

# **U.S. FIREFIGHTER INJURIES – 2005**

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## **Abstract**

NFPA estimates that 80,100 firefighter injuries occurred in the line of duty in 2005, an increase of 5.6% from the year before. Almost half (48.6%) of the all firefighter injuries occurred during fireground operations. An estimated 13,325 occurring during other on duty activities, while 12,250 occurred at non-fire emergency incidents. The leading type of injury received during fireground operations was strain, sprain or muscular pain (44.4%), followed by wound, cut , bleeding, bruise (18.1%). Regionally, the Northeast had the highest fireground injury rate, more than twice the rate for the rest of the country.

Keywords: fire statistics, firefighter injuries, exposures, injury rates, fireground, non-fire emergencies, type of duty, cause of injury, collisions, community size

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## **Overview of 2005 Firefighter Injuries**

- 80,100 firefighter injuries occurred in the line of duty in 2005, an increase of 5.6% from the year before.
- 41,950 or 48.6% of all firefighter injuries occurred during fireground operations. An estimated 13,325 occurred during other on duty activities, while 12,250 occurred at nonfire emergency incidents.
- Regionally, the Northeast had the highest fireground injury rate with 4.8 injuries occurring per 100 fires; this was more than twice the rate for the rest of the country.
- The major types of injuries received during fireground operations were: strain, sprain, muscular pain (44.4%); wound, cut, bleeding, bruise (18.1%); burns (7.0%); smoke or gas inhalation (5.9%). Strains, sprains, and muscular pain accounted for 55.4% of all nonfireground injuries.

## **Background**

Firefighters work in varied and complex environments that increase their risk of on-the-job death and injury. A better understanding of how these fatal accidents, nonfatal injuries, and illnesses occur can help identify corrective actions which, could help minimize the inherent risks.

Each year, the NFPA studies firefighter deaths and injuries to provide national statistics on their frequency, extent, and characteristics. Earlier this year, the NFPA reported 87 firefighters died on duty (See, "2005 Firefighter Fatalities ", NFPA Journal July/August).

This report addresses 2005 firefighter injuries in the United States. The results are based on data collected during the NFPA Survey of Fire Departments for U.S. Fire Experience (2005). An earlier report measured the national fire experience in terms of the number of fires that fire departments attended and the resulting civilian deaths, civilian injuries, and property losses that occurred<sup>1</sup>.

This year's report includes among its results:

- An estimate of the total number of 2005 firefighter injuries.
- Estimates of the number of injuries by type of duty.
- An estimate of the number of exposures to infectious diseases.
- Trends in firefighter injuries and rates.
- Fireground injuries by cause.
- Fire department vehicle accidents and resulting firefighter injuries.
- The average number of fires and fireground injuries per department by population of community protected.
- Descriptions of selected incidents that illustrate firefighter safety problems.

## **Overall Results**

Based on survey data reported by fire departments, the NFPA estimates that 80,100 firefighter injuries occurred in the line of duty in 2005. This is an increase of 5.6% and the highest it's been since 2002. In recent years, the number of firefighter injuries have been considerably lower than they were in the 1990s (Figure 1), but this is due in part to additional questions on exposures which allows us to place them in their own categories. Previously some of these exposures may have been included in total injuries under other categories.

The NFPA estimates that there were 9,915 exposures to infectious diseases (e.g., hepatitis, meningitis, HIV, others) in 2005. This amounts to 0.7 exposures per 1,000 emergency medical runs by fire departments in 2005.

The NFPA estimates that there were 18,000 exposures to hazardous conditions (e.g., asbestos, radioactive materials, chemicals, fumes, other) in 2005. This amounts to 17.3 exposures per 1,000 hazardous condition runs in 2005.

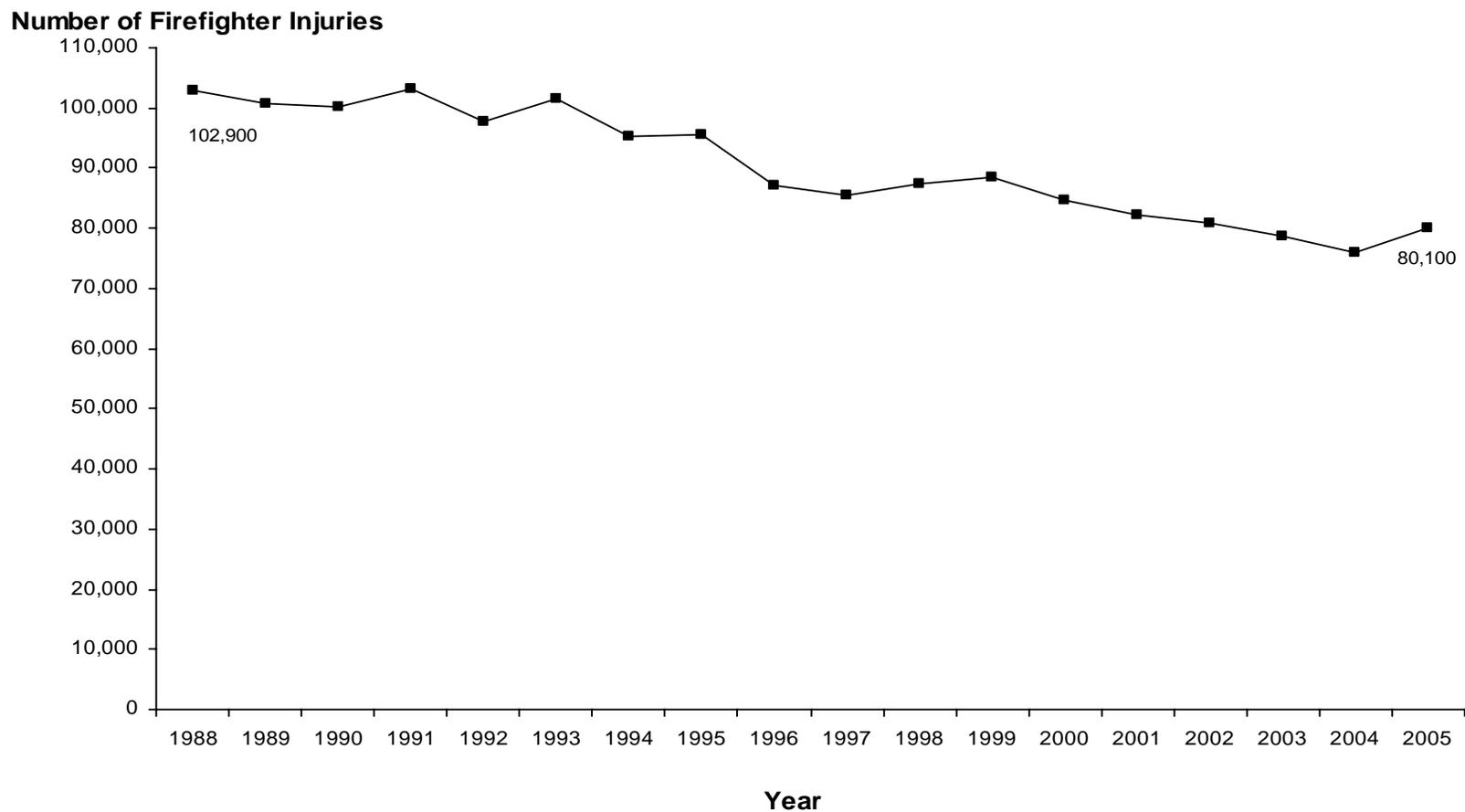
An estimated 19,900 injuries or 24.8% of all firefighter injuries resulted in lost time in 2005.

