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DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
49 CFR Part 571
Docket No. NHTSA-2023-0012
RIN 2127-AM54
Side Underride Guards

AGENCY: National Highway Traffic Safety Administration (NHTSA); Department of Transportation (DOT).

ACTION: Advance notice of proposed rulemaking (ANPRM).

SUMMARY: This ANPRM responds to Section 23011(c) of the November 2021 Infrastructure Investment and Jobs Act (IIJA), commonly referred to as the Bipartisan Infrastructure Law (BIL), which directs the Secretary to conduct research on side underride guards to better understand their overall effectiveness, and assess the feasibility, benefits, costs, and other impacts of installing side underride guards on trailers and semitrailers. The BIL further directs the Secretary to report the findings of the research in a Federal Register notice to seek public comment. In addition, this ANPRM also responds to a petition for rulemaking from Ms. Marianne Karth and the Truck Safety Coalition (TSC).

DATES: You should submit your comments early enough to ensure that the docket receives them not later than [INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: You may submit comments to the docket number identified in the heading of this document by any of the following methods:

- Federal eRulemaking Portal: Go to <http://www.regulations.gov>. Follow the online instructions for submitting comments.
- Mail: Docket Management Facility: U.S. Department of Transportation, 1200 New Jersey Avenue S.E., West Building Ground Floor, Room W12-140, Washington, D.C. 20590-0001.
- Hand Delivery or Courier: 1200 New Jersey Avenue S.E., West Building Ground Floor, Room W12-140, between 9 a.m. and 5 p.m. ET, Monday through Friday, except Federal holidays.
- Fax: 202-493-2251.

Instructions: All submissions must include the agency name and docket number. Note that all comments received will be posted without change to <http://www.regulations.gov>, including any personal information provided. Please see the Privacy Act discussion below. We will consider all comments received before the close of business on the comment closing date indicated above. To the extent possible, we will also consider comments filed after the closing date.

Docket: For access to the docket to read background documents or comments received, go to <http://www.regulations.gov> at any time or to 1200 New Jersey Avenue, S.E., West

Building Ground Floor, Room W12-140, Washington, D.C. 20590, between 9 a.m. and 5 p.m., Monday through Friday, except Federal Holidays. Telephone: 202-366-9826.

Privacy Act: In accordance with 5 U.S.C. 553(c), DOT solicits comments from the public to better inform its decision-making process. DOT posts these comments, without edit, including any personal information the commenter provides, to www.regulations.gov, as described in the system of records notice (DOT/ALL-14 FDMS), which can be reviewed at www.transportation.gov/privacy. In order to facilitate comment tracking and response, we encourage commenters to provide their name, or the name of their organization; however, submission of names is completely optional. Whether or not commenters identify themselves, all timely comments will be fully considered.

Confidential Business Information: If you wish to submit any information under a claim of confidentiality, you must submit your request directly to NHTSA's Office of the Chief Counsel. Requests for confidentiality are governed by 49 CFR part 512. NHTSA is currently treating electronic submission as an acceptable method for submitting confidential business information to the agency under part 512. If you would like to submit a request for confidential treatment, you may email your submission to Dan Rabinovitz in the Office of the Chief Counsel at Daniel.Rabinovitz@dot.gov or you may contact him for a secure file transfer link. At this time, you should not send a duplicate hardcopy of your electronic CBI submissions to DOT headquarters. If you claim that any of the information or documents provided to the agency constitute confidential business information within the meaning of 5 U.S.C. § 552(b)(4), or are protected from disclosure pursuant to 18 U.S.C. § 1905, you must submit supporting information together with the materials that are the subject of the confidentiality request, in accordance with part 512, to the Office of the Chief Counsel. Your request must include a cover letter setting

forth the information specified in our confidential business information regulation (49 CFR 512.8) and a certificate, pursuant to § 512.4(b) and part 512, Appendix A. In addition, you should submit a copy, from which you have deleted the claimed confidential business information, to the Docket at the address given above.

FOR FURTHER INFORMATION, CONTACT:

For technical issues: Ms. Lina Valivullah, National Highway Traffic Safety Administration, 1200 New Jersey Avenue SE, West Building, Washington, DC 20590 (telephone) 202-366-8786, (email) Lina.Valivullah@dot.gov.

For legal issues: Ms. Callie Roach, Office of the Chief Counsel, National Highway Traffic Safety Administration, 1200 New Jersey Avenue SE, West Building, Washington, DC 20590, (telephone) 202-366-2992, (email) Callie.Roach@dot.gov.

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I. Introduction

This ANPRM responds to Section 23011(c) of the BIL that directs the Secretary to complete research on side underride guards to better understand their overall effectiveness, and to assess the feasibility, benefits, and costs of, and any impacts on intermodal equipment, freight mobility, and freight capacity associated with, installing side underride guards on new trailers and semitrailers. The BIL further directs the Secretary to report the findings of the research in a Federal Register notice to seek public comment. NHTSA is also issuing this ANPRM in response to a petition for rulemaking from Ms. Karth and TSC (the Petitioners) to begin studies and rulemakings on side underride guards and front override guards on trucks. NHTSA initiated research on side underride guards following a March 2019 Government Accountability Office (GAO) recommendation to conduct additional research on side underride guards to better understand the overall effectiveness and cost associated with these guards.¹

This ANPRM summarizes a 2022 NHTSA report that presents an analysis of the potential effects of a requirement for side underride guards on new trailers and semitrailers pursuant to Section 23011(c) of the BIL and the March 2019 GAO recommendation. The report, titled, “Side Impact Guards for Combination Truck Trailers: Cost-Benefit Analysis,” is referred

¹ GAO Report to Congressional Requestors, “Truck Underride Guards – Improved Data Collection, Inspections, and Research Needed,” March 14, 2019, (GAO-19-264), <https://www.gao.gov/products/gao-19-264>.

