

Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

On guard

Safety gear on the back of truck trailers is improving ahead of potential new rule to reduce deaths in underride crashes

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On most crash test days at the Institute's Vehicle Research Center, a car or SUV races toward a deformable or rigid barrier in a frontal crash. Recently, though, a Vanguard trailer hitched to a parked rig was the target. A 2010 Chevrolet Malibu hurtled toward the trailer at 35 mph, smashing into the outer half of the trailer's rear underride guard.

Evaluating the Malibu's crashworthiness wasn't the goal of the test. Instead, the trailer's steel underride guard was the focus.

When the test was over, the Malibu ended up behind the trailer — not crushed beneath it — because the Vanguard's underride guard held up. That's important because serious injuries and death can occur if a passenger vehicle slides underneath a higher-riding large truck. The Vanguard's underride guard stopped the oncoming Malibu, preserving survival space for the test dummy in the driver's seat of the car and preventing the dummy's head from contacting the rear of the trailer itself. When that happens, injury measures taken from the dummy almost always indicate certain death for a person in a real crash.

"The Vanguard's underride guard performed great — a big improvement from our earlier tests," says Sean O'Malley, senior test coordinator for the Institute.

The test is part of an IIHS research program to spur better underride guards that won't buckle or break away when a trailer gets rear-ended by another vehicle. IIHS trailer crash tests have demonstrated that underride guards need to be stronger than current U.S. safety standards — and in some cases exceed tougher Canadian

rules — in order to prevent underride in the kinds of crashes that happen on North American highways (see *Status Report*, March 14, 2013, at iihs.org). U.S. regulators have signaled they are working on a new standard (see story p. 4).

Vanguard National Trailer Corp. is among the manufacturers taking the Institute's findings to heart. The trailer's passing score is a big win for the Indiana-based company. Two earlier Vanguard models failed prior IIHS 50 percent overlap tests despite complying with U.S. and Canadian regulations.

In an initial test in 2010, the Malibu slid beneath the 2007 model Vanguard trailer as bolts on the rear guard broke and the guard tore off the trailer. The result was moderate underride at 25 mph and severe underride at 35 mph (see *Status Report*, March 1, 2011).

Vanguard made improvements and requested a second test. When the Institute put the updated 2013 model through another 50 percent overlap test in 2012, the underride guard failed again. The guard's vertical support broke off the trailer on impact, just as it did in the earlier test (see *Status Report*, March 14, 2013). The Vanguard was the only trailer of the eight the Institute tested to fail the 50 percent overlap test. Because it failed, the trailer didn't advance to the next round of 30 percent overlap testing. Only one trailer, a model from Manac, has passed that test so far.

"The Vanguard team is pleased to see a positive result from the recent IIHS test of a new Vanguard rear-impact guard design," says Charlie Mudd, president of Vanguard National Trailer Corp. "We are always interested in reviewing safety-related options."

Spurring better rear underride guards to reduce deaths and injuries in large truck crashes is the goal of an IIHS research program that's drawn the notice of Vanguard and other trailer manufacturers who are adopting improved designs.



This isn't the first time IIHS has evaluated an improved design. Hyundai Translead is another manufacturer that made design changes to a trailer and underride guard after at first failing a full-width IIHS crash test in 2010. Two years later the upgraded model

built to the tougher Canadian standard passed both the full-width and 50 percent overlap tests. Other manufacturers are working on design improvements to their dry van trailers in response to IIHS evaluations and are expected to request retests. ■



2013 Vanguard trailer



2015 Vanguard trailer

Two prior generations of Vanguard trailers (2007 and 2013 models) failed the Institute's 50 percent overlap evaluation. Vanguard redesigned the trailer for 2015, and it passed. This time, the underride guard successfully stopped the Malibu from sliding beneath the trailer.

NHTSA signals plan to address deaths in underride crashes

When a car runs into the back of a tractor-trailer outfitted with a weak underride guard, the outcome is too often deadly for people in the smaller vehicle. Backed by crash tests and studies of real-world underride cases, the Institute has outlined ways to improve rear guards to make them less likely to buckle or break off during a rear crash. Prompted by this research and tougher regulations in Canada, some trailer manufacturers have adopted better designs. Now U.S. regulators are poised to address the issue.

