

# STATUS REPORT

INSURANCE INSTITUTE  
FOR HIGHWAY SAFETY

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## ***AIRBAGS HAVE EVOLVED***

to do a better job of protecting people in multiple kinds of crashes, and each generation has done a better job of this than the one before. That is, until now. A new Institute study suggests that frontal airbags designed to meet the latest federal standards haven't improved protection of adults and, in fact, appear to have reduced protection of belted drivers.

"The newest airbags appear to provide suboptimal protection for drivers who buckle up compared with the airbags that preceded them," says Institute president Adrian Lund. "It's a surprising finding. Based on our analysis of death rates in frontal crashes, belted drivers seem to fare better in vehicles that have many of the advanced

features of current systems but weren't certified to the latest airbag safety standard."

Together with safety belts, airbags are the cornerstone of protection in frontal crashes. Ones to safeguard drivers and front-seat passengers have been standard in all passenger vehicles since 1999. They've saved more than 28,000 lives, the National Highway Traffic Safety Administration (NHTSA) estimates.

A big difference between today's airbags and first-generation ones is that they deploy with less force. Problems cropped up with the first generation of airbags in the mid-1990s. During crashes they were inflating with such force that they killed or seriously injured some children, small-stature adults, and other people who were too close to the

bag when it inflated (see *Status Report*, June 17, 2000; on the web at [ihs.org](http://ihs.org)). NHTSA attributes 296 deaths to frontal airbags, including 191 children, 92 drivers, and 13 adult passengers as of Jan. 1, 2009. Nearly 90 percent of deaths occurred in vehicles made before 1998 when the agency first changed frontal crash safety standards in ways that promoted less forceful deployments.

"Early airbags as opposed to crash forces were the source of injury in some cases," Lund explains. "They saved many lives but at the same time put some vulnerable passengers at risk. When it became clear what was happening, NHTSA allowed automakers to redesign airbags, and once the fixes were in place, deaths dropped sharply."

**Steps to address injuries:** As a first step NHTSA modified safety rules in 1997 to encourage automakers to take energy out of the airbags. Depowering began with 1998 models. Manufacturers were given the option to use sled tests with unbelted dummies to certify that their vehicles met crash performance rules. Or they could continue to run barrier tests with both belted and unbelted dummies.

Most manufacturers picked sled tests, in which a whole or partial vehicle is attached to a moving platform that simulates vehicle crash decelerations and mimics the forces on occupants during crashes. The maximum sled accelerations NHTSA prescribed under this option were lower than typically occur in crash tests so airbags didn't need to deploy as quickly or forcefully to catch and cushion unbelted dummies. Airbags meeting this



standard are called sled-certified. The Institute previously examined the impact of NHTSA's move to allow depowering and found an overall reduction in fatal crash risk associated with depowered airbags compared with earlier designs (see *Status Report*, March 6, 2004; on the web at [iihs.org](http://iihs.org)).

Other research has shown that the fatality risk among children in front seats decreased with sled-certified airbags (see *Status Report*, June 9, 2008; on the web at [iihs.org](http://iihs.org)). At the same time a large-scale public education campaign encouraged parents to restrain children, especially infants in rear-facing restraints, in the back seat, where they're safest. Legislators in many states enacted laws requiring children to sit in the rear. Parents largely got the message.

Today most kids ride restrained in back seats. These and other changes plus increasing belt use have contributed to the drastic decline in frontal airbag-related deaths, the bulk of which occurred in vehicles made before 1998 (see *Status Report*, Aug. 1, 2004, and Aug. 6, 2005; on the web at [iihs.org](http://iihs.org)).

**Tailored deployment:** The sled test option was meant to be a stopgap until NHTSA could write a new standard to explicitly address airbag-induced injuries while also improving protection for a range of different-size people in various frontal crashes. During 2001 the agency issued a certified advanced airbag rule, with phase-in beginning with 2003 models.

Advanced airbags modify deployment patterns if weight sensors detect a small front-seat driver or passenger or a child safety seat. These airbags can be suppressed altogether or deploy with less force when passengers are small or out of position or if a crash isn't severe. They also can determine if occupants' safety belts are buckled.

Certified-advanced airbags generally deploy at lower thresholds for people who aren't using belts.

