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Structure Fires Started by Hot Work

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Abstract

Hot work is an important part of manufacturing, repair, renovation, construction and demolition activities. When safety precautions are not followed, fires, serious injury or death, and damage to property can occur. Based on data from the U.S. Fire Administration's National Fire Incident Reporting System and NFPA's annual Fire Experience Survey, NFPA estimates that during the five-year period of 2010-2014 local fire departments responded to an estimated average of 4,440 structure fires per year involving equipment associated with hot work. These fires caused an average of 12 civilian deaths, 208 civilian injuries and $287 million in direct property damage per year. Forty-two percent of the fires occurred in or on homes. Welding torches were involved in one-third of hot work structure fires. The leading types of hot work equipment involved in structure fires are different in homes than in non-home properties. The peak areas for home fires involving hot work were wall assemblies or concealed spaces, and bathrooms or lavatories while the peak areas for non-home fires were exterior roof surfaces and processing or manufacturing areas.

Previously published descriptions of fires and accident investigation summaries from the Department of Labor's Occupational Health and Safety Administration are also included.

Knowledge of how these fires and workplace injuries occur can help prevent future incidents.

Keywords: fire statistics, hot work fires, torch 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 617-984-7451.

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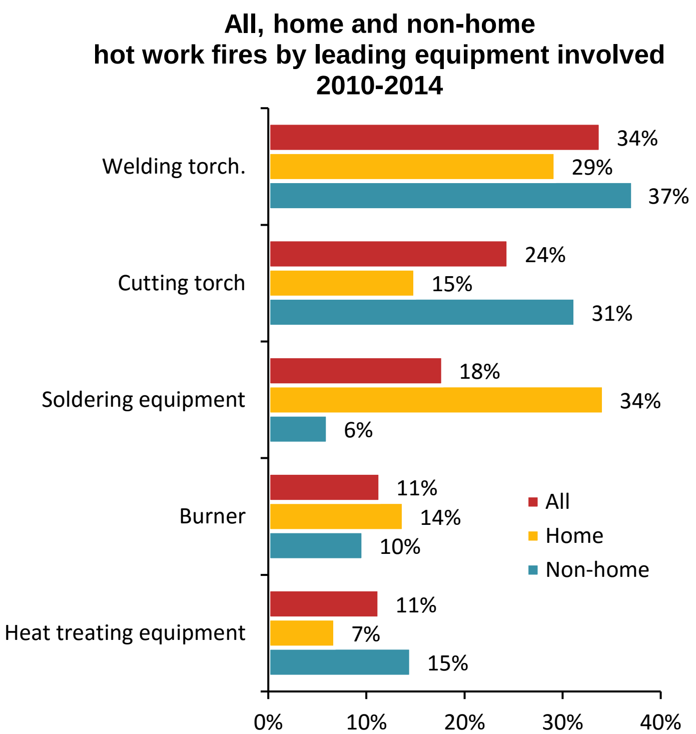
Structure Fires Started by Hot Work Fact Sheet

U.S. fire departments responded to an average of 4,440 structure fires involving hot work per year. These fires caused an average of 12 civilian deaths, 208 civilian injuries and $287 million in direct property damage per year.

From 2001-2015, five firefighters were fatally injured in four unintentional fires started by torches.

Forty-two percent of the fires involving hot work in 2010-2014 occurred in or on homes, including one or two-family homes and apartments or other multi-family homes, while 58% occurred in or on-non-home properties.



Welding torches were involved in one-third (34%) of hot work structure fires. The leading types of hot work equipment involved in structure fires were different in homes than in non-home properties.

.Welding torches were involved in 37% of non-home hot work fires but only 29% of such home fires.

Cutting torches were also involved in a larger percentage (31%) of non-home fires but only 15% of the home fires. Heat treating equipment was involved in 15% of the non-home hot work fires but only 7% of the home incidents.

Soldering equipment was involved in one-third (34%) of the hot work home fires but only 6% of such fires in non-home properties.

- The peak areas for home fires involving hot work were wall assemblies or concealed spaces (15%), and bathrooms or lavatories (14%). Exterior roof surfaces (12%) and processing or manufacturing areas (9%) were peak areas for non-home incidents.

- Structural members or framing were first ignited in one-quarter (25%) of the home fires but only 10% of the non-home fires. Insulation within structural areas was first ignited in 22% of home hot work fires and 9% of the non-home fires.

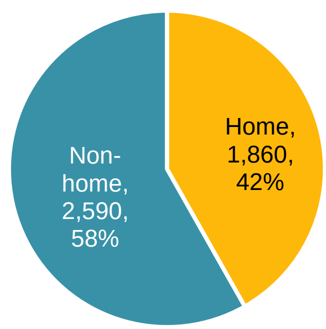
  Flammable or combustible liquids or gases, filters or piping were first ignited in 15% of the non-home fires but only 5% of the home fires. Exterior roof coverings or finish were first ignited in 10% of the non-home fires but only 6% of the home fires.

During the five-year period of 2010-2014, local fire departments responded to an estimated average of 4,440 structure fires per year involving equipment associated with hot work. These fires caused an average of 12 civilian deaths, 208 civilian injuries and $287 million in direct property damage per year. These estimates were derived from the detailed information collected by the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and the summary information from NFPA's annual fire experience survey. See Appendix A for a detailed description of the national estimates methodology used to calculate estimates of fires, civilian deaths and injuries, and direct property damage.

From 2001 through 2015, five firefighters were fatally injured in four unintentional fires started by torches. [1] One was killed in a partial collapse of an apartment building that was undergoing renovations. Another was caught between a manlift and an upper floor at a silo fire while he checked another silo for fire extension. He died as a result of positional asphyxia. Two firefighters were killed in a wind-driven fire in an apartment building that started when molten slag from welding work ignited an attached shed. The welding work was done improperly and without a permit. The fifth firefighter fell down an elevator shaft while operating at a fire that started when slag from welding ignited cork insulation in a vacant warehouse.

42% of hot work fires occurred in or on homes.
Figure 1 shows that during 2010-2014, an average of 1,860 hot work structure fires per year occurred in or on home properties. The term "home" encompasses one-or two-family homes, including manufactured housing, and apartments or other multi-family housing. These fires caused an average of three (27%) civilian deaths, 83 (40%) civilian injuries, and $85 million (30%) in direct property damage per year. The coded data sources do not indicate who was doing the hot work. Consequently, it is impossible to separate out the role of do-it-yourselfers from professional contractors.

Figure 1.
Home and non-home hot work fires 2010-2014



An average of 2,590 (58%) hot work structure fires per year occurred in or on non-home properties, including non-home residential properties such as hotels and motels, dormitories and unclassified residential properties. These fires caused an average of nine (73%) civilian deaths, 125 (60%) civilian injuries, and $202 million (70%) in direct property damage per year.

Table 1 provides a further breakdown of hot-work fires by occupancy. Tables 1A-6A show estimates for home structure fires while Tables 1B-6B show fires for non-home structure fires.

[1] Rita Fahy. *Firefighter Fatalities Resulting from Fires Started by Torches: 2001-2015,* Quincy, MA: NFPA, 2016.

Data Sources, Definitions and Conventions Used in this Report

What do we mean by the term "hot work?" For purposes of this analysis, a fire was said to have involved hot work if any of the following NFIRS equipment involved in ignition codes were used on the fire incident report:

318 - Power nail gun, stud driver or stapler;
331 - Welding torch;
332 - Cutting torch;
333 – Burner;
334 - Soldering equipment'
351 - Heat treating equipment; or
354 – Tar pot or tar kettle

What is included in NFPA's definition of "home?"

- detached dwellings, duplexes, and manufactured housing, and
- apartments, tenements, and flats, townhouses, row houses, and other multi-family housing, regardless of ownership.

Note that definitions used in this report are those used by NFIRS and do not necessarily correspond with those used in NFPA's Codes and Standards documents.

This analysis excludes structure fires with the confined structure fire incident types. These include confined cooking fires, confined chimney or flue fires, confined trash fires, confined fuel burner or boiler fires, confined commercial compactor fires, and confined incinerator fires (NFIRS incident type 113-118). Structure fires for this analysis were identified by NFIRS incident type 110-123, excluding incident types 113-118.)

Additional information: Except for firefighter fatalities, the statistics in this analysis 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. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire.

Except for property use and incident type, fires with unknown or unreported data were allocated proportionally in calculations of national estimates. Property loss has not been adjusted for inflation. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one and property damage is rounded to the nearest million dollars.

Sums may not equal totals due to rounding errors.

Firefighter fatalities are not estimates. Rather they are based on actual counts.

Welding torches were involved in one-third (34%) of hot work structure fires. Table A shows that an average of 1,510 fires per year started by welding torches caused eight (63%) civilian deaths, 97 (47%) civilian injuries, and $115 million (40%)in direct property damage annually.

Cutting torches were involved in an average of 1,090 (24%) fires per year. These fires caused three (24%) civilian deaths, 38 (18%) civilian injuries, and $72 million (25%) in direct property damage annually.

Soldering equipment was involved in an average of 790 (18%) fires per year. These fires caused seven (3%) civilian injuries, and $20 million (7%) in direct property damage annually. No deaths involving soldering equipment were reported.

Table A.
Structure Fires Started by Hot Work, by Equipment Involved in Ignition
2010-2014 Annual Averages

Equipment Involved	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in millions)	
Welding torch.	1,510	(34%)	8	(63%)	97	(47%)	$115	(40%)
Cutting torch	1,090	(24%)	3	(24%)	38	(18%)	$72	(25%)
Soldering equipment	790	(18%)	0	(0%)	7	(3%)	$20	(7%)
Burner	510	(11%)	2	(13%)	34	(16%)	$30	(11%)
Heat treating equipment	500	(11%)	0	(0%)	31	(15%)	$47	(16%)
Tar pot or tar kettle	40	(1%)	0	(0%)	0	(0%)	$2	(1%)
Power nail gun, stud driver or stapler	10	(0%)	0	(0%)	0	(0%)	$0	(0%)
Total	4,440	(100%)	12	(100%)	208	(100%)	$287	(100%)

Source and note: See page 10.

