together.

Area of Origin. Two areas of origin: bedroom for more than five people (code 21) and bedroom for less than five people (code 22) are combined and shown as simply "bedroom." Chimney is no longer a valid area of origin code for non-confined fires.

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.

Appendix B – What Is an Electrical Fire?

There are several possible approaches to estimating the electrical part of the home fire problem.

The most direct and inclusive approach is to identify fires that began because of some type of *electrical failure or malfunction*. Version 5.0 of the National Fire Incident Reporting System (NFIRS), first introduced in 1999, introduced many changes in data classifications, definitions, and rules. Among those changes was the creation of an Electrical Failure or Malfunction section in the Factor Contributing to Ignition data element.

Prior to the introduction of NFIRS Version 5.0, there were two fields that could be used to identify electrical failures. One was the Form of Heat of Ignition field, which had 10 categories defined by different failure modes for electrical equipment plus two additional categories for properly or improperly operating electrical equipment and a thirteenth category for electric lamp or light bulb. The other was the Ignition Factor field, which had two relevant categories – short circuit or ground fault, and other electrical failure.

Because the pre-1999 Form of Heat of Ignition also had two categories each for gas-fueled, liquid-fueled, and solid-fueled equipment, the field was primarily used to distinguish equipment fires by type of fuel or power. NFIRS Version 5.0 provides a separate field on Equipment Power, which means it is no longer necessary to use Heat Source codes as a proxy for this purpose. The new Heat Source field has removed the 13 Form of Heat of Ignition categories that had referred to electrical equipment and added one category for electrical arcing. Seven of the 13 categories that used to be in the Electrical Equipment section of Heat Source are now in an Electrical Failure or Malfunction section of the Factor Contributing to Ignition field. Six of the seven (excluding fluorescent light ballast) are defined by some type of arcing. The former Form of Heat of Ignition category of overloaded equipment within the Electrical Equipment section is now an equipment overloaded category applicable to any type of equipment and located within the Operational Deficiency section of Factor Contributing to Ignition. The other five electrical-related categories – electric lamp or light bulb, properly or improperly operating electrical equipment, and unclassified or unknown-type electrical equipment – either no longer exist or are now represented by the "other" (unclassified or unknown-type) electrical failure or malfunction category.

The unclassified and unknown-type electrical equipment categories that were in Form of Heat of Ignition prior to 1999 both referenced "heat from electrical equipment arcing or overloaded." This phrasing provided a subtle reminder that not all electrical ignitions involve arcing. Overloaded circuits can overheat and ignite nearby combustibles without arcing. The new unclassified and unknown-type electrical failure or malfunction includes no such reminder but is not limited to arcing.

Here are some of the estimates of 1980 home electrical failure or malfunction reported structure fires that could be developed from these two data fields:

(1) 202,500, based on all 13 potentially relevant categories in the Form of Heat of Ignition field;

(2) 100,700, based on the Form of Heat of Ignition field but excluding four specific categories that do not mention a type of electrical failure or malfunction in their labels – electric lamp or light bulb, heat from properly operating electrical equipment, heat from improperly operating electrical equipment, and heat from overloaded equipment – while including fluorescent light ballast; this was the formula used in the 2009 report;
(3) 83,700, based on formula (2) with the additional exclusion of heat from unclassified or unknown-type electrical equipment arcing or overloading; and
(4) 71,700, based on the two Ignition Factor codes, which is the formula used in this report.

From 1999 on, the Factor Contributing to Ignition field provides the most comprehensive but focused identification of fires involving electrical failure or malfunction, and pre-1999, the Ignition Factor field is most similar to the current Factor Contributing to Ignition field. The old Form of Heat of Ignition field had too many categories that might have been mostly or partly filled with fires started by heat from electrical equipment but with no electrical failure or malfunction involved.

The new Heat Source field cannot be used to estimate fires involving all forms of electrical failure or malfunction but only electrical arcing. That approach results in an estimate 35% lower than the 2003-2007 non-confined home fires estimate for electrical failure or malfunction. If fires with Heat Source coded as unclassified or unknown-type within the Operating Equipment section of Heat Source, which includes electrical arcing, are proportionally allocated over the section, the adjusted electrical arcing estimate is still 11% lower than the 2003-2007 estimate based on electrical failure or malfunction as a factor contributing to ignition. Because the latter also includes more detail on the failure mode resulting in arcing, this report does not use the electrical arcing category in Heat Source as the basis of estimates of the size of the electrical failure problem.

In previous years, NFPA analysis of home electrical fires focused on fires where some type of electrical distribution or lighting equipment was the equipment involved in ignition. This approach was not so inclusive as direct analysis of all electrical failures but could be executed more cleanly than the more inclusive approach prior to the introduction of Version 5.0 of NFIRS.

Prior to 1999, NFIRS had 10 electrical distribution equipment categories, including separate categories for unclassified and unknown-type equipment. There was also an eleventh category (rectifier, charger, inverter, battery) that was outside the electrical distribution equipment group prior to NFIRS Version 5.0 but moved into that group as part of the Version 5.0 changes.

In NFIRS Version 5.0, there are 40 distinct electrical distribution or lighting equipment categories. One is for unclassified or unknown-type equipment and is normally proportionally distributed over the other categories for analysis purposes, as was done with the unknown-type category (but not the unclassified category) prior to 1999. There are also three categories for unclassified wiring or related equipment, lighting equipment, or cords or plugs, respectively. These three categories had also been proportionally allocated in the 2008 report in this series but are now kept separate.

Residential Structure Fire Causes

Created by: Dwight Crews (VA)

Report Parameters:

Report Period: From 01/01/2012 to 09/06/2012

State: VA ***Version:*** All ***Status:*** All ***Released:*** All

Report Filters:

NOTE: Report Filter Groups are applied to the report SQL as "AND" conditions (i.e. Group 1 AND Group2 and Group 3 etc...)

Report FDIDs*: All

*Data from deactivated fire depts within the list was not included in the report.

Residential Structure Fire Causes

State: VA ***Report Period:*** From 01/01/2012 to 09/06/2012

CODE	Category	FREQ	FREQ %	CIV DTHS	CIV DTHS %	CIV INJS	CIV INJS %	FF DTHS	FF DTHS %	FF INJS	FF INJS %	PROP LOSS	PROP LOSS %	CONT LOSS	CONT LOSS %	TOTAL LOSS	TOT LOSS %
01	Incendiary, Suspicious	215	5.47 %	7	25.93 %	13	7.18 %	0	0.00 %	7	7.00 %	7,578,024	12.23 %	1,864,127	8.35 %	9,442,151	11.20 %
02	Children Playing	9	0.23 %	0	0.00 %	3	1.66 %	0	0.00 %	0	0.00 %	79,000	0.13 %	26,700	0.12 %	105,700	0.13 %
03	Smoking	114	2.90 %	2	7.41 %	12	6.63 %	0	0.00 %	6	6.00 %	3,593,663	5.80 %	1,403,776	6.29 %	4,997,439	5.93 %
04	Heating	612	15.56 %	2	7.41 %	10	5.52 %	0	0.00 %	6	6.00 %	2,370,819	3.83 %	760,488	3.41 %	3,131,307	3.72 %
05	Cooking	1,368	34.79 %	0	0.00 %	66	36.46 %	0	0.00 %	8	8.00 %	2,961,043	4.78 %	1,273,588	5.71 %	4,234,631	5.03 %
06	Electrical Distribution	162	4.12 %	0	0.00 %	9	4.97 %	1	100.00 %	3	3.00 %	2,476,179	4.00 %	876,727	3.93 %	3,352,906	3.98 %
07	Appliances, AC	156	3.97 %	0	0.00 %	13	7.18 %	0	0.00 %	10	10.00 %	3,756,703	6.06 %	970,792	4.35 %	4,727,495	5.61 %
08	Open Flame, Ember,	187	4.76 %	2	7.41 %	10	5.52 %	0	0.00 %	4	4.00 %	2,943,245	4.75 %	999,677	4.48 %	3,942,922	4.68 %
09	Other Heat, Flame,	108	2.75 %	2	7.41 %	4	2.21 %	0	0.00 %	4	4.00 %	1,453,731	2.35 %	625,677	2.80 %	2,079,408	2.47 %
10	Other Equipment	30	0.76 %	2	7.41 %	2	1.10 %	0	0.00 %	0	0.00 %	469,500	0.76 %	136,600	0.61 %	606,100	0.72 %
11	Natural	88	2.24 %	0	0.00 %	2	1.10 %	0	0.00 %	5	5.00 %	3,989,200	6.44 %	890,501	3.99 %	4,879,701	5.79 %
12	Exposure	38	0.97 %	0	0.00 %	2	1.10 %	0	0.00 %	6	6.00 %	5,735,137	9.26 %	1,525,878	6.84 %	7,261,015	8.62 %
13	Unknown	845	21.49 %	10	37.04 %	35	19.34 %	0	0.00 %	41	41.00 %	24,539,476	39.61 %	10,967,506	49.13 %	35,506,982	42.14 %
	Totals:	3,932	100.00 %	27	100.00 %	181	100.00 %	1	100.00 %	100	100.00 %	61,945,720	100.00 %	22,322,037	100.00 %	84,267,757	100.00 %

Arc Fault Circuit Interrupters

Over the last thirty years, our homes have been dramatically transformed by electrical devices. However, many homes are overburdened by today's electrical demands, putting them at greater risk of arc faults and arc-induced fires.

An arc fault is a dangerous electrical problem caused by damaged, overheated, or stressed electrical wiring or devices. In the United States, electrical problems cause a average of 50,900 home fires each year, resulting in more than 490 deaths, 1400 injuries and more than $1.3 billion in property damage. Arcing faults are a major cause of these fires.

AFCIs Prevent Home Fires

- Arc fault circuit interrupters, or AFCIs, are devices that replace standard circuit breakers in your home's electrical service panel.
- AFCIs provide a higher level of protection by detecting hazardous arcing conditions traditional breakers were not designed to recognize and shutting down the electricity before a fire can start.
- The U.S. Consumer Product Safety Commission (CPSC) estimates that AFCIs could prevent more than 50 percent of the electrical fires that occur every year.
- While new safety requirements require installation of AFCIs only in newly constructed homes, older homes with aging wiring systems can also benefit from the added protection from AFCIs.
- Depending on the size of a given home, the cost impact for installing additional AFCI protection in a home is $140 - $350.

AFCIs and the *National Electrical Code (NEC)*

- Since the 2008 edition, the NEC has included significantly expanded reuqirements for AFCI protection in all new homes. In addition to bedroom circuits, AFCI technology is required in additional areas of the home, including dining, living, and family rooms.
- The NEC's expanded AFCI provisions do not become effective unless the 2008 or 2011 NEC is formally adopted into state and local electrical codes.
- Home builders in some states have challenged the increased requirements for AFCI technology, claiming that these devices will significantly increase the cost of a home while making very little difference in improving safety.
- Safety advocates maintain that the benefits provided to the homeowner by AFCI technology are well worth the cost for AFCI protection.
- State adoption and enforcement of the 2008/2011 NEC with its AFCI provisions intact is the key to preventing fires, protecting homes, and saving lives.

New Technology for Preventing Residential Electrical Fires: Arc-Fault Circuit Interrupters (AFCIs)

By
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Abstract - A new generation of residential electrical branch circuit breakers that incorporates technology to detect and mitigate the effects of arcing faults is described. Fire loss estimates attributed to electrical wiring and the development of the arc-fault circuit interrupter for the prevention of residential electrical fires are discussed. The industry voluntary standard for arc-fault circuit interrupters as well as the 1999 *National Electrical Code* requirement are reviewed.

INTRODUCTION

Annually, over 40,000 fires are attributed to home electrical distribution systems. These fires result in more than 300 deaths and over 1,400 injuries each year. Statistics from 1992-1996 show level trends in each of these estimates with no indications of decline. In 1996, $680 million in property loss was attributed to home electrical distribution fires.[1]

Arcing faults are one of the major causes of electrical wiring fires.[2] A 1994 insurance company survey of 660 electrical fires indicated that over 33% of these fires were from arcing conditions.[3] This data is further supported in a report by Smith and McCoskrie[4] that summarized the characteristics of 149 investigated residential fires.

Many of the investigations revealed failure modes characteristic of unwanted arcing. When unwanted arcing occurs, it generates high temperatures and discharges molten metal that can ignite nearby combustibles such as paper, insulation, vapors, and some carpets. The temperature of an arc can be several thousand degrees Celsius depending on the available current, voltage, and materials involved.[5, 6, 7]

Typically, a circuit breaker or other circuit protection device (e.g. fuse) is used to protect electrical branch circuit wiring, and reduce the risk of fire from overheating of installed wiring due to overloads or faults. The role of the circuit protection device is to interrupt the current before the heat generated by an overload or fault damages the wire's electrical insulation and/or reaches temperatures that could result in a risk of fire. An overload is a condition in which the current drawn by the sum of the electrical loads (appliances), which are connected to a particular circuit, exceeds the current capacity (ampacity) of the circuit conductors.

There are different types of electrical faults. One example is a short circuit, in which circuit conductors of opposite polarity contact each other, resulting in an immediate increase in current. Another type is a ground fault in which an ungrounded line conductor is faulted to a metal enclosure or other grounding conductor.

The Evolution of Circuit Protection Devices

Circuit protection devices have evolved in capability and function from the time that fuses were introduced in the late 1800s, to the introduction of circuit breakers in the 1920s, to today with the introduction of arc-fault circuit interrupters (AFCIs). These

changes evolved both for convenience and to provide enhanced protection for electrical wiring systems.

Fuses were the first overcurrent protection devices used in residential electrical systems. A fuse interrupts current when an internal metal element melts if the current exceeds its rated capacity for a specified length of time. Fuses are designed with characteristics to match the application. A fast-acting fuse opens quicker than a slow-blow fuse, which has a greater thermal inertia to allow short-term overloads that may occur as a consequence of a normal load change. Examples are incandescent lights and refrigerator compressors, which draw initial currents that are several times higher than their steady state levels. Despite the simplicity and reliability of fuses, there are several disadvantages that have diminished their use in residential distribution systems. Fuses without a replaceable link need to be replaced after being blown. Early fuses were the same physical size for several current ratings, so a 20-ampere fuse could be inserted where a 15-ampere fuse was required. Because it is necessary to keep replacement fuses on-hand, some users would bypass the fuse completely if opened often or they ran out of replacements. Either of these could lead to dangerous overheating.

In the 1920s, Westinghouse Corporation invented the circuit breaker,[8] an electromechanical overcurrent protection device that can be reset after it interrupts an overcurrent condition. Upon detection of an overload or fault, an internal latch is released, and the contacts are driven apart by a spring. A circuit breaker uses two different mechanisms to detect an overcurrent condition that will cause it to trip and interrupt the current. The magnetic or instantaneous trip reacts to rapid increases in

current with a magnitude of at least 8 to 12 times the rating of the circuit breaker. This is intended to remove short circuits rapidly. The other mechanism is a thermal trip, which uses a bimetal strip that heats up when the current exceeds the rating. As it heats, the thermal strip bends and unlatches the contacts. The response of the element relies on the product of the square of the current and the time (I^2t). Conventional circuit breakers address many of the disadvantages related to fuses; however, they may be considered less reliable since their operation relies on the action of several mechanical parts and the flow of high currents to activate them.

As part of the U.S. Consumer Product Safety Commission's (CPSC's) 1994 and 1995 efforts to reduce residential electrical system fires, the CPSC sponsored work on detecting and monitoring conditions that could lead to or cause fires in homes. The work was performed by Underwriters Laboratories Inc. (UL) and was documented in a report entitled, "Technology for Detecting and Monitoring Conditions that Could Cause Electrical Wiring System Fires." The study uncovered several possible technologies and concluded that arc-fault detection combined with ground-fault protection was the most promising technology to reduce the risk of fire when combined with conventional circuit breakers.[9] At that time, such an arc-fault circuit breaker did not exist as a commercial device. Additional research[10] has led to the development of the AFCI as a commercial product.

AFCIs are circuit protection devices designed to protect against fires caused by arcing faults in electrical wiring. An AFCI is formally defined as "a device intended to provide protection from the effects of arc faults by recognizing characteristics unique to

arcing and by functioning to de-energize the circuit when an arc-fault is detected."[11] It is important to note that AFCIs may mitigate the effects of arcing faults but cannot eliminate them. In some cases, the initial arc may cause ignition prior to detection and circuit interruption by the AFCI.