This changed the way auto manufacturers test vehicles for compliance. It introduced a range of tests, including head-on and offset frontal crash tests plus out-of-position tests of airbags using different-size dummies. For the first time, the automakers were directed to use dummies representing 5th percentile females and children 1, 3, and 6 years old, in addition to the standard 50th percentile male dummy.

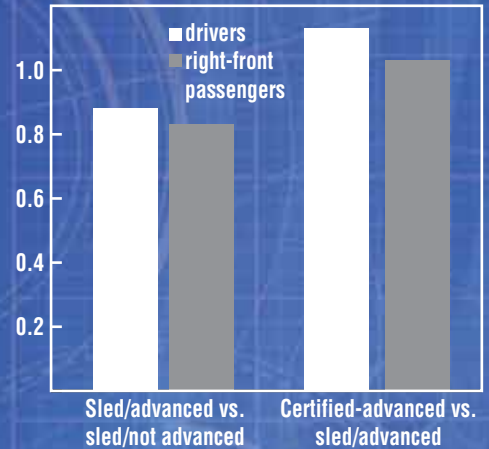
Crash test speeds also changed. For belted male dummies, the rule phased in a 5 mph speed increase, to 35 mph, beginning with 2007 model vehicles. Rigid-barrier tests for unbelted occupants were reinstated, but the crash test speed was lowered from 30 mph to 25 mph (see *Status Report*, June 17, 2000; on the web at [iihs.org](http://iihs.org)).

Anticipating the design changes that an advanced airbag standard would require, some automakers added new features ahead of the rule. These included dual-stage inflators, belt status sensors, seat position sensors, and occupant size and weight sensors. Some new airbag systems also had sensors to detect rear-facing infant restraints in front seats and prevent airbags from deploying. Many of these systems closely resemble certified-advanced airbags.

"The advanced features automakers added changed the game," Lund says. "Instead of tailoring protection and deployment for one group — average-size men in a typical crash — manufacturers were able to design airbag systems to provide better protection for a range of people in a variety of crash situations."

**What the changes mean:** What hadn't been known is how advanced airbags compare with the previous designs. To find out, Institute researchers recently compared mortality rates in frontal crashes among front-seat occupants in vehicles with certified-advanced airbags — the latest generation (*continues on p.6*)

**ADJUSTED MORTALITY RATE RATIOS OF DRIVERS AND ADULT RIGHT-FRONT PASSENGERS**



**BELTED DRIVERS HAVE HIGHER MORTALITY RATES IN VEHICLES MEETING THE ADVANCED AIRBAG RULE COMPARED WITH DRIVERS WHOSE AIRBAGS HAVE ADVANCED FEATURES BUT AREN'T CERTIFIED TO THE LATEST SAFETY STANDARD.**

## **DRINKING CONTINUES TO DECLINE AMONG WEEKEND DRIVERS**

Alcohol use by nighttime drivers on weekends is down sharply since 1973 but remains a major problem in fatal crashes. The latest national roadside breath-test survey indicates 2.2 percent of drivers had blood alcohol concentrations (BACs) of 0.08 percent or more in 2007, marking a 71 percent decline from 1973 when the first survey was conducted. At the same time, 16 percent of nighttime weekend drivers tested positive for drugs, the National Highway Traffic Safety Administration (NHTSA) says. The agency cautions that its first-ever estimate of driver drug use doesn't necessarily imply that these drivers were impaired.

The percentage of alcohol-impaired nighttime drivers in 2007 compares with 4.3 percent in 1996, 5.4 percent in 1986, and 7.5 percent in 1973. There were similar declines during the same period in the percentages of drivers with any detectable alcohol in their systems.

The 2007 survey involved randomly stopping drivers at 300 locations in 48 states on Friday and Saturday nights and during the day on Fridays. The daytime component was new for 2007, along with drug screens, and for the first time the survey included motorcycles.

Drivers were more likely to be impaired by alcohol between 1 and 3 am (4.8 percent) than during the daytime (0.2 percent) or early evening (1.2 percent). This is in line with federal data showing that alcohol involvement in fatal crashes peaks at night and is higher on weekends. All 50 states and the District of Columbia have per se laws defining it as a crime for people to drive with a BAC at or above a proscribed level, 0.08 percent.

"The roadside surveys suggest that the prevalence of alcohol-impaired driving has gone down over time, and that's great news," says Anne McCartt, Institute senior vice president for research. "Fatal crashes tell a different story. The reductions aren't showing up in federal crash data. We can't explain the disconnect, so this merits more research."

