NFPA RESEARCH

HOME FIRES CAUSED BY ELECTRICAL DISTRIBUTION AND LIGHTING EQUIPMENT

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Key Findings

- Local fire departments responded to an estimated average of 32,620 home fires involving electrical distribution and lighting equipment per year in 2015–2019.
- Home fires involving electrical distribution and lighting equipment caused an estimated average of 430 civilian deaths and 1,070 civilian injuries per year in 2015–2019, as well as an estimated $1.3 billion in direct property damage each year.
- Home fires involving electrical distribution and lighting equipment most often originated in a bedroom (16 percent of the total), attic or ceiling (11 percent), or wall assembly or concealed space (8 percent).
- Approximately one-quarter (23 percent) of these fires occurred between midnight and 8 a.m., but they accounted for just over half (52 percent) of the deaths.

Home Fires Involving Electrical Distribution and Lighting Equipment

In 2015–2019, US fire departments responded to an estimated average of 32,620 fires in homes that involved electrical distribution and lighting equipment.[1] These fires accounted for 430 civilian deaths; 1,070 civilian injuries; and $1.3 million in direct property damage each year.

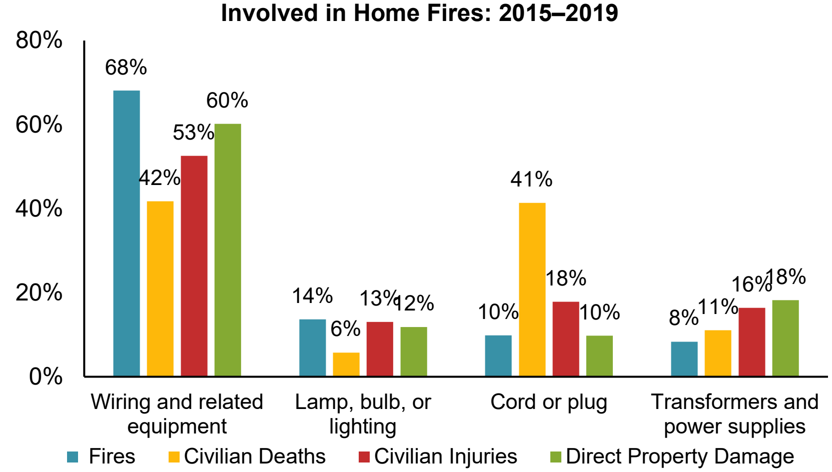
Types of Electrical Distribution and Lighting Equipment Involved in Home Fires

As shown in Figure 1, wiring and related equipment accounted for just over two-thirds (68 percent) of the home fires caused by electrical distribution and lighting equipment and 60 percent of the direct property damage, as well as two in five (42 percent) of the civilian deaths and over half (53 percent) of the injuries.

Faulty wiring in concealed spaces, such as attics or areas behind walls, is particularly dangerous because it can start fires that burn for a prolonged period before detection.

In addition, aluminum wire connections are prone to deterioration that can result in increased resistance to electric current. The cumulative damage of such deterioration can produce hazardous overheating; as a result, the Consumer Product Safety Commission recommends that home aluminum wiring be replaced or repaired by a qualified electrician to reduce the potential for fire.

Figure 1. Types of Electrical Distribution and Lighting Equipment Involved in Home Fires: 2015–2019

