Police Vehicle Warning Signals—An Innovative Approach to Officer Safety

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There has been quite a lot of discussion in recent years about improving the safety of police vehicles, both while operating and while stopped or idling, and lowering the risk of related injuries and property damage. Intersections are often a focus of these discussion, considered by some to be the primary danger zones for law enforcement vehicles (and, indeed, high-risk locations for most vehicles). The good news is that steps are being taken to mitigate these risks. At the administrative level, there are certain policies and procedures that can be put into place. For example, a policy that simply requires emergency vehicles come to a complete stop at red lights while responding and only proceeding once the officer has visual confirmation that the intersection is clear can reduce crashes at intersections. Other policies might require an audible siren at any time the vehicle is in motion with its warning lights active to alert other vehicles to make way. On the warning system manufacturing side, LED technology is being developed at an unprecedented pace, from the diode manufactures creating more efficient and brighter parts, to the warning light manufacturers creating superior reflector and optic designs. The result is light beam shapes, patterns, and intensities the industry has never seen before. Police vehicle manufacturers and upfitters are also involved in the safety efforts, strategically placing warning lights in critical positions on the vehicle. While additional room for improvement exists to really make the intersection concerns disappear completely, it is important to note that current technology and procedures provide the means to make intersections reasonably safer for police vehicles and the other vehicles they encounter on the roadway.

According to Lieutenant Joseph Phelps of the Rocky Hill, Connecticut, Police Department (RHPD) during a typical eight-hour shift, the time spent responding to emergencies and passing through intersections with lights and sirens active might be only a fraction of the total shift time. For example, he estimates that it takes approximately five seconds from the moment a driver enters the intersection's danger zone to the moment he or she exists it. In Rocky Hill, a 14-square mile suburb of Hartford, Connecticut, there are roughly five larger intersections within a typical patrol district. This means a police officer will have his or her vehicle within the danger zone for a total of approximately 25 seconds on an average call—less if the response route doesn't require going through all of them. A patrol car in this community generally responds to two or three emergency ("hot") calls per shift. Multiplying these figures gives RHPD the approximate idea of how much time each officer spends passing through intersections during each shift. In this case, it is roughly 1 minute, and 15 seconds per shift—in other words, during two-tenths of one percent of the shift a patrol car is within this danger zone.[1]

Accident Scene Risks

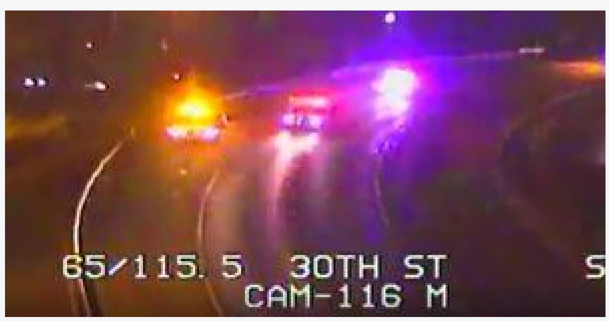

Figure 1.

There is another danger zone, however, that is gaining attention. It's the time the vehicle spends stopped in traffic with its warning lights active. The dangers and risks in this area appear to be growing, particularly at night. For example, Figure 1 is taken from highway camera video footage from Indiana, on February 5, 2017. The picture shows an incident on I-65 in Indianapolis that includes a service vehicle on the shoulder, a fire rescue apparatus in lane 3, and a police vehicle blocking lane 2. Without knowing what the incident is, the emergency vehicles appear to be blocking traffic, while keeping the incident scene safe. The emergency lights are all active, warning approaching motorists of the hazard—there might not be any additional procedure that can be put into place that might lessen the risks of a collision. Nonetheless, seconds later, the police vehicle is struck by an impaired driver (Figure 2).

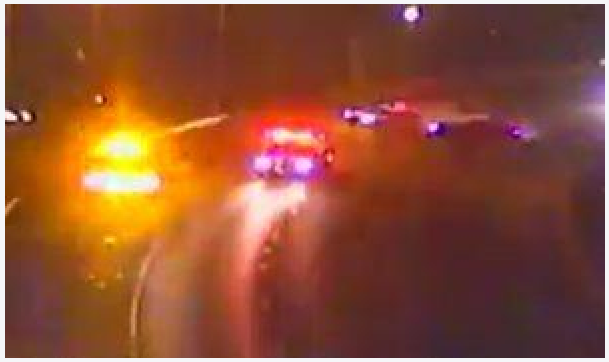

Figure 2.

While the crash in Figure 2 is the result of impaired driving, it could have easily been caused by distracted driving, a growing condition in this age of mobile devices and text messages. In addition to those risks, though, could the advancing warning light technology actually be contributing to the increase in rear-end collisions with police vehicles at night? Historically, the belief has been that more lights, dazzle, and intensity created a better visual warning signal, which would lessen the occurrences of rear-end collisions.

