

PATTERNS OF FIREFIGHTER FIREGROUND INJURIES

Michael J. Karter, Jr.

December 2013



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

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Abstract

For the 2007-2011 period, there was an estimated annual average of 34,065 firefighter fireground injuries at all type of fires (structures, vehicles, outside and other) in the U.S. Of these, an average of 23,885 were minor, and 10,180 were moderate or severe.

The leading types of minor injuries were: strain or sprain accounting for an annual average of 6,200 injuries or (26%); pain only, accounting for 3,095 injuries (13%); thermal burns only, accounting for 2,625 injuries (11%); cut or laceration, accounting for 1,985 injuries (8%).

The leading types of moderate and severe injuries were: strains or sprain accounting for an annual average of 3,420 injuries a year, or 34%; thermal burn, accounting for 1,115 injuries (11%); pain only, accounting for 945 injuries (9%).

Activities related to extinguishing a fire accounted for half of the minor injuries (12,410 or 52%), and for half of the moderate and severe injuries (5,255 or 52%).

The leading causes of minor injuries were exposure to something (5,640, or 24%), while for moderate and severe injuries the leading cause of injuries were fell, slipped, or tripped (3,375 or 33%).

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

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.

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NFPA No. USS02

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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 2007-2011 period. This is the NFPA's fourth 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 2007-2011 period, there was an estimated annual average of 34,065 firefighter fireground injuries at all types of fires (structures, vehicles and outside and other) in the U.S. Of these, an average of 23,885 were minor, and 10,180 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 2007-2011 period for minor injuries at structure fires, there were an estimated annual average of 6,200 strain or sprain a year, or 26% of all minor injuries ([Table 2](#)). Other leading types of minor injuries were: pain only, accounting for 3,095 injuries (13%); thermal burns only, accounting for 2,625 injuries (11%); cut or laceration, accounting for 1,985 injuries (8%); exhaustion or fatigue, accounting for 1,355 injuries (6%); contusion, accounting for 1,355 injuries (6%); smoke inhalation, accounting for 1,200 injuries (5%).

Table 1
Firefighter Fireground Injuries
Total and by Severity, 2007-2011

Year	Total Injuries	Minor	Moderate and Severe
2007	38,340	27,590	10,745
2008	36,595	25,825	10,770
2009	32,505	22,610	9,595
2010	32,675	22,400	10,275
2011	30,505	20,990	9,515
2007-11 Average	34,065	23,885	10,180

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.

Source: National estimate based on 2007-11 NFIRS and NFPA Survey.

Table 2
Fireground Injuries by Primary Apparent Symptom for Total Injuries and by Severity, 2007-2011 Annual Average

Primary Apparent Symptom	Total Injuries	Minor	Moderate and Severe	
Sprain or strain	9,620	28%	6,200	26%
Pain only	4,040	12%	3,095	13%
Thermal burns only	3,740	11%	2,625	11%
Cut or laceration	2,630	8%	1,985	8%
Contusion	1,765	5%	1,355	6%
Exhaustion or fatigue including				
heat exhaustion	1,865	5%	1,355	6%
Smoke inhalation	1,485	4%	1,200	5%
Puncture wound	675	2%	565	2%
Breathing difficulty or				
shortness of breath	610	2%	420	2%
Inhalation of hazardous fumes	420	1%	395	2%
Eye trauma	520	2%	420	2%
Swelling	820	2%	565	2%
Burn or scald	410	1%	320	1%
Abrasion	465	1%	405	2%
Dizziness, fainting, or weakness	630	2%	420	2%
Dehydration	450	1%	320	1%
Cardiac symptoms	550	2%	200	1%
Fracture	580	2%	105	0%
Electric shock	190	1%	155	1%
Nausea	195	1%	150	1%
Crushing	225	1%	140	1%
Foreign body obstruction	105	0%	95	0%
Burns and smoke inhalation	120	0%	75	0%
Dislocation	275	1%	100	0%
Numbness	125	0%	70	0%
Other	1,550	5%	1,150	5%
Total	34,065	100%	23,885	100%
			10,180	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 2007-11 NFIRS and NFPA survey.

