



Andrew R. Young is a principal at Nurenberg, Paris, Heller & McCarthy Co., LPA. He can be reached at 216.621.2300 or ayoung@nphm.com.

## Broken Glass And Shattered Lives – A Mother’s Journey Through Grief Brings Hope For Preventing Underride Truck Crashes

by Andrew R. Young

**E**nergy absorbing bumpers, crumple zones, and seatbelts could not save the lives of backseat passengers, 13 year-old Mary and 17 year-old AnnaLeah. They were traveling in a four-door sedan driven by their mother, Marianne Karth.

Highway traffic slowed to a stop as the Karth sedan was hit from behind by a semi-truck. The first impact spun their blue, four-door sedan 180 degrees. The same semi-truck’s momentum caused a second impact which shoved the Karth sedan backwards underneath yet another truck’s trailer. The rear bar on the second truck’s trailer was not strong enough to prevent the Karth vehicle from going underneath. The rigid structure of the trailer’s steel frame effortlessly shattered the back window, which failed to protect the back of the Karth girls’ heads and bodies. AnnaLeah died instantly. Four days later, Mary died as a result of her catastrophic injuries.

None of the car’s manufactured, safety engineering made a difference to save the lives of Marianne’s daughters. Why? Because the dynamics of the crash resulted in a truck underride.

Little did Marianne Karth know at that moment, on May 4, 2013, that she would become one of the nation’s leading truck safety advocates working toward meaningful prevention of underride truck crashes.

### 5-Star Safety Ratings Matter Little in an Underride Truck Crash

A car is better off hitting a concrete wall than

hitting a commercial truck. No matter how safe the car may actually be, the safety features of a car are only effective if there is good structural interaction (crash compatibility) between collision partners. A “5 star” crash test rating only matters when there is a geometrical match up of the crush structure of both the striking vehicle and the vehicle being struck.

A two vehicle collision involving a commercial motor vehicle (CMV) and a light passenger vehicle frequently results in a mismatch of structural components at the first point of impact. The crash incompatibility is in large part due to the height of the CMV.<sup>1</sup> In a truck collision, all too often, the lower profile passenger vehicle physically goes underneath the higher profile CMV. This is known as a truck underride crash.<sup>2</sup> The first point of impact is beyond the hood and into the glass windshield. The second point of impact then literally becomes the heads, faces, and chest of the lower profile vehicle’s occupants.

Air bags do not deploy because the lower profile vehicle’s bumpers and air bag sensors are not triggered. Energy absorbing bumpers and crumple zones, all designed to keep the passenger compartment intact, become irrelevant. The load path from the crash results in energy that does not initially strike the intended engineered crush structure of the passenger vehicle. With no air bag and the vehicle traveling underneath the opposing vehicle, the occupant compartment is pierced resulting in a passenger compartment intrusion (“PCI”).

Thereafter, the seat belts restraining the occupants

fail to prevent catastrophic injury or deadly consequences as the energy from the collision is absorbed directly by the human body. The car's occupants then suffer the most horrific crash consequences: death by blunt trauma; decapitation; open skull fractures; traumatic brain injuries; degloving of the face; spinal cord injuries; paraplegia; or quadriplegia.

The truck driver, too, suffers with career-ending criminal vehicular homicide or felony vehicular assault charges. At the very least, the truck driver suffers the psychological trauma associated with being an integral part of such a horrific crash.

The truck company then likely encounters a civil lawsuit. The fatalities and catastrophic injuries associated with underride crashes typically produce seven figure to eight figure verdicts, all exceeding minimum insurance requirements. Truck companies are thereafter saddled with paying judgments in excess of insurance coverage. Smaller companies must sell assets and/or file for bankruptcy. Everyone loses in an underride truck crash, the truck company and truck driver included.

