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By John D. Rowell

The sordid history of auto safety glass

A person partly or totally ejected from a car in an accident is ten times more likely to die than someone who remains inside the car. (Nelson, Are Pop-Out Windshields Effective Safety Features? (1969).) In a 1963 General Motors Field Collision Performance Report concerning injuries produced in rollover collisions, Latimer and Silver concluded the average injury level for occupants who remained in the vehicle was "minor," while the average injury level for occupants ejected completely from the vehicle was "severe." The report concluded the most probable location of ejection was a window opening in 16 of 32 ejections studied.

Over the last 20 years, a great deal of effort has been devoted to improving the design of door latching mechanisms, in order to prevent car doors from opening in crashes. Obviously, an open door increases the risk of partial or total ejection even for belted occupants. Surprisingly, studies in the 80s seemed to show that resolving door problems only reduced ejection fatalities from 27 percent to 22 percent. (Blaisdell, Horn, Severy, *Motorist Head and Body Impact Analysis, Methodologies and Reconstruction* (1985).) Even when seatbelts are used in cars with designs which keep the doors closed in accidents, partial ejection through car window openings occurs. (Cf., Sherman and Huelke, *Automobile Occupant Ejection Through The Side Door Glass* (SAE 1971).)

The use of safety glass tremendously reduces the risk of ejection for both belted and unbelted passengers. (Nahum, *Injury Mechanisms in Rollover Collisions* (1972).) Safety glass, also known as laminated glass, has a layer of plastic embedded in it. When broken, safety glass will stay in place and provide an effective barrier. All vehicles sold in the United States are required to use safety glass in the front windshield. However, very few vehicles on the road today use safety glass in any window other than the front windshield.

This was not always the case. Laminated safety glass was first offered as standard equipment on the 1936 Rickenbacker. ("Engineering Breakthroughs: A Century's Worth of Better Ideas," *Car & Driver* (Jan. 1988).) From 1936 to 1959, United States manufacturers used laminated safety glass in *all* windows except the rear window. (Fargo, Windshield Glazing as an Injury Factor in Automobile Accidents (1968).) In the late 50s and early 60s, car manufacturers started looking for cheaper glass to use in the passenger windows. (*Ibid.*) By the 1960s, American manufacturers had, for the most part, abandoned laminated glass in favor of tempered glass. (*Ibid.*) To justify this change, the manufacturers changed the ANSI glazing test methods so that tempered glass could pass the tests. (*Ibid.*)

The shattering truth

Unlike safety glass, tempered glass shatters when broken. Tempered glass breaks upon contact and when the car roof is deformed. As a result, tempered glass provides a particularly ineffective barrier to total or partial ejection in side collisions and rollover accidents. The physical characteristics of rollovers tend to force the head, upper torso and arms of even a belted passenger out of the protected passenger area. Wearing a properly-designed and functioning seatbelt will not prevent an occupant from being partially ejected in a rollover.

One early study concluded that the likelihood of injury when partially or totally ejected from a side window to be 100 percent and the likelihood that injury would be fatal injury 13 to 34 percent. (Marsh and Sherman, "Analysis of Rollover Accident Factors and Injury Causation" (UMTRI 1972).) By 1980, it was generally accepted that ejection occurred most frequently through side and rear windows.

> About 36,000 car occupants per year are ejected. 80 percent totally and 20 percent partially. The windshield [laminated safety glass] as an ejection path was and still is a relatively small part of the problems. The front door and windows were and still are the leading ejection media. (Hansen, Hitchcock, Harm Causation and Ranking in Car Crashes (Feb. 1985).

In 1992, other studies showed that ejection through closed side windows continued to be the most frequent path of occupant ejection. In 1993, one study concluded that over 55 percent of partial ejections occur through side windows. (Hassan, Mackey, Murray, Morris, Parlain, "A Case For Security Glazing" (Nov. 1993) *13th Annual Proceedings*, Association for Advancement of Automotive Medicine.)

Some manufacturers now concede that tempered glass offers no safety benefits and that safety glass significantly reduces the risk and occurrence of ejection. The use of safety glass in passenger windows, coupled with a proper roof, reduce the risk of partial ejection to practical non-existence except in the most violent collisions.

What the auto industry knows

Sadly and predictably, this is not news to the auto industry.

In 1957, an internal document from Libby-Owens-Ford Glass Co. reported on a DuPont Research Program which evaluated "the relative safety performance of laminated versus tempered glass for automotive sidelights." After testing over 600 pieces of tempered glass, both LibbyOwens-Ford and Dupont considered substituting tempered glass for laminated safety glass "to be an unwarranted compromise with safety." DuPont concluded tempered glass was *completely ineffective* in retaining an occupant if the glass cracked in an accident. This stands in sharp contrast to laminated glass which retains great penetration resistance, even after it is cracked.