For the 2007-2011 period for moderate and severe injuries at structure fires there was an annual average of 3,420 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 1,115 injuries (11%); pain only, accounting for 945 injuries (9%); cut or laceration accounting for 645 injuries (6%); fracture, accounting for 475 injuries (5%); exhaustion or fatigue, accounting for 510 injuries (5%); contusion, accounting for 410 injuries (4%); smoke inhalation, accounting for 285 injuries (3%); cardiac symptoms, accounting for 350 injuries (3%); swelling, accounting for 255 injuries (3%); dizziness, fainting, or weakness accounting for 210 injuries, or 2%; and breathing difficulty, accounting for 190 injuries (2%).

Primary Apparent Symptom by Part of Body Injured

For the 2007 -2011 period, the most common injuries received by firefighters at the fireground involved the leg or foot, 7,245 injuries or 21%, and arm or hand, 6,935 injuries or 20%. These were followed by the trunk area, 4,935 or 14%, the head area 4,560 or 13%, and the neck or shoulder area, 4,335 or 13%. ([Table 3](#)).

Firefighters who suffered burn injuries received them most frequently to the head area (38%), the arm or hand (30%), the neck or shoulder area (16%), and the leg or foot (8%).

For firefighters who suffered from smoke inhalation, not surprisingly, 1,670 or 71% of the injuries were of an internal nature.

Firefighters who suffered from wounds, cuts, bleeding most often received injuries to the arm or hand (49%), the head area (20%), and the leg or foot (17%).

Firefighters who suffered dislocations, fractures experienced them most frequently to the leg or foot (34%), the arm or hand (34%), and the neck or shoulders (19%).

Strains and sprains occurred most frequently to the leg or foot (36%), the trunk area (24%), and the neck or shoulder (19%).

Table 3
Fireground Injuries by Primary Apparent Symptom and by
Part of Body, 2007-2011 Annual Average

Part of Body	Total	Burns	Smoke Inhalation		Wound, cut bleeding, bruise, etc.		Fractures, Dislocations		Strains, sprains, muscular pain		Other	
Head	4,560	13%	1,520	38%	90	4%	1,060	20%	25	3%	330	2%
Neck or shoulders	4,335	13%	655	16%	100	4%	260	5%	155	19%	2,620	19%
Trunk area	4,935	14%	90	2%	310	13%	295	5%	65	8%	3,280	24%
Arm or hand	6,935	20%	1,175	30%	5	0%	2,660	49%	275	34%	1,875	14%
Leg or foot	7,245	21%	330	8%	5	0%	915	17%	280	34%	4,855	36%
Internal	2,700	8%	150	4%	1,670	71%	15	0%	0	0%	15	0%
Multiple parts	2,695	8%	0	0%	115	5%	155	3%	15	2%	485	4%
Other	660	2%	50	1%	65	3%	65	1%	5	1%	85	1%
Total	34,065		3,970		2,350		5,430		820		13,550	8,010

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 2007-2011 period for minor injuries, an estimated annual average of 12,410 injuries, or 52% of all minor injuries, occurred at structure fires during activities related to extinguishing a fire ([Table 4](#)). Of these, 9,665 occurred while handling charged hose lines, and 2,305 while using hand tools. Suppression support activities, which include overhaul operations, ventilation, salvage operations, and forcible entry, accounted for an annual average of 6,240 injuries, or 26%. Other incident scene activities, which include laying hose and moving tools or equipment, accounted for 2,245 injuries, or 9%.

Also for the 2007-2011 period for moderate or severe firefighter fireground injuries, an estimated annual average of 5,255 injuries, or 52% of all moderate or severe injuries, occurred at structure fires during activities related to extinguishing a fire ([Table 4](#)). Of these, 4,130 occurred while handling charged hose lines. An annual average of 2,520 injuries, or 25 %, occurred during suppression support activities, an average of 910 occurred during other incident scene activities, and an average of 370 occurred during rescue activities.