## **Injuries by Type of Duty**

Estimates of firefighter injuries by type of duty are displayed in Figure 2. As in past reports, type of duty is divided into five categories:

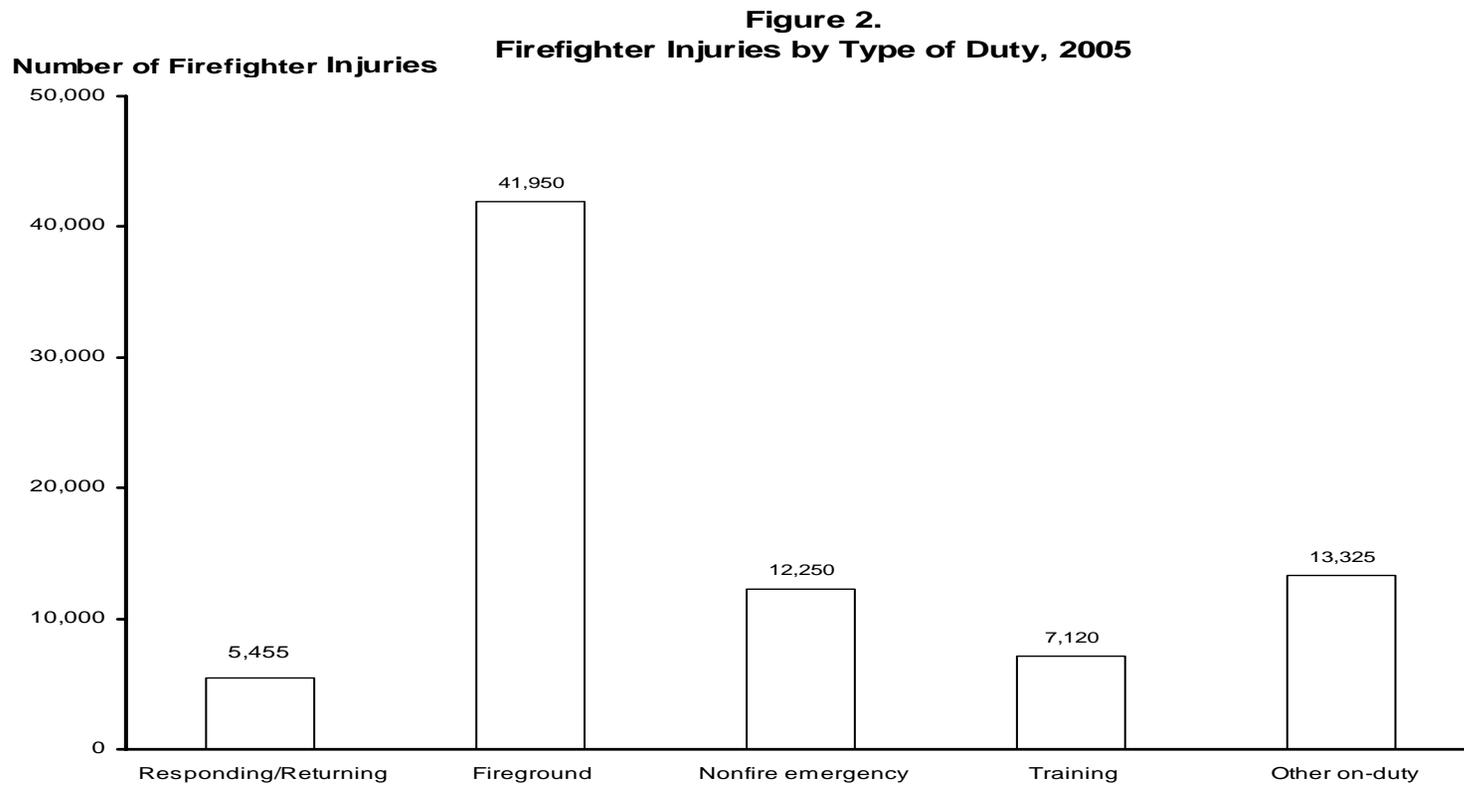
- Responding to or returning from an incident (includes fire and nonfire emergencies).
- Fireground (includes structure fires, vehicle fires, brush fires, etc.), and refers to all activities from the moment of arrival at the scene to departure time (e.g., setup, extinguishment, overhaul).
- Nonfire emergency (includes rescue calls, hazardous calls, such as spills, and natural disaster calls).
- Training
- Other on-duty activities (e.g., inspection or maintenance duties).

**Figure 1**  
**Total Firefighter Injuries by Year (1988-2005)**



Source: NFPA Annual Survey of Fire Departments  
for U.S. Fire Experience (1988-2005)

From 1994 on, number of exposures was collected separately



Source: NFPA Annual Survey of Fire Departments or U.S. Fire Experience (2005)

Results by type of duty indicate not surprisingly that the largest share of injuries occur during fireground operations: 41,950 or 52.4% of all firefighter injuries in 2005 and the highest it's been since 2000. Table 1 displays firefighter injuries at the fireground and injury rates for the 1989-2005 period. Injuries at the fireground decreased from their high of 61,790 in 1988 to a low of 36,880 in 2004 for a decrease of 40.3%. The rate of injuries per 1,000 fires has generally decreased during the period. This is because the number of fire incidents also decreased a considerable 36.4% for the 1988 to 2004 period.

