UTILITY TRAILER MANUFACTURING CO.

January 10, 2022

Via email only – nate.seymour@dot.gov

Josh Nash, Chief
Medium & Heavy-Duty Vehicle Defect Division
Office of Defects Investigation
NHTSA
1200 New Jersey Avenue SE
Washington, DC

Re: DP21-004

Dear Mr. Nash:

Please find the following information responsive to the information requests to Utility Trailer Manufacturing Company ["**UTMC**"] sent on December 13, 2021.

Preliminary Statement

The ODI's decision to open a Defect Petition is a response to a September 14, 2021 Petition from Eric Hein, Marianne and Jerry Karth, and Lois Durso, all of whom lost relatives in accidents involving a semi-trailer (the Karth fatalities involved a crash with the rear of a semi-trailer; there was no relationship to side-impact issues, and a side guard would not have had any effect in that collision). The Petition urges NHTSA to declare all trailers without a "side underride guard" (without specifying what type of guard they have in mind) to be defective and to require manufacturers to recall the over 2 million van trailers currently in operation, and then to retrofit those trailers with this unspecified guard.

While undoubtedly well intentioned, the Petition is premature, overbroad, and replete with statements that are inaccurate or mischaracterize the state of knowledge and technical achievement of guards. The Petitioners routinely support their claims with citations to articles prepared by their own lawyers or purported experts they have paid in connection with litigation. Petitioners fail to cite verifiable test results that show that one of the emphasized guards – the AngelWing – poses significant safety risks when used in the real world. UTMC has not attempted to respond to the inaccurate claims contained in the Petition and literature it cites; rather, UTMC has limited its response to the requests posed by NHTSA in its December 13, 2021 letter to UTMC.

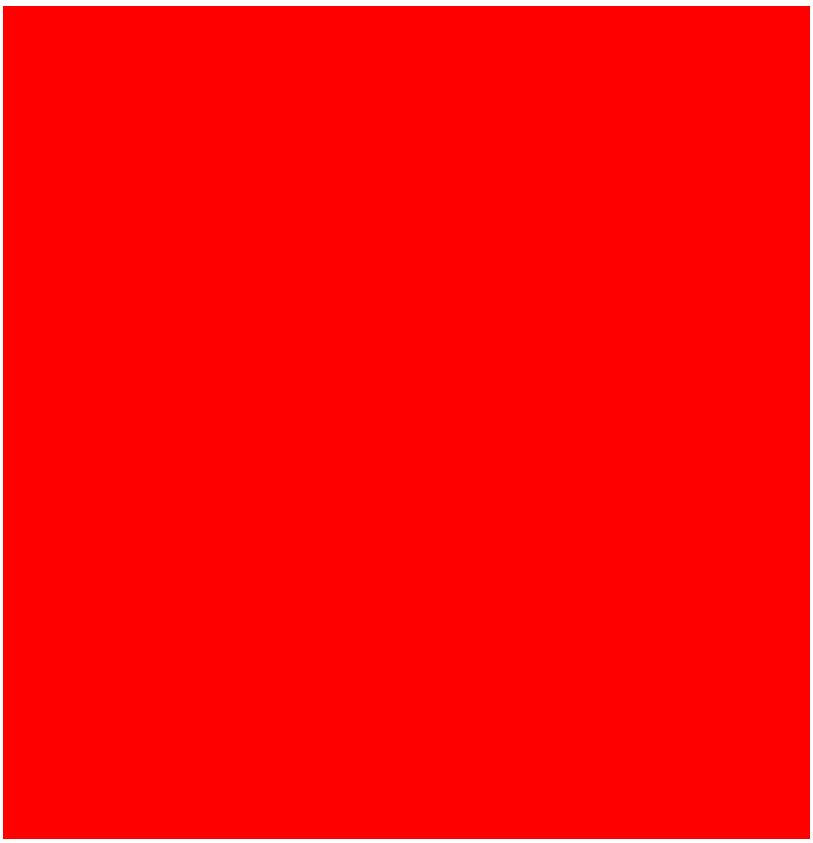
UTMC shares the desire of safety advocates seeking to mitigate the injuries and deaths caused in side-impact accidents. But because UTMC is aware of and shares concerns of those who seek to avoid unintended consequences that create risks of other injuries and deaths by mandating unproven technologies or imperfect regulatory standards, UTMC supports

implementation of side-impact guard technology when appropriate study demonstrates the chosen guard is both technologically and economically feasible.

UTMC agrees with the GAO recommendation that NHTSA perform significant additional research on the effectiveness and cost of side guards so that NHTSA can determine if side guards should be required, and, if so, the appropriate standards for implementing such a requirement.[1] UTMC will continue to support NHTSA in its efforts to collect reliable information in support of an evaluation as to whether side guards are technologically feasible and cost-benefit justified and, if so, what technologies are most suitable for implementation.

1. **State by model year the number of subject vehicles Utility has manufactured for sale or lease in the United States since 2006. Include by model year the number of subject vehicles which were manufactured by Utility with side underride guards as original equipment.**

   This information constitutes business confidential information and is being provided separately to the Office of Chief Counsel.

   [

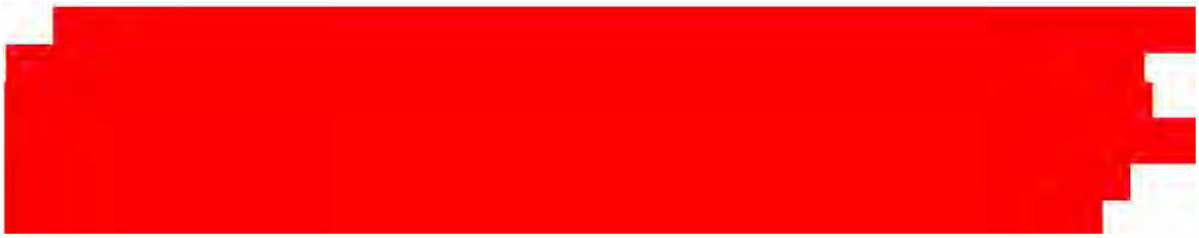
[1] United States Government Accountability Office, Report to Congressional Requesters, *TRUCK UNDERRIDE GUARDS – Improved Data Collection, Inspections, and Research Needed* (March 2019 – GAO-19-264). A copy of this report is included with this submission as Exhibit B.

Information based on UTMC's internal production records. Information current as of January 2022.

2. **State the current or estimated number of Utility subject vehicles still in service for all model years.**

UTMC has manufactured semi-trailers for over 100 years. UTMC does not collect or have access to information showing the number of trailers in any given year or historically that remain in service, and it has no way of providing an accurate number in response to this inquiry.

This remainder of this response constitutes business confidential information and is being provided separately to the Office of Chief Counsel.



Information based on UTMC's internal production records. Information current as of January 2022.

3. **Please report Utility current percent of the subject vehicle market share.**

This information constitutes business confidential information and is being provided separately to the Office of Chief Counsel.

Information based on UTMC's internal production records as compared to total van-type trailer production reported by ACT. Information current as of January 2022.

4. **Provide a brief summary of any and all reports, claims, or other notices received by Utility, or of which Utility is otherwise aware, which relate to, or may relate to, the alleged defect in the subject vehicles or vehicles equipped with side underride guards.**

Other than in the context of litigation, UTMC does not recall receiving any claim that one of its trailers was defective because it did not have a side-impact guard. Typically, UTMC first learns of such a claim when it is served with a complaint in litigation. This is not a frequent occurrence. Although UTMC's records are incomplete, UTMC has been sued approximately 12 times in the last 15 years based on a side-impact collision.

In those instances, the complaint usually contains a claim for strict product liability, alleging that the trailer contained a design defect in that the trailer was not manufactured with a side-impact guard. To UTMC's knowledge, no court has ever issued a final judgment finding that a trailer without a side guard was defectively designed. In the one case in which UTMC has been involved that has gone to trial, the jury determined that the failure to include a side-impact guard was **NOT** a design defect. Some complaints include a strict-liability claim based on failure to warn, or defective manufacturing. Again, no court to UTMC's knowledge has ever endorsed such a claim. Another common cause of action is a general one for negligence – either in the design or manufacture of the trailer or lack of crashworthiness. In the one case in which UTMC was involved, the jury – which as noted found that the trailer was not defective – concluded that UTMC was negligent in some unspecified way. No final judgment was entered in that case.

Occasionally, UTMC learns outside of litigation that one of its trailers has been involved in an accident in which a vehicle struck the side of a trailer. For example, the much-covered case of the Tesla in Florida colliding with the side of a trailer while the driver was not paying attention involved a UTMC trailer. No claim was made in that case. But as noted previously, the only instances that UTMC recalls in which it was alleged that the trailer contained a design defect because it failed to include a side-impact guard are those in which UTMC was sued in litigation.

Information based on UTMC's litigation records and internal discussions. Information current as of January 2022.

5. **Does Utility currently offer side underride guards as standard or optional equipment? If yes, is it a Utility design or from another supplier? If from another supplier, identify the supplier and provide their contact information.**

UTMC currently offers a prototypical side-impact guard as optional equipment to customers where the customer's specifications are consistent with a side-impact guard and UTMC determines that addition of the guard should not result in an unsafe condition. The design is UTMC's. UTMC does not offer as standard or optional equipment any side-impact guard manufactured by any other manufacturer, and no customer of UTMC has requested that UTMC install such a third-party guard on a trailer manufactured by UTMC. UTMC is

not aware of any significant requests that any trailer manufacturer install third-party guards. Information based on UTMC's sales documents. Information current as of January 2022.

6. **Produce copies of all installation, service, warranty, and other documents that relate to, or may relate to, the subject component in the subject vehicles.**

This information constitutes business confidential information and is being provided separately to the Office of Chief Counsel.

[redacted]

Information based on UTMC's engineering and sales documents. Information current as of January 2022.

7. **Provide a brief summary of all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations that relate to, or may relate to the subject component that have been conducted, are being conducted, are planned, or are being planned by, or for, Utility.**

A. UTMC conducted 25 tests on the AngelWing to determine its suitability as a semi-trailer option. In those tests, the AngelWing performed *unsatisfactorily* in 19 of those tests, including instances in which the presence of the AngelWing damaged the trailer or the AngelWing. Based on these results, UTMC has serious concerns that the AngelWing, when exposed to real-world conditions, presents unacceptable risks of damaging the trailer with attendant safety risks to the motoring public resulting from trailer parts becoming detached or partial or catastrophic failure of the trailer during operation.

These risks are in addition to the often-noted danger of a semi-trailer with low ground clearance becoming stuck on railroad tracks and being struck by an on-coming train, which already occurs from time to time.

UTMC has provided additional information concerning these tests of the AngelWing, and its conclusions from those tests, in response to Request #8.

Information based on UTMC's tests of the AngelWing, as documented in the "Testing and Evaluation of AirFlow Deflector's AngelWing™ Side-Impact Guard," (UTMC, July 2019). UTMC includes a copy of that report with this submission as Exhibit A. Test results current as of July 2019; information current as of January 2022.

B. In response to the unacceptable safety risks UTMC associates with the AngelWing design, UTMC designed a prototypical side-impact guard that alleviates the significant deficiencies in the AngelWing. The UTMC guard differs from the AngelWing primarily in the following ways:

- It has significantly greater ground clearance than the AngelWing, yet has significant depth to engage and stop the test vehicle used by the IIHS (2010 Chevrolet Malibu) without injury to the crash-test dummy in perpendicular 35 mph crashes performed both in the center of the guard and in a 30% overlap (70% offset) scenario. Specifically, UTMC's guard has over 26" of nominal ground clearance, as opposed to the maximum of 22" mandated in Federal Motor Vehicle Safety Standards 223 and 224 for rear guards, and the roughly 19" nominal ground clearance of the AngelWing.

- It attaches to the trailer differently than does the AngelWing, using a patent-pending design. This alleviates the trailer damage UTMC noted the AngelWing caused during various floor and lifecycle tests.

- It does not cause the trailer to violate DOT regulations as does the AngelWing, which restricts the forward movement of the trailer suspension and causes the air hoses and electrical lines to rub against the supporting structure of the AngelWing.

- It weighs over 1,000 lbs., as opposed to the roughly 840 pounds of the AngelWing.

UTMC performed both static and dynamic crash tests on its side-impact guard, as well as tests designed to test the effect of the guard on the structural integrity of the trailer; these are the same tests that UTMC performed on the AngelWing.

UTMC crashed two Chevrolet Malibu automobiles into its side guard. In performing these dynamic tests, UTMC set up the trailers similar to the way the IIHS set up the trailers for the rear-guard tests it performs – fully loaded with the weight equally distributed throughout the trailer. As noted previously, for tests of the AngelWing, the IIHS inexplicably did not use this standard configuration; rather it concentrated the weight towards the rear of the trailer. This is not a realistic simulation of a trailer load; in decreased the trailer's inertia in the tested center impact and allowed the trailer to flex and slide, thus dissipating the energy in a way that would not occur in a real-world collision. For comparison purposes, in the IIHS test of the AngelWing, the impact caused the improperly loaded trailer to slide between 12"–15"; in contrast, the impact of the Malibu into UTMC's trailer properly loaded trailer to move approximately 3".

In the first test, UTMC crashed the Malibu at a 90-degree angle into the center of the guard with an instrumented dummy. The results demonstrated that the dummy survived the impact; there was no passenger-compartment intrusion.

In the second test, UTMC performed what is commonly referred to as a 30% overlap test, in which only 30% of the automobile contacts the end (in this case the rear) of the side-impact guard. Again, the instrumented dummy survived the impact. (To UTMC's knowledge, there have not been any 30% overlap test performed on the AngelWing or the SafetySkirt design.)

The files containing data from these tests are very large; UTMC is willing to provide these to NHTSA upon request and arrangement for file transfer.

Information based on UTMC's tests of the AngelWing current as of July 2019, and tests of the UTMC guard (current as of 2021); information current as of January 2022.

C. As part of the TTMA Engineering Committee, UTMC and other trailer manufacturers attempted to provide guidelines through a draft Recommended Practice for the performance of a side-impact guard as possible optional equipment on trailers. These included considerations of dimensions, strength, energy-absorption, and test protocols. The narrowly defined goal was to develop recommendations that would enable the side guard to prevent excessive passenger-compartment intrusion under the crash-test conditions demonstrated by the Insurance Institute for Highway Safety in a 35-mph center/perpendicular impact by a 2010 Chevrolet Malibu, sustaining a total minimum energy absorption of 149,000-foot pounds (from both the side guard and impacting vehicle). Testing would be conducted both in the center of the guard, as well as at 30-percent overlap conditions. An acceptable design would not interfere with or prevent intended usage of structural or other features that are commonly used and may reside under the trailer, such as fuel tanks for refrigeration units, tire carriers, lift gates for side doors, belly boxes, and the like.

TTMA members were ultimately not able to reach consensus on a final Recommended Practice. One major impediment to reaching an agreement was a requirement that the guard meet the current minimum-ground-clearance requirements of Federal Motor Vehicle Safety Standards 223 and 224 that apply to rear guards – that they be no more than 22" above the ground. Several TTMA members were aware of and concerned with the significant possibility of a side-guard with such dimensions high-centering and impacting the ground, or striking other obstacles in day-to-day operations, damaging the guard and the trailer, with potentially catastrophic results.

Other concerns arose from the significant lack of field data on collisions generally, including at collision angles other than perpendicular, which would require a consensus on longitudinal strength, energy absorption and test requirements.

Information based on UTMC's participation in TTMA's Engineering Committee, current as of 2020.

8. **Angelwing is one aftermarket manufacturer of side underride guards. Please assess the compatibility of this product with Utility trailers. See the following link for additional information: http://www.AngelWingskirts.com/**

   a. **Effect, if any, this guard will have on the structural integrity of Utility trailers;**

      Safety and operational issues with the AngelWing caused UTMC to conclude that the AngelWing is not a suitable product ready for market at this time, let alone appropriate for broad-scale application across different trailer designs traveling myriad routes. UTMC is concerned that broadly incorporating the AngelWing design on trailers would significantly endanger the motoring public.

      Over a ten-month period in 2018-2019, UTMC performed a series of 25 tests on the AngelWing to determine its suitability as a semi-trailer option. In those tests, the AngelWing performed unsatisfactorily on 7 of 10 tests performed on UTMC's refrigerated trailer and performed unsatisfactorily on 12 of the 14 tests performed on UTMC's dry-freight trailer – including instances in which the presence of the AngelWing damaged the trailer or the AngelWing in the tests, or caused the trailer to come to a halt when it traversed a change in grade, with the likelihood that damage would occur if the trailer were forced over that terrain.

      These risks all result from an intrinsic element of the AngelWing design: it intrudes into areas of the trailer that experience shows often contact the ground, bollards, or other obstructions. These may occur in loading docks, at steep driveways, at unexpected grade transitions, at railroad crossings, at fire hydrants, and around equipment protected by bollards such as standpipes, corners, and the like. Depending on the nature of the collision between the guard and these items, the guard's rigid structure transmits the force into the trailer, which, either as a result of that single impact or cumulatively, will weaken, bend, or break. If that damage does not itself result in catastrophic loss of the trailer at that time, it likely will weaken the trailer's structural components such that an unexpected catastrophic failure is possible.

      UTMC is experienced with damage to devices under the trailer. Many of its customers complained to UTMC about aerodynamic side skirts being ripped from trailers due to changes in grades or impact with objects on the side of the road. UTMC developed a test ramp that would simulate the same changes in grade that caused these aerodynamic devices to rip off the trailer. It then developed a more flexible aerodynamic side skirt that could traverse the change in grade without damage. They key to avoiding damage was the flexibility of the skirt. But it was apparent to UTMC that inserting a rigid side-impact guard underneath the trailer would pose many of the same hazards that initially plagued the aerodynamic devices.

      UTMC therefore conducted dynamic tests of the AngelWing on the same test fixture UTMC used to test the performance of its aerodynamic side skirts. In those dynamic tests designed to test the ability of the AngelWing to traverse a change in grade encountered by UTMC customers, the unloaded trailer ground to the stop when the guard encountered the high point in the grade (requiring removal of the trailer with a forklift or by

artificially raising the front of the trailer). The fully loaded trailer also ground to a stop, but only after suffering cross-member damage or bottom-rail damage that severely compromised the trailer's integrity. UTMC's static tests designed to simulate impact showed similar concerns.

UTMC also conducted standard floor-strength tests. For both refrigerated and dry-freight trailers, multiple AngelWing brackets that attached the guard to the trailer cracked before the test was complete. This is consistent with results from other tests using TTMA Recommended Practice RP-37 (a standard floor-strength test); the AngelWing-connecting brackets experienced fatigue cracks in multiple locations.

Next, UTMC subjected the AngelWing to the same dynamic and static bumper-strength tests that it performs on its rear guard to determine compliance with DOT standards. It tested the AngelWing by applying forces to the center of the guard, to the front, to the rear, and longitudinally. In all cases, the test severely compromised the guard, and the guard did not perform to the same standards as would be required by a rear guard. Finally, the AngelWing failed during UTMC's fatigue test, designed to show how weaknesses develop over time.

Based on these results, UTMC has serious concerns that the AngelWing, when exposed to real-world conditions, presents unacceptable risks of damaging the trailer with attendant safety risks to the motoring public resulting from trailer parts becoming detached or partial or catastrophic failure of the trailer during operation.

These risks are in addition to the often-noted danger of a semi-trailer with low ground clearance becoming stuck on railroad tracks and being struck by an on-coming train, which already occurs from time to time.[2]

UTMC also has reservations as to whether the trailer with an AngelWing will perform as well over-the-highway as documented in the IIHS tests, since the AngelWing side-impact crash test did not use the same weighting and loading criteria that the IIHS has used for all of its rear-impact tests. Additionally, there is no information from the IIHS concerning how the guard would perform in either a 50%- or 30%-offset scenario, other criteria the IIHS has said is important in determining the performance of rear guards. UTMC's limited tests suggest the AngelWing's performance in the 50%- or 30%-offset scenario is substantially weaker than current rear guards in those scenarios.

UTMC has made its report of its tests available to AngelWing, but – to UTMC's knowledge – neither AngelWing's inventor Perry Ponder nor its manufacturer, Air-Flow

[2] See, for example, the "California Commercial Driver's Handbook" (sections 2.7.5 and 2.15.5), the "Georgia Commercial Driver's Handbook" (sections 2.15.5 and 2.15.6.), and 49 C.F.R. §392.12. All three examples state that a driver of a commercial motor vehicle shall not drive onto a highway rail-grade crossing without having sufficient space to drive completely through the crossing without stopping. Both State handbooks refer specifically to trailers with low ground clearance and warn against rail crossings with steep approaches.

Deflector, has addressed these concerns. Neither AngelWing, the manufacturer, nor Perry Ponder has responded to UTMC.

Finally, UTMC doubts whether there has been sufficient experience with the AngelWing to draw appropriate conclusions that it will perform well in day-to-day operations. To UTMC's knowledge, very few AngelWings have been sold. Although the GAO reports that the manufacturer claims to have sold 100 guards, testimony by the AngelWing's inventor, Perry Ponder, as late as November 2021 stated that there were only approximately 12 guards that had been sold (including those sold for testing to UTMC and Great Dane). UTMC is aware that AngelWing claims that a trailer operating with the AngelWing over roughly a decade has experienced approximately 1 million miles without failure. Based upon information UTMC learned in litigation, this claim relates to a single trailer running a dedicated north/south route in the Central United States. UTMC also learned in litigation that the company that operates that single trailer has a fleet of approximately 100 trailers. Despite that company's claimed experience with the single trailer, it still has not installed the AngelWing on any other trailers, adding to UTMC's concern that the AngelWing is not feasible. To UTMC's knowledge, AngelWing has never conducted the types of tests on its device that UTMC has conducted.

UTMC's test methodology and results are provided in detail in its document titled "Testing and Evaluation of AirFlow Deflector's AngelWing™ Side-Impact Guard," (UTMC, July 2019). UTMC includes a copy of that report as Exhibit A to this submission. If ODI is interested in seeing the underlying tests, UTMC is willing to provide that information to the ODI.

Test results current as of July 2019; information current as of January 2022.

b. **The approximate weight adding this side underride guard will add to Utility trailers;**

The AngelWing guards UTMC purchased for testing weighed, on average, 841 pounds. As noted earlier, UTMC's prototype weighs over 1,000 pounds.

Information based on UTMC's purchase of the AngelWing guard in 2018; information as to UTMC's guard current as of January 2022.

c. **The approximate reduction in cargo carrying capacity adding this side underride guard will have on Utility trailers;**

For a trailer that is otherwise fully loaded, adding an 800 lb. or 1,000 lb. guard results in a pound-for-pound reduction in cargo-carrying capacity. For any trailer that is within the weight of the AngelWing of weighing out, there will be a corresponding decrease in cargo-carrying capacity. UTMC does not have information concerning what number or percentage of trailers weigh out versus cube-out, or how many trailers that do not weigh out are within 800 pounds of weighing out and thus would suffer cargo displacement were the AngelWing, or other side guard, attached to the trailer.

d. **Effect, if any, this guard will have on the durability and service life of Utility trailers;**

As noted previously, UTMC's tests show that the presence of the AngelWing when mounted on a UTMC trailer damages both the trailer and the guard. As a result, the durability and service life are decreased. Additionally, UTMC's tests show that impacts to the guard from hitting the ground or obstacles in normal use are likely to damage the trailer as well as the guard, further decreasing durability and service life. UTMC has not quantified the effect of this decrease. Finally, UTMC's tests show that the AngelWing poses the possibility of catastrophic trailer failure or the risk that components will detach from the guard or trailer during operation, with the risk of striking motorists.

Because the AngelWing (and most guard designs, including the SafetySkirt) make it difficult to access and inspect underneath the trailer, there is added danger that damage to the guard and trailer from impacts with the ground or obstacles will not be detected and remedied in time to avoid a failure of the guard or trailer.

Test results current as of July 2019; information current as of January 2022.

e. **The approximate cost, including materials and labor for installation of these guards both on new production and in-service Utility units;**

The GAO study reports (attached as Exhibit B) that the cost starts at roughly $2,500 per trailer. This is for the guard itself, without labor. This is lower than the amount that UTMC paid for the guards when it purchased two sets for testing in 2018; UTMC has not been able to locate documents showing the quoted purchase price.

Significant labor is required to retrofit a guard to a trailer. When UTMC purchased the two sets of AngelWing devices in 2018, they arrived damaged and required repair by UTMC before they could be installed. Even then, the guards as manufactured and sold by AngelWing didn't match the holes in the trailer, even though UTMC had provided AngelWing with detailed information about each trailer on which the AngelWing would be mounted, including the location, material, and spacing of cross-members. UTMC devoted substantial labor to correcting these issues so that that AngelWing could be mounted properly.

Based on this experience, UTMC expects that there would also be a substantial labor component in attempting to retrofit guards to trailers. This likelihood is exacerbated by the fact that many different AngelWing formulations would need to be manufactured to accommodate myriad trailer designs, dimensions, and specifications. Finally, in those instances where holes and hardware do not match exactly, it is likely that either the trailer or guard will need to be stressed to make the parts fit properly. UTMC has no knowledge concerning what effect, if any, that would have on the performance or longevity of the guard.

Installation regarding installation of AngelWing current as of 2018-2019.

Additional information responsive to this request constitutes business confidential information and is being provided separately to the Office of Chief Counsel.

f. **Effect, if any, this guard will have on the maneuverability and operating environment compatibility of Utility trailers;**

Before there can widespread adoption of side guards, more detailed study is needed concerning how the guards would affect everyday operations. Even the AngelWing manufacturer has acknowledged that more information on this topic is needed before there is more widespread adoption by the motor-carrier or trailer industry.

The AngelWing will adversely affect the trailer's maneuverability and will restrict the trailer's operating environment capability. As noted in UTMC's tests, there is little ground clearance between the AngelWing and the ground. As a result, the AngelWing likely will routinely impact the ground in day-to-day operations, with resulting damage to the guard and trailer. There is also the danger of the trailer's high centering as the AngelWing becomes caught up on obstacles such as railroad crossings. Similarly, the AngelWing is likely to come into contact with obstacles as trailers make turns, encounter fire hydrants, bollards, snow drifts, and the like, again with potential damage to the guard or trailer.