Table 4
Fireground Injuries by Activity at Time of Injury
for Total Injuries and by Severity, 2007-2011 Annual Average

Activity	Total injuries	Minor	Moderate and Severe	
Extinguish Fire or Neutralize Incident	17,665	52%	12,410	52%
Handling charged hose line	13,795	40%	9,665	40%
Using hand tool	3,265	10%	2,305	10%
Using hand extinguisher	190	1%	150	1%
Operating master stream device	190	1%	130	1%
Other	225	1%	160	1%
Suppression Support	8,760	26%	6,240	26%
Overhaul	4,865	14%	3,645	15%
Ventilation with hand tools	1,375	4%	815	3%
Salvage	560	2%	420	2%
Forcible entry	1,095	3%	755	3%
Ventilation with power tools	865	3%	605	3%
Other Incident Scene Activity	3,155	9%	2,245	9%
Picking up tools, hose or equipment	1,025	3%	750	3%
Moving tools or equipment	890	3%	655	3%
Laying hose	850	2%	580	2%
Catching hydrant	270	1%	170	1%
Other	120	0%	90	0%
Access or Egress	1,290	4%	890	4%
Climbing ladder	395	1%	270	1%
Raising ground ladder	305	1%	200	1%
Carrying ground ladder	230	1%	160	1%
Escaping fire or hazard	160	0%	115	0%
Other	200	1%	145	1%
EMS or Rescue	1,120	3%	750	3%
Searching for victim	560	2%	350	1%
Rescuing fire victim	460	1%	320	1%
Other	100	0%	80	0%
Operating Fire Department Apparatus	960	3%	660	3%
Engine or pumper	1,140	3%	570	2%
Aerial ladder or elevating platform	130	0%	90	0%
Other	1,115	3%	690	3%
Total	34,065		23,885	
				10,180

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 2007-11 NFIRS and NFPA survey.

Cause of Injury

Minor firefighter fireground injuries were examined by cause of injury for the 2007-2011 period ([Table 5](#)). Overall, an estimated annual average of 5,640, or 24%, were the result of exposure to something, while an annual average of 5,895, or 25%, 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 5,140 injuries, or 22%, and fell, tripped, or slipped, accounting for an annual 5,200 injuries, or 22%.

The 24% 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 heat or flame and 3% due to exposure to asbestos.

The 22% of minor injuries that were the result of overexertion or strain included 10% that occurred while handling hose line, 4% that occurred during overhaul operations, and 2% that occurred while using hand tools during extinguishment activity.

The 22% of minor injuries that were the result of contact with or being struck by something, for the 2007-2011 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 22% of minor injuries that were the result of falling, slipping, or tripping included 5% 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 2007-2011 period (also [Table 5](#)). Overall, an estimated annual average of 3,375 injuries, or 33%, were the result of falling, tripping, or slipping, while an annual average of 2,845

Injuries or 28%, 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 1,855 injuries, or 18%, and exposure to something, accounting for an annual average of 1,595 injuries, or 16%.

The 33% of moderate and severe injuries that were the result of falling, slipping, or tripping included 6% on an uneven surface, 5% on an icy surface, and another 5% on other slippery or uneven surface.

The 28% of moderate and severe injuries that were the result of overexertion or strain included 12% while handling hose lines, 3% during overhaul operations, and 3% while using hand tools during extinguishment operations.

The 18% of moderate and severe injuries that were the result of contact with or being struck by something 2% including a floor or ceiling, and another 2% including tools or equipment.

The 16% 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, 2007-2011 Annual Average

