

**FIREFIGHTER FATALITIES
IN THE UNITED STATES-2010**

**Rita F. Fahy
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June 2011
(Revised July 2011)



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

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Abstract

In 2010, a total of 72 on-duty firefighter deaths occurred in the U.S. This is another sharp drop from the 105 on-duty deaths in 2008 and 82 in 2009, and the lowest annual total since NFPA began conducting this annual study in 1977. Stress, exertion, and other medical-related issues, which usually result in heart attacks or other sudden cardiac events, continued to account for the largest number of fatalities. More than half of the deaths resulted from overexertion, stress and related medical issues. Of the 39 deaths in this category, 34 were classified as sudden cardiac deaths (usually heart attacks) and five were due to strokes or brain aneurysm.

Keywords: Firefighter fatality, statistics, heart attack, sudden cardiac death

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2010 Experience

In 2010, a total of 72 on-duty firefighter deaths occurred in the U.S. This is another sharp drop from the 105 on-duty deaths in 2008 and 82 in 2009, and the lowest annual total since NFPA began conducting this annual study in 1977.¹ The average number of deaths annually over the past 10 years is 95. Figure 1 shows firefighter deaths for the years 1977 through 2010, excluding the 340 firefighter deaths at the World Trade Center in 2001.

Of the 72 firefighters who died while on duty in 2010, 44 were volunteer firefighters, 25 were career firefighters, two were employees of state land management agencies, and one was a member of a prison inmate crew.²

In 2010, there were four double-fatality incidents. Two firefighters died in a vehicle crash while returning from a training weekend, two died in an apparatus crash while responding to a structure fire and four firefighters were killed during interior operations at two structure fires. More details will be presented throughout this report.

Analyses in this report examine the types of duty associated with firefighter deaths, the cause and nature of fatal injuries to firefighters, and the ages of the firefighters who died. They highlight deaths in intentionally-set fires and in motor vehicle-related incidents.³ Finally, the study presents summaries of individual incidents that illustrate important concerns in firefighter safety.

Introduction

Each year, NFPA collects data on all firefighter fatalities in the U.S. that resulted from injuries or illnesses that occurred while the victims were on-duty. The term *on-duty* refers to being at the scene of an alarm, whether a fire or non-fire incident; while responding to or returning from an alarm; while participating in other fire department duties such as training, maintenance, public education, inspection, investigation, court testimony or fund raising; and being on call or stand-by for assignment at a location other than at the firefighter's home or place of business.

On-duty fatalities include any injury sustained in the line of duty that proves fatal, any illness that was incurred as a result of actions while on duty that proves fatal, and fatal mishaps involving non-emergency occupational hazards that occur while on duty. The types of injuries included in the first category are mainly those that occur at a fire or other emergency incident scene, in training, or in crashes while responding to or returning from alarms. Illnesses (including heart attacks) are included when the exposure or onset of symptoms occurred during a specific incident or on-duty activity.

The victims include members of local career and volunteer fire departments; seasonal, full-time and contract employees of state and federal agencies who have fire suppression responsibilities as part of their job description; prison inmates serving on firefighting crews; military personnel performing assigned fire suppression activities; civilian firefighters working at military installations; and members of industrial fire brigades.

Fatal injuries and illnesses are included even in cases where death is considerably delayed. When the injury and the death occur in different years, the incident is counted in the year of the injury.

The NFPA recognizes that a comprehensive study of on-duty firefighter fatalities would include chronic illnesses (such as cancer or heart disease) that prove fatal and that arise from occupational factors. In practice, there is no mechanism for identifying fatalities that are due to illnesses that develop over long periods of time. This creates an incomplete picture when comparing occupational illnesses to other factors as causes of firefighter deaths. This is recognized as a gap the size of which cannot be identified at this time because of limitations in tracking the exposure of firefighters to toxic environments and substances and the potential long-term effects of such exposures.

The NFPA also recognizes that other organizations report numbers of duty-related firefighter fatalities using different, more expansive, definitions that include deaths that occurred when the victims were off-duty. (See, for example, the [USFA](#) and [National Fallen Firefighters Memorial](#) websites.*) Readers comparing reported losses should carefully consider the definitions and inclusion criteria used in any study.

Type of Duty

Figure 2 shows the distribution of the 72 deaths by type of duty. The largest share of deaths occurred while firefighters were operating on the fire ground (21 deaths). This total is well below the average 32 deaths per year on the fire ground over the past 10 years, and less than a third the average of 69 deaths per year in the first 10 years of this study (1977 through 1986). The low number of fire ground deaths in 2010 is not only because of the small number of multiple-fatality fire incidents – the number of fire incidents resulting in firefighter deaths in 2010 was the lowest recorded, with 19 fatal fires, compared to an average of 28 annually in the previous 10 years.

* USFA link is usfa.dhs.gov/fireservice/fatalities/index.shtm, National Fallen Firefighters' Memorial link is www.firehero.org/

Fourteen of the 21 fire ground deaths occurred at 12 structure fires. Deaths in structure fires are discussed in more detail later in this report. There were seven deaths at seven wildland-related incidents. There were no firefighter deaths at vehicle fires in 2010. Twelve of the 21 fire ground victims were career firefighters, eight were volunteer firefighters and one was a firefighter with a state land management agency. The average number of career firefighter deaths on the fire ground over the past 10 years is 12 deaths per year, while the average for volunteer firefighters is 16 deaths per year. An additional four or more deaths of state or federal wildland management agency personnel, on average, occur on wildland fires each year.

Eighteen firefighters died while responding to or returning from emergency calls. It is important to note that deaths in this category are not necessarily the result of crashes. Twelve of the deaths were due to sudden cardiac events or stroke, five occurred in four collisions or rollovers and one firefighter was crushed between two fire department vehicles as one was backed into the station. All 18 victims were volunteer firefighters. All crashes and sudden cardiac deaths are discussed in more detail later.

Eleven deaths occurred during training activities. Two firefighters died when their personal vehicle crashed while they were returning from a training weekend. Four firefighters collapsed and died of sudden cardiac events after training exercises and one died during unsupervised physical fitness activities. One suffered a stroke after a weekly training meeting at the station, one suffered a brain aneurysm after hose loading training, one died after being exposed to smoke at a wildland live fire training exercise, and one hit his elbow during training and died of necrotizing fasciitis (also known as flesh-eating disease).

Five firefighters died at non-fire emergencies, including two at the scene of motor vehicle crashes (one victim was struck by a vehicle and the other suffered sudden cardiac death), one drowned during a swift water rescue, one died after clearing downed trees after a storm and one was asphyxiated while attempting to rescue a worker from a manhole without SCBA and before the oxygen levels were tested.

The remaining 17 firefighters died while involved in a variety of non-emergency-related on-duty activities. These activities included normal administrative or station duties (11 deaths), fire station construction projects (two deaths), vehicle maintenance (one death), driving to check on a wildland fire the previous day (one death), and a work project in a wildland area (one death). One firefighter died of a self-inflicted gunshot wound while on-duty.

Cause of Fatal Injury or Illness

Figure 3 shows the distribution of deaths by cause of fatal injury or illness. The term *cause* refers to the action, lack of action, or circumstances that resulted directly in the fatal injury.⁴

More than half of the deaths resulted from overexertion, stress and related medical issues. Of the 39 deaths in this category, 34 were classified as sudden cardiac deaths (usually heart attacks) and five were due to strokes or brain aneurysm. See the section below for more detail on sudden cardiac deaths.

The second leading cause of fatal injury was being struck by an object or coming into contact with an object. The 19 firefighters killed included 11 in motor vehicle crashes and four struck by motor vehicles. The 11 deaths in motor vehicle crashes are discussed in more detail in a separate section of this report. One firefighter was struck and killed when a wall collapsed at a structure fire. One firefighter was struck by a falling snag (part of a dead tree). One firefighter was struck by a power hose reel when an overpressurized water tank failed. A firefighter who struck his elbow during training died several weeks later of necrotizing fasciitis.

The next leading cause of fatal injury was being caught or trapped, resulting in eight deaths. Two were killed in a roof collapse in a vacant commercial structure. Two were killed when they became trapped while checking for fire extension and searching for fire victims at a fire in an apartment building. Two others died in separate structure fires when they became lost inside and one firefighter died after being trapped as the fire intensified. A fire chief was killed when a silo exploded as he was climbing down from the roof.

Three firefighters were killed in falls. One firefighter fell while working around the fire station and suffered fatal head injuries. One firefighter, carrying a fire extinguisher, fell while climbing a fire escape ladder at a structure fire. One victim fell backwards and hit his head on the ground while assisting at a fire station construction project.

One firefighter was exposed to smoke during wildland fire training and suffered sudden cardiac death. One firefighter suffocated while attempting to rescue someone from a manhole. One firefighter died of a self-inflicted gunshot wound.

Nature of Fatal Injury or Illness

The term *nature* refers to the medical process by which death occurred and is often referred to as *cause of death* on death certificates and in autopsy reports.

Figure 4 shows the distribution of deaths by nature of fatal injury or illness. Almost half of the fatalities, 35 deaths, were due to sudden cardiac death. One of the sudden cardiac deaths was attributed to

smoke exposure at a wildland training fire.

The other major categories of fatal injuries were internal trauma (22 deaths), asphyxiation or smoke inhalation (six deaths), and stroke (five deaths). The remaining deaths included one each due to drowning, gunshot wound, pulmonary embolism and septic shock.

