Burns Seen in Hospital Emergency Rooms in 2008 by Burn Type and Victim's Age

Marty Ahrens
Fire Analysis and Research Division
National Fire Protection Association

September 2009

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471
www.nfpa.org

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
www.nfpa.org
e-mail: osds@nfpa.org
phone: 617-984-7443

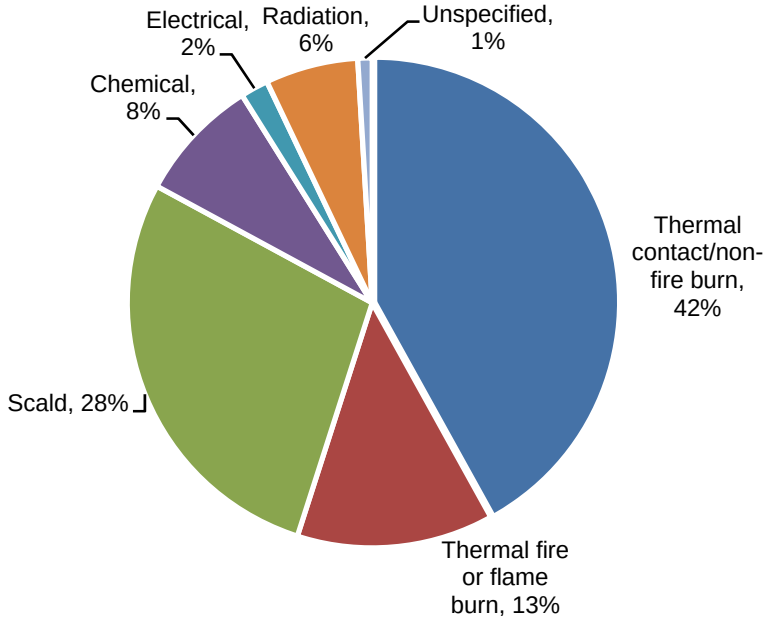
NFPA Index No. 1458

Burns Seen in Hospital Emergency Rooms in 2008 by Burn Type and Victim's Age

The majority of burns are not due to fire. Children under five face a risk of an emergency room (ER) visit for a non-fire burn that is 2.6 -5.0 times that of the general population. While older adults face the highest risk of home fire death, their risk of an ER visit for any type of burn was below average.

Most burns are not due to fire.
In 2008, an estimated 216,100 people went to emergency rooms (ERs) because of various types of burn injuries, according to data from the U.S. Consumer Product Safety Commission's (CPSC's) National Electronic Injury Surveillance System (NEISS). While 55% of the burn injuries were thermal burns, Figure 1 and Table 1 show that only 13% were due to fire or flames. Forty-two percent were other non-fire thermal burns. These typically resulted from contact with hot objects.

Figure 1. Hospital Emergency Room Visits in 2008 for Burns, by Type of Burn



CPSC's National Electronic Injury Surveillance System

The CPSC's National Electronic Injury Surveillance System (NEISS) collects information about all injuries seen in a weighted statistical sample of hospital emergency rooms. The database may be queried and results downloaded for further analysis. Information about the injury cause is obtained from the patient. Fire involvement code zero is used when there is no fire, no unexpected flames or smoke, or no unexpected spread of flames or smoke. Thermal burns with code zero for fire involvement were considered contact or non-fire burns. Fire involvement codes one to three indicate fire involvement or smoke inhalation with or without fire department attendance. No allocation of unknown data was done for the NEISS results presented here. No filters on location and occupancy were included in the queries.

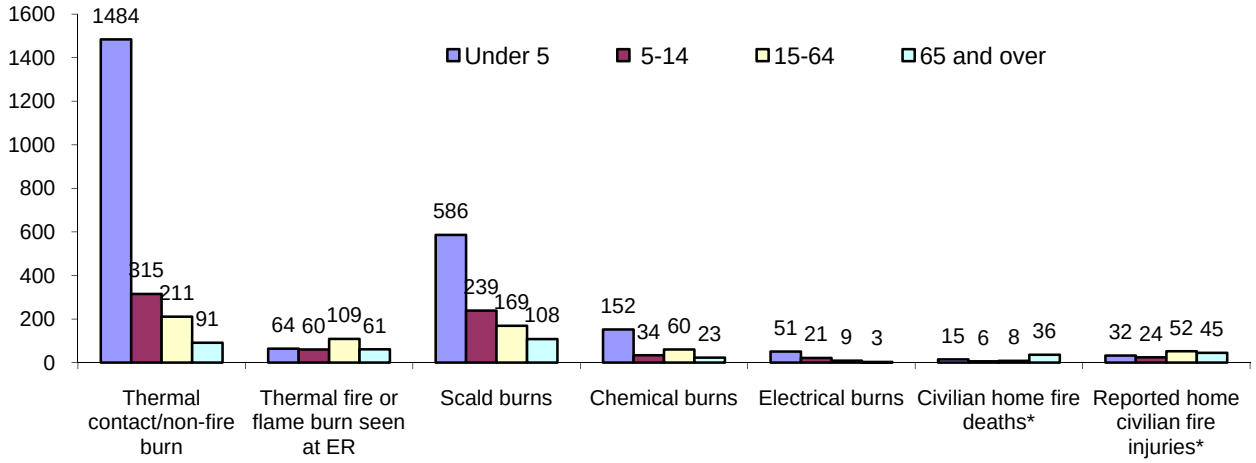
Source: CPSC's NEISS, queried in September 2009.