To return to Rocky Hill, Connecticut, the average traffic stop in that community lasts 16 minutes, and an officer might conduct four or five stops during an average shift. When added to the 37 minutes that an RHPD officer typically spends at accident scenes per shift, this time on a roadside or in a roadway danger zone comes to two hours or 24 percent of the total eight hours—far more time than officers spend in intersections.[2] This amount of time does not take into consideration construction and related details that might lead to even longer time periods in this second vehicle danger zone. Despite the discourse about intersections, traffic stops and accident scenes might present even greater risks.

Case Study: Massachusetts State Police

In the summer of 2010, the Massachusetts State Police (MSP) had a total of eight serious rear-end collisions involving police vehicles. One was fatal, killing MSP Sergeant Doug Weddleton. As a result, the MSP began a study to determine what might be causing the increasing number of rear-end collisions with the patrol vehicles stopped on the interstate. A team was put together by then-Sergeant Mark Caron and current fleet administrator, Sergeant Karl Brenner that included MSP personnel, civilians, manufacturers' representatives, and engineers. The team worked tirelessly to determine the effects of warning lights on approaching motorists, as well as the effects of additional conspicuity tape affixed to the backs of the vehicles. They took into consideration previous studies that showed that people tend to stare at bright flashing lights and that showed impaired drivers tend to drive where they are looking. In addition to looking at research, they conducted active testing, which took place at a closed airfield in Massachusetts. Subjects were asked to travel at highway speeds and approach the test police vehicle that was pulled to the side of the "roadway." To fully understand the impact of warning signals, testing involved daylight and nighttime conditions. To the majority of drivers involved, the warning lights' intensity at night appeared to be far more distracting. Figure 3 clearly demonstrates the intensity challenges the bright warning light patterns might present for approaching drivers.

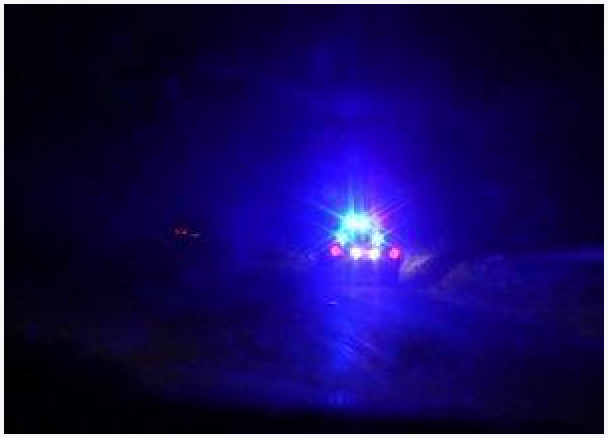

Figure 3. Photo taken during early phases of the MSP testing, showing the challenges faced by drivers approaching an emergency vehicle with its lights in full intensity flash mode.

Some subjects had to look away while approaching the car, while others could not take their eyes off the flashing blue, red, and amber glare. It was quickly realized that the warning light intensity and flash rate that is appropriate when responding through the intersection during the day is not the same flash rate and intensity that is appropriate while the police vehicle is stopped on the highway at night. "They needed to be different, and specific to the situation," said Sgt. Brenner.[3]

The MSP fleet administration tested many different flash patterns from fast, bright dazzles to slower, more synchronized patterns at lower intensity. They went as far as to remove the flash element altogether and evaluate the steady non-flashing colors of light. One important concern was to not reduce the light to the point that it was no longer easily visible or to increase the time it took approaching motorists to identify the subject car. They finally settled on a nighttime flash pattern that was a mix between the steady glow and a flashing synchronized blue light. The test subjects agreed that they were able to distinguish this hybrid flash pattern just as quickly and from the same distance as the fast, active bright pattern, but without the distractions that the bright lights caused at night. This was the version MSP needed to implement for nighttime police vehicle stops. However, the next challenge became how to achieve this without requiring the driver's input. This was critical because having to push a different button or activate a separate switch based on the time of day and the situation at hand could take the officer's focus off the more important aspects of the crash response or traffic stop.

MSP teamed up with an emergency light provider to develop three primary operating warning light modes that were incorporated into the MSP system for further practical testing. The all-new response mode uses fast alternating left to right patterns of blue and white flashes in an unsynchronized manner at full intensity. The response mode is programmed to activate anytime the warning lights are active and the vehicle is out of "park." The goal here is to create as much intensity, activity, and flash movement as possible while the vehicle calls for the right of way on its way to an incident. The second operating mode is a daytime park mode. During the day, when the vehicle is shifted into park, while the warning lights are active, the response mode immediately changes to fully synchronized flash bursts in an in/out type flash pattern. All white flashing lights are cancelled, and the rear of the lightbar displays alternating flashes of red and blue light.