Sudden Cardiac Deaths

Overall, sudden cardiac death is the number one cause of on-duty firefighter fatalities in the U.S. and almost always accounts for the largest share of deaths in any given year. These are cases where the onset of symptoms occurred while the victim was on-duty and death occurred immediately or shortly thereafter. The number of deaths in this category has fallen significantly since the early years of this study. From 1977 through 1986, an average of 60 on-duty firefighters a year suffered sudden cardiac deaths (44.7 percent of the on-duty deaths during that period). The average number of deaths fell to 44 a year in the 1990s and to 39 in the past decade. In spite of this reduction, sudden cardiac death still accounted for 40 percent of the on-duty deaths in the last five years, and 49 percent in 2010 alone.

For 23 of the 35 victims of sudden cardiac events in 2010, post mortem medical documentation showed that nine were hypertensive, eight had coronary artery disease, three were diabetic, and 11 were reported to have had prior heart problems -- such as prior heart attacks, bypass surgery or angioplasty/stent placement. Some of the victims had more than one condition. Other risk factors were represented among the victims of sudden cardiac death, including obesity, high cholesterol, smoking and family history. Medical documentation was not available for the other 12 firefighters.

NFPA has several standards that focus on the health risks to firefighters. For example, [NFPA 1582, Comprehensive Occupational Medical Program for Fire Departments](#), outlines for fire departments the procedures for screening candidate firefighters and handling health problems that might arise during an individual's fire service career. [NFPA 1500, Fire Department Occupational Safety and Health Program](#), calls for fire departments to establish a firefighter health and fitness program based on [NFPA 1583, Health-Related Fitness Programs for Fire Fighters](#), and requires that firefighters meet the medical requirements of [NFPA 1582](#).

Information on developing a wellness-fitness program is available from other organizations, for example, the [IAFC/IAFF Fire Service Joint Labor Management Wellness-Fitness Initiative](#)[†] and the [National Volunteer Fire Council's Heart-Healthy Firefighter Program](#).[‡] The Heart-Healthy Firefighter

[†] http://www.iafc.org/associations/4685/files/healthWell_WFI3rdEdition.pdf

[‡] <http://www.healthy-firefighter.org/>

Program was launched in 2003 to address heart attack prevention for all firefighters and EMS personnel, through fitness, nutrition and health awareness.

An important part of this NVFC program includes health screenings that they make available annually at several fire service trade shows around the country. The purpose of the program is to lower the incidence of cardiac-related problems in the fire service by educating firefighters and their families about nutrition, fitness and heart disease prevention. While those screenings provide valuable information to the individuals tested, they've also collected data that provides a disturbing picture of the health status of many of the nation's firefighters. Since 2003, the program has screened more than 10,000 firefighters, both career and volunteer, for blood pressure, cholesterol, body fat and glucose.

- Cholesterol screening done from 2004 through 2007 found high or borderline-high levels (greater than or equal to 200 mg/dl) in 37.0 percent of the 7,904 firefighters tested.
- Blood pressure screenings from 2005 through 2007 found that 6.2 percent of the tested firefighters had Stage 2 hypertension; 28.9 percent had Stage 1 hypertension; and 48.0 percent were prehypertensive. Only 16.9 percent had normal blood pressure readings.
- Almost all of the 5,065 firefighters tested for glucose (non-fasting) in 2006 and 2007 were found to be in the desirable range (less than 140 mg/dl), with only 2.7 percent found to be diabetic (greater than or equal to 200 mg/dl) and 5.9 percent pre-diabetic (between 140 and 199 mg/dl).
- Of the almost 2,000 firefighters tested for body fat in 2005, 44.7 percent were found to be obese (defined as 25 percent or more of body fat for men and 32 percent or more for women).

Results of the testing in 2008 were reported in a slightly different format.

- Of the approximately 1,650 firefighters tested at four shows, 47.5 percent were determined to have a high overall coronary risk rating, based on the National Institute of Health's "National Cholesterol Education Program."
- Cholesterol screening showed that 5.8 percent of the tested firefighters were at high risk levels (greater than or equal to 240 mg/dl) and 21.4 percent were at moderate risk (200-239 mg/dl).
- Blood pressure screenings found that 27.9 percent of the tested firefighters had high blood pressure; and 49.6 percent were prehypertensive. The remaining 22.5 percent had desired or ideal blood pressure readings.
- Body fat was measured again in 2008, and 41.5 percent of the tested firefighters were found to be at high risk and another 25.1 were found to be overweight.

Only blood pressure was screened at a single show in 2009.

- Of the 137 firefighters tested there, 2.2 percent had Stage 2 hypertension; 20.4 percent had Stage 1 hypertension; and 54.0 percent were prehypertensive. Only 23.4 percent had normal blood pressure readings.

In 2010, cholesterol was tested at seven events. Glucose was tested at one event and body composition was tested at another event. It was not clear if the reported results were only for firefighters, or if other event participants were included.

- Of the 1,395 participants tested for cholesterol at the seven shows, 6.7 percent were at the high risk levels (greater than or equal to 240 mg/dl) and 20.9 percent were at moderate risk (200-239 mg/dl).
- Of the 216 participants tested for glucose, 14.8 percent were found to be diabetic, 32.9 percent were pre-diabetic and 52.3 percent were in the desirable range.
- Of the 225 participants tested for body composition, 47.6 percent were found to be obese and 29.8 percent were overweight.

Through this program, many firefighters have been tested more than once, have come to understand their personal level of risk, and have adopted a more heart-healthy lifestyle.

Ages of Firefighters

The firefighters who died in 2010 ranged in age from 20 to 86, with a median age of 52.5 years. Two were over age 80. Figure 5 shows the distribution of firefighter deaths by age and whether the cause of death was sudden cardiac death or not.

Sudden cardiac death accounts for a higher proportion of the deaths among older firefighters, as might be expected. Sixty percent of the firefighters over age 40 who died in 2010 died of heart attacks or other cardiac events. The youngest victim of sudden cardiac death was aged 33.

Figure 6 shows death rates by age, using career and volunteer firefighter fatality data for the five-year period from 2006 through 2010 and estimates of the number of career and volunteer firefighters in each age group from the NFPA's 2008 profile of fire departments (the mid-year in the range).⁵

The lowest death rates were for firefighters in their 20s. Their death rate was less than half the all-age average. Firefighters in their 30s had a death rate two-thirds the all-age average. The rate for firefighters aged 60 and over was almost four times the average. Firefighters aged 50 and over accounted for more than two-fifths of all firefighter deaths over the five-year period, although they represent only one-fifth of all career and volunteer firefighters in the U.S.

Fire Ground Deaths

Of the 21 fire ground fatalities, eight were due to internal trauma, six to sudden cardiac death, five to asphyxiation, and one each to stroke and aneurysm. Fourteen of the deaths occurred at 12 structure fires, and seven occurred on wildland fires.

Figure 7 shows the distribution of the 21 fire ground deaths by fixed property use. Three of the seven victims at wildland fires suffered fatal cardiac events, another was killed when his vehicle overturned and one each was struck by a snag, a power hose reel when a water tank exploded and by a non-fire department vehicle.

Eight of the 14 firefighter deaths at structure fires occurred in residential properties. Fires in one- and two-family dwellings killed six of the eight and two died in a fire in an apartment building. Two firefighters were killed in a fire in a vacant commercial structure. One firefighter died at a restaurant fire, one at a furniture store fire, one in an egg processing plant and one was killed at a fire involving a grain silo.

The restaurant had a wet chemical suppression system over the stove, but the fire started in the grease chute above the system, and the system did not activate. None of the other structures had an automatic fire suppression system.

To put the hazards of firefighting in various types of structures into perspective, the authors examined the number of fire ground deaths per 100,000 structure fires by property use. Estimates of the structure fire experience in each type of property were obtained from the NFPA's annual fire loss studies from 2005 through 2009 (the 2010 results are not yet available) and from the updated firefighter fatality data for the corresponding years. The results are shown in Figure 8.

This figure illustrates that, although many more firefighter deaths occur at residential structure fires than at fires in any other type of structure, fires in some nonresidential structures, such as mercantile, public assembly and manufacturing properties, are more hazardous to firefighters, on average. There were 7.3 fire ground deaths per 100,000 nonresidential structure fires from 2005 through 2009, compared to 3.8 deaths per 100,000 residential structure fires. The highest death rates over the five-year period occurred in stores and offices. This is a reflection, in part, of the nine deaths that occurred at a single store fire in 2007. The low rate in health care and correctional properties may reflect the fact that these occupancies are among the most regulated and most-frequently inspected and that their occupants are among the most likely to call the fire department to report fires while the fires are still in their early stages. The low rate in that five-year period for storage properties, which includes garages at dwellings, reflects the relatively small number of fatalities that have occurred in such

structures in recent years. In contrast, the similar rate in educational properties is a result of a single fatality over the five-year period in a type of property that has a very low occurrence of reported fires.

Fires in vacant structures are not shown separately in this analysis, as was done in previous years, because of changes in the methodology used to collect fire incident information. They are included in the category for the intended use of the structure; for example, deaths in vacant houses are included in the residential fire category. From 2001 through 2010, there were 12 deaths in 11 fires in vacant buildings, and buildings under demolition or renovation.

