



Volunteer Fire Fighter Dies after Ten-Foot Fall From Engine – Ohio

SUMMARY

On July 24, 2007, a 38-year-old male volunteer fire fighter (victim) died after falling from the top of an engine. The victim had returned to the fire station after working a structure fire and was preparing the engine for future fire calls. Following the reloading of hose on the engine, the victim climbed on the driver's side of the engine to adjust and secure a vinyl hose bed cover. While attempting to adjust the cover, the victim slipped and fell onto the station's concrete apron. The victim landed on his head and lay supine on the ground. The victim was transported to an area hospital where he received medical care and was pronounced dead. Key contributing factors identified in this investigation include: the design of the engine which introduced numerous potential fall risks when loading the hose bed and securing the vinyl protective cover, fire department practices in loading the hose bed and securing the vinyl hose bed cover which were unwritten and inadequately addressed fall hazards, and damage to the mounting system of snaps which made securing the vinyl hose bed cover more cumbersome.

NIOSH investigators concluded that, to minimize the risk of similar incidents, fire departments should:

- *develop and implement Standard Operating Procedures (SOPs) on the correct procedures/safe methods for reloading hose and securing hose bed covers*
- *consider requiring the use of a ladder when servicing items that are out of reach from ground level on the fire apparatus*
- *ensure that hose bed covers on fire apparatus are maintained in good physical condition or are replaced when needed*
- *consider when purchasing a new fire apparatus, that it be equipped with available safety features to assist with hose loading and covering the hose bed (e.g., a hose bed that hydraulically lowers, or hose bed covers that are hydraulic, roll-up, or hinged metal)*

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In fiscal year 1998, the Congress appropriated funds to NIOSH to conduct a fire fighter initiative. NIOSH initiated the Fire Fighter Fatality Investigation and Prevention Program to examine deaths of fire fighters in the line of duty so that fire departments, fire fighters, fire service organizations, safety experts and researchers could learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent future fire fighter deaths and are completely separate from the rulemaking, enforcement and inspection activities of any other federal or state agency. Under its program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim. For further information, visit the Program Website at www.cdc.gov/niosh/fire or call toll free **1-800-CDC-INFO** (1-800-232-4636).



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Although it was difficult to substantiate the actual level of lighting when the incident occurred, NIOSH concludes that as a matter of prudent safe operations, fire departments should:

- *ensure adequate exterior lighting for activities outside the fire station*

INTRODUCTION

On July 24, 2007, a 38-year-old male volunteer fire fighter (victim) died after falling from the top of an engine. Following the reloading of the hose on the engine, the victim climbed on the driver's side to adjust and secure the vinyl hose bed cover. The victim slipped and fell onto the station's concrete apron.

On July 25, 2007, the National Institute for Occupational Safety and Health (NIOSH) was notified of this incident by the U. S. Fire Administration (USFA). On August 22, 2007, an investigation of this incident was conducted by a Safety and Occupational Health Specialist and a guest researcher from NIOSH. Meetings and interviews were conducted with the Chief, a Captain, the assistant Emergency Medical Service (EMS) chief, and the 2 fire fighter/emergency medical technicians (EMT's) from the fire department who were present at the time of the incident. Copies of the department's Standard Operating Procedures (SOPs), vehicle maintenance records, dispatch log, the police report, and the death certificate were reviewed.

FIRE DEPARTMENT

The combination fire department involved in this incident served a population of 8,000 in a geographical area of 85 square miles and was comprised of 40 personnel. Thirty were volunteers and 10 were paid part-time. The volunteers were mostly comprised of individuals who were exclusively fire firefighters. Nine of these individuals were fire fighter/EMT's. The paid personnel were all EMT's exclusively. The fire department received its funding from a combination of local village and township money and charitable donations that were raised through fund raising.

