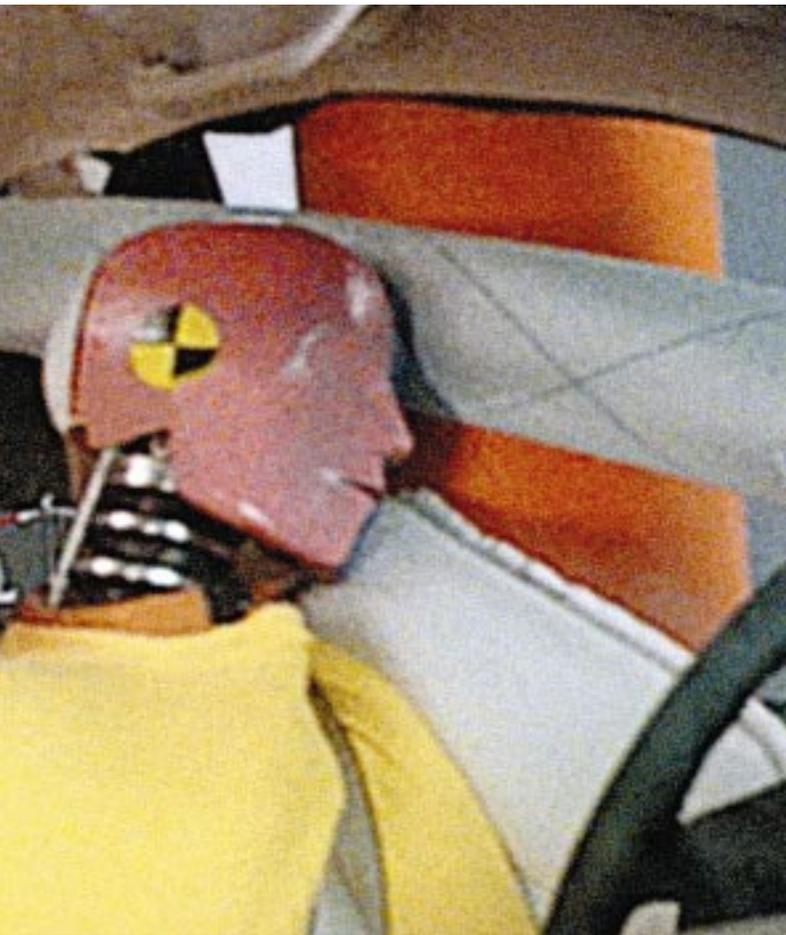


STATUS INSURANCE INSTITUTE FOR HIGHWAY SAFETY REPORT

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Airbags for heads reduce injuries in side impact crashes, but federal rule may restrict their use

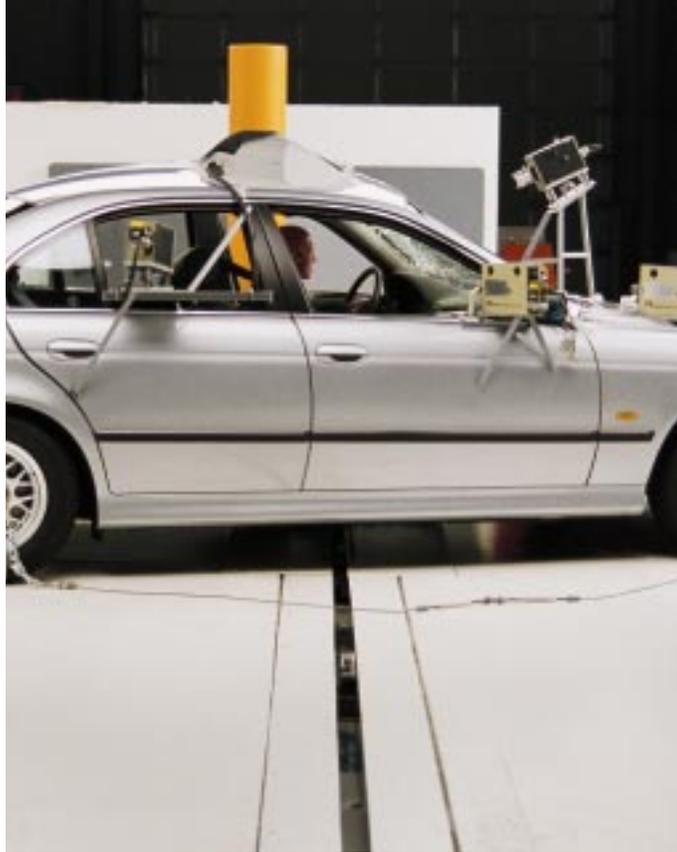
BMW has a new inflatable Head Protection System (HPS) that deploys diagonally across side windows to protect people's heads in serious side impact crashes. HPS is standard in 1998 BMW 5- and 7-series cars. Mercedes, Volkswagen, Volvo, other