In addition to injuries at the fireground, an estimated 13,325 or 16.6% occurred during other on-duty activities, while 12,250 or 15.3% occurred at nonfire emergencies.

### **Nature of Fireground Injuries**

Estimates of 2005 firefighter injuries by nature of injury and type of duty are displayed in Table 2. The nature of injury cause categories are based with modifications on NFPA 901, *Uniform Coding for Fire Protection*. Table 2 indicates that the four major types of injuries that occur during fireground operations are strain, sprain (44.4%); wound, cut, bleeding, bruise (18.1%); burns (7.0%); smoke or gas inhalation (5.9%); thermal stress (5.9%).

Results were fairly consistent during all non-fireground activities, with strains, sprains, and muscular pain accounting for 55.4% of all non-fireground injuries, and wound, cut, bleeding, bruise accounting for 17.2%.

### **Causes of Fireground Injuries**

Because fireground injuries are of particular concern their causes were examined (see Figure 3). The definition of cause here refers to the initial circumstance leading to the injury. The cause categories included on the survey were also based on NFPA 901, *Uniform Coding for Fire Protection*. Fall, slip, jump (25.5%), overexertion, strain (24.1%) were the leading causes of fireground injuries. Other major causes were contact with object (13.2%); and exposure to fire products (9.2%).

**Table 1**  
**Firefighter Injuries at the Fireground, and**  
**at Nonfire Emergencies, 1988-2005**

| Year | At the Fireground |                            | At Nonfire Emergencies |                                    |
|------|-------------------|----------------------------|------------------------|------------------------------------|
|      | Injuries          | Injuries per<br>1000 Fires | Injuries               | Injuries<br>per 1,000<br>Incidents |
| 1988 | 61,790            | 25.4                       | 12,325                 | 1.13                               |
| 1989 | 58,250            | 27.5                       | 12,580                 | 1.11                               |
| 1990 | 57,100            | 28.3                       | 14,200                 | 1.28                               |
| 1991 | 55,830            | 27.3                       | 15,065                 | 1.20                               |
| 1992 | 52,290            | 26.6                       | 18,140                 | 1.43                               |
| 1993 | 52,885            | 27.1                       | 16,675                 | 1.25                               |
| 1994 | 52,875            | 25.7                       | 11,810                 | 0.84                               |
| 1995 | 50,640            | 25.8                       | 13,500                 | 0.94                               |
| 1996 | 45,725            | 23.1                       | 12,630                 | 0.81                               |
| 1997 | 40,920            | 22.8                       | 14,880                 | 0.92                               |
| 1998 | 43,080            | 24.5                       | 13,960                 | 0.82                               |
| 1999 | 45,500            | 25.0                       | 13,565                 | 0.76                               |
| 2000 | 43,065            | 25.2                       | 13,660                 | 0.73                               |
| 2001 | 41,395            | 23.9                       | 14,140                 | 0.73                               |
| 2002 | 37,860            | 22.4                       | 15,095                 | 0.77                               |
| 2003 | 38,045            | 24.0                       | 14,550                 | 0.70                               |
| 2004 | 36,880            | 22.1                       | 13,150                 | 0.62                               |
| 2005 | 41,950            | 26.2                       | 12,250                 | 0.56                               |

Source: NFPA Survey of Fire Departments for U.S. Fire Experience (1988-2005)

**Table 2. Firefighter Injuries by Nature of Injury and Type of Duty, 2005**

| Nature of Injury                            | Responding to or Returning from an Incident |         | Fireground |         | Nonfire Emergency |         | Training |         | Other on-duty |         | Total  |         |
|---|---|---------|------------|---------|-------------------|---------|----------|---------|---------------|---------|--------|---------|
|   | Number                                      | Percent | Number     | Percent | Number            | Percent | Number   | Percent | Number        | Percent | Number | Percent |
| Burns (Fire or Chemical)                    | 155   | 2.8     | 2,930      | 7.0     | 80                | 0.7     | 270      | 3.8     | 215           | 1.6     | 3,650  | 4.6     |
| Smoke or Gas Inhalation                     | 75  | 1.4     | 2,485      | 5.9     | 110               | 0.9     | 135      | 1.9     | 70            | 0.5     | 2,875  | 3.6     |
| Other Respiratory Distress                  | 10  | 0.2     | 905        | 2.2     | 185               | 1.5     | 165      | 2.3     | 125           | 0.9     | 1,390  | 1.7     |
| Burns and Smoke Inhalation                  | 165   | 3.0     | 750        | 1.8     | 65                | 0.5     | 95       | 1.3     | 45            | 0.3     | 1,120  | 1.4     |
| Wound, Cut, Bleeding Bruise                 | 940   | 17.2    | 7,600      | 18.1    | 1,770             | 14.5    | 1,290    | 18.1    | 2,565         | 19.3    | 14,165 | 17.7    |
| Dislocation, Fracture                       | 210   | 3.9     | 970        | 2.3     | 515               | 4.2     | 170      | 2.4     | 450           | 3.4     | 2,315  | 2.9     |
| Heart Attack or Stroke                      | 55  | 1.0     | 315        | 0.8     | 85                | 0.7     | 125      | 1.8     | 185           | 1.4     | 765    | 1.0     |
| Strain, Sprain Muscular Pain                | 3,075                                       | 56.4    | 18,620     | 44.4    | 7,150             | 58.4    | 3,970    | 55.8    | 6,925         | 52.0    | 39,740 | 49.6    |
| Thermal Stress (frostbite, heat exhaustion) | 255   | 4.7     | 2,480      | 5.9     | 285               | 2.3     | 390      | 5.5     | 155           | 1.2     | 3,565  | 4.4     |
| Other                                       | 515   | 9.4     | 4,895      | 11.7    | 2,005             | 16.4    | 510      | 7.2     | 2,590         | 19.4    | 10,515 | 13.1    |
|   | 5,455                                       |         | 41,950     |         | 12,250            |         | 7,120    |         | 13,325        |         | 80,100 |         |

Source: NFPA Survey of Fire Departments for U.S. Fire Experience, 2005

Note: If a firefighter sustained multiple injuries for the same incident, only the nature of the single most serious injury was tabulated.

