

## **Promising Research for Improved Heavy Vehicle Underride Prevention Structures**

### **And Data to Demonstrate Boundaries of Occupant Survivability in Collisions between Large Trucks with Passenger Vehicles and other Vulnerable Road Users (VRUs)**

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Current truck underride (front, back and sideguard) regulations too often do not prevent underride crashes – which led to 228 recorded crash fatalities in the U.S. in 2014. The same year, 310 pedestrians and 39 bicyclists were fatally injured in motor vehicle collisions in Canada. Of these collisions, heavy trucks were involved in 35 pedestrian fatalities and seven cyclist fatalities.

10 After losing our two youngest daughters, AnnaLeah (17) and Mary (13), due to a truck underride crash on May 4, 2013, our family has taken on the goal of improving the regulatory and voluntary standards for currently weak, ineffective and sometimes absent front, back and sideguards. On May 5, 2016, we were co-sponsors, with IIHS and Truck Safety Coalition, of an Underride Roundtable.

15 One of the presenting groups was a Virginia Tech Engineering Senior Underride Design Team. Their students were enthusiastic about a goal which engaged them in a life-saving pursuit. Together with students and professionals, we have taken on the challenge to surpass the current U.S. and Canadian standards. While front, back and sideguards have existed for decades outside of North America, research and development into these lifesaving features is in its infancy in the U.S. , Canada and Mexico.

20 It is anticipated that global harmonization of underride protection standards would be furthered by this invaluable research.

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**Comprehensive Underride Consensus Petition;  
A Summary of Requests for Improved Underride Protection**

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On May 5, 2016, almost 100 people participated in an Underride Roundtable hosted by the Insurance Institute for Highway Safety at their Vehicle Research Center in Ruckersville, Virginia, with cosponsors Truck Safety Coalition and AnnaLeah & Mary for Truck Safety. Participants included  
35 researchers, safety advocacy groups, the trucking industry, truck trailer manufactures and government officials, including members of NHTSA staff.

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Discussions during the meeting ranged from descriptions of the nature and magnitude of the underride problem to potential solutions including better conspicuity, new rear underride guard designs and the potential for side guards to prevent runovers of pedestrians and cyclists in urban environments, as well as prevention of side underride by passenger vehicles. Information shared during our meeting clearly illustrated the need to do more to address underride crashes as well as the possibility of doing so.

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In light of the [tragic](#) and [unnecessary](#) countless [loss](#) of lives which [delays](#) in underride prevention have already cost, as well as the continued tragic and preventable loss of life sure to occur if decisive action is not taken now, we are hereby petitioning the DOT to take the following steps to mandate comprehensive underride protection:

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1. NHTSA should immediately craft a final rule for **rear underride guards on semi-trailers** which will prevent underride and compartment intrusion when struck by a typical passenger vehicle (1500 kg/3307 lbs) and a typical SUV (2000 kg/4409 lbs) at initially at least 35 mph -- 30% offset and center impacts.

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1. NHTSA should immediately issue a Notice of Proposed Rulemaking (NPRM) for **rear underride guards of Single Unit Trucks (SUTs)**, with the intent of aligning SUT and semi-trailer requirements.

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2. NHTSA should immediately issue a Notice of Proposed Rulemaking (NPRM) for **semi-trailer and SUT side underride protection.**

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3. NHTSA should immediately issue a Notice of Proposed Rulemaking (NPRM) for **heavy truck front underrun protection.**
4. In order to ensure that underride equipment is strong enough to allow the inherent crashworthiness of modern passenger vehicles to be realized, as well as to significantly **increase the survivable impact speeds through the energy absorption capability of the underride equipment** itself, NHTSA should immediately issue a RFP to investigate, develop, and test such technology and update the standards accordingly.

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5. NHTSA should thereafter conduct a periodic review of underride standards every five years in order to assess the need for changes in conjunction with advancements in technology and update the standards accordingly. This would include issuing additional RFPs to conduct research as needed.

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6. FMCSA should take the necessary steps to enforce the requirement of **proper maintenance of underride guards** through annual safety inspection.

**Clarification of the Requests  
in the  
Comprehensive Underride Consensus Petition**

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**Rear Underride Protection on Semi-Trailers:**

85 The revised FMVSS 223 should require guards that are strong enough to allow the inherent crashworthiness of modern passenger vehicles to be realized. Specifically, guards should prevent underride and occupant compartment intrusion when struck by a typical passenger vehicle with an impact of at least 35 mph with overlaps ranging from 30 percent of the passenger vehicle's width to full overlap between passenger vehicle and truck trailer. Tests of trailers from Manac, Stoughton, Vanguard, and Wabash illustrate the practicability of providing the level of underride protection described above.