Information based on UTMC's tests of the AngelWing. Test results current as of July 2019; information current as of January 2022.

See discussion in response to Request 10(d) concerning ability of other low-ground-clearance trailers – such as moving vans – to negotiate changes in grade.

g. **Your assessment of the effectiveness this side underride guard would have preventing injury and death of other roadway users when installed on Utility trailers; and**

UTMC does not believe it possible to determine how effective the AngelWing would be in preventing injury and death of other roadway users, and it is nearly certain that it will cause injury and death to roadway users who would not be injured except for installation of AngelWings on a large number of trailers.

The AngelWing has been shown to stop one type of automobile in one type of crash – a perpendicular crash into the middle of the AngelWing at both 35 mph and 40 mph. Even then, the test conducted by the IIHS was dissimilar to that used when the IIHS tests rear guards. More specifically, the trailer was not loaded to the same degree, and it was not loaded throughout the trailer. As a result, the trailer slid more immediately following

impact, lessening the forces experienced by the driver dummy.[3] How the AngelWing will perform in real-world scenarios – including impacts that occur at the end of the AngelWing, or at an angle other than 90 degrees – has not been demonstrated.

Additionally, there is not enough information concerning the nature of the various side-impact collisions that do occur to determine how effective the AngelWing would be. For example, data is lacking concerning the speeds at which passenger vehicles strike the sides of trailers. Sudden deceleration forces on the occupants of striking vehicles can be equally as fatal as the injuries caused by passenger-compartment intrusion. Data for rear collisions into trailers equipped with rear impact guards show that about half of the reported fatalities occur without passenger-compartment intrusion. Until reliable speed data is available for side impacts, it will be difficult to assess the likely benefits of any particular set of performance criteria that may be prescribed for side guards. Also, there is no reliable information concerning where along the side of the trailer the impact occurs, and whether the impact would occur in an area – such as that between the wheels in a wheels-back position and the rear of the guard – where the guard offers no protection.

Similarly, it is impossible to generalize about guard effectiveness based on perpendicular impacts, when there is no data concerning what proportion of impacts meet this scenario, let alone provide a distribution of impacts across the full range of available angles. The vehicle dynamics, occupant kinematics, and injury causation mechanisms will vary greatly in these impacts from the perpendicular impacts that NHTSA has studied in promulgating requirements for rear impact guards. Other factors that must be considered are occupant position and seatbelt status and the accompanying injuries and fatalities that occur in side impacts where occupants are not belted. Also, the only tests of the AngelWing involved perpendicular crashes into a static trailer. Based on UTMC's knowledge of side-impact accidents involving UTMC's trailers, in most instances the trailer is moving, and the movement of the trailer, combined with the movement of the vehicle, affects the crash dynamics and occupant kinetics in ways that the IIHS tests do not discuss. Without additional study that includes consideration of the myriad accident scenarios, it is not possible to generalize how well the AngelWing would be in preventing injury and death of other roadway users.

Finally, large-scale installation of the AngelWing likely will cause individuals to be injured who otherwise would not be injured. First, as noted previously, installation of the AngelWing results in some decrease in cargo-carrying capacity. This decrease causes an increase in the number of tractor-trailer trips that must be made, and the statistics demonstrate that an increase in mileage is associated with an increase in injuries and death, including non-underride fatalities and deaths. Second, it is foreseeable that a vehicle striking the AngelWing could be redirected into traffic, causing a rollover, or coming into contact with another vehicle and potentially injuring the occupants of that other vehicle. Similar considerations are performed when assessing the effectiveness of

[3] As noted previously, the improperly loaded trailer used in the AngelWing test slid between 12"–15". The properly loaded trailer used in UTMC's test of its guard slid approximately 3".

highway guardrails; they would be appropriate here. In these instances, these are individuals who wouldn't have been injured except for the presence of the AngelWing.

h. **Your assessment of any additional concerns, issues, or benefits this side underride guard may have.**

The AngelWing design UTMC purchased for testing would not comply with DOT regulations, since the trailer's electrical and air hoses articulate and reside in the same space occupied by the AngelWing. The result is that these hoses repeatedly rub against the AngelWing diagonal in normal operations, presenting a serious safety issue and a violation of DOT regulations.

Because the AngelWing design severely restricts the suspension travel of UTMC's standard refrigerated and dry-van trailers, operating trailers with the AngelWing attached could be illegal in states such as California and Georgia. More specifically, California requires that the suspension be positioned with a maximum 40-foot distance between kingpin and rearmost-axle centerline.[4] Because of the AngelWing's design, it is not possible to position the suspension as required by California regulations without the air hoses touching the AngelWing's cross braces. For the air hoses to clear the AngelWing entirely, the suspension must be located approximately 45' from the kingpin to the center of the rear axle (or approximately 43' to the center of the rear tandem), which is within 18" of its most rearward position. This is not legal in all states. UTMC believes that its customers will view this to be an unacceptable restriction.

Additionally, UTMC builds its trailers with a protrusion – commonly referred to as stinger – from the front of the suspension to hold the air hoses and electrical cable and prevent them from rubbing. When the suspension was moved forward, the stinger would hit the diagonal, preventing the trailer's suspension from being moved to the most forward position. Although this is not a safety violation, the inability to move the suspension into the most forward position likely would be a significant detriment to those operating the trailers in city environments, and it might affect the operator's ability to comply with bridge laws or weight-distribution limitations, and increases the trailer's turning radius, making it less maneuverable. It therefore is foreseeable that these trailers would have to be modified as part of a retrofit initiative were the AngelWing installed.

---

[4] Cal.Veh.Code § 35400(b) (4); if the trailer is a single-axle trailer, the maximum distance is 38 feet. At least 18 other states have similar restrictions that would prohibit operation of the AW equipped trailer on some or all of its roads, according to *Vehicle Sizes and Weights Handbook*, J.J. Keller & Associates, Inc. (2018 ed.): Connecticut (43' to center of rear axle); Florida (41' to center of rear axle or rear group of axles); Illinois (42.5' to center of rear axle); Indiana (43' to rearmost axle); Maine (43' to center of rear axle); Maryland (41' to center of rear tandem axles); Michigan (37.5' to center of rear axle; 40.5' to center of rear axle assembly); New Hampshire (41' to center of rear axle or midpoint of rear tandem); New Jersey (41' to center of rear axle or rear axle group); New York (43' to center of rear axle); North Carolina (41' to rear axle or midpoint of rear tandem); Pennsylvania (41' to center of rear axle or rear axle group); Rhode Island (41' to center of rear axle); South Carolina (41' to center of rear axle assembly or tandem axle assembly); Tennessee (41' to center of rear axle or midpoint of rear tandem); Vermont (41' to center of rear axle); Virginia (41' to rear axle or midpoint of rear tandem); West Virginia (37' from rear axle of truck-tractor to front axle of semi-trailer).

The lack of warranty and indemnity commitments from the AngelWing manufacturer or inventor is also significantly troubling. Currently, the AngelWing comes only with a limited warranty; this would expose manufacturers to unacceptable risks were the manufacturer to include the AngelWing on trailers.

Finally, UTMC has significant concerns concerning the ability of AirFlow or the AngelWing inventor – Perry Ponder – to stand behind the AngelWing product. UTMC typically requires its suppliers to test their product extensively before marketing it; to UTMC's knowledge, AirFlow has not performed any of the tests performed by UTMC, and UTMC is unaware of tests showing the AngelWing's performance in the real world. Nor has Airflow demonstrated any financial ability to back the product or to respond to claims that likely would result if someone were injured as a result of the AngelWing's installation or failure on a trailer. As of 2019, the AngelWing inventor admitted that he did not have liability insurance to protect against claims arising from the device.

9. **SafetySkirt is one aftermarket manufacturer of side underride guards. Please assess the compatibility of this product with Utility trailers. See link for additional information: https://www.trailerguards.com/**

UTMC has not tested or evaluated the SafetySkirt and therefore is not able to provide meaningful specific responses to the subparts in this request.

UTMC's limited knowledge of the SafetySkirt comes from viewing videos of tests of the SafetySkirt conducted by its inventor and by the IIHS, and from testimony provided by the SafetySkirt's inventor – Aaron Kiefer – in litigation in 2019. The videos show that the vehicle's airbag frequently does not deploy in the collision with the SafetySkirt, removing protection from the vehicle occupants.

UTMC's understanding of the SafetySkirt is that it deflects the vehicle, rather than engaging or trapping it. This comes with its own set of concerns. Deflection of the vehicle adds the risk of causing rollover or deflecting the vehicle into another vehicle, creating another accident (and possible injury or death) that otherwise would not have occurred without the deflecting SafetySkirt. Also, additional study is needed concerning the kinematic forces an occupant would experience in such a deflection – including potential drastic lateral movement of the occupant's head that would lessen the effectiveness of the Safety Skirt's deflection design.

Finally , UTMC understands that the SafetySkirt has been tested only in center impacts. Given the SafetySkirt's extreme elasticity, it is uncertain how the device will perform when a vehicle impacts it closer to its anchor point It certainly is foreseeable that the deflection characteristics of the elastic device will differ significantly depending where along the device the impact occurs. Additional study is required to determine how these differences affect the performance of the guard in stopping the vehicle and on the forces experienced by the occupants.

Additionally, in his litigation testimony, Mr. Kiefer noted that the device he had invented made it difficult to perform a safety inspection and adversely affected the ability to change

tires and access underneath the trailer. He also acknowledged that he had not at the time tested the system for how it reacts in severe heat and cold, even though he anticipates that trailers with his device would travel in the north to Canada and in the deserts of the United States. He also acknowledged that the device wasn't yet ready to be deployed and that "there's definitely work to be done." Testimony of Aaron Kiefer, August 14, 2019, attached as Exhibit C.

UTMC is not aware of any commercial sales of the SafetySkirt to operating motor carriers.

a. **Effect, if any, this guard will have on the structural integrity of Utility trailers;**

b. **The approximate weight adding this side underride guard will add to Utility trailers;**

c. **The approximate reduction in cargo carrying capacity adding this side underride guard will have on Utility trailers;**

d. **Effect, if any, this guard will have on the durability and service life of Utility trailers;**

e. **The approximate cost, including materials and labor for installation of these guards both on new production and in-service Utility units;**

f. **Effect, if any, this guard will have on the maneuverability and operating environment compatibility of Utility trailers;**

g. **Your assessment of the effectiveness this side underride guard would have preventing injury and death of other roadway users when installed on Utility trailers; and**

h. **Please provide your assessment of any additional concerns, issues, or benefits this side underride guard may have.**

10. **Furnish Utility's assessment of the following in today's transportation system:**

Preliminary statement re Questions 10(a) – 10(d).

Questions 10(a) through 10(d) ask UTMC to provide various assessments of "side underride guards." This term is not defined in the requests, or the Code of Federal Regulations; indeed, there is no uniform agreement as to what is meant by the term "side underride guard." (UTMC, for its part, refers to the device as a "side-impact guard.") Consistent with this lack of a common meaning, the Petition to Secretary Buttigieg from Eric Hein, Marianne & Jerry Karth, and Lois Durso that initiated ODI's decision to open a Defect Petition itself mentions 3 patents for a "side underride guard," in addition to the "different underride guards" that have been designed by Perry Ponder and Aaron Kiefer.

(September 14, 2020 letter, p. 4.) There simply is no generally understood definition of what this term means.

Without such a definition, it is impossible to answer the questions precisely. The responses depend on the attributes of each underride device, and also require information derived from extensive testing and real-world experience of how the devices perform in the field. This information is not available.

As noted previously, UTMC extensively tested the AngelWing and determined that it was dangerous and not suitable for installation on UTMC trailers. UTMC then developed its own side-impact guard to remedy many of the deficiencies its testing had revealed with the AngelWing. But UTMC's current design itself involves tradeoffs: to avoid damage to the trailer and the guard and lessen high-centering, the guard has greater ground clearance, and it attaches to the trailer in a unique way. But the greater ground clearance means that there may be low-slung vehicles that would engage the AngelWing in a side-impact collision that would not engage UTMC's side-impact guard.

This reality is true of all guard designs of which UTMC is aware: they involve tradeoffs. And without knowing which choices are being considered when the term "side underride guard" is used, it is impossible to provide truly informative responses.

a. **The feasibility of side underride guards.**

UTMC does not know of a "side underride guard" design that is feasible in all uses. For certain routes and applications, changes in ground clearance may not be an issue: this might be the case for trailers making dedicated runs from facilities close to interstate highways that do not have severe grade-changes in loading docks to similar facilities close to interstate highways. In such a situation, a guard with ground clearance similar to the AngelWing likely would not be a problem (although, such a guard would not address the open space between the end of the guard and the trailer wheels when the wheels are in the rear position, as is often the case in long-haul travel).

But once the routes become less routine or unpredictable, there is no certainty that any given guard will be feasible. This is particularly true for trailers that have to negotiate tight turns in cities – here, the likelihood of side impacts from obstacles near corners increases.

b. **The industry financial cost of side underride guards;**

UTMC is not privy to the financial condition of its competitors or myriad trucking companies – whether large fleets or smaller operations or individual owners – who purchase van trailers. Based on its general understanding of the price of adding guards to trailers, UTMC believes that no trailer manufacturer has the financial resources to retrofit all trailers on the road, and it expects that nearly all fleet and trailer operators are in the same position. For example, as noted, there are likely over 2 million van trailers currently

on the road. Using AngelWing's cost estimate of $2,500 per set of guards,[5] the cost in material cost alone to retrofit this fleet is approximately $5 billion – the cost will be significantly higher when the labor is added to retrofit the guard. In addition, UTMC, and it anticipates other manufacturers, would incur substantial costs in reconfiguring production lines and manufacturing stations to accommodate adding these devices. UTMC does not have an estimate of the added costs that would be involved, but it anticipates any effort to retrofit the UTMC trailers manufactured in the last 15 years would be substantial.

UTMC also believes that any trailer manufacturer that decided to manufacture or retrofit all of its van trailers with guards would suffer a significant if not fatal decline in its financial performance. As noted earlier, while there are applications where current guard technology may be appropriate, it is certainly not all applications, and there has been no significant demand from trailer purchasers to install guards on trailers. UTMC for its part has never been approached by a customer asking it to put an AngelWing (or any other third-party underride guard) on a trailer the customer is interested in purchasing. For some undetermined number of customers, the added cost, inconvenience, weight penalty, and fuel penalty of adding a guard to the trailer is not justified in that customer's own cost-benefit calculation.

This concern is substantiated by the submissions of trucking-industry groups in connection with Senate Bill 665, the *Stop Underrides Act*. In March 2019, the Owner-Operator Independent Drivers Association – with more than 160,000 members representing the views and interests of small-business truckers and professional drivers – wrote Senators Kirsten Gillibrand and Marco Rubio expressing opposition to that bill. Noting that the bill "mandates devices that aren't practical, that don't physically work, and that would create operational impossibilities," the OOIDA emphasized that installing side guards "would unquestionably create challenges for truckers navigating grade crossings and high curbs, backing in to sloped loading docks, properly utilizing spread-axle trailer configures, conducting DOT-required trailer inspections, and accessing vital equipment located under the trailer – such as brakes." The OOIDA concluded that because of the diversity in the trucking industry, "[o]ne-size-fits-all solutions simply don't work." A copy of the OOIDA letter is included with this submission as Exhibit D

Similarly, the American Trucking Association on June 19, 2019, sent a letter to a number of United States Representatives discussing the trucking industry's continued safety efforts and its concern with the *Stop Underrides Act*. In its letter, the ATA cites the significant cost of retrofitting trailers (the ATA statistics, showing a $34.8 billion cost, are not limited to van trailers), and agrees with the GAO report from April 2019 stating that more study is required concerning the issue of underride guards and their unintended consequences in real-world operating scenarios and crashes. The organization also expressed concern regarding damage to the trailer and its longevity as a result of high-centering, impacts with other objects, and adding rigidity to the flexible trailer. A copy of

[5] UTMC understands that there have been significant recent increases in the cost of steel and aluminum, and UTMC believes that AngelWing's cost estimate does not reflect these significant cost increases

the ATA letter is included with this submission as Exhibit E. Based on these submissions from organizations representing the trucking industry and its drivers, UTMC is concerned with acceptance from those purchasing trailers.

Finally, adding guards adds weight to the trailer, increasing fuel consumption and fuel cost. Advocates of the AngelWing note that this can be mitigated by incorporating aerodynamic devices on the outside of the AngelWing. This observation is accurate to a point. But aerodynamic devices do not provide benefit at speeds much below 40 mph, yet the fuel penalty of additional weight still applies. Also, those interested in saving fuel are already able to add aerodynamic devices without adding the AngelWing. The aerodynamic devices simply to not ameliorate the adverse fuel impacts of adding 800 pounds to the trailer.

c. **The effectiveness side underride guards may have preventing traffic crash injuries and fatalities;**

Again, the response to this inquiry depends on what guard is being discussed, and what assumptions are made concerning the number of accidents that occur in which a vehicle impacts the side of a trailer (a) in a spot that otherwise would be covered by a guard; (b) at a speed that would permit the occupants of the vehicle to suffer less injury or avoid a fatality; (c) at an angle that would minimize injury as opposed to catching or spearing the vehicle on the end of the guard, or at an angle that would avoid redirecting the vehicle into traffic and causing other injuries and accidents. Also, information would need to be generated to consider the effect of additional injuries and fatalities that inevitably will occur as the added weight of the guards require trips to occur to account for the payload lost due to gross weight restrictions.[6]

To avoid repetition, please see UTMC's response to Request # 7(g) – effectiveness of the AngelWing in preventing injury or death – and response to Request #9 – evaluation of SafetySkirt – for a more complete discussion of many of the additional factors that need to be considered and studied before one can make any reliable estimates concerning whether any given side guard, or side guards in general, would be effective in preventing traffic crash injuries and fatalities.

Additionally, adding guards to every trailer will increase the weight of that trailer by roughly 800 pounds (other than those that weigh out as a result of adding a guard). This will have an unspecified effect on tractor-trailer stopping distances that one can anticipate will increase accidents and associated injuries and potential fatalities.

Without this additional study and information, it is impossible to make meaningful, let alone confident assumptions concerning the extent to which any guards would positively affect the injury and death rate.

[6] UTMC is aware that a number of side guard advocates have suggested exempting the weight of guards from the GVW restrictions that currently govern semi-trailers. UTMC agrees that such an exemption would ameliorate the problem of an increased number of trailers weighing out – and thus requiring additional trips to make up for the lost payload.

d. **The potential changes in the US transportation system side underride guards may require; and**

UTMC anticipates that any widespread implementation of side guards should be accompanied by a comprehensive, systematic survey (and possible modification) of the road transportation infrastructure to determine those roads that have any of the following characteristics, to name the most prominent examples: (a) severe grade changes that would cause a trailer with a side guard to high-center; (b) railroad crossings that would cause a trailer with a side guard to high-center; (c) loading docks with severe grade changes that would prevent trailers with guards from accessing those docks; (d) roundabouts and traffic circles with too small a radius such that a trailer with a guard attached would cross inward of the tangent to the inward radius of the circle, which present both ground-clearance and damage-from-close-by-obstacle issues; and (e) intersections that contain obstacles – whether fire hydrants, standpipes, poles, traffic signals, bollards, signs, or the like – that are close enough to the corner of the intersection such that a trailer making a turn at that intersection would likely impact the obstacle in either a wheels back or wheels forward situation.

UTMC is aware that advocates of side guards point to low-frame heavy-haul trailers – such as moving vans – and to trailers equipped with belly boxes and other items attached underneath traditional trailers as proof that these high-centering and side impacts with obstacles are unfounded or overstated. But drivers of these combination truck trailers are specially trained and, in many instances, are specially permitted to travel the routes assigned to them. Both these drivers and their associated motor carriers are responsible for assessing the routes and clearance challenges before crossing elevation changes in the roadway that might cause the units to strike ground and hang up or significantly damage the trailer.

In contrast, most commercial truck drivers are not specially trained for these changes of grades or similar dangers, for the simple reason that the majority of truck routes do not present elevation changes that run the risk of high-centering impacts when pulling the typical van trailers in use today that do not have side guards protruding into the space below the trailer. Adding side guards to those trailers, depending on their specifications, would increase the risk of ground impacts and thus the potential for catastrophic trailer failure. Most truck drivers will not anticipate these events.

Additionally, as noted previously, adding guards to every trailer increases the number of tractor-trailer trips that must be made, or increases the weight of the tractor-trailer by 800 lbs. This is likely to have detrimental effect on road and bridge wear that should be considered in providing recommendations concerning side-impact guards.

UTMC is concerned that the risks of damaging trailers equipped with side guards will exceed the current risks of side crashes into unguarded trailers. This technical challenge must be considered in determining whether to mandate side guards, what specific configuration and performance standards a should be mandated, if any, and whether motor carrier regulations should be amended to add operational warnings, driver training, and/or trip permitting specifically to address.

e. **The reports included with this inquiry.**

UTMC has included with this response the results of its tests of the AngelWing and its own side-impact guard, as well as materials related to its side-impact guard.

Reservation of Rights and Objections

UTMC has made a reasonable effort to identify those records and persons in its employ who have meaningful information responsive to the Requests, and to provide the information gathered from those persons and documents in response to the requests. It has not withheld any information based on the requested information's being confidential (although confidential and proprietary information is being provided separately, as directed by the requests) or protected by the attorney-client privilege or attorney-work-product doctrine. To the extent that OID seeks to require UTMC to do more, or seeks additional information, UTMC fully reserves its rights to assert all appropriate objections, including those related to the attorney-client privilege and attorney-work-product protection, in response to future requests. UTMC also objects to the definition of "Utility" as vastly overbroad in its attempt to encompass individuals no longer affiliated with UTMC, as well as all entities that may be considered as agents, contractors, consultants, attorneys, and law firms, and their respective employees.

Respectfully submitted,

Utility Trailer Manufacturing Company

`

cc: Nate Seymour – nate.seymour@dot.gov
ODI_IResponse@dot.gov

Attachments to Utility Trailer Manufacturing Company's Response to ODI Information Requests – DP21-004

Table of Contents

Exhibit A

"Testing and Evaluation of AirFlow Deflector's AngelWing™ Side Underride Impact Guard," (UTMC, July 2019)

TESTING AND EVALUATION OF AIRFLOW DEFLECTOR'S ANGELWING™ SIDE- IMPACT GUARD – JULY 2019

Executive Summary

UTMC performed 25 tests over roughly 10 months on its refrigerated and dry-freight trailer models fitted with the AngelWing™ side-underride-impact guard ["**AW**"]manufactured by AirFlow Deflector ["**AirFlow**"]. Those tests cumulatively demonstrate that AW's current design raises sufficient safety and operational concerns that it is not suitable for mounting on UTMC's trailers for the following reasons:

- Because the AW design severely restricts the suspension travel of UTMC's standard refrigerated and dry-van trailers, operating trailers with the AW attached could be illegal in states such as California and Georgia.
- The AW restricts the trailer's minimum ground clearance to unreasonable levels, prohibiting it from traversing changes in grade that UTMC's trailers easily and routinely handle. This restriction can cause violations of federal and state traffic codes.
- Contact between the AW and the ground when the trailer is loaded in normal operation will likely significantly compromise the structural integrity of the trailer as well as the AW.
- When an AW is attached to UTMC's refrigerated and dry-van trailers, the AW mounting brackets fatigued and cracked well before the forklift floor-rating test completed.
- The AW's bumper strength is only a fraction of the strength that UTMC requires of its rear guards.

- The tests of the AW performed by the Insurance Institute for Highway Safety ["**IIHS**"] and others are inadequate for approving the use of the AW; these tests use lesser loads than the IIHS uses for its rear-guard tests and do not test for offset impacts.

After completing its tests on the AW, UTMC has significant concerns about the overall safety of equipping all trailers with AW guards. The AW presents an unacceptable risk of damaging the trailer and guard in normal operations with the possibility of harming the motoring public who may be struck by parts detaching from a moving trailer, or may be in the vicinity of a trailer that fails catastrophically if an operator continues to operate a trailer in a damaged condition. These risks are in addition to the often-noted danger of a semi trailer with low ground clearance becoming stuck on railroad tracks and being struck by an on-coming train, which already occurs from time to time.[1]

These risks all result from an intrinsic element of the AW design: it intrudes into areas of the trailer that experience shows often contact the ground, bollards, or other obstructions. These may occur in loading docks, at steep driveways, at unexpected grade transitions, at railroad crossings, at fire hydrants, and around equipment protected by bollards such as standpipes, corners, and the like. Depending on the nature of the collision between the guard and these items, the guard's rigid structure transmits the force into the trailer, which, either as a result of that single impact or cumulatively, will weaken, bend, or break. If that damage does not itself result in catastrophic loss of the trailer at that time, it likely will weaken the trailer's structural components such that an unexpected catastrophic failure is possible.

UTMC also has reservations as to whether the trailer with an AW will perform as well over-the-highway as documented in the IIHS tests, since the AW side-underride crash test did not use the same weighting and loading criteria that the IIHS has used for all of its rear-impact tests. Additionally, there is no information from the IIHS concerning how the guard would

[1] See, for example, the "California Commercial Driver's Handbook" (sections 2.7.5 and 2.15.5), the "Georgia Commercial Driver's Handbook" (sections 2.15.5 and 2.15.6.), and 49 C.F.R. §392.12. All three examples state that a driver of a commercial motor vehicle shall not drive onto a highway rail-grade crossing without having sufficient space to drive completely through the crossing without stopping. Both State handbooks refer specifically to trailers with low ground clearance and warn against rail crossings with steep approaches.

perform in either a 50%- or 30%-offset scenario, another criteria the IIHS has said is important in determining the performance of rear guards. UTMC's limited tests suggest the AW's performance in the 50%- or 30%-offset scenario is substantially weaker than current rear guards in those scenarios.