to as the “2022 NHTSA report” in this ANPRM and is provided in the docket to this ANPRM.²

The report details analyses of crash databases for estimating annual fatalities and serious injuries in side underride crashes and NHTSA’s analysis of the benefits and costs of requiring trailers to be equipped with side underride guards to mitigate injuries and fatalities resulting from side underride crashes involving light passenger vehicles and trailers and semitrailers. This report provides a preliminary estimate that would inform any benefit-cost analysis that NHTSA would conduct under E.O. 12866 if the agency were to propose a new Federal Motor Vehicle Safety Standard (FMVSS) to require side underride guards on trailers and semi-trailers. NHTSA estimates that 17.2 lives would be saved and 69 serious injuries would be prevented annually when all trailers in the fleet are equipped with side underride guards. The discounted annual safety benefits when side underride guards are equipped on all applicable trailers and semitrailers are estimated to range from \$129 million to \$166 million at 3 and 7 percent discount rates. The total discounted annual cost (including lifetime fuel cost) of equipping new trailers and semitrailers with side underride guards is estimated to range between \$970 million and \$1.2 billion at 3 and 7 percent discount rates. The resulting cost per equivalent life saved is in the range of \$73.5 million to \$103.7 million.

The agency requests comments that would help NHTSA assess and make judgments on the benefits, costs, and other impacts of side underride guards to increase protection for occupants of passenger vehicles in crashes into the sides of trailers and semitrailers. This ANPRM summarizes NHTSA’s research and requests comment on the accuracy of the estimated

² The report may be obtained by downloading it or by contacting Docket Management at the address or telephone number provided at the beginning of this document. Note that the report uses the term “combination truck (CT)” to mean “tractor-trailer.”

benefits, costs, and other impacts of requiring side underride guards on heavy trailers and semitrailers.

NHTSA requests comments on approaches to potentially mitigate or eliminate these horrific crashes given the disparity in vehicle size and crash outcome. Are there alternative engineering solutions to mitigate underride crashes into the sides of trailers? Are there non-regulatory actions that could be taken to decrease side underride crashes? Public comment, with supporting data or analysis, is sought for advanced technologies and design solutions to reduce deaths and serious injuries resulting from underride crashes into the sides of trailers.

II. Overview

a. Side Underride Guards

Underride crashes are those in which the front end of a vehicle impacts a generally larger vehicle and slides under the chassis of the impacted vehicle. Side underride may occur in collisions in which a passenger vehicle crashes into the side of a large trailer or semitrailer (referred to in this ANPRM collectively as “trailers”)³ because the trailer bed is higher than the hood of the passenger vehicle. In passenger compartment intrusion (PCI) crashes, the passenger vehicle underrides to the extent that the side of the struck vehicle intrudes into the passenger compartment. PCI crashes can result in passenger vehicle occupant injuries and fatalities caused by occupant contact with intruding components of the vehicle.

This ANPRM focuses on side underride guards on trailers to prevent a passenger vehicle from sliding under the trailer in the event of a collision. The guard must be strong enough to

³ A trailer or semitrailer is typically drawn by another motor vehicle referred to as a “tractor”. The combination of the trailer and the tractor is referred to as a “tractor-trailer” in this ANPRM.

withstand the forces of the crash. Other side structures that are sometimes installed on trailers and semitrailers include aerodynamic skirts, which are designed for fuel efficiency, and “lateral protection devices,” which are intended to prevent pedestrians or cyclists from falling in front of the trailer’s rear wheels. Aerodynamic skirts and lateral protection devices are generally not strong enough to prevent underride of a passenger vehicle in a crash. Internationally, side underride guards on trailers to prevent vehicle underride are not required by any country, though some countries have a requirement for lateral protection devices.

There are currently no Federal requirements for side underride guards on trailers. NHTSA specifies requirements for rear impact guards on trailers in Federal motor vehicle safety standards (FMVSSs) Nos. 223 and 224. FMVSS No. 223, an “equipment standard,” specifies performance requirements for rear impact guards on new trailers and semitrailers. FMVSS No. 224, a “vehicle standard,” requires most new trailers and semitrailers with a gross vehicle weight rating of 4,536 kilograms (kg) (10,000 pounds (lb)) or more to be equipped with a rear impact guard meeting FMVSS No. 223.

b. Petitions and Related Rulemakings

NHTSA received a petition for rulemaking from Ms. Marianne Karth and the Truck Safety Coalition (TSC) on September 12, 2013, requesting that the agency increase the stringency and applicability of current requirements for rear impact (underride) guards and begin studies and rulemakings on side underride guards and front override guards on trucks. In response, NHTSA published an ANPRM on July 23, 2015, requesting comment on NHTSA’s estimated costs and benefits of requiring rear impact guards and retroreflective tape on single

unit trucks (SUTs).⁴ Additionally, NHTSA published a notice of proposed rulemaking (NPRM) on December 16, 2015 to increase the stringency of the current rear impact guard requirements by aligning with Transport Canada’s rear impact guard standard that ensures protection to passenger car occupants in 56 kilometers per hour (km/h) (35 miles per hour (mph)) impacts into the rear of trailers and semitrailers.⁵ NHTSA completed this rulemaking by issuing a final rule on July 15, 2022 to upgrade FMVSS No. 223, “Rear impact guards,” and FMVSS No. 224, “Rear impact protection,” to improve occupant protection in crashes of passenger vehicles into the rear of trailers and semitrailers.⁶

Subsequent to the December 2015 NPRM, on February 4, 2021, Mr. Jerry Karth and Ms. Marianne Karth, along with 23 other signatories, submitted a “Petition for Comprehensive Underride Supplemental Rulemaking” requesting enhanced front, side, and rear underride protection on commercial motor vehicles. In response to the September 2013 and February 2021 petitions for rulemaking regarding requirements for side underride guards, this ANPRM seeks comment on NHTSA’s estimated costs and benefits of requiring side underride guards on new trailers and semitrailers.

c. Bipartisan Infrastructure Law

On November 15, 2021, President Biden signed the Infrastructure Investment and Jobs Act (IIJA), commonly referred to as the Bipartisan Infrastructure Law (BIL).⁷ Section 23011 of the BIL specifies provisions for underride protection measures for trailers and semitrailers. As

⁴ 80 FR 43663, RIN 2127-AL57.