In 1971, Larsen and Rosenkrand presented their paper, "The Development of an Experimental Safety Vehicle by General Motors" to the 2nd International Conference on Experimental Safety

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Vehicles. In it they advise General Motors' ESV "has fixed side (laminated) glass to reduce the chance of ejection during rollover."

In addition to being essentially useless in preventing ejection, studies indicate that tempered glass is actually more likely to cause facial injury than laminated glass. (Glogus, Hamstead, Hayes, Mackey, Murray, Rattenburg, Rivkin, Smith, Whale, Some Aspects of Facial Injuries in Present Day Cars (1980); Huelke, O'Day, Barhydt, "Occular Injuries in Automobile Crashes," *Journal of Trauma* (Jan. 1982).)

In February of 1980, the head of NHTSA put manufacturers on notice that laminated glass should be used in side windows to retain all parts of the occupant's bodies in the vehicle during side impacts and rollovers. Contemporaneous internal General Motors memoranda concede that laminated glass in side windows would do the best job of containing occupants. General Motors would not adopt this change because of cost.

Why not use laminated glass?

In 1992, NHTSA suggested the use of laminated glass as a countermeasure for ejection during rollover accidents and asked for comments. In response to NHTSA's suggestion that laminated safety glass be used in side windows, in February of 1996, General Motors' Director of Safety Affairs and Regulations, Milford R. Bennett, advised that it would take at least until model year 2005 to convert to laminated safety glass and that it would take another 10 years before the safety "benefits would be fully realized." General Motors advised NHTSA that it felt the fact that it offered seatbelts was more than sufficient protection for its customers. Bennett had apparently overlooked the fact that as recently as model-year 1984 General Motors offered laminated safety glass "option" packages on the Suburban and the Blazer/Jimmy.

Probably out of frustration, at an SAE conference in 1999, the formation of the Enhanced Protective Glass Automobile Association was announced. This organization was initially comprised of automotive original equipment manufacturers and glass industry suppliers who were to work together to inform the public about the advantages of laminated side and rear window glass. The auto manufacturers soon quit the nascent organization and, under pressure from the automobile industry, on June 18, 2002, NHTSA announced it had terminated all efforts at rule-making on "advanced glazing requirements" (i.e. laminated safety glass) for passenger car and light trucks to reduce the risk of ejection in crashes.

Again under intense political pressure brought to bear by the automobile manufacturers, on July 25, 2003, NHTSA, ignored 50 years of studies by glass suppliers, studies by automobile manufacturers and independent scientists, as well as its own studies, and issued a final rule incorporating as the standard for 2004 and beyond the window glass standards of 1977 as supplemented in 1980. (68 Federal Register 43964.) In other words, NHTSA did nothing to encourage the use of laminated safety glass and removed even the potential that the government would require it.

Ironically, in 2003, BMW announced it had become the first automobile manufacturer to offer DuPont's laminated safety glass as an option for the front and back side windows.

Between 700 and 1000 people will be seriously injured this year as a result of partial ejection during automobile accidents. Virtually all of these injuries are preventable at a cost of approximately $2.50 per vehicle window.

As might be expected, juries presented with these facts have found liability and have assessed substantial damages. In March of 2005, a jury in Zavala County, Texas, awarded $28 million to an ejected decedent's heirs, who argued the model-year 2000 Ford Explorer defectively used tempered rather than laminated glass in the passenger windows. In September of 2005, another Texas jury found that Ford should pay $42 million to the family of a boy who was partially ejected from a Ford Expedition. After the tempered glass window shattered, 10-year-old Matthew Marregim, who was belted, struck the ground as the Expedition rolled over, and was killed.

The following October a South Carolina jury awarded $3.25 million to the family of a woman killed when a Ford Explorer she was driving flipped over in an accident. A mistrial was declared on the issue of punitive damages. In addition to lack of stability, the attorney for the family of the decedent argued that laminated safety glass would have prevented her partial ejection and death.

It appears that as with gas tanks, transmissions, roof strength, stability, airbags, interior surfaces and molding, and tires, it will again be left to the plaintiff's bar to compel these manufacturers to adopt reasonable, inexpensive vehicle safety improvements. The government will be of no assistance to the motoring public and the auto manufacturers remain more interested in saving $6 to $10 per vehicle than reducing the annual toll of thousands of deaths and injuries to the consumer.

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