Finally, UTMC has significant concerns concerning the ability of AirFlow or the AW inventor – Perry Ponder – to stand behind the AW product. UTMC typically requires its suppliers to test their product extensively before marketing it; to UTMC's knowledge, AirFlow has not performed any of the tests performed by UTMC, and UTMC is unaware of tests showing the AW's performance in the real world. Nor has Airflow demonstrated any financial ability to back the product or to respond to claims that likely would result if someone were injured as a result of the AW's installation or failure on a trailer.

Although these safety and operational issues lead UTMC to conclude that the AW is not a suitable product ready for market at this time, UTMC is ready to continue discussions with AirFlow and to consider modifications to the AW – or other side-guard designs – that address the significant risk that incorporating the AW on many trailers will endanger the motoring public.

Background

In March 2016, the Truck Trailer Manufacturers Association ["**TTMA**"] submitted a comment to the National Highway Traffic Safety Administration Docket on "Rear Impact Guards / Rear Impact Protection"[2] that concluded, with respect to the possibility of implementing side-impact guards on trailers, that "TTMA would support the implementation of side-impact guards if they ever become justified and technologically feasible." UTMC agreed with that assessment when TTMA submitted it. It still does.

Roughly a year later, the IIHS tested a potential side-underride-impact guard developed by Perry Ponder and manufactured by AirFlow Deflector – the AW – by crashing a 2010 Chevrolet Malibu travelling 35 mph into the AW mounted on a 53-foot Vanguard trailer at a 90-degree angle. According

[2] Docket No. NHTSA-2015-0118. In the July 10, 2014 notice announcing it was initiating rulemaking with respect to rear-impact guards, NHTSA also stated that the Petitioners had requested that NHTSA begin studies and rulemaking for side guards. In the 2014 notice, NHTSA noted that it was "still evaluating the Petitioners' request to improve side guards … and will issue a separate decision on those aspects of the petitions at a later date." (79 FR 15 39363.) TTMA submitted its comment in response to this statement. Since 2014, NHTSA has not issued any decision on side-impact guards.

to the IIHS, the AW prevented Malibu passenger-compartment intrusion and avoided significant injury to the crash-test dummy. In August 2017, the IIHS crashed a 2009 Malibu into the same trailer at 40 mph. According to the IIHS, the crash-test dummy again avoided significant injury.

When UTMC learned in the spring of 2017 of the IIHS's AW test, UTMC, consistent with the TTMA comment, decided to evaluate whether the AW was "technologically feasible" such that UTMC could offer it to its customers with the assurance that it was safe, did not risk damaging the trailer, and was backed by an organization with sufficient engineering and financial resources to stand behind the device. UTMC's extensive testing and evaluation of the AW demonstrates that the AW fails in each of these criteria.

UTMC's acquisition of AW for evaluation

UTMC contacted AirFlow, manufacturer of AW, to inquire about the device. After discussions with AirFlow's President and its Engineering Director to obtain information about the device, cost, availability, method of attachment, and similar issues, UTMC agreed to purchase two sets of AW for evaluation and testing – one each for UTMC's refrigerated trailer and dry-freight trailer.[3] UTMC provided information about each trailer model's measurements, the location and material used in the cross-members on which the AW would be mounted, and other information needed to make sure that the AW when delivered would fit the UTMC trailers.

AirFlow delivered the two sets of AW in January 2018. AirFlow did not supply any test or performance information, other than that associated with the IIHS tests, and it did not provide any information concerning the AW's warranty or the liability insurance maintained by AirFlow and its inventor, Perry Ponder, to back its device. This is information that UTMC traditionally requires of all its suppliers, but it went ahead with the acquisition without this information and assurance because UTMC was interested in determining the product's suitability for real-world applications.

When delivered, one AW mounting bracket for the dry-freight trailer was damaged, and the shipment was missing the "all-weather barrier water-proofing membrane" required to separate the aluminum from steel

[3] UTMC did not purchase an AW for UTMC's flat-bed trailers, as the engineering and geometry of the AW at that time is not workable with UTMC's flatbed. AirFlow Deflector's website claims that it now has an AW available for most flatbed models. UTMC has not yet evaluated the accuracy of that statement.

components to avoid corrosion. The damage consisted of a slightly bent horizontal member on the AW for the dry-freight trailer; a mounting bracket on the right side rear vertical of the AW for the dry-freight trailer was damaged; and a number of the pre-drilled holes did not line up. UTMC repaired the damaged AW by straightening the bent portion and welding the existing crack and installed the AW on the trailers following AW's installation instructions. UTMC supplied dissimilar-metal barrier tape to separate the steel from the aluminum components.

Potential safety concerns / DOT violations in prescribed installation

UTMC was not able to install the AW on UTMC's base-model trailers in a way that would avoid Department of Transportation safety violations. Without an AW mounted on a trailer, the electrical and air hoses articulate and reside in the space forward of the suspension. But with the suspension forward of the roughly middle position, the electrical and air hoses enter the same space occupied by the AW's diagonal members. As a result, the cable and hoses rub against the diagonal, presenting a serious safety issue and a violation of DOT regulations. Additionally, California requires that the suspension be positioned with a maximum 40-foot distance between kingpin and rearmost-axle centerline. [4] Because of the AW's design, it is not possible to position the suspension as required by California regulations without the air hoses touching the AW cross braces. For the air hoses to clear the AW entirely, the suspension must be located approximately 45' from the kingpin to the center of the rear axle (or approximately 43' to the center of the rear tandem), which is within 18" of its most rearward position. This is not legal

[4] Cal.Veh.Code § 35400(b) (4); if the trailer is a single axle trailer, the maximum distance is 38 feet. At least 18 other states have similar restrictions that would prohibit operation of the AW equipped trailer on some or all of its roads, according to *Vehicle Sizes and Weights Handbook*, J.J. Keller & Associates, Inc. (2018 ed.): Connecticut (43' to center of rear axle); Florida (41' to center of rear axle or rear group of axles); Illinois (42.5' to center of rear axle); Indiana (43' to rearmost axle); Maine (43' to center of rear axle); Maryland (41' to center of rear tandem axles); Michigan (37.5' to center of rear axle; 40.5' to center of rear axle assembly); New Hampshire (41' to center of rear axle or midpoint of rear tandem); New Jersey (41' to center of rear axle or rear axle group); New York (43' to center of rear axle); North Carolina (41' to rear axle or midpoint of rear tandem); Pennsylvania (41' to center of rear axle or rear axle group); Rhode Island (41' to center of rear axle); South Carolina (41' to center of rear axle assembly or tandem axle assembly); Tennessee (41' to center of rear axle or midpoint of rear tandem); Vermont (41' to center of rear axle); Virginia (41' to rear axle or midpoint of rear tandem); West Virginia (37' from rear axle of truck-tractor to front axle of semi-trailer).

in all states. UTMC believes that its customers will view this to be an unacceptable restriction.

Additionally, UTMC builds its trailers with a protrusion – commonly referred to as stinger – from the front of the suspension to hold the air hoses and electrical cable and prevent them from rubbing. When the suspension was moved forward, the stinger would hit the diagonal, preventing the trailer's suspension from being moved to the most forward position. Although this is not a safety violation, the inability to move the suspension into the most forward position likely would be a significant detriment to those operating the trailers in city environments, and it might affect the operator's ability to comply with bridge laws or weight-distribution limitations, and increases the trailer's turning radius, making it less maneuverable.

Since UTMC was not planning to operate the trailers on any public highway as part of the testing regimen, UTMC ignored the safety violation for purposes of the test, mounted the AW on the trailer as directed by AirFlow, and never put the suspension in the most forward position because the diagonals prevented the stinger from sliding all the way forward.

<u>Tests performed</u>

Over a ten-month period, UTMC performed the following tests at its Research and Development facility on its trailer(s) involving the AW, all described below in more detail with associated results:

1. Ramp-clearance test – trailer unloaded (9 tests conducted between April 25 – September 7, 2018)
2. Ramp clearance test – trailer loaded (3 tests conducted on December 12, 2018)
3. Static clearance impact simulation (test conducted August 23, 2018)
4. Track test (2 tests conducted between June 13 – October 4, 2018)
5. In-trailer forklift floor test (2 tests conducted between May 1 – November 26, 2018)
6. Bumper-strength test
    a. Bumper-strength test – center (test conducted January 8, 2019)
    b. Bumper-strength test – rear (2 tests conducted between May 11 – December 20, 2018)
    c. Bumper-strength test – front (test conducted May 17-18, 2018)

d. Bumper-strength test – longitudinal (test conducted February 27, 2019)

7. Pull-down test (2 tests conducted on October 31, 2018, and March 7, 2019)
8. Fatigue test (test conducted between March 8-14, 2019)
9. Hoses and slider gear evaluation

Overall results

The AW performed *unsatisfactorily* on 7 of 10 tests performed on the refrigerated trailer. The AW performed *unsatisfactorily* on 12 of the 14 tests performed on the dry-freight trailer – including instances in which the presence of the AW damaged the trailer or the AW in the tests, or caused the trailer to come to a halt when it traversed a change in grade, with the likelihood that damage would occur if the trailer were forced over that terrain. Based on these results, UTMC has serious concerns that the AW, when exposed to real-world conditions, presents unacceptable risks of damaging the trailer with attendant safety risks to the motoring public resulting from trailer parts becoming detached during trailer operation or partial or catastrophic failure of the trailer during operation.

Specific Test Description and Results

1. Ramp clearance test – trailer unloaded

UTMC tested the AW using the same criteria it uses to test its aerodynamic side skirt. UTMC designs aerodynamic side skirts for and installs them on its trailers after it successfully demonstrates that the skirt – which typically are approximately 14" above the ground (with variance depending on trailer model and position along the skirt) – will survive with minimal damage when the trailer's bottom rail comes within 24" of the ground as the trailer traverses a change-in-grade such as that encountered in a loading ramp.

UTMC first performed this test on an asphalt ramp and adjusted the trailer so that the trailer's bottom rail would come within 24" of the asphalt in a change-of-grade situation. On the dry-freight trailer, the AW horizontal (at the 4th AW vertical) hit the ground approximately 2' before the ramp's apex. This occurred before the bottom rail came within 24" of the ground, and the trailer's rearward movement was stopped at that time. Because it appeared that, had the test continued, either the AW or the trailer would be damaged, or the trailer would hang up, UTMC stopped the test.

Because of differences in height and configuration between the dry-freight and refrigerated trailers, and the equipment available at the time of the test, the bottom rail of the refrigerated trailer never came within 24" of the ground during the tests on the asphalt grade. As the trailer traversed the ramp, the closest the bottom rail came to the ground was 25". At that point, the AW contacted the ground from the 7th vertical to the 4th vertical as the trailer passed over the ramp apex.

In approximately July 2018, UTMC constructed a concrete ramp that permitted it to perform the ground-clearance skirt and AW tests without trailer modifications. The ramp was constructed so that the bottom rail of UTMC's base-model trailer could come within 24" of the ground when the trailer traversed the grade, depending upon the location of the trailer's sliding suspension. UTMC performed a total of 7 tests of an unloaded dry-freight trailer with the following results – 5 with the trailer attached to a yard-goat, and 2 with the trailer attached to day-cab tractor.

Yard-goat tests: With the slider-tandem's center positioned 135" from the rear of the trailer (such that the bottom rail would come within 24" of the ground), UTMC first reversed the trailer down the ramp. The AW horizontal struck the ramp's apex at approximately the AW's 5th vertical, resulting in the trailer's becoming stuck. UTMC needed to raise the front of the trailer to remove it from the ramp. UTMC then moved the trailer up the ramp, and the AW horizontal hit the ground just forward of the AW's 3rd vertical, causing the trailer to become stuck on the ramp apex between the 3rd and 4th verticals. UTMC again raised the front of the trailer to remove it from the ramp. Next, UTMC moved the trailer up the ramp, attempting to maintain tractor/trailer speed/momentum as the trailer traversed the change in grade. The AW horizontal again hit the ground just forward of the AW's 3rd vertical, causing the trailer to become stuck on the ramp apex between the 3rd and 4th verticals. UTMC needed to raise the front of the trailer to remove it from the ramp.

UTMC then positioned the slider-tandem's center in its most rearmost position. As the trailer reversed down the ramp, the rear of the AW's horizontal at the 7th AW vertical contacted the ground approximately 1' before the ramp apex and the trailer ground to a stop. UTMC was able to drag the trailer free of the ramp without raising the front of the trailer. UTMC then moved the trailer up the ramp. The AW horizontal hit the ground at approximately the 3rd AW vertical, and the trailer became stuck on the ramp apex at the 4th AW vertical. UTMC needed to raise the front of the trailer to remove it from the ramp.

Day-cab-tractor tests: With the slider-tandem's center positioned 135" from the rear of the trailer (such that the bottom rail would come within 24" of the ground), UTMC moved the trailer up the ramp. The AW horizontal hit the ramp apex at approximately the 3rd AW vertical, and the trailer became stuck on the ramp apex just rear of the 4th AW vertical. UTMC used a forklift to raise the trailer so it could be moved off the ramp apex.

UTMC then positioned the slider-tandem's center in its most rearmost position. As the trailer moved forward up the ramp, the AW horizontal hit the ramp apex just rear of the 3rd AW vertical, and the trailer became stuck on the ramp just forward of the 4th AW vertical. Reversing the day-cab tractor allowed the trailer to be dragged off the ramp apex.

2. Ramp clearance test – trailer loaded

UTMC performed this test at its specially designed ramp that allows both dry-freight and refrigerated trailers to change grade so that the bottom rail reaches the desired measurement of minimum ground clearance. UTMC's aerodynamic side skirt is tested so that the trailer's bottom rail comes within 24" of the ground, the side skirt must successfully complete that test before UTMC offers its guard for sale.

For both the refrigerated and dry-freight trailers, UTMC set the suspension at a location that would permit the trailer's bottom rail to reach within 24" of the ground as the trailer traversed the change in grade. The tractor was located at the horizontal surface at the top of the ramp with the tractor's rear tires at the edge of the ramp, and the rear-suspension of the trailer was on the ramp incline. The tractor/trailer brakes were released, and gravity pulled the trailer/tractor down the ramp. The trailer's speed as it travelled down the ramp was less than 4 miles per hour.

For the refrigerated trailer, UTMC loaded the trailer to 58,971 GVW and the suspension was placed 125" from the rear to the slider tandem's center; this resulted in the bottom rail coming within 24" of the ramp's apex as the trailer traversed the ramp. As the trailer traversed the change in grade, the AW horizontal contacted the ground just forward of the 7th AW vertical and made continuous contact with the ramp apex until after the 2nd AW vertical cleared the apex. As a result, the AW horizontal on both sides of the trailer was severely deformed. Additionally, 6 of the 7 trailer cross-members that are attached to the AW vertical supports were severely damaged, and the middle cross members that attach to the verticals were

almost completely crushed. The damage to the cross members severely compromised the trailer's structural integrity.

For the dry-freight trailer, UTMC loaded the trailer to 58,983 GVW. UTMC first ran the test with the suspension 135" from the rear to the slider tandem's center line such that the bottom rail would come within 24" of the ground. Although the AW grounded at the apex of the ramp, the trailer's side-wall flexed sufficiently to permit the trailer to traverse the peak. But cracks in the mounting brackets appeared, and existing cracks grew longer. Contact with the ramp apex gouged the AW horizontal member. UTMC then re-ran the test with the suspension moved all the way to the rear of the trailer. (This would cause the bottom rail to come within approximately 17" of the ground.) The AW horizontal grounded at the 7th AW vertical, contacting the ground approximately 1' before the ramp apex, and the trailer became stuck on the ramp apex at the 5th AW vertical. As a result of this contact, damage occurred to the trailer's bottom rails; the trailer's side-wall panels buckled approximately 3"; the AW horizontal deformed; and the AW mounting brackets that connect the AW to the trailer's cross members developed additional cracks. The damage compromised the integrity of the trailer. To remove the trailer from the ramp apex, UTMC blocked the trailer wheels, extended the landing-gear legs, removed the day-cab tractor, and a yard goat with an adjustable-height 5th wheel was used to lift the tractor.

This ramp-clearance test demonstrates that when an AW guard on either a loaded refrigerated or dry van trailer contacts the ground, the AW attachments and the trailer's structural integrity are critically impaired because the AW and its supporting structure are rigid. UTMC notes that non-rigid items – such as mud-flaps, tire-spray suppressors, and flexible aerodynamic devices – may themselves contact the ground when the trailer traverses changes in grade. To avoid damaging the structural integrity of the trailer, these non-rigid items must be sufficiently flexible to be able to contact the ground without damaging or becoming detached from the trailer. Although UTMC's aerodynamic side skirt meets this standard, the AW does not.

3. Static clearance impact simulation

The purpose of this test is to measure the amount of upward force the AW could absorb before damaging either it or the trailer. UTMC loaded the refrigerated trailer to 67,001 lbs GVW, and placed an I-beam under and perpendicular to the road-side AW at the third AW vertical from the front. A load cell placed under the I-beam measured the load. The trailer's legs then

were retracted so that the weight of the trailer was transmitted through the AW to the I-beam. At 22,600 lbs load, the AW deflected 0.5625"; the bottom rail deformed; and the load crushed the cross member above the vertical at the rivet and AW mounting-bracket attachment, compromising the trailer's structural integrity.

4. Track test

UTMC performed a standard track test on both the refrigerated and dry-freight trailers. This test consisted of loading each trailer to a calculated weight of 67,001 lbs GVW and completing 1,100 laps around UTMC's specially designed test track for the refrigerated trailer, followed by 500 laps with the trailer unloaded except for approximately 10,000 lbs over the truck's tandem wheels to control bounce. For the dry-freight trailer, the test consisted of 900 laps around the test track. The AW did not suffer any noticeable damage, nor did the AW cause any noticeable damage to either trailer as a result of the track test. UTMC viewed this result as acceptable for both the refrigerated and dry-freight trailers.

5. In-trailer forklift floor test

UTMC performed its standard in-trailer floor test on both the refrigerated and dry-freight trailers. This test consists of driving a forklift with the front-axle loaded at the trailer floor's maximum rated load in and out of the trailer for a minimum of 10,000 full-length cycles. Following the completion of a minimum of 10,000 full-length cycles, UTMC repeats the test with a 25% front-axle overload for 100 cycles.

The refrigerated trailer tested by UTMC had an older duct-floor design with a 16,000 lbs. rating. Accordingly, UTMC used a forklift with a 16,000 lbs. front-axle load for the test, and a 20,000 lbs. front-axle load for the overload portion of test. For the dry-freight trailer, the floor rating was 20,000 lbs. UTMC used a forklift with a 20,000 lbs. front-axle load for the test, and a 25,000 lbs. front-axle load for the overload portion of the test. UTMC performed all floor tests with the suspension in the rear position because the AW diagonal members interfered with the suspension's stinger and prevented the suspension from moving to its forward position.

Multiple AW brackets that attach the verticals to the trailer cross-members on both the refrigerated and dry-freight trailers developed cracks before completing the floor testing.

Specifically, at 9,400 cycles of the forklift in the refrigerated trailer, on the roadside, all the rear mounting brackets at verticals 4, 5, and 6 cracked. On the curb-side, the front mounting bracket at verticals 1 and 5 cracked. All cracks occurred in the in-board top radius. Additionally, some floor screws broke. Although the tested trailer had a floor rating of 16,000 lbs., UTMC's current duct-floor ratings for its refrigerated trailer are 20,000 lbs. (base model) and 24,000 lbs. (optional). Had UTMC attached the AW to its current refrigerated trailer design with the higher duct-floor rating, UTMC expects that the failures would have occurred significantly sooner since the higher-rated duct-floors have greater cross-member vertical deflection.

At approximately 6,385 cycles of the forklift in the dry-freight trailer (out of the scheduled 10,000), cracks in several AW-mounting brackets developed. These occurred at the lower radii on the roadside of the trailer at the 1st, 5th, and 7th verticals; on the trailer's curbside, the cracks occurred at the 1st and 2nd verticals. After 9,100 cycles, additional cracks appeared on the inboard top radius of both curbside and roadside mounting brackets. Additionally, a number of cross-members located at the forward end of the suspension's slider travel broke at approximately 10,100 cycles. UTMC views these cracks as unacceptable as they pose due to risks of structural failure and detachment of the guard.

6. Bumper-strength tests

Although the IIHS's AW test demonstrated that the AW would stop a 2010/2009 Chevrolet Malibu at 35 mph and 40 mph without passenger-compartment intrusion, the tests used by the IIHS departed significantly from the impact tests the IIHS used to test the strength of rear bumpers. For the rear impact tests, the IIHS loaded each trailer so that the GVW was 25,084 kg (55,301 lbs) distributed evenly throughout the trailer. For the side-impact tests, however, the IIHS put only 6 cement blocks with a 10,200 kg (22,487 lbs) mass in the rear of the trailer so that the weight was concentrated over the rear wheels. The tractor did not experience this payload. The mass of the loaded trailer was 16,584 kg (36,562 lbs), or only 56% of the trailer's 65,000 GVWR.

Because the impact load of the Malibu when it struck the side of the trailer is directly proportional to the mass of the trailer, the impact load was only 56% of the worst-case impact load and 66% of the impact load of the tests IIHS conducted on the rear bumper. As a result, for the AW side-impact test (a) the loading of the trailer was less likely to be consistent with what would be encountered in over-the-highway situations, (b) the trailer's lateral

movement, as opposed to the side guard, would absorb more energy than would be the case in the IIHS's traditional rear-impact tests, and (c) it was not possible to directly compare the results of an IIHS 35 mph rear-impact test with an IIHS 35 mph side-impact test. Finally, although the IIHS tested the rear guards at 50% overlap and 30% overlap, it did not perform any such tests on the side guard, resulting in no information on the subject.

UTMC was interested in determining how the side guard would perform in resisting loads relative to its rear-guard's performance. It therefore performed dynamic and static tests on the side guard similar to those it performs when testing its rear guards for strength and compliance with federal regulations. Specifically, UTMC tested the side guard's strength in the center (similar to the IIHS 100% overlap test), at the rear edge of the guard (similar to an IIHS 30% overlap test); and when pulled longitudinally toward the front of the trailer.

For comparison purposes, UTMC's static tests on its bumper designed to comply with United States and Canadian regulations are performed as follows: In a series of tests, UTMC applies force at required locations on the rear horizontal, measuring the force alone or force and energy as the horizontal deflects forward. United States regulations require that the bumper withstand a static load of 11,240 lbs at an outboard location and also at the center location ("P1" and "P2"). Also, the bumper at the vertical ("P3") must withstand, in a dynamic test, a load of 22,481 lbs as the bumper moves from 0" to 5" of deflection, with a permanent energy of 4,167 ft-lb. The Canadian regulations are identical to the United States regulations for force at locations P1 and P2; Canada's dynamic test applies force across the entire width of the bumper. Within 5" of deflection, the bumper must withstand 78,683 lbs of force with permanent energy of 14,751 ft-lbs.

a. <u>Bumper strength test – center</u>

The test on the refrigerated trailer, which involved 2 runs, significantly compromised the trailer, resulting in bending and cracking the bottom rail, breaking a cross-member, and deforming and collapsing an AW cross-brace at the 4th AW vertical from the front. During the first run, which deflected the guard from 0" to 5", the maximum load was 32,350 lb. The maximum energy was 7,304 ft-lb, and permanent energy was 4,409 ft-lb. At that point, the trailer's bottom rails sustained some damage. During the second run, which deflected the guard from 5" to 10", the maximum load was 34,655 lbs. The maximum energy was 11,797 ft-lb, and the permanent energy was 9,232 ft-lb. The total combined energy for both runs, 0" to 10" of deflection, was 19,101 ft-

lb, and the permanent energy was 16,536 ft-lb. For reference, 19,101 ft-lb equates to a 3,800 lb car travelling at 12.27 mph.

b. Bumper-strength test – rear

UTMC applied lateral force to the bottom rear of the AW on the refrigerated trailer. The test on the refrigerated trailer compromised the trailer at approximately 3.866" of travel, resulting in breaking a cross-member at the mounting-bracket location directly above the spot on the AW where force was applied. The mounting bracket ripped out the attachment's bolt hole and tore along the top flange. At that point, the maximum load was 20,408 lbs; the maximum energy was 4,914 ft-lb; the permanent energy was 3,809 ft-lb. For reference, 4,914 ft-lb equates to a 3,800 lb car travelling at 6.2 mph.

For the dry-freight trailer, applying 23,020 lbs of load resulted in approximately 3.488" of deflection. When the load was increased to 24,000 lbs, the rearmost diagonal AW mounting bracket, directly in line with the pull, broke at a previous repair.

c. Bumper-strength test – front

For the test on the dry-freight trailer, UTMC moved the bumper-strength test to the front curbside of the trailer to avoid areas that had already had sustained damage. This test, which involved 2 runs, significantly compromised the trailer, resulting in bending and distorting of the AW mounting bracket and vertical, welds cracking, deforming the bottom rail, and having the AW cross-brace on the opposite side break free from the AW vertical and mounting bracket. The trailer's structural integrity first was compromised during the first run when a maximum static load of 27,000 lbs was applied, as the trailer sustained damage when the curbside diagonal AW mounting bracket weld broke and detached from the diagonal; the roadside diagonal bracket deformed; both the curbside and roadside AW mounting brackets shifted; and the curbside AW horizontal deformed. At that point, the maximum energy was calculated to be 6,960 ft-lb; the permanent energy was calculated to be 4,930 ft-lb.

In the second run, a maximum static load of 33,050 lbs was applied. The AW diagonal cross brace broke off completely from its welded mounting bracket; the AW verticals and horizontal also were deformed. The trailer's bottom rail deformed at the AW vertical in line with the pull point. The holes drilled through the steel cross-members deformed at the AW mounting

bracket. The maximum energy was calculated to be 13,503 ft-lb and permanent energy was calculated to be 9,192 ft-lb.

d. Bumper-strength test – longitudinal

Because not all impacts occur perpendicular to the side-guard, UTMC tested the resistance of the guard to longitudinal forces by applying force to the 1st AW vertical and pulled towards the front of the refrigerated trailer. The test was designed to test the guard's performance from 0" – 10" of displacement. The test compromised the trailer at approximately 6.25" of travel, as all 7 cross-members broke at the AW mounting bracket and all 7 verticals of the AW deformed. At that time, the maximum load was 26,073 lbs; the maximum energy was 13,670 ft-lb; the permanent energy was 12,318 ft-lb. Following approximately 6.25" of travel, the maximum load dropped by approximately 50% to approximately 13,500 lb.