automakers, and some airbag suppliers are testing similar head protection systems featuring inflatable curtains instead of tubular bags like BMW's. These systems will prevent many serious head injuries in side impact crashes, but a new federal

standard designed to improve head protection may block their use.

The new test requirements of Federal Motor Vehicle Safety Standard (FMVSS) 201 were written before development of systems like BMW's, which the Institute

In conjunction with BMW, the Institute ran side impact pole tests with two BMWs — a 1997 BMW 528 with a side airbag designed to protect the thorax but without the Head Protection System (HPS) and a 1998 model 528 with both the thorax bag and HPS. Each car was propelled sideways at 20 mph into a 10-inch round rigid pole, causing major penetration into the side of each car. In the impact without HPS, the injury measures recorded on the dummy's thorax were low, but its head hit the pole with more than enough force to cause fatal injury in a real-world impact. With HPS, all of the dummy's injury measures were good.



has evaluated. Issued in 1995 to augment the original FMVSS 201 rule of 1968, the new requirements to the head impact standard are to be phased in for new vehicles over five years beginning September 1, 1998. Their purpose is to reduce head injuries when occupants strike upper interior vehicle components including pillars, side rails, headers, and roofs in crashes. By model year 2003, all new cars must meet the new test requirements. These dictate that a headform, essentially a dummy's head, be propelled at 15 mph into specified upper interior areas. The measured head injury criteria must not exceed 1000 (see *Status Report*, Vol. 30, No. 10, Dec. 2, 1995).

To comply, manufacturers anticipate they'll have to add extra interior padding — padding that would need to be located in some of the areas where inflatable head protection systems such as BMW's are stored. BMW and other automakers say that padding thick enough to comply with the headform test requirements at 15 mph would hinder deployment of inflatable side impact head protection systems. So they have asked the National Highway Traffic Safety Administration (NHTSA) to modify the head protection standard.

In response, NHTSA has proposed two additional test options for manufacturers to demonstrate that a system provides required levels (cont'd on p. 4)





Mercedes and Volvo are among import manufacturers hoping to introduce inflatable head protection systems by the year 2000. Both already use side airbags in their vehicles to protect occupants' torsos from injury in side impacts. The new window curtain bags will work in conjunction with these side airbags. The curtain inflates from its storage location in the roof rails to prevent front and rear occupants seated next to side windows from hitting their heads on windows or roof pillars. Mercedes calls its system the "Windowbag" (top). Volvo's is called an "Inflatable Curtain" (bottom).

Inflatable head protection systems in the works for other import models

BMW's are the first production cars with airbags designed specifically to protect people's heads in side impacts, and other import manufacturers are developing similar systems. Plans hinge on a federal rule change to allow use of these airbags (see page 1).

Volvo hopes to offer within two years an "Inflatable Curtain," which in a side impact crash will deploy from the roof to cover the car's side interior and windows. The airbag will cushion the heads of the driver and all passengers seated next to doors in both front and rear seats. This inflatable curtain will work with side airbags, which Volvo was first to introduce in 1994.

