

PATTERNS OF FIREFIGHTER FIREGROUND INJURIES

Michael J. Karter, Jr.

January 2012



**National Fire Protection Association
Fire Analysis and Research Division**

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Abstract

For the 2005-2009 period, there was an estimated annual average of 38,660 firefighter fireground injuries in the U.S. Of these, an average of 27,920 were minor, and 10,740 were moderate or severe.

The leading types of minor injuries were: strain or sprain accounting for an annual average of 6,880 injuries or (25%); pain only, accounting for 3,215 injuries (12%); thermal burns only, accounting for 2,885 injuries (10%); cut or laceration, accounting for 2,285 injuries (8%).

The leading types of moderate and severe injuries were: strains or sprain accounting for an annual average of 3,705 injuries a year, or 34%; thermal burn, accounting for 1,090 injuries (10%); pain only, accounting for 985 injuries (9%).

Activities related to extinguishing a fire accounted for half of the minor injuries (14,090 or 50%), and for half of the moderate and severe injuries (5,440 or 51%).

The leading causes of minor injuries were exposure to something (6,500, or 23%), while for moderate and severe injuries the leading cause of injuries were fell, slipped, or tripped (3,000 or 28%).

Keywords: firefighter fireground injuries, primary apparent symptom, type of activity while injured, age of injured firefighter, time of day, improving firefighter safety.

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Introduction

An analysis of firefighter injury data from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) was undertaken to examine factors that are beyond the scope of results based on the NFPA survey. Results were analyzed for the 2005-2009 period. This is the NFPA's third firefighter fireground injury report since data was collected based on NFIRS 5.0, and most of the injuries were reported in the 5.0 version. National estimates of firefighter injuries for selected breakdowns are based on data from the NFPA survey used in conjunction with NFIRS.

Severity of injury was broken into two groups:

- Minor (includes report only, first aid only, and treated by physician not a lost-time injury)
- Moderate and severe (includes lost time injuries where there was little danger of death or permanent disability, and time lost injuries when there was a potentially life-threatening condition. Because of the small number of severe injuries they were combined with the moderate injuries.

For the 2005-2009 period, there was an estimated annual average of 38,660 firefighter fireground injuries in the U.S. Of these, an average of 27,920 were minor, and 10,740 were moderate or severe (See Table 1).

Primary Apparent Symptom

Because minor injuries outnumber moderate and severe injuries by a factor of more than 2-to-1, they will dominate the results listed in the total column (Tables 2 to 5), and therefore the summary results in the text were not done separately for total injuries, because it would have been redundant of minor injury results.

For the 2005-2009 period for minor injuries at structure fires, there were an estimated annual average of 6,880 strain or sprain a year, or 25% of all minor injuries (Table 2). Other leading types of minor injuries were: pain only, accounting for 3,215 injuries (12%); thermal burns only, accounting for 2,885 injuries (10%); cut or laceration, accounting for 2,285 injuries (8%); exhaustion or fatigue, accounting for 1,640 injuries (6%); smoke inhalation, accounting for 1,445 injuries (5%); and contusion, accounting for 1,545 injuries (6%).

Table 1
Firefighter Fireground Injuries
Total and by Severity, 2005-2009

Year	Total Injuries	Minor	Moderate and Severe
2005	41,950	31,045	10,905
2006	44,120	32,345	11,865
2007	38,340	27,960	10,650
2008	36,595	25,875	10,720
2009	32,205	22,655	9,550
2005-09 Average	38,660	27,920	10,740

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Table 2
Fireground Injuries by Primary Apparent Symptom for Total Injuries and by Severity, 2005-2009 Annual Average

Primary Apparent Symptom	Total Injuries		Minor		Moderate and Severe	
Sprain or strain	10,585	27%	6,880	25%	3,705	34%
Pain only	4,200	11%	3,215	12%	985	9%
Thermal burns only	3,975	10%	2,885	10%	1,090	10%
Cut or laceration	2,975	8%	2,285	8%	690	6%
Contusion	2,030	5%	1,545	6%	485	5%
Exhaustion or fatigue including						
heat exhaustion	2,150	6%	1,640	6%	510	5%
Smoke inhalation	1,745	5%	1,445	5%	300	3%
Puncture wound	750	2%	640	2%	110	1%
Breathing difficulty or						
shortness of breath	735	2%	540	2%	195	2%
Inhalation of hazardous fumes	495	1%	470	2%	25	0%
Eye trauma	660	2%	535	2%	125	1%
Swelling	545	1%	290	1%	255	2%
Burn or scald	560	1%	430	2%	130	1%
Abrasion	480	1%	425	2%	55	1%
Dizziness, fainting, or weakness	600	2%	385	1%	215	2%
Dehydration	370	1%	270	1%	100	1%
Cardiac symptoms	500	1%	210	1%	290	3%
Fracture	675	2%	150	1%	525	5%
Electric shock	205	1%	150	1%	50	0%
Nausea	175	0%	140	1%	35	0%
Crushing	180	0%	90	0%	90	1%
Foreign body obstruction	105	0%	95	0%	10	0%
Burns and smoke inhalation	170	0%	100	0%	70	1%
Dislocation	295	1%	105	0%	190	2%
Numbness	140	8%	85	0%	55	1%
Other	3,000	4%	2,910	10%	450	4%
Total	38,660	100%	27,920	100%	10,560	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums due to rounding.

Source: National estimates based on 2005-09 NFIRS and NFPA survey.