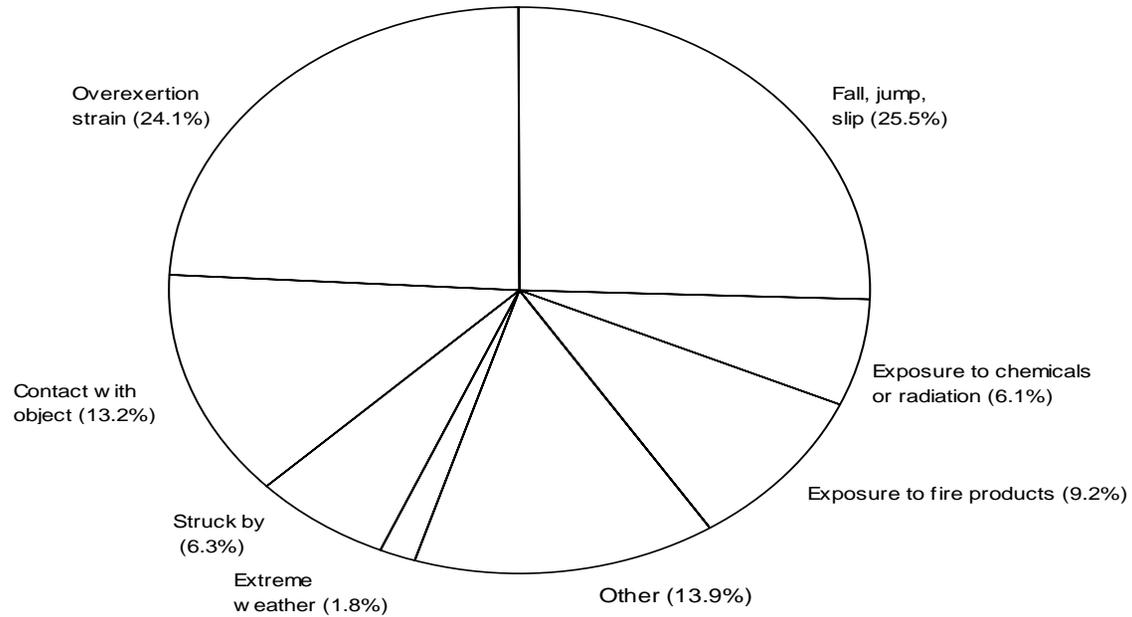
## **Fire Department Vehicle Collisions**

The NFPA reported earlier that 18 firefighters died in motor vehicle collisions in 2005. (See “2005 Firefighter Fatalities” July/August NFPA Journal).

In 2005, there were an estimated 15,885 collisions involving fire department emergency vehicles, where departments were responding to or returning from incidents (see Table 3). To put this number in perspective however, fire departments responded to over 23.2 million incidents in 2005 so that the number of collisions represents about one tenth of 1 percent of total responses. However, these collisions resulted in 1,120 firefighter injuries or 1.4% of all firefighter injuries.

Also, 1,080 collisions involving firefighters’ personal vehicles occurred in 2005 while departments were responding to or returning from incidents. These collisions resulted in an estimated 125 injuries.

**Figure 3.  
Fireground Injuries by Cause, 2005**



Source: NFPA Annual Survey of Fire Departments for U.S. Fire Experience (2005)

**Table 3**  
**Fire Department Vehicle Collisions and**  
**Resulting Firefighter Injuries**  
**While Responding to or Returning From Incidents, 1990-2005**

| <b>Year</b> | <b>Involving Fire Department<br/>Emergency Vehicles</b> |                                  | <b>Involving Fire Fighters'<br/>Personal Vehicles</b> |                                  |
|-------------|---|----------------------------------|---|----------------------------------|
|             | <b>Collisions</b>                                       | <b>Fire Fighter<br/>Injuries</b> | <b>Collisions</b>                                     | <b>Fire Fighter<br/>Injuries</b> |
| 1990        | 11,325  | 1,300                            | 950   | 175                              |
| 1991        | 12,125  | 1,075                            | 1,375   | 125                              |
| 1992        | 11,500  | 1,050                            | 1,575   | 150                              |
| 1993        | 12,250  | 900                              | 1,675   | 200                              |
| 1994        | 13,755  | 1,035                            | 1,610   | 285                              |
| 1995        | 14,670  | 950                              | 1,690   | 190                              |
| 1996        | 14,200  | 910                              | 1,400   | 240                              |
| 1997        | 14,950  | 1,350                            | 1,300   | 180                              |
| 1998        | 14,650  | 1,050                            | 1,350   | 315                              |
| 1999        | 15,450  | 875                              | 1,080   | 90                               |
| 2000        | 15,300  | 990                              | 1,160   | 170                              |
| 2001        | 14,900  | 960                              | 1,325   | 140                              |
| 2002        | 15,550  | 1,040                            | 1,030   | 210                              |
| 2003        | 15,900  | 850                              | 980   | 85                               |
| 2004        | 15,420  | 980                              | 1,150   | 220                              |
| 2005        | 15,885  | 1,120                            | 1,080   | 125                              |

Source: NFPA Survey of Fire Departments for U.S. Fire Experience (1990-2005)

## **Average Fires and Fireground Injuries per Department by Population Protected**

The average number of fires and fireground injuries per department by population of community protected in 2005 are displayed in Table 4. These tabulations show (1) that the number of fires a fire department responds to is directly related to the population protected, and (2) that the number of fireground injuries incurred by a department is directly related to its exposure to fire, i.e., and the number of fires attended by the department. The second point is clearly demonstrated when we examine the range of the statistic: from a high of 118.8 for departments that protect communities of 500,000 to 999,999 to a low of 0.2 for departments that protect communities of less than 2,500.