None of these bumper-test results on the AW demonstrated energy levels near those that UTMC's rear bumpers can achieve. (UTMC has tested its rear bumper at P3 (at one vertical) to 40" displacement with 119,622 ft-lb plastic energy.)

7. Pull-down test

The static pull-down test consists of connecting hydraulic cylinders to rods that pass up through and are mounted to the trailer floor. For the refrigerated trailer, the cylinders are pulled directly down to simulate over-the-road 5.5g loads (approximately 274,250 lbs of water-level load simulation). Although the trailer's side walls and roof had permanent creases as a result of the test, the AW structure was not damaged. For the dry-freight trailer, 2.5g loads were applied. All strain readings were low.

8. Fatigue Test

The dynamic fatigue test consists of connecting hydraulic cylinders to rods that pass up through and are mounted to the trailer floor; this is the same set up as is used for the pull-down test. The cylinders are cycled from 1 – 3gs (approximately a 100,000 lb. load spread).

At approximately 15,000 cycles, the cross-member that the 1st AW vertical attaches to broke free from the floor on the road side of the trailer. At approximately 48,000 cycles, aluminum cross members attached to AW verticals 2-5 broke free from the trailer on the road side. All 5 cross members had been damaged from an earlier test. At the same time, skin cracks

developed, and additional skin cracks developed at approximately 69,000 cycles, though the skin had been damaged from an earlier test. The test was stopped at 134,216 cycles.

Supplier Resources

AirFlow is a relatively new company, and it is unclear whether it has the capital structure and resources to stand behind its product in case of failure and resulting injury.

Although AirFlow had the AW crash tested by the IIHS, to UTMC's knowledge AirFlow has not conducted extensive, real-world testing of the AW to determine how it will react with the trailer in day-to-day operating environments, what damage it will cause to the trailer, and what danger its use on thousands of trailers would pose to the motoring public. AirFlow has stated that in the five years since AW's inventor, Perry Ponder, first advertised the AW for sale, the AW has been mounted on fewer than 10 trailers in actual use.

AirFlow has not provided UTMC with information to establish that it has the financial resources to stand behind its product should it fail and cause injury to the motoring public and damage to the trailers on which the device is mounted. The inventor of the AW, Perry Ponder, has stated that he would stand behind the AW. But Mr. Ponder, an individual, does not appear to have sufficient resources to back this commitment. He has stated that he does not have liability insurance to protect against claims arising from the device.

Exhibit B

United States Government Accountability Office, Report to Congressional Requesters, *TRUCK UNDERRIDE GUARDS – Improved Data Collection, Inspections, and Research Needed* (March 2019 – GAO-19-264)

United States Government Accountability Office
Report to Congressional Requesters

March 2019

TRUCK UNDERRIDE GUARDS

Improved Data Collection, Inspections, and Research Needed

March 2019

TRUCK UNDERRIDE GUARDS

Improved Data Collection, Inspections, and Research Needed

GAO Highlights

Highlights of GAO-19-264, a report to congressional requesters

Why GAO Did This Study

Truck underride crashes are collisions in which a car slides under the body of a truck—such as a tractor-trailer or single-unit truck—due to the height difference between the vehicles. During these crashes, the trailer or truck may intrude into the passenger compartment, leading to severe injuries or fatalities. Current federal regulations require trailers to have rear guards that can withstand the force of a crash, whereas the rear guards required for single-unit trucks do not have to be designed to withstand a crash. There are no federal side or front underride guard requirements.

GAO was asked to review data on truck underride crashes and information on underride guards. This report examines (1) the data DOT reports on underride crashes and (2) the development and use of underride guard technologies in the U.S. GAO analyzed DOT's underride crash data for 2008 through 2017; reviewed NHTSA's proposed regulations and research on new guard technologies; and interviewed stakeholders, including DOT officials, industry and safety groups, and state officials selected based on reported underride crash fatalities and other factors.

What GAO Recommends

GAO recommends that DOT take steps to provide a standardized definition of underride crashes and data fields, share information with police departments on identifying underride crashes, establish annual inspection requirements for rear guards, and conduct additional research on side underride guards. DOT concurred with GAO's recommendations.

View GAO-19-264. For more information, contact Susan Fleming at (202) 512-2834 or FlemingS@gao.gov.

What GAO Found

According to crash data collected by police and reported by the Department of Transportation's (DOT) National Highway Traffic Safety Administration (NHTSA), fatalities from "underride" crashes, such as those pictured below, represent a small percentage of all traffic fatalities.

Crash Tests of Rear Guards with (left) and without (right) Passenger Compartment Intrusion

Source: GAO and Insurance Institute for Highway Safety. | GAO-19-264

From 2008 through 2017, an average of about 219 fatalities from underride crashes involving large trucks were reported annually, representing less than 1 percent of total traffic fatalities over that time frame. However, these fatalities are likely underreported due to variability in state and local data collection. For example, police officers responding to a crash do not use a standard definition of an underride crash and states' crash report forms vary, with some not including a field for collecting underride data. Further, police officers receive limited information on how to identify and record underride crashes. As a result, NHTSA may not have accurate data to support efforts to reduce traffic fatalities.

Underride guards are in varying stages of development, and gaps exist in inspection of rear guards in current use and in research efforts for side guards.

- NHTSA has proposed strengthening *rear guard* requirements for trailers (the rear unit of a tractor-trailer) and estimates about 95 percent of all newly manufactured trailers already meet the stronger requirements. Although tractor-trailers are inspected, Federal Motor Carrier Safety Administration annual inspection regulations do not require the rear guard to be inspected, so damaged guards that could fail in a crash may be on the roadways.
- *Side underride guards* are being developed, but stakeholders GAO interviewed identified challenges to their use, such as the stress on trailer frames due to the additional weight. NHTSA has not determined the effectiveness and cost of these guards, but manufacturers told GAO they are unlikely to move forward with development without such research.
- Based on a 2009 crash investigation, the National Transportation Safety Board (NTSB) recommended that NHTSA require *front guards* on tractors. NHTSA officials stated that the agency plans to complete research to respond to this recommendation in 2019. However, stakeholders generally stated that the bumper and lower frame of tractors typically used in the U.S. may mitigate the need for front guards for underride purposes.
- Regarding *single-unit trucks*, such as dump trucks, NTSB has recommended that NHTSA develop standards for underride guards for these trucks, but the agency has concluded these standards would not be cost-effective.

Contents

Abbreviations

ANPRM	advance notice of proposed rulemaking
CVSA	Commercial Vehicle Safety Alliance
DOT	Department of Transportation
FARS	Fatality Analysis Reporting System
FMCSA	Federal Motor Carrier Safety Administration
IIHS	Insurance Institute for Highway Safety
MMUCC	Model Minimum Uniform Crash Criteria
NHTSA	National Highway Traffic Safety Administration
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board

U.S. GOVERNMENT ACCOUNTABILITY OFFICE

March 14, 2019

The Honorable Roger Wicker
Chairman
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Richard Burr
United States Senate

The Honorable Kirsten Gillibrand
United States Senate

The Honorable Marco Rubio
United States Senate

The Honorable John Thune
United States Senate

An “underride” crash occurs when a passenger vehicle slides under the body of a tractor-trailer or “single-unit truck,” such as a delivery or dump truck.[1] Due to the height difference between the vehicles, the car’s safety features are bypassed because the point of impact is not the front bumper of the car. Without these safety features to absorb the force of the collision, the passenger compartment can be crushed when it contacts the truck, potentially resulting in death or severe head and neck injuries for the occupants. To help prevent or mitigate these crashes, federal regulations require that the rear end of the trailer have a guard meeting specific crashworthiness standards. With these guards in place, the front of the car will impact the guard instead of sliding under the trailer and the car’s safety features will engage to offer some protection to the car’s occupants. Rear guards of specific dimensions are also required for single-unit trucks, but these guards are not required to be able to withstand the force of a crash. There are no federal requirements for side or front underride guards on any type of large truck in the United States.

[1]A tractor-trailer consists of a front unit, called a tractor, and a rear unit, called a trailer. Single-unit truck types are differentiated by their weight and number of axles, and not on their height from the ground.

However, legislation aimed at, among other things, requiring the use of side and front underride guards on all large trucks was introduced in the House of Representatives and the Senate in December 2017.[2] New legislation regarding underride crashes was introduced in March 2019.[3]

You asked us to review data on truck underride crashes and information related to rear, side, and front underride guards in the United States. This report examines: (1) the data the Department of Transportation (DOT) reports on truck underride crashes and (2) the development and use of truck underride guard technologies in the United States.

To address both objectives, we conducted a literature review to identify studies regarding truck safety, in general, and underride guards, in particular; we reviewed these studies and other documentation collected from interviewees, as described below. We also interviewed a variety of stakeholders familiar with topics related to underride crashes and guards, including: officials from DOT's National Highway Traffic Safety Administration (NHTSA), as well as NHTSA's data validation and training contractor; the Federal Motor Carrier Safety Administration (FMCSA); the National Transportation Safety Board (NTSB) and representatives from the Insurance Institute for Highway Safety (IIHS). We interviewed seven trailer manufacturers, nine trucking industry organizations, four organizations representing tractor-trailer fleets, nine traffic safety groups, and four organizations involved in transportation research. Additionally, we interviewed officials of five state DOTs, five state police departments, as well as two local police departments.[4] In selecting the states and localities, we considered various factors—such as reported underride crash fatalities and highway vehicle miles traveled—to identify states that were similar in highway traffic trends and large truck-related fatality rates, but that collected underride crash data differently. The results of these interviews are not generalizable to all states and localities; however, they offer examples of the types of experiences state DOTs and state and local police have with underride crashes and inspections. We also

[2]H.R. 4622, Stop Underrides Act of 2017, 115th Cong. (2017). S. 2219, Stop Underrides Act of 2017, 115th Cong. (2017).

[3]H.R. 1511, Stop Underrides Act of 2019, 116th Cong. (2019). S. 665, Stop Underrides Act of 2019, 116th Cong. (2019).

[4]We interviewed state DOT and state police officials from the following states: California, Illinois, Indiana, Pennsylvania, and Tennessee. We interviewed local police officials from the following localities: Chicago, Illinois and Terre Haute, Indiana.

interviewed officials from transportation agencies in Canada and the European Union.

For the first objective, we also analyzed DOT data on underride crashes and fatalities from 2008 through 2017—the 10 most recent years for which these data were available—and reviewed crash report forms from all 50 states and the District of Columbia. We compared NHTSA's data collection efforts to federal internal control standards related to use of quality information.[5] For the second objective, we reviewed NHTSA's and FMCSA's regulations requiring rear guards, FMCSA's regulations on commercial vehicle inspections, DOT's documentation on underride guard technologies, and DOT's data on commercial vehicle inspections. To assess the reliability of DOT's data on underride crashes and fatalities and commercial vehicle inspections, we reviewed relevant documentation and spoke with agency officials about the data's quality control procedures. We determined that the data were sufficiently reliable for the purposes of this report, specifically to provide a high-level overview of underride crashes and fatalities, as well as commercial vehicle inspections within recent years. However, we did identify potential underreporting of underride crashes and fatalities, as discussed in this report. We compared DOT's efforts to pertinent agency regulations on commercial vehicle inspections, federal internal control standards related to use of quality information, and a statement of federal principles on regulatory planning and review.[6] See appendix I for a detailed description of our objectives, scope, and methodology, including a list of interviewees.

We conducted this performance audit from January 2018 to March 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[5]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

[6]GAO-14-704G. Exec. Order No. 12866, 58 Fed. Reg. 51735 (Oct. 4, 1993).

Background

An underride crash can occur during a collision between a passenger vehicle and a large truck—a tractor-trailer or a single-unit truck, such as a delivery or dump truck—if the height difference between the vehicles is sufficient to allow the smaller vehicle to slide under the body of the truck.[7] The front and rear of passenger vehicles are designed to crumple in a crash and absorb the main force of an impact, while sensors detect the impact and activate safety features within the passenger compartment, such as air bags and seatbelt pretensioners.[8] However, the point of impact in an underride crash could be the hood of the passenger vehicle or—more severely—the windshield. Such impacts can result in "passenger compartment intrusion" by the large truck into the passenger area of the smaller vehicle. This intrusion can kill passengers or leave them with severe head and neck injuries. Underride guards on large trucks essentially lower the profile of the truck's body to be more compatible with that of a passenger vehicle. An underride guard designed to withstand the force of a crash can prevent the car from sliding under the truck and provide an effective point of impact that will activate the car's safety features to protect the car's occupants. Figure 1 shows images from a video depicting the difference in underride crashes with and without passenger compartment intrusion on the rear of a tractor-trailer.

[7]Of the approximately 11.5 million total registered large trucks in the U.S. in 2016, about 2.8 million (24 percent) were tractor-trailers and about 8.8 million (76 percent) were single-unit trucks. FMCSA, *2018 Pocket Guide to Large Truck and Bus Statistics*, (Washington, D.C.: August 2018).

[8]Seatbelt pretensioners retract a limited amount of webbing to help minimize the forward movement of the occupant during a crash.

Figure 1: Crash Tests of Rear Guards with (left) and without (right) Passenger Compartment Intrusion

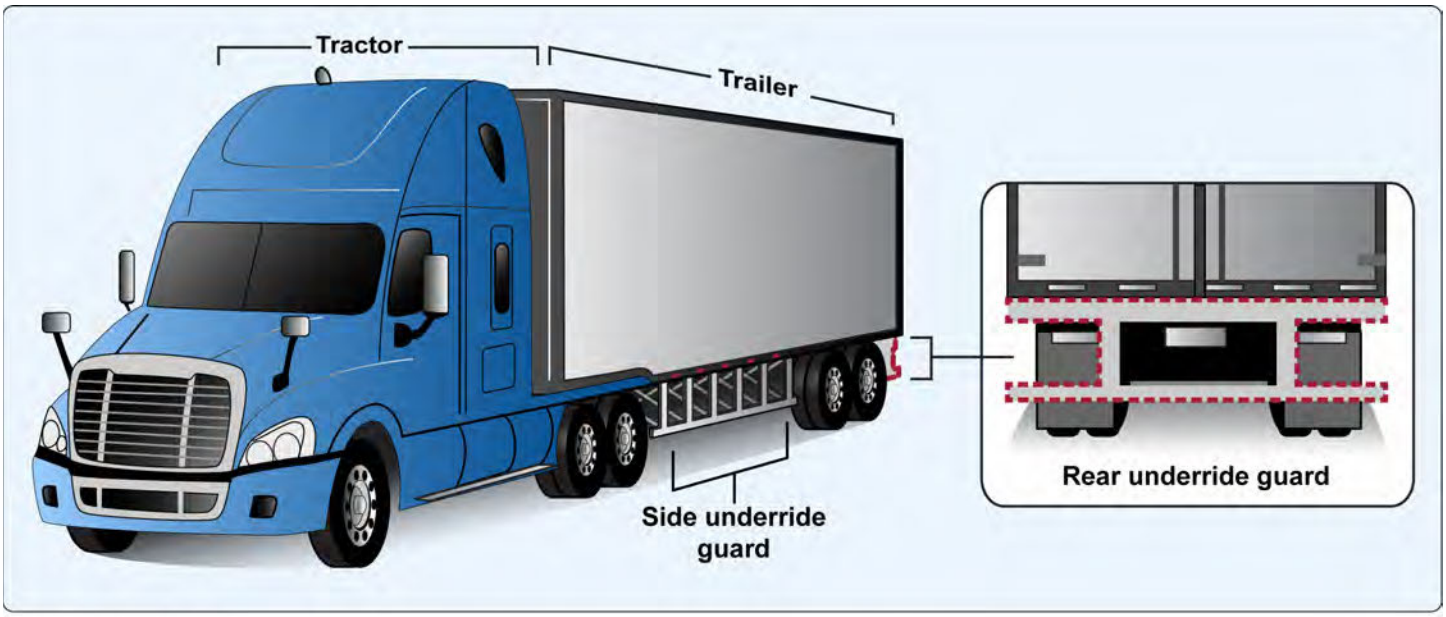
Source: GAO and Insurance Institute for Highway Safety. | GAO-19-264

Note: The images shown are from a video about the difference between underride crashes with and without passenger compartment intrusion. To view the video, go to www.gao.gov/products/GAO-19-264.

Rear and side underride guards limit a passenger vehicle's ability to go under those areas of a trailer in a crash (see fig. 2). Front guards—currently used on tractors in some other countries, such as European Union countries—can reduce the likelihood that a truck would ride over a passenger vehicle in a crash, a situation sometimes referred to as "override". In addition to saving lives and reducing serious injuries, improving traffic safety—including reducing underride crashes—may provide other benefits to society. Specifically, NHTSA has reported that preventing such crashes may result in savings in police and crash investigation resources and reduced property damage, among other things. Federal requirements, in regulations issued by NHTSA and FMCSA, exist for the installation of rear guards on most large trucks, but there are no federal requirements for side or front guards.[9]

[9]These federal requirements apply to trailers and single-unit trucks and exclude certain vehicles, including school buses. 49 C.F.R. §§ 571.223, 224, and 393.86.

Figure 2: Overview of a Tractor-Trailer and Examples of Rear and Side Underride Guards



Source: GAO. | GAO-19-264

NHTSA's mission is to "save lives, prevent injuries and reduce economic costs due to road traffic crashes through education, research, safety standards and enforcement activity." [10] As part of this mission, NHTSA requires that rear guards be installed on most trailers. Federal regulations requiring rear guards of specific dimensions date back to 1952, but the most current regulations—which set force and energy absorption standards, in addition to dimensional requirements—became effective in 1998.[11] These crashworthy rear guards must be designed and tested to protect occupants in a crash of up to 30 miles per hour.

In December 2015, NHTSA published a notice of proposed rulemaking (NPRM) that proposed to align U.S. regulations with stronger Canadian rear guard standards.[12] The Canadian standard includes a stronger

[10]NHTSA, *The Road Ahead: National Highway Traffic Safety Administration Strategic Plan 2016-2020*, DOT HS 812 343 (Washington, D.C.: October 2016).

[11]49 C.F.R. §§ 571.223 and .224. These regulations require rear guards on trailers with a gross vehicle weight rating of 10,000 pounds or more.

[12]80 Fed. Reg. 78418 (Dec. 16, 2015).

energy absorption requirement: 20,000 joules—a measurement of energy—as compared to 5,650 joules in the U.S. NHTSA has not taken action on this NPRM since it was proposed in December 2015. Single-unit trucks that are more than 30 inches above the ground are required to meet the dimensional specifications for rear guards set in 1952 but are not required to meet any force or energy absorption standards.[13] NHTSA introduced an advance notice of proposed rulemaking (ANPRM) in July 2015 that considered requiring rear guards with strength and energy absorption criteria for all newly built single-unit trucks. However, NHTSA has since withdrawn the ANPRM, stating that—based on the comments received as well as analysis of the petitions—the changes being considered were not justified.

Although there are no federal requirements for crashworthy side underride guards, some crashworthy side guards are being developed. For example, one aftermarket manufacturer has developed a side underride guard that was crash-tested by IIHS and successfully prevented underride crashes in tests at 35 and 40 miles per hour. Similar looking technologies—including aerodynamic side skirts and pedestrian/cyclist side guards—are installed on some trailers and single-unit trucks, but they are not meant to mitigate underride crashes (see fig. 3).

[13]49 C.F.R. § 393.86. Unlike requirements for rear guards on trailers, these regulations are not based on the truck's weight.

Figure 3: Side Guard Examples

Guard type description	Example	Designed to mitigate a passenger vehicle underride crash
Side Underride Guard To prevent a passenger vehicle from going under a large truck in a crash.		Yes
Aerodynamic Side Skirt To reduce drag and improve the fuel efficiency of tractor-trailers.		No
Pedestrian/ Cyclist Side Guard To prevent pedestrians and cyclists from being run over by a large truck's rear wheels in a side-impact collision.		No

Source: GAO. | GAO-19-264

FMCSA's primary mission is "to reduce crashes, injuries, and fatalities involving large trucks and buses,"[14] and it does this, in part, through developing safety regulations. These regulations include requirements for rear guards for trailers consistent with Federal Motor Vehicle Safety Standards and for single-unit trucks that are more than 30 inches above the ground, as well as for multiple types of commercial vehicle inspections that are performed by, for example, motor carriers and drivers to ensure that commercial vehicles are safely operating. Table 1 describes the types of commercial vehicle inspections.

[14]FMCSA, *Federal Motor Carrier Safety Administration Strategic Plan Fiscal Years 2015 – 2018*, (Washington, D.C.: August 2016).

Table 1: Commercial Vehicle Inspection Types

Inspection Type	Description
Annual Inspection	• Required of all trucks, trailers, and buses. Employees of the motor carrier may conduct the annual inspections if the vehicles are not subject to a mandatory state inspection program. • "Appendix G" of FMCSA's regulations lists the equipment that must be inspected as part of the annual inspection.
Roadside Inspection	• Inspectors—often certified state police officers—select commercial vehicles on the highway for roadside inspections. • A standardized set of procedures is used to determine whether large trucks are operating safely. There are eight types of roadside inspections, with some inspections examining all parts of a vehicle—including the rear guard—and others reviewing a driver's license and other administrative credentials.
Pre-Trip Inspection	• Drivers are required to check that the vehicle is in safe and proper working condition.
Driver Vehicle Inspection Reports ("Post-Trip Inspection")	• Drivers are required to prepare a post-trip inspection report at the end of each operating day to identify damaged equipment that must be repaired before the vehicle can be used again. • The motor carrier must either (1) repair or replace the defective or damaged equipment, or (2) certify that repairs are not necessary before allowing the vehicle to be driven.

Source: GAO analysis of Federal Motor Carrier Safety Administration regulations. 49 C.F.R. §§ 396.17, 396.9, 392.7, 396.11. | GAO-19-264

For fatal crashes, including fatal underride crashes, data are collected by law enforcement officials at the location of the crash, aggregated at the state level, and then transferred to NHTSA's Fatality Analysis Reporting System (FARS). FARS is a census of all fatal traffic crashes in the U.S. When a fatal crash occurs, a state or local police officer typically completes a crash report form unique to each state. These forms can include a variety of data fields, such as the time of the crash, weather conditions, and the number of killed or injured persons. In the case of an underride crash, officers may indicate an underride crash occurred in a specific field for recording this crash type or in a narrative field. FARS analysts—state employees who are trained by NHTSA's data validation and training contractor to code state crash data for input into FARS—in each state receive and analyze the data in the crash report forms in order to compile a record of the fatal crash. FARS analysts rely on the information within the crash report form in order to enter accurate data.

To encourage greater uniformity of crash data, NHTSA, FMCSA, and other agencies and associations cooperatively developed the Model Minimum Uniform Crash Criteria (MMUCC) in 1998. The MMUCC guideline, currently in the fifth edition, identifies a minimum set of motor vehicle crash data elements and their definitions that states should consider collecting, but are not required to collect. The MMUCC is updated about every 4 to 5 years. Prior to publication of each edition, an expert panel from the relevant agencies and associations convenes to

review all proposed changes suggested by traffic safety stakeholders to determine what will be included in the MMUCC. According to NHTSA officials, the next updated version of the MMUCC is expected to be issued in 2022.

Underride Crash Fatalities Reported by NHTSA Data Are Relatively Low but Are Likely Undercounted

Although Reported Underride Crash Fatalities Represent a Small Percentage of Total Traffic Fatalities, Underride Crashes Present a Greater Risk of Fatalities or Serious Injuries

From 2008 through 2017, the annual number of fatalities resulting from underride crashes involving one or more trucks reported in FARS ranged between 189 and 253, resulting in an annual average of approximately 219 fatalities (see table 2).[15] Comparatively, the FARS data show an annual average of about 34,700 total traffic fatalities and approximately 4,000 fatalities involving large trucks over the same period. Therefore, reported underride crash fatalities on average accounted for less than 1 percent of total traffic fatalities and 5.5 percent of all fatalities related to large truck crashes during this time frame.

[15]To be included in FARS, a crash must have involved a motor vehicle traveling on a trafficway customarily open to the public, and must have resulted in the death of a motorist or a non-motorist within 30 days of the crash. While stakeholders we spoke with noted the factors described in this report that could lead to underreporting of fatalities related to truck underride crashes, the failure to record a fatality that occurred subsequent to—but within 30 days of—a crash could also be a factor in underreporting.

Table 2: Reported Underride Crash Fatalities, Total Traffic Fatalities, and Large Truck Fatalities, 2008 through 2017

Year	Underride Crash Fatalities[a]	Total Traffic Fatalities	Underride Crash Fatalities as a Percentage of Total Traffic Fatalities	Total Large Truck Fatalities[b]	Underride Crash Fatalities as a Percentage of Large Truck Fatalities
2008	198	37,423	0.53%	4,245	4.66%
2009	211	33,883	0.62%	3,380	6.24%
2010	221	32,999	0.67%	3,686	6.00%
2011	189	32,479	0.58%	3,781	5.00%
2012	247	33,782	0.73%	3,944	6.26%
2013	210	32,893	0.64%	3,981	5.28%
2014	213	32,744	0.65%	3,908	5.45%
2015	253	35,485	0.71%	4,094	6.18%
2016	196	37,806	0.52%	4,369	4.49%
2017	253	37,133	0.68%	4,761	5.31%
Average	219	34,663	0.63%	4,015	5.49%

Source: GAO analysis of NHTSA data. | GAO-19-264

[a]Reported underride crash fatalities include those fatalities in which a crash involved a medium or heavy truck.

[b]"Large truck" is defined as any medium or heavy truck, excluding buses and motor homes, with a gross vehicle weight rating greater than 10,000 pounds.