For the 2005-2009 period for moderate and severe injuries at structure fires there was an annual average of 3,705 strains and sprains a year, or 34% of all severe and moderate injuries (Table 2). Other leading types of moderate and severe injuries were: thermal burn, accounting for 1,090 injuries (10%); pain only, accounting for 985 injuries (9%); cut or laceration accounting for 690 injuries (6%) fracture, accounting for 525 injuries (5%); exhaustion or fatigue, accounting for 510 injuries (5%); contusion, accounting for 485 injuries (5%); smoke inhalation, accounting for 300 injuries (3%); cardiac symptoms, accounting for 290 injuries (3%); swelling, accounting for 255 injuries (2%); dizziness, fainting, or weakness accounting for 215 injuries, or 2%; and breathing difficulty, accounting for 195 injuries (2%).

Primary Apparent Symptom by Part of Body Injured

For the 2005 -2009 period, the most common injuries received by firefighters at the fireground involved the leg or foot, 7,935 injuries or 21%, and arm or hand, 7,695 injuries or 20%. These were followed by the trunk area, 5,585 or 14%, the head area 5,185 or 13%, and the neck or shoulder area, 4,770 or 12%. (Table 3).

Firefighters who suffered burn injuries received them most frequently to the head area (36%), the arm or hand (29%), the neck or shoulder area (18%), and the leg or foot (9%).

For firefighters who suffered from smoke inhalation, not surprisingly, 1,745 or 81% of the injuries were of an internal nature.

Firefighters who suffered from wounds, cuts, bleeding most often received injuries to the arm or hand (44%), the head area (26%), and the leg or foot (16%).

Firefighters who suffered dislocations, fractures experienced them most frequently to the leg or foot (34%), the arm or hand (33%), and the neck or shoulders (18%).

Strains and sprains occurred most frequently to the leg or foot (35%), the trunk area (25%), and the neck or shoulder (19%).

Table 3
Fireground Injuries by Primary Apparent Symptom and by
Part of Body, 2005-2009 Annual Average

Part of Body	Wound, cut													
	Smoke		bleeding,		Fractures,		Strains, sprains,		muscular pain		Other			
Total	Burns	Inhalation	bruise, etc.	Dislocations										
Head	5,185	13%	1,670	36%	65	3%	1,840	26%	25	3%	410	3%	1,180	14%
Neck or shoulders	4,770	12%	845	18%	50	2%	305	4%	170	18%	2,810	19%	595	7%
Trunk area	5,585	14%	130	3%	185	9%	325	5%	75	8%	3,825	25%	1,050	12%
Arm or hand	7,695	20%	1,340	29%	0	0%	3,045	44%	310	33%	2,005	13%	985	11%
Leg or foot	7,935	21%	405	9%	10	0%	1,115	16%	315	34%	5,225	35%	865	10%
Internal	3,375	9%	15	0%	1,745	81%	10	0%	0	0%	20	0%	1,560	18%
Multiple parts	3,340	8%	210	4%	70	3%	230	3%	30	3%	665	4%	1,760	20%
Other	975	3%	70	1%	40	2%	100	1%	15	2%	120	1%	630	7%
Total	38,660		4,685		2,165		6,970		940		15,080		8,625	

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Type of Activity at Time of Injury

For the 2005-2009 period for minor injuries, an estimated annual average of 14,090 injuries, or 50% of all minor injuries, occurred at structure fires during activities related to extinguishing a fire (Table 4). Of these, 10,775 occurred while handling charged hose lines, and 2,805 while using hand tools. Suppression support activities, which include overhaul operations, ventilation, salvage operations, and forcible entry, accounted for an annual average of 7,330 injuries, or 26%. Other incident scene activities, which include laying hose and moving tools or equipment, accounted for 2,495 injuries, or 9%.

Also for the 2005-2009 period for moderate or severe firefighter fireground injuries, an estimated annual average of 5,440 injuries, or 51% of all moderate or severe injuries, occurred at structure fires during activities related to extinguishing a fire (Table 4). Of these, 4,355 occurred while handling charged hose lines. An annual average of 2,680 injuries, or 25 %, occurred during suppression support activities, an average of 965 occurred during other incident scene activities, and an average of 385 occurred during rescue activities.

Table 4
Fireground Injuries by Activity at Time of Injury
for Total Injuries and by Severity, 2005-2009 Annual Average

Activity	Total injuries		Minor		Moderate and Severe	
Extinguish Fire or Neutralize Incident	19,530	51%	14,090	50%	5,440	51%
Handling charged hose line	15,130	39%	10,775	39%	4,355	41%
Using hand tool	3,720	10%	2,805	10%	915	9%
Using hand extinguisher	205	1%	160	1%	45	0%
Operating master stream device	235	1%	175	1%	60	1%
Other	240	1%	175	1%	65	1%
Suppression Support	10,010	26%	7,330	26%	2,680	25%
Overhaul	5,500	14%	4,220	15%	1,280	12%
Ventilation with hand tools	1,700	4%	1,110	4%	590	5%
Salvage	625	2%	490	2%	135	1%
Forcible entry	1,185	3%	830	3%	355	3%
Ventilation with power tools	1,000	3%	680	2%	320	3%
Other Incident Scene Activity	3,460	9%	2,495	9%	965	9%
Picking up tools, hose or equipment	1,170	3%	855	3%	315	3%
Moving tools or equipment	995	3%	740	3%	255	2%
Laying hose	845	2%	585	2%	260	2%
Catching hydrant	315	1%	215	1%	100	1%
Other	135	0%	100	0%	35	0%
Access or Egress	1,245	3%	820	3%	425	4%
Climbing ladder	430	1%	290	1%	140	1%
Raising ground ladder	265	1%	180	1%	85	1%
Carrying ground ladder	200	1%	130	0%	70	1%
Escaping fire or hazard	175	0%	105	0%	70	1%
Other	175	0%	115	0%	60	1%
EMS or Rescue	1,225	3%	840	3%	385	4%
Searching for victim	625	2%	435	1%	225	2%
Rescuing fire victim	435	1%	290	1%	140	1%
Other	160	0%	130	1%	20	0%
Operating Fire Department Apparatus	980	3%	710	2%	300	3%
Engine or pumper	840	2%	605	2%	255	2%
Aerial ladder or elevating platform	120	0%	75	0%	45	0%
Other	2,215	6%	1,670	6%	545	5%
Total	38,660		27,920		10,740	

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums due to rounding.