Three years after the Institute first petitioned federal regulators for tougher requirements and suggested specific improvements (see *Status Report*, March 1, 2011, at iihs.org), the National Highway Traffic Safety Administration (NHTSA) has initiated rulemaking to consider new standards for rear underride guards on trailers, semitrailers and single-unit straight trucks.

Underride guards are steel bars that hang from the backs of trailers to prevent the front of a passenger vehicle from moving underneath the trailer during a crash. When a passenger vehicle ends up under a large truck, the top of the occupant compartment gets crushed because the structures designed to absorb the energy of a crash are bypassed. The airbags and safety belts can't do their jobs, and people inside can experience life-threatening head and neck injuries.

Many trailer manufacturers already use stronger guards to comply with new regulations in place in Canada since 2007. Both North American standards require a guard to withstand a certain amount of force

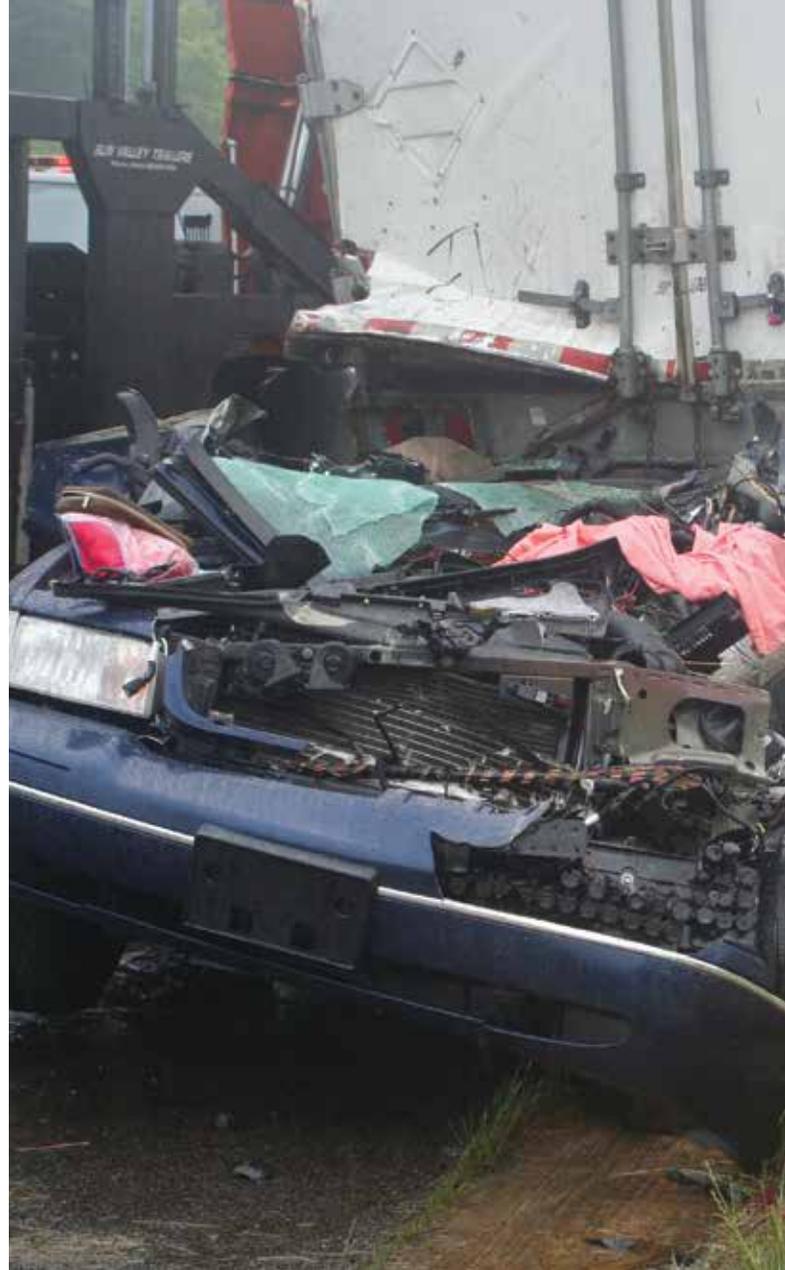
at various points.