Cause of Injury	Total Injuries	Minor	Moderate	Severe
Exposure to	7,235	21%	5,640	24%
Heat or flame	990	3%	635	3%
Fumes, gases or smoke	895	3%	760	3%
Asbestos	730	2%	730	3%
Embers	270	1%	195	1%
Steam	370	1%	260	1%
Dirt, stones or debris	140	0%	110	0%
Floor or ceiling	180	1%	130	1%
Chemicals	275	1%	260	1%
Structural component, other	75	0%	55	0%
Electricity	125	0%	80	0%
Charged hose	105	0%	60	0%
Glass	65	0%	40	0%
Other	795	2%	610	3%
Unknown	2,220	7%	1,715	7%
Contact with or struck by	6,995	21%	5,140	22%
Floor or ceiling	795	2%	565	2%
Tools or equipment	740	2%	555	2%
Nails	325	1%	290	1%
Other structural component	510	1%	375	2%
Glass	480	1%	340	1%
Window	340	1%	220	1%
Charged hose	385	1%	255	1%
Property or structure contents	260	1%	185	1%
Door in building	260	1%	185	1%
Coupling	220	1%	160	1%
Dirt, stones, or debris	220	1%	165	1%
Hot metal	75	0%	65	0%
Embers	110	0%	75	0%
Wall	205	1%	150	1%
Roof	155	0%	100	0%
Department vehicle or apparatus	170	0%	140	1%
Ground ladder	140	0%	100	0%
Uncharged hose	145	0%	95	0%
Vehicle, not department	65	0%	40	0%
Other	1,295	4%	980	4%
Unknown	100	0%	100	0%
Overexertion	8,740	26%	5,895	25%
While handling hose line	3,565	10%	2,375	10%
During overhaul operation	1,315	4%	960	4%
While using hand tools in Extinguishment activity	870	3%	540	2%
			330	3%

Table 5
Fireground Injuries by Cause of Injury for
Total Injuries and by Severity, 2007-2011 Annual Average, (Continued)

Cause of Injury	Total Injuries	Minor	Moderate and Severe		
Overexertion (Continued)					
During ventilation operation with hand tools	305	1%	170	1%	135
During ventilation operation with power tools	330	1%	220	1%	110
During salvage operation	140	0%	95	0%	45
Picking up tools, equipment or hose on scene	335	1%	220	1%	115
During forcible entry activity	255	1%	170	1%	85
Laying hose	215	1%	165	1%	50
Moving tools or equipment	200	1%	155	1%	45
During rescue activity	200	1%	125	1%	75
While operating engine or Pumper	130	0%	80	0%	50
Other	880	3%	620	3%	260
Fell, tripped or slipped	8,575	25%	5,200	22%	3,375
Icy surface	1,695	5%	1,145	5%	550
Uneven surface	1,365	4%	720	3%	645
Other slippery or uneven surface	1,120	3%	660	3%	460
Wet surface	635	2%	390	2%	245
Loose material on surface	470	1%	310	1%	160
Fire Progress, including smoke Condition	440	1%	220	1%	220
Floor collapse	370	1%	210	1%	160
Hole burned through floor	345	1%	185	1%	160
Other holes	355	1%	205	1%	150
Unguarded hole	125	0%	80	0%	45
Stair collapse	90	0%	40	0%	50
Other	945	3%	645	3%	300
Unknown	620	2%	390	2%	230
Other	2,520	7%	2,010	8%	510
Total	34,065		23,885		10,180

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 2009-33 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 2007-2011 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 (62% to 82%) were minor injuries. On the other hand, for dislocation, fracture, strain or sprain, cardiac like symptoms, most of the injuries (59% to 83%) were moderate or severe. The low percent of cardiac symptoms injuries that were moderate or severe injuries (66%) reflects that many of those injuries probably involved chest pains, but did not involve heart ailments.

For the 2007-2011 period, severity of injury for overall activity categories at time of injury was examined ([Table 7](#)). Access or egress activities accounted for a higher occurrence of moderate or severe injuries (52%) than other types of activity. Access or egress activities include carrying or raising a ground ladder, climbing a ladder, and escaping fire/hazard.

Table 6.
Severity of Injury for Selected Primary Apparent Symptom Categories, 2007-2011

Primary Apparent Symptom	Minor	Moderate and Severe	Total
Smoke Inhalation	70%	30%	100%
Breathing difficulty	65%	35%	100%
Burns and smoke inhalation	53%	47%	100%
Burns only, thermal	62%	38%	100%
Cut or laceration	73%	27%	100%
Puncture, wound	84%	16%	100%
Contusion	63%	37%	100%
Abrasions	82%	18%	100%
Dislocation	25%	75%	100%
Fracture	17%	83%	100%
Strain or sprain	41%	59%	100%
Swelling	50%	50%	100%
Cardiac symptoms	34%	66%	100%
Eye trauma	78%	22%	100%
Dizziness, fainting, or weakness	64%	36%	100%
Exhaustion or fatigue	72%	28%	100%
Pain only	49%	51%	100%
Other	66%	34%	100%
Total	57%	43%	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 2007-2011 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 65% of the injuries were minor. For overexertion or strain a higher percent of injuries were moderate or severe (47%), and an even higher percent of injuries caused by fell, slipped, tripped (58%) 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 2007-2011 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 (43% to 49%).