Source: National estimates based on 2005-09 NFIRS and NFPA survey.

Cause of Injury

Minor firefighter fireground injuries were examined by cause of injury for the 2005-2009 period (Table 5). Overall, an estimated annual average of 6,500, or 23%, were the result of exposure to something, while an annual average of 6,135, or 22%, were injured as the result of overexertion or strain. Other major causes of injury were the result of contact with or being struck, accounting for an annual average of 5,525 injuries, or 20%, and fell, tripped, or slipped, accounting for an annual 5,620 injuries, or 20%.

The 23% of minor injuries that were the result of exposure to something included 3% that occurred due to exposure to fumes, gases, and smoke, 3% due to exposure to asbestos, and 2% due to exposure to heat or flame.

The 22% of minor injuries that were the result of overexertion or strain included 9% that occurred while handling hose line, 4% that occurred during overhaul operations, and 2% that occurred while using hand tools during extinguishment activity.

The 20% of minor injuries that were the result of contact with or being struck by something, for the 2004-2009 period, included 2% that occurred due to being struck by or contact with a floor or ceiling, and another 2% due to contact with tools or equipment.

The 20% of minor injuries that were the result of falling, slipping, or tripping included 3% that occurred on an icy surface, 3% on an uneven surface, and 3% on other slippery or uneven surface.

Moderate and severe firefighter fireground injuries were also examined by cause for the 2005-2009 period (also Table 5). Overall, an estimated annual average of 3,000 injuries, or 28%, were the result of falling, tripping, or slipping, while an annual average of 2,490

Injuries or 23%, occurred due to overexertion or strain. Other major causes of injury were contact with or being, struck by something, accounting for an annual average of 1,870 injuries, or 17%, and exposure to something, accounting for an annual average of 1,540 injuries, or 15%.

The 28% of moderate and severe injuries that were the result of falling, slipping, or tripping included 5% on an uneven surface, 4% on an icy surface, and another 4% on other slippery or uneven surface.

The 23% of moderate and severe injuries that were the result of overexertion or strain included 10% while handling hose lines, 3% during overhaul operations, and 2% while using hand tools during extinguishment operations.

The 17% of moderate and severe injuries that were the result of contact with or being struck by something included 2% including a floor or ceiling, and another 2% including tools or equipment.

The 15% of moderate and severe injuries that were the result of exposure to something included 3% due to heat or flame, 1% due to fumes, gases or smoke, 1% due to steam, and 1% due to embers.

Table 5
Fireground Injuries by Cause of Injury for
Total Injuries and by Severity, 2005-2009 Annual Average

Cause of Injury	Total Injuries		Minor		Moderate and Severe	
Exposure to	8,040	21%	6,500	23%	1,540	15%
Heat or flame	1,080	3%	690	2%	390	3%
Fumes, gases or smoke	940	2%	815	3%	125	1%
Asbestos	770	2%	765	3%	5	0%
Embers	310	1%	245	1%	65	1%
Steam	385	1%	295	1%	90	1%
Dirt, stones or debris	150	1%	125	0%	25	0%
Floor or ceiling	175	0%	130	0%	45	0%
Chemicals	385	1%	365	1%	20	0%
Structural component, other	85	0%	70	0%	15	0%
Electricity	110	0%	70	0%	40	0%
Charged hose	110	0%	80	0%	30	0%
Glass	85	0%	50	0%	35	0%
Other	1,270	3%	1,000	4%	270	3%
Unknown	2,315	6%	1,930	7%	385	4%
Contact with or struck by	7,395	19%	5,525	20%	1,870	17%
Floor or ceiling	785	2%	575	2%	210	2%
Tools or equipment	755	2%	570	2%	185	2%
Nails	370	1%	335	1%	35	0%
Other structural component	575	1%	430	2%	145	2%
Glass	495	1%	365	1%	130	1%
Window	410	1%	275	1%	135	1%
Charged hose	390	1%	265	1%	125	1%
Property or structure contents	275	1%	205	1%	70	1%
Door in building	260	1%	195	1%	65	1%
Coupling	265	1%	195	1%	70	1%
Dirt, stones, or debris	240	1%	195	1%	45	0%
Hot metal	85	0%	75	0%	10	0%
Embers	130	0%	100	1%	30	0%
Wall	190	0%	135	0%	55	1%
Roof	195	1%	130	0%	65	1%
Department vehicle or apparatus	160	0%	130	0%	30	0%
Ground ladder	140	0%	95	0%	45	0%
Uncharged hose	130	0%	90	0%	40	0%
Vehicle, not department	70	0%	50	0%	20	0%
Other	1,220	3%	860	3%	360	3%
Unknown	255	1%	255	1%	0	0%
Overexertion	8,625	22%	6,135	22%	2,490	23%
While handling hose line	3,570	9%	2,485	9%	1,085	10%
During overhaul operation	1,375	4%	1,005	4%	370	3%
While using hand tools in Extinguishment activity	885	2%	630	2%	255	2%

