Bumper Systems: Do they protect the passenger from injury?

Respectfully submitted by Dr. Ronald J. Farabaugh

The short answer: NO. The first bumper standard developed was U.S. FMVSS (Federal Motor Vehicle Safety Standard) 215. U.S. FMVSS 215 requires that passenger cars be equipped with bumper systems that can undergo impacts of 3 mph and 5 mph from a pendulum impactor having the same mass as the vehicle. A single 5 mph fixed barrier impact is also required. **The intention of the requirement was to preserve vehicle function and safety equipment in LOSRIC**. This included:

- lamps and reflective devices;
- hood,
- trunk and door operation;
- fuel and cooling systems;
- exhaust systems.

Over the years the standards have been modified several times. **In 1978 the rule was changed from a "safety standard" to a "federal regulation" because the rule was not intended to protect occupants**, other than in relation to fuel spillage, exhaust leakage, etc.

Most importantly, there is was never any wording regarding the intention of any bumper standard to reduce potential injuries to occupants by means of reducing impact loads. Research has shown that bumper isolators, which are fluid and gas filled shock absorbers designed to prevent vehicle damage from collisions with barriers or other vehicles, can set the threshold of visible vehicular damage at delta Vs ranging from 8.1 to 12.4 mph in modern cars (1, 2, 3). Yet below this threshold, the occupant can be exposed to significant acceleration pulses. The reported threshold for soft tissue injury of the neck in healthy adult males is a (vehicle) delta V of 5 mph. Therefore, modern passenger vehicles can crash at nearly twice this injury threshold, yet appear undamaged. Similar effects are seen in cars equipped with polystyrene and polyurethane impact absorbing bumpers (4, 5).

Lower speed collisions result in less plastic deformation of colliding vehicles. In these relatively elastic impacts a greater proportion of force is directed to the occupants. There is no evidence that these bumper designs have mitigated injury to occupants in LOSRIC, and, in fact, they may have increased the likelihood of injury at lower crash velocities. The effect in the medicolegal arena has been that those defending against injury claims have claimed that these bumpers were designed to reduce acceleration forces on occupants, further bolstering their arguments against real injury. These arguments are, however, sophistic.

Paradoxic Relationship. Due to the elastic nature of LOSRIC, the apparent paradox of the inverse relationship between property damage and injury potential is a real one. Previous attempts to correlate these factors have failed to show a relationship (6, 7, 8).

Walz and Muser (9) concluded that, "The greater the vehicular damage, the less the biomechanical loading (and the inverse)." Outcome studies have also not shown a significant relationship between crash damage and injury severity in rear impact collisions (10, 11, 12, 13). For example, recently Radanov et al. (14) reported finding no differences in outcome between crash severity assessment groups.

A presentation by Severy in 1968 was pivotal in the Federal Motor Vehicle Safety Standard requiring head restraints (FMVSS 202). But most importantly, research with smaller late model cars equipped with safety restraints, head restraints and bumper isolators has conclusively proven that forces from low speed rear impacts can result in very significant occupant impulses.

Summary

Bumper isolators are specially designed shock absorbers that mount between the frame and bumper and are designed to reduce that amount of property damage to vehicles.

In fact, the official stated purpose of the new bumper standard concerned only the maintenance of the integrity of:

- exhaust, fuel, cooling, and lighting systems,
- and the ability to open the trunk, hood, and doors following a crash.

And, while there is no good evidence that isolators reduce the loads to occupants in any significant way in LOSRIC (i.e., they don't appreciably reduce the incidence of injuries as far as we can tell), they do prove to be helpful in the analysis of these very crashes. It should be clear that damage occurs at speeds well in excess of reported injury thresholds, thus laying to rest any notions that one can equate a lack of vehicle damage to a non-injury event.

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