Scalds accounted for more than one of every four (28%) ER burn visits. Eight percent were chemical burns, 6% were radiation burns, 2% were electrical, and 1% were unspecified. Almost half of the chemical burns were to the eye.

Nine of every ten radiation burns were to people between 15 and 64.
Ninety-one percent of the people with radiation burns were between 15 and 64 years of age, giving this group a rate of radiation burns of 59 burns per million population. The rate for the overall population was 40 per million. More than three-quarters of the radiation burns occurred during welding operations. Almost one-quarter were sun burns. Four-fifths of the radiation burns were to the eye. Due to the small numbers of these burns in other age groups and the small number of unspecified burns, these categories will not be discussed further.

Compared to other age groups, children under five face the highest risk of non-fire thermal burns, scald burns, chemical burns, and electrical burns.
Table 2 shows the estimated number of the different types of burns, excluding radiation and unspecified burns, by age group. Figure 2 and Table 3 show that children under five had the highest rate per million population of all age groups for thermal contact/non-fire burns, scald burns, chemical burns, and electrical burns. People over 65 had the lowest rates for these burns but the highest rate of home civilian fire deaths.[1] Children under five had a lower than average risk of an ER visit for a thermal fire or flame burn or for a non-fatal home fire injury reported to the fire department.

Figure 2. Rates per Million Population for Burns Seen at Hospital Emergency Rooms during 2008 and Reported Civilian Home Fire Deaths and Injuries in 2002-2005 by Age Group



* 2002-2005 estimates from NFIRS and NFPA's annual fire department experience survey (JD Flynn, 2008).
Sources: CPSC's NEISS, queried in September 2009, Jennifer D. Flynn's 2008 *Characteristics of Home Fire Victims,* U.S. Census Bureau.

Higher rates were seen for thermal contact/non-fire burns and for scald burns compared to thermal fire or flame burns and reported home civilian fire injuries in the same age groups. Home structure fire civilian deaths and reported home structure fire civilian injury rates are based on 2002-2005 and include smoke inhalation, burns, and other conditions. Even with the wider definition, the rates of reported home civilian fire injuries were lower than the rates for thermal fire or flame burns in the same age groups that were seen at hospital emergency rooms. Some fires are not attended by fire departments. In some cases, the injured may have been

[1] Jennifer D. Flynn. *Characteristics of Home Fire Victims,* Quincy, MA: NFPA 2008, pp. 8-9.

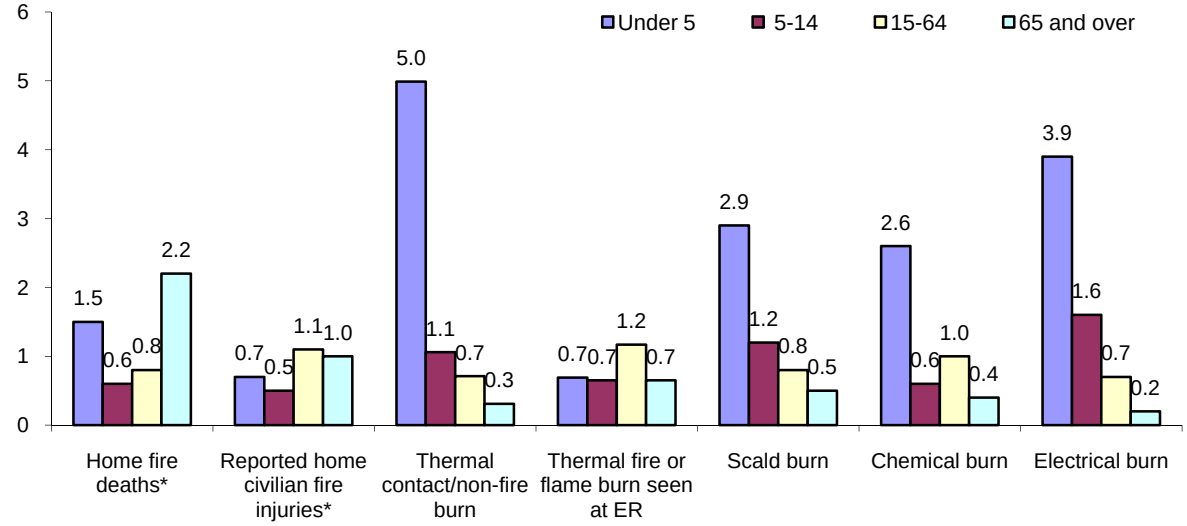
transported away from the scene before the fire department arrived or without the fire department's knowledge.