For the 2007-2011 percent, region of the country by severity of injury was examined ([Table 10](#)). The South (60%) and Midwest (58%) had higher occurrences of firefighter injuries that were minor. The Northeast (48%) and the West (44%) 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, 2007-2011

Type of Activity	Minor	Moderate and Severe	Total
Operating apparatus	55%	45%	100%
Extinguishing fire or neutralizing agent	57%	43%	100%
Suppression support	58%	42%	100%
Access or egress activity	48%	52%	100%
EMS or rescue activity	56%	44%	100%
Other incident activity	55%	45%	100%

Table 8.
Severity of Injury for Overall Causes of Injury, 2007-2011

Cause of Injury	Minor	Moderate and Severe	Total
Fell, slipped or trapped	42%	58%	100%
Exposure to hazard	65%	35%	100%
Contact with or struck by	65%	35%	100%
Overexertion or strain	53%	47%	100%

Table 9.
Severity of Injury for Age of Injured, 2007-2011

Age of Injured	Minor	Moderate and Severe	Total
20-29	68%	32%	100%
30-39	57%	43%	100%
40-49	52%	48%	100%
50-59	51%	49%	100%
60 and over	56%	44%	100%

Table 10.
Severity of Injury by Region of the Country, 2007-2011

Region	Minor	Moderate and Severe	Total
Northeast	52%	48%	100%
Midwest	58%	42%	100%
South	60%	40%	100%
West	56%	44%	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 2007-2011 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, 392,800 or 79%, 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 (8.8).

The rate for residential structures (6.2) was low in comparison to those occupancies, but higher than for public assembly properties, educational properties, and institutional properties. Within residential properties, the rate per 100 fires was 7.1 for one-and two family homes, and 4.9 for apartments.

In 2007-2011, most fire ground injuries, 24,425 injuries or 81% , occurred in structures that were occupied and operating ([Table 12](#)). Another 2,155 injuries or 7% occurred in vacant and unsecured structures, while 2,045 or 7% occurred in vacant and secured structures.

Table 11
Structure Fires, Fireground Injuries and Injury Rates
By Occupancy, 2007-2011 Annual Average

Occupancy	Structure fires	Fireground Injuries	Fireground Injuries per 100 fires
Public assembly	13,500	3%	825
Educational	5,700	1%	250
Institutional	6,200	1%	90
Residential	392,800	79%	24,915
One-and two-family homes	283,500	57%	18,750
Apartments	94,000	19%	5,300
Stores and offices	19,000	4%	1,595
Industrial, utility or manufacturing	10,000	2%	885
Storage	29,100	6%	1,490
Special	22,200	4%	230
Total Structures	498,500	30,280	6.1

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 2007-2011

Structure Status	Fireground	Injuries
Under construction	325	1%
Occupied and operating	24,425	81%
Idle, not routinely used	495	2%
Under major renovation	420	1%
Vacant and secured	2,045	7%
Vacant and unsecured	2,155	7%
Being demolished	120	0%
Other	300	1%
Total	30,280	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.

