Insurance Institute for Highway Safety

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What can be done to improve large truck safety?

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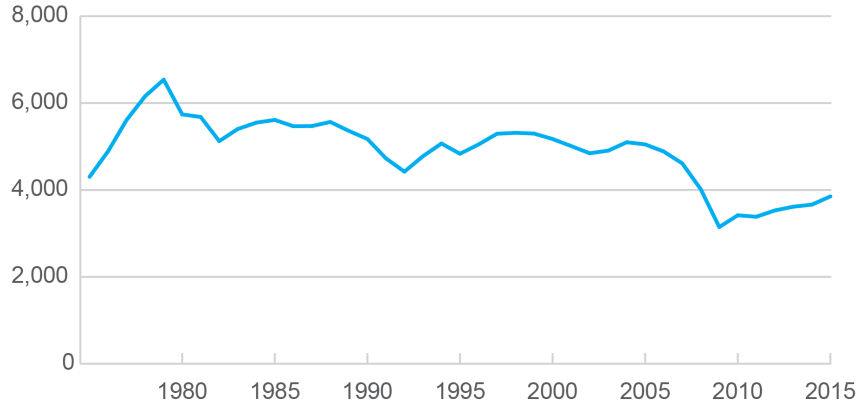
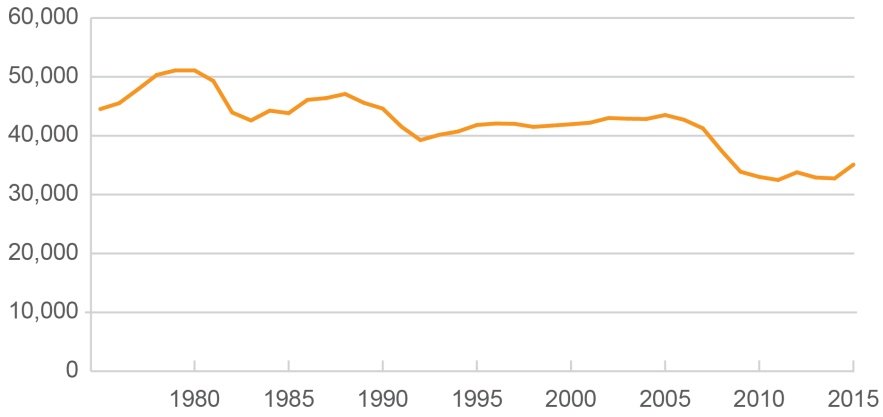
The Insurance Institute for Highway Safety (IIHS) is a nonprofit research and communications organization that identifies ways to reduce deaths, injuries, and property damage on our highways. We are supported by auto insurers. Thank you for the opportunity to testify on the safety of large trucks in the United States.

Motor vehicle crash deaths have increased in recent years to the highest level since 2008, with 35,092 deaths in 2015.[1] Of these, a total of 3,852 deaths involved crashes with large trucks. As the U.S. economy rebounded from recession, deaths in large truck crashes started to climb in 2009. What is especially concerning is that truck-related crash deaths are increasing faster than overall motor vehicle crash deaths. The number of people who died in large truck crashes was 22 percent higher in 2015 than in 2009, while crash deaths overall rose less than 4 percent. The vast majority of people who die in crashes between large trucks and passenger vehicles are people in passenger vehicles. Preliminary data for 2016 indicate that the highway death toll is still on the rise, and we expect that trucks are contributing to this disturbing trend. A variety of countermeasures, both old and new, could address the problem.

Deaths in U.S. crashes involving large trucks, 1975-2015



U.S. crash deaths, 1975-2015



Recent IIHS research – large truck crash factors

IIHS has been studying serious crashes involving large trucks for decades, and, although some aspects have improved, unsafe trucks and tired truckers persist. A recent IIHS study examined the risk factors for large truck crashes, such as defective equipment, safety technology, and carriers' crash history.[2]

Researchers compared large trucks involved in serious crashes in North Carolina during 2010-12 with a sample of similar trucks that weren't involved in crashes to estimate the relative prevalence of various factors and determine which ones are associated with increased crash risk.