Although reported underride crash fatalities make up a small proportion of total traffic fatalities, NHTSA officials told us that severe underride crashes—involving passenger compartment intrusion—are more likely to result in a fatality or serious injury than crashes in which the passenger vehicle's safety features engage and are able to protect the occupants. Officials from four state DOTs we spoke to also stated that while underride crashes are not common, the consequences—fatalities or serious injuries, including head or neck injuries—are more likely to be severe. An official from one state DOT noted that their agency did not consider underride crashes to be a high priority issue. However, upon further review of the state's underride crash data, this official stated that while underride crashes may occur infrequently, they present a higher risk of fatality than the official had previously realized. An official in another state told us they do not regularly review underride crash data but, upon analysis of the data, found that underride crashes constituted a larger percentage than they anticipated—16 percent—of all fatal large truck crashes in the state in 2017.

NHTSA's FARS data show that most of the reported underride crash fatalities occurred when the crash impact was located at the rear or sides of a trailer. From 2008 through 2017, approximately 45 percent (825 of 1836) of reported fatalities in underride crashes with a recorded point of impact on the large truck occurred when the initial impact of the crash was the rear of the trailer. About 32 percent (590 of 1836) of reported underride crash fatalities were in crashes where the side of the trailer was the point of initial impact. Approximately 21 percent (392 of 1836) of reported underride crash fatalities were in crashes with the initial impact at the front of the tractor. These 392 fatalities from crashes involving the front of a tractor could be crashes in which the tractor impacted the rear of a passenger vehicle but might also have occurred in a head-on collision between the car and the tractor. The point of impact for underride crash fatalities with passenger compartment intrusion—the most severe form of underride—had similar distributions, with most reported fatalities occurring when the initial point of impact was the rear or side of the trailer.[16]

State and local police officials we interviewed said that the underride crash fatality cases they are familiar with occurred in high speed scenarios, often exceeding 55 miles per hour. For example, officials representing a state police department described scenarios in which passenger vehicles traveling at high speeds rear-ended tractor-trailers stopped on the highway's shoulder or slowed for highway construction; similar scenarios occurred when tractor trailers failed to slow for stopped traffic and crashed into the rear of passenger vehicles. However, on average, 62 percent of fatalities from underride crashes with passenger compartment intrusion reported in 2008 through 2017 did not include a reported speed. For example, for these fatalities in 2017, 72 percent had speed coded in FARS as missing or not reported. A state and a local police official told us that determining the speed of an underride crash can be challenging due to the often severely damaged condition of the passenger vehicle following an underride crash. Officials representing state police said that they are better able to document whether or not speeding was a factor in an underride crash, rather than an exact speed.

[16]Of the reported underride crash fatalities between 2008 and 2017 in which passenger compartment intrusion occurred, approximately 46 percent (489 of 1062) occurred when the initial point of impact was the rear of the trailer. Approximately thirty percent (323 of 1062) of these fatalities occurred when the initial point of impact was the sides of the trailer, and about 23 percent (243 of 1062) when the initial point of impact was the front of the tractor.

IIHS representatives also acknowledged the difficulty in documenting the speed involved in an underride crash, and further stated that this difficulty brings into question the accuracy of the speed data that are recorded in FARS for underride crashes.

Variability in the Data Collection Process Likely Leads to Underreporting

Stakeholders we interviewed told us that underride crash fatalities are likely underreported in FARS due to several factors, such as variability across states in defining underride crashes, inconsistencies in state crash reporting forms and documentation methods, and limited information provided to state and local police on how to consistently identify and record underride crash data. These factors could contribute to police officers incorrectly and inconsistently documenting underride crash data on the crash report form. As a result, FARS analysts may not have sufficient information to properly categorize the crash as an underride, ultimately affecting the number of underride crash fatalities identified in FARS. *Standards for Internal Control in the Federal Government* notes that management should use quality information to achieve the entity's objectives.[17] Underreporting of underride crashes would affect the quality of NHTSA's data, thereby affecting the agency's ability to accurately identify the magnitude of underride-related crashes and limiting its ability to make informed decisions on rulemaking or other efforts that would help the agency meet its mission to improve traffic safety.

Other researchers and organizations have also commented on the quality of NHTSA's underride crash data. For example, IIHS representatives told us that they compared underride crash cases in FARS and in NHTSA's and FMCSA's *Large Truck Crash Causation Study*—a study of large truck crashes from 2001 through 2003—and identified some cases that involved underride crashes but that were not categorized as such in FARS. Consequently, IIHS representatives stated that they have used more general rear impact crash data as a proxy for underride crashes due to their finding that underreporting of underride crashes occurs in FARS. Additionally, the University of Michigan's Transportation Research

[17]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

Institute reported that it can be difficult or impossible to identify underride in available computerized crash data files, such as FARS.[18]

Variability in Underride Crash Definition

State and local police officers do not use a standard definition of an underride crash when collecting data at the scene of a crash. NHTSA officials told us that the agency's definition for an underride crash—"a vehicle sliding under another vehicle during a crash"—is found in the FARS coding and validation manual, a document primarily used by FARS analysts and researchers. The FARS coding and validation manual further distinguishes underride crashes as those with and without passenger compartment intrusion. The MMUCC, which includes definitions of various crash-related elements, does not include a definition of an underride crash. Among officials from the five state police departments we interviewed, underride crash definitions varied, even within states. For example, in one state, an official from one local police department said that a passenger vehicle would need to have over 50 percent of its hood underneath the trailer to constitute an underride crash, while other officials within the state police used a broader definition consistent with NHTSA's definition, i.e., a vehicle going underneath another vehicle by any amount. A state police official and a local police official we interviewed indicated that they would like a clearer definition of the conditions that constitute an underride crash to help them better identify these crashes. Further, representatives from NHTSA's data validation and training contractor told us that when they have identified anomalous patterns in underride crash data in FARS, the main reason for these anomalies has been varying definitions of this crash type, as reporting officers have many interpretations of what constitutes an underride crash.[19] A standard definition of an underride crash, for example in the MMUCC, would provide greater assurance that underride crashes are accurately recorded.

[18]Blower, D., Woodrooffe, J., Page, O., *Analysis of Rear Underride in Fatal Truck Crashes, 2008*. (Ann Arbor, MI: US DOT HS 811 652, 2012). The underride crash data were collected as a supplement to the 2008 Trucks Involved in Fatal Accidents survey, which in turn supplements NHTSA's FARS file.

[19]NHTSA's data validation and training contractor specializes in training and data quality control support for NHTSA. The contractor supports NHTSA's FARS data collection program, specifically in the delivery and maintenance of the FARS training program and data manuals, and assists NHTSA in quality control and review of data added by FARS analysts.

Inconsistency in State Crash Reporting Forms and Documentation of Underride Crashes

While all states have a crash report form to gather data following a crash, these state forms vary in whether and how underride crash-related information is collected. Specifically, for the most recent crash report forms we examined from the 50 states and the District of Columbia, as of October 2018:

- 17 state forms have a specific field for “Underride.” Eleven of these forms also have data fields for passenger compartment intrusion.
- 32 state forms have a point of impact or area damaged field for “undercarriage.” The point of impact field is generally intended to be used to indicate the locations of initial impact or area that was damaged for all vehicles involved in the crash. Some state police and transportation officials we spoke with noted that this field could be used to indicate that an underride crash occurred, as the initial point of impact on a large truck could be the undercarriage in such a crash.
- Two states, California and Hawaii, do not have a data element related to underride crashes or undercarriage on their state crash report forms.

The presence of an underride field in state crash report forms may affect the extent to which underride crash fatalities are captured in FARS. For example, we observed that after a state revised its form to remove the underride field, the number of reported underride crash fatalities significantly decreased, potentially indicating that underride crashes were being underreported after the change. Conversely, in another state, we observed that the number of reported underride crash fatalities significantly increased following the addition of an underride field to the crash report form, potentially indicating that underride crashes were being reported more accurately following the change.

States have their own discretion to develop crash report forms based on several factors that may be particular to each state. For example, states include or exclude certain data elements on their crash report forms based on the traffic safety priorities within that state. Officials we interviewed from two state police departments told us that they do not have an underride field on their crash report forms because underride crashes are not a traffic safety priority for them. In another state, state DOT officials told us that they chose to include an underride field on the crash report form to better align with the FARS data fields, including those fields related to underride. States may include certain data elements on their crash report form based on the recommended data elements in the MMUCC. However, while the MMUCC was developed to encourage

greater uniformity of crash data, its guidelines are voluntary, and it does not currently include references to underride or override crash data elements. In its June 15, 2017, report, the Post-Accident Report Advisory Committee—a group appointed by the FMCSA Administrator to provide input on additional data elements to be included in police accident reports involving commercial motor vehicles—suggested that MMUCC data elements be updated to include a collection of information about whether underride and override are involved in a crash. However, according to the MMUCC's standard development process and NHTSA officials, to adopt new data elements, the entire MMUCC expert panel—which is comprised of stakeholders representing NHTSA, FMCSA, the Governors Highway Safety Association, states, data collectors, data managers, data users, and safety stakeholders—must reach at least 70 percent agreement for approval of new changes to the MMUCC. Under the MMUCC's standard development process, the MMUCC expert panel will consider recommendations and proposed changes to the MMUCC guidelines, including those proposed by NHTSA in the months preceding the next MMUCC update in 2022.

In states that do not include a specific underride crash field in the state crash report form, state and local police officers we interviewed told us that officers responding to a crash may describe underride crashes in the diagram or narrative fields of the form. However, these officers said that a police officer may inappropriately document an underride crash as a rear impact crash. Similarly, officers may categorize the crash as both an underride and an override crash, which NHTSA's FARS coding and validation manual indicates would be incorrect. Selected state officials told us that unless the officer documenting the crash specifically describes an underride crash in the narrative field, FARS analysts at the state level who review the crash report forms will not have the information to know if a crash involved underride.

Police officers we interviewed in states that include "undercarriage" rather than a specific underride crash field in the crash report form told us that they may use the option as a proxy for an underride crash; however, this field may be used inconsistently. For example, in one state, state police officers said they would select "undercarriage" on the crash report form to reflect an underride crash, whereas a local police officer in the same state said that local officers would not use that field to identify an underride crash occurred and, instead, would document the underride crash in the narrative. NHTSA's data validation and training contractor told us that it is not a recommended practice for officers to select "undercarriage" as a proxy for underride crashes, noting that this inconsistency could lead to

inaccuracies in the resulting FARS data. Including underride as a recommended data field in the MMUCC would provide greater assurance that underride crashes are accurately recorded.

Limited Information Provided to Police

State and local police officials we interviewed said that they receive limited or no training on how to identify and record information for underride crashes. Officials from all five state police departments we spoke with said that they develop their own crash reporting training for police. This training emphasizes overall crash reporting with a limited focus, if any, on underride crashes. An official representing one state police office said that the state police provide training on how to complete crash reports and general traffic safety, whereas FARS analysts—often within the state DOT—are concerned with the quality of data collection for data analysis purposes, which is not a primary focus of law enforcement training. State and local police officials we interviewed said they generally have limited to no follow-up or continuous training on crash reporting beyond initial police academy training. Local police we interviewed also told us that while they develop and implement their own crash report training, they may also receive training from the state police. Some state police officers that we spoke with said that they conduct training for local police departments when requested. One local police official we spoke with said that officers have limited exposure to underride crashes in these training sessions and that the average officer would likely not know how to appropriately identify an underride crash. Officials we spoke with from three state and two local police departments stated that additional information to police departments on underride crashes could help improve data collection and overall traffic safety.

NHTSA provides training to FARS analysts on reviewing crash report forms and appropriately inputting data in FARS, but does not provide information on crash data collection to state and local police who initially collect the data. According to NHTSA's data validation and training contractor, the contractor trains FARS analysts on identifying underride crashes. Specifically, the contractor trains FARS analysts to review the crash report forms for sufficient detail to meet the definition of an underride crash and determine if a crash involved underride for entry in FARS. NHTSA officials told us that it is the responsibility of state police academies to train law enforcement officers to conduct on-site investigations and complete crash report forms. NHTSA officials said that they do not currently provide underride identification information directly to state and local police who initially collect the crash data. However, NHTSA does provide information to state and local police on other topics, such as improving traffic safety and driver behavior, for example through

DOT's Enforcement and Justice Services Division. NHTSA officials acknowledged that it would be feasible to also provide information on identifying and recording underride crashes. *Standards for Internal Control in the Federal Government* notes that management communicates quality information externally through reporting lines so that external parties can help the entity achieve its objectives and address related risks.[20] By providing information to state and local police departments—such as materials or instruction on the definition of an underride crash and how to appropriately document these crashes—NHTSA could improve the quality and completeness of underride crash data that police collect.

Underride Guards Are in Varying Stages of Development, and Gaps Exist in Inspection and Research

Underride guards for the rear, side, and front of tractor-trailers and single-unit trucks are in varying stages of development. NHTSA has issued an NPRM proposing to strengthen rear guard requirements for trailers, and estimates that about 95 percent of all newly manufactured trailers already meet the stronger requirements. While FMCSA requires commercial vehicles to be inspected to ensure they are safe, rear guards may not be regularly inspected. Side underride guards are being developed, but stakeholders identified challenges to their use, such as the stress on trailer frames due to the additional weight. NHTSA has not performed research on the overall effectiveness and cost of these guards, and manufacturers we interviewed told us that they are hesitant to invest in developing side underride guards without such research. In response to a 2009 crash investigation, the National Transportation Safety Board (NTSB) recommended that NHTSA require front guards on tractors. NHTSA officials stated that the agency plans to complete research to respond to this recommendation in 2019. However, stakeholders generally stated that the bumper and lower frame of tractors typically used in the U.S. may mitigate the need for front guards for underride purposes. NTSB has further recommended that NHTSA develop standards for crashworthy underride guards for single-unit trucks—such as dump trucks—but NHTSA recently concluded that these standards would not be cost effective.

[20]GAO-14-704G.

Most Newly Built Trailers Are Equipped with Rear Guards That Exceed NHTSA Requirements

All seven of the eight largest trailer manufacturers—which are responsible for about 80 percent of the trailers on the road in the U.S.—we spoke with told us that they have been building to the stronger Canadian rear guard standard since those requirements became effective in 2007. Some manufacturers said that since trucking company operations may span the border between Canada and the U.S., it was easier to build to a single standard rather than manufacture trailers that comply with either the Canadian requirements or the U.S. requirements. NHTSA is considering strengthening the U.S. requirements for rear guards to align with the Canadian rear guard standards. As part of the 2015 NPRM on strengthening the U.S. requirements to the level of the Canadian standards, NHTSA estimated that 93 percent of all newly manufactured trailers in the U.S. are already equipped with a rear guard that meets the Canadian standard. In July 2018, NHTSA officials told us that figure had increased to 95 percent of all newly manufactured trailers, with the remaining 5 percent from smaller manufacturers who may not wish to incur the additional cost or weight of a Canadian-style rear guard. Trucking industry stakeholders told us that the average lifecycle of a trailer varies: one said the lifespan is 10 to 15 years and another stated a 12-year lifespan.

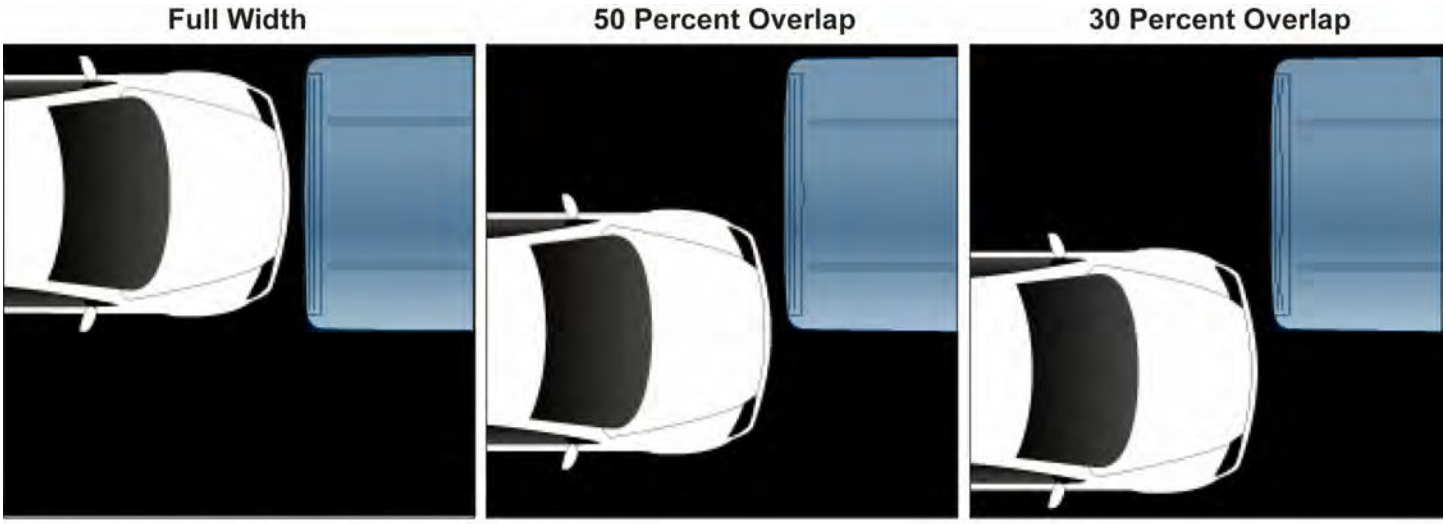
NHTSA performed a cost-benefit analysis as part of the 2015 NPRM in which it preliminarily estimated that requiring newly manufactured trailers to include rear guards built to the new standard would be cost-beneficial. Specifically, NHTSA's analysis found that the cost of a rear guard that meets the Canadian standard was approximately $500 per trailer, which was $229 more than a guard that complies with the existing U.S. requirement. NHTSA's analysis also found that a Canadian-style rear guard was heavier than its U.S. counterpart. The rear guard NHTSA studied that complies with current U.S. regulations weighed 172 pounds, whereas those meeting the Canadian standard weighed between 191 and 307 pounds. Regarding benefits, NHTSA estimated in 2015 that—accounting for the trailers that already meet the stronger standard—adopting the Canadian standard would prevent about one fatality and three serious injuries per year. According to DOT, these estimates may have since changed, as a higher percentage of trailers are now manufactured to meet the Canadian standards. Comments on this NPRM varied. Some comments were in support of the measure, citing the safety benefits. Other comments noted that automated driver assistance

technology may offer better outcomes.[21] Further, some comments called for NHTSA to take additional steps to improve the safety capabilities of rear guards, such as allowing fewer exemptions from compliance. NHTSA has not taken action on this NPRM since it was proposed in December 2015. NHTSA officials we interviewed could not provide information on when the NPRM would move forward.

The largest trailer manufacturers have also taken steps to further improve the design of rear guards to prevent underride crashes in a range of scenarios. Because IIHS found that the weakest points for rear guards are generally the outer edges furthest from the center of the guard, it created a procedure to test the ability of rear guards to withstand crashes at different overlap points, starting at the center of the guard and moving closer to the endpoints. Specifically, this procedure involves three crash tests using full width, 50-percent, and 30-percent overlap of the front of the car with the rear guard, as depicted in figure 4. According to IIHS, as of September 2018, all of the top eight trailer manufacturers operating in the U.S. have successfully passed these tests. Some of these manufacturers provide the improved rear guards as a standard feature on all new trailers, while others offer them as an option for purchase.

[21]These technologies allow vehicles to perform certain driving tasks without human input and encompass a diverse range of automated technologies ranging from relatively simple driver assistance systems to fully self-driving vehicles. See GAO, *Automated Vehicles: Comprehensive Plan Could Help DOT Address Challenges*, GAO-18-132 (Washington, D.C.: Nov. 30, 2017).

Figure 4: Insurance Institute for Highway Safety Rear Guard Testing Procedure at Full Width, 50 Percent Overlap, and 30 Percent Overlap



Source: Insurance Institute for Highway Safety. | GAO-19-264

In addition to strengthening rear guards on trailers, advancements in automatic braking systems in passenger vehicles may help reduce the frequency of underride crashes. These systems, though not federally-required, have been available and installed in some passenger vehicles and tractors and are designed to detect objects or other vehicles in front of the vehicle and automatically apply the brakes to avoid or lessen the severity of an impact. According to NHTSA, twenty automakers representing more than 99 percent of the U.S. automobile market have agreed to make automatic braking systems a standard feature on newly-built passenger vehicles starting in 2022. These braking systems may help reduce the number of passenger vehicles striking the rear of tractor-trailers, potentially reducing the frequency of underride-related crashes, fatalities, and injuries.

Rear Guards in Use on Roads May Not Be Regularly Inspected

FMCSA regulations require commercial vehicles operating in interstate commerce to be inspected to ensure they are safe. However, the rules do not specifically include an inspection of the rear guard. After a rear guard has been installed on a new trailer, stakeholders told us that the guard may be damaged during normal use (see fig. 5), for example by backing into loading docks. However, only certain roadside inspections—which are performed at random or if an officer suspects a problem—specifically require the rear guard to be inspected. Specifically, of the eight types of

roadside inspections, representatives of the Commercial Vehicle Safety Alliance (CVSA)—which helps develop roadside inspection standards—told us that four require the rear guard to be inspected.[22]

Figure 5: Example of a Damaged Rear Guard

Source: GAO. | GAO-19-264

Stakeholders we interviewed told us that a trailer could go its entire lifecycle—estimated as typically 10 to 15 years—without ever being selected for a roadside inspection. FMCSA data show that although rear guard violations may be identified during roadside inspections, they constitute a small percentage of all violations. For example, out of about 5.8 million violations identified during roadside inspections in 2017, approximately 2,400, or 0.042 percent, were rear guard violations. In an effort to learn more about rear guard violations, CVSA encouraged

[22]A fifth type of roadside inspection, known as "Level 4 – Special Inspections," is performed to review one piece of equipment, such as air brakes. Representatives from CVSA, which helps develop roadside inspection standards, stated that a special inspection could potentially be set up to solely inspect rear guards.

commercial vehicle inspectors to specifically focus on rear guards during their roadside inspections performed from August 27 through 31, 2018. According to these data, for the more than 10,000 trailers inspected during that 5-day time frame, about 900 violations (about 28 percent of all violations identified) for rear guard dimensional or structural requirements were identified, including almost 500 instances where the rear guard was cracked or broken, or missing altogether.[23] A CVSA representative stated there was a greater percentage of violations identified because inspectors were asked to specifically focus on the rear guard during this effort.

Inspectors performing annual inspections—which can include employees of the motor carrier—rely on a checklist established in FMCSA regulations, known as "Appendix G." This appendix specifies what equipment must be inspected, such as the brake system, lighting, and wheels. Appendix G does not list the rear guard as an item to be inspected.[24] In August 2018, CVSA petitioned FMCSA to amend Appendix G to include rear guards as an item to be inspected. According to CVSA, in September 2018, FMCSA provided acknowledgment of its intent to review CVSA's petition.

FMCSA's regulations, including those regarding commercial vehicle inspections, help the agency achieve its safety mission of reducing crashes, injuries, and fatalities. Further, *Standards for Internal Control in the Federal Government* notes that management should use quality information to achieve the entity's objectives.[25] Prior to receiving CVSA's petition to amend Appendix G, FMCSA officials told us that not including rear guards in Appendix G does not affect commercial vehicle safety, as FMCSA regulations require all parts and accessories specified within the regulations—which includes the rear guard—to be in safe and proper operating condition at all times. According to DOT, the agency does not believe that motor carriers are ignoring the application of these regulations to rear guards. However, without explicitly including the inspection of the rear guard in Appendix G, there is no assurance that rear guards in operation will be inspected at least annually to ensure they

[23]10,112 trailers were inspected during this time frame, including 1,072 trailers manufactured prior to January 26, 1998—the date when NHTSA's rulemaking requiring crashworthy rear guards on newly built tractor-trailers went into effect.

[24]49 C.F.R., Appendix G to subchapter B of Chapter III.

[25]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

perform as designed to prevent or mitigate an underride crash. This omission potentially affects FMCSA's safety mission to help ensure the safe operation of tractor-trailers on the nation's highways.

Side Underride Guards Are Being Developed, but Limited Information Exists to Assess Overall Effectiveness and Cost

While not currently required in the U.S., crashworthy side underride guards are being developed which could entail both costs and benefits to society. For example, there is currently one IIHS-crash-tested aftermarket manufacturer of side underride guards in North America, which has sold about 100 sets of side underride guards. According to the manufacturer, the cost of the guards starts at about $2,500 per trailer, though the price could decrease in the future as the manufacturing process becomes more efficient and greater quantities are built and sold. These side underride guards have been crash-tested by IIHS and successfully prevented underride crashes in tests at 35 and 40 miles per hour. As a result, the benefits of such guards might include a reduction in the number of fatalities in underride crashes. The manufacturer estimated that more widespread use of side underride guards would occur over the next 3 to 5 years. However, the manufacturer also said that more information on how side underride guards might affect everyday operations is needed before more widespread adoption by the industry. Additionally, some trailer manufacturers told us that they are in the process of developing side underride guards, but none are currently available for purchase. For example, a representative from one trailer manufacturer developing its own side underride guards estimated that it would be feasible to have these guards designed, tested, and available for sale within the next 2 years. However, the representative said that the manufacturer is hesitant to invest additional resources because of uncertainty about potential future regulatory requirements. Specifically, the manufacturer does not want to invest additional resources to develop a side underride guard that might later have to be redesigned to meet federal requirements, if such requirements were to be established and to differ from the manufacturer's design specifications.

Representatives from several trailer manufacturers, trucking industry organizations, and police departments we spoke with cited challenges with the use of side underride guards that would need to be addressed prior to widespread adoption by the industry. Officials from Canada and the European Union—which also do not require the use of side underride guards that can withstand the force of a vehicle crash—noted similar challenges.