### How Great is the Danger of a Truck Underride Crash?

Earlier this year, original equipment manufacturers (OEMs) reported that “[n]ew trailer orders in the United States reached 315,000, the second-highest annual total” and that orders were down in comparison to “2014’s record total” of more than 356,000 new trailers.<sup>3</sup> These new commercial trailers will be added to the 11.7 million registered trailers in existence as reported by the Federal Highway Administration in 2012.<sup>4</sup> Combining all new trailer orders with currently registered trailers puts the total number of commercial trailers in the United States at well over 12 million.<sup>5</sup>

The Interstate Highway System is 46,875 miles long.<sup>6</sup> When one calculates the number of registered trailers per mile of the Interstate Highway System, this equates to over 250 registered commercial trailers for every mile of Interstate Highway. Average daily truck volume reaches up to 50,000 trucks on much of the Interstate Highway System East of the Mississippi River.<sup>7</sup> Each trailer and truck represents an opportunity for an underride crash.

Single-unit trucks (SUTs), more commonly known as “box trucks” or “straight trucks,” likewise present the risk of an underride truck crash also due to the higher vehicle profile. These trucks are not a “combination” of a tractor and a trailer with an articulating section that requires more space for turning and backing. SUTs are typically found in a construction and/or urban settings because they are shorter and allow for tighter maneuverability. Urban settings also present more challenges, not only with greater vehicle congestion, but more bicycle and pedestrian traffic. 360 degree lower-profile protection / guards are necessary on all CMVs to protect bicyclists and pedestrians and to prevent vehicle underride.

### Over 60 Years Without Meaningful Underride Crash Protection

The public seems fairly oblivious to the dangers of underride truck crashes. It is not until a family member loses a loved one that the survivors realize how many decades underride truck crashes have been a threat to the public. Marianne Karth’s website, dedicated to her daughters’ memory, reflects the astonishment and disbelief that not much has been done to protect against the horrors associated with underride truck crashes. For decades, government regulators, original equipment manufacturers and the trucking industry

have remained idle on this issue without meaningfully addressing it.

The National Highway Traffic Safety Administration (NHTSA) is the regulatory agency with the authority to mandate that adequate protective guards be installed by OEMs. NHTSA is well aware of the problems presented by vehicle crash incompatibility and the need to prevent underride crashes as evidenced by its study focused on occupant compartment deformation and

## Glossary of Abbreviations

### **CMV**

Commercial Motor Vehicle

### **FMCSA**

Federal Motor Carrier Safety Administration

### **FMVSS**

Federal Motor Vehicle Safety Standards

### **IIHS**

Insurance Institute for Highway Safety

### **NHTSA**

National Highway Traffic Safety Administration

### **NTSB**

National Transportation Safety Board

### **OEM**

Original Equipment Manufacturer

### **PCI**

Passenger Compartment Intrusion

### **SUG**

Side Underride Guard

### **SUT**

Single Unit Truck

### **TSC**

Truck Safety Coalition

### **VRU**

Vulnerable Road Users

occupant injury.<sup>8</sup> However, NHTSA remains slow to enact meaningful regulation, whereas the European Union and many other nations (United Kingdom, Brazil, Japan and China) have surpassed the U.S. in regulatory requirements for rear guards, front underrun protection, and side underride guards (SUGs).<sup>9</sup>

The U.S. first enacted a rear underride guard standard on CMVs in 1953. This standard mandated rear guards for trucks manufactured after December 31, 1952.<sup>10</sup> This early standard required rear guards to have a maximum ground clearance of 30 inches. Guards were not required if the rear axle/wheel setback was 24 inches or less from the rear of the CMV's cargo bed. This regulation mandated rear guards for **BOTH** single-unit trucks and combination tractor-trailers. This standard included **NO strength testing requirements** for the rear guards. So, as a result, the rear bars simply existed visually and easily folded under in a crash without really preventing underride or PCI.