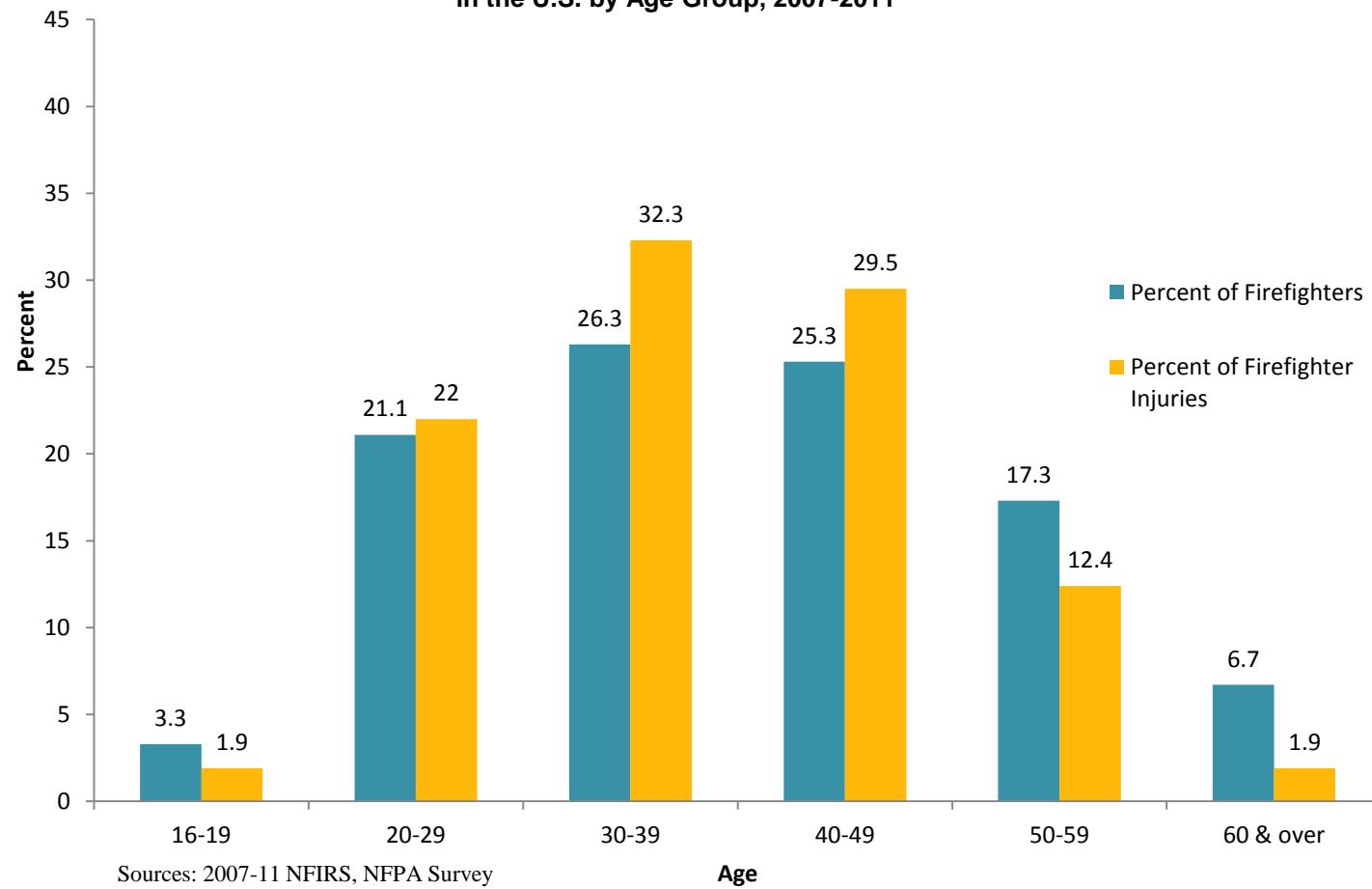
Patterns for Age of Injured, and by Time of Day

For the 2007-2011 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 56% 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 (31.3%). The smallest share of fires occurred in the early morning hours of midnight to 6:00 a.m. (15.1%) ([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. (28.4%), but the real surprise was the high occurrence of fireground injuries in the midnight to 6:00 a.m. slot (24.9%), compared to the 15.1% 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 8.4 to 10.8 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.

