RUHL FORENSIC

Nighttime Visibility

Roland A. Ruhl, B.S., E.I.T. *is a graduate of the Department of General Engineering at the University of Illinois at Urbana-Champaign. He also trained in accident reconstruction at Northwestern University's Traffic Institute and in safety principles and safety training methods through the National Safety Council. He is an ACTAR accredited traffic accident reconstructionist. Mr. Ruhl has a commercial driver's license (CDL), is a graduate of the SOS Big Rig Driving School and has also been trained at the Bondurant School of High Performance Driving.*

Mr. Ruhl is co-author of the book, Vehicle Accident Investigation: A Guide for Risk Managers and Claims Personnel. He also co-authored a paper on the dynamics of truck rollovers presented at the 1997 SAE International Truck and Bus Meeting and Exposition. Mr. Ruhl has extensive experience with accident reconstruction / simulation and computer aided drafting (CAD) software. He additionally is assisting a European consortium in the validation of CARAT, a kinetics based accident reconstruction program that parallels programs presently used in the United States.

Many accidents happen at night, when light levels are low. While operating in daylight conditions, the human eye can detect unlighted and unreflectorized objects at great distances to avoid an impact while driving. Under most nighttime conditions, however, a limiting factor affecting what is visible to a driver is the headlight range of his or her vehicle. The headlights on most motor vehicles are designed to illuminate some distance in front of the vehicle. Beyond that distance there may not be enough light to detect certain objects. At night, a driver may be "over-driving" his or her headlights. Consider the following:

At 35 M.P.H., a car moves over 51 feet per second. Assuming a perception/reaction time of 1.0-1.5 seconds for an unexpected event, the car would move 51-77 feet before driver reaction occurs, be it evasive steering and/or braking. In addition to the distance the car travels during perception/reaction time, assuming a dry, asphalt roadway, it would take another 65 feet for the car to skid to a stop.

In the end, the above driver would need to detect a hazard a minimum of 116 feet away in order to avoid a collision. Increased detection distance is necessary when operating a vehicle at greater speeds or if road conditions are slippery. Depending on atmospheric conditions, the size and reflectance of the object, and the total lighting (vehicle and ambient), a driver may be unable to detect an object at that distance.

Using your bright beams helps, but they too have their limitations. Only so much light output is allowed by government regulations, in part to reduce glare from on-coming vehicles. Motorists can overdrive their high beams at higher speeds just as they can their low beams.

Most state vehicle codes have an "assured clear distance ahead" rule. That is, a driver is expected to drive at the appropriate speed given the conditions - be they fog, ice or darkness. Although many drivers do adjust their driving for ice and fog, many do not adjust for darkness.

When accidents occur that involve a driver striking an object in the roadway at night, a common question asked is "What could the approaching driver see?" Oftentimes, it is desirable to present the jury with a representation of what a driver could see given the prevailing conditions at the time of the collision to either demonstrate that the object was undetectable given reasonable care, or that the object was clearly visible at a safe distance despite low light levels.

During daylight hours, modern still and video cameras can accurately capture the scene so as to be "representative of the human eye." In fact, such evidence is rarely challenged on the basis that the exact light levels existing at the time of the impact are not captured. Any reasonable representation of the objects during daylight is usually assumed to be acceptable. Tests are often performed at different latitudes of the country, at different times and seasons, and with different atmospheric conditions. All of these may affect the light levels present. This is often acceptable because the human eye is so adaptable that anything other than extreme lighting conditions presents no problem.

Because the human eye is so adaptable, particularly at night, there are problems associated with trying to

represent what a driver saw during nighttime conditions. Although still and video cameras can be used to accurately record what the human eye can see in daylight, not all equipment can do the same at night. Even if the equipment is capable of representing what the human eye can see under low light conditions, great care and skill is required to ensure the equipment is properly utilized.

It is difficult to demonstrate that the exact picture shown is representative of the human eye. Under all circumstances, strict procedures must be followed to allow photographs to be representative. Still cameras require long exposure times, often over 1 second. Obviously, motion cannot be shown with still photography. Also, until the film is developed, it is unknown whether the specific exposure settings used are accurate. Therefore, several sets of photos at different exposure levels are often taken, increasing the time of testing.

Taking video at night also requires careful attention. Until recently, only black and white (B&W) cameras could "see" what the eye could at low light levels. Many color cameras require long exposure times just as still cameras do. Unfortunately, normal video is displayed at 30 frames per second. As such, if conditions require more than 1/30 of a second exposure times, then normal video cannot be recorded. Reducing the number of frames per second to increase exposure times may result in choppy motion. There are advantages to video work, though. First, motion can be shown. Second, a monitor can be set up at the scene to allow instantaneous feedback and verification of the accuracy of the video.

Recent advances in camera technology have helped considerably. Digital Video (DV) cameras have about 4 times the scan lines as VHS tape, and about twice as much as Hi8. One effect of being able to record more information per frame is to "see" at much lower illumination levels. Ruhl Forensic, Inc. experiments have shown that some DV color cameras can now accurately represent human eyesight in low light conditions.

Despite the many reasons to attempt to represent a nighttime scene, there are many concerns when trying to use a camera to represent what a human eye can see at night. As noted earlier, protocols such as using gray-scale test targets to demonstrate that the video or still pictures are accurate are often necessary. Despite the inherent difficulties, still and video work have been accepted by courts as evidence of what a human eye can see at night. Oftentimes, this is the only way to accurately describe the existing conditions to a jury.

For further information on this topic, please contact us by e-mail at ruhl@ruhl.com or by calling the Champaign, IL office at (800) 355-7800 or the Scottsdale, AZ office at (800) 235-2808.

Visit us on the web at www.ruhl.com.

Ruhl Forensic, Inc.'s staff *provide expertise in: mechanical and electrical engineering, collision investigation and vehicle dynamics, biomechanics and human factors, heavy vehicle driving and mechanical systems, federal regulations and compliance, fleet safety, traffic engineering, construction zone safety, OSHA, graphic visualization, and other areas.*

Our experts provide a continuum of service from initial on-site investigations through research, testing and reconstruction to courtroom testimony and presentation graphics and visualization.

We offer quick response to your investigation needs 24 hours a day. Contact us by calling 1-800-355-7800, 1-800-235-2808, or 1-800-278-4095.

Please feel free to call us with any questions that you may have and we will direct you to the appropriate individual within our firm.