Forty-five years after the 1953 rule, NHTSA promulgated an updated rear underride guard standard that became effective in 1998. The new rule required the following: rear guard ground clearance to be no more than 22 inches and **strength testing requirements**. Guards are not required if rear wheel setbacks are no more than 12 inches from the end of the cargo bed. The 1998 standard is **for combination tractor-trailers ONLY**.<sup>11</sup> Meaningful regulations have yet to become standard for SUTs, which still operate under the 1953 standard. Please see the Truck Underride Regulation Chronology Sidebar for a comprehensive historical chronology addressing the issues of truck underride regulation.<sup>12</sup>

### Repeated Calls for Underride Protection

As can be seen in the decades long chronology for addressing truck underride, both the Insurance Institute for Highway Safety (IIHS) and the National Transportation Safety Board (NTSB) have repeatedly called on NHTSA to implement better underride protection standards. In the past five (5) years, a 2011 crash-test analysis by the IIHS demonstrated that underride guards on tractor-trailers continue to fail in relatively low-speed crashes in spite of the 1998 regulatory standard.<sup>13 14</sup> In 2011, IIHS petitioned NHTSA for improvements in underride protection.<sup>15</sup>

In a letter dated April 3, 2014, the NTSB urged NHTSA to take action by improving rear underride protection systems. The NTSB letter even went one step further, requesting that newly manufactured trailers be equipped with “**side underride** protection systems that will reduce underride and injuries to passenger vehicle occupants.”<sup>16</sup>

On May 5, 2014, Marianne Karth and the Truck Safety Coalition (TSC) hand-delivered a petition for rule making which asked NHTSA to improve the safety of rear underride guards on trailers and SUTs. Marianne Karth and TSC also requested rulemaking to prevent side underride and front override truck collisions. On July 10, 2015, NHTSA granted, in part, the petition and planned on issuing two separate notices – “an advanced notice of proposed rulemaking pertaining to rear impact guards and other safety strategies for single unit trucks, and a notice of

proposed rulemaking on rear impact guards on trailers and semitrailers.”<sup>17</sup>

### 2015 Rulemaking for Single Unit Trucks

On July 23, 2015, NHTSA issued the “Advance Notice of Proposed Rulemaking Underride Protection of Single Unit Trucks.”<sup>18</sup> The agency’s summary confirms that this rulemaking would respond to Marianne Karth and the Truck Safety Coalition’s petition and also, in part, respond to the earlier petition for rulemaking by the Insurance Institute for Highway Safety.<sup>19</sup> A Google search of “Docket ID: NHTSA-2015-0070” can easily allow for a review of the rule and the seventy-three (proponent and opponent) comments made by the various interested parties.

OEMs and several trade associations are among the strongest opponents, arguing that many SUTs need to have “good off



Figure 1



Figure 2



Figure 3

road mobility at construction sites” or “hitch connections” and therefore cannot have rear impact protection. Specifically, a rear guard would interfere with the work the truck must perform.<sup>20</sup> A review of the Federal Register suggests that NHTSA seems to adopt the opposition arguments that underride guards would not be cost effective on SUTs.

Based upon this author’s research and travel (twice) overseas to “The Commercial Vehicle Show” in Birmingham, England, opposition against rear underride guards on SUTs must be met with severe skepticism.<sup>21</sup> As can be seen in the photographs incorporated herein, many European CMVs already have rear underride guard protection on trucks like dump trucks and box trucks with lift gates (*Please see Figures 1 and 2*).<sup>22</sup> Another photograph depicts a trade show vendor display of rear impact bars that allow for manual adjustment of the guard so that it can be moved up and down as needed (*Please see Figure 3*). This author also videoed this

vendor demonstrating how one of the guards depicted can be manipulated and locked into upward or downward positions. By manually adjusting the guard upward, it allows for a construction vehicle to encounter low ground clearances or to lift the guard out of the way so it does not interfere with a tow hitch when towing a trailer with equipment or materials. Likewise, the photographs show how rear impact guards can easily be integrated with lift gates.

As evidenced by the photographs, the U.S. lags far behind other developed

nations. Hopefully, NHTSA is not too easily swayed by opposition to allow for meaningful regulations for rear impact protection on SUTs. This author submitted these photographs and many of the same arguments in a “public comment” in support of the rulemaking.<sup>23</sup> Eventually, the agency will be swayed by all of the proponents in favor and update the now more than half-century-old 1953 standard and finally mandate strength testing requirements for rear guards on SUTs.