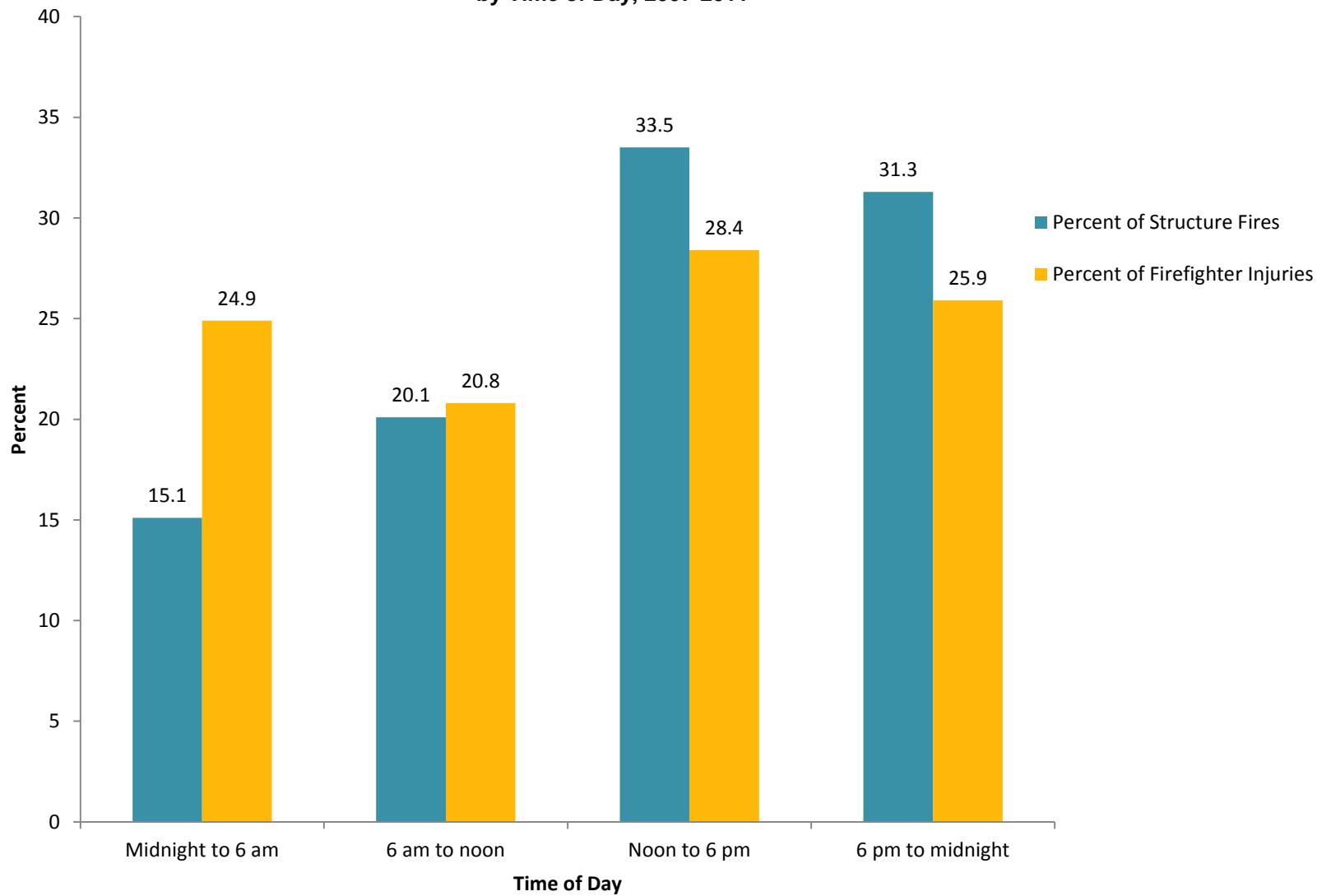
Figure 1
Firefighters and Firefighter Injuries
in the U.S. by Age Group, 2007-2011



