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CRASH TALK

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SUV - Have You Rolled One Lately?

By Jim Graham, P.Eng.

The Ford Explorer/Firestone tire rollover fiasco certainly opened the eyes of the buying public to the SUV rollover problem. In fact, SUV's (not just Ford!) do tend to roll over more frequently than the average car. However, recent sales figures have the SUV at more than 25% of the new passenger vehicle market. Simply stated, the SUV is very popular but has an inherent propensity to rollover. Rollover propensity increases with the following factors:

- High center of gravity
- Added cargo weight
- Narrow track width
- Short wheelbase
- Lower air pressure
- After-market lift kits
- Over-sized tires
- Sharp steering maneuvers

Transport Canada and NHTSA use the term Static Stability Factor to provide some quantitative basis for showing the stability of a passenger vehicle.

$$\frac{T}{2*H}$$

The formula is where T is the track width and H is the center of gravity height (data in inches). A number greater than 1.2 is deemed "stable".

Here are some Static Stability Factors for a range of passenger vehicles (listed from most to least stable):

- 2000 Mazda Miata convertible: 1.47
- 2005 Chrysler 300 sedan 1.38
- 2004 Honda Accord sedan: 1.36
- 2004 Hummer H1: 1.20
- 2004 Toyota Echo: 1.14
- 2003 Ford Explorer 2-door: 1.11
- 2003 GMC 2500 HD pickup: 1.10
- 1998 GMC Jimmy 2-door: 1.04
- 2003 15-passenger van: 1.04
- 2003 Jeep Wrangler, 2-door: 1.02

SUV's are among the most popular vehicles sold in North America due to their utility, their outward visibility (seated higher up), their theoretical off-road capability, and their all-wheel drive advantage. Yet 60% of SUV fatalities are due to rollovers. Moreover, why do we see SUV's in the Alberta ditches on a snowy winter day? What happened to off-road capability? Why does it seem that all-wheel drive simply results in the SUV travelling *further* off the roadway?

First and foremost, an SUV is NOT a replacement for winter tires. Even though SUV's may out-accelerate two-wheel drive cars in slippery conditions, their braking and steering are not generally superior. In fact, an SUV tends to trip and roll sideways on soft soil at 30 km/h, whereas most cars will remain upright.

One solution is to know your vehicle and drive within the vehicle's limits (slow down if you own an SUV). Another solution engineers have recently developed is Electronic Stability Control. Nearly 90% of rollovers occur off the roadway surface. If we can keep the vehicle from going off the road in the first place, we can reduce the chance of rollover. ESC is designed to assist drivers in avoiding a spin-out (over-steer) or a plow-out (under-steer) as it applies brakes to one or more wheels so as to correct the vehicle heading.

In our experience, the rollover accident has the greatest potential for damage and personal injury. Accordingly, ESC may be the most significant safety feature in reducing injuries since the seat belt or air bag, particularly for vehicles prone to roll. An SUV with ESC - have you test driven one lately?

Jim Graham, Principal Engineer, currently drives a passenger car equipped with ESC and has found this highly effective during Edmonton winter driving conditions.

Reconstructing a "T-Bone" Collision

Donald K. Pohl, P.Eng.

Our company is often asked what we do. The following example highlights many of the techniques we routinely use.

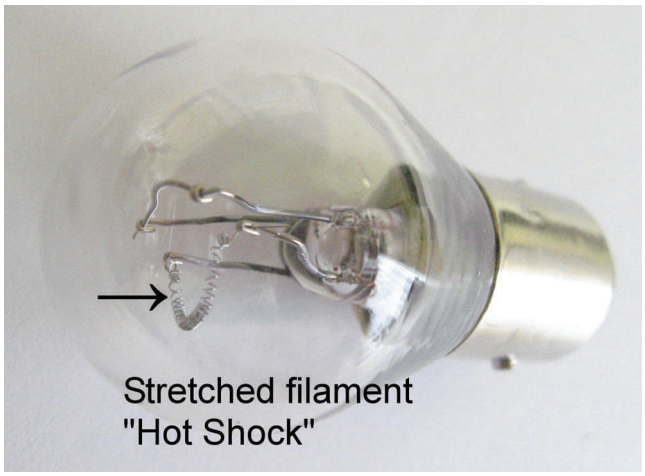
A client called our office about a 2-vehicle crash that had occurred recently. The client's company insured a 1994 Ford Tempo that was crossing a highway from a Stop sign at night when it was T-boned by a 2005 GMC pickup. There were two occupants in each vehicle.

We headed out to the collision site as soon as possible to measure and photograph any physical site evidence. Impact gouges were located near the centerline of the roadway. Also, the collision occurred just over the crest of a hill, indicating a possible sightline issue.

We then examined both vehicles. The Ford had sustained severe crush to the left front fender and wheel area. Both Ford seat belts exhibited loading striations on the tongue surfaces – the occupants were belted. We were able to determine that the left headlamp was on at the time of the collision – the filament exhibited "hot shock". As the right headlamp was not near the damaged area, it displayed no evidence of being on or off – inconclusive.

The GMC front seat belts were examined and neither exhibited loading marks – the occupants were not belted. We then downloaded the Air Bag Control Module (ACM). This downloaded information confirmed that the driver's seat belt was unbuckled. It contained no information about the passenger's seat belt, but did include other information about impact severity, initial vehicle speed and pre-impact braking.

We then reconstructed the impact angle and location on the roadway from vehicle and scene evidence. The impact occurred near the center of the roadway – the GMC swerved left prior to impact. This reconstruction matched well with the post-impact trajectories from both vehicles. Projecting the Ford back from impact, it had been heading straight across the roadway, as opposed to turning left or right onto the highway.



We completed a speed analysis based on the physical evidence and ACM data. There were no skid marks to reconstruct the initial speed since the GMC had anti-lock brakes. However, the ACM recorded speeds prior to impact, which averaged about 20 km/h over the speed limit. Further investigation showed the tires on the GMC were oversized, affecting the ACM data. Considering this, the GMC was going 25 km/h over the speed limit.

In this hypothetical example, we determined that the GMC was traveling about 25 km/h over the speed limit just over the crest of a hill with both occupants unbelted. We confirmed that both Ford occupants were seat belted and that the Ford had its headlights on. In addition, our time-distance reconstruction showed that, as a result of its elevated speed, the GMC was not directly visible to the Ford driver when he left the stop sign. The Ford driver likely would have believed he had sufficient time to cross the highway in safety, but the fast moving GMC reduced that time, resulting in a crash.

Don Pohl, P. Eng. has been a Collision Reconstruction Engineer with Graham Ryan Consulting Ltd. for seven years. He was last seen, being rather green in color, racing for the door.

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Recalls

GM is recalling 2005-2006 Cobalt passenger vehicles not equipped with optional roof-mounted side impact air bags. In a crash, head impact protection may be inadequate.

Toyota is recalling 2004-2004 Tundra trucks and Sequoia mini vans. Some ball joints may wear and loosen, causing increased steering effort, and possible loss of steering control.

Crash Corner

In 2002 3% of all passenger car, SUV, pickup and van crashes resulted in a rollover. Yet, rollovers accounted for nearly 33% of private passenger fatalities.

Passengers are 75% less likely to be killed in a rollover if they are wearing a seatbelt.