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NIOSH

ALERT

SEPTEMBER 1994

REQUEST FOR ASSISTANCE IN

Preventing Injuries and Deaths of Fire Fighters



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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NIOSH ALERT



Request for Assistance in

Preventing Injuries and Deaths of Fire Fighters

WARNING!

Fire departments must review their safety programs and emergency operating procedures; failures to establish and follow these programs and procedures are resulting in injuries and deaths of fire fighters.

The National Institute for Occupational Safety and Health (NIOSH) requests assistance in preventing injuries and deaths of U.S. fire fighters. A recent NIOSH investigation identified four factors essential to protecting fire fighters from injury and death: (1) following established fire-fighting policies and procedures, (2) implementing an adequate respirator maintenance program, (3) establishing fire fighter accountability at the fire scene, and (4) using personal alert safety system (PASS) devices at the fire scene. Deficiencies in any of these factors can create a life-threatening situation for fire fighters.

NIOSH requests that the information in this Alert be brought to the attention of all U.S. fire fighters—including members of the largest metropolitan fire departments and the smallest rural volunteer fire departments—by the following: editors of trade journals and other related publications, safety and health officials, labor organizations, fire-fighting agencies, and insurance companies.

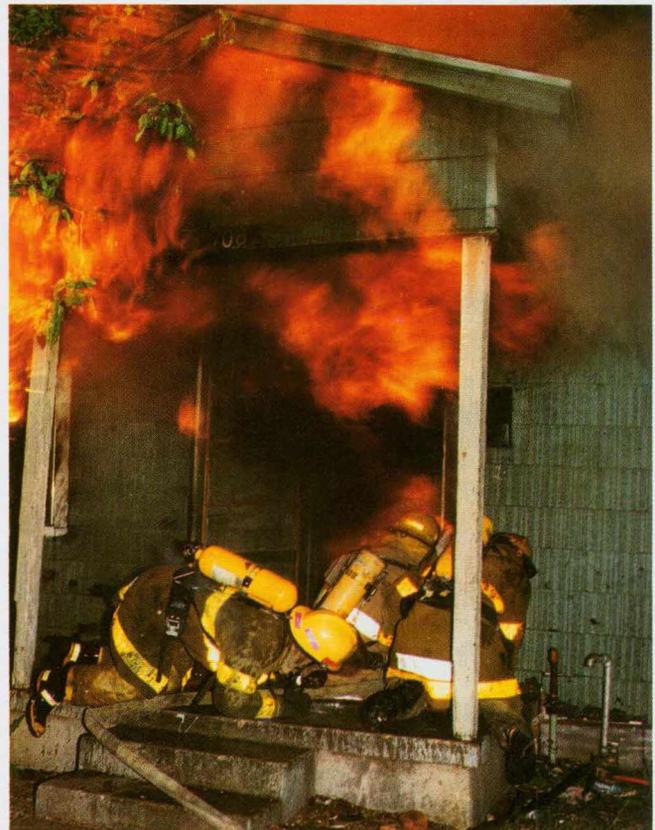


Photo by Glen E. Ellman (printed with permission)

Fire fighters wearing self-contained breathing apparatus (SCBAs) and other protective gear at the scene of a fire.

BACKGROUND

Fatality data for U.S. fire fighters are collected by the NIOSH National Traumatic Occupational Fatalities (NTOF) Surveillance System, the International Association of Fire Fighters (IAFF), and the National Fire Protection Association (NFPA).

During the period 1980–89, 278 fire fighters died from work-related causes, according to data from the NTOF Surveillance System [NIOSH 1994b]. This figure includes only deaths from traumatic injury—not those from other causes such as heart attacks. The actual number of fire fighters who died is higher than reported by NTOF because methods for collecting and reporting these data tend to underestimate the total number of deaths [NIOSH 1993].

Data collected by the IAFF show that 1,369 professional fire fighters died in the line of duty during the period 1970–94 [IAFF 1994].

Data collected by the NFPA show that 280 fire fighters died and approximately 100,000 were injured in the line of duty during the period 1990–92 [Washburn et al. 1991, 1992, 1993].

CURRENT STANDARDS

OSHA and MSHA Regulations

State and local government employees are exempt from Federal OSHA standards. However, in the 25 States currently authorized by OSHA to run their own safety and health programs, all OSHA regulations apply to both public and private employees.