The leading types of hot work equipment involved in structure fires are different in homes than in non-home properties. Figure 2 shows that welding torches were involved in 37% of non-home hot work fires but only 29% of such home fires.

Cutting torches were also involved in a larger percentage (31%) of non-home fires but only 15% of the home fires. Heat treating equipment was involved in 15% of the non-home hot work fires but only 7% of the home incidents.

Soldering equipment was involved in one-third (34%) of the hot work home fires but only 6% of such fires in non-home properties.

Fourteen percent of home hot work equipment fires involved burners, compared to 10% of the non-home fires. It is possible that some of this equipment was actually used for cooking. Torches are used in the preparation of foods such as crème brûlée.

Figure 2.
All, home and non-home
hot work fires by equipment involved
2010-2014

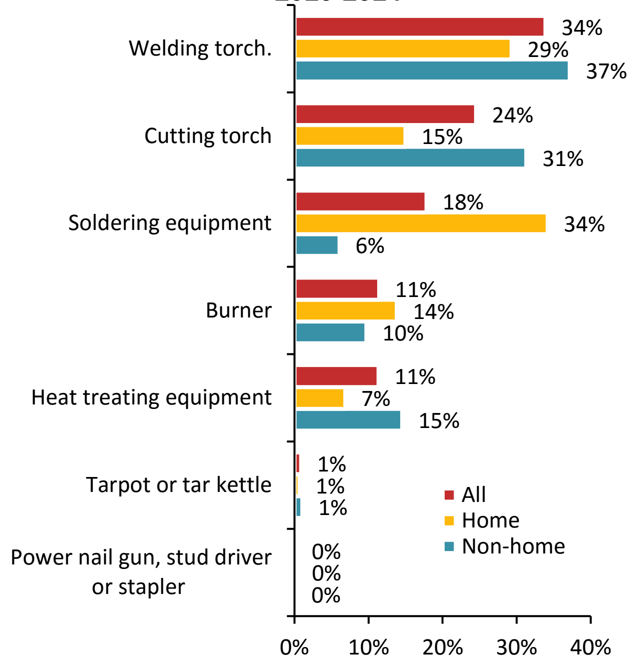
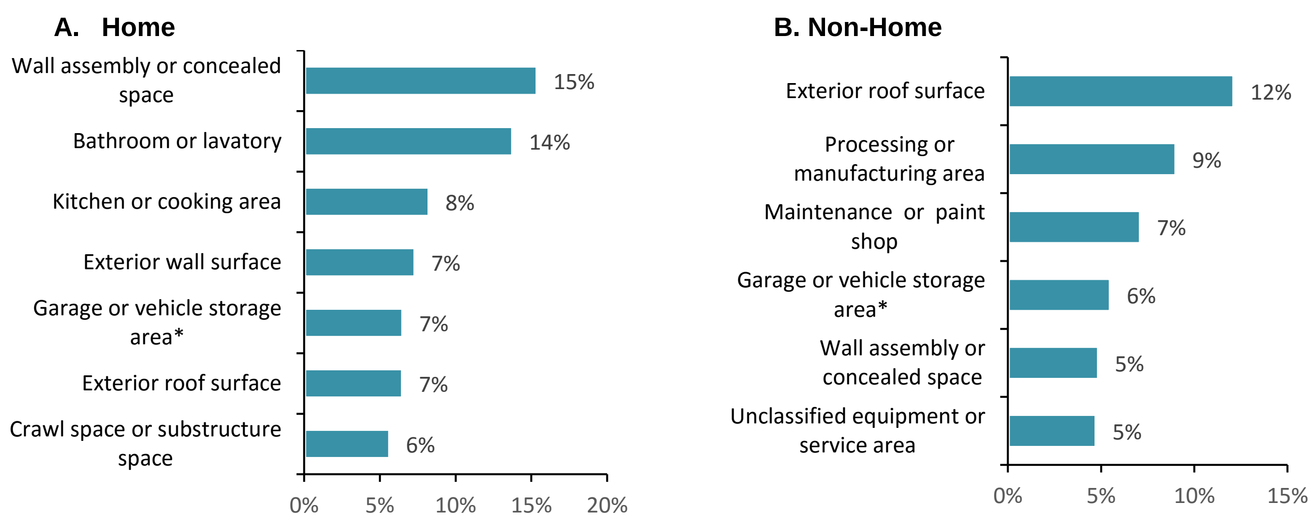


Table 2 shows the equipment involved in home and non-home fires and the losses associated with each.

Three-quarters (78%) of all structure fires involving hot work occurred in properties that were in normal use. Six percent occurred in properties that were undergoing major renovations, another 6% occurred in structures under construction, 4% were in properties that were vacant, and another 4% were in structures that were being demolished. Table 3 shows the structure status for home and non-home properties.

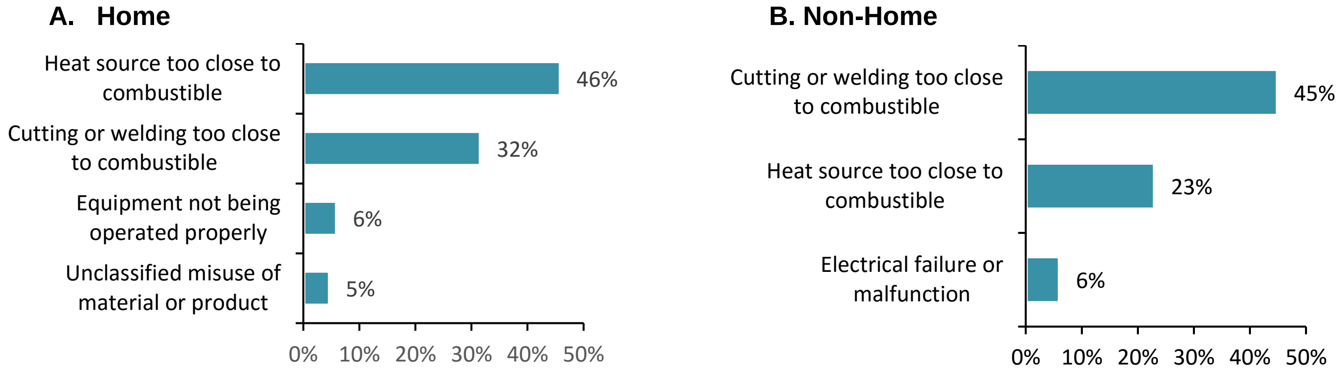
The peak areas for home fires involving hot work were wall assemblies or concealed spaces (15%), and bathrooms or lavatories (14%). Figure 3 shows that exterior roof surfaces (12%) and processing or manufacturing areas (9%) were peak areas for non-home incidents. Table 4 provides more detailed information about fires and losses by area of origin in these properties.

Figure 3.
Structure fires involving hot work, by area of origin
2010-2014



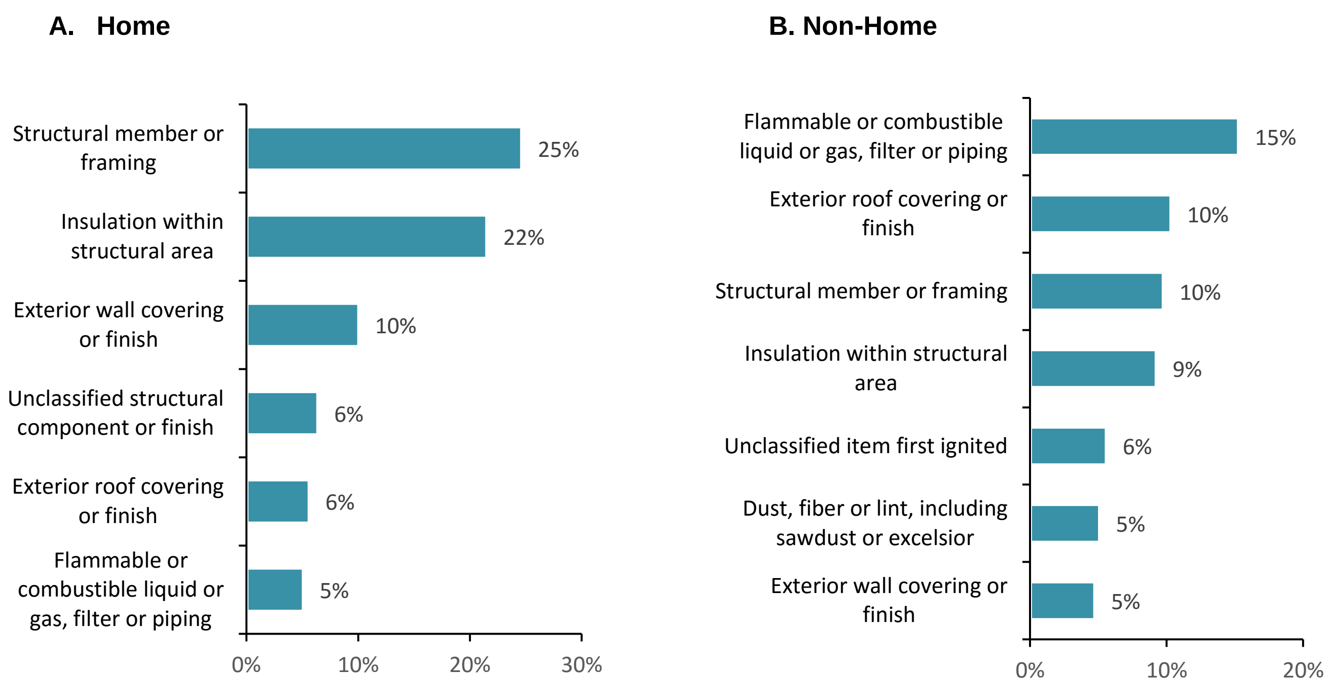
The leading factors contributing to ignition involved a heat source too close to a combustible or cutting or welding too close a combustible. Figure 4 and Table 5 show that electrical failures or malfunctions were a more common factor in non-home hot work fires (6%) than in home fires (2%.)