A useful way to look at firefighter injury experience and to obtain a reading on the relative risk that departments face is to examine the number of fireground injuries that occur for every 100 fires attended. This takes into account relative fire experience and allows more direct comparison between departments protecting communities of different sizes. The number of fireground injuries per 100 fires is displayed in column 4 of Table 4. The overall range of rates varied little from a high of 3.9 for departments that protect communities 500,000 to 999,999 to a low of 1.5 for departments that protect communities of 5,000 to 9,999 and communities less than 2,500 population. Thus, the wide range noted in average fireground injuries by population protected narrows when relative fire experience is taken into account. The overall injury rate for departments protecting communities of 50,000 population or more was 3.4 injuries per 100 fires or 55% higher than the injury rate for departments protecting communities of less than 50,000 population.

The risk of fireground injury per 100 firefighters by size of community protected was also calculated and is displayed in column 5 of Table 4. Larger departments generally had the highest rates with departments protecting communities of 500,000 to 999,999 having the highest rate with 11.0 injuries per 100 firefighters. As community size decreases, the rate drops quite steadily to a low of 1.2 for departments protecting less than 2,500 people. That is a more than a nine-to-one difference in risk of injury between communities of 250,000 to 499,999, and the smallest communities (less than 2,500).

An explanation for this difference is that although a department protecting a community with a population of 500,000 to 999,999 has, on average, more than 50 times as many firefighters than a department protecting a population of less than 2,500, the larger department attends more than 220 times as many fires, and as a result, it incurs considerably more fireground injuries.

**Table 4**  
**Average Number of Fires, Fireground  
 Injuries and Injury Rates**  
**by Population of Community Protected, 2005**

| <b>Population<br/>of Community<br/>Protected</b> | <b>Average<br/>Number of<br/>Fires</b> | <b>Average Number<br/>of Fireground<br/>Injuries</b> | <b>Number of Fire-<br/>ground Injuries<br/>Per 100 Fires</b> | <b>Number of Fire-<br/>ground Injuries Per<br/>100 Firefighters</b> |
|--|--|--|--|---|
| 500,000 to 999,999                               | 3,045.6                                | 118.8  | 3.9  | 11.0  |
| 250,000 to 499,999                               | 1,519.9                                | 55.5   | 3.7  | 10.8  |
| 100,000 to 249,999                               | 581.6                                  | 16.7   | 2.9  | 7.7   |
| 50,000 to 99,999                                 | 277.3                                  | 8.7  | 3.1  | 8.0   |
| 25,000 to 49,999                                 | 147.8                                  | 3.7  | 2.5  | 5.3   |
| 10,000 to 24,999                                 | 72.2                                   | 1.9  | 2.6  | 4.9   |
| 5,000 to 9,999                                   | 41.2                                   | 0.6  | 1.5  | 1.9   |
| 2,500 to 4,999                                   | 26.1                                   | 0.5  | 1.9  | 1.7   |
| Under 2,500                                      | 13.6                                   | 0.2  | 1.5  | 1.2   |

Source: NFPA Survey of Fire Departments for U.S. Fire Experience, 2005

## **Average Fires and Fireground Injuries by Population Protected and Region**

Table 5 displays the average number of fires and fireground injuries per department by population of community protected and region of the country<sup>3</sup>. As in the nationwide results in Table 4, the results of each region of the country indicate that the number of fires a fire department responds to is directly related to the population protected, and the number of fireground injuries incurred by a department is directly related to the number of fires attended. The Northeast reported a substantially higher number of fireground injuries for most community sizes where all departments reported sufficient data by region.

**Table 5**

**Average Number of Fires and Fireground Injuries per Department and Injuries per 100 Fires, by Population of Community Protected, and Region, 2005**

**Column 1: Average Reported Number of Fires  
 Column 2: Average Reported Number of Fireground Injuries  
 Column 3: Number of Fireground Injuries per 100 Fires**

| Population of Community Protected | Northeast |          |          | Northcentral |          |          | South    |          |          | West     |          |          |
|-----------------------------------|-----------|----------|----------|--------------|----------|----------|----------|----------|----------|----------|----------|----------|
|                                   | Column 1  | Column 2 | Column 3 | Column 1     | Column 2 | Column 3 | Column 1 | Column 2 | Column 3 | Column 1 | Column 2 | Column 3 |
| 500,000 to 999,999                | *         | *        | *        | *            | *        | *        | 3,083.0  | 55.0     | 1.8      | 2,900.0  | 58.2     | 2.0      |
| 250,000 to 499,999                | *         | *        | *        | 2,467.2      | 148.4    | 6.0      | 1,370.9  | 23.8     | 1.7      | 912.4    | 23.8     | 2.6      |
| 100,000 to 249,999                | 772.5     | 50.0     | 6.5      | 646.5        | 26.1     | 4.0      | 654.6    | 12.9     | 2.0      | 434.0    | 9.9      | 2.3      |
| 50,000 to 99,999                  | 381.7     | 26.2     | 6.9      | 250.3        | 8.7      | 3.5      | 330.5    | 5.6      | 1.7      | 203.3    | 4.4      | 2.2      |
| 25,999 to 49,999                  | 153.9     | 6.4      | 4.1      | 116.9        | 4.1      | 3.5      | 184.9    | 2.9      | 1.6      | 155.6    | 2.3      | 1.5      |
| 10,000 to 24,999                  | 68.2      | 2.9      | 4.2      | 65.7         | 2.3      | 3.5      | 86.9     | 1.2      | 1.4      | 68.7     | 0.7      | 1.0      |
| 5,000 to 9,999                    | 35.4      | 0.6      | 1.7      | 34.5         | 0.7      | 2.0      | 55.2     | 0.5      | 1.0      | 48.6     | 0.7      | 1.4      |
| 2,500 to 4,999                    | 22.8      | 0.6      | 2.6      | 23.4         | 0.4      | 1.7      | 33.4     | 0.4      | 1.2      | 29.3     | 0.4      | 1.4      |
| Under 2,500                       | 10.5      | 0.3      | 2.9      | 11.3         | 0.2      | 1.8      | 22.2     | 0.2      | 1.0      | 13.7     | 0.5      | 3.6      |
| Overall Regional Rate             |           |          | 4.8      |              |          | 3.1      |          |          | 1.5      |          |          | 2.8      |

Source: NFPA Survey of Fire Departments for U.S. Fire Experience, 2005

\*Insufficient data

## 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. The reference to the appropriate NFPA standard is shown with the example in parenthesis:

- 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 Departments*)
- 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; and NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters*)

- Adoption and implementation of an incident management system.  
(*NFPA 1500, 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*)

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.

