Ralph's Accident Reconstruction Newsletter—Volume 3, Number 1—February 2004

At the end of July of 2003, I attended a joint conference of the South Carolina Accident Reconstruction Society (SCARS) and the Southeast Accident Reconstruction Society (SeARS) in Mt. Pleasant (Charleston), South Carolina. In addition to many fine presentations, there were two staged collisions and a ramping demonstration. The purpose of these live demonstrations was to validate equations and methods used in reconstructing such collisions and events; when pre-crash details and speeds are accurately known, putting the pieces together after the crash using reconstruction formulas and methods and arriving at results that are essentially identical to the known quantities shows that the methods applied to events with unknown parameters are accurate. Rusty Haight with Collision Safety Institute, who is widely known as the human crash dummy, drove the bullet car in both of the staged collisions.

The picture immediately to the left of this text shows the collision between the 2000 Ford Crown Victoria and the 1991 Mercury Capri Convertible. This photograph was taken within milliseconds of the instant of first contact between the cars. The target Capri was stationary, and the speed of the bullet Ford at the instant of impact was 53.8 mph. Accelerometers mounted in each vehicle showed that the delta-v (the rapid speed change that occurs during the intimate-contact phase of the collision) for the Ford was 21.8 mph while the delta-v for the Capri was 29.6 mph. The Ford weighed 3750 pounds at impact; the Capri weighed 2300 pounds. The duration of this crash was 0.145 second (145 milliseconds). After collision, the vehicles separated and moved to their respective final positions.

The two photographs to the left of this text show the as-damaged Capri at its point of rest. Chassis equipment for this Capri had included a driver's-side front air bag, and it fired at impact. One of the purposes of this collision sequence was to demonstrate that a front air bag can fire in an offset lateral collision.

Many vehicles are now equipped with side airbags, intended to fire during broadside impacts and/or during roll-overs. Although their function is similar to front airbags, the parameters under which they are fired are different from the parameters under which front airbags are fired. This newsletter will address some details of the firing of front air-bags.

Front airbags are fired based on a sudden, large, longitudinal deceleration. Vehicles move over distances; the time rate at which a vehicle covers distance is its speed. When we add the concept of direction to speed, we develop the vector property of velocity, which is simply the speed with the direction specified. A car may have a speed of 50 mph; if it is traveling 50 mph north, that is its velocity. Acceleration is the word used to describe the consequences of forces acting on a car to increase or decrease its velocity. Positive acceleration increases its velocity; deceleration (negative acceleration) decreases its velocity. (Acceleration in reverse to back up from a stopped position is considered negative acceleration to your car's accelerometer, but deceleration implies an acceleration to reduce an already established velocity.) All cars with airbags have at least one accelerometer on board; an accelerometer is any device which measures and reports/records instantaneous values of acceleration. When a vehicle cruises at a steady speed, it experiences zero acceleration, because the forces impeding its forward motion (generally, rolling resistance and wind resistance) are balanced by the power applied to the drive wheels by the engine operating through the transmission.

So, what fires an airbag? In the past, airbags have been described as firing based on delta-v. But it's not quite that simple. For a car with a velocity of 50 mph which is driven off the highway into a corn field and comes to a gradual but messy stop by piling corn stalks on the hood, the change in velocity will ultimately be 50 mph, but this change from 50 to 0 will occur over a period of many seconds; the deceleration at any instant will be relatively low. The driver of this car would NOT want his airbag(s) to fire; firing of the airbag(s) would only add hundreds to thousands of dollars to the repair bill and would not provide the occupants with any additional level of safety in this situation. If the occupants weren't wearing

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Or, you may contact me directly with your questions, by the method of your choosing.

If you have any comments, questions, or suggestions regarding content of this or future newsletters, I welcome them. You may use this form to comment by filling in the lines and mailing it, or, as always, you are welcome to contact me by any method of your convenience:_____