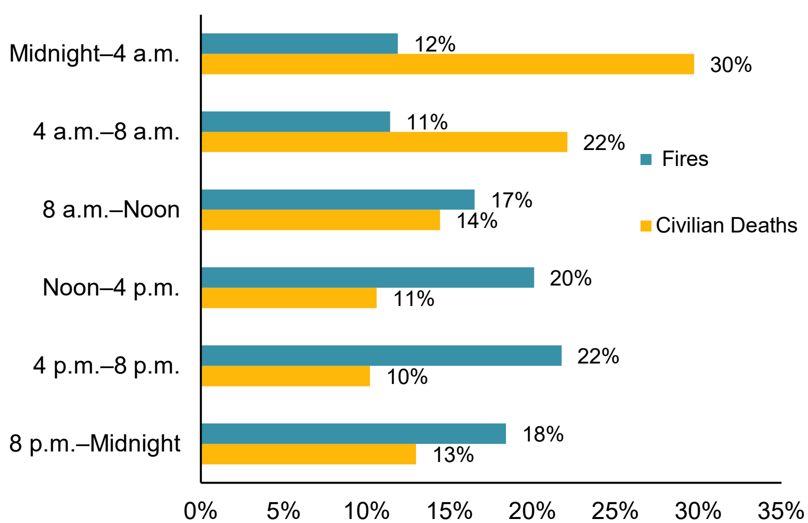


[1] A change in NFIRS data entry rules in 2012 for incidents with equipment-related heat sources or factors contributing to ignition is likely to have influenced estimates of electrical distribution and lighting equipment fires.

Timing of Fires Involving Electrical Distribution and Lighting Equipment

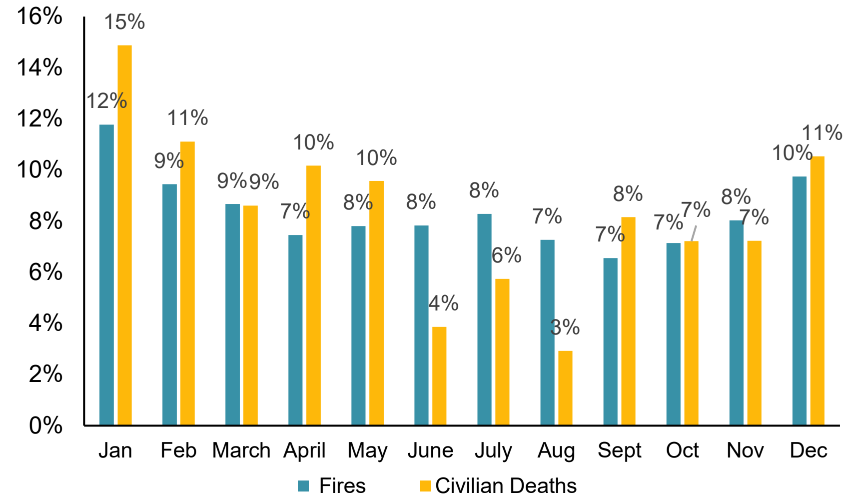
Home fires involving electrical distribution and lighting equipment were less likely to occur in the overnight hours between midnight and 8 a.m. (23 percent of the total). However, these fires accounted for over half (52 percent) of the civilian deaths in 2015–2019, likely as a result of people being home and asleep at those times. See Figure 2 for more information.

Figure 2. Home Fires Involving Electrical Distribution and Lighting Equipment by Time of Day: 2015–2019



The peak months for home fires involving electrical distribution or lighting equipment were the winter months of December, January, February, and March (40 percent of the total). These fires also accounted for 45 percent of the civilian deaths. This is likely because people are usually in the home and using electrical equipment during the cold weather months. Another one-quarter (24 percent) of the fires occurred from May through July, but those fires accounted for only 19 percent of the civilian deaths. See Figure 3.

Figure 3. Home Fires Involving Electrical Distribution and Lighting Equipment by Month: 2015–2019



Factors Contributing to Ignition of Home Fires Involving Electrical Distribution and Lighting Equipment

Electrical failures or malfunctions were a factor contributing to the ignition of nearly four out of every five (80 percent) of the home fires involving electrical distribution or lighting equipment, and these fires accounted for three-quarters (76 percent) of the civilian deaths and direct property damage (76%) and seven in ten (71 percent) of the civilian injuries. Other factors contributing to home fires involving electrical distribution and lighting equipment included heat sources being too close to combustibles, mechanical failures or malfunctions, overloaded equipment, and unclassified misuse of products or materials.

