

Air Bag Inflation and Passenger Safety

It is well-documented that air bags save lives when the driver and passenger are properly belted and the air bag functions as intended. One concern with air bag function is the occasional delay before inflation. If inflation does not begin soon after impact, severe neck injuries and even fatalities are possible. The National Highway Traffic Safety Administration (NHTSA) has developed criteria for predicting the probability of serious neck injury in front end crashes. The neck injury criterion - abbreviated N_{ij} - is a number that is calculated based on the tension force exerted upon the neck and the extension moment of the neck. An N_{ij} value of 1.4 corresponds to a 30% chance of sustaining a severe neck injury. The NHTSA recommends values less than 1.4.

In one research study, a test dummy was placed in an automobile and three tests were conducted to determine the tension force (unit: Newton), extension moment (unit: Newton•meter), and N_{ij} value. All three tests involved a front-end crash of a car at 18 mi/hr. In test 1, an air bag was not used. In test 2, an air bag was inflated in the usual manner - 37.5 milliseconds (ms) after impact. In test 3, the air bag inflation was delayed, occurring 100 ms after impact. The results of the study are shown in **Table 1**.

Table 1: The Effect of Delay of Inflation

	Test 1	Test 2	Test 3
Time Delay of Inflation (ms)	--	37.5	100
Tension (N)	617	1057	4172
Extension moment (N•m)	11.8	14.3	82.6
Calculated N_{ij} Criterion	0.2	0.4	2.0

A second concern pertains to the aggressiveness with which the air bag inflates. If inflation is too violent, it can cause injury – particularly to children and smaller adults. The automobile industry has addressed this concern by reducing the amount of gas released into the air bag. Beginning in 1998, manufacturers began to reduce the internal pressure to which air bags were filled. **Figure 1** compares typical air bags from 1997 cars to 1998 cars. The plotted values represent an average of the data provided by 11 different automobile manufacturers.

Figure 1: Peak Pressure and Inflation Rate for 1997 and 1998 Air Bags