90 The underride guard and trailer structure are a system. As such, compliance testing of rear impact guard strength should be conducted with the guard attached to the trailers and/or a portion of it that includes all structures to which the guard attaches.

95 It was hoped that it would be possible to prescribe a regulatory test procedure based on quasi-static loading and minimum force levels that would lead to guards capable of providing the same or better level of underride protection as demonstrated by guards on Manac, Stoughton, Vanguard and Wabash trailers. However, study of this issue has shown that such a process is: a) not easily done; and b) would not definitively provide a valid comparison.

100 Therefore, the revised FMVSS 223 should require dynamic crash testing of any new guard design to verify that it meets upgraded requirements.

105 In order to create a standard which is attainable by every trailer manufacturer – both the large ones, who would have the option of designing their own guard, as well as the small manufacturers, who might find it financially difficult to design their own guard, NHTSA should issue a Request for Proposals (RFP) by means of which they would fund the development of a [generic](#) rear underride guard (as was done by the Canadian Transportation Equipment Association [CTEA] in 2000. This process could be completed prior to an implementation for the updated rear guard rule.

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115 It should be noted that many entities would be qualified to respond to such an RFP. [Virginia Tech](#) is a prime example of an engineering school which was able to work on such a project, as well as numerous other engineering schools or engineers – many of whom have already done such research or would be eager and qualified to do so. (In fact, there is international interest in this issue as the First International Road Safety Conference has approved an abstract related to underride research for presentation in San Francisco in June 2017.)

120 Because the research undertaken by the IIHS has shown that improved guards are both possible and more effective, this rulemaking should be moved forward as quickly as possible to save lives.

### **Underride Protection on Single Unit Trucks:**

1. People die every year from preventable underride crashes with Single Unit Trucks.
2. No meaningful regulatory change has occurred since 1953 to address this problem.
- 125 3. NHTSA's [cost/benefit analysis](#), as outlined in the ANPRM, is flawed. If the best possible underride protection is required, the cost will not be [prohibitive](#), and the benefits of saved lives will be beyond measure.
4. Move the rulemaking process for underride protection on **Single Unit Trucks** to the next step immediately and issue a Notice of Proposed Rule Making (NPRM).
- 130 5. NHTSA should require SUTs to have the same underride protection which is required of semi-trailers.
6. If a company manufactures a type of SUT which they can show does not allow underride (under the required conditions) – even without an underride guard per se, then they may ask NHTSA to review their circumstances for a potential exemption.

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### **Underride Protection on the Sides of Large Trucks:**

1. Since [1969](#), DOT has been aware of the problem of side underride fatalities and has intended to extend underride protection to the sides of large trucks.
- 140 2. NHTSA's own FARS data [documents](#) the problem of 1534 side underride fatalities between 1994 and 2014 (1715 rear underride fatalities).
3. Crash reconstructionists are well aware of the side underride [problem](#) based on their own crash investigations.

- 145 4. Engineers have designed “side guards” and proven their effectiveness in crash tests. Plans are underway for Airflow Deflector (who currently installs “side guards” on city trucks in Boston and New York) to produce and market a new side guard, [Angel Wing](#). The Angel Wing has already been successfully crash tested by its inventor, Perry Ponder, an engineer/crash reconstructionist, who plans to have it tested by the IIHS as soon as possible.
- 150 5. Thus, there will soon be a viable “side guard” option on the market. It is anticipated that other market-driven alternatives would quickly become available and a rulemaking on “side guards” would obviously hasten that process and contribute to preventing tragic deaths which would otherwise occur due to delays in the implementation of needed underride protection.
- 155 6. This is an international problem with [international solutions](#).
7. Therefore, NHTSA should immediately issue a Notice of Proposed Rulemaking (NPRM) in order to [extend](#) underride protection to the [sides](#) of semi-trailers and SUTs.
8. NHTSA should also immediately issue a Request for Proposals (RFP) to establish the appropriateness of the following recommended “side guard” specifications:
- 160 • Guard Size, Shape, and Position Requirements:
1. Must cover and protect from pedestrian, cyclist, and passenger vehicle intrusion, at minimum, the area between a semitrailer’s landing gear and the forward edge of the rear tires when the semitrailer axle(s) are positioned in their furthest forward position.
- 165 2. Must cover and protect from pedestrian, cyclist, and passenger vehicle intrusion, at minimum, the area between a single unit truck’s forward edge of the cargo carrying portion rearward to the forward edge of the rear wheels.
- 170 3. Must be constructed to direct a vulnerable road user (VRU), such as a cyclist or pedestrian, out and away from the underside of the vehicle in order to prevent contact with the rear tires.
4. Must be composed of a smooth, flat exterior surface that cannot snag, catch, or entangle a vulnerable road user such as a cyclist or pedestrian.
- 175 5. Must be positioned vertically from the lower edge of the trailer/truck box to within 1.25 feet of the roadway surface.
6. Must not extend the length or width of a vehicle beyond the current 3” safety equipment tolerance.