⁵ 80 FR 78418, RIN 2127-AL58.

⁶ 87 FR 42339, RIN 2127-AL58.

⁷ <https://www.congress.gov/bill/117th-congress/house-bill/3684/text>

discussed in detail below, the provisions direct the Secretary to conduct additional research on side underride guards.

Section 23011(c)(1)(A) of the BIL directs the Secretary to complete, not later than 1 year after enactment of the Act, additional research on side underride guards to better understand the overall effectiveness of the guards. Section 23011(c)(1)(B) requires the Secretary to assess, among other matters, the feasibility, benefits, and costs of, and any impacts on intermodal equipment, freight mobility (including port operations), and freight capacity associated with, installing side underride guards on new trailers and semitrailers with a gross vehicle weight rating (GVWR) of 10,000 pounds or more. Section 23011(c)(1)(C) requires consideration of the unique structural and operational aspects of intermodal chassis and pole trailers. Section 23011(c)(1)(D) directs the Secretary to develop performance standards for side underride guards, if warranted.

Section 23011(c)(3) of the BIL directs the Secretary to publish the results of the side underride guard assessment specified in Section 23011(c)(1)(B) within 90 days of completion of the assessment and provide an opportunity for public comment. Section 23011(c)(4) then directs that, within 90 days from the date the comment period closes, the Secretary shall submit a report to Congress on the assessment results, a summary of comments received, and a determination whether the Secretary intends to develop performance requirements for side underride guards, including any analysis that led to that determination.

d. GAO Recommendation

In March 2019, the Government Accountability Office (GAO) published a Report to Congressional Requesters on Truck Underride Guards.⁸ Based on the findings of this report, GAO recommended that the Department of Transportation (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 impact guards, and conduct additional research on side underride guards. Specifically, regarding the research, recommendation 4 of the report stated that “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.” The Department of Transportation (DOT) concurred with this recommendation.

e. Purpose of This ANPRM

In this ANPRM, the agency discusses the research and analysis of side underride crashes detailed in its 2022 report and the potential effects of a requirement for side underride guards on new trailers, and requests comments on the information presented. The agency seeks information that would help NHTSA assess and make judgments on the benefits, costs, and other impacts of side underride guards to increase protection for occupants of passenger vehicles in crashes into the sides of trailers.

III. Research, Benefits, and Costs

This section summarizes the analyses of crash data and estimates of benefits, costs, and cost effectiveness of a requirement for side underride guards on new trailers that is detailed in the

⁸ GAO Report to Congressional Requesters, “Truck Underride Guards – Improved Data Collection, Inspections, and Research Needed,” March 14, 2019, (GAO-19-264), <https://www.gao.gov/products/gao-19-264>.

2022 NHTSA report pursuant to Section 23011(c) of the BIL and the March 2019 GAO recommendation.

a. Crash Data

In order to estimate annual fatalities and injuries associated with side underride crashes, NHTSA analyzed crash data involving light passenger vehicles⁹ and tractor-trailers. The analysis focused on crashes in which the tractor-trailer received damage to the side or undercarriage and the passenger vehicle received damage to the front or top of the vehicle. In other words, the analysis considered side impact, sideswipe, and angled crashes between the two vehicles.

Data sources for this analysis included the Fatality Analysis Reporting System (FARS) 2008-2017, National Automotive Sampling System General Estimates System (GES) 2008-2015, National Automotive Sampling System Crashworthiness Data System (NASS-CDS) 2006-2015, and Crash Report Sampling System (CRSS) 2016-2017.¹⁰ NHTSA used 2008-2017 FARS data to identify fatal crashes involving passenger vehicles and the sides of trailers. GES data from 2011 to 2015 and CRSS data from 2016 and 2017 provided the general patterns of occupant injuries in crashes of passenger vehicles with the sides of trailers. NASS-CDS data from 2006 to 2015 were used to estimate the relative velocity distributions associated with occupant injury severities in side underride crashes. The effects of other crash factors on the number of fatalities and effectiveness of side underride guards were also considered in the analysis. In addition, the

⁹ Light passenger vehicles include passenger cars, light trucks, and vans with gross vehicle weight ratings (GVWRs) of 10,000 pounds or less.

¹⁰ Information on NHTSA's databases are available at [Crash Data Systems | NHTSA](#).

agency reviewed documents cited by the Petitioners in the context of side underride crashes for additional information.

To develop a better understanding of vehicle underride into the side of tractor-trailers, NHTSA conducted a review of Police Crash Reports (PCRs) of all two-vehicle crashes involving a light vehicle crashing into the side of a tractor-trailer in 2017 FARS. In addition to the coded elements in the PCR, the review included the crash narrative, interviews, scene diagrams, and photographs. The PCR review provided details to determine the impact location on the tractor-trailer, whether underride and/or PCI of the light passenger vehicle occurred, whether the impact speed was less than or equal to 64 km/h (40 mph), and whether side underride guards located between front and rear trailer wheels would have mitigated fatalities and injuries. For cases with insufficient information to determine underride, the agency conducted further investigations to obtain crash and vehicle damage details. Of the 184 PCRs reviewed in the 2017 FARS data files, NHTSA determined that 92 crashes of a light passenger vehicle into the side of tractor-trailers involved underride while FARS reported only 52 crashes with underride. NHTSA also determined that among the 184 cases, 105 light passenger vehicle fatalities occurred in crashes with underride while FARS reported only 59 fatalities in crashes with underride. Based on this information, NHTSA estimated that the actual number of fatalities associated with side underride was 78 percent higher than reported in FARS ($= 105/59 - 1$). As noted in the 2019 GAO report on underride, previous evaluations of underride data have indicated that vehicle underride is underreported in FARS. The PCR review provided a best estimate of the current underreporting of side underride crashes in the FARS data files. The agency's analysis of side underride crashes therefore adjusts for the level of underreporting in FARS.