Nearly three-quarters of the crash-involved trucks had vehicle defects identified during a post-crash inspection. Trucks with violations for any type of defect were more than 3 times as likely to be in a crash as trucks without such violations. Violations for brake, tire, and lighting system defects also were associated with increased crash risk. Risk was greater for violations severe enough to place the truck out-of-service.

Carriers with higher past crash rates were associated with an elevated current crash risk. Companies with at least 100 reported crashes per 1,000 power units (tractors or single-unit trucks) within the preceding 24 months had a 72 percent higher risk of crashing than carriers with fewer than 100 reported crashes per 1,000 power units.

Looking at driver-specific factors, researchers found that truckers age 60 and older had a higher crash risk than drivers ages 30-59, who made up 72 percent of the crash-involved drivers in the study. Truckers who reported driving after at least 12 hours since an extended sleep period were 86 percent more likely to crash than drivers who had been awake for less than eight hours. Truckers who reported driving more than five hours without stopping were more than twice as likely to crash as those who drove 1-5 hours.

Several safety features showed promise in reducing crash risk among the large trucks in the study. Antilock braking systems, which have been required since the late 1990s, reduced the risk of crashing by 65 percent. Benefits were also found for electronic stability control (ESC) and roll-stability control, electronic logging devices and speed limiters.

Vehicle stability control systems are designed to intervene when a truck's motion becomes unstable, possibly resulting in rollover, jackknife or other loss of control. ESC and roll-stability control are among the crash avoidance technologies that have been developed for large trucks. Others include forward collision warning/mitigation, blind spot detection, and lane departure warning/prevention. Based on an analysis of crashes during 2004-08, IIHS estimates that a combination of all four technologies could prevent or mitigate as many as 107,000 police-reported crashes each year, representing 28 percent of all crashes involving large trucks.[3] The technology could prevent or mitigate as many as 12,000 nonfatal injury large truck crashes and 835 fatal large truck crashes each year.

Speed

Few things carry more potential risk than a semitrailer barreling down the highway at 80 mph. Extreme speeds have become commonplace as states have set higher and higher limits. These higher speeds are even more dangerous for heavier vehicles. Large trucks have longer stopping distances than other vehicles, making it more difficult for them to avoid a crash. When a crash does occur, it is likely to be more severe. Even a lightly loaded 40,000-pound truck has 13 times the kinetic energy of a 3,000-pound car traveling the same speed, and this energy increases with the square of the vehicle speed.

Despite the deadly consequences of extreme speeds, the idea of lowering limits for all vehicles hasn't gained traction in state legislatures. Given this reality, we welcome the proposal by the Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA) to at least put a cap on the speeds of the biggest vehicles. Some critics of the proposed rule have raised concerns about different vehicles on the same road traveling at different speeds. But most trucks already travel at lower speeds on average than passenger vehicles. That is in part because many companies voluntarily use speed limiters to improve safety and fuel economy. In addition, seven states have lower maximum speed limits for trucks than for passenger vehicles.[4]

However, a small number of trucks do travel at very high speeds, putting their drivers and the people in vehicles around them at grave risk. We recently studied the effect of raising speed limits from 75 to 80 mph for all vehicles on certain road segments in Utah. We found that the proportion of large trucks exceeding 80 mph rose from 0.1 percent to 2.3 percent.[5] While still a small number, every truck traveling that fast represents a big risk because it has 50 percent more energy to manage in an emergency than if it were traveling at 65 mph. Speed limiters that physically prevent trucks from traveling that fast are one way to make roads safer for everyone.

Underride guards

Rear underride guards are important truck safety gear that is long overdue for an upgrade. An underride guard is the metal bumper that hangs from the back of a semitrailer. The idea is to stop a smaller vehicle from sliding beneath a high-riding trailer in a rear-impact crash. All underride guards must meet federal safety standards, but IIHS research and crash tests have shown that many underride guards can buckle or break off in a crash. When guards fail, the resulting underride crashes often result in death or serious injury to people in passenger vehicles.