Table 5
Fireground Injuries by Cause of Injury for
Total Injuries and by Severity, 2005-2009 Annual Average, (Continued)

Cause of Injury	Total Injuries		Minor		Moderate and Severe	
Overexertion (Continued)						
During ventilation operation with hand tools	355	1%	230	1%	125	1%
During ventilation operation with power tools	370	1%	230	1%	125	1%
During salvage operation	125	0%	95	0%	30	0%
Picking up tools, equipment or hose on scene	350	1%	235	1%	115	1%
During forcible entry activity	305	1%	180	1%	125	1%
Laying hose	215	1%	160	1%	55	1%
Moving tools or equipment	190	0%	150	1%	40	0%
Duriung rescue activity	105	0%	65	0%	40	1%
While operating engine or Pumper	170	0%	95	0%	75	1%
Other	610	2%	560	2%	50	0%
Fell, tripped or slipped	8,210	22%	5,620	20%	3,000	28%
Icy surface	1,410	3%	905	3%	400	4%
Uneven surface	1,250	3%	750	3%	525	5%
Other slippery or uneven surface	1,110	3%	870	3%	390	4%
Wet surface	595	2%	410	1%	200	2%
Loose material on surface	480	1%	340	1%	170	2%
Fire Progress, including smoke Condition	420	1%	300	1%	170	1%
Floor collapse	355	1%	215	1%	145	1%
Hole burned through floor	315	1%	200	1%	125	1%
Other holes	355	1%	255	1%	145	1%
Unguarded hole	125	0%	95	0%	40	0%
Stair collapse	70	0%	55	0%	40	0%
Other	1,190	3%	860	2%	455	4%
Unknown	535	1%	365	1%	195	2%
Other	6,390	15%	4,540	15%	1,840	17%
Total	38,660		27,920		10,740	

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums due to rounding.

Source: National estimates based on 2005-09 NFIRS and NFPA survey.

Severity of Injury for Injury Factors

The results for injury factors for fireground injuries presented earlier in Tables 2 to 5 summarized results separately for minor and moderate or severe injuries, that is, within each category what were the leading injury factors (e.g., strains and sprains accounted for 25% of minor injuries). Another way to look at the data is given a certain primary apparent symptom category, e.g., sprains and strains is the injury more likely to have been a minor injury or a moderate or severe injury? In other words, what is the relative risk of the severity of injury for a given primary apparent symptom, a given age group, a certain region of the country, etc. This section examines fireground injuries further to answer some of those questions.

For the 2005-2009 period, severity of injury for selected primary apparent symptom categories was examined (Table 6). This section for minor injuries includes first aid only (report only was excluded), and injuries treated by a physician and not a lost-time injury. For smoke inhalation, breathing difficulty, burns only, cut or laceration, puncture or wound, abrasion, eye trauma, exhaustion and fatigue, most of the injuries (70% to 83%) were minor injuries. On the other hand, for burns and smoke inhalation, dislocation, fracture, strain or sprain, cardiac like symptoms, most of the injuries (55% to 78%) were moderate or severe. The low percent of cardiac symptoms injuries that were moderate or severe injuries (60%) reflects that many of those injuries probably involved chest pains, but did not involve heart ailments.

For the 2005-2009 period, severity of injury for overall activity categories at time of injury was examined (Table 7). Activities involving extinguishing fire or neutralizing agent (60%), and suppression support (61%), resulted in a higher percent of injuries that were minor. On the other hand, activities involving operating apparatus, EMS or rescue, or access or egress activities resulted in 42% to 48% that were moderate or severe injuries. Access or egress activities that account for the high occurrence of moderate or severe injuries include activities like carrying or raising a ground ladder, climbing a ladder, and escaping fire/hazard.

Table 6.
Severity of Injury for Selected Primary Apparent
Symptom Categories, 2005-2009

Primary Apparent Symptom	Minor	Moderate and Severe	Total
Smoke Inhalation	71%	29%	100%
Breathing difficulty	70%	30%	100%
Burns and smoke inhalation	55%	45%	100%
Burns only, thermal	72%	28%	100%
Cut or laceration	75%	25%	100%
Puncture, wound	83%	17%	100%
Contusion	63%	37%	100%
Abrasion	84%	16%	100%
Dislocation	27%	73%	100%
Fracture	22%	78%	100%
Strain or sprain	43%	57%	100%
Swelling	55%	45%	100%
Crushing	50%	50%	100%
Cardiac symptoms	40%	60%	100%
Eye trauma	79%	21%	100%
Dizziness, fainting, or weakness	62%	38%	100%
Exhaustion or fatigue	75%	25%	100%
Pain only	51%	49%	100%
Other	65%	35%	100%
Total	59%	41%	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Totals may not equal sums because of rounding.

Note in this analysis minor injuries includes first aid only, and injuries treated by a physician and not a lost-time injury.

Source: NFIRS and NFPA survey.

For the 2005-2009 period, severity of injury for overall causes of injury was examined (Table 8). For categories exposure to hazard and contact with or struck by object 67% to 69% of the injuries were minor. For overexertion or strain a higher percent of injuries were moderate or severe (44%), and an even higher percent of injuries caused by fell, slipped, tripped (56%) were moderate or severe. In the latter case, firefighters are particularly vulnerable and falls and slips can lead to fractures, dislocations, and severe strains.