Vehicle-Related Incidents

In 2010, 11 firefighters died in nine vehicle crashes. In addition to those deaths, four other firefighters were struck and killed by vehicles.

Five of the 11 firefighters were killed in four crashes while responding to incidents.

- Two firefighters responding with lights and siren to a residential structure fire were killed when their pumper was struck by an SUV at an intersection and overturned. The other driver had the green light; the driver of the apparatus disregarded the traffic signal. Neither victim was wearing a seatbelt and both were ejected.
- A firefighter responding to the fire station in his personal vehicle for a mutual aid EMS call crashed into a truck that had just been involved in a crash and was blocking both lanes of the road. The road was unlit and no warning devices had been placed. The victim was wearing his seatbelt and was not ejected.
- A firefighter responding to a search and rescue call in his personal ATV struck a deer, went off the road and overturned. He was not wearing a seatbelt or a helmet and was ejected.
- A firefighter responding to a motor vehicle crash in his personal vehicle lost control and was ejected. He was not wearing a seatbelt. Excessive speed was a factor in the crash.

The remaining six deaths occurred while returning from training (two deaths), while on official non-emergency assignments (two deaths); on a wildland fire (one death), and during a swift water rescue (one death):

- Two firefighters returning from hazmat training in a personal vehicle were killed in a crash while racing firefighters in another vehicle. The victims' speeding vehicle crossed the center line and struck an oncoming vehicle, fatally injuring the passenger in the other car as well. The road was wet and it was raining. The two firefighters were wearing seatbelts; one was ejected and one was not.

- A firefighter driving a tractor-trailer to the scene of an extinguished wildland fire was killed when he lost control on a curve and the vehicle overturned in a ditch. He was transporting a fire plow in case it was needed to create a fire break. He was wearing his seatbelt and was not ejected.
- A firefighter returning from a brush-clearing work assignment in a crew-carrying vehicle transporting 15 people was killed when the vehicle was struck head-on by a vehicle that crossed the centerline. There was no information on seatbelt use, but the victim was ejected.
- When a tracked vehicle operating on a wildland fire overturned on a steep hill, the driver was pinned between the roll bar and the ground and died. Another firefighter on the vehicle was ejected and survived. Neither was wearing a seatbelt. Limited experience with the vehicle and operation of the vehicle in conditions beyond its capability were cited as factors in the incident. Excessive weight on the retrofitted vehicle may have shifted its center of gravity.
- A firefighter drowned during a swift water rescue when the boat struck a submerged object, entered the rapid current, struck a bridge and capsized. Although the victim was wearing a wetsuit, personal flotation device and helmet, his gear was not appropriate for cold weather and flood conditions. Insufficient risk assessment was also cited as a factor.

Of the nine deaths in road vehicles mentioned above, four of the victims were not wearing seatbelts and were ejected, four were wearing seatbelts (one was ejected and three were not ejected), and no information on seatbelt use was available for one of the victims (he was ejected). Alcohol may have been a factor in one of the crashes. Excessive speed was a factor in at least two of the seven crashes. Other factors reported were driver inexperience, driver inattention, and weather conditions.

Four firefighters were struck by vehicles.

- A firefighter who was directing traffic at the scene of a motor vehicle crash was struck by a vehicle whose driver drove over traffic cones that had been set out to close the road. A flare had been placed near the cones. The victim was wearing coveralls with some reflective material and a high-visibility hat, and was using a flashlight with a traffic wand. However, he had his back to oncoming traffic and had positioned his vehicle, with emergency lights operating, beyond the point where the road was closed. Factors in the death included no advance warning to drivers, inconspicuousness of the victim and careless driving.
- A firefighter operating at a grass fire on a highway median was struck by a vehicle after it was involved in a crash and slid between the parked apparatus and the guardrail.

- While a vehicle was being repaired at the fire station, a firefighter standing between the vehicle and a wall was struck when the vehicle unexpectedly lurched forward.
- A fire chief was struck and crushed between two apparatus when one of the vehicles was backing into a narrow space in the fire station. Factors in the incident included inadequate policies for backing apparatus (e.g., no spotter was used, visual contact was not maintained), inadequate space for the number of apparatus and no backup warning system.

NFPA publishes several standards related to road safety issues.

- [NFPA 1002, Standard on Fire Apparatus Driver/Operator Professional Qualifications](#), identifies the minimum job performance requirements for firefighters who drive and operate fire apparatus, in both emergency and nonemergency situations.
- [NFPA 1451, Standard for a Fire Service Vehicle Operations Training Program](#), provides for the development of a written vehicle operations training program, including the organizational procedures for training, vehicle maintenance, and identifying equipment deficiencies.
- [NFPA 1911, Standard for the Inspection, Testing, Maintenance and Retirement of In-Service Automotive Fire Apparatus](#), details a program to ensure that fire apparatus are serviced and maintained to keep them in safe operating condition.
- [NFPA 1901, Automotive Fire Apparatus](#), addresses vehicle stability to prevent rollovers, and gives manufacturers options on how to provide it. New vehicles will have their maximum speed limited, based on their weight, and will have vehicle data recorders to monitor, among other things, acceleration and deceleration, and seatbelt use.

The provisions of [NFPA 1500, Standard on Fire Department Occupational Safety and Health Program](#), include requirements that operators successfully complete an approved driver training program, possess a valid driver's license for the class of vehicle, and operate the vehicle in compliance with applicable traffic laws. All vehicle occupants must be seated in approved riding positions and secured with seatbelts before drivers move the apparatus, and drivers must obey all traffic signals and signs and all laws and rules of the road, coming to a complete stop when encountering red traffic lights, stop signs, stopped school buses with flashing warning lights, blind intersections and other intersection hazards, and unguarded railroad grade crossings. Passengers are required to be seated and belted securely and must not release or loosen seatbelts for any reason while the vehicle is in motion.

In related efforts, the USFA has formed partnerships with the IAFF, NVFC and IAFC to focus attention on safety while responding in emergency apparatus. Details can be found on [USFA's website](#).[§]

The focus of vehicle safety programs should not be exclusively on fire department apparatus, since, over the years, personal vehicles have been the vehicles most frequently involved in road crashes. [NFPA 1500, Standard on Fire Department Occupational Safety and Health Program](#), includes a requirement that when members are authorized to respond to incidents or to fire stations in private vehicles, the fire department must establish specific rules, regulations, and procedures relating to the operation of private vehicles in an emergency mode. [NFPA 1451, Standard for a Fire Service Vehicle Operations Training Program](#), also requires training for those using personally-owned vehicles.

Requirements are also in effect for emergency personnel operating on roadways. The 2009 version of the Federal Highway Administration's Manual of Uniform Traffic Control Devices (MUTCD) requires anyone working on a roadway to wear an ANSI 107-compliant high-visibility vest. An exemption was created for firefighters and others engaged on roadways that allows them to wear NFPA-compliant retroreflective turn-out gear when directly exposed to flames, heat and hazardous material. NFPA 1500 requires firefighters working on traffic assignments where they are endangered by motor vehicle traffic to wear clothing with fluorescent and retroreflective material and use fire apparatus in a blocking position to protect firefighters. The 2009 edition of NFPA 1901 requires that ANSI 207-compliant breakaway high-visibility vests be carried on all new fire apparatus, and MUTCD 2009 allows emergency responders to use them in lieu of ANSI 107-compliant apparel. Advice on compliance with the updated Federal rules can be found at: [MUTCD](#).^{**} NFPA 1901 also requires reflective striping for improved visibility on new apparatus and a reflective chevron on the rear of fire apparatus. Advice on how to improve visibility of existing apparatus can be found at: [video](#).^{††}

In August, 2010, NFPA's Standards Council established the Technical Committee for Traffic Control Incident Management. The technical committee will have jurisdiction over documents that address professional qualifications for emergency responders in relation to their operations on roadways. NFPA 1091, *Standard on Traffic Control Incident Management*, will identify the minimum job performance requirements necessary to perform temporary traffic control duties at emergency incidents on or near an active roadway.

^{§§} <http://www.usfa.dhs.gov/fireservice/research/safety/vehicle.shtm>

^{**} http://www.respondersafety.com/Articles/2009_Edition_of_the_Manual_on_Uniformed_Traffic_Control_Devices_MUTCD_Released_December_16_2009.aspx

^{††} <http://www.respondersafety.com/MarkedAndSeen.aspx>

Career/Volunteer Comparison

The distribution of deaths of career and volunteer firefighters from local fire departments is shown in Figure 9. At 44, the number of deaths of volunteer firefighters in 2010 is similar to the low level seen the previous year, and maintains the downward, though fluctuating, trend seen since 1999. With the exception of 2007, when nine career firefighters were killed in a single incident, the number of on-duty deaths of career firefighters annually continues its plateau of slightly fewer than 30 deaths each year. There were 25 deaths in 2010.

A breakdown of the fatality experience of the 69 career and volunteer firefighters killed in 2010 is shown in Table 1.

Other Findings

There were no deaths at intentionally-set fires in 2010; though one firefighter died in a vehicle crash while returning to check on an extinguished fire that had been set. From 2001 through 2010, 52 firefighters (5.5 percent of all on-duty deaths) died in connection with intentionally-set fires. The number of these deaths annually has been dropping since 1985.

In 2010, there were no deaths that resulted from false alarms or false calls. Over the past 10 years, 24 firefighter deaths have resulted from false calls, including malicious false alarms and alarm malfunctions.

