The Ford Explorer: HISTORY REPEATS ITSELF

By John D. Rowell

While Firestone tire defects have been the subject of a great deal of publicity since recalled, the role of the Ford Explorer's lack of stability has received much less attention. This is not due to any lack of effort on the part of Firestone. Nor is it the result of lack of factual basis for placing the blame on Ford's shoulders. As Gary Eto points out, discovery has shown that the Explorer's lack of stability was the driving force behind the decision to lower the recommended psi as well as resultant modifications to the Firestone ATX and Wilderness tires.[1] These changes did not come close to solving the Explorer's stability problems.

The majority of deaths in Explorer roll-overs are not tire related. Firestone's claim that many of the injuries would not have occurred but for the Explorer's lack of stability has considerable merit. Discovery to date reveals that Ford must shoulder a large part of the blame for putting this vehicle on the marketplace. Further, discovery to date reveals that Ford management recognized the risks to consumers early on and deliberately chose not to follow it's own design goals so as to save money. These decisions were made both before production in 1991 and again before design modifications were put in place in 1995.

1. Vehicle Stability and Roll-Overs

Vehicle stability issues come into play when a vehicle is put into accident avoidance maneuvers or when the vehicle is caused to sharply turn. This can occur in a variety of ways - -glancing blows to the vehicle causing the operator to lose control; inattention followed by correction efforts; avoiding unexpected obstacles; and loss of tires, either by blow-out or by tread separation. During avoidance maneuvering, depending on the level of vehicle stability, the vehicle will either roll-over or slide out. Roll-overs will also occur, even when the vehicle is relatively stable, if the vehicle is "tripped" by, for example, striking a curb or other object.

Conceptually, there are two factors which contribute to a vehicle's stability. The first is the static condition of the vehicle. The second is the dynamic performance of the vehicle. Roll-overs occur when the center of gravity of a vehicle is elevated and moved to one side or the other to the extent that it moves over a pivot point, the wheel or trip mechanism. Static and dynamic elements determine the amount of elevation and the distance the center of gravity must travel to obtain a rollover.

Static elements are generally measured by comparing the track width to the height of the center of gravity. T/2H or, as Ford does it, T/H. This ratio can then be compared with other vehicles.

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[1] Analysis indicates that the shoulder of the United States manufactured tire was rounded and reduced in mass and side wall softened and reduced in mass. Approximately 2 lbs of rubber was removed from each tire. Thus, a supposedly identical model Firestone tire manufactured in Japan will be heavier and more resistant to deterioration in the shoulder area (which is where tread separation originates).

Dynamic factors can best be thought of as factors which, when the vehicle is being operated, have the effect of reducing the elevation needed to roll or which have the effect of moving the pivot point in-board, reducing the distance of lateral travel needed to roll. An example of a dynamic feature reducing the elevation needed to roll is a suspension system which dramatically "loads" 01 "unloads" in turning maneuvers, essentially springing the opposite side of the vehicle or compressing the vehicle on the rolling side. An example of moving the pivot point would be tires which are designed and constructed so that the outside tire tread tends to roll under the vehicle in turns, such as radial tires.

There are, of course, other significant static and dynamic features such as track length, weight disbursement, wheel canter and the like.

2. Tires and Co-Efficient of Friction

Based upon the static and dynamic stability characteristics of a vehicle, it is possible to estimate the amount of lateral force necessary to precipitate a roll. However, there is one very important factor remaining to be discussed. In order to roll, the vehicle's tires must develop a high enough co-efficient of friction so as to provide a pivot point. Generally, if the tires lose traction, the vehicle will not roll unless another trip mechanism is applied. Thus, a car, like a Corvette, which has a very low center of gravity and wide track, will spin out rather than roll-over, while at certain speeds a Jeep CJ5 will tend to tip over rather than spin out.

The Corvette's tires, even though extremely wide and capable of high coefficients of friction simply cannot provide a pivot point because the amount of lateral force needed to roll is so great. Before the needed lateral force can be applied, the tires lose traction and the vehicle "slides out." Thus, NHTSA statistics show that only 8% of single vehicle accidents involving Corvette's are rollovers.

On the other hand, even thought the tires of the Jeep CJ5 are not capable of providing as high a co-efficient of friction, the high center of gravity, narrow track width and suspension system allow a roll-over when much less lateral force is applied. The NHTSA statistics bear this out. 48% of all single vehicle accidents involving CJ5s are roll-overs.