To obtain a more accurate estimate of fatalities associated with side underride crashes, NHTSA considered the extent of underreporting of side underride crash fatalities determined from the detailed review of PCRs of front-to-side crashes of a passenger vehicle and a tractor-trailer identified in the 2017 FARS data together with results from an analysis of the 2008-2017 FARS data files. Analysis of the FARS data revealed that the annual average number of light passenger vehicle occupant fatalities in crashes with the sides of tractor-trailers was 212, of which 50 fatalities (about 24 percent) were attributed to side underride crashes. NHTSA estimated, taking into account the 78 percent greater number of underride fatalities than that reported in FARS, that on an annual average, there are 89 ($= 50 \times 1.78$) light passenger vehicle occupant fatalities in two-vehicle crashes with tractor-trailers (trailer along with the vehicle with motive power drawing the trailer or semitrailer) where a light passenger vehicle strikes the side of a tractor-trailer and underrides it.

From the analysis of NASS-GES 2011-2015 and the CRSS 2016-2017 data files, NHTSA estimated there are 230 serious injuries to light passenger vehicle occupants in underride crashes into the side of trailers. After applying the estimated 78 percent greater number of side underride fatalities than that in NHTSA databases to serious injuries, we estimate an average of 409 ($= 230 \times 1.78$) serious injuries to light passenger vehicle occupants in underride crashes into the side of trailers annually.

The agency reviewed additional documents cited by the Petitioners in the context of side underride crashes. In a 2012 paper, Brumbelow used the Trucks in Fatal Accidents (TIFA)¹¹

¹¹ TIFA contains records for all medium and heavy trucks that were involved in fatal traffic crashes in the 50 States of the United States and the District of Columbia for the years 1980 to 2010. The TIFA database provides additional detail beyond that in the FARS data files. [Trucks in Fatal Accidents \(TIFA\) and Buses in Fatal Accidents \(BIFA\) | National Highway Traffic Safety Administration \(NHTSA\)](#).

data files for the three-year period from 2006 to 2008 and estimated that on an annual average, there are 530 passenger vehicle occupant fatalities in two-vehicle crashes involving a passenger vehicle impacting the side of a truck.¹² Brumbelow noted that 20 percent of the side-impacted trucks were straight trucks and the remaining were tractor-trailers or tractors without trailers. Brumbelow also noted that TIFA did not provide information on the impact location (impact with tractor, between tractor and trailer, between front and rear axles of the trailer, or behind the trailer rear wheels), and that not all of the fatalities and injuries in the crashes were due to underride. In a 2017 news release, IIHS stated that in 2015, 301 passenger vehicle occupants were killed in two-vehicle crashes involving a passenger vehicle impacting the side of a tractor-trailer.^{13,14} Additional information on the data source and the percentage of crashes with underride was not provided in this 2017 news release. Since the data in these two documents cited by the petitioners are not specific to vehicle underride, the data could not be used to estimate fatalities or injuries in crashes involving vehicle underride.

NHTSA used the available crash data along with the detailed PCR reviews to account for any underreporting of side underrides and associated fatalities. The data sources used form the most comprehensive set available to determine the number of fatalities and serious injuries to light vehicle occupants in side underride crashes with trailers and semitrailers. This ANPRM seeks comment on whether additional data sources provide information about the frequency of

¹² Matthew L. Brumbelow (2012) Potential Benefits of Underride Guards in Large Truck Side Crashes, *Traffic Injury Prevention*, 13:6, 592-599, DOI: 10.1080/15389588.2012.666595

¹³ IIHS News Release, “IIHS crash tests reveal benefits of underride guards for the sides of semitrailers,” 2017.

¹⁴ IIHS also cited requirements in some U.S. cities for “side guards on city-owned and/or contracted trucks.” However, these are lateral protection devices for protecting pedestrian and bicyclists, and are unlikely to prevent vehicle underride.

side underride crashes, injuries, and fatalities or whether the data sources on which NHTSA relied could be improved.

b. Side Underride Guard Effectiveness

Side underride guards are not currently required on trailers by any country. At the time of this analysis, the agency is aware of only one side underride guard system intended to mitigate side underrides and PCI that has been crash tested by a third party and is available for installation on trailers in the United States. The AngelWing guard, manufactured by AirFlow Deflector, is largely constructed of steel and has an off-the-shelf weight of 450 to 800 pounds depending on the specific configuration.¹⁵ In 2017, the IIHS tested the AngelWing side underride guard. In the first evaluation, a midsize sedan struck the side of a trailer at 56 km/h (35 mph). The first crash was conducted with only an aerodynamic fiberglass side skirt on the trailer and resulted in vehicle underride. In the second crash, the trailer had the AngelWing device installed; the guard bent in the crash but the sedan did not underride the trailer. Another crash test was conducted by IIHS later in 2017 at 64 km/h (40 mph) with similar results.