Summary

There were 72 on-duty firefighter deaths in 2010; the lowest total since NFPA began this study in 1977. It is also the fifth time in the past 10 years that the total number of deaths has been below 100. The annual average has dropped to 95 deaths per year in the past 10 years.

While the number of total deaths has dropped sharply, the number of cardiac-related deaths has not. The number of such deaths has been remarkably stable over the past six years, with between 35 and 39 deaths annually. The 35 sudden cardiac deaths in 2010 accounted for almost 50 percent of the total.

There were nine deaths in crashes of road vehicles in 2010, the same as in 2009. This is, again, the lowest total since 1983, when there were only six. Over the past 10 years, the number of deaths in road vehicle crashes has averaged 15 a year, ranging from the low of nine in 2009 and 2010 to a high of 25 in 2003 and 2007.

The lowest number of fire ground deaths since the study began in 1977 occurred in 2010 but, as detailed in the 2009 firefighter fatality study, firefighter death rates while operating inside at structure

fires continue at levels higher than those observed through the 1970s and 1980s.⁶ The 2011 Fire/EMS Safety, Health and Survival Week was held in June, with the theme, "Surviving the Fire Ground – Fire Fighter, Fire Officer and Command Preparedness." The event, co-sponsored by IAFF and IAFC, focused on survival training and education.

This NFPA study focuses on the fire deaths that are directly associated with specific on-duty activities, and does not track the effects of long-term exposure to toxic products that might occur during an individual's time in the fire service. NIOSH has undertaken a multi-year study to examine the cancer risk of firefighters, using health records of approximately 18,000 current and retired career firefighters from suburban and large city fire departments. Results should be available in 2013. More information about the project is available on the [USFA](#) and [NIOSH](#) websites.^{##}

Where did the drop in deaths occur?

The decrease did not occur in the area that accounts for the largest share of on-duty firefighter deaths annually. There was no reduction in the number of sudden cardiac deaths in 2010. In fact, the 35 deaths in 2010 matches the number in 2009 and is almost equal to the average number of deaths in the past five years.

So, where did the drop in deaths occur? The reduction in deaths is actually fairly diverse. In 2010, we saw the lowest number of fire ground deaths ever (21 deaths), and the second lowest number of deaths while responding to or returning from alarms (18 deaths). Deaths at non-fire emergencies were at about two thirds the level of the previous 10 years. Deaths related to training activities and deaths while engaged in other on-duty activities, however, just about matched the average numbers from the previous 10 years (11 and 18 deaths, respectively).

Looking at these findings more closely, we see that we had the second lowest number of deaths of career and volunteer firefighters (69, in 2010, vs. an average of 84 in the previous 10 years), combined with the lowest number of deaths of state, federal and other firefighters (3 in 2010, vs. an average of 14 in the previous 10 years). Deaths of state, federal and other firefighters are most often connected to wildland fires.

Among career firefighters, the number of deaths on the fire ground matched the average for the previous 10 years, but there were no deaths while responding to or returning from alarms or while operating at non-fire emergencies. For volunteer firefighters, except for fire ground deaths, all

^{##} http://www.usfa.dhs.gov/fireservice/research/safety/niosh_cancer_study.shtm and <http://www.cdc.gov/niosh/fire/cancerStudy.html>

categories of type of duty had totals close to the 10-year average (training was slightly higher than average). For fire ground deaths, volunteers experienced half the number of deaths than average (8 deaths in 2010, compared to 16 per year over the previous 10 years).

The second most frequent cause of firefighter deaths is crashes where the victim was an occupant of the vehicle. As mentioned earlier, there were nine deaths in road crashes in 2010 and in 2009. In the 10 years before that, however, there was an average of 16 deaths in road vehicle crashes annually, with 25 deaths in 2003 and 2007. It is too soon to conclude that this is a positive trend, but it is a promising result.

References

1. The NFPA's files for firefighter on-duty fatal injuries are updated continually for all years.
2. For this report, the term *volunteer* refers to any firefighter whose principal occupation is not that of a full-time, paid member of a fire department. The term *career* refers to any firefighter whose occupation is that of a full-time, paid fire department member.
3. For this report, the term *motor vehicle-related incident* refers to motor vehicle collisions (including aircraft and boats) and rollovers, as well as to incidents such as falls from or struck by vehicles where the involvement of the vehicle played an integral role in the death.
4. The categories for cause of injury and nature of injury are based on the 1981 edition of NFPA 901, *Uniform Coding for Fire Protection*.
5. Michael J. Karter, Jr., "U.S. Fire Department Profile Through 2009," NFPA Fire Analysis and Research Division, Quincy, Massachusetts, October 2010.
6. Rita F. Fahy, "U.S. Fire Service Fatalities in Structure Fires, 1977-2009," NFPA Fire Analysis and Research Division, Quincy, Massachusetts, June 2010. See: [link](#).

Credits

This study is made possible by the cooperation and assistance of the United States fire service, the Public Safety Officers' Benefits Program of the Department of Justice, CDC's National Institute for Occupational Safety and Health, the United States Fire Administration, the Forest Service of the U.S. Department of Agriculture, and the Bureau of Indian Affairs and the Bureau of Land Management of the U.S. Department of the Interior. The authors would also like to thank Carl E. Peterson, retired from NFPA's Public Fire Protection Division and Thomas Hales, MD, MPH, of CDC-NIOSH, for their assistance on the study.

U.S. Department of Justice Death, Disability and Educational Benefits for Public Safety Officers and Survivors

Line of duty deaths: The Public Safety Officers' Benefits (PSOB) Act, signed into law in 1976, provides a federal death benefit to the survivors of the nation's federal, state, local and tribal law enforcement officers, firefighters, and rescue and ambulance squad members, both career and volunteer, whose deaths are the direct and proximate result of a traumatic injury sustained in the line of duty. The Act was amended in 2000 to include FEMA employees performing official, hazardous duties related to a declared major disaster or emergency. Effective December 15, 2003, public safety officers are covered for line-of-duty deaths that are a direct and proximate result of a heart attack or stroke, as defined in the Hometown Heroes Survivors' Benefits Act of 2003.

A 1988 amendment increased the amount of the benefit from \$50,000 to \$100,000 and included an annual cost-of-living escalator. On October 1 of each year, the benefit changes as a result. The enactment of the USA PATRIOT bill in 2001 increased the benefit to \$250,000. The current benefit is \$318,111.64, tax free.

A decedent's spouse and minor children usually are the eligible beneficiaries. Generally, in cases in which the public safety officer had no surviving spouse or eligible children, the death benefit is to be awarded to either the individual most recently designated as beneficiary for PSOB benefits with the officer's public safety agency, organization, or unit, or, if there is no designation of beneficiary of PSOB benefits on file, then to the individual designated as beneficiary under the most recently executed life insurance policy on file with the agency at the time of death. (*See* 42 U.S.C. § 3796(a)(4) for specific details.) If no individuals qualify under 42 U.S.C. § 3796(a)(4), then the benefit is paid to the public safety officer's surviving parents.

Line of duty disability: In 1990, Congress amended the PSOB benefits program to include permanent and total disabilities that occur on or after November 29, 1990. The amendment covers public safety officers who are permanently unable to perform any gainful employment in the future. PSOB is intended for those few, tragic cases where an officer survives a catastrophic, line of duty injury. Only then, in the presence of the program's statutory and regulatory qualifying criteria, will PSOB's disability benefit be awarded. The bill's supporters anticipated that few PSOB disability claims would be eligible annually.

Public Safety Officers' Educational Assistance Program (PSOEA): An additional benefit, signed into law in October 1996 and amended in 1998, provides an educational assistance allowance to the spouse and children of public safety officers whose deaths or permanent and total disabilities qualify under the PSOB Act. This benefit is provided directly to dependents who attend a program of education at an eligible education institution and are the children or spouses of covered public safety officers. It is retroactive to January 1, 1978, for beneficiaries who have received or are eligible to receive the PSOB death benefit. Students may apply for PSOEA funds for up to 45 months of full-time classes. As of October 1, 2009, the maximum benefit a student may receive is \$936 per month of full-time attendance.

Further benefits information: To initiate a claim for death benefits, to receive additional information on filing a disability claim or to receive additional information about coverage, call, email, or write the Public Safety Officers' Benefits Office, Bureau of Justice Assistance, Office of Justice Programs, U.S. Department of Justice, 810 7th Street, N.W., Washington DC 20531. The telephone number is (888) 744-6513 and the email address is ASKPSOB@usdoj.gov. PSOB death claims can now be filed online as well, at: <https://www.psob.gov>. Please note that the PSOB Office "Call Center" is now available to take calls Monday through Friday from 7:00 AM until 7:00 PM.