Figure 4. Factors Contributing to Ignition of Home Fires Involving Electrical Distribution and Lighting Equipment: 2015–2019

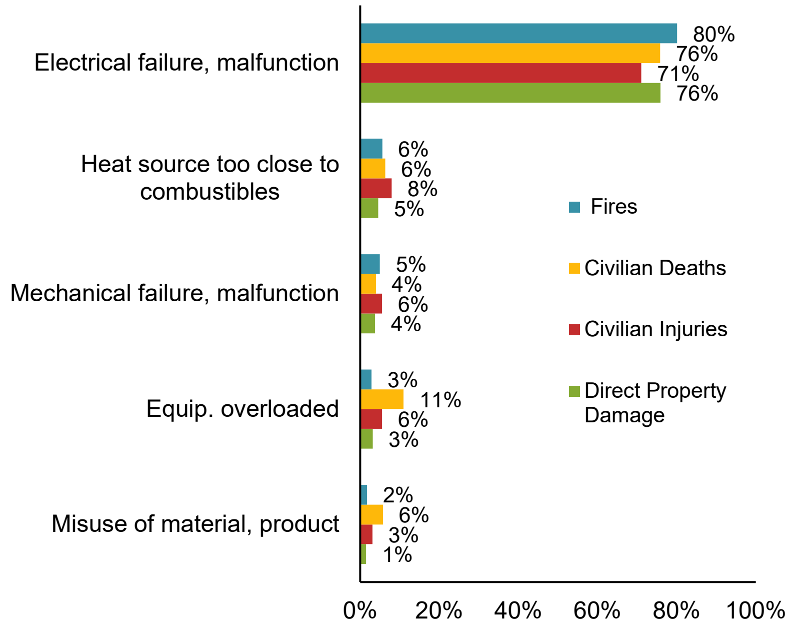
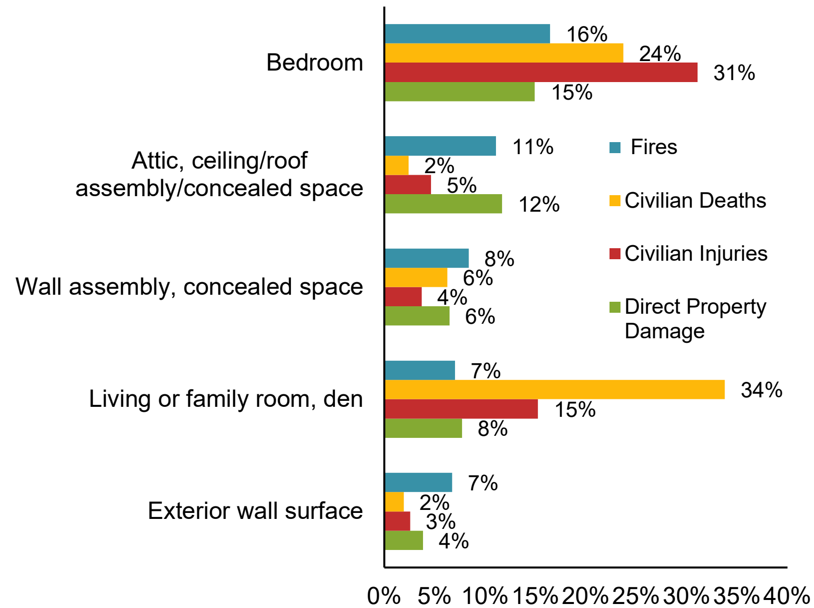


Figure 5. Area of Origin in Home Fires Involving Electrical Distribution and Lighting Equipment: 2015–2019



Area of Origin in Home Fires Involving Electrical Distribution and Lighting Equipment

Almost one in six (16 percent) home fires involving electrical distribution or lighting equipment originated in a bedroom and one in ten (11 percent) originated in an attic or ceiling/roof assembly or concealed space. Fires originating in a living room, family room, or den accounted for a disproportionately large share of civilian deaths (34 percent), while those originating in a bedroom accounted for a disproportionately large share of civilian injuries (31 percent). Fires originating in concealed spaces, such as attics or ceiling roof assemblies, wall assemblies, and crawl spaces, were also common.