Current OSHA regulations that apply to fire fighters include 29 CFR* 1910.134 (Respiratory Protection) and 29 CFR 1910.156 (Fire Brigades). In 29 CFR 1910.134, employers are required to provide respirators suitable for the purpose intended and to establish and maintain a respiratory protection program. In 29 CFR 1910.156, requirements are listed for organizing, training, and equipping fire brigades established by the employer.

NIOSH and Mine Safety and Health Administration (MSHA) regulations [30 CFR 11] list the requirements for certifying respiratory protective devices, including self-contained breathing apparatus (SCBA).

Consensus Standards

The National Fire Protection Association (NFPA) recommends that all fire departments establish a policy of providing and operating with “the highest possible levels of safety and health for all members” [NFPA 1992]. Several NFPA standards apply to fire-fighting operations:

- NFPA 1404 specifies the minimum requirements for a fire service respiratory protection program [NFPA 1989].
- NFPA 1500 specifies (1) the minimum requirements for a fire department’s occupational safety and health program, and (2) the safety procedures for members involved in rescue, fire suppression, and related activities [NFPA 1992].
- NFPA 1561 defines the essential elements of an incident management system [NFPA 1990].

*Code of Federal Regulations. See CFR in references.

- Other relevant NFPA standards include NFPA 1971 (clothing), NFPA 1972 (helmets), NFPA 1973 (gloves), NFPA 1974 (footwear), NFPA 1981 (SCBA), and NFPA 1982 (PASS).

The American Society of Mechanical Engineers (ASME) has recommended the following standards for the control of elevators by fire fighters [ASME 1990a, b]:

- ASME A17.1—1990 Safety Code for Elevators and Escalators (as amended)
- ASME A17.3—1990 Safety Code for Existing Elevators and Escalators (as amended)

CASE REPORT: TWO DEATHS

On April 11, 1994, at 0205 hours, a possible fire was reported on the ninth floor of a high-rise apartment building [NIOSH 1994a]. This building had been the scene of numerous false alarms in the past. An engine company and a snorkel company were the first responders and arrived at the apartment building at 0208 hours. The engine company was the first on the scene and assumed command.

Five fire fighters from the two companies entered the building through the main lobby. They were aware that the annunciator board showed possible fires on the ninth and tenth floors. Lobby command radioed one fire fighter that smoke was showing from a ninth-floor window. All five fire fighters used the lobby elevator and proceeded to the ninth floor.

When the doors of the elevator opened on the ninth floor, the hall was filled with thick black smoke. Four of the fire fighters stepped off the elevator. The fifth fire fighter, who was

carrying the hotel pack,[†] stayed on the elevator (which was not equipped with fire fighter control) and held the door open with his foot as he struggled to don his SCBA. His foot slipped off the elevator door, allowing the door to close and the elevator to return with him to the ground floor.

The remaining four fire fighters entered the small ninth-floor lobby directly in front of the elevator. One fire fighter stated that he was having difficulty with his SCBA and asked for the location of the stairwell. Another fire fighter said, "I've got him," and proceeded with him into the hallway, turning right. Later, one of the four fire fighters stated that he had heard air leaking from the SCBA of the fire fighter having difficulty and had heard him cough.

The remaining two fire fighters entered the hallway and turned left, reporting zero visibility because of thick black smoke. Excessive heat forced them to retreat after they had gone 15 to 20 feet. They proceeded back down the hall past the elevator lobby. There they encountered a male resident, who attacked one of the fire fighters, knocking him to the floor and forcibly removing his facepiece. The two fire fighters moved with the resident through the doorway of an apartment, where they were able to subdue him. One fire fighter broke a window to provide fresh air to calm the resident. At about the same time, the low-air alarm on his SCBA sounded. The other fire fighter was unable to close the apartment door because of excessive heat from the hallway. Both fire fighters and the resident had to be rescued from the ninth-floor apartment window by a ladder truck.

Fire fighters from a second engine company arrived on the scene at 0209 hours. They

[†]Two 100-foot lengths of hose. The hotel pack is also referred to as "standpipe pack" or "high-rise pack."

observed a blown-out window on the ninth floor and proceeded up the west-end stairwell to the ninth floor carrying a hotel pack and extra SCBA cylinders. These fire fighters entered the ninth floor with a charged fire hose and crawled down the smoke-filled hall for approximately 60 feet (the hallway was 104 feet long) before extreme heat forced them to retreat. As they retreated, they crawled over something they thought was a piece of furniture. They did not remember encountering any furniture when they entered the hallway. In the dense smoke, neither fire fighter could see the exit door 6 feet away, and both became disoriented.

