March 6, 2000

The Honorable Rosalyn G. Millman
Acting Administrator
National Highway Traffic Safety Administration
400 Seventh Street S.W.
Washington, D.C. 20590

49 CFR Parts 552, 571, 585, and 595
Federal Motor Vehicle Safety Standards;
Occupant Crash Protection
Docket No. NHTSA 99-6407, Notice 1

Dear Ms. Millman:

In anticipation of a final rule from the National Highway Traffic Safety Administration (NHTSA) on advanced airbags, there has been considerable debate about the possible mandatory return to 30 mph rigid-barrier tests to assess unbelted occupant protection. Central to this debate is evidence from real-world crashes suggesting that 30 mph tests with unbelted dummies will not improve protection of unbelted people in real crashes. Detailed crash investigations have shown that unbelted people in frontal crashes are dying because of overwhelming intrusion of vehicle structure into occupant compartments, because of ejection from their vehicles, or from injuries to out-of-position occupants caused by deploying airbags.

One important fact contributing to this conclusion is that not a single case has been documented of an occupant dying because of inadequate airbag performance. This plus other evidence from crash investigations identifying the important role of intrusion and ejection, which are not addressed at all in the current rulemaking, suggest airbags should not be designed with more power. The Institute’s continuing review of all National Automotive Sampling System (NASS) cases of driver fatalities in frontal crashes of 1990 and newer model airbag-equipped vehicles during calendar years 1989-96 strongly supports this conclusion.

In a letter to the agency dated February 22, 2000, the Center for Auto Safety (CAS) claims NHTSA has identified four NASS cases (two 1998, two 1999) providing evidence that airbags did not perform adequately. Such evidence is important to the current debate, and if NHTSA has reached the conclusions CAS alleges it should immediately publish the reasons for such conclusions. The details of these cases also should
be released for review by groups outside the agency. This is particularly important because, in 1998, some NHTSA representatives claimed privately to have identified six cases in which driver airbags bottomed out. The Institute reviewed these cases and submitted a study indicating that none of the cases provided evidence of bottoming out. We also spelled out the methods by which such cases should be reviewed. Yet almost two years later, we have received no response to this study. The only evidence of its possible effect is that NHTSA no longer claims the six cases involve bottoming out.

Very late in the rulemaking process, we have been advised that two of the cases CAS cited in its February 22 letter have become available on the NASS website (we understand the two 1999 cases remain unavailable to the public). The Institute has reviewed these cases, and we seriously question the validity of any conclusions that the deaths occurred when airbags bottomed out. In one case (02-154A 1998), occupant compartment intrusion measured a devastating 15 inches at the instrument panel, amputating both legs of the belted driver. This case does not include an official cause of death, but a likely cause would appear to be blood loss from the leg injuries. Blunt abdominal trauma of unknown severity was the only upper body injury coded. This might have caused the fatality, but bottoming out the airbag does not account for this injury. It is more likely that the size of the driver (350 pounds) prevented the airbag from deploying in front of his abdomen. In this case, the airbag appears to have done as much as an airbag could do by preventing head and chest injuries. A more powerful or deeper airbag would have provided no added benefit and could have increased upper body injuries by intruding into and through the driver’s normal seating area (see attachment for more detailed information about how Institute researchers reached these conclusions).

Conclusions from the second case (06-147A 1998) are less clear. After this severe pole-type impact (delta V 38 mph), survival space in the occupant compartment remained. Interpretation of the case is complicated by the absence of an officially coded cause of death, even though an autopsy did supply information about blood alcohol concentration (BAC) and drug presence. None of the coded injuries was sufficiently severe to have expected the fatal consequences. It is possible that severe internal chest injuries were not coded, and one explanation for such injuries might have been the lack of adequate ridedown from the airbag. However, this explanation is inconsistent with other facts about the case, and a number of alternative explanations are more plausible. For example, the unbelted driver could have been slumped over the steering wheel when the crash occurred and, if so, the airbag itself could have caused the injuries. The driver’s BAC was 0.32 percent, and loss of consciousness could
explain both this mechanism of injury and the fact that the driver veered into the bridge pillar in the first place. Another possibility is that the driver’s sternum and rib fractures were caused by loading the steering wheel rim, after the steering column rotated upward and to the left during the crash. The driver’s contusions, lacerations, and abrasions are consistent with this scenario, which would have resulted in the driver’s face being very close to the airbag when it deployed. A third alternative is that the driver’s high BAC, by itself or combined with the effects of unspecified drugs, caused the death. Based on the information NHTSA has made available on the web, any of these three alternatives is more plausible than the possibility that the driver bottomed out the airbag (see attachment for more detailed information about how Institute researchers reached these conclusions).