Under the Canadian regulation, a guard must withstand about twice as much force as the U.S. rule requires at the point where the guard attaches to its vertical support. IIHS tests in 2013 demonstrated that underride guards built to the Canadian standard generally work well to prevent underride, except in crashes occurring at the outer edges of trailers. The dramatic tests helped the Institute zero in on one design that raises the bar when it comes to safer truck underride guards (see *Status Report*, March 14, 2013).



Sisters AnnaLeah and Mary Karth were killed in a May 4, 2013, truck underride crash on a Georgia interstate en route to a family celebration in Texas.

NHTSA in a July notice in the *Federal Register* indicated it plans to issue two separate notices — an advanced notice of proposed



rulemaking for single-unit trucks and a notice of proposed rulemaking for trailers and semitrailers.

The agency says it is responding to a petition by the Truck Safety Coalition and Marianne Karth, a North Carolina mother whose daughters AnnaLeah, 17, and Mary, 13, died in an underride crash in 2013. The sisters were on their way to Texas with their mother and brother for a family celebration when on a Georgia interstate a large truck hit their Crown Victoria, spinning it around and pushing it backwards into the rear of another tractor-trailer. AnnaLeah and Mary were seated in the back seat and received horrific injuries.

Surviving family members traveled to Washington, D.C., to present the “AnnaLeah and Mary Stand Up for Truck Safety” petition with more than 11,000 signatures to the U.S. Department of Transportation on May 5, marking the one-year anniversary of the crash.

Karth says the Institute “played an important part in our efforts. First of all, your research and reports enlightened us and then that led to us being enraged and asking the question, ‘If something could be done to make underride guards stronger, then why wasn’t it being done?’ That, of course, led to us being empowered to educate and motivate others to join with us in asking for change.”



Photo courtesy of Georgia State Police

to consider applying the standards to other types of large trucks, such as single-unit straight trucks, that aren't required to have rear underride guards.

The Institute followed up its analysis by putting trailers from the eight largest manufacturers through a series of progressively tougher crash tests. All of the trailers had underride guards that met both U.S. and Canadian standards.

In each test, a 2010 Chevrolet Malibu struck a parked truck at 35 mph. In the first scenario, the car was aimed at the center of the trailer. All eight guards successfully prevented underride. In the second test, in which only half the width of the car overlapped with the trailer, all but one trailer passed.

The third test was the most challenging, and every trailer except one from Canadian manufacturer Manac failed. In the test, the Malibu struck the rear of the trailer at its outermost corner, engaging 30 percent of the car's width.

Manac's design was best in the group. The Institute noted that the supports of the Manac trailer's rear underride guard were attached to a reinforced floor and located closer to the trailer's outer edges than on other models. The design limited the potential for injuries to the dummy in the Malibu and also reduced damage to the trailer itself.

The Institute plans additional crash tests of recent model trailers from manufacturers that have indicated they are using better rear underride guards.

NHTSA says it is considering whether Manac's design should be the model for an upgraded standard. The Truck Safety Coalition-Karth petition requests that "all trucks and trailers should be required to be equipped with energy absorbing rear impact guards mounted 16 inches from the ground with vertical supports

The Karth family led a petition drive for better truck underride guard regulations in the U.S. after losing their two teenage daughters. The family's Crown Victoria was hit by one truck and ended up sliding beneath another, killing the sisters in the back seat and seriously injuring their mother and brother in the front seats.

In its submission to NHTSA, the group references the Institute's petition, as well as the National Transportation Safety Board's recommendations for improving rear impact protection.

NHTSA hasn't officially responded to the Institute but gave a nod to its research in a footnote to the July grant of petition for rulemaking.

"We note that the Insurance Institute for Highway Safety and the National Transportation Safety Board requested some of the same amendments to rear impact guards as the Petitioners," the agency says in its *Federal Register* notice.

"IIHS research and crash tests helped lay the groundwork for an upgraded U.S. standard, and we are pleased to see NHTSA take action on the serious problem of rear underride crashes," says David Zuby, IIHS executive vice president and chief research officer.