Figure 3 and Table 4 show the relative risks of the different types of burn injuries, home fire death, and reported home fire injury. Relative risk makes it easier to see how the risks vary by age group for the different age groups but eliminates comparisons of overall frequency across types of injuries. Children under five were almost four times as likely to suffer an electrical burn as members of the general population. Although the risk of a scald burn to these young children was only three times that of the general population, scalds caused more than 11 times the number of electrical burns in this age group.

Relative Risk

Relative risk is calculated by dividing the rate of burns of each type in each age group by the rate for the general population. A risk of one means that people in that age group face the same risk as does the general population.

Figure 3. Relative Risk of Home Fire Deaths and Reported Fire Injuries Compared to 2008 Thermal Contact/Non-Fire Burns and Thermal Fire or Flame Burns Seen at Hospital Emergency Rooms



* 2002-2005 estimates from NFIRS and NFPA's annual fire department experience survey (JD Flynn, 2008).
Source: CPSC's NEISS, queried in September 2009, Jennifer D. Flynn's 2008 *Characteristics of Home Fire Victims,* U.S. Census Bureau..

Table 1.
Hospital Emergency Room Visits in 2008 for Burns, by Type of Burn

Type of Burn	Number of Visits	
Thermal	118,600	(55%)
Thermal contact/non-fire burn	*90,400*	*(42%)*
Thermal fire or flame burn	*28,300*	*(13%)*
Scald	60,500	(28%)
Chemical	17,700	(8%)
Electrical	4,000	(2%)
Radiation	13,300	(6%)
Welding	*9,300*	*(4%)*
Sunburn	*3,000*	*(1%)*
Unspecified	2,000	(1%)
Total	216,100	(100%)

Source: CPSC's NEISS, queried September 2009

Table 2. Hospital Emergency Room Visits in 2008 for Burns (Excluding Radiation and Unspecified Burns), by Type of Burn and Age

	Population in Millions		Thermal Contact/Non-Fire Burns		Thermal Fire or Flame Burns		Scald Burns		Chemical Burns		Electrical Burns	
Children under 15	61	(20%)	43,800	(48%)	3,800	(13%)	21,900	(36%)	4,600	(26%)	1,900	(48%)
Under 5	*21*	*(7%)*	*31,100*	*(34%)*	*1,300*	*(5%)*	*12,300*	*(20%)*	*3,200*	*(18%)*	*1,100*	*(27%)*
5-14	*41*	*(13%)*	*12,700*	*(14%)*	*2,400*	*(9%)*	*9,600*	*(16%)*	*1,400*	*(8%)*	*800*	*(21%)*
15-64	204	(67%)	43,100	(48%)	22,100	(78%)	34,400	(57%)	12,300	(69%)	1,900	(49%)
65 and up	39	(13%)	3,500	(4%)	2,300	(8%)	4,200	(7%)	900	(5%)	100	(3%)
All ages	304	(100%)	90,400	(100%)	28,300	(100%)	60,500	(100%)	17,700	(100%)	4,000	(100%)

Sources: CPSC's NEISS, queried in September 2009, Jennifer D. Flynn's 2008 *Characteristics of Home Fire Victims*, U.S. Census Bureau.