Mercedes plans a window airbag, too. Like Volvo's version, the Mercedes "Windowbag" prevents both front and rear occupants from hitting their heads on side windows or roof pillars. The bag is triggered at the same time as the door bag and deploys from the ceiling over the front and rear side windows. The window bag is slated to debut in E-Class and S-Class European models next year and could be available in the United States in early 1999.

Toyota projects that a curtain-type system will be in some Lexus models within a year, a company spokesman says.

Volkswagen's research and development team also is reportedly working on a system but "no definite plans have been made," says Tony Fouladpour, Volkswagen spokesman. "We're waiting to find out where the government is going," he says.

(cont'd from p. 2) of head protection. One proposed change would allow automakers to use a full-scale 18 mph rigid pole crash test to demonstrate inflatable head protection systems. The vehicle would be aligned with the pole so the dummy's head likely would strike it without the protection. The headform tests still would have to be run, but the test speed would be reduced from 15 to 12 mph in the areas where the inflatable system is stored.

Institute tests BMW system: In conjunction with BMW, the Institute conducted similar side impact pole tests last month using production BMWs — a 1997 BMW 528 with a side airbag designed to protect the thorax but without HPS and a 1998 model 528 with both the thorax bag and HPS. Each car was propelled sideways at 20 mph into a 10-inch round rigid pole, causing major penetration into the side of each car. In the impact without HPS, the crash dummy's thorax was protected, but its head hit the pole with more than enough force to cause fatal injury in a real-world impact. The head injury criterion was 4720, or more than four times the ref-

erence value (1000) used to indicate the likelihood of a serious head injury like a skull fracture.

In contrast, the head injury criterion in the same crash test with HPS was 620. "It was a remarkable demonstration because despite major intrusion, the impact was survivable," says Institute President Brian O'Neill. "This kind of airbag should protect people in many serious side impacts, not only single-vehicle crashes but also two-vehicle crashes in which there's intrusion in areas near occupants' heads. Unlike fronts and backs of vehicles, side structures cannot provide much crush space. Door and restraint system designs must be the keys to preventing serious occupant injuries in side impacts."

O'Neill adds, "This first of its kind head protection system from BMW demonstrates what can be done to protect people in very serious side impacts."

HPS "is a direct result of BMW's accident research work," says Karl-Heinz Ziwica, general manager of environmental engineering at BMW. "Our data showed that head injuries are overrepresented in

severe side impact collisions. The concept of HPS provides us with an excellent means to protect the head in these types of accidents."

Head injuries are the cause of death in somewhere between 44 and 76 percent of single-vehicle side impacts and in 26 to 52 percent of multiple-vehicle side impacts, an Institute analysis of 1993-95 crashes recorded in the National Automotive Sampling System found. In 39 percent of the single-vehicle side impact crash deaths studied, the vehicle struck a tree or pole on the side where the fatally injured occupant was seated. If all cars were to have inflatable head protection systems like BMWs, about 600 deaths from head injuries in crashes each year could be prevented, NHTSA estimates.

Inflatable side impact systems like BMW's have other advantages, too. They can prevent unbelted people from being partially or completely ejected through a side window in rollover crashes. Current head injury protection standards don't address many of the severe head injuries experienced in real-world crashes because

Single-vehicle side impacts with fatal head/neck injuries from striking objects outside the crashing vehicles

A 1989 Mercedes 560E (right) struck a traffic signal box. The impact was on the driver door. The car rotated counterclockwise, knocking the box. It then hit a sign post and a utility pole, rolled over, and stopped on its left side.



A 1980 Toyota Corolla was on a curve on a road and struck a wooden utility pole.

Safety agency studying first real-world crash deployment of BMW Head Protection System

The National Highway Traffic Safety Administration is investigating the first known real-world deployment of BMW's Head Protection System in a side impact crash that occurred this fall in Missouri.

The agency hasn't released its analysis, but sources say preliminary findings are that the system performed as expected. The impact was on the driver's side of the 1998 model 740 sedan. The driver and her two teenage passengers were uninjured. All were using safety belts.

