## C12 A Semi-Trailer/Ambulance Collision on a Dark and Icy Night: Proof of a Bizarre Bounce Contradicts Witness Statements and a Police Report

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The goal of this presentation is to describe an unusual motor vehicle crash in which misleading eyewitness statements and a careless police report nearly obscured the true cause of the collision. In addition to being an object lesson in the unreliability of eyewitnesses, this case should also serve to instruct attendees on how conclusive statements, even those of official police reports, may be the result of prejudice and uncritical thinking. Finally, it will reemphasize the rewards of iterative investigation techniques.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of continued analysis followed by reexamination of physical evidence suggested by that analysis is an essential part of the forensic process and can yield big returns.

**The Crash:** A northbound ambulance on an emergency run with its blue lights activated collided at highway speed with the side of a southbound semi-trailer hauling 45,000 pounds of paper. The ambulance came to rest in the middle of the highway, rotated about 90 ccw and the tractortrailer came to rest alongside the snow bank lining the southbound side of the road, with the rear of the trailer several feet into the snow bank.

**Road Conditions:** The highway sloped downward from north to south. The temperature was near freezing, with a drizzle falling and freezing along the portion of the road to the north of the crash site, but not to the south, from where the ambulance was coming.

**Driver Statements:** (1) The ambulance driver stated that as the ambulance approached the tractor-trailer the latter jackknifed, its trailer swinging around to block the northbound side of the road all the way to the guardrail. (2) The truck driver said that he had slowed and pulled to the right when he saw the ambulance approaching and just after the ambulance had passed him he heard a crash and, looking back, saw that the ambulance had run into the side of his trailer, which was tracking directly behind the tractor.

**Eyewitness Statements:** All four persons from abutting residences who came forward were insistent that it was the fault of the ambulance driver. The witnesses depicted the ambulance as traveling at a high rate of speed and veering into the truck, which they said was traveling slowly and entirely in its own lane. A northbound driver said that the ambulance lost control after passing a vehicle at a high rate of speed, after which it crashed into the trailer, which was in its own lane of travel. Another driver, who disappeared right after the crash, said that the tractor-trailer had jackknifed, causing the crash.

**Police Report**: The crash occurred in early evening, after dark. The local police investigator concluded that the ambulance had caused the crash and so stated to the region's newspaper, which ran a story to this effect, amplifying it with accounts of the repeated complaints reportedly made by residents concerning ambulances speeding past their houses. It also included the erroneous police statement that the speeding ambulance was just returning to its home station and not on an emergency run.

**Physical Evidence:** The most striking physical evidence was a 50-foot stretch of chewed-up guardrail on the northbound road edge was chewed-up. The top of the guardrail was originally a few inches higher than the bottom of the anti-underside bumper (ICC bumper) on the trailer. That bumper showed massive damage to all areas and it was clear that it had been struck either by the ambulance or by the trailer tires, the carriage for which had been dislodged from its mounts on the trailer's underside. The damage to the trailer, including paint transfer, showed that the ambulance had struck it approximately in the middle and then had slid along it until coming into contact with the trailer's front left outboard tire. (The trailer had dual tandem axles positioned near its aft end.)

The ambulance displayed massive damage to the front left quarter extending back to the region behind the driver's seat. There was essentially no damage to the right side of the ambulance.

**The Problem:** Although the guardrail damage upstream from where the vehicles came to rest strongly suggested that the truck had indeed jackknifed, the adamant statements of the witnesses initially cast doubt on that point. One of the witnesses even asserted that the ambulance post-impact caused the chewed up guardrail. However, a careful examination and reexamination of the ambulance turned up no portions of it that could have ridden the rail in the fashion required for that damage. The police report did not take that damage into account at all; by his own admission, the investigating officer never examined it closely. He was willing to say that both vehicles were slightly over the centerline and that the responsibility was therefore evenly divided.

The biggest sticking point to explaining the crash as resulting from the jackknifing that blocked the

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ambulance's path was the lack of damage on the right side of the ambulance. If the crash had occurred with the trailer's aft portion riding the guardrail, it would seem that the ambulance would have been forced into the guardrail; yet there was no marking on the ambulance to suggest that it had hit the rail at all. Also, it was not clear that the impact of the ambulance against the trailer would have provided the momentum necessary to swing the trailer back off the road on the other side.

**The Solution:** The road was so slippery at the time of the crash that the vehicle dynamics were akin to air table physics. If the truck had been jack knifing so as to bring the ICC bumper into contact with and past the guardrail on the opposite side of the road, the swinging of the trailer would not have stopped at that point, but would have continued so as to bring the outer sidewall of the trailer's left rear-most tire into contact with the guardrail. When that tire was re-examined, two horizontal wear lines at the height corresponding to the heights of the two guardrail protrusions were found. The portions of the rim corresponding to the respective centers of the two wear marks were scored in a way consistent with them having rubbed against the steel guardrail. The fact that there were two discrete wear bands had been overlooked before because of paint in the same area of the tire. Also, a faint black discoloration of the guardrail was found toward the south end of the chewed-up section. As it turned out, the impact between the front left outboard tire and the ambulance had forced the two left-side axles together so that none of the trailer tires could rotate following the impact. It was for this reason that the two parallel scuffmarks remained horizontal to the ground.

This additional evidence of contact between the trailer and the guardrail made it clear that when the truck driver slowed and pulled to the right because of the approaching ambulance the trailer tires locked up on the very slippery surface, resulting in the jack knife. The jack knife went unnoticed by the truck driver, who was intent on the approaching ambulance. Meanwhile, the jack knife continued, the trailer tires not rotating, until the rear end of the trailer hit the guardrail on the opposite side, ultimately bringing its rear, left tire into contact with the rail. The swing continued, causing the tire to be compressed, until the rim came into contact with the rail, halting further swinging. When the swinging ceased, the trailer moved outward from the rail as the result of the force of the compressed tire on the rail. Making reasonable geometric assumptions about the compression, as well as the physical assumption that that part of the tire away from the rail did not change in shape, the reduction in volume of the tire could be estimated. The kinetic energy given to the trailer by its tirerelated rebound from the rail was then equated to the tire pressure (which would have remained essentially unchanged because of the small relative volume change) multiplied by the change in volume as the tire pushed outward

$$W = p \Delta V.$$

This quantity turned out to be approximately 1,200 ft-lb, which in light of the trailer weight and moment of inertia about the fifth wheel, indicates that during the rebound the end of the trailer initially moved away from the guardrail at a speed of about 10 feet/second. As a result, an opening appeared between the trailer and guardrail by the instant of impact. In addition, the trailer was swinging away from the ambulance's lane at the time, and as a result of these two factors, the collision did not force the ambulance into the guardrail. Furthermore, this explains why, when the truck driver heard a bang after passing the ambulance, he looked back to see his trailer tracking behind the tractor. Finally, this explains how the trailer fetched up in the snow bank along its own side of the road, which was part of the basis for the witnesses and police investigator being convinced that the truck could not have been at fault.

**Accident Reconstruction, Jackknife, Eyewitness**

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