As part of its administrative policies, the fire department had standard operating procedures (SOPs) for self contained breathing apparatus (SCBA) use, full bunker gear, PASS devices, communications equipment, emergency vehicle operations, emergency operations, incident command, and a rapid intervention team. It did not have a SOP for seat belt restraint use or 2-in 2-out. The department had not experienced any other deaths or vehicle related incidents prior to this incident.



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TRAINING AND EXPERIENCE

The fire fighter (victim) had been a volunteer member of the combination department for approximately 1 year and 8 months. The victim was certified by the State of Ohio as a volunteer fire fighter. The Volunteer Fire Fighter Certification level course is thirty-six hours in length, and introduces the student to basic concepts, equipment and techniques. The victim took the state certification examination and obtained certification in 2005. He completed additional training for rapid intervention teams (RIT), apparatus operation, first aid and CPR, search and rescue, and live fire training. The victim became a driver for the department in August 2006.

PERSONAL PROTECTIVE EQUIPMENT

At the time of the incident, the victim was wearing a t-shirt, bunker pants, and leather fire fighting boots. The victim was not wearing a helmet, an SCBA, or a coat. It was uncertain if he had gloves on at the time of the incident.

EQUIPMENT

The vehicle that was involved in the incident was an engine/pumper truck. It was registered in the state of Ohio and manufactured locally in 1990 per the fire department's specifications. The department purchased the engine when it was new. The engine's specifications included:

- Overall vehicle length: 27 feet
- Vehicle width: 8 feet 2 inches
- Wheelbase: 17 feet 4 inches
- Height: 10 feet

The fire department had the engine inspected annually (the most recent being July 2006), despite a lack of state requirements to do either vehicle inspection or fire apparatus inspection. The department had an SOP for vehicle maintenance which was being followed at the time. The fire department vehicles were maintained by a local, experienced business, and documented records of the vehicles' maintenance were kept. The Chief of the department, stated that he believed that the current vinyl hose bed cover was the original one that came on the engine when it was purchased in 1990.

WEATHER/CONDITIONS

The incident occurred on a clear and breezy day. The ambient temperature was greater than 80° Fahrenheit. The department apron pad in front of the station where the engine was parked at the time



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of the incident was comprised of concrete. According to some of the fire fighters at the scene, the ambient light seemed good, even though dusk was approaching. The department's front exterior lighting over the garage doors consisted of florescent type light bars. However, they were unable to be utilized because the bulbs needed replaced. Additionally, exterior lights were located on both front corners of the fire station, over each entry door that may have provided additional light if they had been utilized.

INVESTIGATION

On July 24, 2007, the volunteer firefighter (victim) responded with his department to a structure fire at 1711 hours. A total of 9 emergency response vehicles were at the scene including 5 engines (2 of which were from the victim's department), 2 rescue/medic units (1 of which was from the victim's department), 1 grass truck from the victim's department, and a rescue truck from a neighboring department. After being on scene for approximately 3 hours, the chief separated his fire fighters into two groups. The first group remained at the scene, while the second group (which included the victim) returned to the station to prepare the engine for future fire calls.

The victim drove the engine back to the fire station with three fire fighters and a Captain on board. A grass truck with two fire fighters on board followed the engine. They arrived at the fire station at 2041 hours. In addition to these seven individuals, there were two junior fire fighters already at the station. This made a total of nine fire fighters at the station.

The victim parked the engine and positioned it with its rear section in the bay area, while the front section was on the concrete apron in front of the station (Photo 1). According to fire fighters who were at the station during this time, the victim was reloading hose onto the engine's hose bed prior to the incident. The victim and one of the junior fire fighters unloaded approximately 250 feet of hose that had been used at the structure fire. Following the hose unloading, a second fire fighter along with the second junior fire fighter handed approximately 200 feet of dry hose up to two fire fighters that had climbed up on the engine and into the hose bed.