#### 2015 Rulemaking to Update Rear Guards on Tractor-Trailers

On December 16, 2015, NHTSA issued the “Notice of Proposed Rulemaking Upgrade Underride” to enhance the strength testing requirements of the 1998 standard to improve rear impact protection on trailers and semitrailers.<sup>24</sup> Again, the agency’s summary confirms that this rulemaking would respond, in part, to petitions filed by IIHS, the Truck Safety Coalition, and Marianne Karth.<sup>25</sup> A Google search of “Docket ID: NHTSA-2015-0118” will allow for

a review of the rule and the thirty-four public comments, virtually all of which are in support.

Within the rulemaking summary, the agency states that the new rule would upgrade the Federal Motor Vehicle Safety Standards that address rear underride protection in crashes into semitrailers.<sup>26</sup> More specifically, the stated goal of this rulemaking is to harmonize the U.S. standard with the existing 2004 Canadian underride guard strength testing requirements (from 30 mph crash protection to 35 mph crash protection).<sup>27</sup>

A review of the comments demonstrates very little opposition because OEMs already meet the 10-year old Canadian standard. The lack of opposition highlights the fact that NHTSA is seemingly not interested in challenging OEMs to come up with a better and safer underride solution, such as a guard that protects against a 40 mph crash.

While it was a victory that NHTSA granted the petitions submitted by Marianne Karth, the Truck Safety Coalition, and IIHS, both initiatives could do more and it is hoped will do more following NHTSA’s review of the public comments.

#### Side Guards Save Lives

Marianne Karth, the Truck Safety Coalition, and the NTSB all urge NHTSA for a rulemaking mandating side underride guards (SUGs). While the European Union and many nations have had decade long standards for 360 degree lower-profile protection mandates for CMVs, NHTSA has not issued a single rulemaking initiative addressing the side protection of CMVs.

Side guards have proven particularly effective in urban settings protecting bicyclists and pedestrians. The initial impact between a truck-bicycle or truck-



Figure 4

pedestrian is not what causes a fatality. It is the fact that the bicyclist or pedestrian falls toward the larger vehicle and into the gap between the larger vehicle's front and rear axles. The bicyclist or pedestrian then ends up underneath the chassis and wheels of the larger vehicle, causing the fatality. European mandated lateral side guards prevent vulnerable road users (VRU) such as bicyclists and pedestrians from going underneath the larger vehicle. The side guards give something for the pedestrian or bicyclist to interact with upon impact deflecting them away from the truck (*Please see figure 4*). While injury may occur, the VRU does not end up crushed underneath the larger vehicle's tires.

Statistics in Europe have proven that side guards truly save lives. A study published by the Transport Research Laboratory identified a 61% reduction in truck-bicycle fatalities and a 20% reduction in truck-pedestrian fatalities in London since lateral side guards became mandatory in 1986.<sup>28</sup> These impressive statistics have inspired initiatives by exempt and unregulated entities, such as European SUT construction companies, to implement voluntary programs to outfit trucks with side guards. One voluntary program is known as the Construction Logistics and Cyclist Safety (CLOCS) initiative. It brings the construction logistics industry together

to implement a road safety culture to "help protect pedestrians, cyclists, motorcyclists and other road users who share the road with construction vehicles." This program is "an industry led response to improve safety."<sup>29</sup>

Since NHTSA is slow to meaningfully regulate side underride guard protection, City and State Governments, safety advocates, liability casualty insurance companies, and/or trucking company owners have implemented policies of their own requiring installation of side underride guards (SUGs). Integral to this initiative is the aftermarket installation of SUGs since OEMs are not yet likely to install guards without a NHTSA required standard.