Side underride guard designs that have not been finalized, tested, and made available for purchase and installation on trailers have not been included in this analysis of guard costs and benefits because information needed for conducting the analysis are not available for these designs. For example, a “lateral protection system” made by Canadian firm PHSS Fortier for trailers in the United States was not included because test results, pricing information, and effectiveness data are unavailable.¹⁶ NHTSA requests information on side underride guards that

¹⁵ AirFlow Deflector, <https://airflowdeflector.com/>

¹⁶ The system comprises multiple vinyl belts and weighs approximately 540 pounds (245 kg). The system is designed to function as a side underride guard, aerodynamic skirt, and pedestrian/cyclist guard. It reportedly has been tested by PHSS Fortier at impact speeds up to 35 mph. <https://protectionlaterale.ca/en/our-product-lateral-protection/>

have been fully developed and tested and are currently available for installation on trailers in the United States.

From the PCR review of 184 relevant cases in the 2017 FARS data files, NHTSA estimated that 19.9 percent of side underride fatalities occurred at impact speeds below 64 km/h (40 mph). For evaluating the benefits of side underride guards, the subset of crashes at impact speeds below 64 km/h (40 mph) are relevant because 64 km/h (40 mph) is the maximum impact speed at which the existing side underride guard considered in this analysis have demonstrated passenger vehicle occupant protection.¹⁷

To estimate the effect of a side underride guard requirement on safety outcomes, we need an estimate of the effectiveness of side underride guards on trailers in mitigating fatalities and serious injuries. Based on NHTSA's PCR review and the available AngelWing side guard test data, NHTSA assumed (1) side underrides occur where a side guard would be located (between the fifth wheel/kingpin and rear axles), and (2) a zero-percent failure rate of side guards in preventing underride for vehicles that strike the side guards at impact speeds of 64 km/h (40 mph) or less. The agency also estimated the latent risk of fatality and serious injury when a side guard successfully transforms what would have been an underride into a frontal collision using a NHTSA analysis of fatality risk in frontal collisions as a function of change in velocity.¹⁸ Taking into account seat belt use along with the latent risk of fatality, the agency estimated a 3 percent fatality risk in mitigated side underrides. Subtracting this estimated fatality risk in mitigated side underrides yields a 97 percent effectiveness of side underride guards in mitigating

¹⁷ AngelWing side guard tested by the Insurance Institute for Highway Safety (IIHS) mitigated underride of light passenger vehicles in crashes into the side of trailers at impact speeds up to 64 km/h (40 mph). https://airflowdeflector.com/angelwing_underride-1/

¹⁸ Wang, J.-S. (2021). *MAIS (05/08) Injury Probability Curves as Functions of Delta-V*. Washington, DC: National Highway Traffic Safety Administration.

fatalities in underride crashes into the side of trailers at impact speeds 64 km/h (40 mph) or less. A similar process was used for estimating the effectiveness of side underride guards in mitigating serious injuries. NHTSA estimated 85 percent effectiveness of side underride guards in mitigating serious injuries in underride crashes into the side of trailers at impact speeds 64 km/h (40 mph) or less. Details of the methods used for estimating effectiveness of side underride guards are provided in the 2022 NHTSA report.

c. Benefits

Section 6 of Executive Order 12866 directs NHTSA to conduct a benefit/cost analysis of any proposed regulatory requirements.

NHTSA estimated the benefits of equipping trailers with side underride guards by first calculating the total number of fatalities and serious injuries avoided if all trailers were equipped with side underride guards.

NHTSA estimated that there are annually 89 light vehicle occupant fatalities and 409 serious injuries in two-vehicle crashes with tractor-trailers where a light passenger vehicle strikes the side of a tractor-trailer and underrides it. This estimate accounts for the 78 percent higher number of underride fatalities than that in NHTSA's crash databases. Since only 19.9 percent of side underride crashes are at impact speed 64 km/h (40 mph) or less for which side underride guards would be effective, NHTSA estimates the target population for side underride guards as 17.7 ($= 89 \times 0.199$) fatalities and 81 ($= 409 \times 0.199$) serious injuries. Using side underride guard effectiveness of 97 percent for mitigating fatalities in crashes with impact speeds less than or equal to 64 km/h and 85 percent for mitigating serious injuries, NHTSA estimated that 17.2 ($= 17.7 \times 0.97$) lives would be saved and 69 ($= 81 \times 0.85$) serious injuries would be prevented annually when all trailers in the fleet are equipped with side underride guards.

NHTSA uses a “value of statistical life” (VSL) to monetize benefits of lives saved and injuries prevented by regulations. The VSL for NHTSA’s analysis is based on the 2021 Department of Transportation Guidance on Valuation of a Statistical Life in Economic Analysis,¹⁹ with a VSL of \$11.9 million in 2020 dollars. NHTSA’s analysis incorporates components of the economic costs of fatalities and injuries, including medical, EMS, market productivity, household productivity, insurance administration, workplace, legal, congestion, travel delay, and the nontangible value of physical pain and loss of quality of life (i.e., quality adjusted life years, QALYs).²⁰ NHTSA’s analysis applies the same process to estimate the economic costs of serious injuries associated with side underride crashes. Using these comprehensive costs of fatalities and injuries, NHTSA estimated that the discounted lifetime safety benefits in 2020 dollars when side underride guards are equipped on all applicable trailers and semitrailers would be \$165.9 million at a 3 percent discount rate and \$128.5 million at a 7 percent discount rate. This represents a benefit of approximately \$640 per trailer or semitrailer at a 3-percent discount rate (\$490 per trailer or semitrailer at a 7% discount rate).