ARCING

Technically, an arc is defined as "a continuous luminous discharge of electricity across an insulating medium, usually accompanied by the partial volatilization of the electrodes".[12] Some arcs are a normal consequence of device operation, such as opening a light switch or commutation from a motor. These devices are designed to contain arcs from combustible surroundings. However, other arcs are unwanted and may occur as a result of damaged or deteriorated wires and cords. For arcs in electrical distribution systems, the insulating medium is an air gap (for parting arcs), wire insulation, or any other insulator used to separate the electrodes or line and neutral conductors. An arc will not jump an air gap and sustain itself unless there is at least 350 V[7] across the gap. Therefore, in 120/240 Vac systems, it is difficult for arcing to cause ignition unless arc tracking occurs, or the electrodes loosely contact each other causing a sustained arcing fault.[5]

How Arcing Faults Develop

There are two basic types of arcing faults – series and parallel. Series arcing faults occur when the current-carrying path in series with the load is unintentionally broken.

Arcing may occur across the broken gap and create localized heating. The magnitude of the current in a series arc is limited by the load. The series arcing currents are typically well below the typical circuit breaker's ampacity rating (often referred to as handle rating) and, therefore, would never trip the conventional circuit breaker either thermally or magnetically. Series arcing can lead to overheating that can be hazardous. Examples of conditions that may result in series arcing faults include loose connections to a receptacle or a wire splice, a worn conductor from over flexing of a cable, or a pinched cable in which the conductor has been severed.

A parallel arcing fault occurs when there is an unintentional conducting path between conductors of opposite polarity. Parallel arcing is only limited by the available fault current of the source and the impedance of the fault. If the fault is of low impedance, then the overcurrent device should open. However, when the fault impedance is relatively high, there may be insufficient energy to open the overcurrent device. This can cause arcing that can propel particles of molten metal onto nearby combustibles. A short circuit caused by an intermittent contact is one type of parallel arcing fault that can create hazardous arcs. A line-to-ground arcing fault is another form of parallel arcing fault and occurs when an ungrounded line conductor is faulted to a metal enclosure or other metal structure in contact with a grounding conductor. Examples of these are cords cut by furniture with a metal leg or loose wires that contact a grounded surface.

Parallel arcing faults are known to develop in three stages: leakage, tracking, and arcing.[13] Leakage currents normally occur in every electrical wiring system due to parasitic capacitance and resistance of the cable insulation. Leakage current values below 0.5 mA

are considered safe.[14] If the wiring is maintained in good condition, the wiring may be used safely for several decades.[15] However, when the wiring is subjected to moisture, conductive dusts, salts, sunlight, excessive heat, or high-voltage lightning strikes, the insulation can break down and conduct higher leakage currents.[7] As leakage current increases – undetected across the conduction path – the surface can heat up and pyrolyze the insulation. This process, known as tracking, produces carbon that generates more heat and progressively more carbon.[16] Although this process may continue for weeks, months, or longer without incident, eventually, sustained arcing may occur.

Parallel arcing faults are generally considered more hazardous than series arcing faults, since there is more energy associated with a parallel arcing fault than a series arcing fault. Parallel arcing faults usually result in peak currents above the handle rating of the conventional circuit breaker. This may trip the circuit breaker magnetically, if the impedance of the fault is low and the available fault current is sufficient. However, in many instances, the available short-circuit (fault) current is not sufficient to trip the circuit breaker instantaneously (magnetic trip). In addition, in many instances, the fault may be intermittent, so the overcurrent will not be sustained long enough to trip the conventional circuit breaker thermally.

MITIGATING THE EFFECTS OF ARCING

Conventional circuit breakers are designed to protect the branch circuit wiring. The thermal settings are selected to prevent overloading of the circuit, while the instantaneous trip is intended for rapid removal of short circuits. Typically, instantaneous

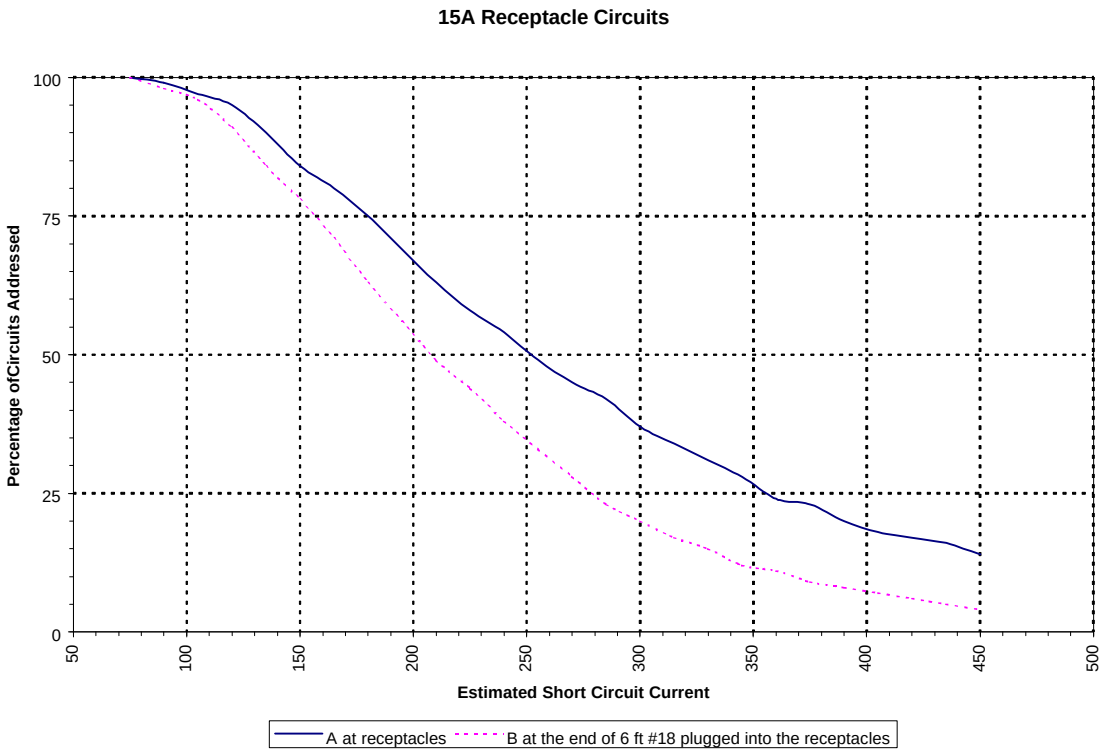
tripping levels for 15 ampere (A) and 20 A residential circuit breakers are set way above 120 A rms (between 140 to 225 A rms) to avoid nuisance tripping from appliance inrush currents. The *Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker*, UL 489,[17] requires that 15 A and 20 A circuit breakers trip thermally in 2 minutes with a load current of 200 percent of the handle rating and in 1 hour with a 135 percent load current. This means that a 15 A circuit breaker can have a 30 A load for 2 minutes or a 20.25 A load for 1 hour before tripping. There are no calibration requirements for instantaneous tripping for conventional circuit breakers in UL 489.

Lowering the Instantaneous Trip Level of Circuit Breakers

A 1992 study[18] sponsored by the Electronic Industries Association (EIA) was conducted by UL to determine if the instantaneous trip level of conventional circuit breakers could be significantly reduced. The purpose of reducing the instantaneous threshold was to mitigate the effects of arcing faults in extension and power cords used with appliances in residences. Tests were conducted on 1,590 receptacles in 80 residences to determine the available short-circuit current in 15 A and 20 A receptacles. Plot A in Figure 1 is a distribution of the estimated short-circuit current available versus the percentage of circuits having sufficient fault current to trip a breaker. Plot B in Figure 1 is the short-circuit current with 6 feet of No. 18 AWG appliance cord plugged into the receptacle being tested. The average available short-circuit current in surveyed residences at receptacles in 15 A branch circuits was 300 A. The average available short-circuit current at receptacles in 20 A branch circuits was 467 A.

Figure 1 shows that 100 percent of the receptacles surveyed had over 75 A available short circuit current. The ability of the circuit breaker to trip depends on the instantaneous trip level of the installed circuit breaker and the available short-circuit current. A 15 A circuit breaker with a 150 A instantaneous trip level should trip with a short-circuit fault in 84 percent of the receptacles surveyed. However, for a fault at the end of a 6-foot No. 18 AWG appliance cord plugged into the receptacle, the available fault current at only 78 percent of the receptacle locations would be sufficient to trip a 15 A circuit breaker. Similarly, a 15 A circuit breaker with a 195 A instantaneous trip level would trip with a short circuit fault in 69 percent of the receptacles surveyed. With a fault at the end of a 6-foot appliance cord plugged into the receptacle, the breaker would trip only 56 percent of the receptacles.

Figure 1.



When an arcing fault occurs rather than a short circuit, the data is even less favorable. This is because 1) an arcing fault adds some impedance to the circuit that limits the fault current even further, and 2) parallel arcing faults have erratic current flow that reduces the rms current, which is needed to trip the circuit breaker. According to one manufacturer, these two factors increase the effective instantaneous trip level by 50 A.[6] In the previous example, for short-circuit currents, a circuit breaker with a 150 A instantaneous trip level would trip 84 percent of receptacles. For an arcing fault, however, the effective instantaneous trip level would increase to 200 A. Thus, the circuit breaker would trip in less than 69 percent of receptacles (the percentage associated with an instantaneous trip level of 195 A).

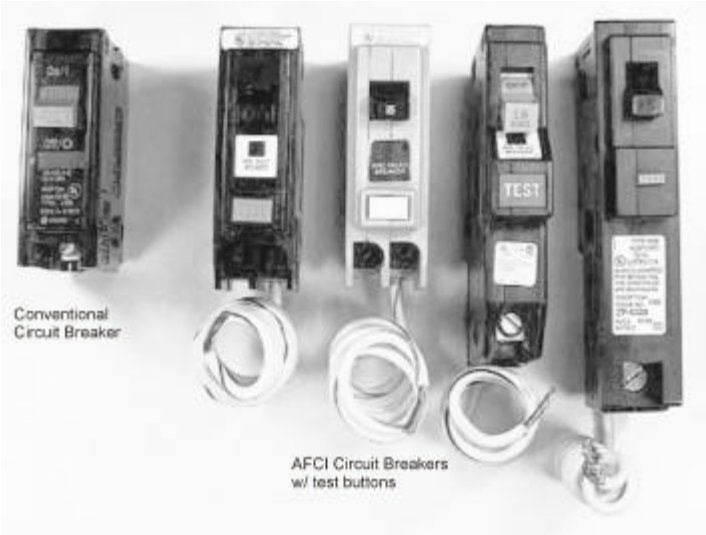
The results of the study sponsored by the EIA determined that lowering the instantaneous trip level below 105 A rms would provide a greater potential reduction in fire risk. Lowering the instantaneous trip level to 75 A rms to cover all receptacles would also increase the possibility of nuisance tripping. AFCI technology, on the other hand, has the ability to detect the current signatures of parallel arcs so that the effective instantaneous trip level can be lowered to 70 A rms without the increased risk of nuisance tripping.

Arc-Fault Circuit Interrupters (AFCIs)

Presently, AFCIs are designed into conventional circuit breakers combining traditional overload and short-circuit protection with arc fault protection. The AFCI circuit breaker provides protection for branch circuit wiring and limited protection for power cords and extension cords. Some designs combine GFCI (ground-fault circuit interrupter) and AFCI protection (see section on GFCIs). Receptacle types are being developed, but no receptacle-type AFCIs were available at the time this paper was written.

Single-pole 15-ampere and 20-ampere AFCI circuit breakers are presently available, although additional AFCI design configurations are anticipated. Presently, the AFCI circuit breakers cost about the same as the GFCI circuit breakers, but costs are expected to decrease with demand. The AFCI circuit breakers have a test button and look similar to GFCI circuit breakers (see Figure 2). Like GFCIs, AFCIs require monthly testing to inform the user that the AFCI is functioning properly.

Figure 2.



How AFCIs Work

Both “good” and “bad” arcs produce a current signature or waveform. “Good” arcs are characterized by being periodic or repetitive (occur each 60 Hz cycle) and can be non-sinusoidal (not the shape of a sine wave). “Bad” arcs are characterized by non-periodic or non-repetitive waveforms. The AFCI circuitry continuously monitors current flow through the AFCI. AFCIs use detection circuitry to discriminate between normal and unwanted arcing conditions. Once an unwanted arcing condition is detected, the control circuitry in the AFCI trips the internal contacts, thus de-energizing the circuit and reducing the potential for a fire to occur.

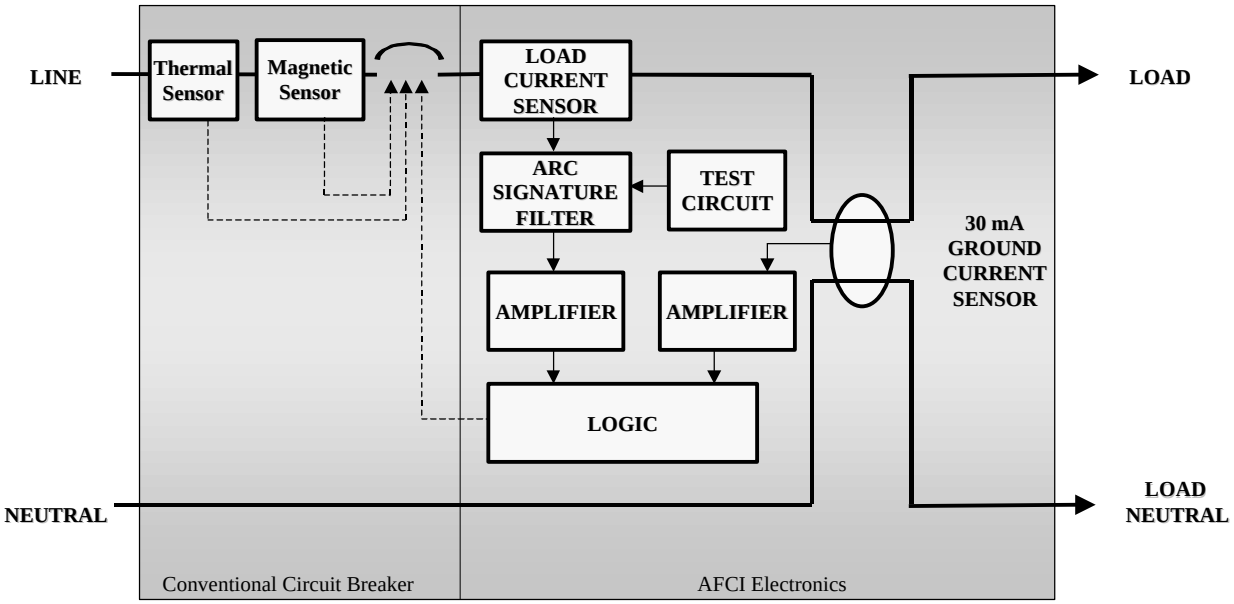
Methods for the detection of “bad” arcs include looking at certain frequencies, discontinuities, and inconsistencies in the current waveform. For detection, both

magnitude and duration of a particular half cycle are required. Some detection algorithms also look at rising or falling edges of an arcing current for their detection criteria. The industry voluntary standard for AFCIs requires a trip if 8 half cycles of arcing occur within a 0.5 second window.[♣] An AFCI should not trip during normal current conditions.

Figure 3[19] is a block diagram of a single pole AFCI circuit breaker. The AFCI electronics function independently from the thermal and instantaneous sensing functions of the conventional circuit breaker. The AFCI electronics detect current flow from the load terminals with the use of a load current sensor. The load current sensor can be either a resistive sensor or a magnetic sensor. The output of the load current sensor is fed into an arc signature filter that passes frequency components of arcing waveforms while rejecting other power line frequencies. The arc signature filter output is amplified and fed into a logic circuit that determines if an unsafe condition exists. As discussed before, both amplitude and duration are used to detect the unwanted arcing condition. If the logic determines that the load must be de-energized, a signal is fed to a triac used to energize a solenoid that opens the circuit breaker contacts.

