Keeping Officers Safe on the Road

by Beth Pearsall

Several reports highlight visibility issues for law enforcement and safety personnel responding to roadside incidents.

Oct. 21, 2008, began like any other day on the job for police officer David Tome.

Early that Tuesday morning, Tome and the rest of the accident reconstruction team from the Northern York County Regional Police Department were on Route 15 in York County, Pa., investigating a fatal crash that had occurred days earlier. The team set up traffic cones to close the right lane of the road and began the investigation.

However, around 9 a.m., a passing sport-utility vehicle hit Tome where he stood in the right lane, sending him flying over a guardrail. Tome — a five-year veteran of the force, a husband and a father of two young children — died instantly. He was 31 years old.[1]

David Tome's story is tragic and sadly common. Every week, new stories emerge of law enforcement officers, firefighters and other first responders who are injured or killed in roadside crashes throughout the United States.

The National Institute of Justice has collaborated with fire service and automotive engineering agencies on several studies that address roadway safety. Increasing emergency vehicle visibility and developing training and tools aimed at keeping first responders safe on the road have emerged as next steps in the effort to prevent future tragedies.

Alarming Numbers

Preliminary data for 2009 from the National Law Enforcement Officers Memorial Fund show that for the 12th year in a row, more officers were killed in the line of duty in traffic incidents than from any other cause of death, including shootings. These incidents comprise automobile and motorcycle crashes as well as officers struck while outside their vehicles. In 2009, 56 law enforcement officers had died in traffic-related incidents, accounting for close to 50 percent of officer deaths for the year.[2]

In the previous year, 28 out of the 118 firefighters who died while on duty were killed in vehicle crashes. Another five firefighters were struck and killed by vehicles.[3]

These sobering numbers clearly show the need to protect law enforcement officers, firefighters and other first responders as they perform their duties on the nation's streets and highways.

Vehicle Visibility

Visibility is essential to roadside safety for emergency responders. Can drivers see and recognize an emergency vehicle as it navigates through traffic on its way to the scene of an accident or fire? When the first responder has reached the scene and is on the side of the road, can drivers clearly see both the person and the vehicle?

Several factors affect a vehicle's visibility — its size and color, for example. Environmental conditions, such as the weather and time of day, also play a role in whether drivers can easily see emergency vehicles along the road.

Emergency vehicles have features designed to draw attention to their presence even when drivers are not actively looking for them. These include warning lights, sirens and horns, and retroreflective striping, which reflects light back to its source. Such features provide information about the vehicle's size, position, speed and direction of travel so drivers can take suitable action.[4]

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Some emergency response fields have national standards that govern the visibility of vehicles. The National Fire Protection Association's (NFPA's) Standard for Automotive Fire Apparatus requires fire trucks and ambulances in the United States to have retroreflective striping and markings in multiple locations, including at least:

- Fifty percent of the cab and body length on each side.
- Twenty-five percent of the front width of the vehicle.
- Fifty percent of rear-facing surfaces, in a 45-degree down-and-away "chevron" pattern.

Although compliance with the NFPA standard is voluntary, vehicle manufacturers typically comply to limit liability and ensure the marketability of their products.[5]

Law enforcement does not have a similar national standard. However, many law enforcement agencies apply retroreflective markings to patrol cars, motorcycles and other vehicles.[6]

The demands of the law enforcement profession also create unique visibility issues. Sometimes personnel do not want their cars to be readily detectable. Officers may want to be almost invisible to other drivers under certain circumstances. The need for high visibility at certain times must be balanced against a need for stealth at other times.

Using Reflectors to Improve Visibility

A recent study took a closer look at some commercially available products to determine whether they help increase emergency vehicle visibility and improve roadway safety for emergency responders and the public. The NIJ-funded research was conducted by the U.S. Fire Administration and the International Fire Service Training Association.[7]

Looking specifically at retroreflective striping, high-visibility paint, built-in lighting and other reflectors on emergency vehicles, the researchers found that:

- Retroreflective materials can help heighten emergency vehicle visibility, especially during nighttime conditions.
- Using contrasting colors can help civilian drivers find a hazard amid the visual clutter of the roadway.