The City of Boston was the first U.S. institution to pass and enforce a law with meaningful side underride prevention. In 2014, Mayor Martin J. Walsh submitted the "Ordinance to Protect Vulnerable Road Users in the City of Boston."<sup>30</sup> The ordinance requires both City owned trucks and companies that contract with the City to install "lateral protection devices" or SUGs on their fleet of CMVs. The City of New York and many other cities are following Boston's lead. On May 11, 2015, the University of Washington announced that it has installed side guards on the thirty-one box trucks that are part of its campus fleet.<sup>31</sup> The only downside is that these devices are designed to protect VRU and are not strong enough to prevent vehicle underride. Hopefully, side guards protecting VRU will simply be step one and as the public and industry become accustomed to seeing the benefits side guards bring, then step two will be to prevent underride from cars.

## The Market Is Demanding Better Underride Protection

Marianne Karth, the TSC, and IIHS anticipate that market adaptation will make the regulatory case easier for future side underride truck crash prevention. To help incentivize underride protection beyond mere regulatory compliance, Marianne Karth and the others hosted the first ever "Underride Roundtable" on May 5, 2016. IIHS's Vehicle Research Center in Ruckersville, Virginia served as the host facility.

Over the past year, momentum and excitement grew as the Underride Roundtable's agenda was finalized. Even beforehand, early registration reflected the importance of this historic event. The broad spectrum of attendees included safety advocates, trucking industry representatives, engineers, regulatory officials, trailer manufacturers, the media, and many others.

The first hour and a half was dedicated to a "Description of the Problem of Underride" with presentations from NHTSA Engineer Robert Mazurowski and NTSB Deputy Director for the Office of Highway Safety, Robert Molloy. Advocates for Highway and Auto Safety also gave a talk highlighting the concerns regarding the aforementioned slow regulatory progress.

The second half of the morning was dedicated to "Research That Points to a Solution." IIHS' brilliant Senior Research Engineer, Matt Brumbelow, gave a lecture reviewing the research on underride crashes and the safety evolution of guard performance.<sup>32</sup> Virginia Tech Senior Design Team next gave a presentation showcasing their new rear underride guard design with innovative strength enhancements to further protect cars from occupant deformation. To end the morning session, Kris Carter from the Mayor's Office of New Urban Mechanics, City

# Truck Underride Regulation Chronology

<p>1953 First federal standard requires underride guards for both combination tractor-trailers and single-unit trucks, but includes no strength testing requirements.</p> <p>1967 Actress Jayne Mansfield dies in a rear underride truck crash.</p> <p>1969 National Highway Safety Bureau (precursor to NHTSA) proposes guards on combination tractor-trailers and single-unit trucks with 18-inch max clearance; predicts side guards will be added after further research.</p> <p>1971 NHTSA abandons 1969 rulemaking.</p> <p>1971 NTSB recommends NHTSA require energy-absorbing underride and override barriers.</p> <p>1972 NTSB urges NHTSA to renew the abandoned underride proposal.</p> <p>1977 IIHS petitions NHTSA for a new rear underride standard.</p> <p>1981 NHTSA issues proposal to upgrade underride protection requirement.</p> <p>1996 NHTSA issues new standard effective 1998, covering combination tractor-trailers and requiring 22-inch max clearance and strength testing. The standard does not effect single-unit trucks.</p> <p>2004 Transport Canada issues standard after crash tests show U.S. standard is insufficient. Canadian rule approximately doubles strength requirements.</p>	<p>2010-12 IIHS testing shows guards can fail in 35 mph impacts. Guard on Manac trailer is only one from 8 largest manufacturers to prevent severe underride in 30% overlap test.</p> <p>2011 IIHS petitions NHTSA for improvements to standard for rear underride protection.</p> <p>2013 NHTSA releases study, "Heavy-vehicle crash data collection and analysis to characterize rear and side underride and front override in fatal truck crashes."</p> <p>April 3, 2013 NTSB urges NHTSA to take action to improve underride guards.</p> <p>May 5, 2014 Marianne Karth and Truck Safety Coalition submit their own petition for underride rulemaking.</p> <p>July 23, 2015 In an advance notice of proposed rulemaking, NHTSA suggests rear underride guards would not be cost-effective on single-unit trucks.</p> <p>December 16, 2015 NHTSA proposes adopting Canadian underride guard requirements for combination tractor-trailers.</p> <p>May 5, 2016 IIHS, Annaleah &amp; Mary for Truck Safety, and Truck Safety Coalition host industry-wide, Underride Roundtable to identify solutions to this six decade long safety concern.</p>
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

of Boston gave a presentation about the City's Ordinance mandating SUGs for the protection of vulnerable road users. Boston is truly leading the way as a bicycle and pedestrian friendly City.