Based on fatal crash data, the proportion of fatally injured drivers with BACs at or above 0.08 percent declined by about a third between 1982 and 1994, from 49 percent to 33 percent. Since 1994 the percentage of fatally injured nighttime drivers with BACs at or above 0.08 percent has remained about a third. Likewise, the percentage of fatally injured drivers with 0.15 percent or higher BACs has slid 30 percent since 1982 but with little change since 1996.

A complication in the latest roadside survey may be that drivers were less willing to participate in 2007 than in years past. NHTSA notes that the 85 percent participation rate was lower than the 96 percent recorded in 1996 and 94 percent recorded in 1986. This might reflect driver concerns about litigation and privacy rights. It also might reflect a general reluctance to be interviewed. NHTSA accounted for this by using passive alcohol sensors to estimate refusers' BACs.

Surveyed male drivers were more likely to have illegal BACs than females (2.6 percent versus 1.5 percent). Compared with 1996, a lower percentage of males had illegal BACs in 2007 (3.5 percent in 1996). The percentage of female drivers with illegal BACs didn't change between 1996 and 2007. Fatal crashes among male drivers are much more likely to involve alcohol than those among females.

Motorcycle riders in the 2007 survey were more than twice as likely as car drivers to have BACs at or above 0.08 percent (5.6 versus 2.3 percent), followed by pickup truck drivers (3.3 percent). However, crash data indicate that alcohol is a bigger factor in passenger vehicle driver deaths. Thirty-five percent of fatally injured passenger vehicle drivers versus 30 percent of cyclists had BACs of 0.08 percent or more in 2008.

Drivers were asked to complete a questionnaire to estimate the prevalence of binge drinking, defined as consuming 6 or more drinks on a single occasion at least monthly, and heavy drinking, defined as 5 or more drinks a day 4 or more times a week. About 26 percent of drivers said they don't drink.

Binge drinking was widely reported by nighttime drivers with high BACs. Among people who said they drink, about 19 percent met the criteria for heavy drinking and 18 percent





for bingeing. These two groups accounted for the largest percentage of drivers with positive BAC results in the roadside survey. Since this questionnaire was new for 2007 NHTSA can't compare responses with prior surveys. The agency says the results suggest the need to focus on binge drinkers through tougher enforcement of DUI/DWI laws and prevention programs.

"Another option is requiring alcohol detection devices for all drivers once the technology is fully developed," McCart says. The devices would prevent any driver from starting a vehicle after drinking too much. This idea has strong public support (see *Status Report*, Sept. 17, 2009; on the web at [iihs.org](http://iihs.org)).

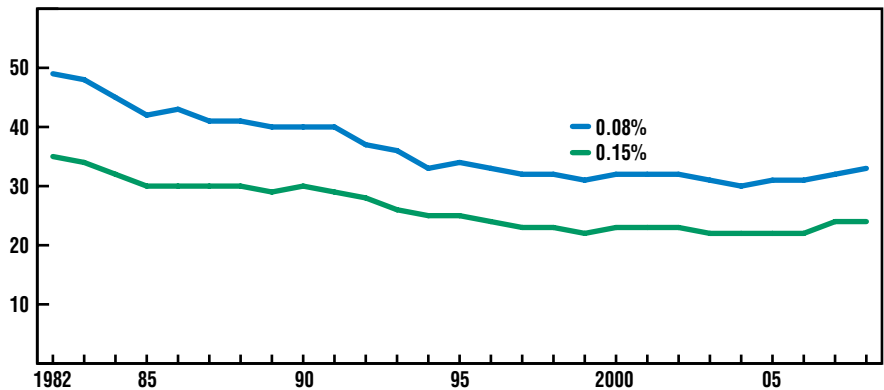
Previous roadside surveys estimated only alcohol use, but NHTSA expanded testing in 2007 to include screening of saliva and blood samples for over-the-counter, prescription,

and illegal drugs. More nighttime than daytime drivers tested positive (14 versus 11 percent). The drugs most often detected were marijuana (8.3 percent), cocaine (3.9 percent), and methamphetamine (1.3 percent).