- *Weight:* According to the aftermarket side underride guard manufacturer, the side underride guards currently available for sale weigh between 575 to 800 pounds in total. Representatives from two trucking industry organizations we spoke with stated that the additional weight from side underride guards may require carriers to put more trailers on the roads to ship goods in order to stay under federal maximum weight restrictions (generally 80,000 pounds). Federal regulations allow for certain exemptions in the federal weight limits, such as for auxiliary batteries. Some stakeholders also stated that the additional weight from side underride guards would increase fuel costs (assuming all else remains the same) and could put stress on the trailer's frame, reducing its lifespan and potentially increasing maintenance costs.
- *Road clearance:* Some stakeholders we interviewed—including two trucking industry organizations, a tractor-trailer fleet operator, and a trailer manufacturer—stated that side underride guards limit a trailer's clearance from the ground, which could limit the geographic locations that could be serviced by a trailer or—if the guards drag along the ground—result in damage to the guards or even the trailer. Conditions involving limited clearance could include traveling over raised railroad crossings or navigating sloped loading docks. While aerodynamic side skirts may also drag along the ground in similar conditions, they are more flexible than side underride guards and less likely to damage the trailer.
- *Effects on under-trailer equipment and access:* Installation of a side underride guard may limit access to or displace equipment currently underneath a trailer, including spare tires, fuel tanks, and aerodynamic side skirts. Additionally, the rear axles of some trailers can be adjusted to evenly distribute the weight of the trailer's cargo. For example, trailer manufacturers told us that when the axle is moved to the furthest rear position of the trailer, a fixed-length side underride guard could leave a gap large enough for a car to still have an underride crash. Further, some police officers we interviewed told us that it could be challenging to perform roadside inspections of trailers equipped with side underride guards because the guards could limit access to the underside of the trailer.

Representatives from three trucking industry organizations we spoke with indicated that crash avoidance technologies may be more effective than underride guards at minimizing underride crashes, including side underride crashes. However, while these technologies have the potential to mitigate crashes, it is unlikely that they will be available on a more widespread scale in a time frame soon enough to render underride

guards unnecessary. While automatic braking systems for passenger vehicles are to become a standard feature on newly built vehicles starting in 2022, IIHS representatives told us that these systems are less effective at detecting and mitigating side crashes than rear or frontal crashes. Specifically, the representatives stated that automatic braking systems would not be effective in situations where the passenger vehicle impacts the side of a trailer at an oblique angle rather than at a perpendicular angle. According to stakeholders we interviewed, it will take a considerable amount of time for the passenger fleet to adopt automated vehicle technologies, with some stating that there will be a mix of automated and non-automated technologies on the nation's highways for decades—longer than the 3 to 5 years estimated by the side underride guard manufacturer for more widespread use of these guards.[26]

NHTSA recently issued a study on the safety performance of certain materials used for side underride guards.[27] However, NHTSA has not performed research on the overall effectiveness and costs associated with or the design of side underride guards. NHTSA's mission is to "save lives, prevent injuries and reduce economic costs due to road traffic crashes, through education, research, safety standards and enforcement activity."[28] Additionally, a statement of federal principles on regulatory planning and review indicates that in deciding whether and how to regulate, agencies should assess all costs and benefits of available alternatives, including the alternative of not regulating, and that the agency should base its decisions on the best reasonably obtainable scientific, technical, economic, and other information.[29] Additional research on the effectiveness and cost associated with side underride guards could better position NHTSA to determine whether these guards should be required and, if so, appropriate standards for their

[26]We have previously reviewed DOT's approach to automated vehicles and recommended that the department develop a comprehensive plan for addressing associated challenges. DOT agreed with our recommendation and has begun to take actions to implement it. See GAO, *Automated Vehicles: Comprehensive Plan Could Help DOT Address Challenges*, GAO-18-132 (Washington, D.C.: Nov. 30, 2017).

[27]NHTSA, *Computer Modeling and Evaluation Of Side Underride Protective Device Designs*, DOT HS 812 522 (Washington, D.C.: April 2018).

[28]NHTSA, *The Road Ahead: National Highway Traffic Safety Administration Strategic Plan 2016-2020*, DOT HS 812 343 (Washington, D.C.: October 2016).

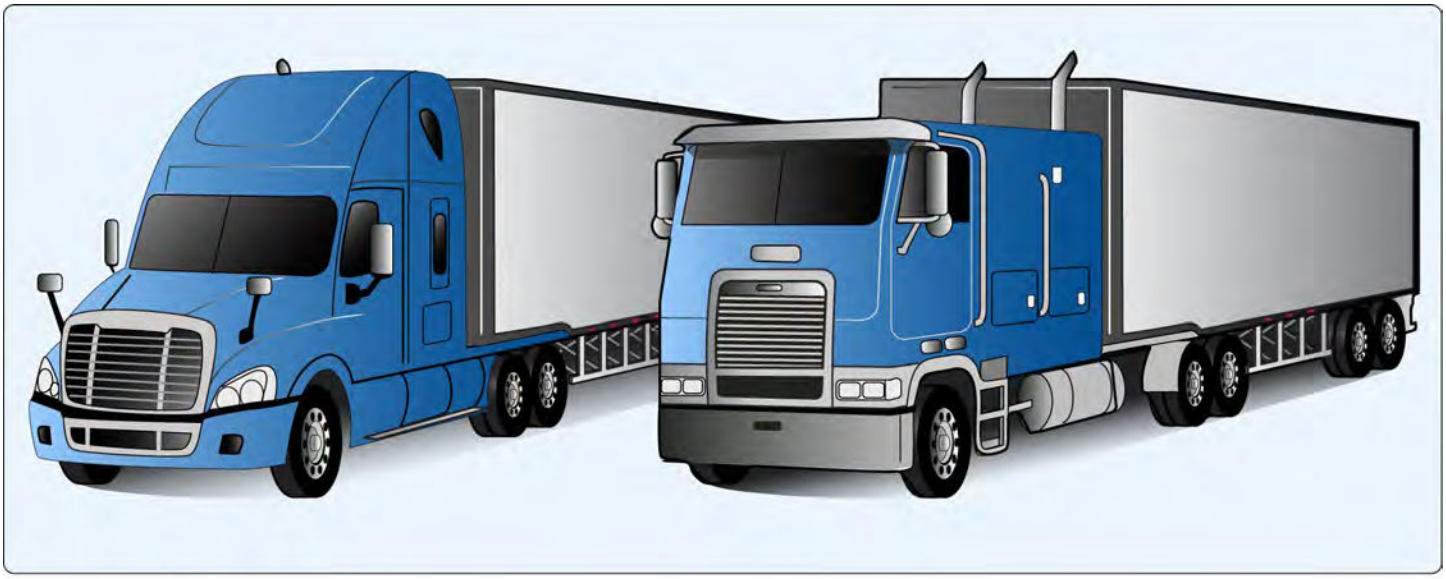
[29]Exec. Order No. 12866, 58 Fed. Reg. 51735 (Oct. 4, 1993).

implementation. Such research may also help provide information to address the challenges stakeholders cited with side underride guards.

Stakeholders Generally Agreed That North American Tractor Designs May Mitigate the Need for Front Guards for Underride or Override Purposes

In general, there are two types of tractors used in tractor-trailer combinations: conventional tractors, wherein the tractor is lower to the ground and the engine is in front of the cab where the driver sits, and "cab-over" tractors, which are designed so the driver sits atop the engine (see fig. 6). Conventional tractors are generally used in North America, whereas cab-over tractors are used more frequently in the European Union.

Figure 6: Examples of a Conventional Tractor (left) and Cab-Over Tractor (right)



Source: GAO. | GAO-19-264

Since 2000, the European Union has required tractors to include front guards to improve the protection of passengers in cars involved in head-on collisions with tractors. These guards are designed to lower the front profile of a cab-over tractor to be more compatible with that of a

passenger vehicle to reduce the potential for underride or override, and to help absorb the force of a collision.[30]

Some conceptual designs for front guards on conventional tractors have been proposed by researchers in the U.S., but there are no designs available for purchase or installation as there are for side underride guards. Some research organizations have developed computer models of front guards, but these guards have not been produced for U.S. tractor configurations. Representatives from three trucking associations we spoke with stated that their members were not researching, producing, or installing front guards. A government official from Canada—where the conventional tractor design is also commonly used—said that they did not know of any tractor manufacturers or truck fleets that use front guards. Representatives from a tractor manufacturer that operates in both the U.S. and the European Union told us that front guard designs currently used in the European Union would not be compatible with conventional tractors used in the U.S., stating that these guards would need to be installed in the same space that the bumper, frame, and some equipment—including crash avoidance technologies—already occupy.

The design of conventional tractors may mitigate the need for front guards for underride or override purposes, as the lower bumpers and frame make the height of conventional tractors more compatible with passenger cars. A 2013 NHTSA study found that tractors with lower bumper heights were less likely to be involved in an override crash than those with higher bumper heights.[31] Government officials from the European Union told us that they did not see the need for conventional tractors to have front guards, since the lower bumpers essentially function as guards in frontal crashes. Officials from a state DOT, a state police department, and a local police department all stated that they do not see the need for front guards because the tractor is already so low to the ground.

Further, state and local officials we spoke with noted that the front underride crashes they have seen often occurred at higher speeds, such

[30]We focused our review of front guards on their use to prevent or mitigate underride or override crashes. Our work did not evaluate the force absorption capabilities or general crashworthiness of tractors in the U.S. or elsewhere.

[31]NHTSA, *Heavy-Vehicle Crash Data Collection And Analysis to Characterize Rear and Side Underride and Front Override in Fatal Truck Crashes*, DOT HS 811 725 (Washington, D.C.: March 2013).

as when a truck fails to stop for congested traffic or in a head-on collision at higher speeds. In these cases, the speed combined with the much greater weight of the truck could cause the truck to override the car (in the first scenario) or the car to underride the tractor (in a head-on collision). According to these officials, the force of the crash at those speeds—regardless of whether there was underride or override—would very likely be unsurvivable.

Additionally, automatic braking systems in tractors and passenger vehicles may further mitigate the need for front guards for underride or override purposes. These technologies—which, according to a tractor manufacturer we interviewed, have been available and installed in some tractors—can potentially stop a tractor from, for example, overriding a passenger vehicle by automatically applying brakes in situations where a potential rear-end collision is detected. Representatives from a tractor manufacturer told us that about 70 to 80 percent of all newly manufactured tractors it produced are equipped with these braking systems and estimated that more than 50 percent of newly built tractors sold by all manufacturers in the U.S. include these systems. Additionally, front guard researchers we spoke with told us that some front underride guard systems would be optimally effective when paired with automated technologies, such as automatic braking systems.

While stakeholders generally agreed that North American tractor designs may mitigate the need for front guards for underride or override purposes, NTSB has called for greater use of front guards. Specifically, in 2010, NTSB recommended that NHTSA, among other things, develop performance standards for front guards and, after doing so, require all newly manufactured trucks weighing more than 10,000 pounds to install these front guards. NTSB issued these recommendations based on its investigation of a June 2009 multi-car crash on an Oklahoma interstate, in which the driver of a tractor trailer failed to slow down for traffic stopped on the roadway. NTSB reported that the tractor-trailer's high impact speed and structural incompatibility with the passenger vehicles contributed to the severity of the crash. As of December 2018, NHTSA had not implemented NTSB's recommendations. NHTSA reported to NTSB in 2014 that it was in the process of conducting further examination of crash data, but that efforts in developing standards for front guards are a secondary priority to upgrading rear guard standards. NTSB stated that NHTSA's response was disappointing and that it continues to believe that NHTSA actions are needed to implement this recommendation. Additionally, NTSB recommended in 2015 that NHTSA develop performance standards and protocols for assessing forward collision

avoidance systems in commercial vehicles, which could also help to stop a tractor from overriding a passenger vehicle. According to NTSB, although NHTSA has performed some research on this technology, NTSB has deemed NHTSA's responses as unacceptable. NHTSA officials told us that the agency anticipates completing relevant research and testing in 2019 that would give the agency the information it needs to make appropriate decisions on next steps related to these NTSB recommendations.

The Wide Variety of Single-Unit Truck Configurations Creates Challenges for Implementing Crashworthy Underride Guards

FMCSA regulations require rear guards for certain single-unit trucks, such as delivery or dump trucks, that are more than 30 inches above the ground. However, according to representatives of the trucking industry we interviewed as well as NTSB, the wide variety of single-unit trucks makes it challenging to develop a one-size-fits-all requirement for underride guards. Single-unit trucks can vary widely with respect to weight, dimensions, and purpose and can include large pick-up trucks, fire trucks, and dump trucks. The FMCSA regulations exempt certain single-unit trucks—such as those already low to the ground—from the requirement to have a rear guard if the vehicle is constructed and maintained such that the body or other parts of the vehicle provide rear end protection comparable to rear guards required for other single-unit trucks.

A trucking industry representative we spoke with said that his association was not aware of any manufacturers currently designing or planning to design crashworthy rear, side, or front underride guards for single-unit trucks due to the variability of single-unit truck design. Some U.S. cities, such as Boston, require pedestrian/cyclist side guards be installed on municipally owned single-unit trucks, but these guards are not designed to mitigate a passenger vehicle underride crash.

Research shows that crashes involving single-unit trucks occur less often and are less likely to cause serious injuries and fatalities than those involving tractor-trailers. For example, a 2013 NTSB study of crash data from 2005 through 2009 found that single-unit truck crashes occurred less often, resulted in fewer fatalities, and were less likely to cause serious

injuries than tractor-trailer crashes.[32] NHTSA has also acknowledged that single-unit trucks represent the majority of the registered heavy vehicle fleet, but account for a lower percentage—27 percent—of rear end fatalities.

To help address fatalities associated with underride crash fatalities involving single-unit trucks, as part of its 2013 study, NTSB recommended that NHTSA develop standards for crashworthy rear, side, and front guards for single-unit trucks, as well as devote efforts to crash avoidance technologies and include more variables in FARS to improve data collection. NTSB also noted that, because of the variability in vehicle design and cargo body styles, safety countermeasures for single-unit trucks would need to be adapted for different truck types to address technical challenges to their implementation.

NHTSA published an ANPRM in 2015 that considered requiring rear guards with strength and energy absorption criteria for all newly built single-unit trucks. However, NHTSA subsequently found that the costs of this requirement outweighed the benefits.[33] Comments on this ANPRM varied. For example, the American Trucking Associations stated that it believed NHTSA underestimated the costs associated with installing crashworthy rear guards for single-unit trucks. In contrast, IIHS, in its comments on the ANPRM, questioned NHTSA's assumptions and stated that the agency was undervaluing the benefits and overestimating the costs. Specifically, IIHS noted that NHTSA overestimated the additional weight of the rear guards, thereby overestimating the cost by about 35 to 40 percent. IIHS also stated that due to concerns with the underlying data, NHTSA underestimated the number of crashes into the rear of

[32]NTSB, *Crashes Involving Single-Unit Trucks that Resulted in Injuries and Deaths*, NTSB/SS-13/01, PB2013-106637 (Washington, D.C.: June 17, 2013). For the crashes and fatalities information, NTSB used 2005 through 2009 data from the Trucks in Fatal Accidents database. For the serious injuries information, NTSB used 2005 through 2009 data from the Crash Outcome Data Evaluation System for the following states: Delaware, Maryland, Minnesota, Nebraska, and Utah. Additional research from IIHS using 2010 FARS data found that 75 percent of deaths in large truck crashes in 2010 were in crashes involving tractor-trailers whereas 25 percent were in crashes involving single-unit trucks. IIHS, "Fatality Facts: Large Trucks, 2010," accessed October 24, 2018, http://www.iihs.org/iihs/topics/t/large-trucks/fatalityfacts/large-trucks/2010.

[33]NHTSA's cost-benefit analysis included in the ANPRM considered the effects of requiring rear guards with strength and energy absorption capabilities on newly built single-unit trucks for class 3 (e.g., delivery trucks) through class 8 (e.g., dump trucks). NHTSA estimated that this requirement would not be cost-effective, even if class 3 single-unit trucks were excluded from the analysis.

single-unit trucks with passenger compartment intrusion. NHTSA officials told us that they disagreed with IIHS's assessment and stated that the data NHTSA used in the ANPRM were valid and appropriate. The ANPRM also considered requiring single-unit trucks to install red and white retroreflective tape meant to increase the visibility of these trucks, especially in the dark. NHTSA found that this requirement would be cost-effective at preventing or mitigating crashes involving single-unit trucks. However, NHTSA has since withdrawn the ANPRM, stating that—based on the comments received as well as analysis of the petitions—the changes being considered were not justified.

Conclusions

The likely underreporting of underride crashes and fatalities due to variability in the data collection process limits NHTSA's ability to accurately determine the frequency of such crashes. An underride field in MMUCC and additional information from NHTSA on how to identify and record these crashes would provide greater assurance that state and local police officers are accurately reporting data on underride crashes. Such reporting would, in turn, enable NHTSA to better identify and support measures—such as rulemakings and research efforts—to help address this issue. While the stronger rear guards being voluntarily implemented by the largest trailer manufacturers show promise in mitigating the potentially devastating effects of rear underride crashes, rear guards will only be effective if they are properly maintained and replaced when damaged. The lack of specific requirements that rear guards be inspected annually for defects or damage potentially affects the safety of the traveling public and FMCSA's ability to achieve its safety mission. Finally, designs of crashworthy side underride guards show promise at mitigating underride crashes, but manufacturers may be reluctant to move forward with further development of these types of guards without information from NHTSA on the effectiveness, cost, and implementation standards for these devices. With additional research on resolving the challenges associated with side underride guards, these guards may be closer to being a feasible solution than automated driver assistance technologies designed to prevent or mitigate side impacts that could lead to an underride crash.

Recommendations for Executive Action

We are making the following four recommendations to DOT:

The Administrator of the National Highway Traffic Safety Administration should recommend to the expert panel of the Model Minimum Uniform Crash Criteria to update the Criteria to provide a standardized definition of underride crashes and to include underride as a recommended data field. (Recommendation 1)

The Administrator of the National Highway Traffic Safety Administration should provide information to state and local police departments on how to identify and record underride crashes. (Recommendation 2)

The Administrator of the Federal Motor Carrier Safety Administration should revise Appendix G of the agency's regulations to require that rear guards are inspected during commercial vehicle annual inspections. (Recommendation 3)

The Administrator of the National Highway Traffic Safety Administration should conduct additional research on side underride guards to better understand the overall effectiveness and cost associated with these guards and, if warranted, develop standards for their implementation. (Recommendation 4)

Agency Comments

We provided a draft of this report to DOT for comment. In its written comments, reproduced in appendix II, DOT stated that it concurred with our recommendations. DOT also provided technical comments, which we incorporated as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees, the Secretary of Transportation, and other interested parties. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or flemings@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.

Susan Fleming
Director, Physical Infrastructure

Appendix I: Objectives, Scope, and Methodology

Our work for this report focused on truck underride crashes, and the U.S. Department of Transportation's (DOT) efforts related to this issue. In particular, this report examines (1) the data DOT reports on underride crashes, and (2) the development and use of underride guard technologies in the U.S.

For both objectives, we conducted a literature review to identify studies regarding truck safety, in general, and underride guards, in particular, published from 1970 through 2018. We conducted a search for relevant peer-reviewed articles, government reports, trade and industry articles, and think tank publications. Key terms included various combinations of "underride," "crash," "collision," and "guard." We included those studies that were methodologically sound and covered underride crash data, guard technologies, and benefits and costs relevant to our scope. Additionally, we interviewed and analyzed the perspectives of government officials from DOT, the National Highway Traffic Safety Administration (NHTSA), the Federal Motor Carrier Safety Administration (FMCSA), and the National Transportation Safety Board. We interviewed officials from foreign transportation agencies—Canada and the European Union—that were selected based on our review of literature identified above and recommendations from preliminary interviewees. We also interviewed a variety of relevant non-governmental organizations to gain their perspectives on topics related to underride crashes and guards. These organizations represent a variety of key players in their respective fields on underride crash-related topics. We grouped these entities into the following categories: (1) trailer manufacturers, (2) trucking industry organizations, (3) tractor-trailer fleets and related organizations, (4) traffic safety organizations, and (5) research organizations. We interviewed seven of the top eight trailer manufacturers in the United States, as identified by the Insurance Institute for Highway Safety. We requested an interview with Stoughton Trailers, but they declined to participate. The organizations we contacted as part of this work are listed at the end of this section. We also interviewed NHTSA officials and conducted semi-structured interviews with officials in five selected states, including officials in five state departments of transportation and five state and two local police departments to understand and identify limitations, if any, in how underride crash-related data are collected and analyzed. The results of these interviews are not generalizable to all states and localities; however, they offer examples of the types of experiences state DOTs and police have with underride crashes and inspections. We selected states based on several factors to identify states that were similar in highway traffic trends and large truck-related fatality rates, but collected underride crash data differently. Selection factors included highway vehicle miles

traveled per state, total underride crash fatalities by state in 2016 as reported by NHTSA, and the presence of an underride crash data field on each state's crash report form. Based on these factors, we selected and conducted interviews with state DOT and state police officials in California, Illinois, Indiana, Pennsylvania, and Tennessee. We also corresponded with officials from the Ohio DOT for clarification questions. We interviewed local police departments in Chicago, Illinois and Terre Haute, Indiana.

To identify the data DOT reports on truck underride crashes, we analyzed existing DOT data on underride crashes and fatalities from 2008 through 2017, the 10 most recent years for which these data are available. We reviewed DOT documentation for policies and procedures on data collection and data reliability assessments for underride crash-related data. NHTSA fatality data came from the Fatality Analysis Reporting System (FARS). FARS is a census of all fatal traffic crashes in the United States that provides uniformly coded, national data on police-reported fatalities. We analyzed these data to determine the reported number of fatalities involving underride crashes. To assess the reliability of the FARS data, we reviewed relevant documentation and spoke with agency officials about the data's quality control procedures. We determined that the data were sufficiently reliable for the purposes of this report, specifically to provide a high-level overview of underride crash fatalities within recent years. However, we did identify potential underreporting of underride crashes and fatalities, as discussed in this report. We also reviewed NHTSA's annual *Traffic Safety Facts* reports—which use FARS data—to determine the annual number of traffic and large truck crash fatalities from 2008 to 2017, the 10 most recent years for which these data are available. We reviewed state crash report forms from all 50 states and the District of Columbia to understand the variability of underride crash-related data elements and how such variability could affect DOT's data collection and analysis efforts. We compared NHTSA's data collection efforts to federal internal control standards related to use of quality information.

To describe the development and use of truck underride guard technologies in the United States, we reviewed research and documentation on underride guards. Primarily, we reviewed documents relating to underride guards from NHTSA and FMCSA, as well as information from traffic safety groups, trucking industry organizations, research organizations, and selected foreign transportation agencies. We reviewed NHTSA's regulations requiring rear guards, FMCSA's regulations requiring commercial vehicle inspections, DOT's

documentation on underride guard technologies, and DOT data on commercial vehicle inspections. To assess the reliability of DOT's commercial vehicle inspection data, we reviewed relevant documentation and spoke with agency officials about the data's quality control procedures. We determined that the data were sufficiently reliable for the purposes of this report, specifically to provide a high-level overview of commercial vehicle inspections within recent years. We compared DOT's efforts to pertinent agency regulations on commercial vehicle inspections, federal internal control standards related to use of quality information, and a statement of federal principles on regulatory planning and review. We spoke with relevant non-governmental organizations to obtain their perspectives on the perceived benefits and costs of rear, side, and front underride guards, and the potential factors that may influence the benefits and costs.

