Volume 1, Issue 4

CRASH TALK

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Does Size Matter?

By James W. Graham, P.Eng.

As an Accident Reconstruction Engineer for 22 years, I have examined thousands of crashed vehicles. After I mention what I do for a living, one question is often asked of me: What kind of car do YOU drive?" The logic behind the question is that I must drive the *safest* vehicle known to mankind since I have seen just about every make and model smashed head-on, T-boned, bent around a tree or rolled into the ditch. Instead of the expected answer (some high-tech passenger car), I usually respond by saying I drive a 1981 Chevette! My point being that the safest car is generally the one with the most alert driver.

Contemporary technology can certainly help make crashes more survivable in any vehicle. However, regardless of the number of air bags or automatic protective devices installed, the effect of mass is still a significant factor in crash survivability.

To illustrate the effect that mass has on a crash, let us consider a head-on impact between a variety of vehicle sizes. For illustration, let's assume the impact is hood ornament to hood ornament.

The severity of an impact is best quantified or described by the velocity change during the impact, dubbed "Delta-V" by engineers. Transport Canada conducts head-on tests using brand new production vehicles at 48 km/h into a rigid barrier to test for compliance with various safety standards including seat belts, windshields, fuel systems and occupant injury assessment (Head Injury Criterion, etc.).

If two vehicles of equal mass collide head-on from 50 km/h, they stop right there, and the Delta-V is 50 km/h. Conversely, if a heavier vehicle impacts a lighter vehicle head-on, both at 50 km/h, the heavier vehicle continues forward after impact while the lighter vehicle is stopped in its tracks and forced backwards during impact (the lighter your vehicle, the more you get pushed around).

Contemporary technology can certainly help make crashes more survivable

So if an intermediate 4-door sedan goes head-to-head with a 1-ton pickup truck, the sedan occupants undergo a sudden Delta-V of about 68 km/h while the pickup occupants experience about 32 km/h. Seat belts and air bags are stressed to their limits at 68 km/h Delta-V while a 32 km/h Delta-V is a relative "walk-in-the-park". The sedan may very well have an "industry best 5-Star Crash Rating", but the mass of the heavier vehicle is often the deciding factor, because the human body can only undergo so much Delta-V before injury or death occurs.

Conversely, anyone messing with a loaded tractor-trailer will quickly lose that battle. If the same pickup truck goes head to head with a loaded tractor-trailer, the driver of the tractor-trailer experiences an impact severity of about 5 km/h, whereas the pickup truck driver undergoes 95 km/h. Collision analysis shows size matters in head-on crashes, either be the heavier vehicle or the safer driver. However, heavier vehicles are less maneuverable and have a higher propensity to roll. So while size does play a role in collisions, high tech safety devices and driver awareness are equally important.

Jim Graham, Principal Engineer has attended an SAE seminar on "Vehicle Dynamics, Before and After the Crash". During his involvement with crash testing and has been the sole occupant of one of the involved crash-tested vehicles on over 35 occasions.

High-Tech Vehicle Safety Features

By Chris T. Yip, P. Eng.

Vehicle safety features and crashworthiness has become very important selling features in new cars and trucks. In the past, safety was not considered an important or marketable feature. In the last decade, this has changed. Many consumers consider safety one of the most important factors when choosing a new vehicle. In response to this, manufacturers have introduced remarkable new safety features to cars. Here are some of the new technologies that are (or may soon be) available:

- **Seat Belt Pre-Tensioners**: A pyrotechnic charge which fires during a crash to tighten the seat belt. Tightening the seat belt keeps the occupant properly positioned before the air bag deploys and reduces peak forces on the body.
- **Intelligent Air Bag Systems**: A computer in the vehicle called the Air Bag Control Module decides whether or not, and how forcefully to deploy the air bag in a crash. This allows optimal air bag deployment for the severity and type of crash, and the positioning and stature of the passengers. This technology is common in many new vehicles.
- **Electronic Stability Control**: A computer performs braking to individual wheels to keep the vehicle on the desired path and prevent the vehicle from spinning out of control (GM StabiliTrak, BMW Dynamic Stability Control).
- **Lane Departure Warning System**: A camera monitors the position of the vehicle in the lane and activates a warning if the vehicle begins to drift out of the lane (available in some Infiniti models).
- **Automated Cruise Control**: Radar sensors monitor the distance of vehicles ahead and the vehicle automatically brakes or accelerates to maintain a safe following distance (Mercedes-Benz "Distronic Plus").
- **Pedestrian Impact Technology**: Pyrotechnics in the hood deploy to raise the hood by several inches, creating a "cushion" between the pedestrian and the stiff engine (Jaguar "Pedestrian Contact Sensing").

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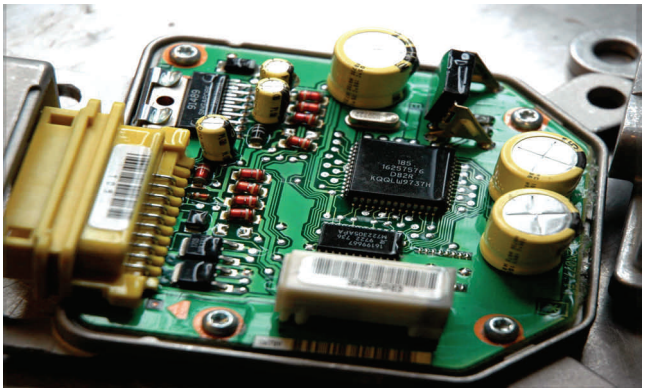

Air Bag Control Module

- **Emergency Occupant Positioning**: In an emergency situation the vehicle tightens the seat belts, moves the passenger seats rearwards, and closes the windows and sunroof (Mercedes-Benz "Pre-Safe").

Some of these technologies have already proven responsible for a significant reduction in the number of serious collisions. A study recently published by the Insurance Institute for Highway Safety indicated that Electronic Stability Control reduces the risk of all single-vehicle crashes by more than 40 percent. This success has prompted several manufacturers to make the systems standard on their entire vehicle line-up. Although these technologies will never be a replacement for competent driving, they are changing the face of the vehicle industry, and helping to save the lives of the consumers who purchase the vehicles.

Chris Yip P.Eng has been with Graham Ryan Consulting Ltd for four years. He recently completed the newly updated Crash Data Retrieval Data Analyst Certification Course. This course specializes on the interpretation of data downloaded from vehicle Air Bag Control Modules, for the purpose of collision investigation.

Recalls

2007 Mitsubishi Eclipse and Eclipse Spyder. May develop loss of steering control due to a metal part of the front crossmember being improperly manufactured, causing a sudden failure.

2001-2003 Dodge Durango with bench seats only. Fluids in floor mounted cup holder may spill into power outlet, causing a short circuit and fire.

Crash Corner

In 2007 Honda Canada will introduce an air bag system on their Gold Wing motorcycle. The air bag, a first for a production motorcycle, inflates in the event of a severe frontal crash.

NHTSA's Third Report to Congress advises an air bag and a seat belt provides 73% injury protection, whereas an air bag alone provides only 29%.