Next, attendees and participants witnessed a live crash test of a Chevy Malibu into the back of a 53 foot semitrailer. The test performed was a "30% overlap, offset at 35 mph."<sup>33</sup>

Wabash, Stoughton, Vanguard, and Great Dane (four of the largest U.S. trailer manufacturers) had representatives attending this event. Wabash and Stoughton donated trailers for testing purposes. Wabash, in particular, received recognition after safety advocates gave an award to motor carrier giant, J.B. Hunt, for ordering 4,000 Wabash National DuraPlate® dry van trailers that include

the new RIG-16 Rear Underride Guard System.<sup>34</sup> "This new rear impact guard is engineered to prevent underride in multiple offset, or overlap, impact scenarios."<sup>35</sup> Representatives from each trailer manufacturer walked away with the message that their companies' future market share depends on going beyond compliance to address underride concerns.



*Live crash test at the Truck Underride Roundtable*



*Andy Young and Marianne Karth at the Truck Underride Roundtable*

The day ended with an engaging more than two hour panel discussion focused on “Identifying a Unified Approach to Implementing Solutions to the Problem.” This author was humbled and proud to be asked to participate as Moderator. The panelists included:

- Jack Graczyk, Director of Fleet Services, New York City;
- Scott Manthey, Vice President of Safety, Interstate Distributors (a motor carrier);
- Mark Roush, Vice President of Engineering, Vanguard National Trailer;
- Robert Martineu, CEO, Airflow

Deflector (an aftermarket SUG manufacturer);

- Roy Crawford, crash reconstructionist who lost a son in an underride crash; and,
- Dr. Alex Epstein, Volpe, The National Transportation Systems Center.

This diverse group of panel members helped attendees “connect the dots” and flush out much of the debate, both pros and cons, as to why 360 underride protection on CMVs is a “no brainer” to protecting the motoring public. Overall, the message was fairly clear that the consumer (the trucking industry) wants

a safer product that will value safety above all else. J.B. Hunt’s 4,000 trailer purchase is the best example that market forces are likely to surpass regulatory red tape.

Marianne Karth, the Truck Safety Coalition and IIHS are to be thanked for this historic opportunity for bringing real hope to survivors of underride truck crashes. Marianne Karth in particular should be commended for her courage and perseverance to turn “sorrow to strength” (her words) in raising meaningful awareness that will without a doubt save lives. In this author’s opinion, Marianne Karth deserves hero status and recognition for all of the work she has done honoring the memory of her daughters AnnaLeah and Mary.

\* \* \*

*Postscript: In honor of her daughters, Marianne Karth founded a truck crash victim advocacy organization, “AnnaLeah & Mary for Truck Safety.” In addition to advocacy, the organization raises funds to support Underride Research. To donate to this fund, please visit [www.fortrucksafety.com](http://www.fortrucksafety.com). To learn more about Marianne and her family’s highway safety advocacy, you can visit her website, [www.annaleahmary.com](http://www.annaleahmary.com). There Marianne shares, in a personal, moving, and inspirational way, the story of her daughters – 13 year old Mary and 17 year old AnnaLeah. From the heartbreak of their deaths, Marianne Karth has forged real hope for preventing truck underride crashes. ■*

#### End Notes

1. A standard tractor-trailer sits 50 inches from the ground, the average height of a common loading dock.
2. Crashes in which one vehicle goes over another vehicle can be referred to as underride or override. “Underride” is the spelling utilized by U.S. Government publications. The City of Boston Ordinance requiring lateral protection devices spells it as “under-ride.” In Europe, the phrase “underrun” is used to describe a crash wherein a smaller vehicle ends up beneath the larger vehicle.