In 2011, the Institute asked NHTSA to require rear underride guards that are strong enough to remain in place during a crash. The petition came after IIHS crash tests and research found that guards meeting federal safety standards can fail in relatively low-speed crashes. Researchers concluded that the current minimum strength and dimensions required for underride guards are inadequate. At the time, the Institute also asked NHTSA to broaden rules

mounted 18 inches from the side edges." The petition doesn't name Manac but notes, "We are well aware of a trailer manufacturer which has gone beyond these standards and 'raised the safety bar.'"

The group also asked NHTSA to require impact guards to address the problem of side underride and front override crashes. The agency said it is evaluating the latter request.

The U.S. government doesn't require tractor-trailers to have front or side underride guards. In Europe, front underride guards have been required on large trucks since 1994 to protect passenger vehicle occupants in crashes with combined speeds of about 35 mph. Europe also requires side guards to protect pedestrians and bicyclists but not people in passenger vehicles. The Institute has found that front and side underride guards have the potential to reduce injury risk.

In a 2012 IIHS study of fatal crashes between large trucks and passenger vehicles, an estimated 63 percent involved the front of a truck, 22 percent involved the side and 15 percent the rear. Analyses of smaller samples of fatal crashes found that 88 percent involving the side of the large truck and 82 percent involving the rear produced underride. ■

Adaptive headlights help drivers spot objects earlier; glare not excessive

Headlights that swivel around curves in response to steering input allow drivers to spot a hard-to-see object on a dark, curvy road about a third of a second earlier than they would with conventional headlights, a new IIHS study has found.

The experimental study of adaptive headlights was conducted with volunteer drivers on a rural road near the Institute's Vehicle Research Center in Ruckersville, Va. It compared drivers' ability to spot objects on the roadside in vehicles with fixed halogen headlights, fixed high-intensity discharge (HID) headlights and adaptive HID headlights. The results suggest that HID lights, whether fixed

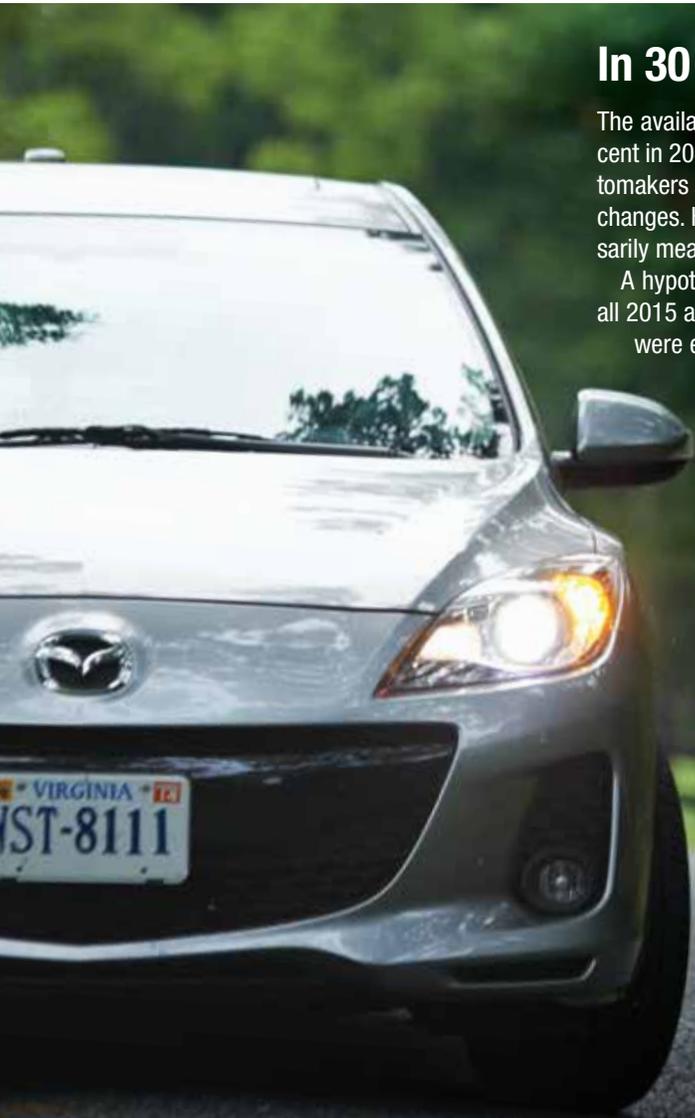
or adaptive, have a small advantage over halogen ones, and adaptive HID lights improve visibility over either type of fixed headlight.