We conducted this performance audit from January 2018 to March 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Organizations Contacted

We interviewed representatives from the following entities:

Federal Government Entities

- U.S. Department of Transportation
  - National Highway Traffic Safety Administration (NHTSA)
  - National Institute for Safety Research (NHTSA's data validation and training contractor)
  - Federal Motor Carrier Safety Administration
- National Transportation Safety Board

State Government Entities

- California Department of Transportation
- California Highway Patrol
- Illinois Department of Transportation

- Illinois State Police
- Indiana Department of Transportation
- Indiana State Police
- Pennsylvania Department of Transportation
- Pennsylvania State Police
- Tennessee Department of Transportation
- Tennessee Highway Patrol

Local Police Departments

- Chicago, Illinois Police Department
- Terre Haute, Indiana Police Department

Foreign Government Entities

- European Commission for Growth—Internal Market, Industry, Entrepreneurship and SMEs
- European Commission for Mobility and Transport
- Transport Canada

Trailer Manufacturers

- Great Dane Trailers
- Hyundai Translead
- Manac Inc.
- Strick Trailers
- Utility Trailer Manufacturing Company
- Vanguard National Trailer Corp.
- Wabash National

Trucking Industry Organizations

- AirFlow Deflector
- American Trucking Associations
- Arconic

- Hydro
- Motor and Equipment Manufacturers Association
- Owner Operator Independent Drivers Association
- Truck and Engine Manufacturers Association
- Truck Trailer Manufacturers Association
- Volvo

Tractor-Trailer Fleets and Related Organizations

- Association for the Work Truck Industry
- M&J Intermodal/Eagle Intermodal
- National Association of Fleet Administrators
- US Foods

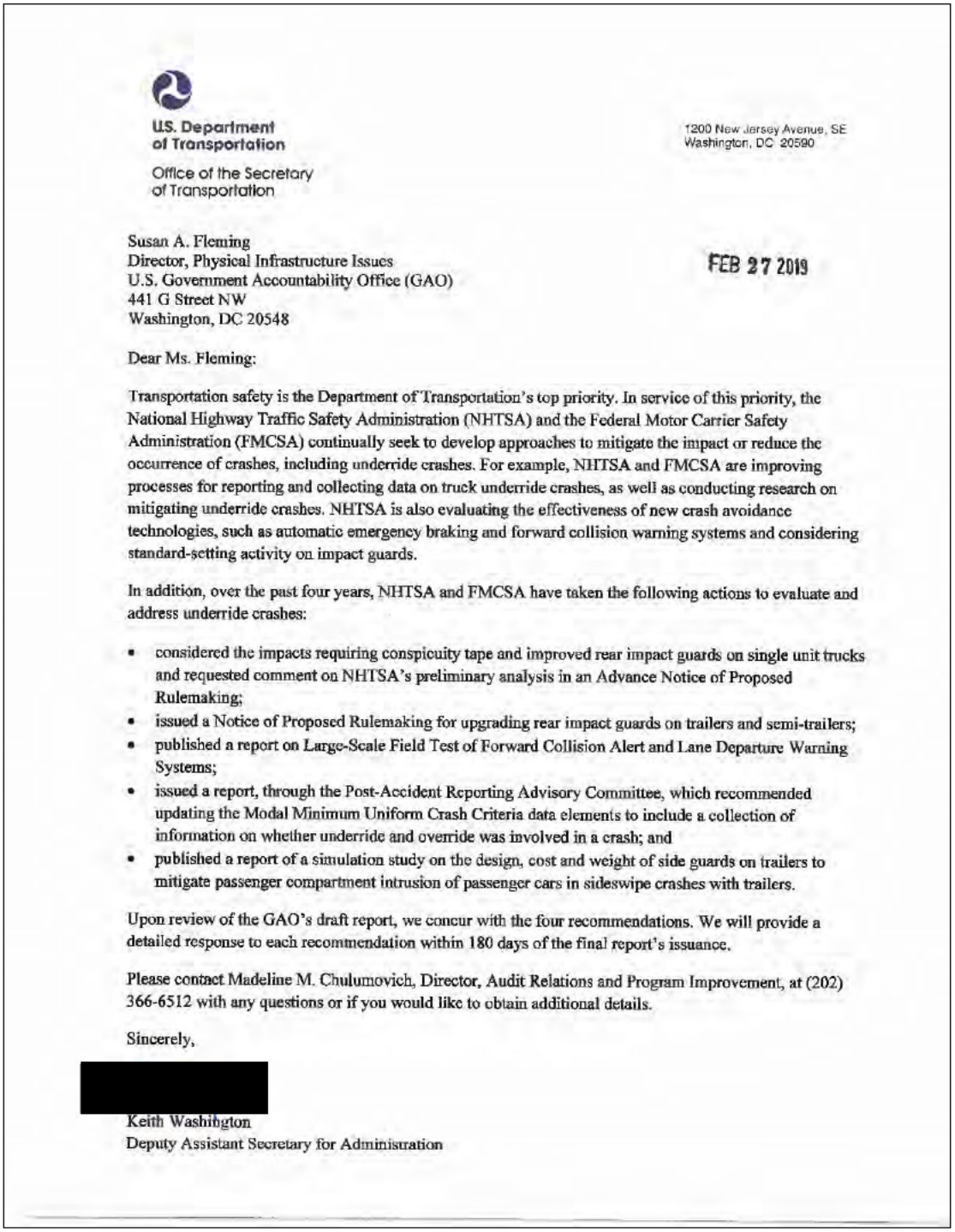
Traffic Safety Organizations

- Advocates for Highway and Auto Safety
- AnnaLeah & Mary for Truck Safety
- Commercial Vehicle Safety Alliance
- Governors Highway Safety Association
- Insurance Institute for Highway Safety
- National Sheriffs' Association
- Property Casualty Insurers Association of America
- Stopunderrides.org
- Truck Safety Coalition

Research Organizations

- Collision Safety Consulting
- Friedman Research Corporation
- Texas A&M Transportation Institute, Center for Transportation Safety
- University of North Carolina, Gillings School of Global Public Health

Appendix II: Comments from the Department of Transportation



U.S. Department of Transportation

Office of the Secretary of Transportation

1200 New Jersey Avenue, SE
Washington, DC 20590

Susan A. Fleming
Director, Physical Infrastructure Issues
U.S. Government Accountability Office (GAO)
441 G Street NW
Washington, DC 20548

FEB 27 2019

Dear Ms. Fleming:

Transportation safety is the Department of Transportation's top priority. In service of this priority, the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) continually seek to develop approaches to mitigate the impact or reduce the occurrence of crashes, including underride crashes. For example, NHTSA and FMCSA are improving processes for reporting and collecting data on truck underride crashes, as well as conducting research on mitigating underride crashes. NHTSA is also evaluating the effectiveness of new crash avoidance technologies, such as automatic emergency braking and forward collision warning systems and considering standard-setting activity on impact guards.

In addition, over the past four years, NHTSA and FMCSA have taken the following actions to evaluate and address underride crashes:

- considered the impacts requiring conspicuity tape and improved rear impact guards on single unit trucks and requested comment on NHTSA's preliminary analysis in an Advance Notice of Proposed Rulemaking;
- issued a Notice of Proposed Rulemaking for upgrading rear impact guards on trailers and semi-trailers;
- published a report on Large-Scale Field Test of Forward Collision Alert and Lane Departure Warning Systems;
- issued a report, through the Post-Accident Reporting Advisory Committee, which recommended updating the Modal Minimum Uniform Crash Criteria data elements to include a collection of information on whether underride and override was involved in a crash; and
- published a report of a simulation study on the design, cost and weight of side guards on trailers to mitigate passenger compartment intrusion of passenger cars in sideswipe crashes with trailers.

Upon review of the GAO's draft report, we concur with the four recommendations. We will provide a detailed response to each recommendation within 180 days of the final report's issuance.

Please contact Madeline M. Chulumovich, Director, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if you would like to obtain additional details.

Sincerely,

[redacted]

Keith Washington
Deputy Assistant Secretary for Administration

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Susan Fleming, (202) 512-2834 or flemings@gao.gov.

Staff Acknowledgments

In addition to the contact named above, Sara Vermillion (Assistant Director); Daniel Paepke (Analyst in Charge); Carl Barden; Jessica Du; Mary Edgerton; Timothy Guinane; David Hooper; Gina Hoover; Madhav Panwar; Joshua Parr; Malika Rice; Oliver Richard; Matthew Rosenberg; Pamela Snedden; and Michelle Weathers made key contributions to this report.

GAO's Mission	The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.
Obtaining Copies of GAO Reports and Testimony	The fastest and easiest way to obtain copies of GAO documents at no cost is through GAO's website (https://www.gao.gov). Each weekday afternoon, GAO posts on its website newly released reports, testimony, and correspondence. To have GAO e-mail you a list of newly posted products, go to https://www.gao.gov and select "E-mail Updates."
Order by Phone	The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, https://www.gao.gov/ordering.htm. Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537. Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.
Connect with GAO	Connect with GAO on Facebook, Flickr, Twitter, and YouTube. Subscribe to our RSS Feeds or E-mail Updates. Listen to our Podcasts. Visit GAO on the web at https://www.gao.gov.
To Report Fraud, Waste, and Abuse in Federal Programs	Contact: Website: https://www.gao.gov/fraudnet/fraudnet.htm Automated answering system: (800) 424-5454 or (202) 512-7700
Congressional Relations	Orice Williams Brown, Managing Director, WilliamsO@gao.gov, (202) 512-4400, U.S. Government Accountability Office, 441 G Street NW, Room 7125, Washington, DC 20548
Public Affairs	Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800 U.S. Government Accountability Office, 441 G Street NW, Room 7149 Washington, DC 20548
Strategic Planning and External Liaison	James-Christian Blockwood, Managing Director, spel@gao.gov, (202) 512-4707 U.S. Government Accountability Office, 441 G Street NW, Room 7814, Washington, DC 20548

Exhibit C

Testimony of Aaron Kiefer, *Hein v. Utility Trailer Manufacturing Company,* August 14, 2019

Page 397

Page 399

MR. SIEVERS: The plaintiffs would call Aaron Kiefer.

AARON JOSEPH KIEFER,

Page 398

Page 400

after having been first duly sworn under oath, was questioned, and testified as follows:

DIRECT EXAMINATION

BY MR. SIEVERS:

Q. Mr. Kiefer, will you please introduce yourself to the jury.

A. My name is Aaron Joseph Kiefer.

Q. And are you the engineer who described something called the trailer guard safety skirt?

A. I am.

Q. And is that different from the AngelWing and the Gen. 3 design that we have been hearing about?

MR. CORONEL: Objection; leading.

THE COURT: Sustained.

Q. We'll talk about your underride guard design, but first, I want to ask you about how you got into this work. Where do you live?

A. I live in Morrisville, North Carolina, and work in an adjacent town Cary, North Carolina.

Q. And do you have an education in engineering?

A. I do. I have a bachelor's degree and master's degree in mechanical engineering from North Carolina State University.

Page 401

Q. When did you get those degrees?
A. Bachelor's was 2002 and master's was 2004.
Q. And where did you go to work after you got your master's degree?
A. Since that time I've been working with an engineering company in Cary called Accident Research Specialists.
Q. Okay. Do you still work there?
A. I do.
Q. And what kind of work do you do there?
A. My day-to-day work is forensic engineering and accident reconstruction, so evaluating the physics and how that emulates to a motor vehicle accident and its causation.
Q. And have you also started your own company?
A. I did. In 2014, I spun off a small side business. I say small because it's me. And I call that Collision Safety Consulting.
Q. And what does Collision Safety Consulting do?
A. Well, I started to notice a pattern in the accidents which I was seeing which a smaller vehicle or a pedestrian or bicyclist --
MR. CROASDELL: Objection, Your Honor. May we approach?

Page 402

(Bench conference held.)
MR. CROASDELL: This was my concern earlier. What we're getting is they're trying to establish him as an expert based on his experience and his technical knowledge, and they're going to try to get lay opinions in under 701. 701 specifically says it cannot be based on specialized knowledge. So I don't know if he wants to ask other questions, and we argue this later or we take a break now.
MR. SIEVERS: Your Honor, I'm not trying to lay a foundation to make him an expert. It's just background information about who he is and why he got interested in the topic of underride guards.
THE COURT: So I'm going to allow the questions as to his background, and I believe there's nothing wrong to have some more lay witness opinion and whether or not it's based on his knowledge and it's rationally related to his observations, so I'll be listening closely.
MR. CROASDELL: But the rule specifically says it cannot be specialized, technical, or other -- I'm sorry. It can't be specialized or technical knowledge, that it can't be an opinion based on that. Otherwise, he's a 702 expert and should have been disclosed, which he has never been.

Page 403

THE COURT: You have heard the basis of what I'll be listening to, and you know that there will be a lot of sustained objections.
(The following proceedings were held in open court.)
Q. Okay. Mr. Kiefer, before the objection, you were talking about your experience as an accident reconstructionist and the pattern that you were noticing. Can you finish what you were talking about?
A. Yes. So the pattern I was noticing was that when a commercial vehicle is involved in an accident, there's a propensity for the other vehicle or pedestrian or bicyclist to go underneath the commercial vehicle and either to be injured or to become entrapped by that type of interaction with the larger vehicle which has a very high floor.
Q. And approximately what time frame did you start thinking about your own -- developing your own side underride guard?
A. I was probably thinking about it in 2012, 2013. And in 2014, I started this small company and just started doing some research and also building a side guard and beginning the process of prototyping and testing.

Page 404

Q. And so at some point, did you sit down and draw up a plan for your underride guard?
A. Yeah, I worked with an engineering graduate student, and we put together some 3-D models of a lightweight and flexible trailer guarding system, which I call the safety skirt, and we did some analyses, and then actually began building prototypes, as I recall, late in 2014.
Q. Did you apply for a patent for your underride guard?
A. I did.
Q. And when did you first do that?
A. My recollection is either 2014 or 2015 I started that process.
Q. Okay. And did you receive a patent for your device?
A. I did.
MR. SIEVERS: Okay. May I approach, Your Honor?
THE COURT: Yes, you may.
Q. I'm going to hand you Exhibit 8I. Do you recognize that document, Mr. Kiefer?
A. I do.
Q. And what is it?
A. This is the first of two patents that I

Page 405

have received.
Q. And does it include drawings of the different parts of the safety skirt and how it connects to a semi trailer?
A. It does.
Q. And that's one of the first, I guess, iterations of the safety skirt?
A. That is correct.
Q. And do those drawings reflect -- the drawings in your patent reflect your concept for a side underride guard?
A. Yes, that was the initial application.
MR. SIEVERS: Okay. Your Honor, I move to admit Exhibit 8I.
THE COURT: Any objection?
MR. CROASDELL: Objection; hearsay. It's not admissible under 703 because Mr. Keifer's not being offered as an expert.
THE COURT: Mr. Sievers.
MR. SIEVERS: It's relevant -- I'm sorry. It's not being offered for expert opinion testimony. It's offered to illustrate his concept for a side underride guard, which he is here to talk about.
THE COURT: Okay. Overruled.
(Exhibit 8I admitted.)

Page 406

Q. Let me take it back and display it for the jury. And this is one of the pages in your patent; right?
A. That's correct.
Q. Can you just sort of use this, and you can draw on the screen -- and we haven't quite mastered that yet -- but you can draw on the screen, if you need to, just to explain the basic concept of your underride guard system using this illustration.
A. Sure. So the concept is that a trailer could be guarded by using a lightweight flexible woven textile. So I've used in this situation a polyester strap, which is otherwise used for lifting very heavy equipment, it is lightweight and can be folded and sewn. So that's the long member that you see stretching along the length of the trailer.
And that flexible member is anchored in the rear corner with a triangulated reinforcement, and that is on the far right side of the screen. That component serves two purposes. It strengthens the existing rear underride guard, which is shown to be incapable in some circumstances of stopping a vehicle from breaking through and penetrating underneath. So that component forms the rear mount and also reinforces the rear guard.

Page 407

Then in the forward portion of the image is a drawing illustrating the first version of a system to connect this flexible skirt into the region of the landing gear. And so the concept was to look at what a minimalist type design could do, one that uses existing trailer structure as much as possible, and also provides some aerodynamic benefit.
And then finally the part there in the center is a guide member to position the safety skirt so that does not interfere with the rear axles of the trailer.
Q. And the three pieces that you see called out in the circled parts of the illustration, what are those made of?
A. All my prototyping has used aluminum because that material is lightweight and strong and easy to work with.
Q. And does your design -- as far as the patent goes, does the patent specify the types of materials that have to be used for the braces or the fabric?
A. Within reason it does. It illustrates the fabric can be any kind of textile or other semi flexible material rather than a metallic or other design. And then the illustration here just gives

Page 408

you the concept. It doesn't mean that they have to look identical to this, but the idea is hard mounts front and rear and then a tension side member.
Q. So when you actually build a device like this, does the weight of it vary on the materials that are used?
A. It absolutely could, yes.
Q. And have you physically built a safety skirt following your design and put it on a trailer?
A. Yes, we have prototyped three different iterations of this design.
MR. SIEVERS: May I approach?
THE COURT: Yes, you may.
Q. I'm going to hand you what we have marked as P10. And do you recognize that?
A. I do.
Q. What is that?
A. This is the very first prototype back in probably late 2015 mounted onto a trailer.
MR. SIEVERS: Your Honor, I move to admit Exhibit P10.
THE COURT: Any objection?
MR. CROASDELL: I object on relevance, Judge.
THE COURT: Overruled. It's admitted.

Page 409

(Exhibit P10 admitted.)
MR. SIEVERS: Thank you, Your Honor.
Q. So what type of material was used for the side panel in this version of the safety skirt?
A. So this is the very first attempt. And what you have is a laminate or basically a folded long tarp on the side of the trailer that hides inside of it a 12-inch tall polyester lifting strap that has a tensile capability of about 100,000 pounds. And so it's a little bit crude, but that's my first attempt of the flexible member along the side of the trailer.
Q. Have you weighed the safety skirts that you have physically built?
A. Yes.
Q. And how much does -- how much do they weigh all together? What's the range of the weights as far as the prototypes that you've built?
A. Well, the prototypes have varied a little bit. But in general, the polyester webbing for one side of the trailer weighs about 70 pounds, and then the rear reinforcement weighs from 50 to 70 pounds as well on one side of a trailer, and in the mount that goes in the front is about another 40 or 50. And so I just estimated about 400 pounds including the

Page 410

hardware to go onto the trailer.
Q. Have you been personally involved in purchasing the materials that go into the prototypes?
A. Yes, it's all been purchased piecemeal up to this time.
Q. Are the materials that go into your guards a new technology or are they something that has been around for a while?
A. No. Polyester has been around since the 1950s or '60s.
Q. And what is the range of the cost of the materials for a single safety skirt, as far as your prototype goes?
A. Yes, depending on exactly what the design looks like, my cost estimate is about $1,000 out-of-pocket when I go and buy one piece of aluminum and one length of polyester. I would expect if this were ever manufactured, that there would be significant savings.
MR. CROASDELL: Your Honor, he's offering expert opinion.
THE COURT: Sustained.
Q. Have you done anything to see if the safety skirt would actually stop a car from going underneath the side of a trailer?

Page 411

MR. CROASDELL: Objection; expert opinion.
THE COURT: Overruled.
A. I have.
Q. What have you done?
A. Well, I have conducted crash testing. I call it grass roots crash testing because it's done by myself and several volunteers, but I've tested these systems over 20 times.
Q. And can you describe how those crash tests have been conducted as far as the logistics of it? How does that work?
MR. CROASDELL: Objection, Your Honor. May we approach?
THE COURT: Yes, please do.
(Bench conference held.)
THE COURT: Should we take a break and discuss this during lunch?
MR. CROASDELL: Sure.
THE COURT: This is a good time.
(The following proceedings were held in open court.)
THE COURT: Ladies and Gentlemen, looking at the time, it's 12:04, so it seems like a very ideal time for a lunch break. Please be back at 1:15, and we'll reconvene or recommence at that time.

Page 412

And my oft repeated instruction about not conducting any independent research or talking with anyone else outside of this case about the case during the break stands. So see you at 1:15.
(The following proceedings were held outside the presence of the jury.)
THE COURT: Thank you. We are in recess. You may step down.
Counsel, let's --
MR. CROASDELL: Judge, my objection is based on Rule 701.
THE COURT: Let me just ask as a start, should we wait until the witness is out of the courtroom?
MR. CROASDELL: Yes, sir.
THE COURT: I didn't mean to interrupt trying to make that distinction.
MR. CROASDELL: I appreciate that, Judge.
Under Rule 701, a lay witness may not offer testimony that is of scientific, technical, or other specialized knowledge. And what we're going to get into is we're going to get into his crash testing, his methodology for crash testing, a lot of scientific, technical knowledge on how he went about proving that his device works. And ultimately, he

Page 413

will say that -- he will be asked the question does this work, and he will say yes, based on where they're going with the question. There's no other reason to ask the questions that they're asking.

So what they're trying to do is they're trying to get in a second expert witness on a device that has not been appropriately tested. But regardless, they're trying to get in a second expert witness.

THE COURT: Okay. Mr. Croasdell, again, to be very transparent about my thought process as we go through this, 701 deals with opinion testimony by lay witnesses.

MR. CROASDELL: Yes.

THE COURT: And just so you know, I've been trying to be very mindful and attentive to distinction between testimony about this witness' own acts or own experiences in this matter or own designs versus allowing opinion testimony along the lines of what you just stated. So I want you to specifically tell me what or where you would have me draw that line, and I don't mean as an advocate draw it before he ever steps up here. I mean, help me understand where you appropriately think that line is drawn.

MR. CROASDELL: Sure. Here's my thought on

Page 414

it, Judge. Here's where I'm thinking. With his statement that he has done crash testing comes the implied opinion that his crash testing was appropriate. My only cross-examination of him when he stands up and says, I've done all this crash testing, is to say, in your opinion was this appropriate, or prove to him why the crash testing was not appropriate, which requires him then to give an opinion. So what they're doing is through the implied opinions that they're giving by going through that he's an engineer, that he's qualified, that he came up with this idea, that he's doing all of this testing, they are giving implied opinions that the testing was appropriate and that the results were verifiable.

The line then is he doesn't have the foundation to say that the testing was appropriate. If he doesn't have that foundation, and he can't establish it because he's not an expert, then the testing that he's done is not relevant. Because what they're trying to do is they're trying to bring in a device that cannot and has not been shown to be an appropriate device. And so I think the line, Judge, is when they are starting to talk about what he did to prove up this device, which is why I objected when

Page 415

I did, when they start talking about what he did to prove up this device is when they're crossing into this specialized, technical implied opinions that the testing is all correct.

Mr. Cyr, a UTM witness, is going to have to get up and testify that he has a background in testing to be able to discuss the testing UTM did, not so much that he can say the testing was appropriate -- we're not going to ask him that question -- but to say that he can understand and explain the testing. That would be very different than -- it would just be factually here's what we did, and here's what our conclusion was based on our test protocol. But it's not going to be, I think the testing was appropriate, or I think the testing passed the standard of care. He will not be giving those kind of opinions.

But there's an implied opinion coming in through all of this that his device works, and he's the only one that's going to be testifying to it, and that's inappropriate.

THE COURT: Okay. And Mr. Sievers -- I mean, again, I'm turning very transparent so you can see where I'm struggling to find the 701 line. And I appreciate your input.

Page 416

Mr. Sievers what would you -- how would you have me gauge when this witness is straying into impermissible, inappropriate lay opinion testimony?

MR. SIEVERS: Well, first of all, I think that there has been no opinion testimony. I haven't asked any questions that are asking for opinion testimony. But my plan is to go and ask him to describe what happened in the crash test and describe how they are set up. In other words, I think for the first series of tests, they use the truck to push a car into a trailer with the guard on it. They describe how the test was set up, and then to describe what happened to the car based on his personal observations of what happened in the scene. It's not an opinion.

And as far as if we were to ask him if the testing were appropriate, I think that would be probably within the realm of expert testimony. But to just ask him to describe what happened, and what he saw with his own eyes is not an opinion. It doesn't follow under the 700 rules at all.

THE COURT: Okay. And to address a good point that Mr. Croasdell made that is foreseeable and not that far down the line, that is his cross, because, you know, I am concerned that I am going to

Page 417

be hamstringing his ability to examine the witness' credibility and qualifications, and I also don't want a string of objections while he's presenting. So what are your thoughts on that?

MR. SIEVERS: Your Honor, I don't quite understand what that objection is. The cross is going to be whether I think it's appropriate?

THE COURT: I guess part of it I imagine is going to be, you know, making sure it's clear that he's not here as an expert witness. It is going to be -- you know, I think it is going to necessarily involve spelling out the divide that we have just been discussing here between lay and expert.

MR. SIEVERS: I just don't see how that affects what's happening on direct, which is asking him to describe in simple terms what he saw with his own eyes. I mean, I think he's allowed to give that testimony. If Mr. Croasdell wants to cross him on whether or not he knows it's appropriate, then that's fine.

THE COURT: Okay. So two things from this discussion, which is, one, I am sympathetic to implied opinions, and yet I think cross is the best way for us to deal with that.

Also, from this discussion, I think it's

Page 418

clear that I am -- I mean, I'm unbiased generally other than fairness. I'm saying, I share defense counsel's concern that this could very easily stray because he's giving essentially lay testimony based on scientific, technologic, or other specified knowledge, but because it's his own actions, I'm giving you greater leeway with this. But if it strays into any questions about the appropriateness or whether there was a pass or a fail or other things other than his own perceptions of the testing, I'm going to uphold and sustain objections.

MR. SIEVERS: Okay.

THE COURT: Is that clear? I know it's not perfect, Mr. Croasdell, but is that clear enough for us to proceed after lunch with this witness, and hopefully not either interrupt Mr. Croasdell's cross every 30 seconds or your direct?

MR. CROASDELL: I understand the Court's opinion.

MR. SIEVERS: Yes.

THE COURT: Thank you very much. With that, we're in recess until 1:15. Thank you.

(Court stood in recess at 12:14 p m.)

(Court in session at 1:22 p.m.)

(The following proceedings were held in

Page 419

open court.)

THE COURT: Please be seated. Mr. Sievers, you may begin when you're ready.

MR. SIEVERS: Thank you, Judge.

CONTINUED DIRECT EXAMINATION

BY MR. SIEVERS:

Q. Mr. Kiefer, before the lunch break, we were talking about the setup of your testing that you did on the side skirt -- the trailer guard safety skirt. Who supplied the trailer that was used for your crash test?

A. I have used three different trailers, and I personally purchased the first one, and the second two were donated by industry.

Q. Okay. Did you reuse the same trailer for multiple crash tests?

A. I did.

Q. And explain why you did that?

A. Well, myself finding this research and development project, so I did use what I had as long as I could.

Q. What types of vehicles have you crashed into the side skirt?

A. I've used mostly vehicles which are similar to the Chevrolet Malibu, and the reason for that is

Page 420

the Malibu is the test vehicle used by IIHS, Insurance Institute for Highway Safety.

Q. When you conduct the crash tests, how do you get the cars moving and up to speed so they're able to get up to speed and crash into the guard without driving it?

A. I have built a custom tow system that hooks onto the front wheels of the car. Earlier in the research, I was simply pushing the truck with a pickup truck.

Q. Have you done anything to record the speed of the cars on impact with the safety skirt in your crash testing?

A. Yes, we use some high speed cameras and just a couple traffic cones to estimate the speed. And the additional benefit of using a Chevrolet Malibu or similar, those cars have a data recorder that is triggered during a collision, so I'm able to read the information about the traveling of the car and the severity of the impact as well.

Q. And did you conduct your crash testing at different crash speeds at varying crash speeds?

A. Yes, I did.

Q. What's the lowest crash speed that you've done?

Page 421

A. The very first test was about 10 miles an hour, just rolling the vehicle into the trailer.
Q. And what's the highest crash speed that you have used so far?
A. Approximately 33 to 34 miles per hour is the highest speed so far.
Q. Okay. In the crash test that you did at 34 miles per hour, can you -- did you see the car after it was crashed into the safety skirt?
A. Yes.
Q. Can you describe the condition of the car after the crash?
MR. CROASDELL: Objection; calls for expert testimony.
THE COURT: Overruled.
MR. SIEVERS: Go ahead.
A. Yes, I did observe the car after the crash. And in that particular test, the car rebounded away from the trailer, and there was no PCI, which we use to abbreviate passenger compartment intrusion, and that is when the side of the trailer cuts into the passenger's compartment.
Q. Where was the most recent crash test of the safety skirt, where did it happen?
A. That was done in Washington, D.C.