Figure 3.

[♣] UL 1699 defines an arcing half cycle as, "all of the current traces occurring within a period of 8.3 ms (for a device rated 60 Hz). Within that time period there may be current flow for some but not all of the time. Prior to and following each period of current flow, there may be a period of no current or very reduced current. Very reduced current is considered to be current with an amplitude less than 5% of the available current or current that continues for not more than 0.42 ms. This may last for either a portion of a half cycle or for several half cycles. A complete sinusoidal half cycle of current flow is not considered to be an arcing half cycle."



Single Pole AFCI Circuit Breaker

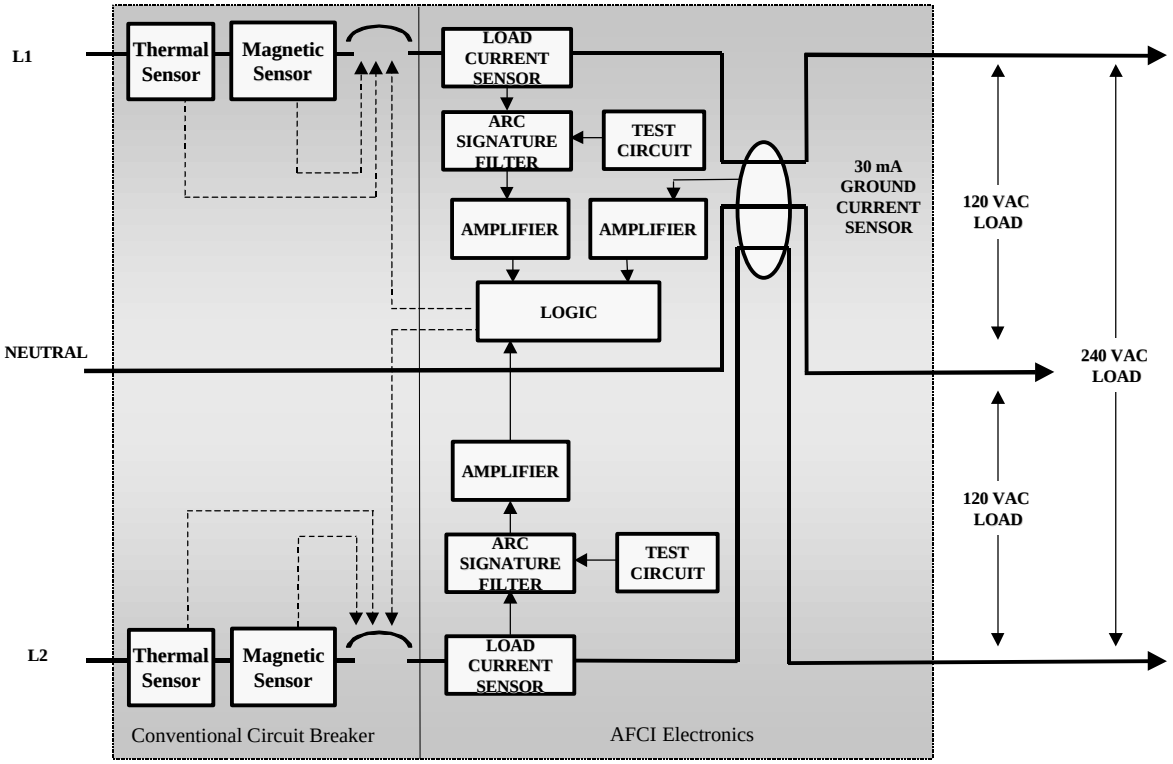
An AFCI also uses a ground current sensor (typically 30 mA) for "pre-arcing" detection and protection. This sensor allows the AFCI to detect slowly-developing insulation breakdown that typically precedes line-to-ground and line-to-neutral arc faults. Additionally, lower level series arcing may become a fault to ground in three wire systems or systems that are grounded. The ground current sensor output is amplified and fed into the logic circuit. If the logic determines that the magnitude and duration of the ground fault is hazardous, the solenoid will open the circuit breaker contacts.

A test circuit is provided to ensure that the arc fault detection circuit is functioning properly. A test button is used to generate a signal that is similar to an arcing output waveform of the load current sensor. The test button will de-energize the circuit if the device is functioning properly.

An AFCI circuit breaker can be combined with personnel level GFCI protection by lowering the threshold of the ground current sensor to 6 mA. A second test circuit is required to test the GFCI function of the combination AFCI and GFCI device. Also, the grounded neutral protection is required per UL 943, *Standard for Ground Fault Circuit Interrupters*.

Figure 4[19] is a block diagram of a two-pole AFCI circuit breaker. This device can be used on a variety of circuits including 3-wire, 120/240 Vac circuits, 120 Vac shared neutral circuits, or 240 Vac circuits obtained from a 120/240 Vac source.[20] The shared neutral circuit, also referred to as a “home run” or “multi-wire branch” circuit, is a common household wiring technique that uses one three-conductor plus ground cable instead of two separate two-conductor plus ground cables to feed two branch circuits. Many electricians use this practice in order to save labor and material costs. These applications must use a load current sensor, arc signature filter, and amplifier for each of the phases L1 and L2. Although the logic circuit determines if a circuit needs to be de-energized, both phases must be de-energized, since the fault may be in the three-conductor plus ground cable. The device requires two test circuits, one for each phase. The ground current sensor uses all three conductors to sense leakage currents, and both circuits trip.

Figure 4.



Two Pole AFCI Circuit Breaker

Similarly to the single pole, combination AFCI and GFCI, a two-pole AFCI circuit breaker can combine personnel GFCI protection. Like the single-pole version, an extra test button is required to test the GFCI function of the combination AFCI/GFCI.

The AFCI circuit breakers described above use analog circuitry with custom chips or integrated circuits (ICs) to perform some of the circuit functions. Similar arc detection technologies can be achieved using a digital approach. The digital AFCI can use the same

current sensor and ground current sensors. Both the current signal and the ground current signal are amplified and converted into a digital signal with an ADC (analog to digital converter). The microprocessor then calculates the line current and the irregularities in the current signals using special algorithms in software to determine if arcing is present. If the microprocessor determines that the load must be de-energized, a signal is fed to a triac used to energize a solenoid that opens the circuit breaker contacts. As in analog circuitry, a custom IC can be used to reduce the required space of the digital circuitry. The digital approach allows for easier algorithm changes in the development process and increased flexibility in the testing process.

Existing AFCIs do not detect another cause of electrical fires – the glowing connection – unless an arc or ground fault is also present.[21] A glowing connection is a special case of a high resistance connection that can dissipate a considerable amount of energy and glows to the point of incandescence.[22] In addition to their heat output, glowing and other poor connections are manifested by excessive voltage drop across the connection. The magnitude of the voltage drop varies with the impedance of the connection and the load current. (The impedance of the circuit will also have an effect on the ability of a conventional circuit breaker to instantaneously trip when the short circuit current is below the instantaneous trip threshold.) The AFCI will detect some of the secondary effects of the glowing connection, such as arc faults and ground faults. By detecting these secondary effects, the AFCI can eliminate a critical factor in further destruction – the flow of electric current.

UL STANDARD FOR AFCIs

In December 1996, a task force of the Molded Circuit Breaker Section of the National Electrical Manufacturers Association (NEMA), with UL's participation, completed a draft standard for AFCIs. In the fall of 1997, the standard was transferred to UL for conversion to a UL standard for AFCIs. The first edition of the *Standard for Arc-Fault Circuit-Interrupters*, UL 1699, was published in February 1999. Prior to this time, AFCIs were listed under the *Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures*, UL 489, and classified for mitigating the effects of arcing faults.

The first edition of UL 1699 has three major sections, which are summarized below:[23]

Efficacy Tests - The device shall demonstrate arc detection by sensing current levels and conditions unique to arcing and function to de-energize the circuit. Two methods are used to simulate arcing:

- The carbonized path method uses high voltage to cause electrical insulation pyrolysis across parallel conductors resulting in arcing.
- The point contact or guillotine method represents contact arcing when sharp objects cut through parallel wires.

Unwanted Tripping Tests - The device shall demonstrate the ability to avoid nuisance tripping with loads that might produce waveforms similar to an unwanted arc. The six categories of load conditions are:

- Inrush Current – These loads require high currents for initial startup of the load, such as tungsten-filament light bulbs and motors with starting capacitors.
- Normal Operation Arcing – These loads have normal operating arcs that are generally not hazardous. Examples of these loads are motors with brushes, thermostatically controlled heating appliances, wall switches, and unplugging of loads with power on.
- Non-sinusoidal Waveform – These loads have non-sinusoidal current waveforms during normal operation. The loads include electronic lamp dimmers, variable-speed power tools, switching power supplies in computers, and fluorescent lamps.
- Cross Talk – This test is designed to ensure that the device under test does not trip as the result of an arcing condition on an adjacent circuit.
- Multiple Load – This test uses multiple combinations of loads with non-sinusoidal waveforms to test for nuisance tripping.
- Lamp Burnout – These tests are designed to verify that the AFCI will not experience a nuisance-tripping problem when lamps burn out.

Operation Inhibition Tests - The device shall demonstrate that it can detect arcs and de-energize the circuit when it is in series or parallel with a range of circuit conditions that could hide, attenuate, or mask the arc signature. The three conditions are:

- Masking - The device is subjected to a variety of loads in series and parallel with the arc.

- EMI filters – EMI filters are installed on a branch circuit to determine if the filter affects the device's ability to detect an arc.
- Line Impedance – Line impedance that might attenuate energy at certain frequencies is tested to determine if the device trips.

UL 1699 requires over 75 different tests to qualify the AFCIs for UL listing. UL 1699 also includes surge protection and test requirements similar to UL 943.

CPSC STAFF TESTS OF AFCIs

In 1997, when the devices were first produced for sale, the CPSC staff began evaluating AFCIs. These first production samples were rated 15 A or 20 A, 120 V, single pole. The main objective of the tests was to determine if the AFCIs could distinguish an electrical signal of a normal load from that of an arcing fault and not pose a nuisance tripping problem. The CPSC staff conducted a series of tests to evaluate the AFCIs including both efficacy and unwanted tripping tests.

Tests followed the requirements established in the draft UL standard, although some tests were modified (more stringent than the standard) to simulate loading of appliances that might cause unwanted tripping (e.g. adding an additional 500 watts of load to the inrush current test or excessively loading and stalling power tools). Waveforms for the tests were captured and stored.

Figures 5 and 6 are representative waveforms recorded from the Efficacy Tests completed by the CPSC staff and are characteristic of "bad" arcs. Figures 7-9 are

representative waveforms from the Unwanted Tripping Tests and are characteristic of "good" or normal arcs.

Figure 5 shows a parallel arc waveform from a guillotine test using an SPT-2 No.16 AWG wire specimen. When the guillotine shorted the line and neutral conductors, arcing occurred up to the available fault current during portions of half cycles 1, 3, 4 and 5. As shown in Figure 5, arcing did not occur during half cycle 2. Waveforms from "bad" arcs have discontinuities and may not conduct on consecutive half cycles. Arcing from half cycles 3, 4 and 5 was above 70 A peak, and the AFCI tripped.

Figure 5.

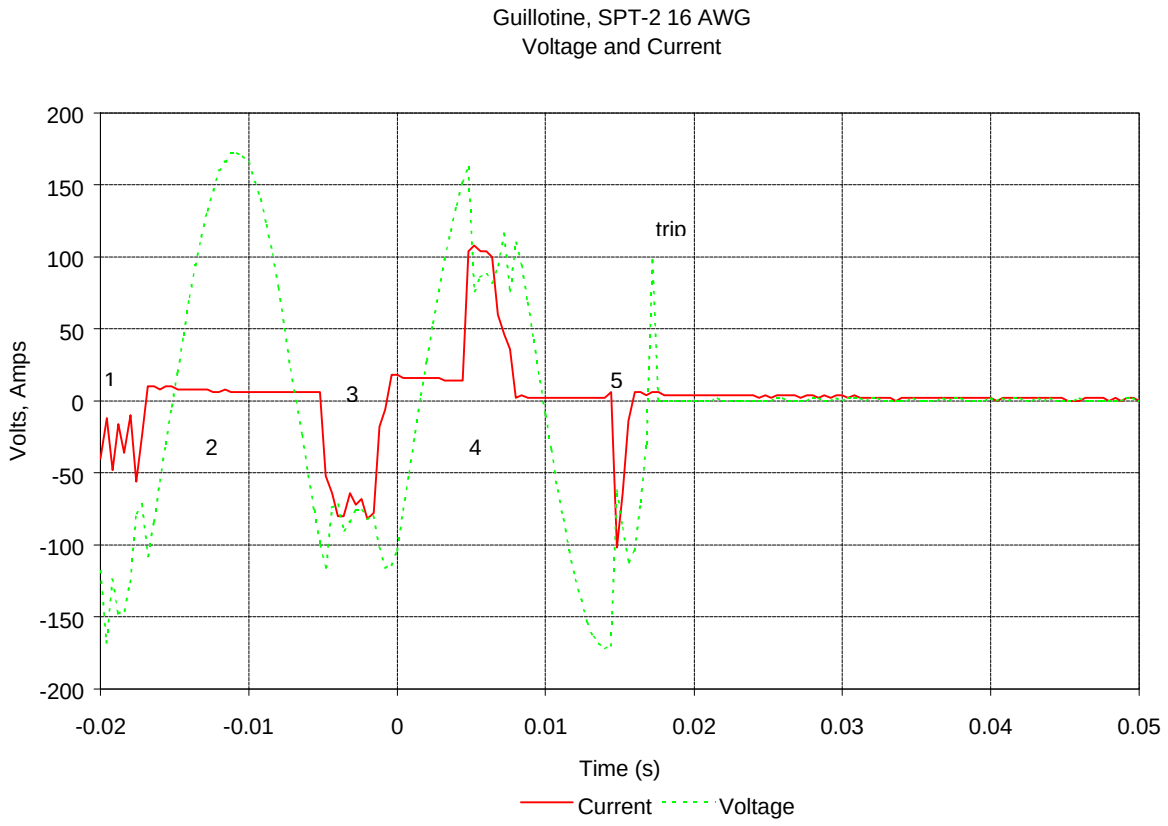

Guillotine, SPT-2 16 AWG
Voltage and Current
200
150
100
50
0
-50
-100
-150
-200
Volts, Amps
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05
Time (s)
1
2
3
4
5
trip
Current
Voltage

Figure 6 shows the results of a guillotine test on type NM-B 14-2 AWG wire with ground. This cable is the common cable installed in homes today. For this test, the AFCI was found to trip quicker than in the line-to-neutral fault in the SPT-2 cable. This is because the AFCI included a 30 mA ground current sensor for detection of ground faults. The guillotine created a ground fault between the bare ground conductor located between the line and neutral conductors. In most instances, a fault from either the line or neutral conductor will occur to the ground conductor next to it. The AFCI tripped after the first half cycle. The potentially hazardous currents shown in Figures 5 and 6 would not trip a conventional circuit breaker.

Figure 6.