In 2015, 427 of the 2,646 passenger vehicle occupants killed in large truck crashes died when the fronts of their vehicles struck the back of trucks.[6] Gaps in federal crash data make it difficult to pinpoint exactly how many of these crashes involve underride. An IIHS analysis of a smaller sample of fatal crashes involving the rear of a trailer equipped with an underride guard found that 94 percent produced underride.[7]

NHTSA has proposed a rule that would upgrade the rear underride guard regulations for tractor-trailers, but the proposal does not go far enough to ensure the guards withstand vehicle impacts, especially in offset crashes.[8] The proposal would align U.S. regulations with stricter ones in place in Canada since 2007. NHTSA estimates that 93 percent of new semitrailers sold in the U.S. already comply with the Canadian rules, based on information from the Truck Trailer Manufacturers Association. The agency estimates the rule would save one life and prevent three serious injuries a year. Ahead of an updated U.S. standard, IIHS has been evaluating underride guard designs. Our crash tests show that compliance with the Canadian standard does not mean the guards will prevent underride when cars run into the outer ends of a trailer, where the underride guards are weakest.

Trailer manufacturers have paid attention to our tests and have made significant improvements. To recognize their efforts, we created a new award for rear guards that successfully prevent underride in three progressively tougher test modes.[9] We presented the IIHS **TOUGH**GUARD award in March to five North American semitrailer manufacturers. All the changes these manufacturers have made to improve performance in our tests exceed current rules in place in the U.S. and Canada, as well as NHTSA's proposed new requirements. Highway safety would be better served by regulations that require underride guards to withstand even the most extreme offset crashes, which NHTSA's proposal does not address.

Summary and conclusions

Highway deaths have been on the rise as the economy has improved, but truck-related crash deaths are increasing faster than overall motor vehicle crash deaths. Vehicle defects, tired truckers and high travel speeds are factors that can influence the incidence and outcome of large truck crashes. Making sure that equipment is in good working order, drivers are properly rested, and truck speeds are reduced are important steps that would improve the safety of all road users. Strong rear underride guards are another lifesaving measure that should not be overlooked.

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Safety defects, long hours at wheel are underlying factors in large truck crashes

Understanding why large trucks crash is key to developing countermeasures to reduce those crashes. New IIHS-sponsored research shows that serious vehicle defects triple the risk of being involved in a crash. For drivers, long hours behind the wheel and use of the short-haul exemption under federal hours-of-service rules also are important contributors to crashes.

In 2015, 3,852 people died in crashes involving large trucks. Sixteen percent of these deaths were truck occupants, 69 percent were passenger vehicle occupants and 15 percent were pedestrians, bicyclists or motorcyclists.

IIHS has been studying serious crashes involving large trucks for decades, and, although the outlook has improved, IIHS research shows unsafe trucks and tired truckers persist. During the 1980s, the Institute studied large truck crashes in Washington and found that tractor-trailers with defective equipment were twice as likely to crash as trucks without defects (see *Status Report*, Sept. 19, 1987, at iihs.org).

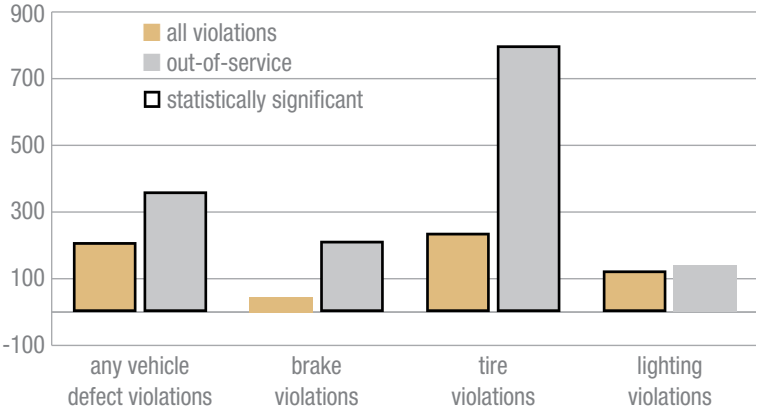
The latest study updates that research and for the first time looks at the short-haul exemption's effect on crash risk. Drivers who work for an interstate carrier and operate within a 100-mile radius of their work base can apply for the exemption if they work fewer than 12 hours a day and don't make overnight trips.