Following the reloading of hose, the first junior firefighter descended from the back of the engine, while the victim remained on top of the engine to load the fire nozzle that was attached to the end of the hose. The victim then began to cover the bed with a vinyl hose bed cover. He attached the cover with a bungee cord to the water deck gun at the front of the hose bed because most of the grommet-snaps on the front of the cover no longer worked (Photo 2). He then attached the right side of the cover with the original grommet-snaps on the cover (Photo 3). After securing the back of the cover, the victim descended from the hose bed at the back of the engine.

The victim walked around to the driver's side of the engine to a point that was even with the front of the hose bed. He ascended the side of the engine near the pump panel by gripping a handle and climbing up on two extended foot steps (Photo 4). He was positioned with his left foot on the top step and his right knee on a metal ledge next to the hose bed where the hard suction hose is mounted.



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It should be noted, that the victim only had approximately 3 inches of available space on the metal ledge for his knee, due to the strainer hose and mounting hardware. The victim began to draw the vinyl cover over the hose bed's front left side (Photo 5). The left side of the cover required the use of bungee cords because the grommet-snaps no longer worked on this side. While the victim was attempting to adjust the cover over the hose bed, a fire fighter in the area saw the victim lose his balance and fall backwards from the engine. Attempting to arrest his fall, the victim reached for the front corner of the vinyl cover, however, it was unable to support his weight and it tore. The victim continued falling approximately ten feet and landed on the concrete apron at approximately 2107 hours. The victim landed on his head and lay supine on the concrete ground.

Fire fighters on the scene, stated that the victim became rigid and began to suffer from full body convulsions. Assistance was immediately rendered by the fire fighters at the scene in the form of cervical spine stabilization and backboard placement. At 2108 hours, the Captain radioed the 911 dispatcher and requested a medic be sent from the structural fire scene. At 2109 hours, a radio request was made for a medic, and two EMT/fire fighters returned to the station in the department's rescue/medic unit.

An additional EMT and the EMS chief/assistant fire chief were dispatched from the scene to assist the victim. The EMS Chief arrived on scene at 2118 hours and radioed for a medical helicopter.

Following the request for a medical helicopter, the Captain and a fire fighter took the fire engine to a local park to block the road and establish a landing zone for the medical helicopter. The victim was loaded on the department's rescue/medic unit and taken to the local park. During the transport, the victim had a pulse present and he was breathing, but he was not responding to verbal questions. At 2127 hours, the medical helicopter landed at the park and three of its emergency medical personnel assisted with the victim's care. The victim was deemed as too unstable to be transported by a medical helicopter. He was transported at 2152 hours to the local hospital in the department's rescue/medic unit. The victim was transferred to an emergency room and hospital personnel performed cardiopulmonary resuscitation (CPR). The resuscitation efforts were unsuccessful and the victim was pronounced dead at 2225 hours.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. NIOSH investigators identified the following items as key contributing factors in this incident that ultimately led to the fatality:

- The design of the engine which introduced numerous potential fall risks when loading the hose bed and securing the vinyl protective cover.
- Fire department practices in loading the hose bed and securing the vinyl hose bed cover which were unwritten and inadequately addressed fall hazards.



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- Damage to the mounting system of snaps which made securing the vinyl hose bed cover more cumbersome.

CAUSE OF DEATH

The medical examiner listed the cause of death as a cerebral contusion with head injury and a skull fracture resulting from a fall.

RECOMMENDATIONS

Recommendation #1: Fire departments should develop and implement Standard Operating Procedures (SOPs) on the correct procedures/safe methods for reloading hose and securing hose bed covers.