For the 2005-2009 period, severity of injury for age of injured was examined (Table 9). Results clearly indicate and not surprisingly that younger firefighters 20 to 29 had a higher percentage of injuries (68%), that were minor while older firefighters age groups 30 to 39, 40 to 49, 50 to 59, and 60 and over, tended to have a higher percentage that were moderate or severe injuries (42% to 46%).

For the 2005-2009 percent, region of the country by severity of injury was examined (Table 10). The South (63%) and Midwest (61%) had higher occurrences of firefighter injuries that were minor. The Northeast (46%) and the West (42%) had higher occurrences of moderate or severe injuries. The high occurrence of firefighter injuries in the Northeast has been well documented in the Annual NFPA Firefighter Injury Report, www.nfpa.org/firefighterinjuries.

Table 7.
Severity of Injury for Overall Activity Categories
at Time of Injury, 2005-2009

Type of Activity	Minor	Moderate and Severe	Total
Operating apparatus	58%	42%	100%
Extinguishing fire	60%	40%	100%
or neutralizing agent			100%
Suppression support	61%	39%	100%
Access or egress activity	52%	48%	100%
EMS or rescue activity	55%	45%	100%
Other incident activity	57%	43%	100%

Table 8.
Severity of Injury for Overall Causes of Injury, 2005-2009

Cause of Injury	Minor	Moderate and Severe	Total
Fell, slipped or trapped	44%	56%	100%
Exposure to hazard	69%	31%	100%
Contact with or struck by	67%	33%	100%
Overexertion or strain	56%	44%	100%

Table 9.
Severity of Injury for Age of Injured, 2005-2009

Age of Injured	Minor	Moderate and Severe	Total
20-29	68%	32%	100%
30-39	58%	42%	100%
40-49	55%	45%	100%
50-59	54%	46%	100%
60 and over	55%	45%	100%

Table 10.
Severity of Injury by Region of the Country, 2005-2009

Region	Minor	Moderate and Severe	Total
Northeast	54%	46%	100%
Midwest	61%	39%	100%
South	63%	37%	100%
West	58%	42%	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Totals may not equal sums because of rounding.

Note in this analysis minor injuries includes first aid only (report only was excluded), and injuries treated by a physician and not a lost-time injury.

Source: NFIRS and NFPA survey.

Patterns of Structure Fires by Occupancy and Structure Status

In 2005-2009 fires in residential structures accounted for about eight out of ten firefighter fireground injuries in structures (Table 11). This was in large part due to the large portion, 400,500 or 78%, of all structure fires that are residential fires. When differences in fire occurrence by occupancy are taken into account, results are quite different. The highest firefighter fireground injury rates per 100 fires by occupancy occurred in industry, utility, and manufacturing properties (10.7); store and office properties (8.6); and public assembly properties (7.4).

The rate for residential structures (6.9) was low in comparison to those occupancies, but higher than for storage properties, educational properties, and institutional properties. Within residential properties, the rate per 100 fires was 7.2 for one-and two family homes, and 6.3 for apartments.

In 2005-2009, most fire ground injuries, 27,170 injuries or 81% , occurred in structures that were occupied and operating (Table 12). Another 2,435 injuries or 7% occurred in vacant and secured structures, while 2,430 or 7% occurred in vacant and unsecured structures.

Table 11
Structure Fires, Fireground Injuries and Injury Rates
By Occupancy, 2005-2009 Annual Average

Occupancy	Structure fires		Fireground Injuries		Fireground Injuries per 100 fires
Public assembly	14,000	3%	1,045	3%	7.4
Educational	6,100	1%	325	1%	5.3
Institutional	6,800	1%	110	0%	1.6
Residential	400,500	78%	27,630	81%	6.9
One-and two-family homes	291,100	57%	21,080	62%	7.2
Apartments	93,900	18%	5,960	18%	6.3
Stores and offices	20,300	4%	1,750	5%	8.6
Industrial, utility or manufacturing	10,800	2%	1,160	3%	10.7
Storage	30,000	6%	1,690	5%	5.6
Special	23,700	5%	230	1%	1.0
Total Structures	512,200		33,950		6.6

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Table 12
Fireground Injuries by Structure Status
Annual Average 2005-2009

Structure Status	Fireground Injuries	
Under construction	365	1%
Occupied and operating	27,170	81%
Idle, not routinely used	560	2%
Under major renovation	500	1%
Vacant and secured	2,435	7%
Vacant and unsecured	2,430	7%
Being demolished	115	0%
Other	375	1%
Total	33,950	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Patterns for Age of Injured, and by Time of Day

For the 2005-2009 period, younger firefighters accounted for the major portion of all firefighter fireground injuries, a result that is somewhat higher than the distribution of firefighters in the U.S. (Figure 1). In all, 51% of firefighters in the U.S. are in the under 40 age group, and they accounted for 58% of firefighter fireground injuries.

The peak periods for structure fires attended by fire departments were noon to 6:00 p.m. (33.5%) and 6:00 p.m. to midnight (31.2%). The smallest share of fires occurred in the early morning hours of midnight to 6:00 a.m. (14.9%) (Figure 2). Firefighter fireground injuries, as one might expect, occurred very often during the peak fire frequency period of noon to 6:00 p.m. (27.4%), but the real surprise was the high occurrence of fireground injuries in the midnight to 6:00 a.m. slot (25.2%), compared to the 14.9% of fires occurring in this time period.

This point is made even clearer when firefighter fireground injuries per 100 structure fires are examined (Figure 3). The highest injury rates per 100 fires occurred in the midnight to 8:00 a.m. time frame, when 8.8 to 12.6 injuries occurred per 100 structure fires attended. Among the factors that may contribute to the high injury rates during the night time hours are lack of visibility, cold temperatures, and lower alertness of firefighters.