Every fire service organization, needs to make a commitment to reduce firefighter injuries. Practically all of the priorities listed above are components of NFPA 1500, *Fire Department Occupational Safety and Health Program*, which provides a framework for a safety and health program. It is a good place to begin when developing programs for the reduction of firefighter injuries.

## **Definition of Terms**

**Fire:** Any instance of uncontrolled burning. Excludes combustion explosions and fires out on arrival (whether authorized or not), overpressure rupture without combustion; mutual aid responses, smoke scares, and hazardous materials responses, e.g., flammable gas, liquid, or chemical spills without fire.

**Incident:** The movement of a piece of fire service apparatus or equipment in response to an alarm.

**Injury:** Physical damage suffered by a person that requires (or should require) treatment by a practitioner of medicine (physician, nurse, paramedic, EMT) within one year of the incident (regardless of whether treatment was actually received), or that results in at least one day of restricted activity immediately following the incident.

## **Description of NFPA Survey and Data Collection Method**

The NFPA annually surveys a sample of departments in the United States to make national projections of the fire problem. The sample is stratified by the size of the community protected by the fire department. All U.S. fire departments that protect communities of 100,000 or more are included in the sample, because they constitute a small number of departments with a large share of the total population protected. For departments that protect less than 100,000 population, stratifying the sample by community size permits greater precision in the estimates. Survey returns in recent years have ranged from 2,700 to 3,500 departments annually. The national projections are made by weighting sample results according to the proportion of total U.S. population accounted for by communities of each size. Around any estimate based on a sample survey, there is a confidence interval that measures the statistical certainty (or uncertainty) of the estimate. We are very confident that the actual number of total firefighter injuries falls within 6.5% of the estimate.

The results in this report are based on injuries that occurred during incidents attended by public fire departments. No adjustments were made for injuries that occurred during fires attended solely by private fire brigades, e.g., industrial or military installations.

Data collection for the selected incident summaries was enhanced by a form that was sent to departments requesting information. The form included questions on type of protective equipment worn, age and rank of firefighters injured, and description of circumstances that led to injury.

## Footnotes

1. Michael J. Karter, Jr., "2005 Fire Loss in the United States", *NFPA Journal*, Vol. 100, No. 5 (November 2006).
2. Around any estimate based on a sample survey, there is a confidence interval that measures the statistical certainty (or uncertainty) of the estimate. Based on data reported by fire departments responding to the NFPA Survey for U.S. Fire Experience (2005), the NFPA is very confident that the actual number of firefighter injuries falls within the range of 74,900 to 85,300.
3. The four regions as defined by the U.S. Census Bureau include the following 50 states and the District of Columbia:
  - Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.
  - Northcentral: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.
  - South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia and West Virginia.
  - West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming

## **SELECTED INDIVIDUAL INCIDENTS**

**(These Incidents were Selected to Illustrate Typical Firefighter Safety Problems)**

## **Fireground**

Two firefighters were injured during a multiple-alarm fire at a condominium complex. A 13-year veteran was hurt after falling through a hole in the floor. A second firefighter received minor soft tissue injuries after tripping over a supply hose.

One of the first companies on scene immediately deployed a 2-inch handline and began to enter the structure through the front door. When the officer of the crew took a step into the room, his right leg went through the floor and he fell through up to his hip. His crew was able to pull him out, and he was not hurt.

He retreated to the porch and heard someone say that a firefighter was down. The officer of the crew turned around, only to see another firefighter holding on to some floor joists with his elbows near where the officer had fallen through.

Three firefighters in the immediate vicinity began to extricate the victim with the fire burning below. A rapid intervention team had been established but was not deployed as the victim was extricated almost immediately and was brought outside to a medic unit. He was transported to the hospital where he remained for two days.

The 38-year-old victim suffered smoke inhalation when his self-contained breathing apparatus mask was knocked off. He also suffered musculoskeletal injuries to his back. He missed 72 days of work at an estimated cost of more than \$15,000. The cost estimate does not include overtime costs and some medical bills. He returned to full duty without restriction.

## **Fireground**

One firefighter was injured while using a thermal-imaging camera to search for the fire at a manufacturing plant.

Plant employees first observed chemicals bubbling in a mixing vat and shut the mixers off. They sought assistance from a lab technician who told them to turn the mixers back on. When they returned to the mixing vat, the room had completely filled with thick smoke and they could not enter. The fire department was notified, after a 15-minute delay.

The first engine company on scene reported a light smoke condition and began investigating. Personnel from the manufacturing company told them the fire location and provided a list of the chemicals being used in the manufacturing process.

After the incident commander determined the proper level of protection for firefighters, two crews were given directions by plant personnel to the room of origin. Two minutes later, a firefighter opened a double door on the mezzanine level, looked into the room with the thermal-imaging camera, and saw what appeared to be a solid floor and proceeded into the smoke-filled room. He immediately fell onto a concrete floor approximately 15 feet (4.5 meters) below. The remaining crew found him on the lower level and requested assistance in removing him from the building.

A rapid intervention team (RIT) consisting of two additional companies was sent inside to assist. Six minutes after the call for help, the victim was safely removed by the RIT and original crews. He was then transported by ambulance to the hospital.

The victim, who was properly wearing a complete protective ensemble, suffered a compression fracture of the spine and tailbone. He was hospitalized for 3 days and returned to work 5 months later. The estimated cost of his injury was \$78,000.

According to the fire department, a factor in the incident is that the thermal-imaging camera does not distinguish elevation differences. It detects differences in temperature. Therefore, if the temperatures are the same between the floor and an opening, the image will appear as a level, continuous floor.

The fire department reported that the fire detection system and automatic sprinklers did operate, but they did not provide any specific details on the systems.

### **Fireground**

A 35-year-old lieutenant fell approximately 35-40 feet (10-12 meters) down an elevator shaft while searching for fire victims on the second story of a 319-unit apartment building.

A natural gas explosion in the second-story laundry room severely damaged the elevator doors. At the time of injury, there was zero visibility due to heavy smoke.