Discussion: Fire departments should develop and implement SOPs on safe methods for reloading hose and attaching hose bed covers on a fire apparatus. The SOPs should apply to all persons reloading fire hose and placing any hose bed cover on the fire apparatus. To minimize or eliminate the risk of falling off the top of an apparatus, when placing any type of soft style hose cover on an apparatus, fire fighters should consider being positioned in the middle of the hose bed and on their knees, which offers better stabilization, and work from front to back of the hose bed while replacing and fastening the hose cover. The departmental SOPs could assist in ensuring that all personnel understand the correct ways in which to utilize the handles, handrails and steps that are on the vehicle. It is also important to discuss the footwear that fire fighters wear (e.g., rubber bunker boots, leather boots and station-type shoes) while climbing and performing duties on a fire apparatus.¹

According to the International Fire Service Training Association (IFSTA), *Essentials of Fire Fighting and Fire Department Operations Handbook*, to ensure safety on a fire apparatus, fire fighters should “use the steps and handrails when mounting or dismounting the apparatus.” “Using the steps and handrails reduces the chances of accidentally slipping and falling from the apparatus.”² Fire fighters should be provided with training to ensure they understand the importance of any provided handrails and steps on fire apparatus, and that they are properly utilized. This training is especially important for departments that are using an apparatus hose bed above the water tank. The training should consist of using handrails, climbing, wearing the proper foot wear, hand and foot placements, and learning about awkward body positions and working from heights.

Recommendation #2: Fire departments should consider requiring the use of a ladder when servicing items that are out of reach from ground level on the fire apparatus.

Discussion: When servicing items that are on top of the fire apparatus, fire departments should consider requiring that fire fighters use a step ladder. Step ladders can be useful in allowing for stable access to elevated surfaces. If ladders are to be used, then the fire department must ensure that



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the ladder is used in accordance with all applicable ladder safety standards. The Occupational Safety and Health Administration (OSHA) standards require that the base, or feet, of ladders be placed on a substantial base; that they extend 3 feet above the working surface; and that ladders in use be tied, blocked, or otherwise secured to prevent displacement.³ In this incident, a ladder may have provided a more stable base for standing and adjusting the vinyl hose bed cover.

When using a ladder, training must be provided and should include safe work practices for employees to avoid the risk of being injured or killed while working from ladders. Fire departments could use OSHA safety standard 29 CFR 1926.1053 as a source of information and provide training to fire fighters who face the risk of a fall from a ladder. The use of a step ladder would be a more appropriate choice for this particular job than a traditional fireground ladder.

Recommendation #3: Fire departments should ensure that hose bed covers on fire apparatus are maintained in good physical condition or are replaced when needed.

Discussion: According to the International Fire Service Training Association (IFSTA), *Manual on Pumping Apparatus, Driver/Operator Handbook*, “any item that is stored on the exterior of the fire apparatus should be maintained in good physical condition.” IFSTA also notes that “if an apparatus is equipped with a hose bed cover, it should be in good condition and in place.”⁴ In this incident, the vinyl hose bed cover was attached on the officer’s (right) side with all of the original grommet-snaps. However, most of the front portion of the vinyl hose bed cover and the entire driver’s (left) side were missing the grommet-snaps and were being held down by bungee cords that were attached through the holes of the missing grommet-snaps and hooked on various locations along the engine’s side. If the vinyl hose bed cover used in this incident would have been in good repair and all of the grommet-snaps in working order, replacing the cover over the hose bed may have been less cumbersome. In addition to repairing or replacing hose bed covers fire departments should consider replacing them with a different type of cover retrofitted for the fire apparatus (e.g., roll-up type or a hinged, metal type).

Recommendation #4: Fire departments should consider when purchasing a new fire apparatus, that it be equipped with available safety features to assist with hose loading and covering the hose bed (e.g., a hose bed that hydraulically lowers, or hose bed covers that are hydraulic, roll-up, or hinged metal).