As Ford advised NHTSA back in August of 1973, vehicles should be designed to forgive unskilled driving.[2] While only 18% of serious accident involve roll-overs, PARS data reveals that 25% of all vehicle fatalities occur in roll-overs. As the project engineer for the Ford Explorer conceded in a recent deposition, when a vehicle is properly designed, it should slide out rather than roll over on relatively flat surfaces.

3. The Development of the Ford Explorer

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[2] NHTSA Docket 73-10.

As to lack of vehicle stability, the Explorer has a fine pedigree. Ford played a significant role in the design of what became the Jeep. The Jeep CJ5 was eventually condemned as unstable. In the 80's SUV-type vehicles began to be introduced. In 1983 -1984 the Chevy Blazer, the Ford Bronco II and the Jeep Cherokee, and in 1986-1987 the Jeep Wrangler. In the mid-eighties, Ford started development of the UN46 which was to be an update to the Bronco II. While in development al Ford, the UN46 was often referred to in-house as the Bronco III.

A Ford internal memo dated May 1,1987 states that the stability of the UN46 is worse than the Bronco II but that UN46 stability can be improved by widening, lowering and using a smaller tire. A design goal, "no two wheel lift", was to be implemented. However, these recommendations were ignored - - with predictable results. A month later another internal memo indicates the design of the Firestone ATX (not a smaller tire) was discussed and approved for use on the UN46. Apparently someone decided that a "solution" to the problem was to "tweak" the tires. A report of computer modeling (ADAMS) in 1988 states that the UN46 demonstrated "performance issues" at 35 psi but that more favorable results were expected at 26 psi. Nonetheless, an internal Ford Test Report of November 25,1988 showed that the UN46 lifted wheels at 55 miles an hour due to a high center of gravity, tires and front suspension system. A 1989 internal Ford document discusses cornering ability and tire pressure reduction and the fact that, "Engineering has recommended use of tire pressures below maximum allowable inflation levels for all UN46 tires." Another internal memo dated January 11,1989, reports a meeting with Firestone to discuss front suspension "jacking" on the UN46 and Bronco II, a phenomena that is "undesirable from a vehicle stability standpoint." Two weeks later, Ford engineers conceded the design goal (no two wheel lift) had not been met using the P235 ATX tire.

The use of a P245 size tire proved even worse. In a letter dated February 9, 1989 to James Avouris from Mr. Tapia of the Arvin Calspan Tire Research Facility, Tapia reports that the "P245 test tires at the 29 psi pressure condition show a severe 'tread package' separation from the tire carcass." On February 20, an internal Ford memo recommended the use of 26 psi front and back along with various spring changes due to stability testing showing two wheel lift with 35 psi. On March 2,1989, in a memo to Ford, Firestone acknowledged that Calspan reported that when it tested the UN46 with P245 at 26 psi, the tire showed severe tread separation. Firestone then assured Ford that tread separation would not be a problem in the real world.

In April of 1989, two years before production, it became obvious to Ford that it might not be wise to continue the Bronco line, at least in name. You might remember the Consumer's Union reports on the Suzuki Samurai; the subsequent 60 Minutes segment deploring that vehicle's lack of stability (1989); and the resultant threat of a NHTSA recall. The resulting bad publicity and market share loss of the Samurai was not lost on manufacturers. A Ford internal memo dated April 5,1989 reports that Consumer's Union told Ford's Vice President for Public Relations, Mr. Sloan: "You have a real problem" with your Bronco II. When Ford learned that Consumer's Union was on the verge of issuing a report on the Bronco II similar to that on the Samurai, it took action. On April 21, 1989, Sloan reports, in an internal memorandum to upper management, that the Ford staff had met with Consumer Union and had successfully "clouded their minds." No report was issued. In June of 1989 Consumer Reports published an article telling buyers they should "avoid" the Bronco II. It was clear the UN46 would not be named the Bronco III.

As the UN46 design matured, the stability test results got worse. A May 10, 1989 Ford Test Report revealed that J-turn results showed the UN46 "rolls over" in 5 of 12 tests. The same test report advises the Blazer and Bronco II did not roll over. Keep in mind the J-turn test is a simple turn. The Consumer's Union had been using an avoidance test, which much more closely resembles the type of maneuver a driver would employ to escape perceived danger. The Consumer's Union test also brought more dynamic elements into play. Although testing using the Consumer's Union test in Arizona was authorized in May of 1989, written records of the results have not been produced. Circumstantial evidence indicates the UN46 failed those tests. In June of 1989, a Ford engineer recommended design changes to the Explorer and management recommended adopting as many as possible without delaying production. In July, 1989, Ford lowered the front end of the Explorer $\frac{1}{4}$ inch and stiffened the front springs to increase stability.