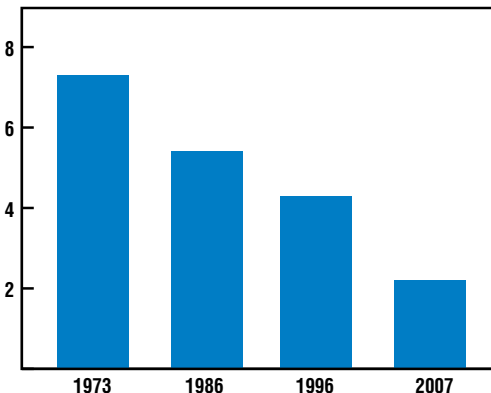
It's difficult to tell whether the drivers were impaired by the drugs because some drugs can be detected in the body weeks after use. Also unclear is the dose at which driving is impaired. NHTSA is conducting more research to understand the impact of drug use on highway safety, including which drugs impair driving ability and at what dose levels and which drugs are linked to higher crash rates.

Access "2007 national roadside survey of alcohol and drug use: alcohol prevalence rates" and "2007 national roadside survey of alcohol and drug use: drug prevalence rates" at [www.nhtsa.dot.gov](http://www.nhtsa.dot.gov).

**PERCENT OF FATALLY INJURED DRIVERS WITH BACS AT OR ABOVE SPECIFIED THRESHOLDS, 1982-2008**



**PERCENT OF WEEKEND NIGHTTIME DRIVERS WITH BACS 0.08 OR MORE**



The percentage of impaired nighttime drivers in the 2007 roadside survey was 2.2 percent. This compares with 4.3 percent in 1996, 5.4 percent in 1986, and 7.5 percent in 1973. There were similar declines in percentages of drivers with any detectable alcohol in their systems during the same period. Drivers with BACs of 0.15 percent or more accounted for 0.4 percent of all drivers in 2007 versus 0.6 percent in 1996, 1 percent in 1986, and 1.4 percent in 1973.



## **NHTSA EXAMINES FATAL CRASH FACTORS**

Airbags and safety belts vastly improve occupant protection, yet thousands of people die in frontal crashes each year. A federal study of the factors behind these deaths suggests the need for improved vehicle designs and advanced restraints to better protect people in corner and oblique crashes, impacts with narrow objects like poles, and underrides with large trucks and trailers. The findings are in line with Institute research.

Last year the Institute combed federal crash data to explore why crash deaths and serious injuries happen in vehicles that earn good ratings based on frontal tests and suggested crash types for further analysis (see *Status Report*, March 7, 2009; on the web at [iivs.org](http://iivs.org)). Similarly, a research team from the National Highway Traffic Safety Administration reviewed every crash in which a belted driver or right front-seat passenger died in a model year 2000 or newer vehicle to obtain a sample of 121 crashes to study. Data are from the Crashworthiness Data System of the National Automotive Sampling System.

While the Institute looked at deaths and serious injuries, limiting cases to vehicles with good crash test ratings, the federal researchers focused on fatalities and didn't put any conditions on test performance. The agency's results skew toward 2000-03 models, and the Institute's work focuses on 2004-06 models with more crashworthy designs.

Just over half of the people who died were in exceedingly severe crashes or had physical conditions that may have raised their injury risk. Being elderly or obese were common factors.

The next most common factor involved vehicle structures that didn't line up well enough to absorb crash energy, resulting in lots of occupant compartment intrusion. This was the case in corner crashes, impacts with poles and trees, underrides, and crashes with an oblique impact direction.

Access "Fatalities in frontal crashes despite seat belts and airbags" at [www-nrd.nhtsa.dot.gov/Pubs/811102.PDF](http://www-nrd.nhtsa.dot.gov/Pubs/811102.PDF). Access "A study of the factors affecting fatalities of airbag and belt-restrained occupants in frontal crashes" by R.W. Rudd et al. at [www-nrd.nhtsa.dot.gov/database/nrd-01/esv/asp/esvpdf.asp](http://www-nrd.nhtsa.dot.gov/database/nrd-01/esv/asp/esvpdf.asp).

(continued from p.3) of airbags — with sled-certified ones with advanced features. They also looked at mortality among front-seat occupants of vehicles with sled-certified airbags with advanced features versus those without advanced features. The researchers analyzed the effects of airbag design changes by driver age, gender, and belt use. They also looked at mortality rates for children in front seats. The study included 1998-2006 model vehicles in crashes during 2004-07.

Some people were benefiting from advanced airbag features even before airbags were certified as advanced. Mortality rates were 16 percent lower for drivers of vehicles with sled-certified airbags with advanced features than for people who drove vehicles with sled-certified airbags without advanced features. The benefit was 17 percent for adults riding in front passenger seats.