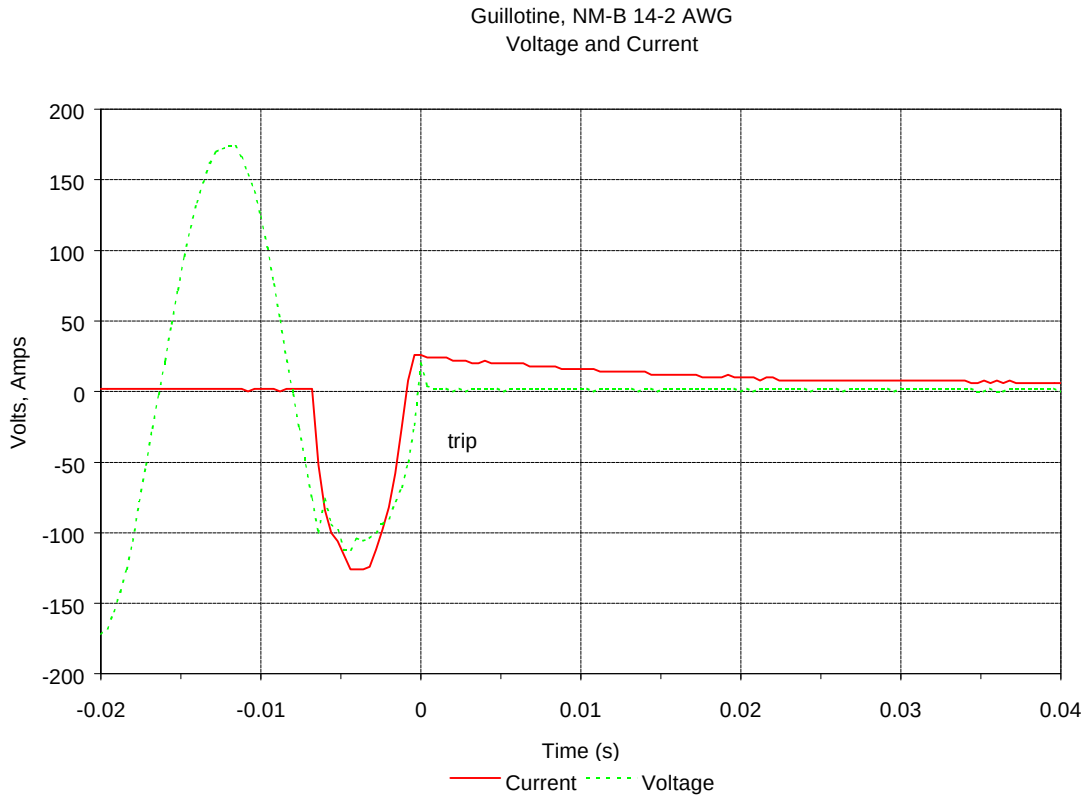

Guillotine, NM-B 14-2 AWG
Voltage and Current
200
150
100
50
0
-50
-100
-150
-200
Volts, Amps
trip
-0.02
-0.01
0
0.01
0.02
0.03
0.04
Time (s)
Current
Voltage

Figure 7 shows the inrush current of an 1800 watt tungsten filament lamp load. Typical inrush currents for lamps are 10-15 times greater than the steady-state currents and are larger when the current is switched on near the peak of the voltage and the bulbs are cool. In this case, a peak current of 150 A was measured with an 1800 watt load. The AFCI did not nuisance trip.

Figure 7.

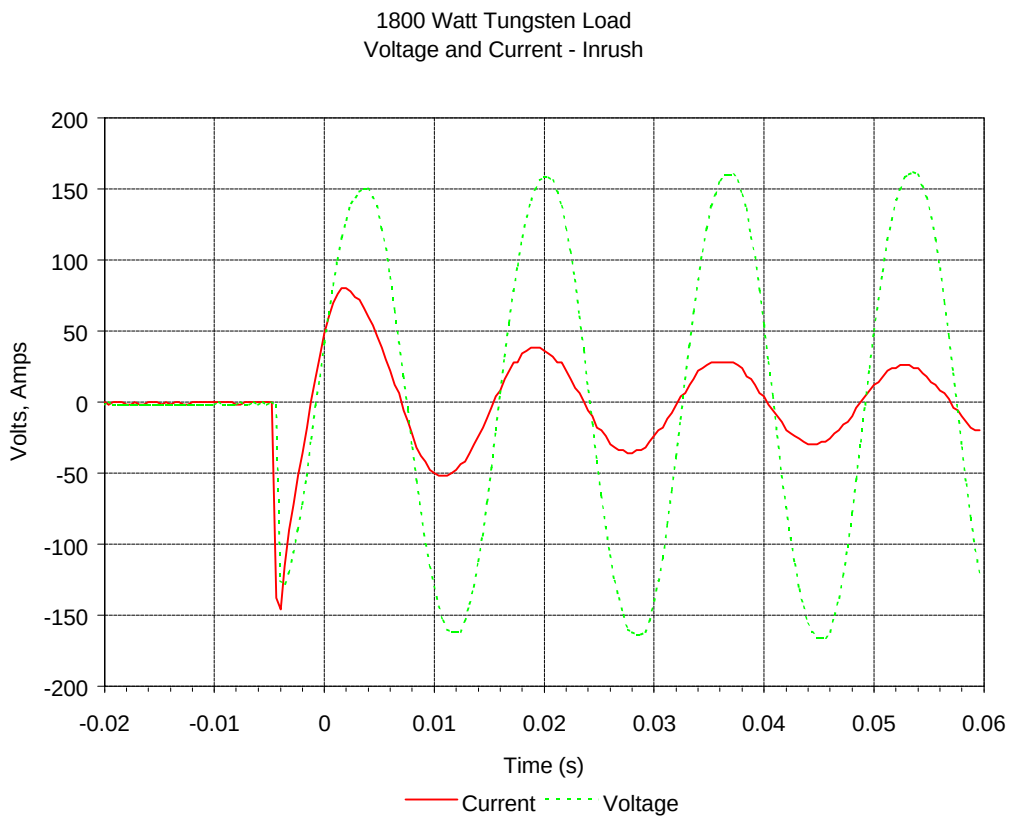


Figure 8 shows the current waveform for a 12 A rms air conditioner. Initially, only the fan is on so the current draw is low. When the compressor starts, it draws 80 A peak current for about 0.15 seconds (nine cycles of 60 Hz). The inrush current is approximately five times the steady state current draw. The AFCI did not nuisance trip.

Figure 8.

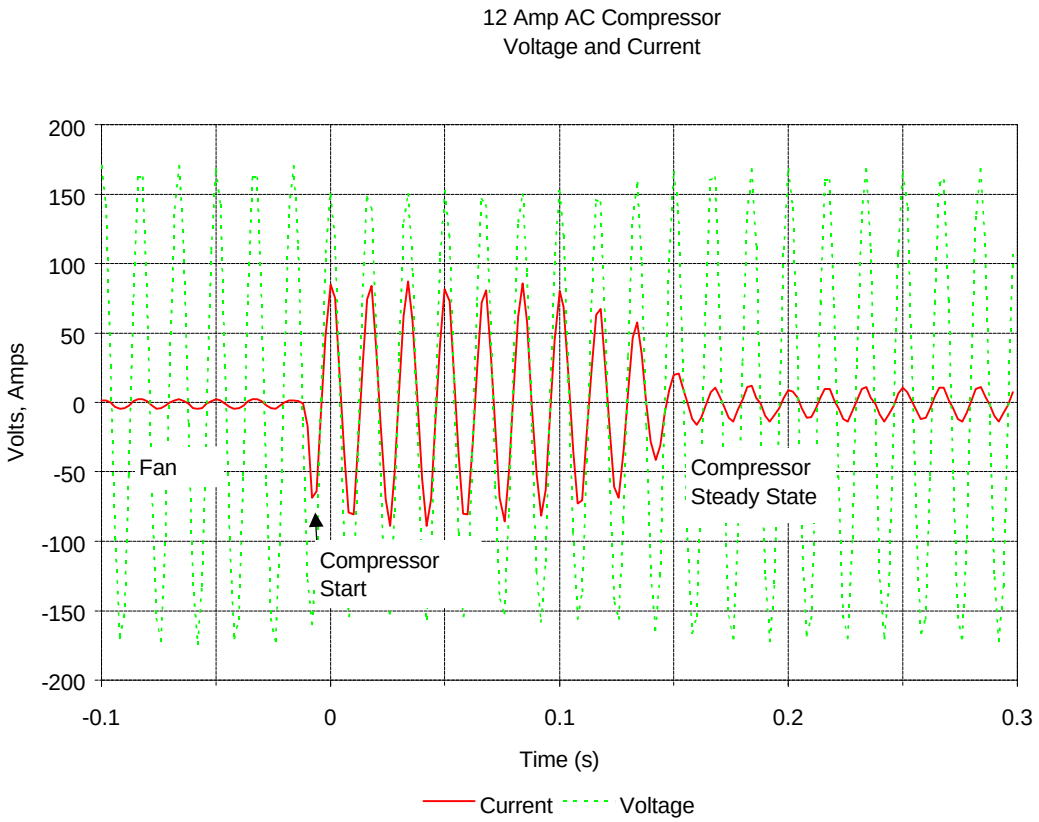
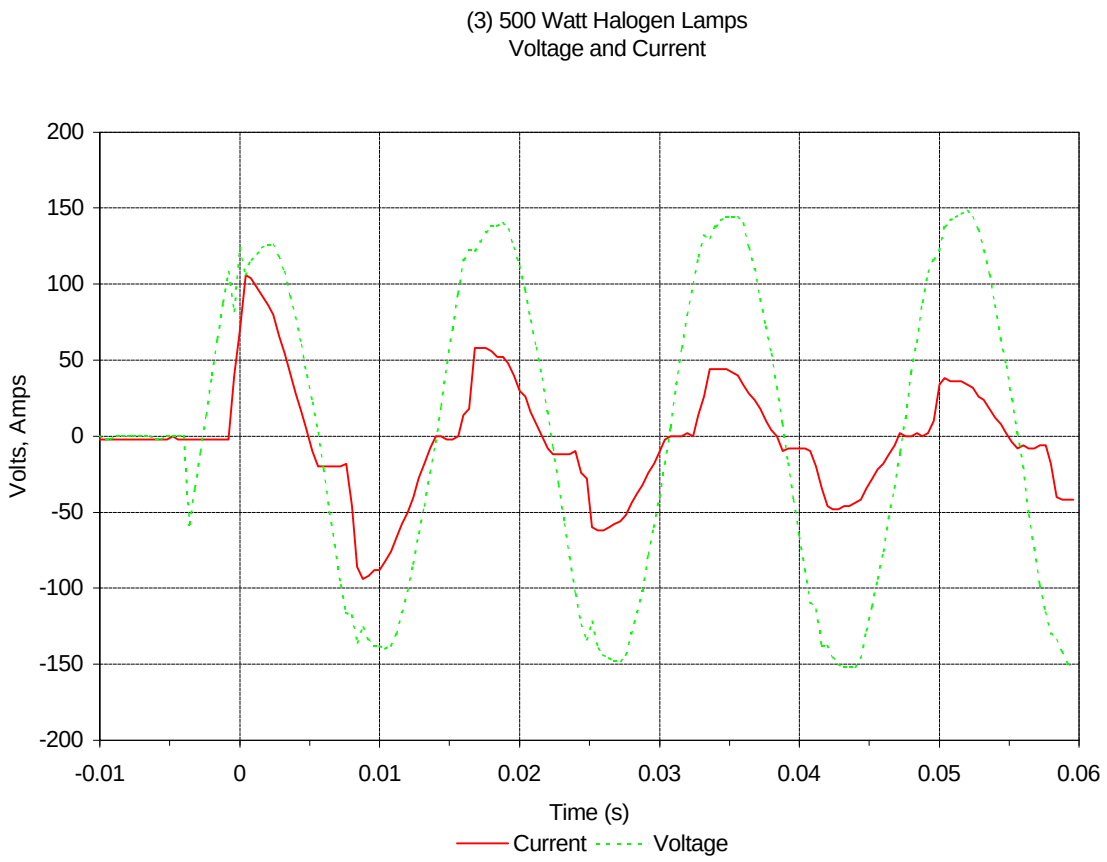


Figure 9 shows the current to three 500 watt halogen lamps with triac dimmers. The lamps were controlled by a single snap switch and were set to three-quarters power. The current waveform is non-sinusoidal because each lamp is controlled by a triac that switches current on during a portion of each half cycle. The phase of the current is delayed based on the dimmer switch setting. Initial peak inrush currents of 120 A were measured when the lamps were switched on. The AFCI did not nuisance trip.

Figure 9.



CPSC staff completed four different efficacy tests on several AFCIs from different manufacturers. CPSC staff also completed over 25 unwanted tripping tests with these AFCIs. The AFCIs all passed.

The CPSC staff's tests verified that AFCIs would trip when "bad" arcing was simulated by shorting adjacent conductors and carbonizing insulation. In addition, AFCI circuitry distinguished "good" arcs or electrical signals of normal household loads without presenting nuisance tripping problems.

1999 *NATIONAL ELECTRICAL CODE* REQUIREMENTS

The 1999 *National Electrical Code* (*NEC*) requires AFCIs on bedroom branch circuits effective in the year 2002.[11] AFCIs would replace the conventional thermal/magnetic circuit breakers currently used in a panel. Although the *NEC* requirement is only for bedroom circuits in new residential construction, AFCIs may be applied for added protection in other circuits and for installation in existing homes as well. Older homes with aging and deteriorating wiring systems can especially benefit from the added protection of AFCIs. AFCIs should also be considered whenever adding or upgrading a panel box while using existing branch circuit conductors.

GROUND-FAULT CIRCUIT INTERRUPTERS

The AFCI should not be confused with the GFCI, or ground-fault circuit interrupter. The GFCI is designed to protect people from severe or fatal electric shocks, while the AFCI protects against fires caused by arcing faults. The GFCI also can protect

against some electrical fires by detecting arcing and other faults to ground,[24] but it cannot detect hazardous across-the-line arcing faults that can cause fires.

The *NEC* requires GFCI protection for receptacles located outdoors; in bathrooms, garages, kitchens, crawl spaces and unfinished basements; and at certain locations such as near swimming pools. A combination AFCI and GFCI can be used to satisfy the *NEC* requirement for GFCI protection only if it is specifically marked as a combination AFCI and GFCI.

SUMMARY:

Over 40,000 fires are attributed to home electrical wiring each year; arcing faults are one of the major causes of electrical wiring fires. To reduce the number of residential electrical fires, the U.S. Consumer Product Safety Commission sponsored a study of new technologies that could detect and monitor conditions that could lead to or cause electrical fires. The study, conducted by Underwriters Laboratories, led to the introduction of arc-fault circuit interrupter technology combined with conventional circuit breakers. This present generation of AFCIs offers protection to mitigate the effects of arcing faults without presenting nuisance tripping problems.

The 1999 *National Electrical Code* (*NEC*) requires AFCIs on bedroom branch circuits effective in the year 2002. Although the *NEC* requirement applies only to new residential construction, AFCIs may be used for installation in existing homes as well. Older homes with aging and deteriorating wiring systems can especially benefit from the added protection of AFCIs.

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The views are those of the authors and are not intended to represent the views of the Commission or other members of its staff. Since the article was written in the authors' official capacity, it is in the public domain and may be freely copied or reprinted.

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Residential Building Electrical Fires

These short topical reports are designed to explore facets of the U.S. fire problem as depicted through data collected in USFA's National Fire Incident Reporting System (NFIRS). Each topical report briefly addresses the nature of the specific fire or fire-related topic, highlights important findings from the data, and may suggest other resources to consider for further information. Also included are recent examples of fire incidents that demonstrate some of the issues addressed in the report or that put the report topic in context.

Findings

- Annually, an estimated 28,300 residential building electrical fires cause 360 deaths, 1,000 injuries, and $995 million in direct loss.
- Fifteen percent of residential building electrical fires start in bedrooms.
- Nearly half (47%) of the residential building electrical fires where equipment was involved were caused by the building's wiring.
- Twenty-two percent of residential building electrical fires occur during December and January.

Electricity is a basic part of residential life in the United States. It provides the energy for most powered items in a contemporary home, from lights to heating systems to televisions. Today it is hard to imagine a residence without electricity. It is a part of our homes and our activities that most of us take for granted. We rarely think how powerful electricity is.

Yet, using electricity can have dangerous consequences. Electrical fires are pervasive throughout the United States, causing injury, claiming lives, and resulting in large losses of property. Faulty electrical systems cause many fires. Even more electrical fires result from inappropriate wiring installations, overloaded circuits, and extension cords. Based on the latest available data for 2003 to 2005, an estimated 28,300 residential building electrical fires occur annually and cause 360 deaths, 1,000 injuries, and losses of $995 million.[1,2,3] Electrical fires accounted for 7% of all residential building fires in this 3-year period.

Fire Rates Attributed to Residential Electrical Building Fires

Electrical fires in residential buildings result in more damage and higher death rates per 1,000 fires on average than nonelectrical residential fires (Table 1). Dollar loss per fire for residential building electrical fires is more than double that for nonelectrical residential building fires; deaths per 1,000 fires is about 70% higher for residential building electrical fires. The injury rates resulting from residential building electrical and nonelectrical fires, however, are roughly the same, at 28 to 29 injuries per 1,000 fires.

Table 1. Loss Measures for Residential Building Electrical Fires (3-year average, 2003-2005).