IIHS researchers partnered with the University of North Carolina Highway Safety Research Center and the North Carolina State Highway Patrol to investigate factors that affect crash risk for large trucks operated by interstate carriers. Researchers compared large trucks involved in serious crashes in North Carolina with injuries or deaths during 2010-12 with a sample of similar trucks that weren't involved in crashes. The matched case-control design allowed researchers to compare the relative prevalence of various factors to determine which ones are associated with increased crash risk.

Researchers collected data on a total of 197 crash and control pairs. More than a third of crashes were fatal and 17 percent involved an incapacitating injury. Crashes were more likely to occur during the daytime and to involve another vehicle besides the tractor-trailer.

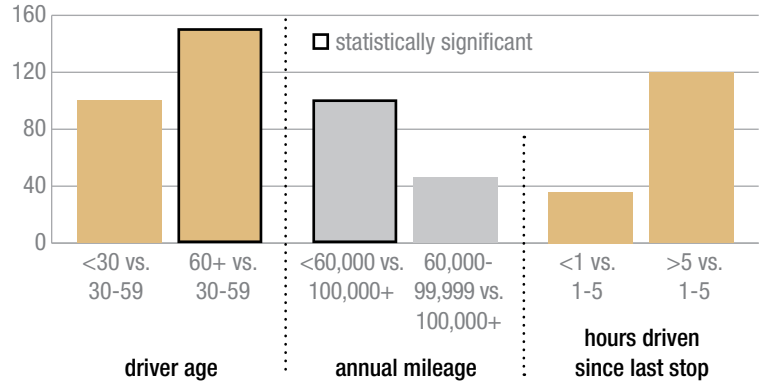
Vehicle safety violations predict crash risk...

Percent change in crash risk



...as driver factors also come into play

Percent change in crash risk



Vehicle violations raise crash risk

Nearly three-quarters of the crash-involved trucks had vehicle defects identified during a post-crash inspection. Trucks with out-of-service violations for any type of defect were more than 4 times as likely to be in a crash as trucks without such violations. The crash risk for a truck with any out-of-service vehicle defect deemed as the striking vehicle in a multiple-vehicle crash was 10 times as high as the risk for comparable trucks without vehicle defects.

A commercial motor vehicle inspector can issue an out-of-service order for a mechanical or loading problem that makes the truck a serious hazard on the road and would likely cause a crash or breakdown. Examples include faulty brakes, fraying sidewalls on tires and burned out headlights, taillights or brake lights.

Having vehicle defects of any type raised crash risk. Trucks cited for brake violations were 50 percent more likely to crash than the comparison trucks, and out-of-service brake violations tripled crash risk. Tire and lighting system violations were generally associated with bigger increases in crash risk, but researchers caution this may be the case in part because some of the violations inspectors flagged resulted from crash damage.

"Highway patrol officers and roadside inspectors serve as the front line of defense when it comes to spotting unsafe trucks, and these efforts should continue," says Eric Teoh, a senior statistician with the Institute and the study's main author. "Defects on 40-ton vehicles are a serious threat to highway safety."

Carriers with higher past crash rates were associated with an elevated current crash risk. Firms with at least 100 reported crashes per 1,000 power units (tractors or single-unit trucks) within the preceding 24 months had a 72 percent higher risk of crashing than carriers with fewer than 100 reported crashes per 1,000 power units.

"Some trucking groups have suggested that carriers shouldn't be penalized for crashes that weren't the fault of the driver or were unpreventable, but these results show counting all crashes is

Electronic stability control and roll stability control are two crash avoidance features for large trucks that are proven to reduce crashes. The tractor-trailer in this North Carolina crash didn't have either technology.

Courtesy North Carolina State Highway Patrol

meaningful. We don't always know who was at fault in crashes, and if something about a carrier's operation puts them at high risk for not-at-fault crashes, that's important to know too," Teoh says.

Tired truckers and short-haul exemption are factors

Looking at driver-specific factors, researchers found that truckers age 60 and older had a higher crash risk than drivers ages 30-59, who made up 72 percent of the crash-involved drivers in the study.