Figure 4.
Structure fires involving hot work, by factor contributing to ignition
2010-2014



The percentage of hot work fires beginning with structural members or framing and with insulation within structural areas was more than twice as high in home fires compared to non-home fires. Figure 5 and Table 6 show that structural members or framing were first ignited in one-quarter (25%) of the home fires but only 10% of the non-home fires. Insulation within structural areas was first ignited in 22% of home hot work fires and 9% of the non-home fires. Flammable or combustible liquids or gases, filters or piping were first ignited in 15% of the non-home fires but only 5% of the home fires. Exterior roof coverings or finish were first ignited in 10% of the non-home fires but only 6% of the home fires.

Figure 5.
Structure fires involving hot work, by item first ignited
2010-2014



Previously published hot work fire incidents and OSHA hot work worker accident investigation summaries show how fires and injuries can occur and how they can be prevented. The fire incidents include short articles from the "Firewatch" columns in *NFPA Journal* and incidents from either the large-loss fires report or catastrophic multiple death fires report. It is important to remember that this is anecdotal information. Anecdotes show what can happen; they are not a source to learn about what typically occurs.

The Department of Labor's Occupational Safety and Health Administration (OSHA) maintains a worker database of fatality and catastrophe investigation summaries. The public may search it at https://www.osha.gov/pls/imis/accidentsearch.html. Note that some states do not participate. The selection of summaries that follow show some of the types of occupational hot work injuries that have occurred.

NFPA 51B, *Standard for Fire Prevention during Welding, Cutting, and Other Hot Work* provides essential guidance to prevent these incidents.

Table 1A.
Home Structure Fires Started by Hot Work, by Occupancy
2010-2014 Annual Averages

Occupancy	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions	
One-or-two-family dwelling	1,330	(72%)	2	(49%)	49	(58%)	$50	(58%)
Apartment or multi-family dwelling	520	(28%)	2	(51%)	35	(42%)	$36	(42%)
Total	1,860	(100%)	3	(100%)	83	(100%)	$85	(100%)

Note: Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience survey.

Table 1B.
Non-Home Structure Fires Started by Hot Work, by Occupancy
2010-2014 Annual Averages

Occupancy	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions)	
Manufacturing or processing	610	(24%)	4	(49%)	45	(36%)	$71	(35%)
Storage properties	550	(21%)	2	(24%)	5	(4%)	$24	(12%)
Vehicle storage, garage or fire station	160	(6%)	0	(0%)	3	(2%)	$5	(2%)
Warehouse, residential or self-storage	100	(4%)	0	(0%)	0	(0%)	$14	(7%)
Grain or livestock storage	40	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified storage property	240	(9%)	2	(24%)	3	(2%)	$5	(2%)
Mercantile or office	550	(21%)	2	(27%)	30	(24%)	$22	(11%)
Service station or vehicle sales, service or repair	160	(6%)	1	(12%)	18	(15%)	$9	(4%)
Office, bank or mail facility	110	(4%)	0	(0%)	3	(2%)	$2	(1%)
Specialty shop	50	(2%)	0	(0%)	2	(1%)	$4	(2%)
Grocery or convenience store	50	(2%)	0	(0%)	4	(3%)	$2	(1%)
Laundry, dry cleaning, professional supplies or services	30	(1%)	0	(0%)	0	(0%)	$2	(1%)
Department store or unclassified general retail	30	(1%)	0	(0%)	2	(2%)	$0	(0%)
Textile, or apparel sales	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified mercantile or office	80	(3%)	0	(0%)	0	(0%)	$2	(1%)
Public assembly	180	(7%)	0	(0%)	1	(1%)	$6	(3%)
Eating or drinking establishment	80	(3%)	0	(0%)	0	(0%)	$3	(2%)
Place of worship or funeral property	30	(1%)	0	(0%)	1	(1%)	$1	(1%)
Club	20	(1%)	0	(0%)	0	(0%)	$1	(0%)
Library, museum, courthouse or other public property	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Variable use or amusement or recreation	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Residential property	170	(6%)	0	(0%)	6	(5%)	$22	(11%)
Hotel or motel	60	(2%)	0	(0%)	2	(2%)	$20	(10%)
Dormitory, fraternity, sorority or barracks	10	(1%)	0	(0%)	3	(2%)	$0	(0%)
Unclassified residential property	80	(3%)	0	(0%)	1	(1%)	$1	(1%)

Table 1B.
Non-Home Structure Fires Started by Hot Work, by Occupancy
2010-2014 Annual Averages (Continued)

Occupancy	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions)	
Industrial, utility, defense, agriculture or mining	150	(6%)	0	(0%)	11	(9%)	$33	(16%)
Agriculture	40	(2%)	0	(0%)	0	(0%)	$7	(3%)
Utility or distribution system	30	(1%)	0	(0%)	8	(6%)	$20	(10%)
Laboratory	20	(1%)	0	(0%)	1	(1%)	$0	(0%)
Energy production plant	10	(1%)	0	(0%)	1	(1%)	$1	(0%)
Unclassified utility, defense, agriculture or mining	50	(2%)	0	(0%)	1	(1%)	$4	(2%)
Outside or special property	120	(5%)	0	(0%)	3	(2%)	$6	(3%)
Construction site, oil/gas field,	60	(2%)	0	(0%)	1	(1%)	$2	(1%)
Bridge, tunnel, or outbuilding	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified or unknown-type special property	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Educational property	110	(4%)	0	(0%)	6	(5%)	$12	(6%)
Preschool through grade 12	70	(3%)	0	(0%)	2	(2%)	$5	(3%)
Adult education or college classroom	30	(1%)	0	(0%)	4	(3%)	$0	(0%)
Health care, detention or correction	80	(3%)	0	(0%)	15	(12%)	$2	(1%)
Hospital or hospice	30	(1%)	0	(0%)	13	(10%)	$0	(0%)
Clinic or doctor's office	20	(1%)	0	(0%)	2	(2%)	$1	(1%)
Nursing home	20	(1%)	0	(0%)	0	(0%)	$1	(0%)
Unclassified or unknown property use	60	(3%)	0	(0%)	2	(2%)	$4	(2%)
Total	2,590	(100%)	9	(100%)	125	(100%)	$202	(100%)

Note: Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis. Only occupancies with rounded totals of at least 1% of the fires are shown.

Source: NFIRS 5.0 and NFPA’s fire experience survey.

Table 2A.
Home Structure Fires Started by Hot Work, by Equipment Involved in Ignition
2010-2014 Annual Averages

Equipment Involved	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions)	
Soldering equipment	630	(34%)	2	(49%)	33	(39%)	$37	(44%)
Welding torch.	540	(29%)	0	(0%)	23	(27%)	$20	(24%)
Cutting torch	280	(15%)	0	(0%)	9	(11%)	$11	(13%)
Burner	260	(14%)	2	(51%)	13	(16%)	$9	(11%)
Heat treating equipment	130	(7%)	0	(0%)	5	(7%)	$6	(7%)
Tar pot or tar kettle	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Power nail gun, stud driver or stapler	0	(0%)	0	(0%)	0	(0%)	$0	(0%)
Total	1,860	(100%)	3	(100%)	83	(100%)	$85	(100%)

Table 2B.
Non-Home Structure Fires Started by Hot Work, by Equipment Involved in Ignition
2010-2014 Annual Averages

Equipment Involved	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions)	
Welding torch.	960	(37%)	6	(67%)	65	(52%)	$78	(39%)
Cutting torch	810	(31%)	3	(33%)	16	(13%)	$52	(26%)
Heat treating equipment	380	(15%)	0	(0%)	22	(18%)	$36	(18%)
Burner	250	(10%)	0	(0%)	21	(17%)	$21	(11%)
Soldering equipment	160	(6%)	0	(0%)	1	(1%)	$14	(7%)
Tar pot or tar kettle	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Power nail gun, stud driver or stapler	0	(0%)	0	(0%)	0	(0%)	$0	(0%)
Total	2,590	(100%)	9	(100%)	125	(100%)	$202	(100%)

Note: Fires in which the equipment involved in ignition was unknown or not reported have been allocated proportionally among fires with known equipment involved. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Fires with unclassified shop tools and industrial equipment (NFIRS equipment involved in ignition code 300) were allocated proportionally among fires specific shop tools and industrial equipment. Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience survey.

Table 3A.
Home Structure Fires Started by Hot Work, by Structure Status
2010-2014 Annual Averages

Structure Status	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in millions)	
In normal use	1,500	(81%)	3	(100%)	74	(89%)	$70	(82%)
Under construction	110	(6%)	0	(0%)	3	(3%)	$3	(3%)
Under major renovation	110	(6%)	0	(0%)	5	(5%)	$5	(6%)
Vacant and secured	60	(3%)	0	(0%)	2	(2%)	$6	(7%)
Being demolished	30	(2%)	0	(0%)	0	(0%)	$1	(1%)
Idle or not routinely used	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified structure status	10	(0%)	0	(0%)	0	(0%)	$0	(0%)
Vacant and unsecured	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Total	1,860	(100%)	3	(100%)	83	(100%)	$85	(100%)

Table 3B.
Non-Home Structure Fires Started by Hot Work, by Structure Status
2010-2014 Annual Averages

Structure Status	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in millions)	
In normal use	1,950	(75%)	9	(100%)	121	(97%)	$159	(79%)
Under major renovation	170	(7%)	0	(0%)	3	(2%)	$23	(12%)
Under construction	160	(6%)	0	(0%)	1	(1%)	$6	(3%)
Being demolished	130	(5%)	0	(0%)	0	(0%)	$8	(4%)
Vacant and secured	60	(2%)	0	(0%)	0	(0%)	$0	(0%)
Idle or not routinely used	50	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified structure status	40	(1%)	0	(0%)	0	(0%)	$5	(2%)
Vacant and unsecured	40	(1%)	0	(0%)	0	(0%)	$0	(0%)
Total	2,590	(100%)	9	(100%)	125	(100%)	$202	(100%)

Note: Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience survey.