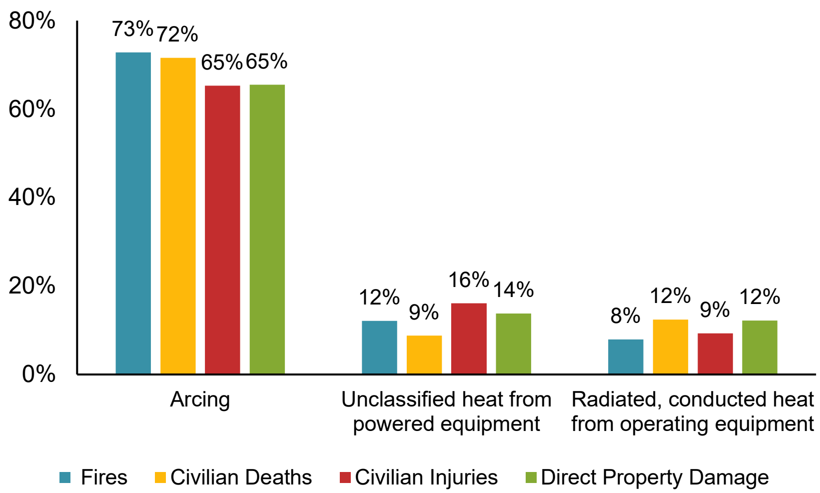
Item First Ignited in Home Fires Involving Electrical Distribution and Lighting Equipment

The item that first ignited in home fires involving electrical distribution and lighting equipment was electrical wire or cable insulation in 32 percent of the fires. One in three (34 percent) of the fires first ignited an item that was part of the building (structural member or framing, insulation within the building area, exterior or interior wall cover or finish, or structural component or finish). See Table 9 in the accompanying tables document for more information. This indicates the importance of the awareness of hidden electrical hazards, including electrical distribution and lighting equipment that is too close to combustible structural elements.

Heat Source in Home Fires Involving Electrical Distribution and Lighting Equipment

Arcing served as the heat source in almost three-quarters (73 percent) of the home fires involving electrical distribution and lighting equipment, and these fires also accounted for a great majority of the civilian deaths and injuries and direct property damage. The heat from powered or operating equipment accounted for another one in five fires and most of the remaining losses.

Figure 6. Heat Source in Home Fires Involving Electrical Distribution and Lighting Equipment, 2015–2019



Methodology

The statistics in this analysis are estimates derived from the US Fire Administration's National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's annual survey of US fire departments. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates. Only civilian (non-firefighter) casualties are discussed in this analysis.

NFPA's fire department experience survey provides estimates of the big picture. NFIRS is a voluntary system through which participating fire departments can report detailed factors about the fires to which they respond. To compensate for fires reported to local fire departments but not captured in NFIRS, scaling ratios are calculated and then applied to the NFIRS database using the formula below.

$$\frac{\text{NFPA's fire experience survey projections}}{\text{NFIRS totals}}$$

The NFIRS data element of Factors Contributing to Ignition was used to identify and estimate electrical failures or malfunctions.

In this field, the code None is treated as an unknown and allocated proportionally. Multiple entries are allowed in this field. Percentages are calculated on the total number of fires, not entries, so some sums are greater than 100 percent.

Any fire in which no factor contributing to ignition was entered was treated as unknown.

Entries in the electrical failure, malfunction category (factor contributing to ignition 30–39) were grouped together in this analysis. This category includes the following:

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
30. Electrical failure or malfunction, other

NFIRS data element Equipment Involved in Ignition (EII) codes 200–263 were used to identify and estimate fires caused by electrical distribution and lighting equipment.

NFPA noticed that many fires in which the EII was coded as None (NNN) had other causal factors that indicated equipment was a factor or that were completely unknown. To compensate, NFPA treated fires in which EII =

NNN and the heat source was not in the range of 40–99 as additional unknowns.

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

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

In addition, fires and losses associated with code EII 200, electrical distribution, lighting, and power transfer, other, were allocated proportionally across specific kitchen and equipment codes in 211–263. Equipment that is totally unclassified (EII code 000) was not allocated further. Unfortunately, equipment that was truly different was erroneously assigned to other categories.

Because of the large number of specific EII codes, most have been grouped into more general categories.

Code Grouping	EII Code	NFIRS definition
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	Panelboard, switchboard, 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 lan
	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

For more information on the methodology used for this report, see *How NFPA's National Estimates Are Calculated for Home Structure Fires.*

Acknowledgments

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 makes this analysis possible. Their contributions allow us to estimate the size of the fire problem.

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

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