After the fire fighter from the first company rode the elevator to the ground floor lobby, he obtained a replacement SCBA and climbed the west-end stairs to the ninth floor. When he opened the ninth-floor exit door, he saw the two fire fighters from the second engine company in trouble. He pulled both into the stairwell.

When a rescue squad arrived at the scene at 0224 hours, lobby command could not tell them the location of the fire fighters from the first company. They proceeded up the west-end stairs to the ninth floor.

The rescue squad opened the ninth-floor exit door and spotted a downed fireman approximately 9 feet from the door. He was tangled in television cable wires that had fallen to the floor as a result of the extreme heat. The downed fireman was from the first engine company; his body may have been what the fire fighters from the second engine company encountered in the hallway. He was still wearing his SCBA, but he was unresponsive. The rescue squad carried him down the stairs to the eighth floor, where advanced life support was started immediately.

The rescue squad then entered the first apartment to the left of the exit door and found a

second fire fighter from the first engine company kneeling into a corner and holding his mask to his face. He was unresponsive. The rescue squad carried the fire fighter down the stairs to the eighth floor where advanced life support was started.

Both fire fighters were removed within minutes and taken to a local hospital, where advanced life support was continued; but neither responded. Both victims died from smoke and carbon monoxide inhalation.

Both victims wore PASS devices; but because the devices were not activated, no alarm sounded when the fire fighters became motionless.

DISCUSSION

Many factors contributed to the deaths and injuries that occurred in this incident. The key factors were as follows:

- The first five fire fighters on the scene took an elevator to the floor of the fire—a violation of their department's written policy. Fire fighter entrapment in automatic elevators is a recognized hazard, and the elevators in this incident had no fire fighter control. ASME standards require fire fighter control for all elevators, and many elevator codes and installation practices were changed years ago to facilitate their safe use for fire fighting.
- At least one of the SCBAs leaked during this incident, and the respirator maintenance program appears to have been deficient. All four SCBAs tested by NIOSH failed at least two of five performance tests.

- When the rescue squad inquired about the location of the first fire fighters at the scene, no one could account for them. Accountability for all fire fighters at the scene is one of the fire command's most important duties.
- PASS devices were worn but not activated by the two fire fighters who died. These devices should always be worn and activated when fire fighters are working at the fire scene.

CONCLUSIONS

Although many factors contributed to the deaths and injuries reported here, they might have been prevented if these essential steps had been taken:

- Following established fire-fighting policies and procedures
- Implementing an adequate respirator maintenance program
- Establishing fire fighter accountability at the fire scene
- Using PASS devices at the fire scene

These precautionary steps are well known to fire departments and fire fighters, but they require constant emphasis to assure the safety of fire fighters.

RECOMMENDATIONS FOR FIRE DEPARTMENTS

NIOSH recommends that fire departments take the following precautions to protect fire fighters from injury and death:

1. Establish and implement an incident

management system with written standard operating procedures for all fire fighters. The system should provide for the following:

- A well-coordinated approach to the emergency
- Accountability of all fire fighters
- Overall safety of all fire fighters at the scene of the emergency

Train fire fighters in this system and provide periodic refresher courses to review policies and procedures. Fire fighters must always be fully aware of standard operating procedures and of their roles and responsibilities.

2. Develop and implement a written respirator maintenance program for all respiratory protective equipment used by fire fighters. Establish service and maintenance procedures and rigidly enforce them to provide respirators that are dependable and are constantly evaluated, tested, and maintained.

Include the following elements in the respiratory program:

- *Service checks.* Include daily, weekly, and monthly service checks in the standard operating procedures for servicing and testing SCBAs, cylinders, air quality, and air supply equipment. Such testing and servicing is extremely important in maintaining SCBAs for use in emergencies.
- *Approved respirators.* Use only respirators approved for use in hazardous atmospheres; maintain them in a NIOSH/MSHA-approved condition so that they are the equivalent of devices that have received a certificate of approval [30 CFR 11.2(a)].