Table 4A.
Home Structure Fires Started by Hot Work, by Area of Origin
2010-2014 Annual Averages

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions)	
Wall assembly or concealed space	290	(15%)	0	(0%)	9	(11%)	$18	(21%)
Bathroom or lavatory	260	(14%)	2	(51%)	15	(18%)	$13	(15%)
Kitchen or cooking area	150	(8%)	0	(0%)	13	(15%)	$5	(5%)
Exterior wall surface	140	(7%)	0	(0%)	0	(0%)	$3	(4%)
Garage or vehicle storage area*	120	(7%)	0	(0%)	12	(14%)	$5	(5%)
Exterior roof surface	120	(7%)	0	(0%)	2	(2%)	$6	(7%)
Crawl space or substructure space	110	(6%)	0	(0%)	3	(3%)	$6	(7%)
Attic or ceiling/roof assembly or concealed space	80	(4%)	0	(0%)	4	(4%)	$11	(13%)
Ceiling/floor assembly or concealed space	60	(3%)	0	(0%)	2	(2%)	$1	(2%)
Bedroom	60	(3%)	2	(49%)	6	(8%)	$3	(4%)
Laundry room or area	40	(2%)	0	(0%)	1	(1%)	$1	(1%)
Conduit, pipe, utility, or ventilation shaft	30	(2%)	0	(0%)	1	(1%)	$2	(2%)
Unclassified outside area	30	(2%)	0	(0%)	0	(0%)	$1	(1%)
Exterior balcony or unenclosed porch	30	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified function area	30	(2%)	0	(0%)	1	(1%)	$0	(1%)
Living room, family room or den	30	(1%)	0	(0%)	0	(0%)	$1	(1%)
Exterior stairway, ramp or fire escape	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified storage area	20	(1%)	0	(0%)	2	(2%)	$1	(1%)
Heating equipment room	20	(1%)	0	(0%)	3	(3%)	$1	(1%)
Unclassified structural area	20	(1%)	0	(0%)	0	(0%)	$0	(1%)
Closet	20	(1%)	0	(0%)	1	(1%)	$0	(1%)
Storage of supplies or tools or dead storage	20	(1%)	0	(0%)	1	(1%)	$0	(0%)
Exterior surface of vehicle	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified area of origin	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Construction or renovation area	10	(1%)	0	(0%)	2	(2%)	$0	(0%)
Courtyard, terrace or patio	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Storage room, area, tank or bin	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified means of egress	10	(1%)	0	(0%)	1	(1%)	$0	(0%)

Table 4A.
Home Structure Fires Started by Hot Work, by Area of Origin
2010-2014 Annual Averages (Continued)

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions)	
Other known area	90	(5%)	0	(0%)	5	(6%)	$3	(4%)
Total	1,860	(100%)	3	(100%)	83	(100%)	$85	(100%)

Note: Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience survey.

Table 4B.
Non-Home Structure Fires Started by Hot Work, by Area of Origin
2010-2014 Annual Averages

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss (in Millions)	
Exterior roof surface	310	(12%)	0	(0%)	1	(1%)	$21	(10%)
Processing or manufacturing area	230	(9%)	4	(47%)	17	(14%)	$56	(28%)
Maintenance or paint shop	180	(7%)	2	(27%)	31	(25%)	$13	(6%)
Garage or vehicle storage area*	140	(6%)	0	(0%)	8	(6%)	$6	(3%)
Wall assembly or concealed space	130	(5%)	0	(0%)	3	(3%)	$7	(3%)
Unclassified equipment or service area	120	(5%)	0	(0%)	8	(7%)	$24	(12%)
Exterior wall surface	100	(4%)	0	(0%)	3	(2%)	$1	(1%)
Unclassified storage area	90	(3%)	0	(0%)	1	(1%)	$9	(4%)
Machinery room or area	80	(3%)	0	(0%)	1	(1%)	$4	(2%)
Storage room, area, tank or bin	80	(3%)	1	(14%)	1	(1%)	$3	(1%)
Construction or renovation area	60	(2%)	0	(0%)	1	(1%)	$3	(1%)
Unclassified structural area	60	(2%)	0	(0%)	0	(0%)	$6	(3%)
Storage of supplies or tools or dead storage	60	(2%)	0	(0%)	3	(2%)	$1	(0%)
Ceiling/floor assembly or concealed space	50	(2%)	0	(0%)	1	(1%)	$3	(1%)
Unclassified outside area	50	(2%)	0	(0%)	0	(0%)	$2	(1%)
Duct for HVAC, cable, exhaust, heating, or air conditioning	50	(2%)	0	(0%)	1	(1%)	$4	(2%)
Attic or ceiling/roof assembly or concealed space	50	(2%)	0	(0%)	1	(1%)	$3	(1%)
Crawl space or substructure space	40	(2%)	0	(0%)	14	(11%)	$3	(2%)
Conduit, pipe, utility or ventilation shaft	40	(2%)	0	(0%)	8	(6%)	$2	(1%)
Kitchen or cooking area	40	(1%)	0	(0%)	0	(0%)	$1	(0%)
Unclassified technical processing area	30	(1%)	0	(0%)	0	(0%)	$3	(2%)
Heating equipment room	30	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified vehicle area	30	(1%)	0	(0%)	1	(1%)	$1	(0%)
Lavatory or bathroom	30	(1%)	0	(0%)	0	(0%)	$1	(0%)
Vacant structural area	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified area of origin	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Shipping, receiving or loading area	30	(1%)	0	(0%)	0	(0%)	$0	(0%)

Table 4B.
Non-Home Structure Fires Started by Hot Work, by Area of Origin
2010-2014 Annual Averages (Continued)

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss Damage (in Millions)	
Unclassified function area	30	(1%)	0	(0%)	0	(0%)	$0	(0%)
Office	30	(1%)	0	(0%)	0	(0%)	$16	(8%)
Lawn, field or open area	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified service area	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Conveyor	20	(1%)	0	(0%)	0	(0%)	$1	(0%)
Laboratory	20	(1%)	0	(0%)	8	(6%)	$0	(0%)
Unclassified means of egress	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Exterior surface of vehicle	20	(1%)	0	(0%)	1	(1%)	$0	(0%)
Exterior stairway, ramp or fire escape	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Lobby or entrance way	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Laundry room or area	10	(1%)	0	(0%)	1	(1%)	$1	(0%)
Trash or rubbish chute, area or container	10	(1%)	0	(0%)	2	(2%)	$0	(0%)
Other known area	160	(6%)	1	(12%)	7	(6%)	$4	(2%)
Total	2,590	(100%)	9	(100%)	125	(100%)	$202	(100%)

Note: Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience survey.

Table 5A.
Home Structure Fires Started by Hot Work, by Factor Contributing to Ignition
2010-2014 Annual Averages

Factor Contributing to Ignition	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss Damage (in Millions)	
Heat source too close to combustible	850	(46%)	0	(0%)	34	(40%)	$35	(41%)
Cutting or welding too close to combustible	590	(32%)	0	(0%)	27	(33%)	$39	(45%)
Equipment not being operated properly	110	(6%)	0	(0%)	6	(7%)	$5	(6%)
Unclassified misuse of material or product	90	(5%)	3	(100%)	2	(2%)	$2	(2%)
Equipment unattended	50	(3%)	0	(0%)	1	(1%)	$2	(2%)
Electrical failure or malfunction	40	(2%)	0	(0%)	1	(1%)	$1	(1%)
Unclassified operational deficiency	40	(2%)	0	(0%)	4	(5%)	$3	(3%)
Unintentionally turned on or not turned off	40	(2%)	0	(0%)	2	(2%)	$1	(2%)
Unclassified factor contributed to ignition	40	(2%)	0	(0%)	0	(0%)	$1	(1%)
Equipment used for unintended purpose	30	(2%)	0	(0%)	3	(4%)	$1	(1%)
Abandoned or discarded material or product	20	(1%)	0	(0%)	2	(2%)	$1	(1%)
Flammable liquid or gas spilled	10	(1%)	0	(0%)	4	(5%)	$1	(1%)
Leak or break	10	(1%)	0	(0%)	3	(4%)	$1	(2%)
Exposure fire	10	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified fire spread or control	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Improper startup	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Other known factor	50	(3%)	0	(0%)	9	(11%)	$3	(3%)
Total fires	1,860	(100%)	3	(100%)	83	(100%)	$85	(100%)
Total factors	2,020	(109%)	3	(100%)	100	(119%)	$97	(113%)

Note: Multiple entries are allowed which can result in sums higher than totals. Fires in which the factor contributing to ignition was coded as "none," unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition. Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience survey.