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- Guard Strength Requirements:

Must be sufficiently strong to prevent a mid-sized passenger sedan (3,000 lb nominal weight) traveling at 35 mph from intruding beneath the truck/trailer structure sufficiently to create measurable passenger compartment intrusion (PCI).

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- Guard Certification:

1. VRU performance should be certified by snag/drag tests to simulate cyclist and pedestrian encounters in an urban setting.
2. Vehicle performance should be certified via 35 mph crash tests at 90 degree and 45 degree approach angles with respect to the trailer body.

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### **Underride/Override Protection on the Front of Large Trucks:**

Initiate rulemaking on **front override protection** by immediately issuing a Notice of Proposed Rule Making (NPRM).

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1. *An EU requirement was introduced in 2000 based on ECE Regulation 93 requiring mandatory rigid front underrun protection defining a rigid front underrun protection system for trucks with a gross weight over 3.5 tonnes Directive 2000/40/EEC. Studies performed by EEVC WG 14 have shown that passenger cars can 'survive' a frontal truck collision with a relative speed of 75 km/h if the truck is equipped with an energy absorbing underrun protection system. Furthermore, these systems could reduce about 1,176 deaths and 23,660 seriously injured car occupants in Europe per year. Research shows that the benefits of a mandatory specification for energy absorbing front underrun protection would exceed the costs, even if the safety effect of these measures was as low as 5%. European Commission: Front Underrun Protection Systems [Note: 75 kmh = 46.6028 mph]*

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2. Front guards must have 3 levels of resistance; soft front for pedestrians and cyclists, middle area must be softer than the partner vehicle in crashes and able to absorb energy such as through crush, and rear area must be strong and stiff enough to resist underride and rotate high-speed vehicles away from the truck. Extend the front guard from the truck 600 mm (2 feet) to give room for a 500 mm (1.6 feet) radius curve to deflect crash partners including VRU and cars. The extra 600 mm should give 102 km/h or (63 mph) of protection which would exceed a general goal of 60 mph (100 km/h) -- an average speed for highway crashes in the real world.

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3. NHTSA should immediately issue an RFP to identify the appropriate requirements for a [front underrun protection](#) standard.

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## Periodic Review of Underride Standards:

1. In light of the long-term awareness of underride deaths as well as the advancement of technology along with research for viable solutions, NHTSA should immediately issue a Request for Proposals (RFP) and **fund the research and design of a high capacity rear underride barrier prototype for the development of a generic guard** which would demonstrate successful prevention of underride and protection against severe passenger injury at high impact capacity (62 mph) in two categories:
  - a. with energy absorption, including solutions which have been proposed internationally -- both in Germany (Energy absorbing underrun protection crash structures on commercial vehicles have to become standard, as they are on passenger cars for decades). and Australia (through the use of inflatable large airbags on the front and rear of trucks), and in the United States (one example of this is a proposal which has been submitted for the development of an energy absorption solution) to significantly increase the survivable impact speeds.
  - b. without energy absorption.
2. The results of this research should then be evaluated and the underride standards should be upgraded as appropriate to provide the best probable underride protection.
3. Thereafter, conduct a periodic review of underride standards every five years in order to assess the need for changes in conjunction with advancements in technology and update the standards accordingly.
4. Additionally, this periodic review should include appropriate cross-border collaboration with Transport of Canada.
5. *AnnaLeah & Mary for Truck Safety* intends to organize additional Underride Roundtables and to advocate for an International Underride Task Force to convene and cooperate with the Department of Transportation.

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