The injured lieutenant, who was wearing a complete protective ensemble, suffered multiple fractures in his back, foot, and ribs. He returned to full duty 6 months after his fall. The department reported an estimated cost of \$83,912.

The department did not provide any information on rescue operations or the use of a rapid intervention crew.

### **Fireground**

Two firefighters received minor injuries during operations at a storage warehouse fire. One was struck in the face with a water stream, and the other suffered smoke inhalation.

The fire occurred in a single-story, wood-frame warehouse that stored equipment and supplies for an excavation and concrete company. The building did not have a suppression or detection system. Flames had already burned through the roof of the structure when the fire department was notified.

An assistant chief suffered facial injuries after being struck in the face with an out-of-control handline. The victim was standing next to a firefighter operating a 1¾" handline when the firefighter lost control of the nozzle. The nozzle man, a mutual aid firefighter, was changing the shape of the water stream from a fog pattern to a straight stream when he experienced a great deal of nozzle reaction and lost control of the line. The assistant chief suffered a minor eye injury and returned to work two weeks after the incident.

A department investigation indicated two possible causes for the assistant chief's injury. The first was the mutual aid firefighter's lack of familiarity with the department's nozzle. A second cause may have been the deployment of a large diameter supply line to a ladder truck at approximately the same time, which may have created a temporary surge in water pressure.

The department's investigation report also included two recommendations to prevent future injuries. The first was to replace existing nozzles on the department's apparatus with newer ones, which will make all the equipment uniform with surrounding departments':

The second recommendation was for incident commanders and company officers to place more personnel on the hoseline. At the time of injury, the assistant chief had given the nozzle to the firefighter so he could communicate over a portable radio, leaving the firefighter alone on the handline.

The second firefighter suffered smoke inhalation injuries after removing the mask to his self-contained breathing apparatus (SCBA). The victim, who was wearing a full protective ensemble, stated that his SCBA malfunctioned and he needed to exit the building. He was treated at the hospital and released, returning to full duty a week later.

After the firefighter complained of the equipment malfunction, the department confiscated the SCBA immediately and inspected the unit. They then sent the unit to an independent company to be tested. Both parties reported no problems with the SCBA and that it was in perfect working order. The member was retrained on the use of SCBA and exhibited competent skills on two subsequent training dates.

### **Fireground**

The fire department responded to a fire in a one-story, wood-frame single-family dwelling, where self-contained breathing apparatus (SCBA) equipment failed and resulted in an injury to a 25-year veteran of the department.

The victim was advancing a handline through the front door of the structure. He was approximately 15-20 feet (4-6 meters) inside the building when he became entangled in some furniture. An object then fell and struck him in the face, dislodging his SCBA facepiece.

While he was readjusting the facepiece, the regulator hose became entangled on something and detached. He tried to reattach the regulator but was unsuccessful and activated his personal alert safety system (PASS). He then began to exit the structure. On his way out, he passed a lieutenant from the accompanying ladder company and told him he needed to get himself out of there.

A few minutes later, the lieutenant of the ladder company noticed fire beginning to spread behind the fire companies, cutting off their means of egress. He informed the officer of the engine company and they began to extinguish the fire behind them and exit

the structure. At this time, the lieutenant noticed a firefighter facedown several feet from the doorway.

A Mayday broadcast was attempted. Although the transmission was unclear, members in the vicinity heard the plea for assistance and immediately located and grabbed the victim by the SCBA straps and removed him to the front porch of the house. A paramedic unit was on scene and immediately initiated advanced life support on the unconscious victim and transported him to the hospital. According to the department timeline and incident log, the time from the firefighter-down transmission to transport to the hospital was approximately 10 minutes.

The department investigation revealed a problem with the SCBA model where the regulator was easily separating from the facepiece. By working with the manufacturer, the deficiency was identified and the manufacturer was able to make adjustments and correct the problem.

The investigative report also mentioned that the victim turned on his PASS device; however, none of the firefighters recalled hearing the device in alarm. According to the department, one reason that the PASS device was not heard may have been that the victim collapsed facedown on top of the device muffling its sound.

The 52-year-old victim suffered burns in his throat and lungs. Carbon monoxide levels in his blood were described as being extremely elevated. He was hospitalized in the burn unit for 5 days and received 3 hours of treatment in a hyperbaric chamber. He returned to full duty 2 months later.

### **Fireground**

A rapid intervention team (RIT) located a missing, unconscious firefighter in a burning apartment building and pulled him to safety. The victim, who was wearing a complete ensemble with an automatic integrated personal alert safety system (PASS) device, was injured when a roof collapsed while he searched for trapped occupants.

Four firefighters were searching the two bedrooms on the second story of the apartment adjacent to the apartment of origin when the collapse occurred. Heat and flames immediately dropped from the attic area onto the firefighters. The victim was struck by falling debris, which dislodged the facepiece of his self-contained breathing apparatus (SCBA). All members began to retreat from the structure. The victim removed his left glove in order to reposition his facepiece. He immediately felt intense pain and burned his hand. He was still able to put his facepiece back on and descend the stairs.

When the three other firefighters exited the structure, they realized that the victim was not with them and notified the incident commander. A personal accountability roll call was conducted, confirming that there was a missing firefighter. A chief officer was appointed as the rescue sector commander and the RIT was deployed to the sector from which the report of the missing firefighter originated. Simultaneously, a second engine company was deployed by another chief because of their proximity to the exit the other members of the victim's company had used. The last known location of the missing

firefighter was the second story, so this company immediately deployed a ground ladder and hoseline to the second story and began their search. After searching the second story, they made their way down the staircase and heard a PASS device in alarm. They followed the sound of the PASS device and found the unconscious victim in the hallway leading to the first-story kitchen. They immediately notified command and requested a medical unit. He was removed from the building and transported to the hospital by an on-scene emergency medical unit. It took approximately 28 minutes from the missing firefighter message to arrival at the hospital, according to the investigative timeline.

The victim suffered from smoke inhalation and received second-degree burns to his left hand. His palm, the back of his hand, and the flesh between his thumb and index finger were not burned because he was wearing the protective wristlet on his turnout coat. His helmet and left glove were found on the second story and his protective hood was found on the first story. The department report states the hood was most likely pulled off while he was dragged from the building. The department sent the SCBA unit to NIOSH to be evaluated, but no malfunction was found.

