## C7 Dynamic Testing of Guardrails and Vehicle Fuel Systems: Discovery of New Hazards and Development of Alternative Vehicle Fuel System Designs

*Mark C. Pozzi, MS*, Sandia Safety Sciences, 2 Marietta Court, Suite A, Edgewood, NM 87015*

After attending this presentation, attendees will understand the correct interpretation of forensic evidence cross-correlates with similar vehicle and guardrail damage shown during controlled dynamic experimental tests. A nationwide roadside hazard was discovered which was not previously recognized.

This presentation will impact the forensic community and/or humanity through the implementation of the scientific method to identify the source of failure in the subject vehicle, development of objective testing to identify not only the failure mode but also to validate alternative fuel system designs. The foregoing process identified a public safety hazard that existing research and development and the formal Department of Transportation certification testing had not revealed.

The goal of this presentation is to present detailed information from a field collision investigation, combined with a series of experimental crash tests which were conducted to determine potential hazards of guardrail appliances, and potential alternative vehicle fuel system designs.

Forensic investigation of a post-collision vehicle fire revealed unusual damage to the fuel system. The only object in the environment that could have been responsible for penetration of the fuel system was a component of the guardrail end. The guardrail end appliance is considered a “state-of-the-art” safety device. Research indicated that the guardrail end had been dynamically tested via frontal vehicle impacts, but not in rear impacts. Thousands of these guardrail ends have been installed throughout the U.S.; therefore this is a prevalent hazard.

A series of dynamic crash tests with exemplar vehicles was conducted under controlled, repeatable conditions at the same or higher velocities than the impact by the subject vehicle. A new, identical guardrail and end appliance was installed per manufacturer specifications. One vehicle was modified with a fuel tank shield to protect the OEM fuel system. Another vehicle was modified with a production trunk-mounted fuel tank from an earlier model vehicle produced many years earlier by the same manufacturer. The vehicle trunk was modified with a full firewall and improved structural elements, as well as improved trunk lid retention. The vehicles impacted the guardrail at the rear centerline. New replacement guardrail was installed for each collision. Collision damage and fuel system integrity was documented and analyzed.

Results of the testing revealed a consistent hazard created by the guardrail end appliance and attachment hardware on the subject vehicle and both test vehicles, although fuel leakage was prevented due to the alternative designs. The testing proved there were reasonable, technically and economically feasible alternative designs that would have prevented the fuel system leakage under the same or more severe impact loading than occurred in the subject collision. Reasonable, technically and economically feasible designs could also attenuate the hazards posed by the guardrail end appliance. The guardrail end appliance hardware should be modified by shielding of protruding structures, or modification of attachment hardware to reduce force- concentrating structures.

**Guardrail, Rear-Impact, Fuel System Integrity**

 ** Presenting Author*