HID lamps began appearing in luxury vehicles in the 1990s and have gained popularity because they improve visibility by casting a whiter light and illuminating the driver's peripheral field more than halogen lamps. Adaptive headlights were first introduced in the 2004 model year. As of the 2014 model year, they were standard on 14 percent of models and optional on 22 percent.

Earlier research by HLDI showed that vehicles equipped with optional adaptive headlights had lower rates of insurance claims

under most coverage types than the same vehicles without the technology (see *Status Report*, July 3, 2012, at iihs.org). The benefits were greater under property damage liability insurance, which covers damage to someone else's vehicle or other property, than they were for collision insurance, which covers damage to the insured vehicle. Injury claim rates also were lower.

"We already had evidence that adaptive headlights are reducing crash damage and injuries," says David Zuby, IIHS executive vice president and chief research officer. "This study fills in some of the gaps in our knowledge about how they help."



In 30 years, adaptive headlights won't be unusual

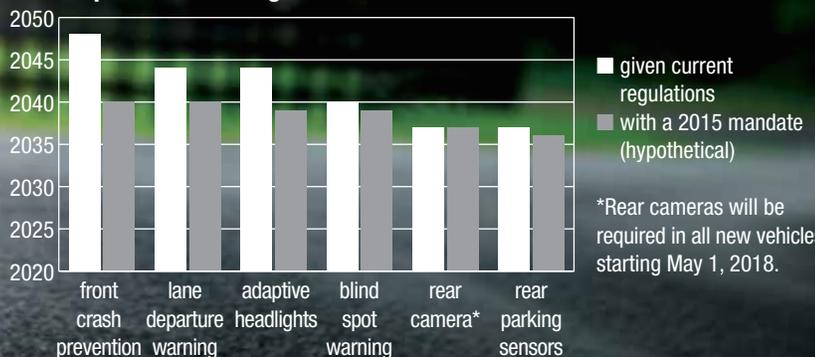
The availability of adaptive headlights in the registered vehicle fleet is predicted to reach 95 percent in 2044, a recent HLDI study has found. The analysis takes into account both how quickly automakers are expected to add the feature to new vehicles and how quickly the makeup of the fleet changes. Having a feature available could mean that it was offered as an option; it doesn't necessarily mean the vehicle is equipped with it.

A hypothetical government mandate to include adaptive headlights as standard equipment on all 2015 and later vehicles would speed up the process by about five years. If such a requirement were enacted, the fleet would reach 95 percent availability in 2039, HLDI estimates. Although adaptive headlights have shown benefits, the government hasn't signaled that it plans to require them.

HLDI performed the same analysis with other driver assistance technologies, including front crash prevention, lane departure warning, blind spot warning, rear cameras and rear parking sensors. The study is similar to one HLDI released in 2012 (see *Status Report*, Jan. 24, 2012), which focused primarily on an older group of safety features.

For a copy of "Predicted availability of safety features on registered vehicles — an update," email publications@iihs.org. ■

Year in which features reach 95 percent of the registered vehicle fleet



In the IIHS study, 20 volunteers drove a pair of 2013 Mazda 3 small cars. One car had adaptive headlights with HID bulbs. The adaptive lighting system could be turned off, making the headlights fixed HID lights. The second vehicle had fixed halogen lights.

Each participant drove an 8-mile round trip with each of the three types of headlights. The driving was done at night on a two-lane road with no markings. Aluminum targets, measuring 8 by 12 inches, were placed at various locations on the side of the road. Half of the targets were highly reflective, and half were less reflective. As they drove at 30 mph, the drivers were tasked with pushing a button each time one of the targets came into view.

With adaptive headlights, the drivers spotted low-reflectance targets located inside of curves as much as a third of a second earlier, or about 15 feet sooner at 30 mph, than with regular headlights. Response times also were shorter for low-reflectance targets on the outside of curves, but these results weren't statistically significant. As expected for a system designed to help drivers negotiate curves, there was no difference between adaptive and fixed headlights when the targets were on straight stretches of road.

HID lamps also appeared to help visibility even when they were fixed. In this case, the benefit was seen with high-reflectance targets on straight sections of road. HLDI's 2012 analysis of Mercedes-Benz features also indicated a benefit from fixed HID over halogen lamps. Together these observations indicate that the advantage of adaptive systems is partly due to their steerability and partly a result of using HID instead of halogen lamps.