Table 1
Comparison of On-Duty Deaths Between
Career and Volunteer Firefighters, 2010*

	Career Firefighters		Volunteer Firefighters	
	Number of Deaths	Percent of Deaths	Number of Deaths	Percent of Deaths
Type of duty				
Operating at fire ground	12	48%	8	18%
Responding to or returning from alarms	0	0%	18	41%
Training	3	12%	8	18%
Operating at non-fire emergencies	0	0%	5	11%
Other on-duty	10	40%	5	11%
Totals	25	100%	44	100%
Cause of fatal injury				
Exertion/stress/other related	13	52%	26	59%
Struck by or contact with object	2	8%	14	32%
Caught or trapped	7	28%	1	2%
Fell	2	8%	1	2%
Exposure to smoke/lack of oxygen	0	0%	2	5%
Assault	1	4%	0	0%
Totals	25	100%	44	100 %
Nature of fatal injury				
Sudden cardiac death	11	44%	24	55%
Internal trauma	5	20%	14	32%
Asphyxiation (including smoke inhalation)	5	20%	1	2%
Stroke/aneurysm	2	8%	3	7%
Blood clot/embolism	1	4%	0	0%
Drowning	0	0%	1	2%
Gunshot wounds	1	4%	0	0%
Septic shock	0	0%	1	2%
Totals	25	100%	44	100%
Rank				
Firefighter	16	64%	23	52%
Company officer	8	32%	11	25%
Chief officer	1	4%	10	23%
Totals	25	100%	44	100%

Table 1
Comparison of On-Duty Deaths Between
Career and Volunteer Firefighters, 2010* (Continued)

	Career Firefighters		Volunteer Firefighters	
	Number of Deaths	Percent of Deaths	Number of Deaths	Percent of Deaths
Ages of Firefighters				
All deaths				
20 and under	0	0%	2	5%
21 to 25	1	4%	2	5%
26 to 30	2	8%	2	5%
31 to 35	4	16%	2	5%
36 to 40	4	16%	1	2%
41 to 45	1	4%	1	2%
46 to 50	4	16%	3	7%
51 to 55	4	16%	8	18%
56 to 60	3	12%	3	7%
61 to 65	2	8%	10	23%
66 to 70	0	0%	6	14%
Over 70	0	0%	4	9%
Totals	25	100%	44	100%
Ages of Firefighters				
Sudden cardiac deaths only				
31 to 35	1	9%	1	4%
36 to 40	2	18%	1	4%
41 to 45	0	0%	1	4%
46 to 50	2	18%	2	8%
51 to 55	4	36%	6	25%
56 to 60	2	18%	0	0%
61 to 65	0	0%	8	33%
66 to 70	0	0%	3	13%
over 70	0	0%	2	8%
Totals	11	100%	24	100%
Fire ground deaths by fixed property use				
Dwellings and apartments	5	42%	3	38%
Wildland	2	17%	4	50%
Vacant commercial structure	2	17%	0	0%
Stores	1	8%	0	0%
Egg processing plant	1	8%	0	0%
Storage	0	0%	1	13%
Restaurant	1	8%	0	0%
Totals	12	100%	8	100%

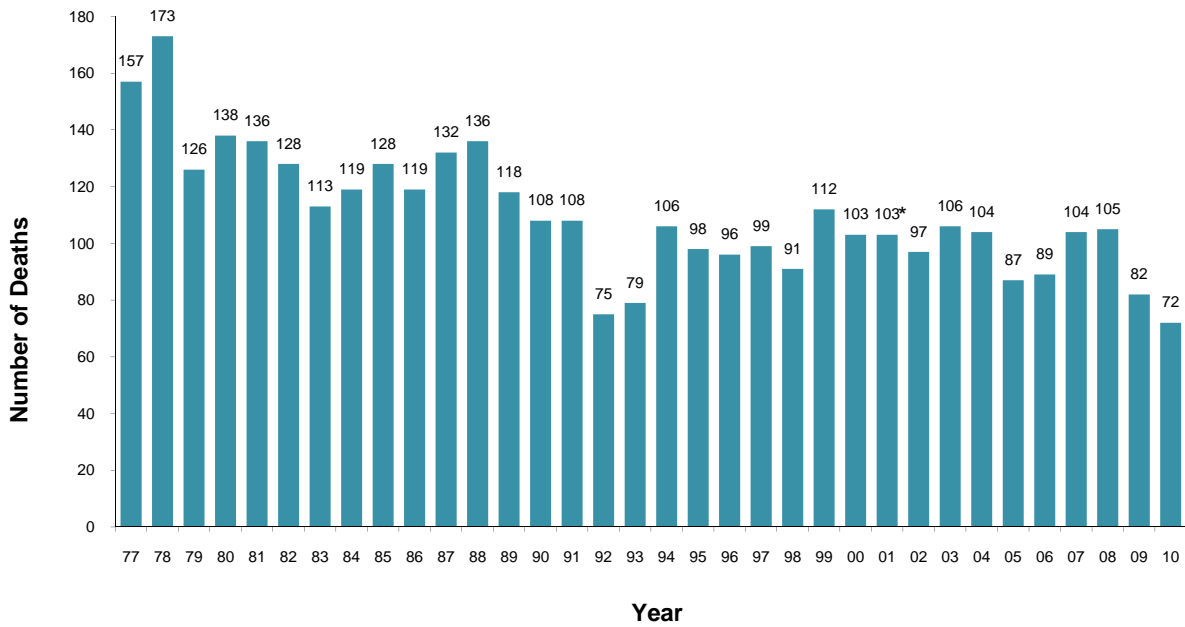
Table 1
Comparison of On-Duty Deaths Between
Career and Volunteer Firefighters, 2010* (Continued)

	Career Firefighters		Volunteer Firefighters	
	Number of Deaths	Percent of Deaths	Number of Deaths	Percent of Deaths
Years of service				
5 or less	7	28%	9	20%
6 to 10	2	8%	9	20%
11 to 15	4	16%	2	5%
16 to 20	2	8%	5	11%
21 to 25	4	16%	3	7%
26 to 30	4	16%	5	11%
over 30	2	8%	11	25%
Totals	25	100%	44	100%
Attributes of fire ground deaths**				
Intentionally-set fires	0		0	
Search and rescue operations	3		0	
Motor vehicle crashes				
	0		9	
False alarms				
	0		0	

* This table does not include the three victims who were employees of state land management agencies or belonged to an inmate firefighting crew.

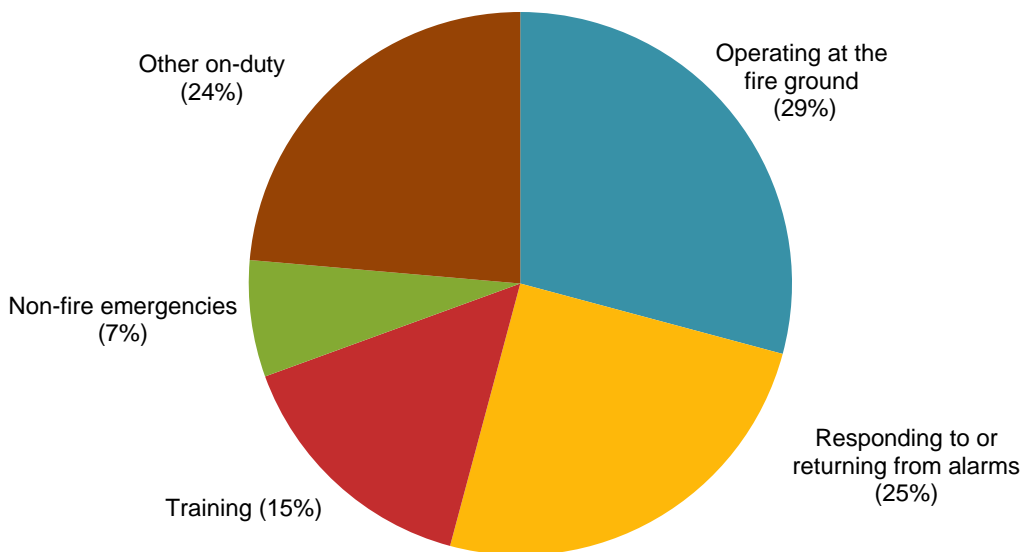
** Because these attributes are not mutually exclusive, totals and percentages are not shown.