Figure 1
Firefighters and Firefighter Injuries
in the U.S. by Age Group, 2005-2009

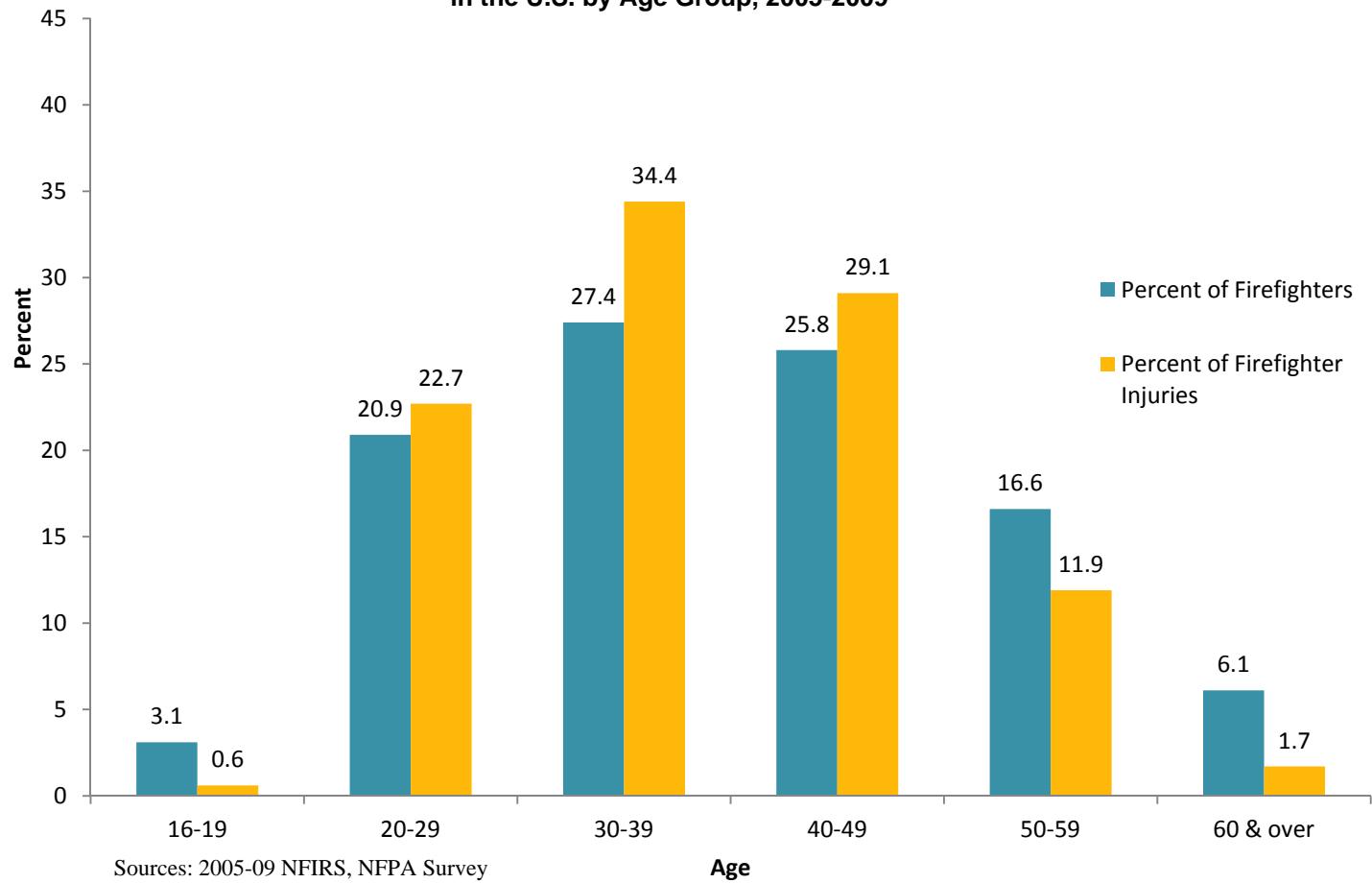
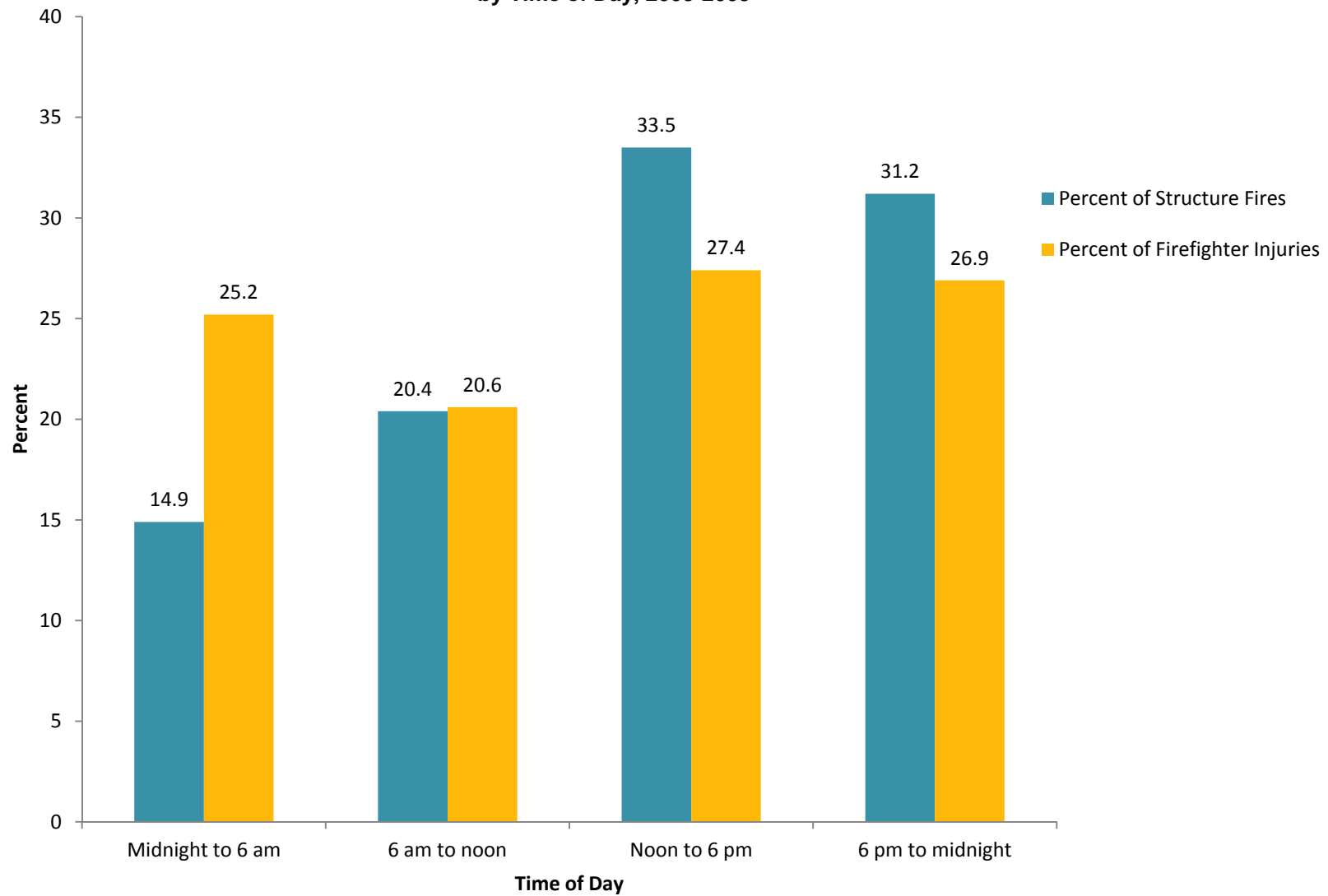
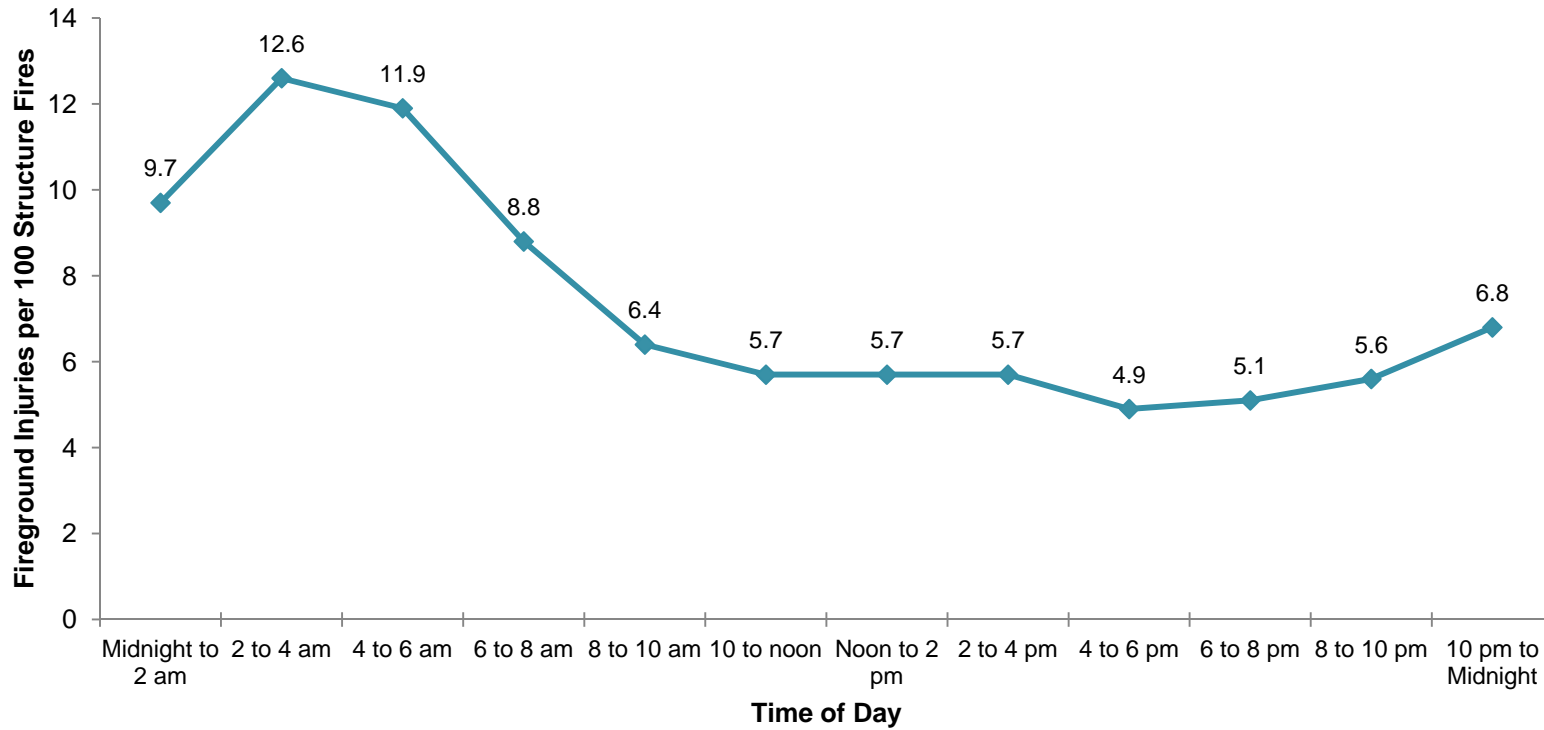