- Fluorescent colors (especially fluorescent yellow-green and orange) offer higher visibility during daylight hours.

Researchers also identified ways for first responders to improve the ability of civilian drivers to see and recognize emergency vehicles during all phases of an emergency. These include:

- Using retroreflective material to outline an emergency vehicle with "contour" or "edge" markings, especially on large vehicles.
- Placing retroreflective material lower on emergency vehicles to take advantage of headlights from approaching vehicles. Researchers noted that law enforcement could concentrate retroreflective material on the rear of vehicles to preserve stealth when facing traffic or patrolling.
- Using fluorescent retroreflective material when responders want a high degree of day- and nighttime visibility.
- Applying distinctive logos or emblems made with retroreflective material to improve emergency vehicle visibility and recognition.

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Warning Lights: Help or Hindrance?

USFA and the Society of Automotive Engineers conducted a separate NIJ-funded study to examine another important feature of emergency vehicles — warning lights.[8]

Researchers in this study looked specifically at how the color and intensity of warning lights affect driver vision and emergency vehicle safety during the day and night. They examined whether the lights alerted drivers to the presence and location of an emergency vehicle as intended or whether they unnecessarily distracted drivers or hindered their ability to detect emergency responders on foot.

"Right now, emergency lighting used by some departments is based on tradition and opinion," said Bill Troup, a fire program specialist at the USFA National Fire Data Center. "Some agencies use red warning lights; others use blue, and some use a combination of colors. Why are the colors this way? Because that's the way it's been done. It's tradition, and in some cases, this tradition has become state law. With this study, we wanted to add some science to the 'why' of emergency lighting."

The researchers asked study participants, who were representative of the driving public, to perform three tasks while viewing a simulated traffic scene:

- Look for emergency warning lights.
- Look for pedestrian emergency responders near the warning lights.
- Rate the ability of the warning lights to draw attention to the emergency scene.

During this field experiment, the researchers varied the color and intensity of the warning lights (using white, yellow, red and blue lights at low and high intensities). They also varied the location of the emergency vehicle (placing it to the left or right of participants) and the surrounding light (creating day and nighttime lighting conditions). The emergency responders wore two different sets of protective clothing. Both sets had standard retroreflective markings; however, the background material on one set was black, and the other was yellow.

The most significant difference occurred between day and night: Researchers found that participants' ability to find warning lights at night was uniformly good and did not improve when they increased the lights' intensity. During the day, however, a higher intensity of each of the four colors improved participants' ability to spot the lights. Blue was the easiest light color for participants to see, day and night.

Even though the responders outside the emergency vehicles wore protective clothing with retroreflective markings, participants had substantially more difficulty finding the responders at night than during the day. Researchers found no difference in participants' ability to find responders wearing the black versus yellow clothing in either the day or night. The warning lights had little effect on participants' ability to see the responders during both lighting conditions.

Based on these findings, the researchers offered three recommendations for improving safety during roadside emergencies:

- **Consider different intensity levels of warning lights for day and night.** Researchers noted that finding a single intensity for warning lights — one that is intense enough for daytime conditions but not too intense for nighttime conditions — can be difficult. Using at least two levels of intensity might be a more effective choice.
- **Make more overall use of blue lights, day and night.** According to the researchers, strong agreement already exists about the advantages of using blue lights at night. In this study, they found that when participants searched for warning lights in the daytime, blue was more effective than any of the three other colors tested. This finding provides more evidence in favor of using blue lights during all lighting conditions.
- **Use color to make a clear visual distinction between parked emergency vehicles in two different paths.** Researchers suggest using one color of light for vehicles that are parked in the normal path of traffic (for example, red lights). Another color could be used for vehicles that may be near the normal path of traffic but are not obstructing it.

More Tools to Improve Safety

Aside from research studies on vehicle visibility, NIJ also has supported developing Web-based tools that will help improve the safety of law enforcement officers, firefighters and other emergency responders on the roadways.

With support from NIJ, USFA collaborated with the Cumberland Valley Volunteer Firemen's Association's Emergency Responder Safety Institute to create ResponderSafety.com. This Web site contains the latest news and training on roadside safety as well as recent cases of responders who were injured or killed by vehicles while on duty. The site aims to be a place where

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transportation, public safety and emergency personnel around the country can share lessons learned, thus helping them to respond more safely and effectively to roadway incidents.