Figure 1
On-Duty Firefighter Deaths - 1977-2010

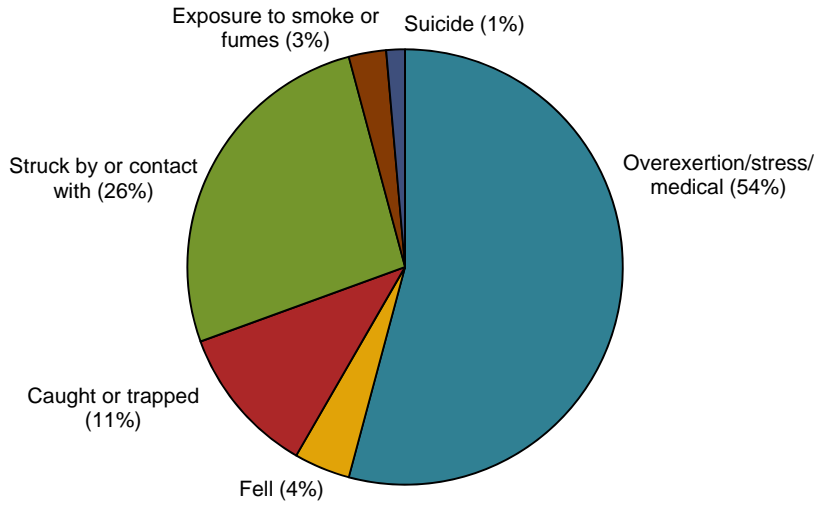


* excluding the 340 firefighter deaths at the World Trade Center

Figure 2
Firefighter Deaths by Type of Duty - 2010



**Figure 3
Firefighter Deaths by Cause of Injury - 2010**



**Figure 4
Firefighter Deaths by Nature of Injury - 2010**

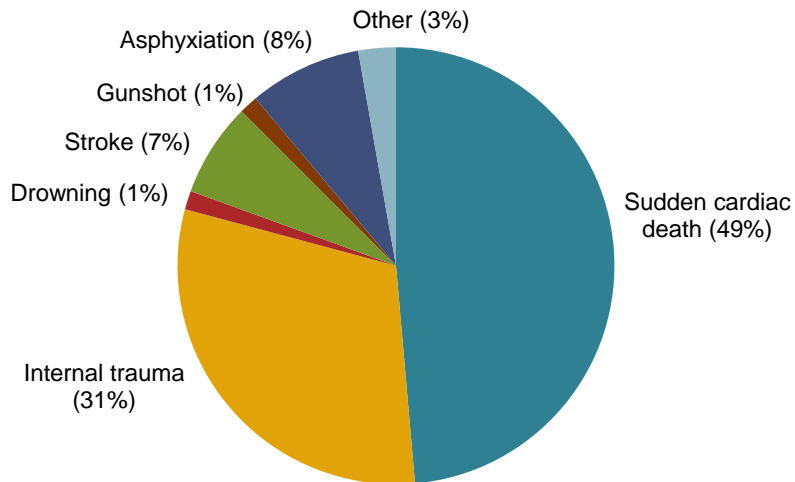


Figure 5
Firefighter Deaths by Age and Cause of Death - 2010

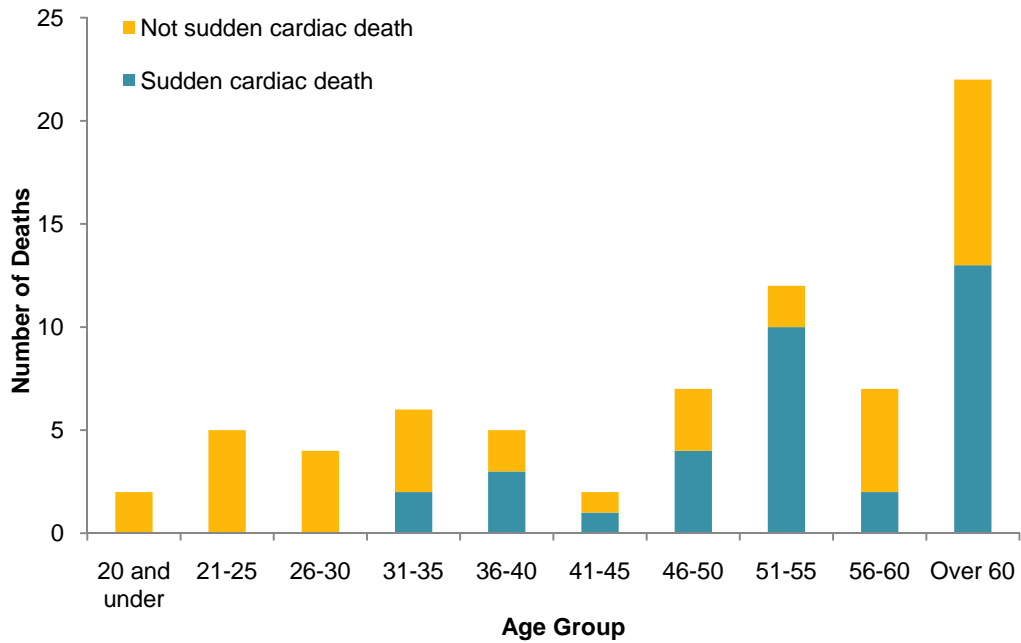


Figure 6
On-Duty Death Rates per 10,000 Career and Volunteer Firefighters 2006-2010

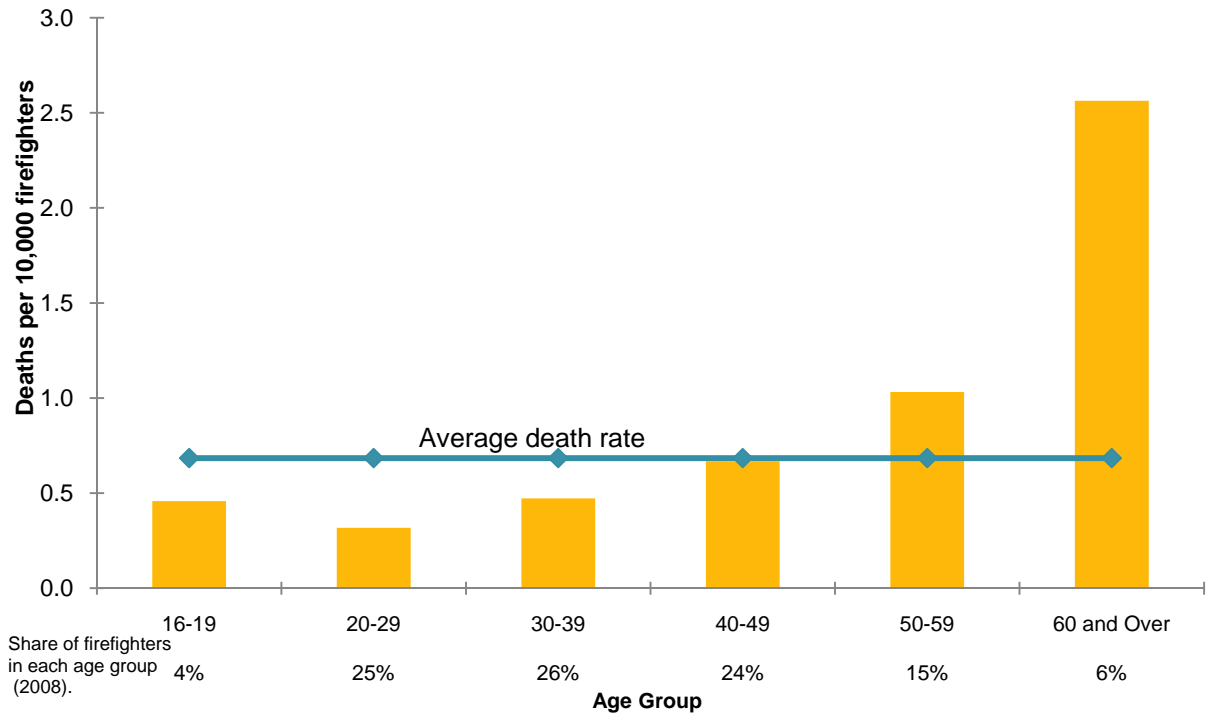
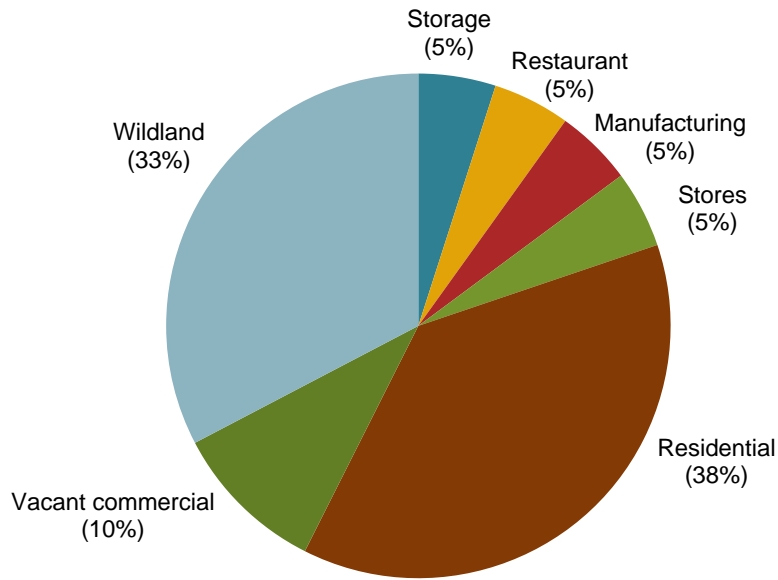


Figure 7
Fire Ground Deaths by Fixed Property Use - 2010*



*There were 21 deaths on the fire ground in 2010.