Loss Measure	Residential Building Electrical Fires	All Nonelectrical Residential Building Fire Causes
Loss per fire	$25,126	$10,635
Injuries per 1,000 fires	28.5	28.2
Deaths per 1,000 fires	6.3	3.7

Source: NFIRS 5.0

Note: Loss per fire is computed only for those fires where loss and cause information was available.

The Electrical Fire Problem

Despite their prevalence, electrical fires are not always noted as such. When fire is severe, it can be difficult, for example, to discern whether an electric appliance started the fire or if a poorly wired plug was the cause. Heat-producing electrical equipment (e.g., hair dryers, portable heaters, cooking

continued on next page

appliances, and the like) tend to use more power than other electrical equipment. Devices like these may overload a circuit, especially one that is already reaching its maximum amperage allowance. Coupled with a faulty circuit breaker, this overload can cause the products to overheat and possibly to catch fire. Moreover, electrical fires that start in walls can smolder for some time. By the time the fire is detected, most likely it already has spread within the walls, unseen. There are over three times more residential building electrical fires than nonresidential building electrical fires, so the problem is particularly important for each of us in our homes.

Electrical fires can be particularly tricky to put out. Since they involve electricity, and water conducts electricity, using water to put out the fire can cause electrocution. Chemical powders can cause the fire to smolder rather than extinguish, setting the stage to reignite. Turning power off to the residence is an important step, if it is possible to do so.

While new construction is not immune from electrical fires caused by faulty wiring, there are many older homes with outdated wiring that is deteriorating, inappropriately amended, or insufficient for the electrical loads of a typical household in the 21st Century.

According to Underwriters Laboratories (UL), over 30 million homes—more than one-third of all U.S. housing—are more than 50 years old.[4] Consider the expansion in the number of appliances used by residents in the past half-century, and it is quickly obvious that overloaded wiring and circuitry is likely in these structures. Overloading will heat up wiring that already could be deteriorating, crumbling, and no longer a good insulator.

Just how big this problem is remains to be seen. The Residential Electrical System Aging Research project was launched by the Fire Protection Research Foundation to study how the age of wiring, outlets, junctions, and other connectors affects the pattern of electrical fires in homes.[5,6] One objective of the study is to make improvements to the National Electrical Code® (NEC) (National Fire Protection Association (NFPA) 70) and through the building codes adopted by local and State jurisdictions around the country. Already, changes in wiring practices dictated by better electrical codes and the required use of smoke alarms have made new construction safer.[7]

Residents demand higher levels of electrical energy to power their homes and appliances than they did in the past, and new homes are built to meet this demand for multiple televisions, phones, hairdryers, microwaves, washers and dryers, etc. As the consumers' electrical demands increase, so does their expectation that their homes will supply adequate power to meet these. They meet their needs by adding more circuitry (and circuit breakers in blank spots on the breaker panel, or even another circuit breaker box) and outlets to accommodate their purchases. If an outlet is added to an existing circuit, then the load easily can be more than the wiring originally was designed to conduct—perhaps decades ago.[8]

What these consumers really do is create unseen hazards in their homes. Inside the walls, wiring is heating and damaging its own insulation, wood frames are being charred by high-wattage light bulbs too close to ceilings, and fixture wattage ratings are being exceeded. But as long as the lights come on and the appliances start, the consumer remains unaware of the danger—until a fire starts.[9]

Where Residential Building Electrical Fires Occur

The functional and structural areas of the home are the most likely to experience electrical fires (Figure 1). Included in the functional category are bedrooms, dining rooms, kitchens, bathrooms, laundry areas, and the like. Fifteen percent of residential building electrical fires start in a bedroom (Table 2). The bedroom also is the leading area of fire origin for fires with injuries and dollar loss—bedrooms account for 30% of residential building electrical fires that result in injuries and 16% of residential building electrical fires that result in dollar loss. Structural areas of the home include areas such as crawl spaces, attics, walls, porches, and roofs. Attics, the second leading area of fire origin, account for 11% of residential building electrical fires. Over a quarter of all residential electrical fires start in these two areas. While fewer residential electrical fires start in lounge areas (family rooms, living rooms, and the like), these fires result in nearly a third of the deaths (31%).

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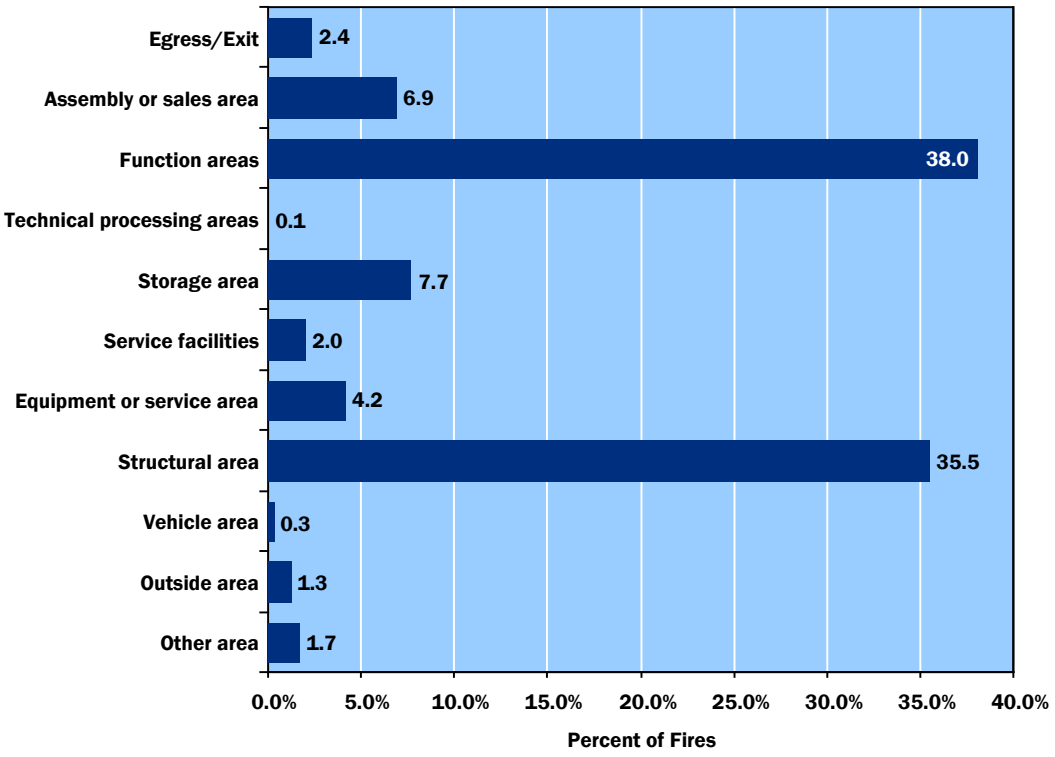
Figure 1. General Area of Fire Origin in Residential Building Electrical Fires, 2003–2005.



Source: NFIRS 5.0
Note: Percentages may not equal 100 due to rounding.

Table 2. Leading Area of Fire Origin in Residential Building Electrical Fires, 2003–2005 (fire-based).

Area of Fire Origin	Fires	Fires with...		
		Deaths	Injuries	Dollar Loss
Bedroom for fewer than 5 people	15.1%	16.6%	29.6%	16.0%
Attic: vacant, crawl space above top story	11.3%	—	—	11.6%
Cooking area, kitchen	9.4%	6.4%	6.2%	9.0%
Wall assembly, concealed wall space	8.4%	5.7%	5.9%	8.2%
Common room, den, family room, living room, lounge	6.8%	31.2%	13.9%	7.1%
Function areas, other	—	8.3%	6.6%	—

Source: NFIRS 5.0

What Ignites

By far, building structural components is the largest category of items first ignited in residential building electrical fires (Figure 2). Structural components include structural member or framing, insulation, trim, wall coverings, flooring, and the like. Of these components, structural framing (usually wood) accounts for 17% of residential electrical fires (Table 3). Insulation and interior and exterior wall coverings (e.g., paneling, wallpaper, siding) account for an additional 18% of residential electrical fires. However, the leading item first ignited in residential electrical fires is the insulation around electrical wires and cables. At 30% of residential electrical fires, it accounts for nearly the entire general materials category.

Together, insulation around electrical wires and structural member/framing account for 38% of all deaths from fires in residential buildings.

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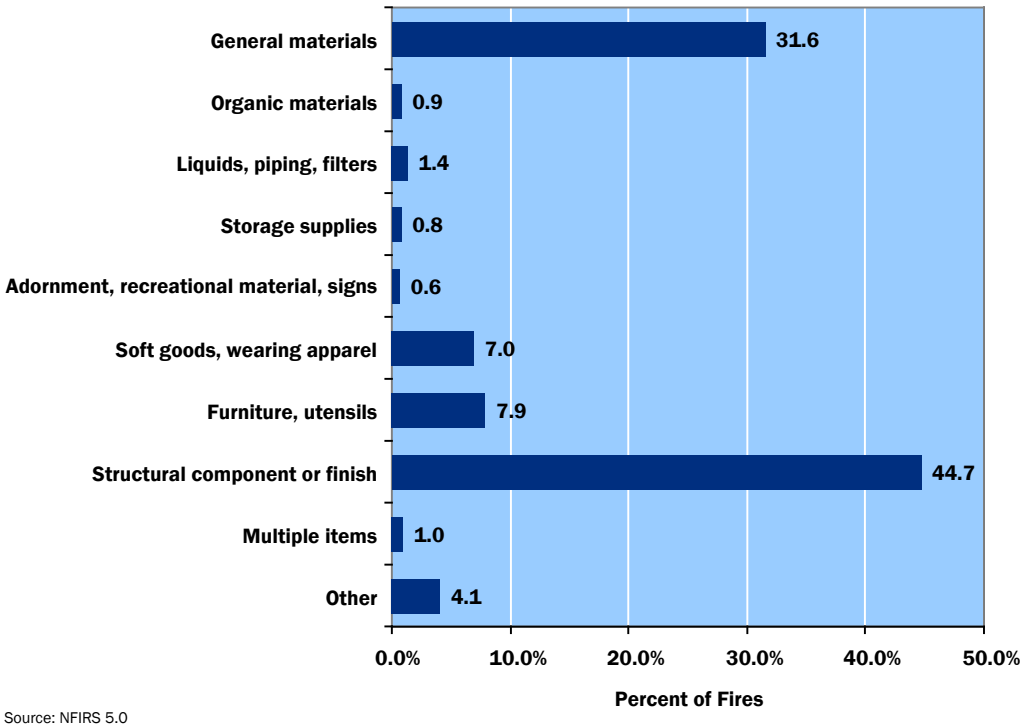
Figure 2. General Items First Ignited in Residential Building Electrical Fires, 2003–2005.



Source: NFIRS 5.0
Note: Percentages may not equal 100 due to rounding.

Table 3. Leading Items First Ignited, Electrical Fires, 2003–2005.

Item First Ignited	Percent of Fires
Electrical wire, cable insulation	30.2%
Structural member or framing	17.1%
Thermal, acoustical insulation within wall, partition, or floor/ceiling space	7.0%
Interior wall covering excluding drapes, etc.	6.5%
Exterior sidewall covering, surface, finish	4.7%

Source: NFIRS 5.0

When Residential Building Electrical Fires Occur

Heating, lighting, and cooking activities are highest in winter and so, too, are the occurrence of indoor fires stemming from electrical problems. Throughout most of the year, the pattern of residential electrical fires is consistent, but occurrences peak in December and January, accounting for 22% of all such fires (Figure 3). In the winter months, the relative humidity within the walls of a typical home can be very, very low and can turn wood wall framing into kindling, easily ignited by an arcing current. Fire deaths also are high in these months, but March and October, still dry months, both have similar peaks. Summertime has the lowest incidence of deaths resulting from electrical fires in the home. Figure 4 shows that late afternoon and evening are the most likely time for electrical fires to occur in residences. But it is the hours before dawn, between 3 and 6 in the morning, when deaths are most frequent.

Equipment Involved in Residential Building Electrical Fires

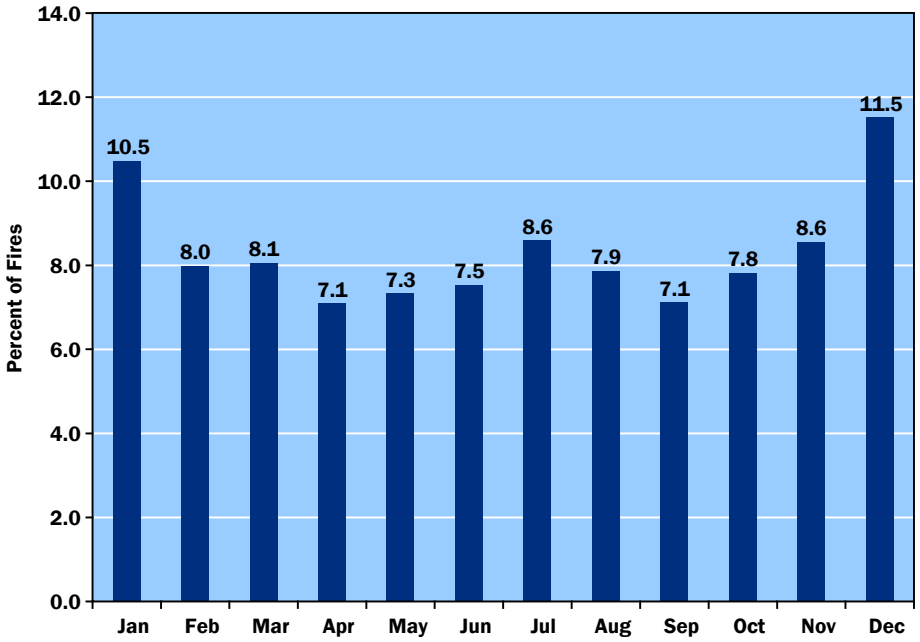
Wiring and electrical components have a life expectancy that does not always equal the life cycle of the building. As the electrical equipment wear out, fires are more probable. Electrical wiring with its various components is by far the major culprit in residential building electrical fires. Lamps and other lighting and cords and plugs also present severe problems (Figure 5).