Unless NHTSA has additional information about these two cases that has not been made available on the NASS website and might clarify how these deaths occurred, the cases do not support a return to 30 mph rigid-barrier tests with unbelted dummies. In one case, the airbag could not be expected to have prevented the fatality because the crash was too severe. In the second case, the cause and mechanism of death is unknown. The facts of both cases are inconsistent with bottoming out the airbags.

The Institute does not know whether NHTSA researchers have reached the conclusions CAS alleges. However, we would be surprised if the agency’s research staff does not have serious doubts, as we do, that the deaths in the two NASS cases occurred because of too little airbag energy.

Sincerely,

Adrian K. Lund, Ph.D.
Senior Vice President, Research

cc: Docket Clerk, Docket No. NHTSA 99-6407, Notice 1

Attachments: Summary Analysis, NASS Case 02-154A 1998
Summary Analysis, NASS case 06-147A 1998
**Crash Description**

A deer entered the road in the path of a 1991 Ford Taurus. The Taurus struck the deer and then crossed the centerline where it stuck the front of a 1995 Toyota Avalon traveling in the opposite direction. This was a frontal offset crash, with what appears to be approximately 50 percent overlap. Maximum crush for the Avalon was 86 cm (34 inches) and 43 cm (17 inches) for the Taurus. Principal direction of force for both vehicles was 12 o’clock. The Avalon’s driver was unconscious at the scene and pronounced dead on arrival at the emergency room. The driver of the Taurus was transported to the hospital and released.

**Delta V**

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avalon</td>
<td>27 (44 km/h)</td>
</tr>
<tr>
<td>Taurus</td>
<td>30 (48 km/h)</td>
</tr>
</tbody>
</table>

**Driver**

- **Avalon:** 51-year-old male, 72 inches, 350 pounds, using lap/shoulder belt; airbag deployed
- **Taurus:** 20-year-old female, 63 inches, 130 pounds, using lap/shoulder belt; airbag reportedly deployed in first impact with deer

**Driver Injuries**

- **Avalon:**
  - Blunt/traumatic abdominal injury (AIS 5150997) from steering wheel rim contact
  - Lower extremity amputation, left and right (AIS 8110003), from left instrument panel and below
  - Facial skin contusion (AIS 2904021) from airbag
  - Upper extremity skin abrasion (AIS 7902021) from airbag

- **Taurus:**
  - Right talus fracture (AIS 8532002) from foot controls
  - Multiple AIS 1 abrasions, lacerations, and contusions plus one AIS 1 finger fracture from instrument panel, airbag, belt restraint webbing/buckle, and steering wheel rim

**Analysis of Avalon Fatality**

It is not clear when the crash occurred, but emergency vehicles arrived about 15 minutes after notification. There is no information about how long it took to extricate the driver from the Avalon, but the emergency vehicle arrived at the hospital more than an hour later. No medically reported cause of death is recorded, but the most life-threatening injury recorded is the amputation of both legs. Despite the low AIS code (3), such injuries introduce severe blood loss, which would be exacerbated by the driver’s upright position after the crash and any delay in the administration of treatment. These injuries were clearly caused by the severe intrusion into the occupant compartment. The NASS case notes cuts on the steering wheel rim as evidence of possible head contact, but no head injuries were listed. No chest injuries were recorded, either, but the driver did sustain blunt abdominal trauma of unknown severity attributed to steering wheel rim contact. This injury code might indicate the presence of uncoded internal injuries with life-threatening consequences. The driver seat was located between the middle and rear-most seat track position. Given the driver’s size (6 feet, 350 lbs.) and seat position, it is likely that he was in close proximity to the bottom rim of the steering wheel, even when belted and in a normal posture. Photographs show the bottom half of the steering wheel rim was deformed and pushed toward the center hub. The abdominal trauma probably resulted from contact with the bottom of the steering wheel rim from underneath the airbag, which is consistent with the damage pattern evident in photographs of the steering wheel. It is possible that the airbag was overwhelmed by the driver’s heavy mass, but it is more likely that his large girth placed him very close to the steering wheel, preventing the airbag from deploying downward to protect the abdomen. If there was intrusion of the steering column, which is likely given the extent of instrument panel and toepan intrusion, this too would have contributed to the driver’s abdominal injuries. Because of extrication damage, the condition of the Avalon immediately after impact is difficult to determine. However, the NASS investigator estimated 15 inches of instrument panel intrusion and 16 inches of toepan intrusion. With so much intrusion, it is unlikely the crash was survivable. It is likely that the steering assembly also would have moved toward the driver, eliminating the ridedown space necessary for an airbag (or any restraint) to be effective. The Avalon’s estimated delta V is only 27 mph, but the impact was very severe in the driver’s space. By comparison, in an Institute offset test of a 1996 Toyota Avalon with a 40 mph closing speed, toepan intrusion was a maximum of about 10 inches and instrument panel intrusion was less than 5 inches.
NASS Case 06-147A 1998