BMW plans to conduct its own evaluation of how the system performed on the road when it gets more details about the crash from the agency.

undeployed. With the padding deployed, another test would be run at 18 mph. Headform tests would be conducted at 15 mph at other test points. Manufacturers also must demonstrate in a side impact test required by FMVSS 214 that the padding will deploy in a crash.

The Institute supports NHTSA's proposal to allow these two alternative test procedures and has told the agency it "strongly supports" amendments to the head protection standard "which would provide necessary relief from specific test requirements for manufacturers who demonstrate that their deployable systems provide superior protection."

Says Lund, "Without the proposed amendments, FMVSS 201 could discourage introduction of advanced technology with the potential to provide vehicle occupants with even greater head protection than the standard mandates. This proposal is a good example of the agency acting to ensure its rules don't inadvertently preclude manufacturers from using advanced technology." He adds, "We expect and hope the agency will move quickly to adopt it."

such injuries are sustained from contacts outside the vehicle, says Adrian Lund, Institute senior vice president. "Inflatable systems that prevent these contacts should provide significant additional protection," he says.

"Given an appropriate test dummy, NHTSA's proposed side impact test procedure does appear to provide a good demonstration of the additional head protection offered by systems such as BMW's

which soon will be offered by other manufacturers," Lund explains.

Other test options: NHTSA suggests a second alternative test to accommodate dynamic systems that deploy additional padding directly over the impact points specified for the headform tests. These tests would be conducted at two different test speeds. For test points directly over an undeployed system, the first test would be conducted at 12 mph with the padding



...e in a six-lane divided highway when it left the pavement. The impact was on the driver door.



A 1993 Toyota Camry left the pavement during a left turn at an urban intersection. It hit a utility pole, spun out, hit a switch box, and then hit the pole's guide wire.



Nova Scotia parents and teenagers support graduated licensing

As more U.S. states adopt graduated licensing laws, Institute surveys have found strong support among U.S. parents and teenagers for graduated licensing (see *Status Report*, Vol. 32, No. 5, May 10, 1997). A survey in Nova Scotia, Canada, where graduated licensing has been in place for several years, shows parents and teens there endorse the system, too.

Established in 1994, the Nova Scotia program applies to all new drivers, not just teenagers, and includes a 6-month learner stage and a 24-month newly licensed stage. During the learner stage a teen may drive only when accompanied

by an experienced driver and no other passengers, and the driver must be free of alcohol. During the newly licensed stage, restrictions include a night driving curfew from midnight to 5 a.m., a zero blood alcohol concentration, and no more than one front-seat passenger. To graduate to a full privilege license, drivers must complete a defensive driving course.

A total of 450 teens ages 16-18 and 500 parents of teenagers ages 16-18, who were in either the learner or newly licensed stage, were interviewed in the summer and fall of 1996.

Both parents and teens endorsed the program. Eighty-seven percent of parents of teenage drivers in the learner stage and 92 percent of parents of teens in the newly licensed stage favored the system. Teenagers were less enthusiastic about gradu-

ated licensing, but the majority still approved of the program. Sixty-one percent of teenagers in the learner stage and 67 percent of newly licensed teens expressed support for graduated licensing.

All parents, as well as the vast majority of learners and newly licensed drivers, favored the zero blood alcohol requirement. Parents of learners, and to a lesser extent learners themselves, strongly endorsed the other restrictions as well. Among parents, 97 percent agreed with the supervision requirement and 87 percent agreed with the passenger restriction, compared with 66 percent of learners who agreed with the requirements.

The night driving curfew also received overwhelming parental support — 86 percent agreed with this restriction. However, only 28 percent of newly licensed teenagers approved.

Most teenagers said they complied with the restrictions, and their parents agreed. Only 9 percent of learners admitted to driving unsupervised, 20 percent admitted to violating the no-passenger restriction, and 2 percent admitted to drinking and driving. Newly licensed drivers more often admitted violating the restrictions. Forty percent of newly licensed drivers admitted they had violated the night curfew, and 39 percent admitted to driving with more than one passenger in the front seat. Very few admitted to drinking and driving (3 percent).