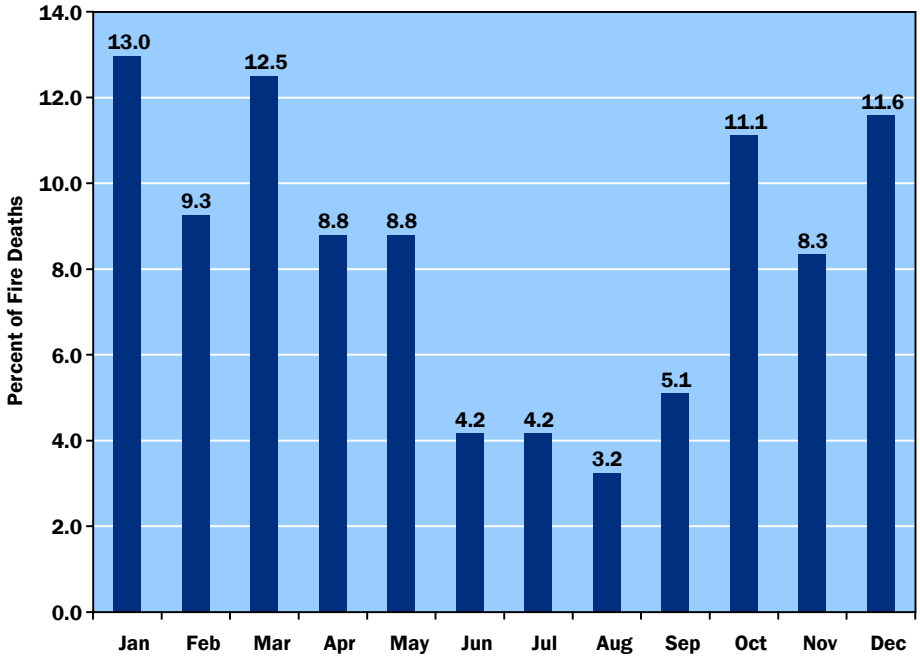
Fire Spread

Most residential building fires are confined to the object of origin (62%) with 38% of fires spreading through the residence and beyond (Figure 6). Fire spread from residential building electrical fires, however, has nearly the opposite

continued on page 8

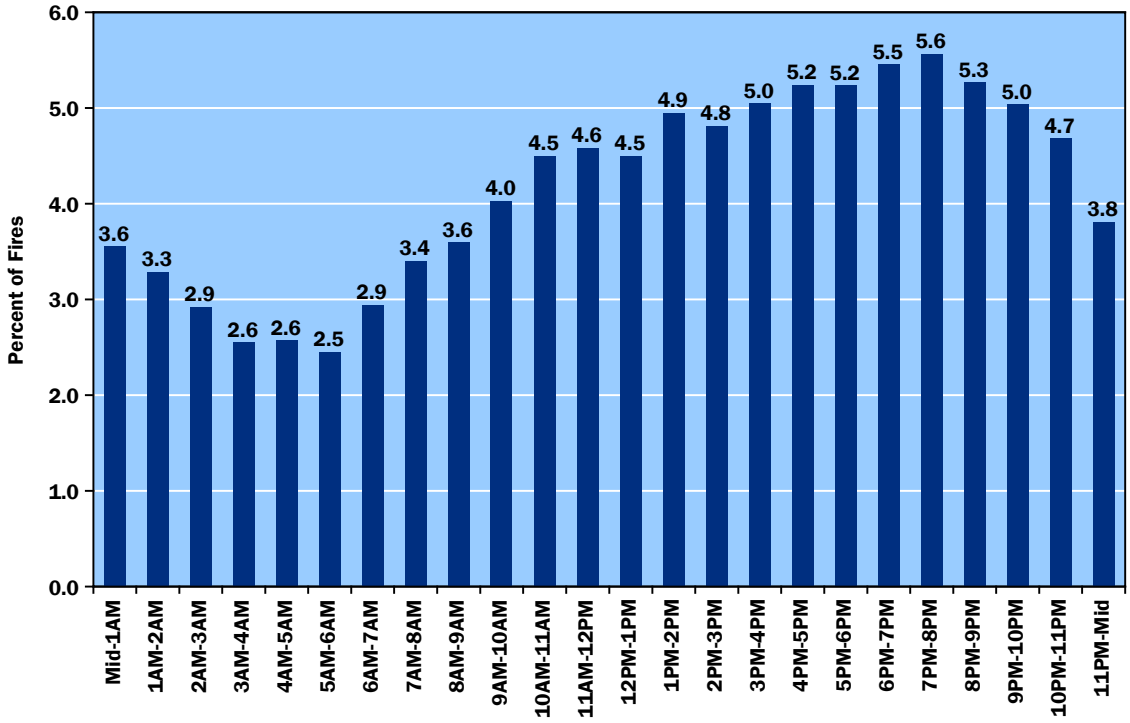
Figure 3. Month of Occurrence for Residential Building Electrical Fires and Fire Deaths, 2003–2005.

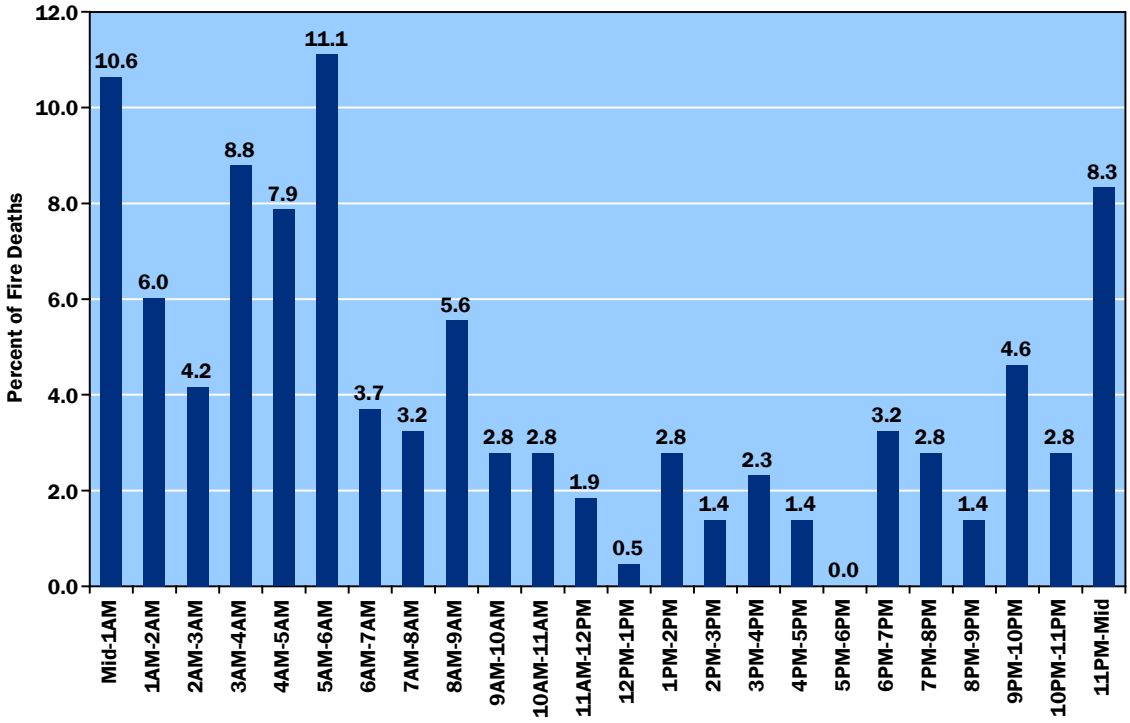




Source: NFIRS 5.0
Note: Percentages may not equal 100 due to rounding.

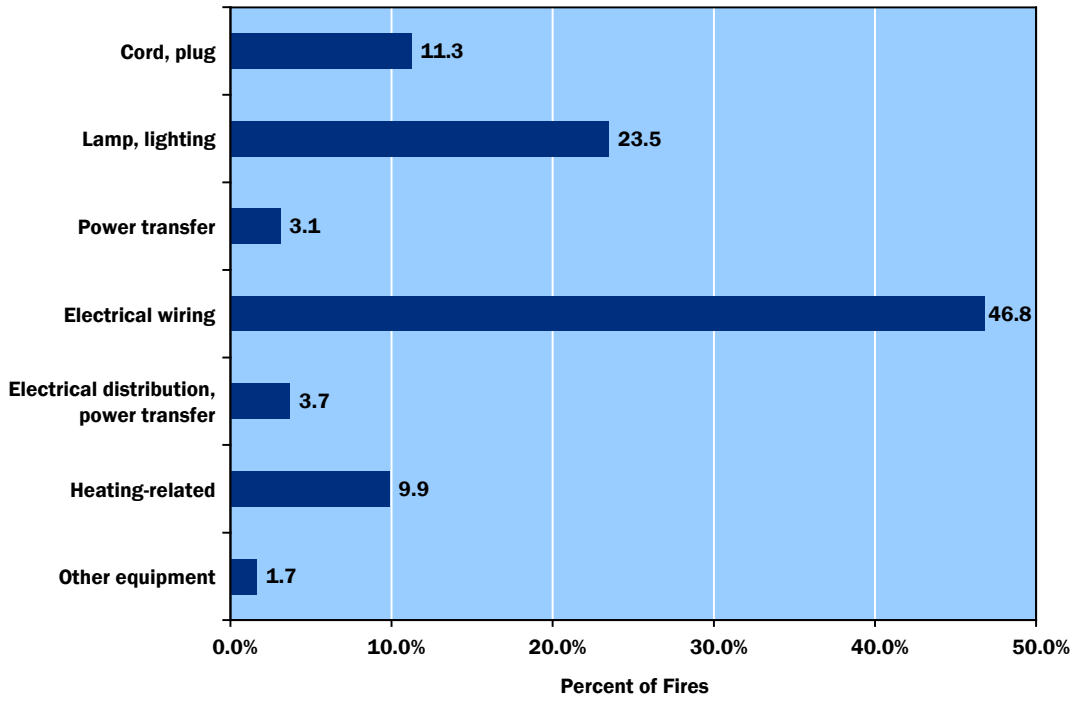
Figure 4. Alarm Time for Residential Building Electrical Fires and Fire Deaths, 2003–2005.





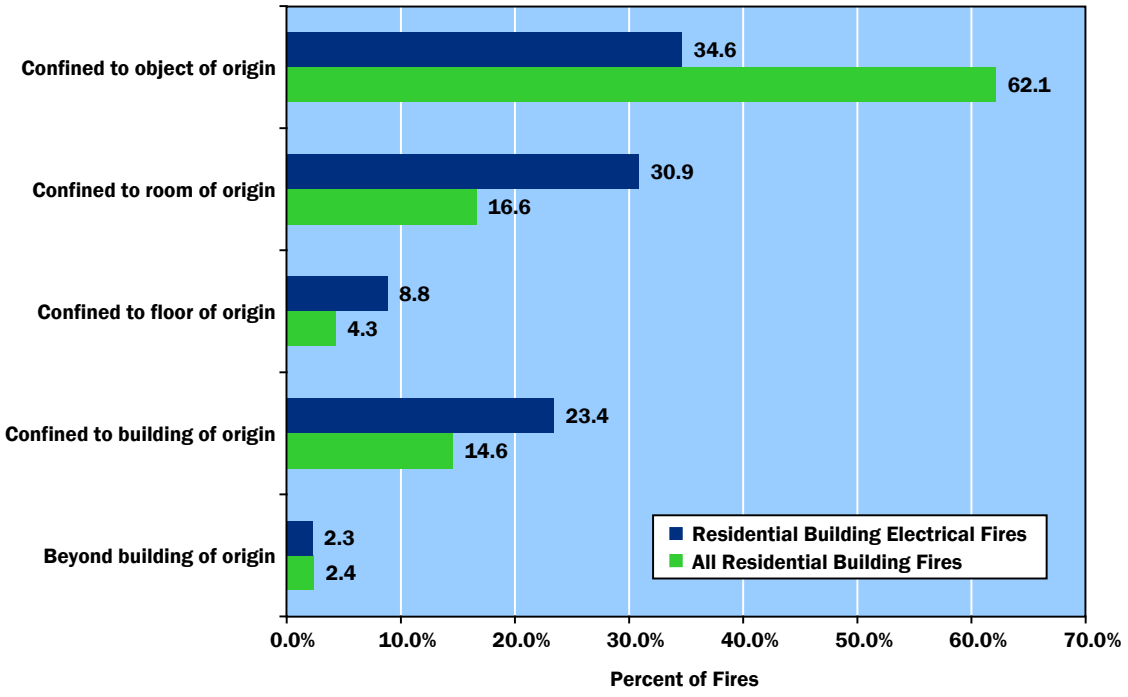
Source: NFIRS 5.0
Note: Percentages may not equal 100 due to rounding.

Figure 5. General Equipment Involved in Ignition in Residential Building Electrical Fires, 2003–2005.



Source: NFIRS 5.0

Figure 6. Fire Spread in Residential Building Electrical Fires, 2003–2005.



Source: NFIRS 5.0

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profile—these electrical fires are more likely to spread throughout the home. Sixty-five percent of residential building electrical fires spread beyond the initial object that started the fire. Structural members and framing contribute most to flame spread (27%).

Leading Factors Contributing to Residential Building Electrical Fires

Not surprisingly, when a factor was noted as contributing to ignition, some type of electrical failure accounted for 89% of electrical fires in residential buildings. The four leading specific factors, all electrical issues, account for 81% of these electrical failures (Table 4).

Table 4. Leading Factors Contributing to Ignition, Electrical Fires, 2003–2005.

Factor Contributing to Ignition	Percent of Fires
Electrical failure, malfunction, other	35.4%
Unspecified short-circuit arc	26.0%
Short-circuit arc from defective, worn insulation	15.1%
Arc from faulty contact, broken conductor	4.4%
Mechanical failure, malfunction, other	3.8%

Source: NFIRS 5.0

Electrical Safety Devices

Arc Fault Circuit Interrupters (AFCI) or Arc Fault Interrupters (AFI) and Ground Fault Circuit Interrupters (GFCI) or Ground Fault Interrupters (GFI) perform different jobs.[10] A GFCI protects you from electrical shock. An AFCI breaker protects you and your house from a fire caused by electrical arcs. [11,12]

GFCIs traditionally meet the standard for protecting against electric shock. GFCIs were first implemented as an electrical code requirement in the early 1970s for bathroom outlets. Over time, GFCIs have become required in other areas likely to pose a risk for shock, especially those in potentially wet locations such as kitchens, unfinished basements, garages, outdoors, Jacuzzis, and hot tubs. Although GFCIs are designed to protect people from electrocution, they are not designed to protect against house fires.

AFCIs identify arcing at cords, outlets, and lights and trip breakers before the arcing can start a fire. AFCIs recently became a requirement for bedrooms in new construction by the NEC in use in many local and State jurisdictions. This technology is better suited for new homes with updated wiring rather than older homes where the grounding for wiring is questionable.

Examples

The following recent examples illustrate typical residential building electrical fire scenarios:

> July 2007, Havre, MT: A family lost all of their personal belongings in an electrical fire. The fire, which officials said originated in one of the wall outlets, consumed an 8' x 14' bedroom and its contents. Fire or smoke was not seen although a family member smelled something burning. Bedrooms were checked and, in the corner of one, was a fire. "At first it started small but it went up fast," the young woman observed.[13]

> November 2007, Newton, KS: A malfunction in the electric distribution system was determined to be the cause of an apartment complex fire that sent three people to the hospital. The fire originated in an electric box on the outside of the building near the stairwell.[14]

> December 2007, Salem, OR: Fire blamed on a worn extension cord extensively damaged a house in Salem, OR. Fire investigators noted the fire was caused by an extension cord that had been pinched under the corner of a couch. The investigators expected the house to be a total loss.[15]

Conclusion

While the source of an electrical fire can be hard to determine, some known culprits—overloading circuits with heat producing equipment, for example—can lead to items such as the insulation around electrical wires and cables catching fire, either slowly or immediately. With over three times more residential building electrical fires than nonresidential building electrical fires, it is important to ensure that the electrical panels, outlets, switches, and junction boxes in your home are correctly installed and not damaged or modified by unlicensed electricians. Do not use extension cords and multiple plug-in devices as a replacement for new circuits. Since 15% of residential building electrical fires start in a bedroom, upgrade bedrooms with AFIs where possible.

Never use water on suspected electrical fires, and inform your local fire department when you call 9-1-1 that you presume the fire to be electrical.

Notes:

[1] NFIRS 5.0 contains both converted NFIRS 4.1 data and native NFIRS 5.0 data. This topical report includes only native 5.0 data and excludes incident type '110', since it is a 4.1 conversion code.

[2] National estimates are based on 2003 to 2005 native version 5.0 data from the National Fire Incident Reporting System (NFIRS) and residential structure fire loss estimates from the National Fire Protection Association's (NFPA) annual survey of fire loss. Fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25, and loss to nearest $M.

[3] In NFIRS 5.0, a structure is a constructed item of which a building is one type. The term "residential structure" commonly refers to buildings where people live. The definition of a residential structure fire has, therefore, changed to include only those fires where the NFIRS 5.0 structure type is 1 or 2 (enclosed building and fixed portable or mobile structure) with a residential property use. Such fires are referred to as "residential buildings" to distinguish these buildings from other structures on residential properties that may include fences, sheds, and other uninhabitable structures. In addition, incidents that have a residential property use, but do not have a structure type specified are presumed to be buildings.

[4] "Drawing Wisdom from the Wall," http://www.ul.com/newsroom/wiring/index.html

[5] Ibid.

[6] Rasdall, Joyce, "Aging Residential Wiring Issues: Concerns for Fatalities, Personal Injuries, and Loss of Property," Education Presentation, Annual Household Equipment Technical Conference, Louisville, KY, Oct. 26-28, 2005, http://www.esfi.org/educators/documents/AheeAgingResidentialWiringIssues5-05.pdf

[7] Ibid.

[8] Ibid.

[9] "Drawing Wisdom from the Wall," http://www.ul.com/newsroom/wiring/index.html

[10] AFCIs also are known as Arc Fault Interrupters (AFI). GFCIs also are known as Ground Fault Interrupters (GFI).