Figure 8
On-Duty Fire Ground Deaths per 100,000 Structure Fires 2005-2009

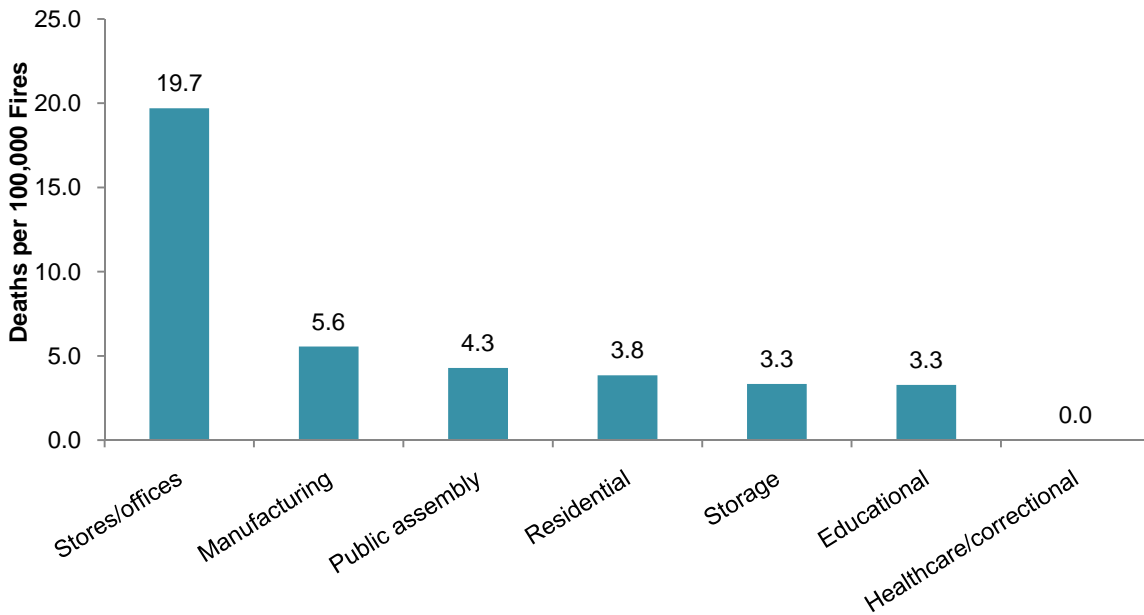
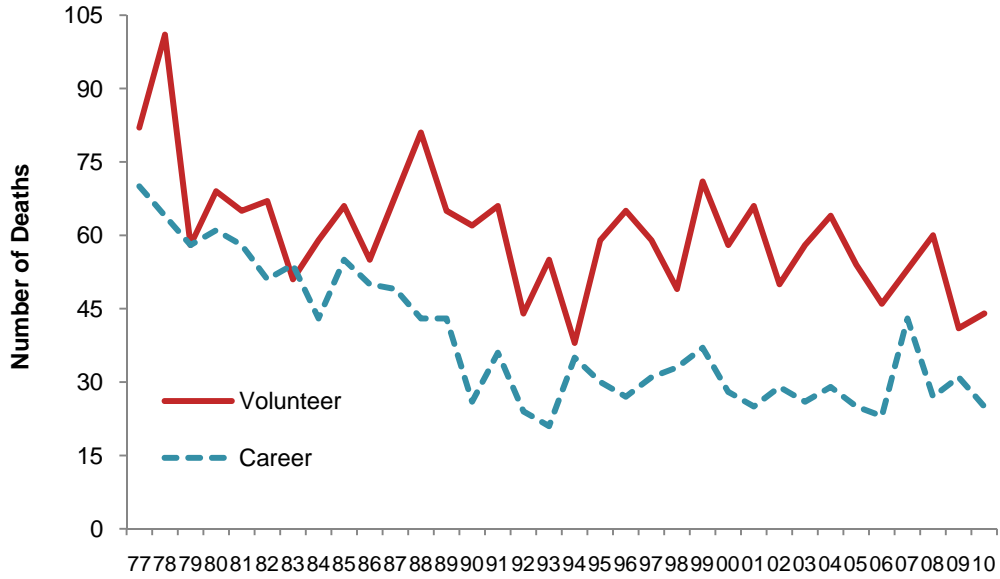


Figure 9
Career and Volunteer Firefighter Deaths
1977 - 2010*



* excluding the 340 firefighter deaths at the World Trade Center in 2001

SELECTED FIREFIGHTER FATALITY INCIDENTS

Crash during response

At 6 a.m., an 81-year-old firefighter crashed into a truck while driving his own car to the fire station to pick up an ambulance to respond to an emergency medical service (EMS) call. The truck had been involved in a crash and was blocking both travel lanes on a dark, unlighted roadway on which no hazard warning devices had been placed. After crashing into the rear of the truck, the firefighter's vehicle went off the road and struck a traffic sign. The vehicle then veered back onto the road, crossed it, and went off the opposite side of the road, where it came to a halt. The firefighter died on impact from severe blunt force trauma to the head.

Struck by vehicle

At 12:30 p.m., the fire department and other first responders, including fire/police officers, responded to a two-vehicle crash that knocked down a utility pole. A 62-year-old fire/police officer wearing a reflective vest put orange cones down to mark the crash scene and began directing traffic. He had been doing so for an hour when a 72-year-old man crashed through the cones and hit him. The impact threw the officer onto the front of the car and into the front windshield, which smashed, and over the roof into the rear windshield, which also smashed. The officer was transported to the hospital, where he was pronounced dead from blunt force trauma.

NIOSH investigated this incident and offers recommendations on its web site at <http://www.cdc.gov/niosh/fire/reports/face201006.html>

Drowning during rescue

At 1 a.m., the fire department received a mutual aid request for a swift water rescue crew to help evacuate people from a flooded area in a neighboring jurisdiction. A five-member team responded with its 14-foot (4-meter) hard-deck, soft-hull, self-bailing pontoon boat. When they arrived at the flooded area, the firefighters dressed in wet suits with personal floatation devices, quarter-length boots, gloves, and polycarbonate helmets. Three of the firefighters operated the boat while the other two stood by or worked with another department.

The crew in the boat had already completed four evacuations and removed 15 people when they received a call to help two more people who were trapped by the floodwaters. As they responded, the bottom of the boat hit a submerged object, causing it to make a hard left turn that sent it into the fast current. As the current carried them down stream, the firefighters yelled for help, but the boat struck a bridge and capsized before anyone could reach them. Two of the men were rescued by other firefighters. The body of the third was recovered six days later, 4.5 miles (7 kilometers) downstream. The cause of death was drowning, with a contributory factor of multiple blunt force injuries.

NIOSH investigated this incident and offers recommendations on its web site at <http://www.cdc.gov/niosh/fire/reports/face201009.html>

Training

At 8 a.m., a 53-year-old fire lieutenant with 30 years of service started his shift, as he had most of his previous shifts, by preparing morning reports and outlining the routine for the day. At 10 a.m., the fire department conducted a bi-annual training session consisting of a ladder climb, a hose drag, use of a pike pole, a crawl through a confined space, a dummy drag, a hose carry, and operation of a sled mechanism that simulates forcible entry with an ax. During the untimed session, which was done at a walking pace, the firefighters wore a full protective clothing ensemble with a self-contained breathing apparatus.

After the lieutenant completed the training, he complained of pain in his shoulder and left the training area.

When an alarm came in, both on-duty crews were dispatched. The lieutenant did not respond, and each crew assumed that he had responded with the other company or missed the call because he was taking a shower. On returning to the station, however, they found the lieutenant unconscious in the bunkroom. Firefighters began cardiopulmonary resuscitation and advanced life support, and the lieutenant was taken to a hospital where resuscitation efforts continued for another 10 minutes until the attending physician pronounced him dead. The cause of death is listed as an acute thrombus of left anterior descending artery due to hypertensive arteriosclerotic cardiovascular disease.

NIOSH investigated this incident and offers recommendations on its web site at <http://www.cdc.gov/niosh/fire/reports/face201011.html>.

Crash during response

At 9:15 p.m., a 25-year-old firefighter responding on his all-terrain vehicle (ATV) to a search and rescue call for a missing elderly man hit a whitetail deer that was crossing the road. The collision caused the ATV to veer off the road into a ditch and roll over. The firefighter, who was not wearing a helmet, was ejected from the ATV, which was not equipped with a seat belt. A passerby stopped at the crash scene and called 911 to report it. Although responding fire and police personnel found the firefighter in the ditch and administered first aid immediately, EMS personnel pronounced him dead at the scene. Cause of death was listed as blunt trauma of the head.

The elderly man returned home later that evening.

Wall collapse

A passerby discovered a fire at 4:45 a.m. in a building that housed a used office furniture store and warehouse and immediately called 911. The two-story structure, which was of ordinary construction and contained 14,000 square feet (1300 square meters) of ground floor area, was closed for the evening.

Responding to the fire was a battalion fire chief, four engine companies, a ladder company, and a quint, a combination fire apparatus with an aerial ladder as well as a pump, hose, water tank, and ladders.

The ladder company arrived and began to set up for a defensive attack in case it was needed. The first two engine companies forced the front door open but did not enter the building for an interior attack. When he arrived, the battalion fire chief did a scene size-up and ordered the fourth-due engine company to act as the rapid intervention team (RIT). The officer and a firefighter from the quint, dressed in full

protective clothing, advanced a charged 1 3/4-inch (44-millimeter) hose line through the front door, followed by a two-member team from each of the first two engine companies and the ladder company, also dressed in full protective clothing. Only one hose line was advanced into the structure.

The crews inside the building were confronted with crackling noises, intense heat, and thick smoke that resulted in zero visibility, but they didn't see any flames or hear any sounds of falling debris. After advancing the line of hose inside approximately 50 feet (15 meters), the crews left the building, leaving the hand line inside. The battalion fire chief, after setting up the command post, decided to begin a defensive attack but did not communicate this over the department radio.

A reported flashover took place some time after all the firefighters had left the building, blowing out the structure's front windows and causing fire to vent through the roof on the left side. Fire crews suppressed the fire using a defensive attack. One of two officers operating a hose line on the front right side of the building had walked about 6 feet (1.8 meters) away from the structure when the wall and a steel I-beam collapsed outward, striking the other officer who was within the collapse zone. The RIT and another officer quickly rescued the stricken man and transported him to a local hospital, where he was diagnosed as paralyzed from the waist down. He also had two broken arms, a broken left femur, a broken pelvis, broken ribs, and a punctured lung. His arteries were also damaged.