Discussion: When a fire department decides to purchase a new fire apparatus, considerations towards recently available safety features to assist with hose loading and covering the hose bed should be taken into account. An example of such a safety-related feature is a hose bed that hydraulically lowers the top of the hose bed to a standing at ground level position. A fire apparatus equipped with a hose bed that hydraulically lowers the top of the hose bed to a standing at ground level position removes the need for fire fighters to be on top of a truck. The hose bed hydraulically deploys the full-size hose bed in the rear of an engine to waist level. A normal hose bed on an engine is 10-12 feet above the ground, and it usually takes several fire fighters to reload the hose, which places each at risk of falling. By bringing the hose bed carriage down to ground level the possibility of falling



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from the top of the engine while loading/unloading hose is greatly reduced.⁵ This type of moveable hose bed system provides a comfortable, ergonomic position for pulling and repacking hose, and the hose bed side panels conveniently flip-down for repacking and flip-up when complete. This type of hydraulically lowered hose bed system provides a safer alternative than traditional hose beds and it allows fire fighters to pack hose quicker and more efficiently and allows the unit to get back into service much sooner. Vinyl hose bed covers require fire fighters to expend time and energy in placement and removal, and increase their exposure to fall hazards on a fire apparatus. Another option on newly purchased fire apparatus is a hydraulic hose bed cover. The hose bed storage area is covered with aluminum doors that are power-operated with a self-contained hydraulic system that smoothly opens and closes the doors. The doors stay firmly closed in road-ready position until the operator applies the momentary switch to open the door in order to access the hose. Manually operated hose bed covers are also available in a variety of styles that roll-up or are hinged metal.

Although it was difficult to substantiate the actual level of lighting when the incident occurred, NIOSH concludes that as a matter of prudent safe operations:

Recommendation #5: Fire departments should ensure adequate exterior lighting for activities outside the fire station.

Discussion: It was dusk at the time of the incident. Fire fighters reported that there was still ambient light, but it was diminishing rapidly. The department's front exterior lighting over the garage doors consisted of florescent type light bars. However, they were unable to be utilized because the bulbs needed replaced. Additionally, exterior lights were located on both front corners of the fire station, over each entry door that may have provided additional light if they had been utilized. In regards to the available lighting on the engine, there were several light features available near the hose bed that could have been utilized to better illuminate the area. A means to ensure adequate lighting when working under diminished lighting conditions include the station establishing a policy to have the lights on after a certain time and installing automatic light sensing switches that illuminate after the ambient daylight falls below a certain level. Finally, if duties are being performed in an area that has inadequate lighting, the vehicle's exterior lights may be used to light the work area.

REFERENCES

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2. IFSTA [2008]. Essentials of Fire Fighting, 5th ed. Stillwater, OK: Fire Protection Publications, Oklahoma State University. International Fire Service Training Association.



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3. Code of Federal Regulations [2008]. 29 CFR 1926.1053. Safety and health regulations for construction. Ladders. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
4. IFSTA [2001]. Pumping apparatus driver/operator handbook. Stillwater, OK: International Fire Service Training Association.
5. Vaccaro B. [2004]. Take a Load Off. Fire Rescue Magazine, Vol.22, No. 11, pp. 42-50.

INVESTIGATOR INFORMATION

This incident was investigated by Nancy Romano, Safety and Occupational Health Specialist, and Scott Leslie, M.D., guest researcher, NIOSH, Division of Safety Research, Surveillance and Field Investigation Branch. An expert technical review was conducted by William Peters. Mr. Peters is a retired Battalion Chief with over 28 years experience with the Jersey City, New Jersey Fire Department and is active in the National Fire Protection Association (NFPA) consensus standards process.



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Photo 1. Approximate Position of the Engine During the Incident.
(NIOSH photo)



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Photo 2. Aerial View of the Front Section of the Vinyl Hose Bed Cover.
(NIOSH photo)



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Photo 3. Aerial View of the Engine Vinyl Hose Bed Cover.
(NIOSH photo)



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Photo 4. Side of the Engine Where the Victim Ascended and the Incident Occurred.
(NIOSH photo)



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**Photo 5. Handle and Metal Ledge with the Hard Suction Hose
Where the Victim's Right Knee was Positioned.
(NIOSH photo)**