The department investigative report included several recommendations: establishing a safety sector, improved use of thermal-imaging cameras, better positioning of RITs, emphasis on the proper use of protective clothing, advanced life support units on scene, and providing accurate information on the location of missing firefighters.

The victim was able to return to full duty 28 weeks after the incident. The estimated cost of his injury was nearly \$300,000.

### **Responding to or returning from an incident**

Three firefighters were injured while responding to an alarm when a pickup truck struck their fire apparatus.

The apparatus approached an intersection and came to a stop to account for 10 lanes of travel. The fire apparatus proceeded through the intersection after all traffic came to a stop. The pickup truck tried to go around the stopped traffic by switching to an open lane and failed to stop.

The pickup truck struck the fire apparatus on the driver side just in front of the rear axle. The apparatus slid a few feet then rolled over 360 degrees coming to rest on its tires. The department report does not indicate any civilian injuries and damage to the pickup.

The engine company was responding to a medical run so none of the members was wearing protective clothing; however, all three were wearing seatbelts. The officer returned to duty after missing 48 hours. The driver of the apparatus suffered minor unspecified injuries and missed 144 hours of work before returning to full duty. The passenger in the rear seat was facing forward and suffered rib and abdominal trauma. He missed a total of 835 hours before returning to full duty.

### **Responding to or returning from an incident**

A 25-year-old firefighter fell from his apparatus while responding to a reported structure fire.

The victim took a position behind the company officer on the right side of the 1988 Mack® tower ladder. At the first intersection, the truck took a left turn, his door swung open, and he fell from the truck.

The fire department report indicated a locking device in the door might have been a factor in this mishap. The department did not report on the use of seatbelts.

The injured firefighter suffered a fractured skull, numerous head and neck trauma, and internal bleeding. He had 3-1/2 years' experience and his future in the fire service is uncertain.

### **Fireground**

A firefighter suffered severe burns on his hands while operating the nozzle of a charged hoseline at a fire in a single-family home.

On arriving on scene, the victim was wearing a complete protective ensemble, including protective hood. His approved gloves fell from the pockets of his turnout coat when he dismounted the apparatus. When he could not find his gloves, he decided to use a pair of garden gloves in his pocket that were damp from rolling hose at a previous fire. According to the department, a major contributing factor to the severity of his burns was the dampness of the non-approved gloves.

His approved gloves were later found on the ground next to the apparatus.

At this time, he is unable to perform his duties as a firefighter and is in the retirement process.

### **Responding to or returning from an incident**

A 25-year veteran retired from the department after he fell from a moving fire apparatus.

The engine company was responding to a reported explosion. After mounting the apparatus in the rear seat behind the officer, the victim signaled to the apparatus operator that he was all set and they could respond. The victim was standing, donning his protective gear in the open cab without using the safety bar, when the apparatus made a left turn and he was thrown from the vehicle. The only protective gear the victim was wearing when he fell from the apparatus were his boots and bunker pants. He suffered contusions and abrasions to his upper body and head.

The reported explosion ended up being a fireworks display and not a fire.

### **Other on-duty activities**

After returning from a fire in a single-family home, a 48-year-old firefighter went into cardiac arrest at the fire station.

The victim, a 22-year veteran, had complained of nausea and indigestion while at the fire scene. Back at the station, approximately 90 minutes later, he complained of nausea and chest pain. Fellow firefighters requested an ambulance to respond.

Several minutes later, before the ambulance arrived on scene, the victim collapsed into cardiac arrest and fellow firefighters began cardiopulmonary resuscitation, breathing for the victim with a bag-valve mask and using a cardiac monitor/defibrillator on him. After the first defibrillation, the patient's status improved. He was stabilized and transported to the hospital.

He was hospitalized for an undisclosed amount of time. Twelve months after the incident, the victim retired from the fire service. The department indicated that the medical costs for the injury were over \$36,000 and the cost of his salary was approximately \$38,000.

### **Training**

A 35-year-old firefighter suffered a head injury after he tripped or slipped while removing kinks from a 5-inch supply line during a training exercise.

During the training evolution, the victim, who was operating a pump, attempted to remove some kinks from the supply line. Witnesses stated they saw him trying to pull the hose backward. For an unknown reason, he either slipped or tripped, falling backwards and striking his head on the pavement. He was wearing his helmet, which was pushed forward over his face after the initial impact. His head then hit the pavement a second time without the helmet in place.

Paramedics came to his aid and found him unconscious. They treated and transported him to the hospital.

The victim was hospitalized for nine days and suffered permanent loss of his sense of taste. He returned to full duty 72 days after his injury. The department reported the cost of his injury to be near \$46,000.

### **Responding to or returning from an incident**

Two firefighters and a firefighter recruit were injured after their ambulance was struck by a locomotive.

The ambulance had been dispatched to a medical call along with a first responder engine company to an industrial complex. A firefighter from the engine company stopped the ambulance just before the railroad crossing when they approached the scene. The firefighter stepped up onto the running board of the ambulance to provide directions to the driver. Because he was standing in the driver's window, obstructing the view of the driver and officer of the ambulance, they never saw an approaching lone locomotive. The engineer realized that the ambulance was not going to cross the track and could not see the locomotive and immediately sounded his horn. The firefighter standing on the running board jumped from the side of the ambulance to safety; the others did not have time to react. The locomotive, traveling at approximately 35 miles per hour (56

kilometers per hour), struck the driver's door and spun the ambulance around. The ambulance came to rest approximately 50 yards (45 meters) from the point of impact.

All three injured members were seated and wearing seatbelts. The department did not provide detailed medical information about the victims, only describing the injuries as cuts and bruises. All of the victims returned to full duty after some time performing restricted work activities.

### **Fireground**

One firefighter was injured after being struck by a vehicle while extinguishing a fire in a single-family home.

Firefighters asked the homeowner to move his vehicle from the driveway to the street. At the time of the fire, the temperature was below zero, and the vehicle's windows were iced over. The owner got into his vehicle and tried to move it without clearing the windows. With no visibility, the driver struck a firefighter standing at the end of the driveway.

The 51-year-old firefighter did not see the vehicle and suffered a dislocated shoulder. He returned to fire duty 30 weeks after the incident.