Table 5B.
Non-Home Structure Fires Started by Hot Work, by Factor Contributing to Ignition
2010-2014 Annual Averages

Factor Contributing to Ignition	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss Damage (in Millions)	
Cutting or welding too close to combustible	1,160	(45%)	7	(80%)	66	(53%)	$105	(52%)
Heat source too close to combustible	600	(23%)	0	(0%)	31	(25%)	$21	(10%)
Electrical failure or malfunction	160	(6%)	0	(0%)	2	(1%)	$29	(15%)
Unclassified mechanical failure or malfunction	120	(4%)	0	(0%)	0	(0%)	$8	(4%)
Equipment not being operated properly	100	(4%)	0	(0%)	1	(1%)	$1	(1%)
Equipment unattended	70	(3%)	0	(0%)	0	(0%)	$3	(1%)
Unclassified factor contributed to ignition	60	(2%)	0	(0%)	3	(2%)	$9	(4%)
Failure to clean	60	(2%)	0	(0%)	13	(10%)	$2	(1%)
Leak or break	50	(2%)	2	(21%)	5	(4%)	$9	(5%)
Unclassified operational deficiency	50	(2%)	0	(0%)	2	(1%)	$9	(4%)
Unclassified misuse of material or product	40	(2%)	0	(0%)	1	(1%)	$3	(1%)
Abandoned or discarded material or product	40	(1%)	0	(0%)	2	(1%)	$1	(0%)
Flammable liquid or gas spilled	30	(1%)	0	(0%)	5	(4%)	$0	(0%)
Improper startup	30	(1%)	0	(0%)	2	(1%)	$0	(0%)
Automatic control failure	20	(1%)	0	(0%)	2	(1%)	$1	(1%)
Unintentionally turned on or not turned off	20	(1%)	0	(0%)	2	(1%)	$1	(1%)
Equipment used for unintended purpose	20	(1%)	0	(0%)	0	(0%)	$2	(1%)
Unclassified fire spread or control	20	(1%)	0	(0%)	3	(2%)	$3	(2%)
Other known factor	120	(5%)	0	(0%)	12	(10%)	$6	(3%)
Total fires	2,590	(100%)	9	(100%)	125	(100%)	$202	(100%)
Total factors	2,770	(107%)	9	(100%)	151	(121%)	$213	(106%)

Note: Multiple entries are allowed which can result in sums higher than totals. Fires in which the factor contributing to ignition was coded as “none,” unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition. Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA’s fire experience survey.

Table 6A.
Home Structure Fires Started by Hot Work, by Item First Ignited
2010-2014 Annual Averages

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss Damage (in Millions)	
Structural member or framing	460	(25%)	3	(100%)	14	(17%)	$27	(31%)
Insulation within structural area	400	(22%)	0	(0%)	15	(18%)	$17	(19%)
Exterior wall covering or finish	190	(10%)	0	(0%)	3	(4%)	$7	(9%)
Unclassified structural component or finish	120	(6%)	0	(0%)	1	(1%)	$5	(6%)
Exterior roof covering or finish	100	(6%)	0	(0%)	1	(1%)	$5	(6%)
Flammable or combustible liquid or gas, filter or piping	100	(5%)	0	(0%)	18	(22%)	$8	(10%)
Unclassified item first ignited	70	(4%)	0	(0%)	3	(4%)	$3	(4%)
Interior wall covering. excluding drapes	50	(3%)	0	(0%)	2	(2%)	$2	(2%)
Cooking materials, including food	50	(3%)	0	(0%)	5	(6%)	$1	(2%)
Exterior trim, including doors	30	(2%)	0	(0%)	0	(0%)	$0	(0%)
Dust, fiber or lint, including sawdust or excelsior	20	(1%)	0	(0%)	4	(5%)	$0	(0%)
Multiple items first ignited	20	(1%)	0	(0%)	2	(2%)	$1	(1%)
Interior ceiling cover or finish	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Light vegetation, including grass	20	(1%)	0	(0%)	0	(0%)	$1	(1%)
Unclassified organic material	20	(1%)	0	(0%)	2	(2%)	$0	(1%)
Cabinetry	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Floor covering rug, carpet or mat	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Box, carton, bag, basket or barrel	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Electrical wire or cable insulation	10	(1%)	0	(0%)	1	(1%)	$0	(0%)
Mattress or bedding	10	(1%)	0	(0%)	2	(3%)	$1	(1%)
Rubbish, trash or waste	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Upholstered furniture	10	(1%)	0	(0%)	1	(1%)	$1	(1%)
Unclassified furniture or utensils	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item	90	(5%)	0	(0%)	8	(10%)	$3	(4%)
Total	1,860	(100%)	3	(100%)	83	(100%)	$85	(100%)

Note: Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience survey.

Table 6B.
Non-Home Structure Fires Started by Hot Work, by Item First Ignited
2010-2014 Annual Averages

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss Damage in (Millions)	
Flammable or combustible liquid or gas, filter or piping	400	(15%)	8	(86%)	59	(48%)	$51	(25%)
Exterior roof covering or finish	270	(10%)	0	(0%)	0	(0%)	$17	(9%)
Structural member or framing	250	(10%)	0	(0%)	1	(1%)	$15	(7%)
Insulation within structural area	240	(9%)	0	(0%)	6	(5%)	$9	(5%)
Unclassified item first ignited	150	(6%)	0	(0%)	6	(5%)	$4	(2%)
Dust, fiber or lint, including sawdust or excelsior	130	(5%)	0	(0%)	13	(10%)	$2	(1%)
Exterior wall covering or finish	120	(5%)	0	(0%)	0	(0%)	$1	(0%)
Unclassified structural component or finish	80	(3%)	0	(0%)	0	(0%)	$3	(2%)
Light vegetation, including grass	70	(3%)	0	(0%)	0	(0%)	$3	(2%)
Multiple items first ignited	70	(3%)	0	(0%)	7	(5%)	$3	(1%)
Rubbish, trash or waste	60	(2%)	0	(0%)	3	(2%)	$4	(2%)
Box, carton, bag, basket or barrel	60	(2%)	0	(0%)	5	(4%)	$4	(2%)
Interior wall covering	50	(2%)	0	(0%)	2	(2%)	$41	(21%)
Material being used to make a product	50	(2%)	0	(0%)	1	(1%)	$2	(1%)
Electrical wire or cable insulation	40	(2%)	0	(0%)	0	(0%)	$4	(2%)
Agricultural crop, including fruits and vegetables	40	(2%)	0	(0%)	0	(0%)	$1	(0%)
Floor covering rug, carpet or mat	40	(2%)	0	(0%)	0	(0%)	$1	(0%)
Interior ceiling cover or finish	40	(1%)	0	(0%)	0	(0%)	$9	(5%)
Unclassified organic materials	40	(1%)	0	(0%)	0	(0%)	$5	(2%)
Film or residue, including paint, resin and creosote	30	(1%)	0	(0%)	7	(5%)	$1	(1%)
Exterior trim, including doors	30	(1%)	0	(0%)	3	(3%)	$0	(0%)
Oily rags	20	(1%)	0	(0%)	0	(0%)	$1	(0%)
Cabinetry	20	(1%)	0	(0%)	0	(0%)	$1	(0%)
Upholstered furniture or vehicle seat	20	(1%)	0	(0%)	0	(0%)	$1	(0%)
Adhesive	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Conveyor belt, drive belt or V-belt	20	(1%)	0	(0%)	0	(0%)	$1	(0%)
Unclassified storage supplies	20	(1%)	0	(0%)	0	(0%)	$10	(5%)
Magazine, newspaper or writing paper	20	(1%)	0	(0%)	2	(1%)	$2	(1%)
Clothing	20	(1%)	1	(14%)	0	(0%)	$1	(0%)
Cooking materials, including food	20	(1%)	0	(0%)	0	(0%)	$0	(0%)
Bulk storage	10	(1%)	0	(0%)	2	(1%)	$2	(1%)

Table 6B.
Non-Home Structure Fires Started by Hot Work, by Item First Ignited
2010-2014 Annual Averages (Continued)

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Dollar Loss Damage in (Millions)	
Rolled or wound material	10	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known item	130	(5%)	0	(0%)	8	(6%)	$2	(1%)
Total	2,590	(100%)	9	(100%)	125	(100%)	$202	(100%)

Note: Sums may not equal totals due to rounding errors. Confined structure fires (NFIRS incident type 113-118) were excluded from this analysis.

Source: NFIRS 5.0 and NFPA's fire experience 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_2012.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 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.

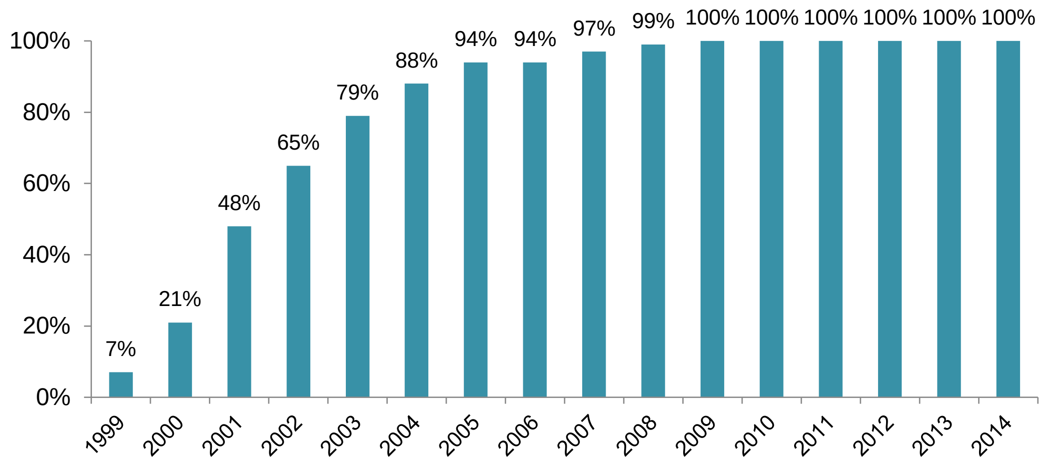
Figure A.1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

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

$$\frac{\text{NFPA survey projections}}{\text{NFIRS totals (Version 5.0)}}$$

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.

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



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.

Because this analysis focused on fatalities only, no distinction was made between confined and non-confined fires.

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.

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.

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.

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.

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

All fires
___
(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. Equipment that is truly different is erroneously assigned to other categories.