These estimates do not account for the potential effects of advanced driver assistance technologies (ADAS) such as automatic emergency braking, blind spot detection, and lane keeping technologies, which could reduce the number of crashes even without the presence of underride guards. ADAS is expected to help mitigate underrides by preventing collisions and mitigating impact speeds, which would reduce the number of fatalities and serious injuries relevant to this analysis, but NHTSA does not have sufficient data to account for this effect. Additionally, because side underride occurs predominantly at impact speeds above 40 mph,

¹⁹ [Departmental Guidance on Valuation of a Statistical Life in Economic Analysis | US Department of Transportation](#)

²⁰ The comprehensive economic costs of injury are detailed in the 2022 NHTSA Report.

protective effects from ADAS above 40 mph could generate a large increase in the safety benefits. However, we do not have information available on the degree to which side underride guards may offer passenger vehicle occupant protection above the test speed of 40 mph. The agency requests data on additional factors that affect the estimated benefits of side underride guards on trailers and semitrailers.

d. Costs

NHTSA used the existing AngelWing system as the basis for the price, weight, and installation costs of side underride guards on trailers. Initial hardware cost for the AngelWing was listed at \$2,897 per trailer at the time of data collection. We acknowledge that broad adoption of side underride guards would likely lead to considerable changes in the market, and thus it is feasible that the market would experience downward price pressure due to increasing returns to scale and competition from other potential suppliers. However, we do not have sufficient information to project the impact on prices, and thus apply the unadjusted price for this analysis. Installation is stated to require fewer than two hours for two people. We assumed an average of 1.5 hours per person per trailer. With two people, we estimate 3 labor hours per trailer at \$31 per hour²¹ for a total labor cost of \$93 per trailer. The average total cost of installing side underride guards on a trailer, including hardware and labor, was therefore estimated to be \$2,990 in 2020 dollars.

We estimate that a requirement for side underride guard would apply to 260,000 new trailers and semitrailers sold annually. Given these figures, the total annual initial cost for equipping all applicable new trailers with side underride guards would be approximately \$778

²¹ Estimates from the Bureau of Labor Statistics for an automotive repair worker.

million. This cost estimate does not include any additional costs associated with reinforcing trailers to accommodate the side underride guards and any associated changes to trailer loading patterns. We acknowledge that such costs would add to total hardware, installation, and operating costs. However, we do not have sufficient information available to estimate these additional costs.

We also calculated lifetime incremental fuel costs for applicable trailers in the fleet subject to a side underride guard requirement. With an estimated ratio of one Class 8 truck per two trailers, the equivalent of 130,000 trucks would carry new trailers equipped with side underride guards. We assumed that 40 percent of all applicable new trailers would be equipped with aerodynamic side skirts, which reduce per-mile fuel costs. With a weight increase of 450 to 800 pounds per trailer, requiring side underride guards is estimated to increase lifetime fuel costs for new trailers entering the fleet each year by approximately \$250 million to \$430 million at a 3 percent discount rate, and approximately \$200 million to \$340 million at a 7 percent discount rate. Incremental fuel costs represent between approximately one-fourth and two-fifths of estimated total costs, depending on the side underride guard weight and the discount rate.

Under a side underride guard requirement, total annual costs for new trailers were estimated to increase by \$1.02 billion to \$1.20 billion at a 3 percent discount rate, and \$970 million to \$1.12 billion at a 7 percent discount rate, depending on the weight of the guards. The cost per trailer would be approximately \$3,930 to \$4,630 at a 3-percent discount rate, and \$3,740 to \$4,300 at a 7 percent discount rate. We assumed that the annual sales of trailers and semitrailers would remain the same in the future, and consequently the annual cost of equipping new trailers with side underride guards and the discounted lifetime fuel costs remain the same in future years.

These estimated cost impacts do not include additional costs that accrue due to incremental wear and tear on equipped trailers. Side underride guards may impose non-uniform loads on trailer floors, adding stresses that decrease trailer lifetimes in the absence of repair. It is possible that side underride guards would obstruct proper safety inspections of the underside of the trailer. They may also strike or entangle with road structures and loading area components, leading to additional repair costs or restricted access to destinations. Another unquantified cost could result from restrictions on trailer axle configurations. The rear axles of trailers are commonly able to be moved fore and aft to adjust to loading conditions; losing this capability would add to operating costs. We seek comment on these potential effects of installing side underride guards. Furthermore, the estimated costs do not include any potential effects of side underride guards on port and loading dock operations and freight capacity, and on increased greenhouse gases and other pollutants resulting from increased fuel consumption. We seek comment on the practicability and feasibility of side underride guards regarding intermodal operations and effects of side underride guards on intermodal equipment, freight mobility, freight capacity, and port operations.

e. Net Benefits and Cost Effectiveness

The estimated benefits and costs discussed in the preceding sections were used to calculate the net benefits for a side underride guard requirement on trailers and semitrailers. The estimated annual benefits, costs, and net benefits are summarized in Table 1. The benefits and costs were also used to estimate the cost effectiveness (cost per equivalent life saved). These values are summarized in Table 2.

Table 1. Estimate of Annual Total Benefits, Total Costs, and Net Benefits (Equipping 260,000 Eligible New CT Trailers with Side Underride Guards, in Millions of 2020 Dollars)

Scenario	3% Discount Rate	7% Discount Rate
<i>Total Benefits:</i>		
Central Case	\$165.9	\$128.5
<i>Total Costs:</i>		
Low Cost Estimate: 450-Pound Side Guard Weight	\$1,022.5	\$972.7
High Cost Estimate: 800-Pound Side Guard Weight	\$1,203.8	\$1,117.2
<i>Net Benefits (total benefits less total costs):</i>		
Low Cost Estimate, Central Case	-\$856.7	-\$844.2
High Cost Estimate, Central Case	-\$1,037.9	-\$988.7

Table 2. Estimated Cost Per Equivalent Life Saved (in Millions of 2020 Dollars)

Scenario	3% Discount Rate	7% Discount Rate
Low Cost Estimate, Central Case	\$73.5	\$90.3
High Cost Estimate, Central Case	\$86.6	\$103.7

f. Sensitivity Analysis

NHTSA also conducted a sensitivity analysis to consider the effects of changes in cost assumptions and the effects of a larger target population using the upper-bound underreporting factor from the FARS-PCR analysis. The analytical inputs specified above in subsections a. through e. (e.g., underreporting rate, hardware cost, vehicle miles traveled) are the best representations of these values NHTSA could develop based on available information and that set of inputs is referred to as the “central case.” There is uncertainty in the analytical inputs, however. In the sensitivity analysis, we explored alternative values to identify the extent to which the relationship between benefits and costs associated with a side underride guard requirement changed as the inputs changed.