3. The American Trucking Association, [Transport Topics, Trailer Shipments Set Record As 2015 Orders Stay Strong](#), by Roger W. Gilroy, Page 1, Week of February 1, 2016.
4. <https://www.fhwa.dot.gov/policyinformation/statistics/2012/mv11.cfm> See also the American Trucking Association's February 5, 2016 Comment on the pending NPRM Docket No. 2015-0118 Rear Impact Guards, Rear Impact Protection. Note: as referenced in the ATA comment, many of these trailers are not used on a regular basis.
5. According to the U.S. Census, the State of Ohio has a population of 11,594,163. The State of Pennsylvania has a population of 12,787,209. The population of these states provides a basis of comparison to show the magnitude of registered trailers in the United States.
6. <https://www.fhwa.dot.gov/interstate/faq.cfm#question3>
7. U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, "Estimated Average Annual Daily Truck Traffic." [http://ops.fhwa.dot.gov/freight/freight\\_analysis/nat\\_freight\\_stats/docs/06factsfigures/index.htm](http://ops.fhwa.dot.gov/freight/freight_analysis/nat_freight_stats/docs/06factsfigures/index.htm)
8. Eigen, A.M.; Glassbrenner, D., Mathematical Analysis Division, National Center for Statistics and Analysis, U.S. Department of Transportation, National Highway Traffic Safety Administration, *The Relationship Between Occupant Compartment Deformation and Occupant Injury*, DOT HS 809 676, November, 2003.
9. United Nations Economic Commission for Europe ECE Regulation No. 73, Lateral Protection; United Nations Economic Commission for Europe ECE Regulation No. 93, Front Underrun Protection; and, United Nations Economic Commission for Europe ECE Regulation No. 58 for Rear Underrun Protection. <http://www.unece.org/trans/main/wp29/wp29regs41-60.html>
10. Blower, D., Woodrooffe, J., Page, O., University of Michigan Transportation Research Institute; on behalf of the U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Applied Vehicle Safety Research, *Analysis of Rear Underride in Fatal Crashes, 2008*, DOT HS 811 652, August, 2012.
11. NHTSA. FMVSS: Rear Impact Protection; Final rule. *Federal Register*; Vol 61, p. 2004, January 24, 1996. Federal Motor Vehicle Safety Standards 223 and 224: 49 C.F.R. § 571.223 Standard No. 223; Rear impact guards. 49 C.F.R. §571.224 Standard No. 224; Rear impact protection.
12. This historical chronology addressing Truck Underride from 1953 to present was put together by this author (who served as a Moderator of the May 5, 2014 Underride Roundtable), in collaboration with IIHS representatives, the Executive Director of the Truck Safety Coalition, and Marianne Karth.
13. The American Trucking Association, [Transport Topics, Insurance Group Cites Concerns on Underride Guards](#), March 1, 2011.
14. Brumbelow, M.L. and Blanan, L., "Evaluation of US Rear Underride Guard Regulation for Large Trucks using Real-World Crashes." [Stapp Car Crash Journal](#) 54: 119-131, 2010.
15. Insurance Institute for Highway Safety, 2011 "Petition for Rulemaking; 49 C.F.R. § 571 Federal Motor Vehicle Safety Standards; Rear Impact Guards; Rear Impact Protection." Arlington, VA [http://www.iihs.org/laws/petitions/pdf/petition\\_2011-02-28.pdf](http://www.iihs.org/laws/petitions/pdf/petition_2011-02-28.pdf) The petition requested, among other things, a lower ground clearance from 22 inches and an inclusion of SUTs.
16. Hersman, Deborah A.P., Chair, National Transportation Safety Board, Safety Recommendations, H-14-001 through -007, letter to the Honorable David J. Friedman, Acting Administrator, National Highway Traffic Safety Administration, page 14.