Table 3. Rate of Hospital Emergency Room Visits in 2008 for Burns per Million Population (Excluding Radiation and Unspecified Burns), by Type of Burn and Age Compared to 2002-2005 Civilian Home Fire Deaths and Reported Home Civilian Fire Injuries

Age	Thermal Contact/Non-Fire Burns	Thermal Fire or Flame Burns	Scald Burns	Chemical Burns	Electrical Burns	Civilian Home Fire Deaths*	Reported Civilian Home Fire Injuries*
Children under 15	717	62	358	75	31	9	26
Under 5	*1,484*	*64*	*586*	*152*	*51*	*15*	*32*
5-14	*315*	*60*	*239*	*34*	*21*	*6*	*24*
15-64	211	109	169	60	9	8	52
65 and up	91	61	108	23	3	36	45
All ages	298	93	199	58	13	10	46

Table 4. Relative Risk of Hospital Emergency Room Visits in 2008 for Burns (Excluding Radiation and Unspecified Burns), by Type of Burn and Age Compared to 2002-2005 Civilian Home Fire Deaths and Reported Home Civilian Fire Injuries

Age	Thermal Contact/Non-Fire Burns	Thermal Fire or Flame Burns	Scald Burns	Chemical Burns	Electrical Burns	Civilian Home Fire Deaths*	Reported Civilian Home Fire Injuries*
Children under 15	2.4	0.7	1.8	1.3	2.4	0.9	0.6
Under 5	*5.0*	*0.7*	*2.9*	*2.6*	*3.9*	*1.5*	*0.7*
5-14	*1.1*	*0.6*	*1.2*	*0.6*	*1.6*	*0.6*	*0.5*
15-64	0.7	1.2	0.8	1.0	0.7	0.8	1.1
65 and up	0.3	0.7	0.5	0.4	0.2	3.7	1.0
All ages	1.0	1.0	1.0	1.0	1.0	1.0	1.0

* 2002-2005 estimates from NFIRS and NFPA's annual fire department experience survey (JD Flynn, 2008).

Sources: CPSC's NEISS, queried in September 2009, Jennifer D. Flynn's 2008 *Characteristics of Home Fire Victims*, U.S. Census Bureau.

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.

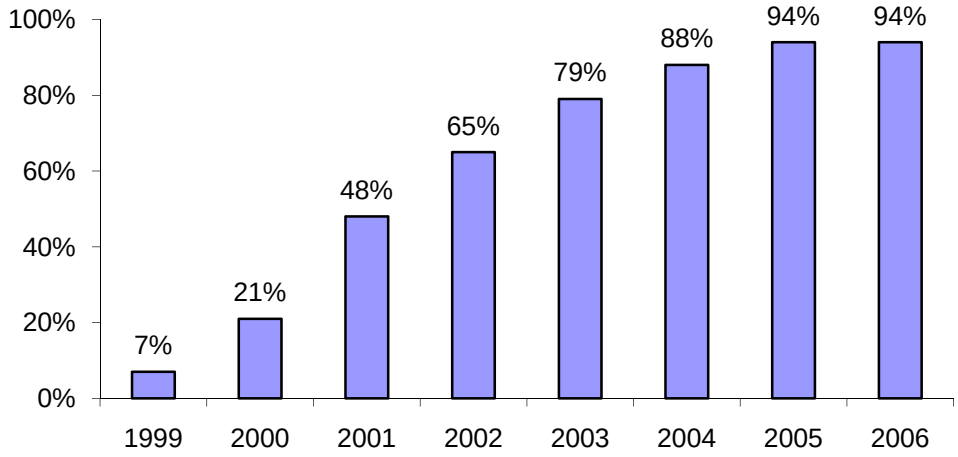
Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific 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 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 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 1. Fires Originally Collected in NFIRS 5.0 by Year



For 2002 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

NFPA survey projections
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 (typically 10-20%). 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 alls 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.

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, 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.

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 electrical failure or malfunction (factor contributing to ignition 30-39) are combined and shown as "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.

Type of Material First Ignited (TMI). This field is required only if the Item First Ignited falls within the code range of 00-69. NFPA has created a new code "not required" for this field that is applied when Item First Ignited is in code 70-99 (organic materials, including cooking materials and vegetation, and general materials, such as electrical wire, cable insulation, transformers, tires, books, newspaper, dust, rubbish, etc..) and TMI is blank. The ratio for allocation of unknown data is:

$$\frac{\text{(All fires – TMI Not required)}}{\text{(All fires – TMI Not Required – Undetermined – Blank)}}$$

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

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

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 as 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. (Confined fire incident types are not discussed here)

Code Grouping	EII Code	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	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
Wiring, switch or outlet	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	214	Wiring from meter box to circuit breaker
	216	Electrical branch circuit
	217	Outlet, receptacle
	218	Wall switch
Power switch gear or overcurrent protection device	215	Panel board, switch board, circuit breaker board
	219	Ground fault interrupter
	222	Overcurrent, disconnect equipment
	227	Surge protector
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

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."

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.

Inflation. Property damage estimates are not adjusted for inflation unless so indicated.