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: Recent Selected Published Incidents

The following are selected published incidents involving torches, burners, or soldering equipment. Included are short articles from the "Firewatch" columns in *NFPA Journal* and incidents from either the large-loss fires report or catastrophic multiple death fires report. It is important to remember that this is anecdotal information. Anecdotes show what can happen; they are not a source to learn about what typically occurs.

NFPA's Fire Incident Data Organization (FIDO) identifies significant fires through a clipping service, the Internet and other sources. Additional information is obtained from the fire service and federal and state agencies. FIDO is the source for articles published in the "Firewatch" column of the *NFPA Journal* and many of the articles in this report.

Sprinklers Extinguish Fire in Plastics Manufacturing Plant, Tennessee
Sparks from a cutting torch ignited dust and filters inside a paint booth at a plastics manufacturing plant, activating two sprinkler heads, which extinguished the fire before it could spread. Workers from a contracting company were using the cutting torch to remove a piece of equipment over the paint booth.

The fire department arrived at 9:50 a.m. after a flow switch on the sprinkler system triggered an alarm to central dispatch. The fire chief told news reporters that the fire "was actually out when we got there" and that "the sprinklers did their job." Crews shut off the activated sprinklers and used exhaust fans to clear smoke from the building.

The facility was constructed with brick and block walls and a bar joist roof deck, and was protected by a wet pipe sprinkler system. In addition, firewalls were present in the facility's interior, but details were not available on their type or location.

The plastics manufacturing plant had a ground-floor area of 200,000 square feet (61,000 square meters). Investigators indicated that there were no losses to the building, valued at $2.5 million, or its contents.

Richard Campbell, 2016, "Firewatch," *NFPA Journal* May/June.

One Man Killed, another Injured in Explosion at Oil Field, Utah
A 28-year-old oil field employee was killed when a large metal tank that held water that had been separated from crude oil exploded and landed on top of him. Another employee sustained significant injuries in the explosion.

The incident occurred at a one-acre oil field, which contained a battery of equipment, five metal storage tanks, a heating and separation unit, an electric generator, and a storage shed. The well pump drive engine and the generators were powered by natural gas that was piped to the site, as were the heaters used to heat the crude oil for ease in pumping. Additional monitoring equipment was powered by photovoltaic solar panels.

One of the steel tanks used to store the separated water had an ongoing maintenance issue and the three men were replacing it when it developed a small leak. After the victim, who was a welder, tried unsuccessfully to “wet” weld the hole, the manager of the oil field decided to purge the tank to permit the men to repair the tank properly. The third employee was draining the tank when the explosion occurred, lifting the tank off the ground and dropping it on its side. The victim was found in a pool of crude oil under the tank, fatally burned.

Investigators spoke with the two witnesses and learned that the victim was using a wire wheel hand grinder to prepare the tank site for welding. They concluded that sparks from the grinder or spot welder ignited residual flammable gas in the tank, causing the catastrophic explosion and fire.

Kenneth J. Tremblay, 2015,"Firewatch", *NFPA Journal*, March/April 2015.

Explosion in Storage Building, Michigan

A 54-year-old man had first-, second-, and third-degree burns to his upper body when his boat, which was stored in a marina building, exploded as he worked on it. The ensuing fire spread to six of the 80 boats in the building, before the sprinkler system limited further fire spread.

The one-story, metal-frame building, which covered approximately 37,000 square feet (3,437 square meters), had a fire detection system that provided heat and smoke detectors, as well as a wet-pipe sprinkler system.

The victim was performing maintenance inside his boat, and another man was working on the bow of an adjacent boat at the same time. Each boat had been elevated from the floor on jacks, and ladders were needed to get onto them.

The man on the bow of his boat felt a pressure wave that nearly knocked him to the ground, then saw flaming debris raining down inside the building, followed by smoke and flames. Jumping down, he saw that the boat next to his had been blown off its jacks and its front had been peeled off.

He tried to find the other boat's owner, but flames 20 feet (6 meters) high forced him to retreat and he ran to the storage yard office for help, calling 911 as he went. When he returned to the building, he saw the burned victim walking out on his own. The victim was moved away from the building and cared for by another boat owner until an ambulance arrived to take him to a hospital.

When firefighters arrived, they found the sprinklers controlling the blaze. Smoke from burning fiberglass and fuel made suppression difficult.

Investigators determined that the explosion occurred when a butane torch the victim was using to heat shrink tubing around electrical wires ignited gasoline vapors that had built up in the cabin.

The building, which was valued at $2 million, sustained $500,000 in damage. Its contents, valued at $26 million, sustained an estimated $3.5 million in damage.

Kenneth J. Tremblay, 2015, “Firewatch,” *NFPA Journal*, January/February 37.

Fifty Story Office Building Fire Results in Three Deaths, Texas

At 10:18 a.m. on a December morning, the fire department was notified of a fire in an occupied 50-story office building of fire-resistant construction. No information was reported on the building floor size. There was a complete wet-pipe sprinkler system. The system was in the area of the explosion and fire and three sprinkler heads operated. Information on their effectiveness was not reported. No information was reported on detection equipment.

Investigators learned that an unknown type gas exploded in the basement where three workers were located. The workers were using welding or cutting equipment in a tank in the basement of the high-rise office building. They were trapped and died before they could be rescued.

Adapted from Stephen G. Badger’s report, *Catastrophic Multiple-Death Fires in the United States, 2014*, Quincy, MA: NFPA, 2015, p. 8.

Fire Damages High School Carpentry Shop, Massachusetts

A fire in the carpentry shop at the rear of a vocational high school caused $1 million in damage, in part because the building was not sprinklered.

The two-story, steel-frame trade school, which covered approximately 217,000 square feet (20,160 square meters), was irregularly shaped, with concrete block walls and metal bar joist roof construction. A fire detection system, including smoke detectors, had been installed in the common hallways, and manual pull stations were connected to a municipal fire alarm system, but there was no detector located in the area of origin. There were no sprinklers.

A teacher was cutting wood with a router in the carpentry shop of a vocational high school in preparation for the next day’s class when he smelled smoke. Turning around, he discovered that a bag filled with dust from a collection system connected to the router had ignited.

The teacher pulled the manual pull station and called 911 at 5:23 p.m., then tried unsuccessfully to control the fire with two portable dry chemical fire extinguishers.

Arriving firefighters ordered a second alarm when they saw smoke billowing from the shop, which was located at the rear of the building. They used two hose lines to extinguish the blaze.

The building and contents, valued at nearly $40 million, sustained an estimated loss of $1 million.

Kenneth J. Tremblay, 2014,”Firewatch” *NFPA Journal*, July/August, 37.

Fire in Apartment under Construction Causes $10 Million Dollar Loss, Arizona
Around 3:15 p.m. on a September afternoon, the fire department was notified of a fire in a three-story apartment building was under construction. The building had unprotected wood-frame construction. It was part of an apartment complex that covered 12 acres (5 hectares) with seven three-story, wood-frame buildings completed and occupied and five buildings of the same construction materials under construction. There were also eight garage buildings under construction. A security guard was on site at the time of the fire.

There were no smoke alarms present at this point in construction. There was a sprinkler system partially installed, but it was not yet completed or operational.

A fire broke out in a second-story center apartment in the bathroom area. It was caused by plumbers' hot work igniting fiberboard being used in the wall construction around a water heater. Upon arrival of the fire department, three buildings under construction were already involved in fire.

At the time of the fire, the temperature was 102 degrees F (39 degrees C), winds were 5 to 10 mph (8 to 16 kph), and relative humidity was 18 percent. The fire destroyed five three-story apartment buildings in various stages of construction, as well as four garage buildings, and damaged two occupied three-story buildings. A sprinkler system in a nearby occupied building activated when the fire caused a window to break and ignited that building. Property loss was estimated at $10 million dollars.

Adapted from Stephen G. Badger's report, *Large-Loss Fires in the United States, 2012,* NFPA, Quincy, MA: 2013, p.19.

Three Killed when Pipe with Flammable Vapors Was Cut, Arkansas
At 3:27 p.m. on a May afternoon, the fire department was notified of an explosion and fire that involved piping connected to an obsolete flammable liquid storage tank at an oil well.

This explosion and fire occurred as a worker (one of the victims) used a power rotary saw to cut a pipeline that contained flammable vapors. The pipeline had not been purged, bonded, or blocked before the cutting operations began. The three victims were engulfed in the fire following the explosion.

Adapted from Stephen G. Badger's report, *Catastrophic Multiple-Death Fires in 2012,* NFPA, Quincy, MA, 2013

Large-Loss Apartment Fire, $20 Million Dollar Loss, Texas
Around 6:09 p.m. on a July evening, the fire department was notified of a fire in a five-story, 300-unit, 60,000-square-foot (5,574-square-meter) apartment building of unprotected ordinary construction was under construction. Workers were on site at the time of the fire.

There was no automatic detection equipment. A full-coverage wet-pipe sprinkler system had been installed, but it was not yet operational.

Investigators learned that a worker grinding and cutting metal caused a small fire in a wall, which traveled up the wall and spread laterally throughout the building. The worker who started the fire thought it had been extinguished and continued working. Arriving firefighters found that the hydrants in the area were inoperable, but the cause of the problem was not reported. Property damage was estimated at $20 million dollars.

Adapted from Stephen G. Badger's report, *Large-Loss Fires in the United States, 2014*, NFPA, Quincy, MA, 2015.

Cutting Torch Fire Destroys Mill, Rhode Island

A large mill-type building that was being converted into a wood pellet manufacturing plant was destroyed by a fire that began when sparks from a cutting torch ignited its wooden support structure.

The four-story building, which measured 300 feet (91 meters) by 50 feet (15 meters), was constructed of heavy timber and had brick walls, wooden floors, and a wooden roof. Its fire detection system was tied directly to the fire department. The fire sprinkler system had been turned off while the building was being renovated.

