C6 Retro-Reflective Efficiency of Conspicuity Tape at Entrance Angles Greater Than 45 Degrees: Application to Nighttime Automobile/Semi-Trailer Collisions

James B. Hyzer, PhD, Hyzer Research, 1 Parker Place, Suite 330, Janesville, WI 53545-4077*

ability to visually perceive conspicuity tape is significantly worse than if glare were not present.

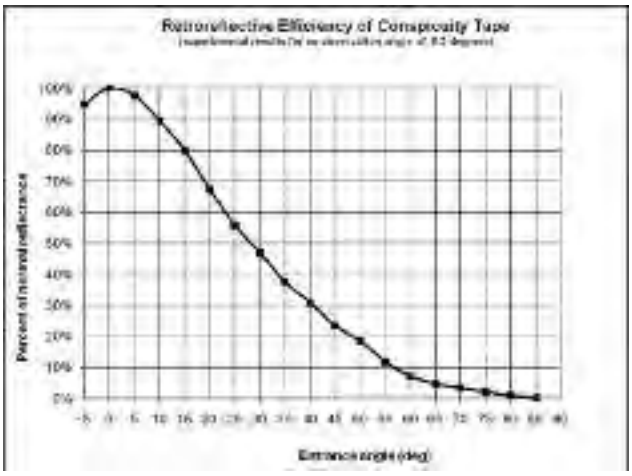
Geometric Considerations: The geometry of the 53 foot long semi-trailer is such that it can easily block two 12-foot lanes of a roadway, at angles greater than 45 degrees from perpendicular to the centerline, as the tractor-trailer pulls onto the roadway from a drive.

Experimental Study/Results: A photometric study was undertaken to quantify the retroreflective efficiency of conspicuity tape under typical driving conditions. Two inch by four inch wide rectangles of both red and white retroreflective tape were mounted into a gonimeter and illuminated by tungsten halogen headlamps. The observation angle was controlled to 0.2 degrees as the entrance angle was varied from -90 to 90 degrees in 5 degree increments. Relative retroreflective efficiency was then determined as a percent of maximum and is plotted as shown.

The experimental results demonstrate that, all else being equal, conspicuity tape on a semi-trailer that is blocking a lane of travel at 45 degrees will be less than one quarter as bright as it would be if the semi-trailer were perpendicular to the lane of travel. As the entrance angle becomes greater than 45 degrees the reflectance efficiency of the tape, and therefore its brightness and conspicuity to oncoming drivers, decreases rapidly with angle with values less than 5% at 65 degrees and then effectively zero as the angle approaches 90 degrees.

The goal of this presentation is to show that the retro reflective efficiency of conspicuity tape falls off dramatically at entrance angles greater than 45 degrees.

This presentation will impact the forensic science community by demonstrating to the audience how semi-trailers that may be highly conspicuous to oncoming drivers when approached on a perpendicular path can be nearly inconspicuous under conditions where the semi-trailer blocks the lane of travel at an angle greater than 45 degrees from perpendicular, and that the situation then significantly worsened in the presence of disability glare.



Background: In driving situations, conspicuity is defined as the ability of an object, such as a hazard, to visually draw the attention of a driver. Hazards which are more conspicuous are first detected and recognized (visually perceived) at greater distances than hazards that are less conspicuous. Conspicuity tape is intended to make semi-trailers more conspicuous and identifiable as a hazard to an oncoming driver at night. Tape brightness for the approaching driver/observer depends on several factors: (1) the level of illumination from the headlamps that shine onto it; (2) the angle at which the light from the headlamps strike the tape (entrance angle); and, (3) the subtended angle between the drivers eyes, the tape, and the headlamps (observation angle). Additionally, conspicuity tape that is older (weathered), dirty, and/or physically degraded (partially missing or scratched) is less efficient and therefore will be less conspicuous to oncoming drivers.

Disability Glare: Bright headlamps on vehicles in the opposing lane is a well known cause of visual disability glare for drivers at night. The degree to which glare disables the ability of a driver to visually detect and recognize hazards in the road ahead is dependent on a number of factors, including: (1) the luminous intensity of the glare source; (2) the angular position of the glare source relative to the hazard that requires detection and recognition; (3) the duration of glare exposure in relation to the time of impact, and, (4) the degree to which a particular driver is affected by glare (middle-aged to older drivers are generally more affected by glare than younger drivers, for example). It will be shown that the presence of disability glare, an approaching driver's

Conspicuity Tape, Visibility, Accident Reconstruction

 ** Presenting Author*