[11] Consumer Product Safety Commission, GFCI Fact Sheet, http://www.cpsc.gov/cpscpub/pubs/99.html

[12] Consumer Product Safety Commission, AFCI Fact Sheet, http://www.cpsc.gov/CPSCPUB/PUBS/afcifac8.PDF

[13] "Electrical fire consumes family belongings," Elizabeth Doney, *Havre Daily News*, (Havre, MT), http://www.havredailynews.com/articles/2007/08/07/local_headlines/local.txt

[14] "Accident ruled cause of Nov. 18 blaze," The Kansan.com, http://www.thekansan.com/stories/112707/topstories_112707008.shtml

[15] "Extension cord blamed for fire," Statesman Journal (Salem, OR), http://www.statesmanjournal.com/apps/pbcs.dll/article?AID=/20071213/NEWS/712130324

VIRGINIA DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
DIVISION OF BUILDING AND FIRE REGULATION

Code Change Form for the 2012 Code Change Cycle

Code Change Number:_____

Proponent Information (Check one): ☐Individual ☐Government Entity X Company

Name: Robert Torbin Representing: Omega Flex, Inc

Mailing Address: 213 Court Street Suite 1001 Middletown, CT 06457

Email Address: bob.torbin@omegaflex.net Telephone Number: (413) 388-2390

Proposal Information

Code(s) and Section(s): USBC G2411.1

Proposed Change (including all relevant section numbers, if multiple sections):

ADD THE FOLLOWING NEW TEXT TO SECTION G2411.1:

CSST with an arc-resistant jacket listed by an approved agency for installation without the direct bonding, as prescribed in this section, shall be installed in accordance with its listing and the manufacturer's installation instructions.

Supporting Statement (including intent, need, and impact of the proposal):

See attached Supporting Statement.

Submittal Information

Date Submitted: 6 August 2012

The proposal may be submitted by email as an attachment, by fax, by mail, or by hand delivery.

Please submit the proposal to:

DHCD DBFR SBCO (State Building Codes Office)
600 East Main Street
Suite 300
Richmond, VA 23219

Email Address: Vernon.hodge@dhcd.virginia.gov
Fax Number: (804) 371-7092
Phone Numbers: (804) 371-7150

Supporting Statement

The use of a CSST product with a protective, arc-resistant jacket is an alternate method of protection against electrical arcing damage caused by high voltage transient events such as a nearby lightning strike. An arc-resistant jacket does not rely on direct bonding to the grounding electrode system to reduce or eliminate damage from electrical arcing. Instead, the protective jacket acts as a resistor and is designed to locally absorb and dissipate the arcing energy over a short length of the jacket. The jacket, in essence, disrupts the focus of the arc and reduces the energy level below the threshold value that can cause a perforation of the tubing wall. This dynamic action is equally effective compared to the current CSST bonding method regardless of the bonding conductor size or length. The protection against arcing is provided uniformly throughout the piping system, and is not affected by close proximity to other metallic systems that may not be similarly bonded.

The ICC Evaluation Service has developed listing criteria for arc-resistant jackets to verify that this design approach will provide an ability to resist damage from transient arcing currents under a wide range of conditions. A copy of the PMG Listing Criteria (LC1024) is included with this proposal. Currently, three CSST products are listed to PMG LC1024. The listing criteria defines the experimental means to determine whether the protective jacket provides resistance to damage from indirect lightning strikes without the need for additional bonding as prescribed currently in Section G2411.1 of the VA Uniform Statewide Building Code. A proposal to include performance requirements for an arc-resistant jacket based on the PMG LC1024 Listing Criteria is presently under consideration by the ANSI LC-1 TAG.

Extensive testing has been performed by Lightning Technologies Inc. (Pittsfield, MA) to demonstrate that the protective, arc-resistant jacket can resist in excess of 4.5 coulombs without a perforation of the tubing wall. A copy of a pertinent LTI test report is attached. By comparison, experimental testing has determined that energy levels around 0.15 coulombs are sufficient to perforate uncoated CSST. While no product or system is immune to damage from a direct lightning strike, lightning experts agree that a level of approximately 2 coulombs is the upper end of the energy level induced in metallic systems (inside the building) from a nearby/indirect lightning strike. A recent IEEE paper by Dr. Michael Stringfellow (attached) on lightning damage confirms that the proposed energy value (2 coulombs and lower) appears consistent with lightning damage observed in the field, and the acceptance level (4.5 coulombs) represents an appropriate safety threshold for this type of lightning protection.

The cost impact to the consumer of allowing the use of arc-resistant jacket CSST as an alternate method of bonding CSST should be minimal if not zero. The small extra cost per foot of arc-resistant jacket is more than offset by the elimination of the two bonding connections, the 6 AWG conductor wire, and the labor time for the electrician to install.

CSST with arc-resistant jacket has been commercially installed since 2004, and at the present time, three different (black-jacketed) products are commercially available. Field experience has been very favorable with no known cases of indirect lightning damage to CSST piping systems using these arc-resistant jackets. Currently, at least 10 states permit the installation of the arc-resistant CSST without the need for additional bonding. Given that both conventional (yellow) and advanced (black) CSST products will continue to be commercially available, both methods of electrical protection of CSST systems should be recognized and permitted within the Code.

Addenda to the Second Edition of
ANSI LC 1-2005 • CSA 2.26-2005
ANSI LC 1a-2009 • CSA 2.26a-2009

American National Standard/ CSA Standard for **Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)**

Preface

The standards set forth herein apply to the second edition of the Standard for Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST), ANSI LC 1-2005 • CSA 2.26-2005 and Addenda "a" ANSI LC 1a-2009 • CSA 2.26a-2009, and supersede corresponding standards therein. Following their preparation by the supervising Technical Advisory Group, they were accepted by the American National Standards Institute (ANSI) and the Interprovincial Gas Advisory Council (IGAC), and subsequently approved.

NOTE: Changes, other than editorial, are denoted by a vertical line in the margin.

APPROVED

December 2, 2011
American National Standards Institute, Inc.

IGAC

December 22, 2011
Interprovincial Advisory Council
Effective in Canada June 1, 2013

Standard Developer

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Addenda to American National Standard/ CSA Standard for Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)

Part I: Construction

1.1 Scope

1.1.3

This standard does not apply to CSST, whether coated or uncoated, intended for direct burial underground. Tubing shall be installed underground only when encased inside either an approved conduit or as part of an approved engineered system and in accordance with local codes and the manufacturer's instructions.

1.4 Gas Pressure Regulators

A piping system for use at gas pressures exceeding $^1/_2$-psi (3.45-kPa), but intended to serve equipment rated for $^1/_2$-psi (3.45-kPa) maximum, shall include a gas pressure regulator to limit the downstream supply pressure to $^1/_2$-psi (3.45-kPa), and the installation instructions for the piping system shall specify that such a regulator shall be installed (see 1.8-m). Gas pressure regulators supplied by the manufacturer for use with CSST systems shall comply with a nationally recognized standard for pressure regulators.

For system pressures up to 5-psi (34.5-kPa), the regulator shall either incorporate construction which will "lock up" under no-flow conditions to prevent downstream pressure in excess of 5-psi (34.5 kPa) or the regulator must be installed with an overpressure protection device.

1.8 Instructions

Complete detailed instructions, including appropriate illustrations, necessary for proper sizing, installation, inspection and repair of the piping system shall be provided by the manufacturer. These instructions shall be included in a printed design and installation manual to be provided with the piping system. The manual shall include instructions on all topics and in the exact prescribed format shown in Exhibit D, Minimum Design and Installation Manual Requirements.

Included in the instructions shall be statements to the effect that:

a. A warning to the installer that the installation instructions shall be followed as prescribed by the manufacturer.

b. The installation shall be made in accordance with local codes, or, in the absence of local codes, in accordance with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, *Natural Gas and Propane Installation Code, CSA B149.1*, the *International Fuel Gas Code*, the *Uniform Plumbing Code*, the *Federal Manufactured Home Construction and Safety Standards, 24 CFR Part 3280*, the *Manufactured Housing Construction and Safety Standards, ICC/ANSI 2.0*, or the Standard on *Manufactured Housing, NFPA 501*, as applicable.

c. Precautions shall be taken by the installer to ensure any exposed tubing is not damaged or abused during building construction or reconstruction.

d. The piping system is for use with fuel gases only and is intended for operating pressures not exceeding 5 psi (34.5 kPa) or 25 psi (172.5 kPa). The maximum actual operating pressure, including transients, shall not in any case exceed 6.5 psi (44.8 kPa) for 5 psi (34.5 kPa) rating or 30 psi (207 kPa) for 25 psi rating.

e. If the piping system installation requires components in addition to those supplied by the piping system manufacturer, the installation instructions shall specify the specific components required. The instructions shall state that only the components provided or specified by the manufacturer are to be used in the installation.

f. The size and depth of installation clearance holes or notches for routing the tubing through wall studs and joists shall comply with the requirements of the local building code.

g. Concealed tubing shall be protected from puncture threats, using the shielding devices specified by the manufacturer, at all points of penetration through studs, joists, plates or similar structures. The extent of protection shall be defined as follows:

    1. At points of penetration less than 2 in (50.8 mm) from any edge of a stud, joist, plate, etc., a listed striker plate is required to provide protection at the area of support and within 5 in (127 mm) of each side (if appropriate) of the support.

    2. At points of penetration 2 to 3 in (50.8 to 76.2 mm) from any edge of a stud, joist, plate, etc., a listed striker plate is required to provide protection throughout the area of support.

    3. At points of penetration greater than 3 in (76.2 mm) from any edge of a stud, joist, plate, etc., no protection is required.

    4. Tubing routed horizontally through studs shall be protected from puncture threats between the studs using the shielding devices provided.

    5. CSST greater than 1 in (25.4 mm) inside diameter installed within hollow cavity walls of 2 x 4 construction shall be protected along the entire concealed length in the manner and using the shielding devices specified by the manufacturer.

    6. The width of the installed striker plate, at the points of penetration through wall studs, floor joists, plates, sills, etc., shall be out at least 1.5 times the outside diameter of the tubing.

h. The inspection, testing and purging of the installation shall be performed using the procedures specified in Part 4, General, of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, and/or *the Natural Gas and Propane Installation Code, CSA B149.1*, or the *International Fuel Gas Code*, the *Uniform Plumbing Code,* or in accordance with the requirements of the applicable local codes. The installed gas piping system shall not exhibit any loss of pressure during the field pressure test.

i. The minimum permissible bend radius for the tubing, and minimum permissible bend radius for fitting/tubing combinations. A warning to avoid sharp bends, stretching, kinking or twisting of the tubing

j. Sizing tables for 0.5 psi (3.45 kPa), 2 psi (13.8 kPa), 5 psi (34.5 kPa), 10 psi (69 kPa), if applicable, and 25 psi (172.5 kPa), if applicable, service as a minimum shall be provided to aid the installer or contractor in selecting the proper size tubing for the system.

k. Flame spread and smoke density ratings for nonmetallic coating materials as determined by the Test Method for Surface Burning Characteristics of Building Materials, ASTM E84, test procedures (see 1.2.7). For ratings greater than 25 for flame spread and/or greater than 50 for smoke density, the instructions shall include a statement that the installer shall meet local building codes with respect to flame spread and smoke density regulations for nonmetallic materials.

l. Installation instructions shall provide minimum requirements for bonding of the CSST system including but not limited to: (refer to Appendix B, Guidelines for the Direct (Electrical) Bonding of CSST Piping Systems, for guidelines).

   1. Location of connection;

   2. Method of connection;

   3. Size of bonding conductor; and

   4. Connection to the grounding electrode system.

m. The instructions shall include information on acceptable regulators, including regulator make, model number, size required and any special installation requirements. The regulator(s) specified shall be listed by a nationally recognized testing agency as complying with 1.4, Gas Pressure Regulators, of this standard.

n. Guidelines for installing and protecting tubing located outdoors (above ground). The guidelines shall place limits on outdoor installations to those required to make connections to gas meters or outdoor gas appliances which are attached to, mounted on or located in close proximity to the building structure.

o. When an excess flow valve is supplied as part of the gas piping system, the CSST manufacturer's design and installation instructions, or instructions supplied with the part by the valve manufacturer, shall include data on sizing and pressure drop across the device as a function of flow (up to the activation flow rate) for each size valve.

p. For operating pressures above 5-psi (34.5 kPa), the manufacturer shall provide engineering guidance for sizing CSST systems. The sizing data shall be provided in the form of actual test data, tables, graphs or formulas for natural gas (LP gas optional) as determined by the manufacturer.

Part II: Performance

2.15 Electrical Properties

2.15.1 Resistance and Conductivity

An assembly of tubing and fittings shall not have an electrical resistance that exceeds the value given in Table 6, Maximum Electrical Resistance.

Method of Test

A length of tubing (with sheathing) is to be laid out (essentially straight) on a flat, horizontal, noncombustible, electrically nonconductive surface. The segment length shall be 6-ft (1830-mm) long. Connection to the tubing shall be made using appropriate end fittings, and installed in accordance with the manufacturer's instructions. A single, low-resistance copper conductor (no smaller than 6 AWG) of sufficient length shall be secured (by an appropriate means as determined by the testing agency) to each end fitting and to an alternating-current supply with a no-load voltage not to exceed 12-V.

A current of 25-A shall be passed between the end fittings of the test assembly by starting with an impressed potential of 0.0 volts AC and gradually increasing the voltage until 25 ampere current is attained. The test specimen shall not be moved or otherwise manipulated during any part of this test. The voltage drop between the end fittings shall be measured. The resistance shall be calculated from the measured voltage drop and the current in the following equation and compared against the acceptance value listed in Table A, Capacity Tables of CSST.

$$R = E/I;$$

where:

E = volts

I = amperes

R = ohms

Tables Referenced In Parts I And II

Table I. Flow Capacity Data Chart RAW Data

Vendor _____ Date _____

Inner Diameter _____

Effective Hydraulic
Diameter _____

Column 1				Column 2										
Inlet Pressure				Pressure Drop				Tubing Length feet (m)						
psi (kPa)		In. W.C.(kPa)		psi (kPa)		In. W.C. (kPa)		30 (9.1)	50 (15.2)	80 (24.4)	100 (30.5)	150 (45.7)	200 (60.9)	250 (76.2)
0.253	(1.74)	7.0	(1.74)	0.0181	(0.12)	0.50	(0.12)							
0.361	(2.49)	10.0	(2.49)	0.1085	(0.75)	3.0	(0.75)							
0.505	(3.48)	14.0	(3.48)	0.217	(1.49)	6.0	(1.49)							
2.0	(13.79)	55.4	(13.79)	1.5	(10.30)	41.49	(10.33)							
5.0	(34.47)	138.4	(34.48)	3.5	(24.10)	96.81	(24.10)							

Table II. Flow Capacity Data Chart RAW Data

Vendor _____ Date _____

Inner Diameter _____

Effective Hydraulic
Diameter _____

Column 1				Column 2										
Inlet Pressure				Pressure Drop				Tubing Length Feet (m)						
psi (kPa)		In. W.C. (kPa)		psi (kPa)		In. W.C. (kPa)								
0.253	(1.74)	7.0	(1.74)	0.0181	(0.12)	0.50	(0.12)							
0.361	(2.49)	10.0	(2.49)	0.1085	(0.75)	3.0	(0.75)							
0.505	(3.48)	14.0	(3.48)	0.217	(1.49)	6.0	(1.49)							
2.0	(13.79)	55.4	(13.79)	1.5	(10.30)	41.49	(10.33)							
5.0	(34.47)	138.4	(34.47)	3.5	(24.10)	96.81	(24.10)							

Table VI Maximum Electrical Resistance

Nominal size of pipe (in)	Resistance (Ω/ft)
$^{3}/_{8}$	0.180
$^{1}/_{2}$	0.150
$^{3}/_{4}$	0.120
1.0	0.120
1-$^{1}/_{4}$	0.090
1-$^{1}/_{2}$ and 2	0.090

Appendix B
Guidelines for the Direct (Electrical) Bonding of CSST Piping Systems

Purpose:

The bonding of the CSST piping system to the grounding electrode system at the entrance to the premises in which it is installed will lower the voltage build-up on the CSST resulting from indirect lightning strikes. The bonding will help achieve an equi-potential state between the CSST and other similarly bonded metallic systems (such as the water piping, structural steel and coax cable). The bonding will help reduce the possibility and/or severity of arcing between the conductive systems when energized by a lightning strike nearby the premises.