NHTSA estimated 78 percent higher number of side underride fatalities than that reported in FARS. Increasing the percent higher number of side underride fatalities to that reported in FARS to 155 percent²² yields lifetime safety benefits of approximately \$185 million to \$240 million, at a 7 percent and 3 percent discount rate, respectively.

In the central case, we used a hardware cost equal to the assumed baseline price for the AngelWing system. A 20 percent reduction in the cost would reduce annual hardware costs by an estimated \$151 million to \$603 million. With no assumed change in installation costs, the total annual hardware and installation cost would be an estimated \$627 million, versus \$778 million in the central case.

We also considered a sensitivity case in which the trailer vehicle miles traveled (VMT) increased by five percent due to capacity and operational constraints under a side underride guard requirement.²³ The additional fuel cost impacts involve the incremental costs of carrying all trailer weight (the original trailer weight plus the side underride guard weight) across the five percent increment of VMT. The resulting estimated incremental fuel costs dominate all other impact measures in both the central analysis and the sensitivity analysis; a 5 percent increase in VMT would result in increased lifetime fuel costs of approximately \$2.0 to \$2.5 billion at a 7 percent and 3 percent discount rate, respectively.

With the estimates above, we were able to examine a variety of sensitivity cases. In all sensitivity cases, as in the analysis of the central case presented in subsection a. through e., the net benefits of a side underride guard requirement for all new trailers remain negative. In the

²² The 155 percent is an upper bound of the higher number of underride crash fatalities than that reported in FARS identified in NHTSA's PCR review for crash speeds below 40 mph.

²³ The additional weight of side underride guards could potentially reduce cargo capacity due to weight limitations and shift some cargo to new truck trips that would not otherwise have taken place, leading to higher VMT and greater operational costs.

best-case scenario (i.e., 155 percent greater number of fatalities than that reported in FARS and 20 percent lower hardware costs), the lifetime net benefits are still negative (approximately -\$630 to -\$640 million at a 3 percent and 7 percent discount rate, respectively). We seek comment on other factors that could affect the estimated net benefits of mandating side underride guards on trailers.

g. Summary of Analysis

The analysis discussed in this document indicates that equipping all new trailers with side underride guards would reduce the number of fatalities and serious injuries for passenger vehicle occupants associated with side underride crashes into trailers. Equipping a new trailer with side underride guards is estimated to generate approximately \$640 in lifetime discounted safety benefits at a 3 percent discount rate under the central range of assumptions evaluated, or approximately \$490 per trailer at a 7 percent discount rate. The total discounted lifetime costs of equipping new trailers with side underride guards are estimated to be approximately \$3,930 to \$4,630 per trailer at a 3 percent discount rate, or approximately \$3,740 to \$4,300 per trailer at a 7 percent discount rate. On a per trailer basis, the total discounted lifetime costs of equipping new trailers and semitrailers with side underride guards is six to eight times the corresponding estimated safety benefits. The net benefits for a side underride guard requirement on trailers and semitrailers are estimated to be in the range of -\$844 million to -\$1,038 million. The cost per equivalent life saved is estimated to be in the range of \$73.5 million to \$103.7 million.

The analysis considered a range of input assumptions to account for uncertainty in the size of the target population, hardware costs, and fuel consumption impacts. The target population of fatalities and serious injuries could increase if: (1) the baseline level of relevant fatalities and serious injuries is much larger than estimated; or (2) side underride guards provided

some protection to passenger vehicle occupants at impact speeds above 40 mph. The PCR review offered a thorough analysis of one year's crashes and established a meaningful estimate of the rate of side underride underreporting in FARS. By basing our estimated target population on the underreporting rate from the PCR review, we are confident that we have represented the target population accurately. Side underride occurs predominantly at impact speeds above 40 mph, so protective effects above 40 mph could generate a large incremental improvement above the safety benefits estimated in this analysis. However, we do not have data available on the degree to which side underride guards may offer passenger vehicle occupant protection at impact speeds above 40 mph.

The results of this study reflect existing side underride guard designs. It is possible that future designs may: mitigate side underride at higher speeds (increasing safety benefits); have lower hardware costs (reducing costs); or weigh less (reducing costs). There are also unquantified factors that would be expected to reduce net benefits. The safety benefits may be smaller than estimated due to decreases in crash risks associated with ADAS, leading to a smaller baseline level of side underride fatalities and serious injuries. Cost impacts may also be larger than estimated due to increased VMT. However, we do not have any data to support modified characteristics in place of our baseline assumptions.

The analysis did not include any effects of side underride guards on port and loading dock operations and freight capacity. It did not take into consideration modifications to infrastructure, maintenance and practicability and feasibility of intermodal operations for trailers equipped with side underride guards.

IV. Request for Comment

NHTSA requests comments that would help the agency assess and make judgments on the benefits, costs, and other impacts of requiring side underride guards on trailers. In providing a comment on a particular matter or in responding to a particular question, interested persons are asked to provide any relevant factual information to support their opinions, including, but not limited to, statistical and cost data and the source of such information. For easy reference, the questions below are numbered consecutively.

1. The injury target population was obtained by reviewing crash data and estimating side underride underreporting in FARS through PCR reviews. We seek comment on the estimated injury target population resulting from underride crashes with PCI into the side of trailers.