Sources: 2007-11 NFIRS, NFPA Survey

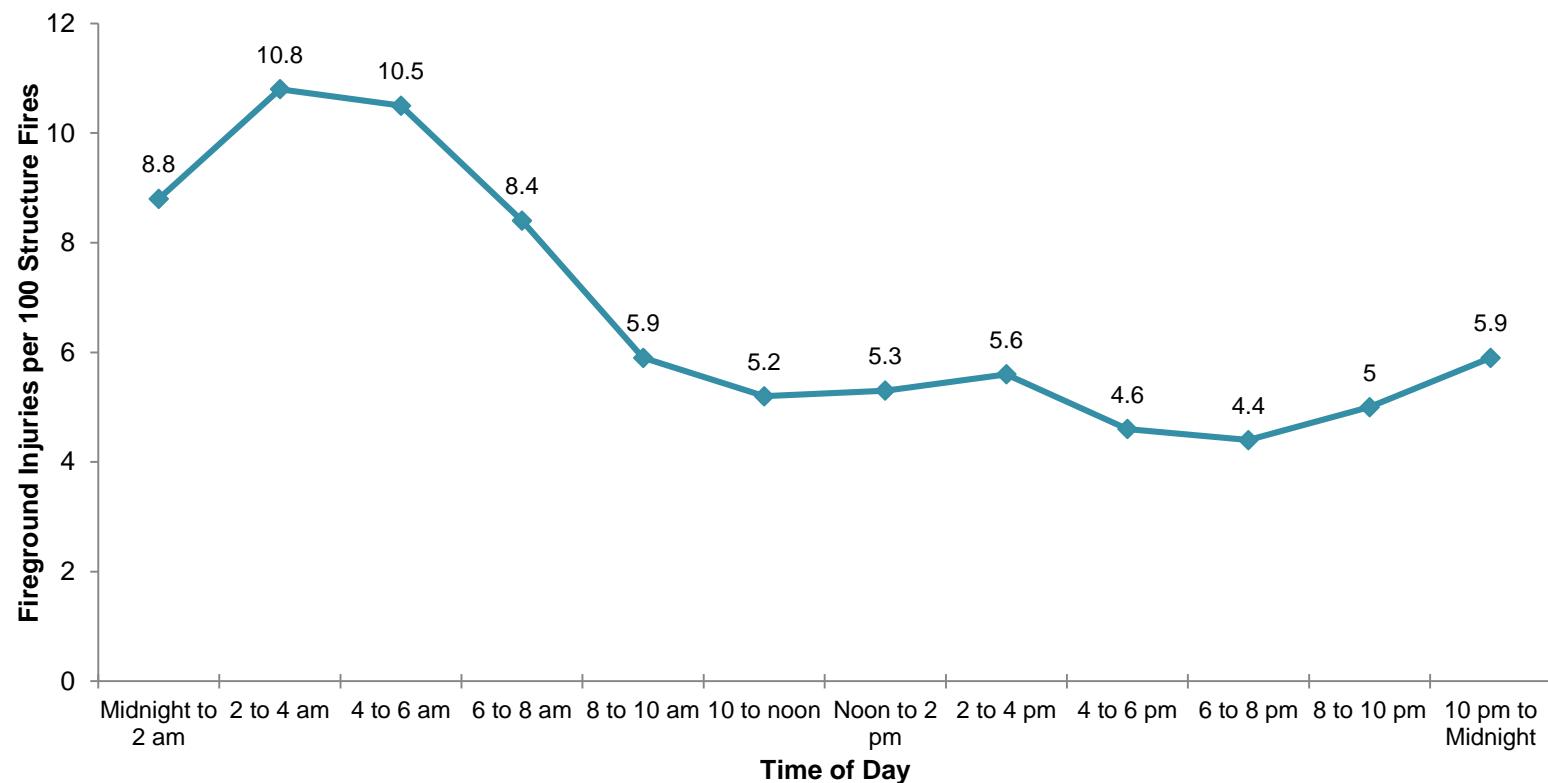
Age

Figure 2
Fires and Firefighter Injuries in Structures
by Time of Day, 2007-2011



Sources: 2007-11 NFIRS, NFPA Survey

Figure 3
**Firefighter Fireground Injuries per 100 Structure Fire
by Time of Day, 2007-2011**



Source: 2007-11 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; NFPA1582, Standard on Comprehensive Occupational Medical Program for Fire Departments; NFPA1583, 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 2007-2011 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 for the 2007 to 2011 period ranged from 97% to 100%.

This update for 2007-11 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, whiles percentages are rounded to the nearest whole percent.
Totals in tables may not equal sums due to rounding.