He was transferred to two additional hospitals and underwent numerous surgeries. He had progressed to the point that he was doing physical therapy, but died five months later of an unexpected pulmonary embolus as a result of complications of paraplegia.

Fall

At 00:36 a.m., the fire department was dispatched to a fire in a restaurant on the first floor of a four-story, mixed-occupancy building. When they arrived, firefighters determined that the fire was in the grease chute that extended from the ground level to the roof. The building was of ordinary construction with 1,650 square feet (153 square meters) of ground floor area. The stove area was protected by a fixed, wet-chemical system that did not activate; the reason why was not reported.

A 31-year-old firefighter with two years' experience, dressed in a full protective clothing ensemble including a self-contained breathing apparatus, climbed a fire escape to the fourth story carrying a water extinguisher. He then tried to scale a fixed fire escape ladder to the roof, still carrying the water extinguisher, but lost his grip and fell to the sidewalk. On-scene firefighters immediately performed first aid and transported him to a hospital, where he died of multiple traumatic injuries.

Brush Fire

At 5:45 p.m., more than 80 firefighters responded to a fast-moving grass fire across rough terrain with 10-foot (3-meter) flames. Two hours into the fire, a 54-year-old firefighter with more than 30 years' service collapsed on the fire ground. He was transported to a hospital, where he was pronounced dead from cardiomyopathy. He had had a pacemaker implanted 5 years earlier and had just had a physical examination, which cleared him to fight fires.

Exercising

At 4:30 p.m., firefighters found the deputy fire chief unconscious in the fire station workout room. He had been participating in an unsupervised, mandatory 40-minute exercise session that included the use of an exercise machine, shortly after responding to an emergency medical call. Paramedics were unable to resuscitate the chief, and he was pronounced dead at the hospital as a result of cardiac arrhythmia.

NIOSH investigated this incident and offers recommendations on its web site at <http://www.cdc.gov/niosh/fire/reports/face201033.html>.

Equipment failure

At 2:19 p.m., a 26-year-old firefighter with 2 months' experience was killed when a 120-gallon (454-liter) galvanized water tank he and his crew were using to fight a large brush fire failed. The four-member crew was operating from an SUV-type vehicle with off-road capability, along with firefighters from other departments. The vehicle's water tank was designed to be pressurized to a maximum of 75 psi using two 3,000-psi self-contained breathing apparatus cylinders connected to a pressure regulator. The tank was connected to a power reel that contained the fire hose.

The four firefighters were standing at different positions around the vehicle when the tank failed. The victim, who was taking a break from fighting the fire with hand tools, was standing at the rear on the driver's side.

When the tank failed, the end of it struck the power reel and deflected into the woods. The power reel separated from the bed of the vehicle and struck the tailgate, which sent the reel into the air. It hit the firefighter on the head and shoulder, killing him instantly. The nature of death was listed as traumatic injuries to the head. A second firefighter who was also injured was transported to the hospital, treated, and released.

Confined space

At 3:52 p.m., the department of public works (DPW) received a telephone call from the police about sewage backing up. A heavy motor equipment operator and a road maintenance foreman, who was also a volunteer firefighter, responded in a truck equipped with a large vacuum. The general foreman of the DPW also responded. Their attempt to clear the blockage was unsuccessful, but they were able to trace the blockage to the front of a municipal volunteer fire station. They notified the fire department, and a short time later, the fire chief and a firefighter arrived. A second firefighter in the area also came to the site to see what was happening.

After failing to clear the blockage in the front of the station, the DPW crew moved to the back of building and opened a manhole. The road maintenance foreman shouted that the sewer was clogged and went into the manhole without any protective clothing or equipment. No one tried to stop him, and witnesses said that they thought he had fallen when they saw him at the bottom of the 15-foot (4.6-meter) manhole. The general foreman told the fire chief to call for the ambulance squad and the two firefighters to get boots, a length of rope, and a gas meter from the station.

One of the two firefighters, a 51-year-old friend of the foreman, entered the manhole in a rescue attempt. No one tried to stop him, although he was not wearing protective clothing or a self-contained breathing apparatus, either. When he reached the halfway point, he collapsed to the bottom of the manhole. Only

then was the gas meter lowered into the manhole. The meter's alarm went off, indicating that there was only 11 to 14 percent oxygen available. Both men died as a result of asphyxiation from the lack of oxygen and sewer gases in the manhole.

The State Department of Labor investigated the incident and found four problems. First, the DPW stated that their work force did not enter confined spaces because they have trucks equipped with vacuums, but they did, in fact, enter confined spaces. Second, the fire department was not prepared to enter confined spaces. Third, the fire department's respiratory program was lacking, and fourth, the firefighters were not properly trained to identify the hazards of confined spaces. As a result of these findings, the state issued four notices of violation that require the municipality to correct them or be fined \$200 per day per violation.

Individuals entering a confined space for rescue purposes should be qualified to NFPA 1006, *Technical Rescuer Professional Qualifications*, Chapter 7 Confined Space Rescue. Requisite knowledge includes the effects of hazardous atmospheres. Requisite skills include the ability to use atmospheric monitoring equipment and use and apply appropriate personal protective equipment. Organizations providing confined space rescue should also meet the requirements of NFPA 1670, *Operations and Training for Technical Search and Rescue Incidents*, Chapter 7 Confined Space Search and Rescue.

Vehicle Maintenance

A 53-year-old fire captain with 5 years' of service was killed instantly when he was caught between the firehouse wall and the department's brush truck as he helped another firefighter work on the truck's front left wheel. At one point during the work, the wheel had to be repositioned, and a firefighter got into the truck to turn the wheel. The firefighter thought the ignition key was in the locked position, but when he turned it, the truck lurched forward, striking the fire captain who was standing in front of it. Another firefighter standing in front of the truck was able to jump out of the way and escaped serious injuries. The fire captain died as a result of a basilar skull fracture due to blunt force trauma injury.

NIOSH investigated this incident and offers recommendations on its web site at <http://www.cdc.gov/niosh/fire/reports/face201037.html>.

Structure Fire

A 52-year-old lieutenant and his wife, also a firefighter, responded to an alarm of fire at a single-family dwelling at 11:59 a.m. Within 2 minutes, the lieutenant, who was in street clothes, arrived at the scene driving a pumper, and his wife arrived driving a tanker. The fire chief, assistant fire chief, and seven firefighters also responded in their own vehicles. On arrival, they found the fire burning in the hallway and living room of the unoccupied house.

The lieutenant parked the pumper, placed the pump in gear, and stretched two 200-foot (61-meter), pre-connected, 1 ³/₄-inch (44-millimeter) lines of hose to the front door. The assistant fire chief then operated the pump as firefighters began interior fire suppression. The lieutenant got a 60-pound (27-kilogram), gasoline-engine-driven, positive-pressure ventilating fan from the pumper, brought it to the front porch, and started it by pulling on the rope starter. A few minutes later, the fan ran out of fuel and stopped. The lieutenant retrieved a 2-gallon (7.5-liter) container of fuel and refueled and restarted the fan. He then left the front porch and collapsed a short distance away at approximately 12:15 p.m. The

on-scene firefighters found him unresponsive, without a pulse and not breathing, and started CPR. They also notified fire dispatch.

In accordance with dispatch protocol, an ambulance was already responding to the scene in case someone got hurt. Dispatch informed the ambulance crew of the lieutenant's collapse, upgrading their response. When they arrived at approximately 12:21 p.m., paramedics found the lieutenant still unresponsive, with CPR in progress. A cardiac monitor revealed ventricular fibrillation, and paramedics applied a shock, to which the lieutenant did not respond. Cardiac resuscitation medications were administered through an intravenous line, and two additional shocks were applied, but the lieutenant's heart rhythm remained the same.

The ambulance left the fire scene at 12:36 p.m. and arrived at the emergency department at 12:40 p.m. After 45 minutes of continuous attempts to revive the lieutenant, the attending physician pronounced him dead. The death certificate listed arteriosclerotic cardiovascular disease as the cause of death. The 9-year veteran had had two previous heart attacks. The first, in 1998, resulted in five-vessel coronary artery bypass grafts, and the second, in 2008, resulted in an angioplasty with stent placement.

NIOSH investigated this incident and offers recommendations on its web site at <http://www.cdc.gov/niosh/fire/reports/face201026.html>

Struck by snag

At 9:30 p.m., wildland firefighters arrived at the scene of a fire on a rocky bluff and decided not to start suppression activities immediately because of the terrain, wood debris, and lack of resources at risk. After a safety meeting at 8:30 the next morning, a four-person team dressed in appropriate firefighting clothing started suppression activities, constructing a fire line at the top of the steep bluff and in other areas to prevent materials from rolling off the edge.

The four firefighters then went to the base of the bluff where spot fires were burning. While they were making a small line with hand tools, a snag at the top of the bluff fell and rolled down the hill, striking a 58-year-old firefighter on his hardhat. The snag was a tree whose roots burned through. The victim sustained serious head injuries that left him unconscious, with a fractured hip, bruises, and second-degree burns on his calves. The on-scene firefighters provided first aid until he was transported to the hospital by helicopter.

Five months later, after numerous operations, the firefighter died as a result of complications due to the traumatic injuries he had received.

An investigation into the cause of the fire revealed that a construction and excavation company clearing a construction site had set a brush pile on fire despite a ban on burning. The fire spread, consuming 12 acres (4.8 hectares) of wildland.