Death rates were lower for both male and female drivers ages 15-59, as well as for men older than 60. Unbelted male drivers had a 38 percent lower death rate in vehicles with sled-certified airbags with advanced features compared with vehicles with sled-certified airbags lacking such features.

Results for certified-advanced airbags don't follow the same pattern. Although children benefited from both kinds of advanced airbag systems, drivers didn't. People who drove vehicles with certified-advanced airbags had a higher mortality rate than drivers of vehicles equipped with sled-certified airbags with advanced features.

Belted drivers had the biggest uptick in the risk of death — 21 percent — compared with drivers of vehicles with sled-certified airbags with advanced features.

"This finding puzzles us because these drivers had otherwise done everything right in terms of buckling up," Lund says. "It suggests there might be potential problems with the way manufacturers are required to

certify airbags as advanced because the technology introduced in vehicles during the sled test era seems to work. But when the new standard is fully in effect we don't see an improvement."

The agency's 2001 decision to reintroduce a rigid-barrier crash test for unbelted occupants was controversial. Automakers contended the unbelted test would prompt a return to overly aggressive airbags. The Institute initially objected to reinstating the unbelted barrier test, while other safety groups favored it (see *Status Report*, Oct. 9, 1998, and Feb. 6, 1999; on the web at [iihs.org](http://iihs.org)).

The maximum test speed sparked debate, too. NHTSA at first proposed 30 mph but settled on 25 mph in the final rule, a change the Institute supported (see *Status Report*, March 15, 2003; on the web at [iihs.org](http://iihs.org)). Some safety groups, however, feared 25 mph would provide inadequate protection for large occupants, particularly unbelted men. Public Citizen and the Center for Auto Safety sued NHTSA, but a federal appeals court upheld the agency (see *Status Report*, Aug. 1, 2004; on the web at [iihs.org](http://iihs.org)).

"Automakers may have had a point," Lund concedes. "Airbags may be too aggressive because of the rigid-barrier test requirements for unbelted dummies. It's also possible that advanced deployment algorithms result in some airbags not deploying at all when they would be beneficial. NHTSA needs to look at our study and try to understand if the new standard missed the mark on striking a balance between protection for both belted and unbelted occupants. In particular, belted drivers aren't reaping the benefits we expected."

For a copy of "How have changes in airbag designs affected frontal crash mortality?" by E.R. Braver et al., write Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, Va. 22201, or email [publications@iihs.org](mailto:publications@iihs.org).



## NEW SAFETY RATINGS FOR SMALL PICKUPS

The Nissan Frontier has the strongest roof and the Chevrolet Colorado the weakest among five 2010 small pickup trucks the Institute recently evaluated for occupant protection in rollover crashes. The Frontier, which also is sold as the Suzuki Equator, is the only pickup in the group to earn the highest rating of good. The Ford Ranger is rated acceptable while the Dodge Dakota, Toyota Tacoma, and Colorado, which also is sold as the GMC Canyon, earn the second lowest rating of marginal. Go to [iihs.org](http://iihs.org) for full results.

The rating system is based on Institute research showing that occupants in rollover crashes benefit from stronger roofs (see *Status Report*, March 24, 2009; on the web at [iihs.org](http://iihs.org)). Vehicles that earn good ratings must have roofs that are more than twice as strong as the minimum required by the current federal safety standard. As a group, small pickups aren't performing as well as small cars or small SUVs.

"It's harder to find a small pickup truck that performs well in all of our crashworthiness evaluations," says Institute senior vice president David Zuby. In fact, no small pickup earns the Institute's *TOP SAFETY PICK* award.

The Institute also conducted new side impact tests of small pickups. Earning good ratings are the Frontier with standard front and rear head curtain airbags and the Ranger with standard front-seat mounted combination head and torso airbags. Also rated good is the Tacoma. In contrast, the Colorado is rated poor for side protection.

### ROOF STRENGTH

<b>GOOD</b>	NISSAN FRONTIER SUZUKI EQUATOR
<b>ACCEPTABLE</b>	FORD RANGER
<b>MARGINAL</b>	DODGE DAKOTA
<b>MARGINAL</b>	TOYOTA TACOMA
<b>MARGINAL</b>	CHEVROLET COLORADO GMC CANYON

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