Truckers who reported driving after at least 12 hours since an extended sleep period were 86 percent more likely to crash than drivers who had been awake for less than eight hours. Truckers who reported driving more than five hours without stopping were more than twice as likely to crash as those who drove 1-5 hours.

Hours-of-service regulations govern how much time truck drivers can be on the road and when and for how long they need to rest. The current regulations allow up to 11 hours a shift and up to 77 hours over seven days (see *Status Report*, April 26, 2011, and Jan. 24, 2012). Driver fatigue is a significant contributor to crashes involving large trucks.

The new mandate for electronic logging devices (ELDs) set to take effect in late 2017 should help reduce the problem by making it harder for drivers to fudge the time they really spend on the highway without sufficient rest (see *Status Report*, Feb. 26, 2016).

Although short-haul drivers must comply with federal rules on work and rest times, they don't have to record their service hours.

Researchers found that the crash-involved trucks whose drivers operated under a short-haul exemption were less likely to operate on interstates and more likely to involve owner-operators and single-unit trucks. These trucks logged fewer miles per year than other trucks. Researchers found that drivers using a short-haul exemption had a crash risk nearly 5 times as high as those who weren't. What is more, short-haul trucks were more likely to have inspection violations than other crash-involved trucks.

Teoh says he was surprised that the data showed a higher crash risk for trucks operating under the short-haul exemption.

"Short-haul trucks are used differently and may be more at risk if they have vehicle defects," Teoh says. "The short-haul exemption merits a more in-depth look to understand what's really going on."

Safety technologies can lower crash risk

Several safety features showed promise in reducing crash risk among the large trucks in the study. Antilock braking systems for large trucks reduced the risk of crashing by 65 percent. Antilock brakes, which keep wheels from locking during hard braking, improve driver control of large trucks during emergency stops and reduce the likelihood of a tractor-trailer jackknifing. Antilocks have been required on new tractors since 1997 and on new trailers, single-unit trucks and buses since 1998.

"We also found benefits for electronic and roll-stability control, speed governors and electronic logging devices," Teoh adds.

Antilock brakes on trucks reduced the risk of a crash by 65 percent, while having electronic or roll stability control was associated with a 19 percent lower crash risk.

ESC will be required on tractor-trailers and buses as of August 2017 (see *Status Report*, July 30, 2015). A mandate for speed limiters also is under consideration, along with a requirement that trucks with a gross vehicle weight rating of 10,000 pounds or more have a forward collision warning system with automatic braking (see *Status Report*, Feb. 26, 2016).

For a copy of "Crash risk factors for interstate large trucks in North Carolina" by E.R. Teoh et al., email publications@iihs.org. ■

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IIHS recognizes semitrailer manufacturers with new underride guard safety award

ARLINGTON, Va. — Five North American semitrailer manufacturers earn the Insurance Institute for Highway Safety's new **TOUGH**GUARD award recognizing rear underride guards that are designed to prevent a range of deadly underride crashes. Semitrailers from Great Dane, Manac Inc., Stoughton Trailers LLC, Vanguard National Trailer Corp. and Wabash National Corp. earn the accolade.

An underride guard is the metal bumper that hangs from the back of a semitrailer. The idea is to stop a smaller vehicle from sliding beneath a high-riding trailer in a rear-impact crash to preserve survival space for the people inside the lower-riding vehicle. All underride guards must meet federal safety standards, but IIHS research and crash tests have shown that many underride guards can buckle or break off in a crash. When guards fail, the resulting underride crashes often result in death or serious injury to people in passenger vehicles.

The IIHS **TOUGH**GUARD winners have rear guards that prevent underride of a midsize car in three test modes – full-width, 50 percent overlap and 30 percent overlap. In each configuration, a midsize car travels at 35 mph toward a parked semitrailer. In the full-width test, which is the easiest to pass, the car strikes the center of guard head on. In the 50 percent overlap, half of the car's front end strikes the guard. In the toughest test, 30 percent of the front of the car strikes the trailer at its outermost corner. Underride guards are weakest at the outer edges of a trailer.

The **TOUGH**GUARD award is the culmination of six years of IIHS research and testing. The Institute began its underride crash test program in 2011 and has since evaluated multiple trailers from eight of the largest trailer manufacturers in North America.