Crash Description
A 1997 Honda Civic traveling on a two-lane, two-way wet road struck a support pillar for an overhead railroad track with its front plane. The impact point was slightly to the driver side of center. Principal direction of force was 12 o’clock. Maximum crush was 78 cm (31 inches). The driver, who according to autopsy records had a 0.32 percent blood alcohol concentration and tested positive for drugs, was pronounced dead at the scene.

Delta V
38 mph (61 km/h)

Driver
29-year-old male, 71 inches, 146 pounds, unbelted; airbag deployed

Driver Injuries
Injuries and sources determined by the NASS investigator
- Right tibia fracture shaft open/displaced/comminuted (AIS 8534223) from knee bolster
- Right femur fracture (AIS 8518003) from center instrument panel and below
- Rib cage fracture, 2-3 ribs any location (AIS 4502202), from airbag
- Sternum fracture (AIS 4508042) from airbag
- Multiple AIS 1 level contusions, abrasions, and lacerations to face, neck, upper extremities, lower extremities and chest, from airbag and interior components

Analysis
The cause of death was not recorded. The two most severe (AIS 3) injuries recorded were to the tibia and the femur. Fractures (AIS 2) of the rib cage and sternum also are listed. The most plausible causes of death appear to be possible uncoded internal chest injuries or death from drugs and alcohol (the driver’s blood alcohol concentration was 0.32 percent, more than 3 times the legal limit in most states; other drugs also were present). It is not clear why the autopsy did not reveal the cause of death. Operating on the assumption that the chest injuries were the cause of death, it is noteworthy that the investigator listed the airbag as the cause of these injuries. This is possible if the driver, as a result of his excessive alcohol consumption and drug use, was passed out and slumped over the steering wheel prior to the collision. This also might help explain why the driver veered into the bridge support in the center of the road. In addition, he struck a narrow bridge pillar almost in the middle of the bumper, which may have delayed airbag deployment and given the driver time to move closer to the airbag. Again, proximity to the airbag may have caused the fatal injuries. Other scenarios also are possible. One is that the unbelted driver’s chest injuries resulted from contact with the steering wheel through the airbag, which would argue for a more powerful, deeper airbag. However, if the coded injuries are the most severe, then under this scenario the airbag appears to have limited the chest injuries to no more than AIS 2. It is also remarkable that steering wheel rim deformation is not visible in the photographs, even though the steering column appears to have rotated upward. If the driver rode down the airbag, loading the steering hub with his chest and causing the column to rotate, then steering wheel rim deformation and evidence of occupant contact with the A-pillar, windshield, or other forward interior components would have been expected (the driver was almost 6 feet tall, 146 pounds). Such contact is not evident. It seems more plausible that the severe crush from the impact of the bridge support into the center of the vehicle caused the steering column to rotate up and outward before the airbag was fully deployed. In this case, the driver’s sternum and rib fractures may have been caused by loading the rim of the steering wheel on the edge, which can be very stiff when contacted at this angle. If this is what occurred, the driver’s face was likely near the airbag at the time of deployment, resulting in the AIS 1 facial contusions and lacerations plus the observed neck/throat/skin abrasions. Finally, it is possible that the driver was dead from excessive alcohol and drugs prior to the crash, that he died from post-crash complications due to the alcohol and drugs in his system, or that he was not found for several hours after the crash and died from blood loss. Given the reported injuries to the chest (sternum fracture and fracture of several ribs), there is no indication that he died from severe chest trauma.
NASS Case 06-147A (1998): Honda Civic, Front Exterior Damage

NASS Case 06-147A (1998): Honda Civic, Interior