



In the Best Light

The driver rounds a curve as dusk falls, and suddenly is blinded by flashing lights. Parts of the scene ahead are overilluminated, while others are thrown into heavy shadow. Suddenly, the driver brakes and swerves, just missing a law enforcement officer standing near the edge of the road in a poorly lit area.

It is an unfortunate fact that automobile crashes, including being struck along the roadway, represent the second-leading cause of on-duty death for both law enforcement officers and firefighters nationwide. Only gunshot wounds (law enforcement) and stress/overexertion (firefighters) strike down more officers in the line of duty.

In an effort to reduce these deaths, a number of Federal agencies are combining resources to fund a research project on emergency vehicle warning lighting systems.

In cooperation with the Society of Automotive Engineers and with support from the U.S. Department of Transportation's Federal Highway Administration, the National Institute of Justice (NIJ) and the U.S. Fire Administration (USFA) are working together to study the effects of warning lights and ways to effectively mitigate the disorientation they produce for motorists, with emphasis on the differing effects on normal, impaired, and drowsy drivers.

"Emergency lighting systems will be examined under all types of operational conditions as part of this study," says Bill Troup of the USFA National Fire Data Center. "The study will focus on LED [light-emitting diode] systems, which are increasingly being used in emergency vehicle lighting."

Troup serves on NIJ's Personal Protection Equipment Technology Working Group, one of a number of working groups that assist the agency in identifying operational needs associated with specific programs having broad significance to State and local agencies. The working groups' recommendations provide the basis for NIJ's research and development program.

According to Troup, the initial phase of the study has been completed and involved examining crash data for fire apparatus and analyzing incidents when firefighters

were struck and killed on or near a road where the use of emergency lighting may have been a factor. Details on the summary findings for this phase appear in a July 2005 report, *Inferences about Emergency Vehicle Warning Lighting Systems from Crash Data*, available at www.usfa.dhs.gov/downloads/doc/sae0905.doc.

In this phase of the study, the Society of Automotive Engineers (SAE) conducted tests at an automotive test track in Michigan. This research included a nighttime field study of emergency warning lighting examining colors, intensity, and flash patterns of emergency vehicle warning lamps relative to desirable (visibility) and undesirable (glare) effects. Results from this operational study are detailed in an April 2007 report, *Effects of Warning Lamps on Pedestrian Visibility and Driver Behavior*, available at www.sae.org/standardsdev/tsb/cooperative/nblighting.pdf. Initial findings include the following:

- Pedestrian and first-responder visibility when wearing retroreflective (also known as retroflective) clothing is a major issue. When the headlights of a car illuminate retroreflective materials, the reflected light is directed toward the car and its driver and is not wasted by going in all directions as with diffuse reflection. The distances at which drivers can detect pedestrians and emergency responders wearing typical clothing on or near a road at night are very short (shorter than typical stopping distances). In contrast, distances at which drivers can detect pedestrians and emergency responders wearing retroreflective markings are much longer.
- Under night conditions, blue-colored lamps provided an especially good combination of effects by allowing greater pedestrian visibility and providing higher conspicuity.

"Presently, we are examining how to use design, technology, and operating practices to effectively mitigate motorist disorientation," Troup says. "Issues include lighting design and flash rate, lighting color and emergency vehicle visibility, and the amount of lighting. The study will include live operational testing of emergency warning lighting systems." The next phase, he says, will

involve daylight operational testing of emergency warning lighting.

The following chart shows that the first time a motorist sees a law enforcement officer, firefighter, or other first responder who is not wearing retroreflective markings could be when the motorist strikes that individual with a vehicle. [See full *TechBeat* pdf for chart.]

“The research illustrates the importance of visibility by the use of appropriate retroreflective protective clothing on the roadway for law enforcement officers and other emergency responders,” says Mike O’Shea, NIJ program manager.

For more information on the emergency vehicle warning lighting systems study, contact Mike O’Shea, 202-305-7954 or Michael.O’Shea@usdoj.gov. Additional information about other USFA emergency vehicle project efforts of interest to law enforcement can be found at www.usfa.fema.gov/research/safety/vehicle.shtm.

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