- **Training.** Train fire fighters in the use, care, and maintenance of respiratory equipment. Provide courses to review the fire department's policies and procedures for respiratory protection.
- **Recordkeeping.** Recordkeeping is a critical element of any respiratory protection program. Record the following items:
 - Results of the regular calibrations of the test equipment recommended by the manufacturer
 - Results of regularly conducted performance tests
 - Repairs made during routine preventive maintenance and necessary maintenance on SCBAs taken out of service.

These records should include the SCBA and regulator identification numbers, test equipment identification numbers, dates of servicing, a description of the action taken (including parts replaced and part numbers involved), and identification of the repair person [29 CFR 1910.134; 49 CFR 173; NFPA 1989; NIOSH 1987].

- **Tracking system for SCBA cylinders.** Establish a tracking system for SCBA cylinders to ensure that they are hydrostatically retested and recertified (every 3 years for aluminum and composite cylinders, and every 5 years for steel cylinders) as required by the Department of Transportation (DOT) [49 CFR 179.34 (e)(13)] and NIOSH [30 CFR 11.80(a)].

3. Establish and implement a system of accountability that will enable the commander at the scene of the emergency to account for the location and function of each company or unit at the scene. Also

use a standard personnel identification system that can rapidly account for each department member at the scene.

4. Employ a buddy system whenever fire fighters wear SCBAs. Fire fighters who wear breathing apparatus should never enter a hazardous area alone. Two fire fighters should work together and remain in contact with each other at all times. Two additional fire fighters should form a rescue team that is stationed outside the hazardous area. The rescue team should be trained and equipped to begin a rescue immediately if any of the fire fighters in the hazardous area require assistance. A dedicated rapid-response team may be required if more than a few fire fighters are in the hazardous area [Morris et al. 1994; NFPA 1990, 1992; NIOSH 1990].

5. Provide PASS devices and ensure that fire fighters wear and activate them when they are involved in fire fighting, rescue, or other hazardous duties [NFPA 1992].

6. Encourage municipalities to review and amend their elevator and life safety codes to require fire fighter control for all elevators with a total travel distance greater than 25 feet [ASME 1990a,b].

7. Guard against heat stress and other medical emergencies at the fire scene; provide cool water supplies, rest areas, and access to emergency medical personnel [NIOSH 1985, 1986].

RECOMMENDATIONS FOR FIRE FIGHTERS

Fire fighters should take the following steps to protect themselves from injury and death:

1. Follow all established policies and procedures.

2. Wear and activate your PASS device at the scene of every emergency.

3. Wear the appropriate protective clothing and equipment (including your SCBA) at all incidents where hazardous atmospheres might be encountered.

4. Check your SCBA to assure that it is in working order and has been properly maintained.

5. Drink fluids frequently and be aware of signs of heat stress [NIOSH 1985, 1986].

ACKNOWLEDGMENTS

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We greatly appreciate your assistance in protecting the lives of U.S. workers.



Linda Rosenstock, M.D., M.P.H.
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NIOSH ALERT

Preventing Injuries and Deaths of Fire Fighters

WARNING!

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- Develop and implement a written respirator maintenance program for all respiratory protective equipment used by fire fighters. Establish service and maintenance procedures and rigidly enforce them to provide respirators that are dependable and are constantly evaluated, tested, and maintained.
- Establish and implement a system to account for the location and function of all companies, units, and fire fighters at the scene of an emergency.
- Employ a buddy system whenever fire fighters wear self-contained breathing apparatus (SCBAs).
- Provide personal alert safety system (PASS) devices and ensure that fire fighters activate them when they are involved in fire fighting, rescue, or other hazardous duties.
- Encourage municipalities to review and amend their elevator and life safety codes to require fire fighter control for all elevators with a total travel distance greater than 25 feet.
- Guard against heat stress and other medical emergencies at the fire scene; provide cool water supplies, rest areas, and access to emergency medical personnel.

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- Wear the appropriate protective clothing and equipment (including your SCBA) at *all* incidents where hazardous atmospheres might be encountered.
- Check your SCBA to assure that it is in working order and has been properly maintained.
- Drink fluids frequently and be aware of signs of heat stress.



Photo by Glen E. Ellman (printed with permission)

Fire fighters in protective gear at the scene of a fire.

Call 1-800-35-NIOSH (1-800-356-4674) for additional information or for free single copies of the complete *NIOSH Alert: Request for Assistance in Preventing Injuries and Deaths of Fire Fighters* [DHHS (NIOSH) Publication No. 94-125].

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