17. Department of Transportation, National Highway Traffic Safety Administration, Grant of Petition for Rulemaking; 49 C.F.R. § 571 Federal Motor Vehicle Safety Standards: Rear Impact Guards; Rear Impact Protection, Federal Register Number 2014-16018. <https://www.regulations.gov/#!documentDetail;D=NHTSA-2014-0080-0001>
18. Department of Transportation, National Highway Traffic Safety Administration, Docket No. NHTSA-2015-0070, Rear Impact Protection, Lamps, Reflective Devices, and Associated Equipment, Single Unit Trucks. <https://www.regulations.gov/#!docketBrowser;rpp=25;po=25;dc=PS;D=NHTSA-2015-0070>
19. *Id.*
20. *Id.*
21. *Id.* See Public Comments both in support of and opposition to the proposed rulemaking.
22. These two photographs were taken by this author in Birmingham, England at "The Commercial Vehicle Show" April, 2015.
23. The author's public comment to the rulemaking can be found at this link <https://www.regulations.gov/#!documentDetail;D=NHTSA-2015-0070-0075>
24. Department of Transportation, National Highway Traffic Safety Administration, Docket No. NHTSA-2015-0118, NPRM Upgrade Underride. <https://www.regulations.gov/#!docketBrowser;rpp=25;po=0;dc=PS;D=NHTSA-2015-0118>
25. *Id.*
26. Department of Transportation, National Highway Traffic Safety Administration, Docket No. NHTSA-2015-0118, NPRM Upgrade Underride. <https://www.regulations.gov/#!documentDetail;D=NHTSA-2015-0118-0001>
27. *Id.*
28. Robinson, Tanya; Cureden, Richard; Transport Research Laboratory, *Safer Lorries in London: Identifying The Casualties Associated With Side Guard Rails And Mirror Exemptions*, Published Project Report PPR683, 2014. Tanya Robinson met with this author in Birmingham England at "The Commercial Vehicle Show" April, 2015.
29. Construction Logistics and Cyclist Safety (CLOCS) Standard Compliance. <http://www.clocs.org.uk/about/>
30. Mayor Martin J. Walsh, The City of Boston, Letter Addressed to the City Council, dated September 8, 2014. See the City of Boston Underride Ordinance - <http://www.cityofboston.gov/isd/weightsandmeasures/sideguards/documents/ordinance.pdf>
31. Press Release, University of Washington, Transportation Services, University Transportation Center, 3745 15th Ave., NE, Box 355360, Seattle Washington 98105, May 11, 2015. <http://www.washington.edu/facilities/transportation/files/images/blog/UW-sideguards.jpg>
32. Matt Brumbelow is a well-known author and voice on the issue of passenger compartment intrusion and underride truck crash prevention.
33. 100% "overlap" no "offset" is when 100% of the car's bumper from the right side to the left side, interacts squarely with 100% of the back of the rear guard, again from right to left. In a real-world crash, however, the driver often attempts to steer away from the truck at the last minute. Assuming the car driver steers left, then only 50% or 30% of the right side of the passenger car's bumper interacts ("overlaps" or "offsets") with 50% or 30% of the left portion of the rear guard. Past IIHS testing showed the majority of trailer manufacturers failed to prevent underride in offset crashes. Passenger compartment intrusion would occur along just one side of the car. Frequently, occupants not affected by the passenger compartment intrusion (particularly at lower speeds) can sustain no injury at all while those affected by the PCI can suffer fatal consequences or catastrophic injuries. Trailer manufacturer engineers have worked toward preventing PCI even in these "offset" impacts.
34. For more information as to why this award was presented please see "J.B. Hunt Transport Services, Inc. Orders 4,000 Trailers with New Rear Impact Guard Design." March 25, 2016. [http://www.jbhunt.com/company/newsroom/company\\_news/jb\\_hunt\\_orders\\_4000\\_trailers\\_with\\_new\\_rear\\_impact\\_guard\\_design/](http://www.jbhunt.com/company/newsroom/company_news/jb_hunt_orders_4000_trailers_with_new_rear_impact_guard_design/)
35. *Id.*