During the late 80's Ford was also designing an alternate to the UN46, the PN38. This vehicle incorporated a lower center of gravity, wider track width and properly inflated tires. The suspension was also modified. This effort continued up until the decision to adopt the UN 105 for model year 1995. According to the testimony of Mr. White and Mr. Kenneth Snodgrass of Ford, Ford abandoned the PN38 because it was too expensive.

Ford knew what it had done and accepted the risks. On September 11,1989, Roger Stornant of Ford, in an internal email to Charles White stated:

> "I believe that new information is that our competitors are recognizing the CU [Consumer's Union] Test as a requirement and have designed their new utility vehicles to meet. OGC [Office of General Counsel] is concerned we will be the only OEM with a vehicle that has a significant chance of failing the CU test. I believe that management is aware of the potential risk W/P235 tires and has accepted the risk. CU test is generally unrepresentative of real world and I see no 'real' risk in failing except what may result in a waive of spurious litigation."

In December 1989 a Ford internal memo reports that the Explorer with P235 tires set at 26 psi passed the roll-over test. So far, it is not clear what test was performed, where it was performed or when. The Ford Test Report on this roll-over test has not been located or produced. Assuming this was a report of on-track testing, the last on-track testing of the Explorer for stability (until model year 2002) was completed in 1989. Ford then determined not to use anything but computer modeling to test its' Explorer designs. It used the ADAMS program and only tested for J-turns on the ADAMS program. However, Ford claims it no longer has any of the data that was inputted in the ADAMS programs for the UN46, nor any of the output.

In a deposition taken of Ford engineer Kenneth Snodgrass on October 11,2000, he supplied the following numbers comparing static stability ratios (using T/H rather than T/2H):

CJ5		2.19	(2/81)
Bronco II		2.14	(11/82)
UN46		2.2-2.27	(4/87)
UN46		2.29	(9/87)
	4x2 4 Door	2.16	(6/88)
	4x2 2 Door	2.18	(6/88)
	4x4 4 Door	2.19	(6/88)
PN38		2.43-2.49	(6/88)
	Intermediate MPV	2.59-2.94	(6/88)
	Intermediate Utility	2.40-2.50	(6/88)
	Compact P/U	2.53-2.76	(6/88)
	Intermediate P/U	2.63-2.80	(6/88)

The role of dynamic stability factors is evident. Even though the UN46 enjoyed (according to Ford) an advantage in static stability over the CJ5 and Bronco II, it rolled in 5 out 12 on track tests in May of 1989, while neither the CJ5 nor the Bronco II rolled in any.

The Explorer truly was a Bronco III. The production four-door Explorer used 50% of its parts from the old Bronco II; the two-door model used 80% of its parts from the old Bronco II.

4. Mileage Concerns

Before the first Explorer was sold, Ford recognized that the lower tire psi, and resultant increased rolling resistance, was going to result in a penalty in fleet fuel economy. Accordingly, Ford started investigating tire modifications for the 1995 model year. That vehicle prototype was named the UNI 05. However, correspondence and e-mails show both Ford and Firestone knew that a tire with less rolling resistance would affect "vehicle dynamics" i.e. roll-over resistance. Again, Ford ignored its own engineers on stability and implemented the UN 105. According to Ford witnesses, the UN 105 or 1995 1/4 model year Explorer lowered the engine height by 1/2 inch, and replaced the dual I beam suspension with independent front suspension.

5. 2002 Explorer

Ford makes about $10,000 per Explorer. It is the best selling SUV on the marketplace and Ford apparently wants it to stay that way. Ford redesigned the Explorer for the 2002 model year. The engine height has been reduced by 4 *Yi* inches (clearance is little better than before); the track width has been increased by approximately 2 1/2 inches; the track length has also been increased by more than 2 inches (although the overall vehicle width has been reduced); and the suspension has been modified. The 2002 Explorer does not come equipped with Firestone tires. The 2002 Explorer has been subject to on track testing by Ford, including avoidance testing as well as J-turns.

There are presently a number of requests in different cases for this material and Ford has been ordered in one case to produce testing and design documents for the 2002 model. Presumably, these changes should improve roll-over resistance.

6. Conclusion

As the above history shows, Ford Explorer stability cases should be punitive damage cases. According to one witness, when William Clay Ford saw the Explorer with a size P215 tire (the smaller tire recommended by Ford engineers) he ordered larger tires used because "the wheel well wasn't full." Larger tires raise the center of gravity, reducing roll-over resistance. Ford knew this.

However, before you go out and sign up a lot of these cases, you should know that Ford rarely settles these cases unless there is a component of tire failure involved. Accordingly, be prepared to spend a lot or money and go to trial!

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