The fire department received the alarm at 7:38 p.m. When firefighters arrived four minutes later, they could see no sign of fire on the outside of the building. While walking to the second floor, however, they smelled smoke and were informed that smoke was coming from several third-floor windows. When they got to the warehouse area on the second floor, they saw about 25 feet (8 meters) of fire near the ceiling. As smoke came pouring down the staircase, the firefighters made a fast exit and switched to exterior operations. Ultimately, the fire went to eight alarms, and the last unit was not cleared until four days later.

Investigators determined that workers using cutting torches on piping inadvertently heated the wooden structural framing to its ignition point and that the building caught fire 60 to 90 minutes after they completed work for the day.

Neither the value of the building and its contents nor damage estimates were reported. Two firefighters suffered dehydration while battling the fire and were transported from the scene by ambulance.

Kenneth J. Tremblay, 2012, "Firewatch," *NFPA Journal*, May/June, 28.

Hot Slag Starts Fire in Retail Store, Minnesota

A large retail store undergoing renovation lost $500,000 worth of its contents when hot slag from a welding operation on the roof dripped into the building and ignited combustibles below.

The single-story structure was 200 feet (61 meters) long and 300 feet (91 meters) wide. A wet-pipe sprinkler system had been installed.

The fire department received the call about the water flow alarm at 8:14 a.m. and responded with two engines, a ladder, a rescue vehicle, a truck, and a tanker. When they arrived four minutes later, they used a thermal imaging camera to find the fire, which two sprinklers had confined to several boxes stored on the top shelf of a rack in a rear storage area.

Investigators discovered that the construction crew on the roof had earlier spotted a fire on the roof and extinguished it with snow. They were unaware that hot slag had entered the building below the area they were working on and started a fire until two sprinklers activated and the water flow alarm sounded.

Damage to the building was minimal, but damage to its contents was estimated at $500,000. There were no injuries.

Kenneth J. Tremblay, 2012, "Firewatch," *NFPA Journal,* March/April, 21-22.

One Killed When Welder Ignites Flammable Vapors, Indiana
One person was killed and two others were injured when a welder working on a steel storage tank in a single-story storage and maintenance facility inadvertently ignited flammable vapors in the tank, causing an explosion.

The incident occurred near the entrance of the building, which had concrete walls and a wooden roof covered with asphalt shingles. The facility was not equipped with a suppression or detection system.

A 911 call at 11:25 p.m. reported the explosion, and arriving firefighters found three people injured, one critically. Investigators determined that the steel tank had last contained gasoline, and the residual vapors were ignited by the torch.

The dead man, whose age was not reported, died of injuries related to the explosion. The other two victims suffered smoke inhalation injuries.

The value of the building and estimates of the damage were not reported.

Kenneth J. Tremblay, 2012, “Firewatch,” *NFPA Journal,* January/February 21-22.

Torch Starts Roof Fire at Lumber and Hardware Store, Utah
A propane torch being used to seal the roof membrane of a lumber and hardware store ignited the material, and the fire spread to wooden structural members.

The two-story, wood-frame building, which measured 100 feet (30 meters) by 120 feet (37 meters), had concrete block walls and a wooden roof deck with a built-up surface of asphalt and rubber roofing material. The structure had no fire detection or suppression equipment.

Earlier in the day, a roofing contractor was repairing a section of the roof by removing damaged substrate and underlayment, and laying down new roofing material. He used a propane-fired torch to heat the roofing membrane to bond sections together and seal the joints. The contractor finished his work for the day around 5 p.m. and sent his crew home after checking the roof surface.

About 30 to 45 minutes later, employees preparing to close the store for the evening smelled something burning. When they went to investigate, they saw smoke and flames coming from the corner of the building where the contractor had been working. They called 911 at 5:55 p.m.

Arriving firefighters evacuated the store and called in additional resources. The suppression operation lasted for more than four hours, as crews fought to prevent the blaze from spreading further and involving the warehouse.

Flames consumed a large portion of the wooden roof and significantly damaged the store, which was valued at $1.5 million. There were no injuries.

Kenneth J. Tremblay, 2011, "Firewatch", *NFPA Journal,* May/June, 33.

Propane Torch Ignites Wall in Nursing Home, California
A contractor using a propane torch to remove flooring in a nursing home unknowingly ignited a wood-framed wall. The fire smoldered inside the wall until staffers in an employee break room saw smoke coming from a wall-mounted air conditioner and called 911 at 5:09 p.m.

Firefighters arriving five minutes after the alarm saw nothing showing from the outside of the building and began an interior investigation. They had just started to examine the air conditioner, which the staff had unplugged, when a firefighter informed the incident commander of a small fire at the base of the wall opposite the air conditioning unit. Opening up the wall, the firefighters found a fire burning near the base of the wall channel and used a water extinguisher to put it out.

When the fire investigators questioned the construction contractors, they learned that one of them had used a propane torch to remove flooring in that area earlier in the day. When he left the area, he was unaware that he had ignited the wall of the break room.

Fire spread was limited to the area of origin. The building, which was valued at $5 million, sustained $5,000 in damage. No damage estimates were given for the nursing home's contents. There were no injuries.

Kenneth J. Tremblay, 2011, "Firewatch", *NFPA Journal,* May/June, 49.

Sprinkler Douses Welding Fire at Manufacturing Plant, Texas
A single sprinkler extinguished a fire at a heavy equipment and machine manufacturing plant before firefighters arrived. The fire started when a robotic welder ignited lubricants in a milling machine.

The one-story, steel-frame plant, which was 550 feet (168 meters) long and 300 feet (91 meters) wide, had concrete tilt-up walls and a metal-deck roof. The property was protected by a wet-pipe sprinkler system.

The plant's staff was preparing to close the building for the night when they saw the fire and called 911 at 6:17 p.m. Firefighters arriving four minutes later found moderate smoke coming from the rear of the building and discovered that the sprinkler had already extinguished the blaze.

Investigators determined that the robotic welder near the milling machine had unintentionally been left operating, and the cooling and lubricating oil in the machine ignited. Plastic drums containing more lubricating oil and coolant stored near the point of origin failed, further fueling the fire. When the flames reached the ceiling, the sprinkler system activated.

The building was valued at $15 million, as were its contents. Damage to the building was estimated at $11,500, while damage to its contents was estimated at $56,000. There were no injuries.

Kenneth J. Tremblay, 2011, "Firewatch", *NFPA Journal,* May/June, 46-47.

Appendix C: Workplace Injuries Involving Hot Work

The Department of Labor's Occupational Safety and Health Administration (OSHA) maintains a worker database of fatality and catastrophe investigation summaries. The public may search it at https://www.osha.gov/pls/imis/accidentsearch.html. Note that some states do not participate. The selection of summaries that follow show some of the types of occupational hot work injuries that have occurred. They should not be considered representative. Information identifying the companies, communities, and exact dates has been removed by NFPA.

California. Unprotected Worker Incurs Stomach Burns in Torch Flareback

At approximately 8:45 a.m. on April XX, 2014, Employee #1, a welder/cutter employed by a structural steel contractor, was working at an old building being structurally upgraded. His foreman was in the general area. Employee #1 was preparing to use a torch to cut a concrete pavement. As Employee #1 began to light the torch, a flareback occurred from the torch or its components. Employee #1 was burned. He went to tell his foreman, and the foreman transported Employee #1 to XX Hospital. Employee #1 later was transferred to XXX Hospital, where he was admitted and treated for burns to his abdomen. Employee #1 had a burn and scar on his front abdominal area that measured approximately 6 inches by 10 inches. This event was reported to Cal/OSHA by a concerned citizen. An investigation was conducted at the construction jobsite on April XX, 2014. An interview was conducted with the foreman, who initially told the investigator that no work-related injury had occurred at the worksite. He finally admitted to the event. The investigator was unsuccessful in his attempts to interview Employee #1. Employee #1 had legal counsel representing him and was instructed to plead the Fifth Amendment. Employee #1's legal counsel also attempted to have Cal/OSHA grant immunity to his client. The employer was cited three serious accident-related violations: T8 CCR 4845(q) requires the welder to inspect the torch for safe operation at the beginning of each work shift. T8 CCR 4845(b) requires appropriate clothing be worn for the work being done. Employee #1 could not have inspected the torch before use. Had he inspected the torch, he would have found that backflow protection had not been provided. Employee #1 did not wear protective clothing to prevent burns. The Division was not notified of this event and Employee #1's injuries. The investigation observed additional violations, and the employer was cited accordingly.

Indiana. Worker Dies from Burns after Spark Ignites Cigarette Lighter

On March XX, 2014, Employee #1, working at a construction company's job site, was engaged in exterior carpentry. He was using a cutting torch. A spark from the torch fell into the worker's front pocket. The worker had a butane lighter in his pocket. The spark caused the lighter to explode, and the worker sustained severe burns. Emergency services were called. Either at the job site or subsequently at the hospital, the worker died from his burns. This fatality was investigated by Indiana OSHA. The investigation determined that there was no employer/employee relationship between the fatally injured worker and the construction company.

California. Tank Explodes, Kills One and Injures Another

On December XX, 2013, Employee #1, a 33-year-old male and Employee #2, a 23-year-old male…, were working on an old used 300 gallon tank at a ranch. In addition, of the two workers from XXX, there was a ranch foreman, representing the ranch management company, XXX, on the jobsite. Employee #2 was grinding on the tank with a wire cup brush to clean it up. After Employee #2 finished, Employee #1 approached the tank with an oxy-acetylene torch to braze some small holes. As Employee #1 touched the end of the torch to the tanks hole, the tank exploded, and killed Employee #1. Employee #2 and the foreman from the ranch sustained serious injuries and burns in the explosion that required hospitalization.