These guidelines describe the requirements for the direct bonding of corrugated stainless steel tubing (CSST) gas piping systems, and must be performed by a qualified person recognized by the local jurisdiction as capable of performing such work. Direct bonding is required as part of the installation of all new CSST natural and LP gas piping systems whether or not the connected gas equipment is electrically powered. These guidelines are applicable to typical single-family and multi-family dwellings and certain commercial buildings.

CSST installed inside or attached to the exterior of a building or structure shall be electrically continuous and directly bonded to the electrical ground system of the building. The gas piping is considered to be directly bonded when installed in accordance with the following instructions:

- A bonding jumper is permanently and directly connected to the electrical service grounding system. This can be achieved through a connection to the electrical service equipment enclosure, the grounded conductor at the electrical service, the grounding electrode conductor (where of sufficient size) or to the one or more grounding electrodes used.

- A single bond connection is made to the building gas piping system between the point of delivery and the first CSST fitting, or on the first CSST fitting. A "daisy chain" configuration of the bonding conductor is permitted for multi-meter installations. A bonding connection shall not be made to the underground, natural gas utility service line or the underground supply line from a LP storage tank.

- The bonding conductor is not smaller than a 6 AWG copper wire or equivalent. The bonding conductor is installed and protected in accordance with the *National Electrical Code, NFPA 70, (NEC)* and the *Canadian Electrical Code CSA-C22.1 (CEC)*.

- The bonding conductor is attached in an approved manner in accordance with NEC/CEC and the point of attachment for the bonding conductor is accessible.

- Bonding/grounding clamp used is listed to *UL 467, Grounding and Banding Equipment,* or other acceptable national standards.

- The bonding clamp is attached at one point within the piping system to a segment of rigid pipe or a pipe component such as a nipple, fitting, manifold or the first CSST fitting. (See Figure 1, Bonding Attachment to Pipe, for guidance.) The corrugated stainless steel tubing portion of the gas piping system shall not be used as the point of attachment of the bonding clamp at any location along its length. The bonding clamp is attached such that metal to metal contact is achieved with the pipe component.

- CSST should not be directly supported on or by other electrically conductive systems including copper water pipe, electric power cables, air conditioning and heating ducts, communications cable and structural steel beams.

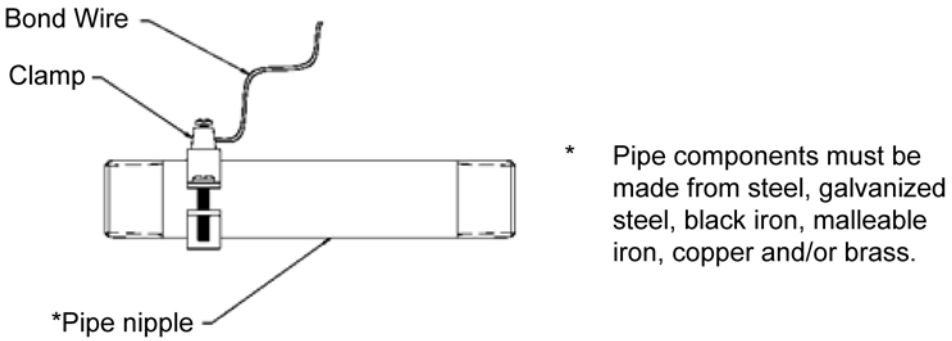

Figure 1. Bonding Attachment to Pipe

Part I: Construction

1.10 Installer Training

The manufacturer shall establish and maintain an installer training program and a database of installers who have completed the manufacturer's training requirements. An identification card shall be supplied to each installer who has completed the manufacturer's training requirements, and a record of the installer's contact data shall be maintained in the database. The identification card shall include the following information:

- CSST manufacturer's name and telephone number
- CSST product(s)/brand(s) covered by training
- Unique serial number for the identification card (recorded in database)
- Installer's name and the date of training or card issuance (recorded in database), and
- Statement that the named installer has completed the manufacturer's training program to install [insert manufacturer's name or brand] CSST

RATIONALE: *Training of installers is a manufacturer-based requirement, and therefore it transcends any other installer qualifications imposed by the country, state or local jurisdiction such as licensing, education or apprenticeship. CSST systems have unique features, including fitting attachments proprietary to each manufacturer, which are not interchangeable between brands. The requirement has been modified and moved to the body of the Standard and not in Exhibit B since training is required whether the installer is US-based or Canada-based. The training requirement was modified to create auditable action items for the certifying agency such as a database and a training program.*

1.2 Materials

1.2.6
For tubing which includes a nonmetallic coating or covering, the coating shall comply with the international color designation of yellow. A jacket or covering applied to the tubing shall be either yellow or black, and marked in a contrasting color.

RATIONALE*: To recognize alternate color jackets that are currently available in the marketplace consistent with other commercial gas-piping products.*

Part II: Performance

2.15 Arc Resistant Jacket or Covering System (Optional)

2.15.1 General

2.15.1.1 Unless otherwise specified, all testing shall be performed in accordance with the general requirements of ANSI LC-1 and as stipulated in Part II Performance.

2.15.1.2 Tubing which has an arc resistant jacket or covering system as an alternate direct-bonding means (henceforth referred to as the "jacket") shall comply with the following tests.

2.15.1.3 Unless otherwise specified, the jacket shall comply with the following tests with the tubing, jacket, and fitting(s) assembled as a final installation and in accordance with the manufacturer's instructions.

2.15.1.4 Testing shall be performed on samples of tubing sizes ½-inch and 1-inch in diameter. Each test sample shall be at least three feet in length or as specified within the Method of Test.

2.15.2 Resistance of Jacket Material To Extreme Environment(s)

2.15.2.1 Resistance of Jacket Assembly to Extreme Temperature Cycles

Test specimens of the jacket material shall be prepared (based on the fabrication technique used to apply the jacket) and subjected to exposure to low temperature in accordance and compliance with ASTM D746-07 for Brittleness Temperature of Plastics and Elastomers by Impact. The manufacturer shall present a test report from an accredited testing laboratory to the listing agency including a statement on the minimum embrittlement temperature.

2.15.2.2 Resistance of Jacket Assembly to Corrosion

The tubing, jacket and fitting assembly (assembled per the manufacturer's instructions) shall be subjected to the *Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM B117-97*, for not less than 96 hours without evidence of pitting, flaking, cracking or signs of corrosive attack in accordance with Part 1.2.5, and then shall be subsequently subjected to and pass Part 2.15.3 Electrical Tests. Two samples of each size shall be prepared and subjected to the prescribed test. Products that do not incorporate a metallic layer or component as part of the jacket are not required to be tested to 2.15.2.2. The manufacturer shall present a test report from an accredited testing laboratory to the listing agency and deliver the test samples to the laboratory performing the Electrical Tests.

2.15.3 Electrical Tests

2.15.3.1 Robustness Against Arcing (Indirect Lightning)

Tubing, jacket and fitting assemblies shall withstand electrical arcing, in accordance with the following method of test without perforation of the tubing and without leakage in excess of that specified in Part 2.2, Leakage. The test samples subjected to the salt spray exposure (if applicable) in Part 2.15.2.2 Resistance of Jacket Assembly to Corrosion shall be used in the testing. Other samples shall be used if no samples are required to be subjected to salt spray exposure in Part 2.15.2.2. Testing shall be performed by an accredited lightning testing laboratory acceptable to the listing agency.

Method of Test

For arc robustness determination, a electrical waveform (Current vs. Time) shall be utilized. (NOTE: Additional testing intended to address a wider range of possible transient sources and behaviors may be considered, but this has not been included in the prescribed Method of Test.) The waveform is defined by its rise-time to peak current and fall-time to 50 percent of peak amplitude. The selected waveform is 10µs x1000µs.

Generator Calibration:

An electrical test generator and appropriate measurement equipment shall be assembled to generate the waveform under consideration and to record generator output. (See Figure 1 for schematic.) The generator assembly shall utilize an electrode of ¼ in diameter attached to the output of the generator (i.e. live terminal). The test sample is grounded to the generator with a minimum AWG 6 copper conductor or equivalently sized braided strap. The test sample shall be supported in such a manner to prevent arcing or conduction from the test sample to adjacent equipment.

A length of copper pipe is installed as the test sample, with a 1/8 in gap between the copper pipe and the generator electrode. The generator is charged to the desired level, and discharged through the electrode to the copper pipe (via an arc) and then to ground. Arc attachment to the tubing shall be verified. Arc attachment to nearby equipment or to end connections on the copper tubing invalidates this test run. The recorded generator output is verified against the desired waveform. Adjustments to the generator assembly are made and re-tested until the generator output matches the desired waveform output.

Testing:

The test sample is installed with the electrode placed over a straight portion of the sample, with a 1/8 in gap between the exterior of the jacket and the generator electrode. (Refer to Figure 1) The generator is charged to the desired level, and discharged through the electrode to the test assembly (via arc) and to ground. Arc attachment to

the tubing shall be verified. Arc attachment to nearby equipment or to end connections on the tubing invalidates this test run.

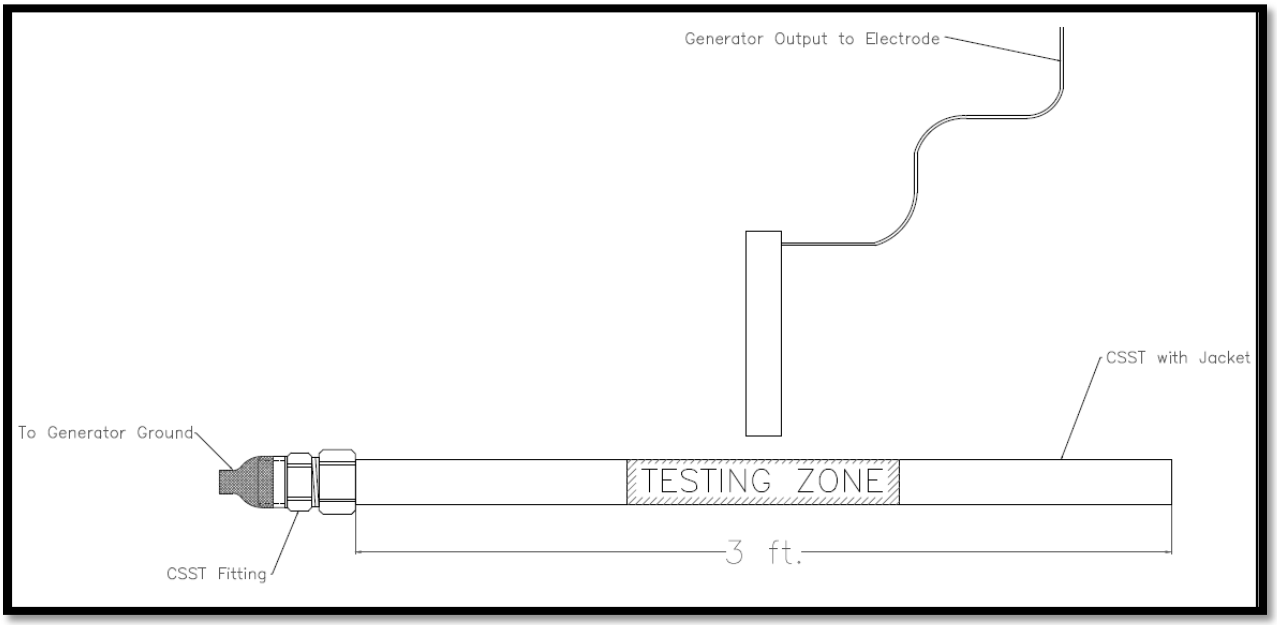

Figure 1 Experimental Set-Up for Arc Resistance Test

The recorded generator output is verified against the desired waveform. Peak current and coulombs transferred (the integral of the waveform) are recorded. The jacket is removed from the site of the arc termination allowing a visual inspection of the exposed tubing. The tubing must show no puncture of the stainless steel tubing.

The test assembly must withstand a minimum of 4.5 Coulombs without leakage as defined by Part 2.2 Leakage.

2.15.4 Resistance to Installation Damage

Tubing and jacket assemblies shall withstand damage from friction/wear in a simulated "drag-zone" installation without excessive damage to the jacket in accordance with the following method of test.

Method of Test

Three individual simulated joists/ studs (spaced 16-inches on-center) made from solid, dimensional lumber (2 x 6 min) are mounted in a framework as shown in Figure 2. The "drag-zone" apparatus can be table or floor mounted. A routing hole shall be drilled through each joist in a 3-in off-set pattern as shown in Figure 2. Each routing hole shall be ½-inch greater in diameter than the outside diameter of the jacketed tubing specimen. The routing holes shall be drilled with a standard hole-cutter/drill bit and no post-drilling cleaning or dressing of the holes shall be permitted. No metal fasteners

shall be installed within the drag zone. The test apparatus shall be solidly secured to the table/floor to prevent movement or shaking of the assembly during the pull tests.

Two test specimens of each size, each consisting of a 15-ft length of tubing, shall be prepared. Each test specimen shall be “snaked” through the three offset holes before starting the test. The length of tubing is then pulled, by hand, through the drag zone until the end of the test specimen exits the last member. The rate of pull should be approximately 1 to 2 feet per second.

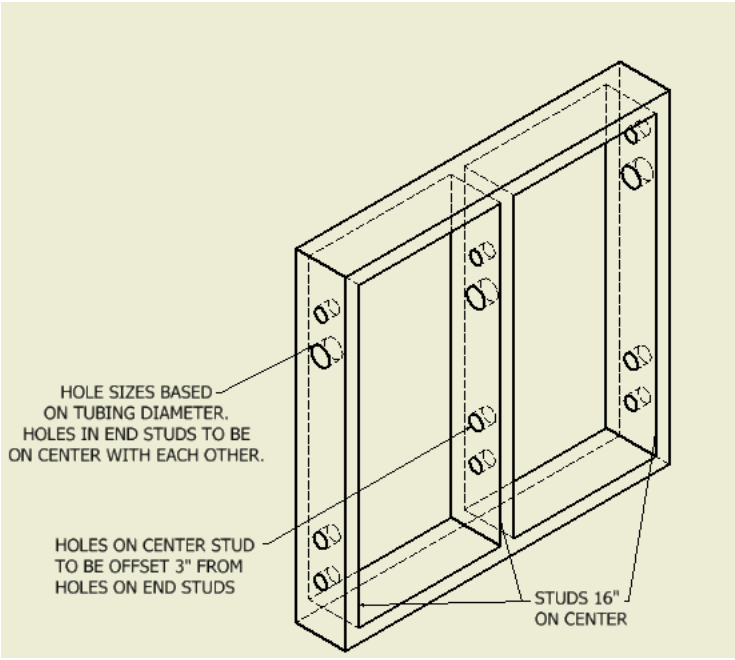

Figure 2 Set-Up for Tubing Wear Test

Upon completion of the pull test, the tubing and jacket shall be inspected for physical damage. Any tearing or ripping of the jacket exposing the underlying stainless steel tubing indicates non-compliance with this requirement.

RATIONALE: *Some CSST products have been developed that use a coating or covering system to provide an alternate means of direct-bonding. If such a coating is provided as part of the CSST system, the added tests address the durability and integrity of the coating. The performance requirements and acceptance criteria represent minimally acceptable values that have been developed by independent sources. The International Code Council Evaluation Services have developed such testing methods and listing criteria (LC1024 – Listing Criteria for CSST Utilizing a Protective Jacket) that are being used to list current products. The proposed test methods are similar to testing widely used in the lightning analysis industry and have been recommended by independent lightning experts.*

~~Exhibit B: Items Unique to United States~~

~~**B.1** The installation shall be done by a qualified installer, who has passed the manufacturer's certification/training program.~~

RATIONALE: *Training of installers is a manufacturer-based requirement, and therefore it transcends any other installer qualifications imposed by the country, state or local jurisdiction such as licensing, education or apprenticeship. CSST systems have unique features, including fitting attachments proprietary to each manufacturer, which are not interchangeable between brands. The requirement has been modified and moved to the body of the Standard and not in Exhibit B since training is required whether the installer is US-based or Canada-based. The training requirement was modified to create auditable action items for the certifying agency such as a database and a training program.*