Page 422

Q. Okay. And you were there for that one; right?
A. Yes, I was there to conduct the crash testing.
Q. And was it just your safety skirt being crash tested, or was there another device being crash tested as well?
MR. CROASDELL: Objection; hearsay.
THE COURT: Overruled.
A. I conducted three crash tests in Washington, D.C. The first one was conducted on Mr. Ponder's AngelWing design, the second crash test was on my safety skirt, and then the final test was into a trailer that was not guarded.
Q. And did you watch all three of those tests?
A. I did.
Q. Okay. Before you took the stand, did you review two videos that were taken at the crash test in Washington, D.C.?
A. I did.
Q. And you were present when those videos were taken?
A. I was.
Q. Does the first video, Exhibit P13A, which is the unguarded trailer, does that fairly and accurately depict what happens to the car that was crashed into a trailer with no guard attached?
MR. CROASDELL: Objection. These videos were never produced in discovery.
THE COURT: Mr. Sievers.
MR. SIEVERS: They were, Your Honor.
THE COURT: Side bar, please.
(Court stood in recess at 1:29 p m.)
(Court in session at 1:47 p m.)
(Bench conference held.)
THE COURT: I am not finding this request that this appears on the production.
MR. CROASDELL: I believe, Judge, the crash test was conducted after close of discovery.
MR. SIEVERS: We did list this on our exhibit list a month ago. They never asked Mr. Ponder about it at his deposition, which was last week. They could have asked him about it then. Now, Mr. Croasdell was at the crash test and saw this happening. I don't know if there's a Rule of Evidence that would preclude us from using this at this point.
MR. CROASDELL: Judge, there was an authenticity objection. And as the Court identified, we were supplementing discovery right up until the day of trial. If counsel is going to use this thing, they needed to supplement discovery, even if it was after the close of discovery. They never did. And we did make an authenticity objection to the -- both an authenticity and otherwise objecting to his listing of this. So we have objected to it from the very beginning.
MR. SIEVERS: We did disclose it in our exhibit list, and we produced a copy of it before trial, long before trial.
THE COURT: So you produced it?
MR. SIEVERS: We produced a copy of it before trial. I don't know exactly when, but we produced a copy of the video before trial.
MR. CROASDELL: The exhibits were produced to us on August 5.
MR. SIEVERS: And the exhibit list was July 12th.
THE COURT: So, first of all, to make sure I'm clear, was this produced prior to trial?
MR. SIEVERS: Yes.
MR. CROASDELL: On August 5, one week prior to trial, as part of the exchange of exhibits for trial.
THE COURT: Okay. Again, recognizing what

Page 423

Page 424

Page 425

you just mentioned as well, that we were trading exhibits right up until trial, what would be the basis for keeping this out?

MR. CROASDELL: I wasn't trading exhibits. I was supplementing discovery, and the Court said I could not use the exhibit, the summary, executive summary of the testing that I supplemented. Right up until trial, the Court excluded me from using it. And so producing something as part of the exhibit list is not producing something in discovery or supplementing discovery. And if the Court wants to follow that line of reasoning, the Court said we couldn't use what we supplemented at a late date, though we were following the rules. I think it should also apply equally to plaintiff.

THE COURT: And in terms of the objection, tell me what is it again, is it just authenticity?

MR. CROASDELL: Well, we have never had an opportunity to test it, we have never had an opportunity to review it. None of the information relating to the testing has ever been produced, so we don't have -- we don't know if it was at seven miles an hour, 35, or 50. We don't know anything about it. We're going to be learning about all this information for the first time at trial. He wants to just show

Page 426

the video, but none of the scientific data has ever been produced to us to have our expert look at it to determine --

MR. SIEVERS: We don't have it either.

THE COURT: Then it's excluded.

MR. SIEVERS: That video is excluded?

THE COURT: Yes.

MR. CROASDELL: And just to make a quick record, Judge, along this continuing line of questioning, there is a case called State versus Duran that said when observation is the -- the testimony is properly excluded when it has neither the kind of personal observation that a layperson is capable of making or common knowledge within the general public, we're going to get into crash testing and also into things that are not within the normal layperson realm. These are expert testimony ideas. Plaintiffs disclosed experts on April 26, 2018, never supplemented to include Mr. Kiefer. They didn't even include him as a non-retained expert. So we're going to continue to get his observations that a normal layperson would not get, would not have, and that are not within the general -- the knowledge of the general public.

THE COURT: Okay. The video is excluded.

Page 427

And on the standby, I was looking at the ruling before we went to lunch. But again, that ruling also stands with respect to objections and what's going to get sustained.

(The following proceedings were held in open court.)

THE COURT: You may continue in your record.

Q. (By Mr. Sievers) Mr. Kiefer, before the break, we were talking about the crash test that you did in Washington, D.C. What was the speed at which that crash test was conducted?

A. All three crash tests were conducted at 30 miles per hour approximately, give or take a mile per hour.

Q. Okay. And based on what you saw with your own eyes, what did you see happen to the car in that crash?

A. Well, the car that encountered either the AngelWing or the safety skirt guard did not pass underneath the body of the trailer, while the car that did encounter the unguarded trailer passed underneath to a great extent such that the occupant compartment where the driver and front passenger would have been was completely crushed by the side of

Page 428

the trailer.

Q. Is the safety skirt something you hope to sell to be put on trailers after they're built or something trailer manufacturers would put on the original equipment?

MR. CROASDELL: Objection; foundation.

THE COURT: Sustained.

Q. Is it your vision to have the safety skirt offered for sale?

A. Yes.

Q. Okay. Is it also something that you would be satisfied if the trailer manufacturers incorporated that into the original design of its trailer?

MR. CROASDELL: Objection; foundation, relevance.

THE COURT: Overruled.

A. Yes, I think a trailer manufacturer could take what I've done and build off of it and create a useful product for a commercial vehicle and highway safety.

Q. Did you ever have a crash test among the 20 crash tests that you've performed where the car -- where the guard --

THE COURT: Excuse me.

Page 429

MR. SIEVERS: I'm sorry. Please come up here.
(Bench conference held.)
THE COURT: Mr. Sievers' question, I think was fine, but the answer strayed into what I think is impermissible. So, again, I'm bringing you up here because I don't claim to be omniscient. I'm just saying if his answers, even though your question didn't specifically state it, but as to what was the industry should be doing or other expert areas. And then we'll have another side bar about whether this continues.
MR. SIEVERS: Okay.
MR. CROASDELL: I would ask that the Court instruct the jury to -- strike his testimony and instruct the jury not to take into account his answer there.
MR. SIEVERS: I think that the last answer was just about what he sees, what his vision is as to whether it's something that's going to be offered for sale or whether it's something that it would be okay --
THE COURT: That probably wouldn't work or something for the industry.
MR. SIEVERS: Okay.

Page 430

THE COURT: I think that it will work or be useful or something for the industry.
MR. SIEVERS: Okay.
THE COURT: I don't know if it that's true, but that is straying into the opinions. So again, I'm not faulting you for the question.
MR. SIEVERS: Okay.
THE COURT: We're going to have to make sure the answers don't go there either.
MR. SIEVERS: I'll try, yes.
(The following proceedings were held in open court.)
THE COURT: Please continue when you're ready.
MR. SIEVERS: Thanks, Judge.
Q. Out of the 20 or so crash tests that you conducted, have any of the crash tests happened where the car actually went under the trailer and the guard did not stop the car from doing that?
A. Yes, definitely there have been some failures.
Q. And what did you do after that, did you give up on the testing?
A. No, I made engineering adjustments to the system and tried again.

Page 431

Q. Have you ever spoken to any of the major trailer manufacturers about your design?
A. I have. There were a couple of gatherings in 2016 and 2017 at the IIHS where I did discuss my work with some of the manufacturers.
Q. And was Utility Trailer represented at that roundtable?
A. Not to my knowledge.
Q. Have you ever reached out to anyone from Utility Trailer about your design?
A. Yes. Following up on the first roundtable, I reached out to the major trailer manufacturers to let them know what I was doing.
Q. And did anyone from Utility Trailer respond to you?
A. No.
MR. SIEVERS: I pass the witness, Your Honor.
THE COURT: Thank you.
Mr. Croasdell.
MR. CROASDELL: Thank you, Judge.
CROSS-EXAMINATION
BY MR. CROASDELL:
Q. Mr. Kiefer, you and I have never met; is that correct?

Page 432

A. Not to my knowledge.
Q. You met with Mr. Sievers before today, though?
A. I have.
Q. And it was either Mr. Sievers or Mr. Ponder that asked you to come out and testify today; right?
A. Mr. Sievers did.
Q. And they contacted you, and asked you to come out and testify?
A. Yes, they asked me if I would donate some time and energy to come out here and offer testimony about the testing that I have done.
Q. Okay. And part of what you're hoping for is that your idea gets picked up and you make some money off this?
A. I would like to at least make back what I have put into it. It's been a more expensive process than I thought it would be.
Q. What you've offered, what you've suggested, no one has ever said, let's put a piece of cloth along the back side; right?
A. Of a trailer?
Q. Yes, sir.
A. Not to my knowledge.
Q. As a rear impact guard; correct?

Page 433

A. I don't believe so.
Q. You've checked out the DOT regulations to make sure that your device matches the regulations?
MR. SIEVERS: Objection; misleading. There are no regulations on this issue.
MR. CROASDELL: That's incorrect. But I just need an answer to see if he has checked them out.
THE COURT: Overruled.
A. Yes. So there are two regulations that govern rear guards. That is FMVSS 223 and 224.
Q. And I don't mean to interrupt you, Mr. Kiefer, but let me stop you. Let me ask you if you have checked out the DOT regulations on overwidth?
A. I have.
Q. And the DOT regulations on overwidth say that you cannot be more than three inches overwidth on a trailer?
A. I'm aware of that.
Q. And your design violates DOT regulations?
A. My design is less than three inches beyond each side of the trailer.
Q. Okay. You're saying that that little abutment on the patent is under three inches?

Page 434

A. Yes.
Q. All of your testing -- so your first design, you went basically to Wal-Mart or Costco, and you bought the tarp that we can get there, and you put the strap in between; correct?
A. That's right. It wasn't Wal-Mart. But yes, I just bought a tarp.
Q. And it's the same kind of tarp that we see put on, you use it to cover loads, if you're hauling stuff in your truck?
A. Well, this tarp is more like a commercial tarp where you would see it on a tractor-trailer like a flatbed covering the load, so yes.
Q. And wind flaps, that kind of phrase is what we're talking about?
A. Well, the heavy duty tarps on the road generally don't flap and fray if they're tightened down.
Q. But if they're not tightened down, they flap and fray?
A. They definitely could.
Q. True. Another thing about your design is it covers those rear tires, doesn't it?
A. It does.
Q. It makes it difficult to do a safety

Page 435

inspection?
A. Yes. The more recent versions of the product are taking that into account.
Q. But you haven't resolved that problem yet?
A. Well, with relieving some of the areas of the trailer's skirt, then there is an access granted for inspections. But these are the exact issues that a company could overcome with their engineering abilities.
MR. CROASDELL: Objection. Move to strike, Your Honor.
THE COURT: Sustained.
Q. What you have put on your website is that this product needs to be fully researched, prototyped, and developed. And that hasn't happened yet; correct?
A. Well, it's not fully done yet, but we're in the process.
Q. This is not a commercially available product?
A. It is not.
Q. All right. And you have concerns about this one because it is not as robust as putting large steel guards onto a trailer?
A. Yes, this is more of a minimalist design

Page 436

that looks at all the different ways a bicyclist or a pedestrian or a car can interact. But obviously, it's going to be easier to stop a car with steel than it is with a textile.
Q. You haven't tested this device for -- you haven't put it in extreme cold?
A. I have not.
Q. You haven't put it in extreme heat?
A. Well, heat in North Carolina is pretty extreme, but depends on what you mean.
Q. Well, I've been through Death Valley in the middle of the summer. That's what I'm thinking of. You haven't done that?
A. I have not.
Q. And you know that if this was going to go on trucks, it would go up into the northern parts of Canada; right?
A. It could.
Q. And so is it fair to say, Mr. Kiefer, that this is just something that's not yet ready for prime time?
A. No, I would say it's actually proven surprisingly effective and robust, but there's definitely work to be done.
Q. You've started a crowd sourcing to try to

Page 437

get some funding to continue to develop your product?
A. That's correct.
Q. And the list of people who have donated are on your website; right?
A. Those are the people who have donated time and energy. Those are not donors financially.
Q. Perry Ponder has never donated financially?
A. I'm not sure, but I don't think so.
MR. CROASDELL: No further questions, Judge.
THE COURT: Thank you.
Mr. Sievers.
REDIRECT EXAMINATION
BY MR. SIEVERS:
Q. Mr. Kiefer, how could a company like Utility Trailer deal with some of the problems that Mr. Croasdell raised?
MR. CROASDELL: Objection; foundation.
THE COURT: Sustained.
Q. Do you have the resources to do an unlimited amount of testing on the trailer guard?
A. No, I do not. I'm just using personal funds to do this, and it's a very expensive undertaking.
MR. SIEVERS: Thank you. No more

Page 438

questions.
THE COURT: Thank you. Is there anything further for this witness?
MR. SIEVERS: No, Your Honor.
MR. CROASDELL: Nothing from the defense.
THE COURT: Than you're excused.

Page 439

Page 440

Exhibit D

March 7, 2019 letter from Owner-Operator Independent Drivers Association to Senators Kirsten Gillibrand and Marco Rubio

Owner-Operator Independent Drivers Association

National Headquarters: 1 NW OOIDA Drive, Grain Valley, MO 64029
Tel: (816) 229-5791 Fax: (816) 427-4468

Washington Office: 1100 New Jersey Ave. SE, Washington, DC 20003
Tel: (202) 347-2007 Fax: (202) 347-2008

March 7, 2019

The Honorable Kirsten Gillibrand
478 Russell Senate Office Building
Washington, DC 20510

The Honorable Marco Rubio
284 Russell Senate Office Building
Washington, DC 20510

Dear Senator Gillibrand and Senator Rubio,

The purpose of this letter is to convey the Owner-Operator Independent Drivers Association's (OOIDA) strong opposition to S. 665, the *Stop Underrides Act*, which would mandate the installation of rear, side and front underride guards on all commercial motor vehicles (CMV) and trailers that exceed 10,000 pounds in gross vehicle weight (GVW).

OOIDA is the largest trade association representing the views and interests of small-business truckers and professional drivers. We have more than 160,000 members nationwide, all of which would be directly impacted by S. 665.

Over the last several decades, the National Highway Traffic Safety Administration has considered numerous options involving underride guards, but has consistently concluded federal mandates would be impractical and costly, thus outweighing any perceived safety benefits. The reintroduction of the *Stop Underrides Act* intentionally disregards this reality and ignores the safety, economic, and operational concerns we raised with you last Congress.

To be clear, OOIDA supports efforts to improve highway safety. In fact, we agree the existing rear underride guard on trailers – commonly referred to as a "DOT Bumper" in the United States – could be enhanced to reduce the risk of rear underrides for personal automobiles. If the Canadian standard was applied in the U.S. on the manufacture of new trailers, we would not oppose it.

Unfortunately, S. 665 goes too far. Regarding rear underride guards, it would mandate truckers install them on trailers that can't physically accommodate them, such as low boys, household goods trailers, auto transporters, etc. The mandate would retroactively apply to all trailers, including those nearing the end of their service.

S. 665 would also mandate the installation of side underride guards. While existing technologies may reduce passenger compartment intrusion in certain situations, the bill fails to recognize numerous other issues limiting the real world practicality of side underride guards. For example, installation of the equipment would unquestionably create challenges for truckers navigating grade crossings and high curbs, backing in to sloped loading docks, properly utilizing spread-axle trailer configurations, conducting DOT-required trailer inspections, and accessing vital equipment located under the trailer – such as brakes. We also want to reiterate S. 665 would mandate side underride guards on trailers that can't physically accommodate them, such as intermodal, bulk, specialized, and flatbed trailers.

Further, because the bill applies the underride guard mandate to all CMVs in excess of 10,000 pounds GVW, it would require dually trucks pulling wedge trailers – commonly referred to as "hot shots" – to install these devices. Yet, the exact same dually not operating commercially wouldn't be required to have them. Here again, most wedge trailers can't physically accommodate what this bill would mandate.

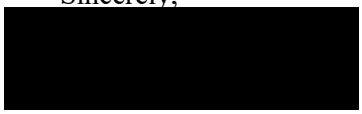
S. 665 also mandates a front underride guard on CMVs. Admittedly, we're less familiar with these devices, because they aren't currently commercially available in the U.S. However, similar to the rear and side underride guard provisions, this requirement would likely be extremely problematic for reasons we can discuss in more detail at a later time.

We would also point out that the bill would require the creation of performance standards for underride devices. Meaning, if an underride guard fails to meet the standard while in operation, the vehicle would be placed out of service and unable to operate. We have no idea how a trucker would get a side underride guard, weighing approximately 1,000 pounds, delivered to the roadside. Nor do we have any idea how the equipment would be installed on the roadside.

In sum, the bill mandates devices that aren't practical, that don't physically work, and that would create operational impossibilities. We should also note that the bill impacts millions of CMVs, trailers, straight trucks, and other vehicles. With an estimated price tag of tens of billions of dollars, S. 665 would implement the single most costly federal trucking mandate in history.

We would encourage you to learn more about the trucking industry, including its incredible diversity, before continuing to promote S. 665. One-size-fits-all solutions simply don't work.

Sincerely,



Todd Spencer
President & CEO
Owner-Operator Independent Drivers Association, Inc.

cc: Members of the Committee on Commerce, Science & Transportation

Exhibit E

June 19, 2019 letter from American Trucking Association to listed members of the House of Representatives

AMERICAN TRUCKING ASSOCIATIONS
950 N. Glebe Road ★ Suite 210 ★ Arlington, VA ★ 22203-4181
www.trucking.org

June 19, 2019

The Honorable Peter DeFazio
Chairman
House Committee on Transportation
& Infrastructure

The Honorable Sam Graves
Ranking Member
House Committee on Transportation
& Infrastructure

The Honorable Eleanor Holmes Norton
Chair
Subcommittee on Highways
& Transit

The Honorable Rodney Davis
Ranking Member
Subcommittee on Highways
& Transit

Dear Chairs and Ranking Members DeFazio, Graves, Norton and Davis:

I write on behalf of the American Trucking Associations (ATA), to address the trucking industry's continued safety efforts and investments; an issue area that was discussed at great lengths during the June 12, 2019 "State of Trucking in America" hearing before the Subcommittee on Highways and Transit. ATA President and CEO Chris Spear appreciated the opportunity to testify before the subcommittee on behalf of the trucking industry, highlighting the industry's unwavering commitment to safety on our nation's roads and bridges, and the safety of the motoring public.

As you know, safety anchors the very foundation of the trucking industry, shaping our core values and decision-making. That is why the trucking industry invests approximately $10 billion annually in safety initiatives, and while some of these investments are made to meet a myriad of regulatory requirements, many of them are voluntary, progressive safety initiatives adopted by our members that are paying dividends in highway safety. That being said, there is still more work to be done, and we are committed to the goal of accident and fatality-free highways.

During the hearing, and further highlighted in his written testimony, Mr. Spear voiced ATA's concerns for, and opposition to, the Stop Underrides Act of 2019, introduced earlier this year in both the House (H.R.1511) and Senate (S.665). However, to supplement his testimony, and also respond to troubling comments and testimony submitted by other witnesses at the hearing, I would like to reaffirm our opposition to the Stop Underrides Act, and further illuminate the unintended consequences this misguided mandate would have on our industry.

The Stop Underrides Act is not based on sufficient science, data or demonstrated overall effectiveness. Moreover, it disregards the significant technical issues a mandate of this nature raises, as well as the other proven technologies that exist for addressing these and other crashes, such as automatic emergency braking, camera monitoring systems, and adaptive turning assist. The bill also ignores the diversity of our industry, failing to take into account that trucking is not a one size fits all industry, and that investments in certain technologies that one company makes may not make sense, or be safe, for another. Standards for both new and in-service truck equipment should be based on sound economic and engineering principles that enhance safety, take into account real-world operations, and weigh possible unintended consequences.

In the written testimony provided by Andy Young, a fellow witness at last Wednesday's hearing, Mr. Young stated that the cost arguments raised by ATA, and others opposing the Stop Underrides Act, must be "taken into perspective". ATA has reviewed the figures provided in Mr. Young's testimony, and has applied those very figures provided to real-world operations, considering the real-world impacts if this requirement were mandated. In his testimony, Mr. Young states that there are 11.7 million registered trailers in existence, as reported by the Federal Highway Administration in 2012.[1] The testimony further states that trailer orders, in 2019, are projected to reach 324,000 trailers. By these projections, the testimony concludes that "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." Equipping the estimated 12 million trailers with a side underride guard, identified in Mr. Young's testimony as costing approximately $2,900 including shipping, would equate to approximately $34.8 billion spent on underride guards. That staggering figure would result in what is likely the largest unfunded mandate on a private sector industry in U.S. history. Furthermore, when combined with the expected cost of labor in installing these guards, would exceed the industry's annual net revenue, essentially putting trucking out of business, and grinding our economy to a screeching halt. Even if the cost of this unproven technology was phased in over a few years as the Stop Underrides Act directs, it would indisputably divert industry resources away from crash avoidance technologies with wide-ranging benefits in all types of crashes to focus on a narrow type of crash and very specific countermeasure unproven in real-world applications.

As you are also aware, in April the Government Accountability Office (GAO) published a report[2], requested by Members of Congress, reviewing the topic of underride crashes. Through a yearlong investigation, including numerous interviews with State and Federal Government, Local Police Departments, Foreign Governments, and over 29 industry groups, including those supportive of this mandate, GAO concluded that more study should be conducted by DOT on this issue—study that can examine the possibilities of unintended consequences that no parties involved with this issue wants to see. ATA agrees with GAO's findings and recommendation for additional research on side underride guards. Our industry's unwavering commitment to safety should not be impeded by hastily mandating a technology that government experts report requires greater study.

Advocates for mandating side underride guards have reiterated that these devices have been tested. ATA is only aware of testing that has been completed on a closed course, at well below highway speeds, during perpendicular side impact crashes into a stationary trailer. Earlier this year at Audi Field, ATA witnessed firsthand that these crash tests were successful in stopping the vehicle from penetrating underneath the side of the trailer within a controlled test environment. What we have not witnessed, nor do we know what *may* happen, is the results of a crash during a realistic highway scenario—at highway speeds, with a moving truck and trailer, and with other traffic present. For instance, a concern remains that a side underride guard may successfully stop the passenger car from going underneath the trailer, however, the potential for that car to bounce off the trailer and strike other vehicles is a concern that should be researched.

Another example of an unintended consequence was provided in comments filed with the National Highway Traffic Safety Administration (NHTSA) in May 2016, the Truck Trailer Manufacturers Association (TTMA). TTMA's comments noted a European trailer manufacturer's experience with trailer failures due to the increased rigidity in the trailer structure from added frame supports for side underride guards. The trailers were less flexible when operated over uneven road surfaces or on surfaces that produced twisting forces, which led to the trailers becoming disabled during highway use, presenting safety risks to other motorists. The TTMA comments also point out that there would be a significantly increased likelihood of high-centering of the side guards on steep changes in highway and street levels, such as

[1] https://www.fhwa.dot.gov/policyinformation/statistics/2012/mv11.cfm
[2] (March, 2019). *Truck Underride Guards, Improved Data Collection, Inspection, and Research Needed* (Report No. GAO-19-264). Retrieved from United States Government Accountability Office: http://www.gao.gov/assets/700/697585.pdf.

elevated railroad crossings, and at warehouse docking wells. High-centering incidents already occur when operators of low frame trailers misjudge clearance heights at railroad crossings, which can result in tractor-trailers becoming stranded on railroad tracks. If all commercial vehicles were to have substantial side underride guards, as this bill requires, high-centering incidents would likely become more frequent.[3]

The Stop Underrides Act also fails to consider numerous complicating factors such as engineering tradeoffs involving weight, strength, and effectiveness of side guards. This is *not* an issue of the added weight to the trailer requiring companies to transport less freight, but rather serious concerns for the potential to degrade the structural ability of a trailer over time. As referenced in Mr. Young's testimony, trailers often see a lifespan of over 15 years. Without further study, it is impossible for us to anticipate the effects of this added weight. Furthermore, the bill raises significant operational issues related to ground clearance, moveable trailer axles, and the diversity of truck and trailer designs. For example, the ridged specified design of side underrides would not work well with tank and bulk trailers that are cylindrical in size and require underbelly accessibility; flatbed trailers, which unloaded, are naturally curved to suppress weight; and intermodal trailers that are shipped and locked onto specific designed chassis for hauling. Simply put, these glaring operational concerns do not suggest real world applicability, nor justify an industry-wide mandate.

ATA continues to believe that the most effective improvements to road safety should be directed at preventing the crash from happening in the first place. The Stop Underrides Act focuses on mitigation after the crash has already taken place. Our focus should be on crash avoidance that can be achieved by enhancing vehicle-to-vehicle (V2V) connectivity. As such, ATA has been a leading member of the Safety Spectrum Coalition, which includes the National Safety Council, in the effort to preserve the 5.9 GHZ spectrum for vehicle safety use, which will have significant implications for connectivity crash avoidance. In NHTSA's January 2017, V2V Notice of Proposed Rulemaking for light-duty vehicles, the Agency estimates that four safety applications enabled by the proposed rule could avoid or mitigate 89% of light-duty vehicle crashes.[4] NHTSA is currently also conducting research on V2V for heavy vehicles, and estimates that 70% of crashes involving trucks occurred in scenarios that could be addressed by V2V systems.[5]

Based on the testimony provided at last weeks hearing, we felt it necessarily to further communicate our concern for, and opposition to the Stop Underrides Act. As you can see, our concerns are very broad in scope, and not solely an issue of the economic impact. The technical concerns, unintended consequences, diversity of operations, vehicle/trailer designs, and consideration of alternative technologies have brought us to the position we reiterate today. Nevertheless, ATA and the trucking industry remain dedicated in a commitment to improving the safety of our nation's roads and bridges, and look forward to our continued work with your respective Committees, Congress, the Administration, enforcement, and other interested parties on the shared the goal of enhancing highway safety.

Thank you for your thoughtful consideration, and leadership on this critical issue.

[redacted]

Vice President, Safety Policy
American Trucking Associations

[3] Truck Trailer Manufacturers Association letter to NHTSA Administrator Mark Rosekind, May 13, 2016. Docket No. NHTSA-2015-0118-0041.
[4] 82 Fed. Reg. 3863.
[5] Chang, J. (2016, July). Summary of NHTSA heavy-vehicle vehicle-to-vehicle safety communications research. (Report No. DOT HS 812 300). Washington, DC: National Highway Traffic Safety Administration.