The change from an alternating flash to an in/out type flash is created to clearly outline the vehicle edges and create a larger "block" of flashing light. From a distance, and particularly during inclement weather, the in/out flash pattern does a much better job at depicting the position of the vehicle in the roadway to approaching motorists, than do alternating light patterns.[4]

The third warning light operating mode for the MSP is a nighttime park mode. With the warning lights active and the vehicle placed in park while under low outside ambient light conditions, the nighttime flash pattern is displayed. The flash rate of all lower perimeter warning lights is reduced to 60 flashes per minute, and their intensity is greatly lowered. The lightbar flashing changes to the newly created hybrid pattern, dubbed "Steady-Flash," emitting a low intensity blue glow with a flicker every 2 to 3 seconds. At the back of the lightbar, the blue and red flashes from the daytime park mode are changed to blue and amber flashes for nighttime. "We finally have a warning system method that takes our vehicles to a new level of safety," says Sgt. Brenner. As of April 2018, MSP has more than 1,000 vehicles on the road equipped with situational based warning light systems. According to Sgt. Brenner, the instances of rear-end collisions to parked police vehicles have been reduced dramatically.[5]

Advancing Warning Lights for Officer Safety

Warning light technology didn't stop advancing once MSP's system was put in place. Vehicle signals (e.g., gear, driver actions, motion) are now being used to solve a number of warning light challenges, resulting in increased officer safety. For instance, there is the capability to use the driver's door signal to cancel the light that is emitted from the driver's side of the lightbar when the door opens. This makes entering and exiting the vehicle more comfortable and reduces the effects of night blindness for the officer. In addition, in the event an officer has to take cover behind the open door, the distraction for the officer caused by the intense light beams, as well as the glow that allows a subject to see the officer is now nonexistent. Another example is utilizing the vehicle's brake signal to modify the rear lightbar lights during a response. Officers who have participated in a multicar response know what it is like to follow a car with intense flashing lights and not be able to see the brake lights as a result. In this warning lights model, when the brake pedal is pressed, two of the lights in the rear of the lightbar change to steady red, supplementing the brake lights. The remaining rear facing warning lights can be simultaneously dimmed or cancelled completely to further enhance the visual braking signal.

Advancements, though, are not without their own challenges. One of these challenges is that the industry standards have failed to keep up with advancements in technology. In the warning light and siren arena, there are four main organizations that create the standards of operating: the Society of Automotive Engineers (SAE); the Federal Motor Vehicle Safety Standards (FMVSS); the Federal Specification for the Star of Life Ambulance (KKK-A-1822); and the National Fire Protection Administration (NFPA). Each of these entities has its own requirements as they pertain to warning systems on responding emergency vehicles. All have requirements that are focused around meeting a minimum light output level for flashing emergency lights, which was key when the standards were first developed. It was much more difficult to reach effective warning light intensity levels with halogen and strobe flash sources. However, now, a small 5-inch light fixture from any of the warning light manufacturers can emit similar intensity as an entire vehicle could years ago. When 10 or 20 of them are placed on an emergency vehicle parked at night along a roadway, the lights may actually be creating a condition that is less safe than a similar scenario with the older light sources, despite being compliant with the lighting standards. This is because the standards require only a minimum intensity level. During a bright sunny afternoon, bright dazzling lights are probably appropriate, but at night, with low ambient light levels, the same light pattern and intensity might not be the best or safest choice. Currently, none of the warning light intensity requirements from these organizations take ambient light into account, but a standard that changes based on ambient light and other conditions might ultimately reduce these rear-end collisions and distractions across the board.

Conclusion

We’ve come a long way in just a short time, when it comes to emergency vehicle safety. As Sgt. Brenner points out,

The job of the patrol officers and first responders is inherently dangerous by nature and must put themselves in harm’s way routinely during their tours. This technology allows for the officer to focus his attention on the threat or the situation with minimal input to the emergency lights. This allows technology to become part of the solution instead of adding to the danger.[6]

Unfortunately, many police agencies and fleet administrators might not be aware there are now methods in place to correct some of the risks that remain. The other warning system challenges might still be easily corrected with modern technology—now that the vehicle itself can be used to alter the visual and audible warning characteristics, the possibilities are endless. More and more departments are incorporating adaptive warning systems into their vehicles, automatically displaying what is appropriate for the given situation. The result is safer emergency vehicles and lower risks of injury, death, and property damage.

Notes:

1 Joseph Phelps (lieutenant, Rocky Hill, CT, Police Department), interview, January 25, 2018.
2 Phelps, interview.
3 Karl Brenner (sergeant, Massachusetts State Police), telephone interview, January 30, 2018.
4 Eric Maurice (inside sales manager, Whelen Engineering Co.), interview, January 31, 2018.
5 Brenner, interview.
6 Karl Brenner, email, January 2018.