"Our research told us that too many people die in crashes with large trucks because underride guards are too weak," says David Zuby, the Institute's executive vice president and chief research officer. "So we designed crash tests to replicate scenarios where guards have failed in real-world crashes. At first, only one of the semitrailers we evaluated passed all three tests — the Manac. Now five trailers do. Manufacturers really took our findings to heart and voluntarily improved their guard designs."

In the initial round of evaluations, the guards on all of the semitrailers prevented underride in the full-width test. In the 50 percent overlap, 7 of 8 guards prevented underride. In the 30 percent overlap, only Manac's guard stopped the car from underriding the trailer. Great Dane, Stoughton, Vanguard and Wabash subsequently reworked their designs and asked for retests.

The manufacturers used different countermeasures to toughen their guards. Stoughton, Vanguard and Wabash added vertical supports to the outboard edges, while Great Dane added larger fasteners to existing vertical supports to reduce the chances that the supports would be torn from the trailer. Great Dane also increased the size of the lower horizontal member of the bumper, which made it stronger. The new Great Dane design is the latest to be tested.

Great Dane made improvements to its rear underride guard to successfully prevent underride in the IIHS 30 percent overlap test.

All of the changes manufacturers have made exceed current rules in place in the U.S. and Canada, as well as proposed new requirements from the National Highway Traffic Safety Administration that would essentially align U.S. underride regulations with Canadian ones.

Semitrailers from Hyundai Translead, Strick Trailers LLC and Utility Trailer Manufacturing Co. have passed the full-width and 50 percent overlap tests but not the 30 percent overlap evaluation. These three manufacturers are working on improvements, and IIHS will evaluate the new designs when they are available for testing.

“IIHS isn’t a regulatory agency, and other than safety, there was no incentive for semitrailer manufacturers to make improvements,” Zuby notes. “When we started testing, we weren’t sure how they would respond. These companies deserve a lot of recognition for their commitment to addressing the problem of underride crashes.”

In 2015, 427 of the 2,646 passenger vehicle occupants killed in large truck crashes died when the fronts of their vehicles struck the back of trucks. That is up 39 percent from 2011 when 260 of the 2,241 passenger vehicle occupants killed in large truck crashes died in impacts with the rear of a large truck. Gaps in federal crash data make it difficult to pinpoint exactly how many of these crashes involve underride.

In a 2012 IIHS study of fatal crashes between large trucks and passenger vehicles, an estimated 15 percent involved the rear of the truck. An IIHS analyses of a smaller sample of fatal crashes found that 82 percent involving the rear of the truck produced underride.

Passenger vehicle occupant deaths in crashes with large trucks

Year	Passenger vehicle rear-ends large truck	All crashes with large trucks
2015	427	2,646
2014	371	2,485
2013	354	2,410
2012	342	2,352
2011	260	2,241

See next page for full ratings.

For more information, go to iihs.org

The Insurance Institute for Highway Safety is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from crashes on the nation's roads. The Institute is wholly supported by auto insurers.

LARGE TRUCK REAR UNDERRIDE GUARD RATINGS

		 Full-width test	 50% overlap	 30% overlap
IIHS TOUGHGUARD	**Great Dane** Applies to units equipped with the RIG30 rear impact guard system.	✔	✔	✔
IIHS TOUGHGUARD	**Manac** Applies to all 90,000 series dry van, refrigerator and open top units built after June 2011.	✔	✔	✔
IIHS TOUGHGUARD	**Stoughton** Applies to all dry van units built after October 2016.	✔	✔	✔
IIHS TOUGHGUARD	**Vanguard** Applies to all dry van units built after December 2015 and all refrigerator units built after September 2016.	✔	✔	✔
IIHS TOUGHGUARD	**Wabash** Applies to dry van units with the RIG-16 option built after February 2016. Applies to refrigerated units with the RIG-16 option built after December 2016.	✔	✔	✔
	Hyundai Translead Applies to all standard dry van and refrigerated units built after April 2011.	✔	✔	✖
	Strick Tested model: 2013 dry van	✔	✔	✖
	Utility Applies to trailers built after December 2012.	✔	✔	✖