California. Welder Sustains Burns to Torso

At approximately 2:30 p.m. on December XX, 2013, an employee was working as a welder. He was welding a steel plate onto a steel beam. The employee was doing long welding passes to heat up the metal, when he felt a hot sensation. He took off his welding helmet to find his shirt below his chest on fire. His abdomen to his waist was unprotected, because he was not wearing a leather bib. He sustained burns on his torso.

California. Oil Rig Worker Burned when Acetylene Leak Ignites

At approximately 9:00 a.m. on December XX 2013, Employee #1, a 40-year-old male, welder… was performing the routine task of prepping steel using a grinder. Employee #1 was working by himself on the first level of an oil rig platform sub-base. Another Fitter/Welder was working on the second level of the platform and the crew supervisor was working on the second level of the platform. Employee #1 was using a grinder and was standing inside a recessed box, where the oxygen acetylene torch hoses were also present. A leak from the acetylene hose provided the fuel source and a spark from the grinder provided the ignition source for a flash fire to occur. This fire resulted in serious burns to Employee #1's legs and feet. Employee #1 was transported by ambulance to an occupational physician and from there was transported to the hospital. Employee #1 was admitted to the hospital for ten-days for burn injuries. The investigation concluded that fire occurred due to a defective splice on the acetylene hose that allowed the acetylene leak causing a fire and the serious injury. The facility involved in the incident was a 114-person business engaged in the fabrication of industrial steel items. The injured employee #1 had been working there for seven years performing duties of a welder, including preparing steel before hot work began.

California. Employee Is Caught by Fallen Trellis, Suffers Fractures

At about 3:00 p.m. on July XX, 2013 , Employee #1, a foreman with XXX, was securing a 22 foot wide by 65 foot long trellis between two buildings that were under construction. Employee #1 was working alone, removing safety brackets, with an acetylene torch (oxy-acetylene), from the column supporting the trellis. The trellis brackets were about 18 feet above the ground. Employee #1 noticed that the steel tube connecting the trellis to the northwest column was not straight. Employee #1 was the foreman responsible for safety and the proper installation of the trellis at the site. Employee #1 decided that the welded connection at the northwest column was unacceptable and had to be repaired. Employee #1 used an acetylene torch (oxy-acetylene) to cut the bottom weld on the steel tube connecting the trellis to the northwest column. When the bottom weld was cut, the weight of the trellis was too great for the remaining welds to support the 15,000 pound structural steel trellis. This action allowed the northwest corner of the trellis to fall approximately two feet and trap Employee #1 between the trellis and the wall. Apparently, the structural design of the structure was modified by an unqualified foreman, when he removed structural welds. This caused the remaining welds to fail under the load, and allow the structure to fall. Employee #1 was transported to the hospital, and he was admitted for over 24 hours, for chest and facial fractures.

California. Employee Is Burned while Operating Cutting Torch

At approximately 7:30 a.m. on May XX, 2013, Employee #1, a supervisor and well driller … began cutting a pipe with an oxygen-acetylene torch after he removed the cap from the well casing and marked the cut line. He was cutting the well casing to raise it for the pump pad. Then, a piece of slag fell in excess of 30 feet down into the well casing, igniting an unknown substance. This caused flames to rise to the top of the well. Employee #1 was leaning over the open well casing when flames hit him in the arms, neck and chest area. Employee #1 received flash burns to the face, neck, anterior torso and bilateral upper extremities. The well was not properly tested with a gas monitor prior to cutting the well casing. Employee #1 was not wearing the appropriate personal protective equipment (a long sleeve shirt (cotton or FRC)); (leathers and welding gloves). Employee #1 was hospitalized.

Michigan. Employee Is Struck by Flying Lid, Later Dies

At approximately 1:30 p.m. on April XX, 2013, Employee #1, a laborer, and a coworker from different companies were removing the guide rails, floating lids and associated equipment from digester tanks in a sewage treatment facility. The employees were removing the guide rail on one of the digester tanks that was full of sewage, using a cutting torch. Employee #1 and the coworker started cutting the bolts on the center hub of the floating lid. The sparks and slag ignited the methane gas that had accumulated under the hub, propelling the lid 8 feet into the air, and struck the employees. Employee #1 and the coworker were transported to an area hospital, where Employee #1 later died.

California, Maintenance Worker Catches on Fire while Arc Cutting

At approximately 10:00 a.m. on November xx, 2012, Employee #1, a 35-year-old male temporary worker … was working at a construction site in …, California. Employee #1 was attempting to remove and replace a broken tooth on the digging bucket at the maintenance yard for the XXX replacement project. Employee #1 was performing repair on the XXX clamp pocket by using air arc to cut old metal off to put on a new pocket. Prior to this task, Employee #1 had worked on a hydraulic valve at different location, about a five- minute drive from the construction site. After the hydraulic valve task was completed, Employee #1 did not put the flammable solvent- XXX- bucket away before starting the cutting, grinding, and welding task. Employee #1 kept the plastic bucket and some dirty rags at the work-bench on the back of the truck. The work-bench was about 3 feet above the ground and 10 feet away from the cutting area. The grinding and cutting area was about 5 feet above the ground. While Employee #1 was using an air arc to cut the old metal off the pocket, some sparks caught rags on fire behind the truck. Employee #1 pulled the rags underneath the bucket to put down the fire. The solvent splashed on his upper body and caught him on fire. Employee #1 suffered second and third degree burns to 40-percent of his upper body. Employee #1 was transported to XXX Hospital and later was transferred to XXX Burn Center, where he was hospitalized and treated for three and a half weeks.

California. Worker Is Exposed To Welding Fumes and Sustains Burn in Ear

Sometime between 8:30 a.m. and 2:00 p.m. on July XX, 2012, Employee #1 was working for the XXX School District, in XXX CA. XXX School District maintenance department had eight maintenance employees, who serviced all of the schools in the district... Employee #1 had been working for the employer for nearly four years. Four months before the incident, a coworker had been assigned the task of securing a lock to a gate at XXX Elementary School to keep it from swinging. The coworker asked Employee #1 to help the coworker. At the school, Employee #1 and the coworker were to divide the work of grinding and welding. The coworker injured his hand, however, so Employee #1 did much of the welding work. On the day of the incident, he was grinding and welding. He was wearing a welding hood and gloves, but notably he was not wearing a welding jacket or respirator. While Employee #1 was grinding the surface coating in preparation for welding, a piece of hot metal went into his ear, causing a burn and noticeable pain. Employee #1 reported this injury to the employer the same day. (Other reports indicated that the ear injury was due to slag from welding. This was inaccurate, as Employee #1 indicated that his ear injury occurred during grinding.) Employee #1 continued his work after this injury. Employee #1 welded a total of 11 brackets: 4 brackets on the gates near rooms 16 and 17, 4 brackets on the gates between rooms 20 and 22, and three brackets between the multipurpose room and room 26. Employee #1 estimated that he did about 4 hours of welding.

Employee #1 was welding angle bracket at various points on the gate, including welds at the bottom of the gate, requiring his head to be close to the welding area. Employee #1 noted that it was a mild day with not much wind. Employee #1 stated that the welding fumes were coming up inside the welding mask. During the welding, he had to remove his welding helmet several times to allow it to air out. Following the exposure to both the welding fumes and the metal burr, Employee #1 experienced fever, headache, and sore throat. The following day…he had an appointment for his ear injury. The next day…he was taken to an emergency room with a fever, headache, and sore throat. He was hospitalized for four days. On XXX, the Cal/OSHA XXX District office received a call from the XXX School District's human resources analyst about an accident involving an employee "inhaling fumes" and being hospitalized for five days (though elsewhere, the narrative said the hospitalization lasted four days). The opinion of Cal/OSHA's medical unit was that "Employee #1 suffered an episode related to workplace exposures on 7/XX/12 during a welding operation on a galvanized gate." As previously mentioned, Employee #1 was welding angle iron onto a galvanized steel gate. Samples of the metals with which he was working were sent to the testing laboratory XXX for analysis, in part to determine if there were any metals that may have contributed to Employee #1's illness. The angle bracket was 97 percent iron, with trace amounts of other metals. The galvanized steel gate was 98 percent iron, 1 percent manganese, and 1 percent zinc substrate, with a 97 percent zinc coating. The welding wire was composed of iron, copper, and manganese. A complete analysis of the metals was included in the case file. During his investigation, the Cal/OSHA investigator held a meeting with two representatives of the employer. They indicated that the employer was starting to put an injury and illness prevention plan (IIPP) together…

Utah. Welder Dies from Burns Caused by Vapors Igniting

On July XX, 2012, an employee of XXX, was working at a new tank construction project. He was grinding/welding near a previously used component that was being installed. Vapors ignited, and the employee was critically burned. The employee was hospitalized. On August XX, 2012, the employee died from his injuries.

California. Employee's Legs Are Burned when Sparks Ignite Gasoline

On February XX, 2011, Employee #1 was working for a firm that repaired and sold lawnmowers. Employee #1 was a permanent full-time employee with no other contracts. He was using a four inch (102 mm) grinder to cut a piece metal one inch (25 mm) in diameter from the top of a lawnmower that was no longer functional. The metal piece would then be welded onto another lawnmower, a 22 inch (0.56 meter) hand push, rotary lawnmower manufactured by XXX, where it would act as a guide. The guide would be located on the hood of the lawnmower's engine to protect the cord from fraying and tearing. Employee #1 was inside the shop grinding on the metal piece, and there were sparks flying. Some sparks flew into an open container of gasoline and ignited the contents, starting a flash fire. The container for the gasoline was 6 inches deep by 6 inches wide by 10 inches long (152 mm by 152 mm by 254 mm). Employee #1's pants caught on fire, causing Employee #1 to sustain second- and third-degree burns to his legs. Employee #1 was hospitalized for 14 days. The employer called the XX District Office on February XX, 2011 to report the injury. The employer could not say how much gasoline had been in the container, but burn marks were still evident around the area after the fire.