Similar positive support for graduated licensing was found in a recent survey of parents of teenagers in Ontario, Canada, where a graduated licensing program has been in place since 1994. More than 80 percent of parents with teenage drivers in the graduated licensing program approved of the system.

For a copy of "Graduated Licensing in Nova Scotia: A Survey of Teenagers and Parents" and "Graduated Licensing in Ontario: A Survey of Parents" by D.R. Mayhew et al., write: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, Virginia 22201.

Reflective markings on U.S. large trucks, trailers may not be best for nighttime

Trailers fully outlined with white tape are more visible at night in clear, rainy, and snowy weather new research indicates

Retroreflective material required on new U.S. large truck trailers and tractors may not be as conspicuous as other tape configurations, a Canadian study indicates.

The University of New Brunswick evaluated different conspicuity treatments for the rear and sides of trailers in various nighttime weather conditions — rain, snow, fog, and clear weather. The 120 test subjects viewed video recordings filmed by an observation vehicle approaching a trailer at the end of a runway. The trailer was fitted in each test with a different tape configuration. Nine rear and five side tape configurations were evaluated. Test subjects were asked to identify the point at which they first noticed the trailer.

Retroreflective tape did little to increase trailer conspicuity in fog, the study found. Rears of trailers fully outlined with solid white tape were most visible at night under clear, rainy, and snowy weather. For sides of trailers, a continuous stripe of white tape at the trailer bottom was most visible in clear and snowy conditions.

The rear and side tape configurations rated most effective had substantially better results than the ones the U.S. government requires for truck trailers and tractors. For example, in clear weather test subjects were able to spot the rear of a fully outlined trailer 325 feet further away than a trailer fitted with markings the United States requires.

U.S. truck trailers manufactured after December 1, 1993 must have a horizontal stripe of alternating red and white tape along the bottom of the trailer at the rear and white tape in the top rear corners.



Retroreflective tape increases truck conspicuity, but a Canadian study indicates some tape configurations are more visible than others. Stripes of red and white retroreflective tape required on new U.S. trailers made after December 1, 1993 aren't as visible as a continuous stripe of white tape, the study found.

Tractors made after July 1, 1997 must have similar white reflective markings in the upper right and left rear corners and alternating red and white tape on the rear fenders or mudflaps or mudflap support brackets. The National Highway Traffic Safety Administration requires an intermittent horizontal stripe of red and white tape for the sides of trailers.

Canada requires retroreflective tape for new truck trailers, as well. The tape configurations are the same as those the United States mandates, but in Canada, truckers also may substitute solid white, yellow, or alternating yellow and white tape on trailer rears and sides.

In 1993, the Institute petitioned the National Highway Traffic Safety Administration to amend the reflective markings rule to extend coverage to single unit trucks

and tractors (see *Status Report*, Vol. 28, No. 4, April 3, 1993). The agency in 1997 extended the rule to new truck tractors but not to single unit trucks. The Federal Highway Administration is contemplating requiring older trailers to be retrofitted with reflective materials but hasn't issued a rulemaking proposal (see *Status Report*, Vol. 29, No. 5, May 7, 1994). The highway administration regulates commercial vehicles involved in interstate commerce. The safety agency sets standards for the manufacture of new motor vehicles.

For a copy of "Effectiveness of Heavy Truck Conspicuity Treatments Under Different Weather Conditions" by E. Hildebrand et al., write: Transportation Group, University of New Brunswick, P.O. Box 4400, Fredericton, New Brunswick, E3B, 5A3, Canada.

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BMW's new HPS protects heads from serious injury in side impact crashes . . . p.1

Import automakers plan window curtain airbags for heads p.3

Federal crash studies show severe vehicle damage in fatal side impacts p.4

Graduated licensing has strong support among Nova Scotia parents, teens . . . p.6

Truck reflective material study finds tape U.S. requires may not be best . . p.7

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