When it comes to improved headlight systems, it's important to consider how changes affect other drivers on the road. The IIHS researchers conducted a separate study to compare the glare from the Mazda's halogen, fixed HID and adaptive HID headlights. The 20 volunteers were asked to rate the glare from approaching vehicles on a scale of 1 to 9, with 1 being unbearable and 9 barely noticeable. They also rated a fixed high-beam headlight system to serve as a benchmark for excessive glare.

Participants rated the HID low beams as slightly more glaring than the halogen lamps, but neither was excessively glaring. There was no difference between adaptive HID low beams and fixed HID low beams. Measurements taken from light meters located near the participants supported their subjective ratings.

For copies of "On-road experiment to assess drivers' detection of roadside targets as a function of headlight system, target placement, and target reflectance" and "Test track evaluation of headlight glare associated with adaptive HID, fixed HID, and fixed halogen low beam headlights," both by I.J. Reagan et al., email publications@iihs.org. ■

Small overlap results are mixed for large luxury cars

Results for three large luxury cars recently put through the Institute's small overlap front test for the first time are a mixed bag. The Infiniti Q70 earns a good rating, while the Lincoln MKS and the BMW 5 series are the worst performers out of seven large luxury cars tested so far for small overlap protection.

In the Q70, the driver space was maintained reasonably well, and the dummy's movement was properly controlled. The side curtain airbag provided sufficient coverage to protect the head. Measures taken from the dummy showed low risk of any significant injuries in a crash of this severity. The rating applies to the 2014-15 Q70 and the 2013 Infiniti M, as the car was previously called. With good ratings in the Institute's four other crashworthiness evaluations and an available front crash prevention system, the Q70 qualifies for the 2014 IIHS *TOP SAFETY PICK+* award.

The performance of the Lincoln MKS couldn't have been more different. The driver space was severely limited after the crash, with the structure pushing in as much as 12 inches. The steering column moved 5 inches inward and 6 inches to the right. The dummy's head barely contacted the front airbag before sliding off and hitting the instrument panel. Injury measures from the dummy showed that left hip injuries would be likely. The poor rating applies to 2009-15 models.

The BMW 5 series performed somewhat better, earning a marginal rating. Like the MKS, the 5 series also saw as much as 12 inches of intrusion. However, there was considerably less intrusion in the upper interior. The dummy's movement was well controlled. Injury measures indicated that left leg injuries would be likely. The marginal rating applies to 2011-15 models.



The Infiniti Q70 is a *TOP SAFETY PICK+*.

IIHS introduced the small overlap evaluation in 2012. A good or acceptable rating is a requirement for *TOP SAFETY PICK*, along with good ratings in the moderate overlap front, side, roof strength and head restraint tests. To qualify for *TOP SAFETY PICK+*, a vehicle must also earn a basic, advanced or superior rating for front crash prevention.

The 2014 Q70's optional front crash prevention system includes a forward collision warning system that meets the National Highway Traffic Safety Administration's criteria. However, the feature's automatic braking function failed to reduce the vehicle's speed in IIHS track tests. For this reason, it earns a basic rating. The 2015 Q70 has an upgraded system that may perform better in track tests. However, the Institute hasn't had an opportunity to test it yet, so for now the basic rating remains.

The Q70 is the fifth large luxury car to qualify for the 2014 *TOP SAFETY PICK+* award. The others are the Hyundai Genesis, Mercedes-Benz E-Class sedan, Volvo S80 and Acura RLX. Tests of three other luxury cars — the Audi A6, Cadillac CTS and Lexus GS — had been planned, but the manufacturers told IIHS they are making changes for small overlap protection. The Institute's policy is to wait to test a vehicle if such changes are planned within a reasonable time frame. These models will be tested early next year.

"The five manufacturers that have already achieved the *TOP SAFETY PICK+* designation for their cars are offering consumers state-of-the-art safety," says IIHS President Adrian Lund. "Meanwhile, Audi, BMW, Cadillac, Lexus and Lincoln are playing catch-up in the large luxury category." ■

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The **Highway Loss Data Institute** shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model.

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