USFA also collaborated with the International Association of Firefighters to develop a separate Web-based training program called "Improving Apparatus Response and Roadway Operations Safety for the Career Fire Service." NIJ and USFA are working to expand this roadside-safety training program to cover all emergency responders, including law enforcement. The program is scheduled to launch in 2010.

Roadside Safety: A Multifaceted Issue

Roadside safety issues are complex. Using warning lights and retroreflective material to increase an emergency vehicle's visibility is just one important focus area. Setting up a proper safety zone at the scene of an accident or other roadside hazard, as well as increasing the visibility of emergency responders on foot, is also critical. Perhaps one of the most essential parts of the equation is the alertness of civilian drivers and their ability to recognize an emergency vehicle and take suitable action to avoid a collision. NIJ will continue to work with law enforcement, firefighters and other emergency responders — and the public — to address these concerns and help improve safety for everyone on the road.

For More Information

- http://www.ResponderSafety.com.
- USFA, *Emergency Vehicle Visibility and Conspicuity Study,* FA-323/August 2009, http://www.usfa.dhs.gov/downloads/pdf/publications/fa_323.pdf.
- USFA and SAE International, *Effects of Warning Lamp Color and Intensity on Driver Vision,* October 2008, http://www.sae.org/standardsdev/tsb/cooperative/warninglamp0810.pdf.
- USFA's emergency vehicle safety efforts: http://www.usfa.dhs.gov/fireservice/research/safety/vehicle.shtm.
- USFA's roadway safety efforts: http://www.usfa.dhs.gov/fireservice/research/safety/roadway.shtm.

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Notes

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3. U.S. Fire Administration, *Firefighter Fatalities in the United States in 2008,* Emmitsburg, MD: U.S. Department of Homeland Security, Federal Emergency Management Agency, September 2009, http://www.usfa.dhs.gov/downloads/pdf/publications/ff_fat08.pdf.
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7. Ibid.
8. Flannagan, M.J., D.F. Blower, and J.M. Devonshire, *Effects of Warning Lamp Color and Intensity on Driver Vision,* Warrendale, PA: SAE International, October 2008, http://www.sae.org/standardsdev/tsb/cooperative/warninglamp0810.pdf.

Finding Safe and Effective Alternatives to the Highway Flare

Law enforcement officers often use flares to point out an accident location or other traffic hazard and increase visibility.

However, the magnesium-based highway flares traditionally used by law enforcement can create great risks for officers and the surrounding area. These flares burn at high temperatures for 15 to 30 minutes, creating smoke and fumes that can overwhelm the user. Once the flare has finished burning, the officer is left to dispose of the hot, melted remains. Besides the immediate risks, there are potential long-term effects on the surrounding environment. For example, the byproducts of burning flares can poison a nearby water supply.

"Most agencies do not have policies about the disposal of flares," said Charlie Mesloh, director of the Weapons and Equipment Research Institute at Florida Gulf Coast University. "It's completely discretionary. Officers frequently kick them to the side of the road, leaving sharp metal spikes that can create a future road hazard."

With funding from NIJ, Mesloh and his colleagues assessed alternative highway flares that use chemical or electric sources of energy, thus reducing the risks posed by traditional flares.

The research team found the chemical and electric flares tested were less visible than the traditional flare when placed at ground level. Sometimes, minor depressions in the roadway were enough to obscure the alternative flares. However, when researchers lifted these flares off the ground — even by just a few inches — visibility increased by one-fourth of a mile. When placed on a cone, the alternative flares were visible at one mile or more.

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"When you increase the ability of people to see at greater distances, you give them more time to react," Mesloh said. "The most dangerous time for officers at an incident scene is when they are setting up the flares and cones. Officers need to be able to set up the flares quickly, efficiently and in such a fashion that drivers understand what to do."

In addition, the researchers found that basic, uncomplicated designs for cones and flares were the most effective and visible. Arrangements using multiple flare types disoriented and confused other drivers.

For more information on this study, go to http://www.ncjrs.gov/pdffiles1/nij/grants/224277.pdf.