Figure 2
Fires and Firefighter Injuries in Structures
by Time of Day, 2005-2009



Sources: 2005-09 NFIRS, NFPA Survey

Figure 3
Firefighter Fireground Injuries per 100 Structure Fire
by Time of Day, 2005-2009



Source: 2005-09 NFIRS, NFPA Survey

Improving Firefighter Safety

As the statistics in this report and previous reports attest, fire fighting presents great risks of personal injury to firefighters. Moreover, because of the kind of work performed and the hazards of the incident scene environment, it is unlikely that all firefighter injuries can be eliminated. A risk management system and the application of existing technology, however, can offer options to reduce present injury levels and bring about corresponding reductions that are recommended by NFPA that could be taken at the local level.

- Commitment on the part of top fire service management to reducing injuries [NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, Section 4.3\)](#)
- Establishment of a safety committee headed by a safety officer to recommend a safety policy and the means of implementing it [NFPA 1500, Section 4.5\)](#).
- Develop and implement an investigation procedure that includes all accidents, near misses, injuries, fatalities, occupational illnesses, and exposures involving members. [NFPA 1500, 4.4.4 and 4.4.5\)](#)
- Provision of appropriate protective equipment and a mandate to use it. [NFPA 1500, Section 7.1 through 7.8\)](#)
- Development and enforcement of a program on the use and maintenance of SCBA [NFPA 1500, Section 7.9 through 7.14](#)
- Development and enforcement of policies on safe practices for drivers and passengers of fire apparatus [NFPA 1500, Section 6.2 and 6.3\)](#)
- Development of procedures to ensure response of sufficient personnel for both fire fighting and overhaul duties. [NFPA 1500, 4.1.2; NFPA 1710 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments; and NFPA 1720, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Department\)](#)
- Implementation of regular medical examinations and a physical fitness program [NFPA 1500, Section 10.1 through 10.3; NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments; NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters-\)](#)
- Adoption and implementation of an incident management system. [NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, Section 8.1; and NFPA 1561, Standard on Emergency Services Incident Management System](#)
- Training and education for all members related to emergency operations [NFPA 1500,, Chapter 5\)](#)

- Implementation of programs for the installation of private fire protection systems, so that fires are discovered at an earlier stage, exposing the firefighter to a less hostile environment [*NFPA 1 Uniform Fire Code NFPA 101 Life Safety Code*](#),[®]; [*NFPA 5000 Building Construction and Safety Code*](#)
 - Increased efforts in the area of fire safety education programs, so that citizens are made aware of measures to prevent fires and of correct reactions to the fire situation
[*NFPA 1201, Standard for Providing Emergency Services to the Public*](#), Chapter 6
- Other NFPA standards that may help in reducing firefighter injuries include:
- [*NFPA 1584, Standard on the Rehabilitation Process for members During Emergency Operations and Training Exercises*](#), 2008 Edition, Chapter 4 Preparedness and Chapter 6 Incident Scene and Training Rehabilitation
 - [*NFPA 1002, Standard for Fire Apparatus Driver/Operator Professional Qualification Risk Management*](#), 2010 Edition, Section 4.8 The Risk Management process
 - [*NFPA 1620, Standard for Pre-Incident Planning*](#), 2010 Edition, Chapter 4 Pre-Incident Planning Process, Chapter 5 Physical & Site Considerations, Chapter 7 Water supplies & Fire Protection Systems, Chapter 8 Special Hazards

Efforts need to be made to recognize that firefighter injuries can be reduced. By addressing the priorities listed above Fire Service organizations can make significant strides towards reducing the number and impact of such injuries.

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.

In this analysis, only data originally collected in NFIRS 5.0 is included in the calculations of the 2005-2009 national estimates for firefighter injuries in structure fires. The portion of fires and firefighter injuries originally collected in NFIRS 5.0 compared to the earlier NFIRS 4.1 version has increased steadily over time. The percent of fires coded in version 5.0 has increased from 94% in 2005, 94% in 2006, 97% in 2007, 99% in 2007 and 100% in 2009.

This update for 2005-09 includes injuries that occurred at all fires (incident type 110-171), at the fireground (where injury occurred codes 5 and 6), and severity of injury (1 to 5). The analysis in this report is based on 24,522 injuries that met these criteria. Except for Tables 11, and 12, and Figures 2 to 3, which are for structure fires only, all tables are based on fireground injuries that occurred at all fires. The national annual estimates of firefighter injuries were weighted for the individual years using total fireground injuries from the annual NFPA Fire Experience Survey.

In this report, where data for a factor was unknown, it was assumed to have the same proportional distribution as the distribution where the data was known. The "Other" category includes cases specifically coded as "other" and cases coded in specific categories but with very low frequency.

Note that the number of occurrences for fires has been rounded to the nearest hundred, the number of firefighter fireground injuries has been rounded to the nearest five, while percentages are rounded to the nearest whole percent. Totals in tables may not equal sums due to rounding.