2. The agency assumed side underride guard effectiveness of 97 percent for fatalities and 85 percent for serious injuries in light vehicle crashes with PCI into the sides of trailers at speeds up to 40 mph. We seek comment on this effectiveness estimate.

3. In estimating benefits, the agency assumed that side impact guards would mitigate fatalities and injuries in light vehicle impacts with PCI into the sides of trailers at impact speeds up to 40 mph. We recognize, however, that benefits may accrue from underride crashes at speeds higher than 40 mph. We seek information on quantifying possible benefits of side impact guards in crashes at speeds above 40 mph.

4. Are there other benefits that NHTSA has not considered that could be used to justify a mandate for side underride guards? The agency seeks information and supporting rationale concerning these additional benefits of side underride guards.

5. In estimating benefits, NHTSA did not account for the potential effects of advanced driver assistance technologies (ADAS) which could reduce the number of crashes independently of the

presence of underride guards. The agency requests data on additional factors that affect the estimated benefits of side underride guards on trailers and semitrailers.

6. In estimating costs, the agency did not include the cost and weight of strengthening the beams, frame rails, and floor of the trailer to accommodate side underride guards. NHTSA seeks information on changes that would be required and the additional costs resulting from these changes.

7. NHTSA's cost estimates were based on the AngelWing side underride guard manufactured by Airflow Deflector. NHTSA seeks relevant information on side underride guards that have been fully developed and tested and are currently available for installation on trailers in the United States.

8. NHTSA did not take into consideration the practicability and feasibility of side underride guards on trailer and semitrailer operations. Could side underride guards scrape or snag on the road surface when the vehicle travels over humped surfaces such as a highway-rail crossing, or when the vehicle enters a steep loading dock ramp? Could this interaction of side underride guards with the ground disable movement of the trailer and significantly damage the side underride guards, thereby requiring their replacement? We seek information on the effects of side underride guards on trailer and semitrailer operations.

9. The analysis did not account for the effects of side underride guards on port and loading dock operations and freight capacity, and the practicability and feasibility of side underride guards in intermodal operations. We seek information on the effects of side underride guards on intermodal operations.

V. Rulemaking Analyses

Executive Order 12866, Executive Order 13563, and DOT Regulatory Policies and Procedures

The agency has considered the impact of this ANPRM under Executive Orders (E.O.) 12866 and 13563 and the Department of Transportation's regulatory policies and procedures. In this ANPRM, the agency requests comments that would help NHTSA assess and make judgments on the benefits, costs and other impacts, of strategies that increase the crash protection to occupants of vehicles crashing into the side of trailers and semi-trailers. Strategies discussed in this ANPRM are possible requirements for the installation of side underride guards on new trailers and semitrailers. This ANPRM is significant under E.O. 12866 and was reviewed by the Office of Management and Budget.

The agency has made preliminary estimates of the costs and benefits of the above strategy. Equipping a new trailer with side underride guards is estimated to generate approximately \$640 in lifetime discounted safety benefits at a 3 percent discount rate under the central range of assumptions evaluated, or approximately \$490 per trailer at a 7 percent discount rate. The total discounted lifetime costs of equipping new trailers and semitrailers with side underride guards are estimated to be approximately \$3,930 to \$4,630 per trailer at a 3 percent discount rate, or approximately \$3,740 to \$4,300 per trailer at a 7 percent discount rate. The net benefits for a side underride guard requirement on trailers and semitrailers are estimated to be in the range of -\$844 million to -\$1,038 million. The cost per equivalent life saved is estimated to be in the range of \$73.5 million to \$103.7 million.

NHTSA requests comments on these estimates. Information from the commenters will help the agency further evaluate the course of action NHTSA should pursue in this rulemaking on side underride guards.

Paperwork Reduction Act

Under the Paperwork Reduction Act of 1995 (PRA), a person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid OMB control number. This ANPRM would not establish any new information collection requirements.

Privacy Act

In accordance with 5 U.S.C. 553(c), DOT solicits comments from the public to better inform its rulemaking process. DOT posts these comments, without edit, including any personal information the commenter provides, to www.regulations.gov, as described in the system of records notice (DOT/ALL-14 FDMS), which can be reviewed at www.dot.gov/privacy.

Plain Language

Executive Order 12866 requires each agency to write all rules in plain language. Application of the principles of plain language includes consideration of the following questions:

- Have we organized the material to suit the public's needs?
- Are the requirements in the document clearly stated?
- Does the document contain technical language or jargon that isn't clear?
- Would a different format (grouping and order of sections, use of headings, paragraphing) make the document easier to understand?
- Would more (but shorter) sections be better?
- Could we improve clarity by adding tables, lists, or diagrams?
- What else could we do to make the document easier to understand?

If you have any responses to these questions, please include them in your comments.

Regulation Identifier Number (RIN)

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

VI. Submission of Comments

How Can I Influence NHTSA's Thinking on This Rulemaking?

In developing this ANPRM, we tried to address the concerns of all our stakeholders. Your comments will help us improve this rulemaking. We invite you to provide different views on options we discuss, new approaches we have not considered, new data, descriptions of how this ANPRM may affect you, or other relevant information. We welcome your views on all aspects of this ANPRM, but request comments on specific issues throughout this document. Your comments will be most effective if you follow the suggestions below:

- Explain your views and reasoning as clearly as possible.
- Provide solid technical and cost data to support your views.
- If you estimate potential costs, explain how you arrived at the estimate.
- Tell us which parts of the ANPRM you support, as well as those with which you disagree.
- Provide specific examples to illustrate your concerns.

-- Offer specific alternatives.

-- Refer your comments to specific sections of the ANPRM, such as the units or page numbers of the preamble.

Your comments must be written and in English. To ensure that your comments are correctly filed in the docket, please include the docket number of this document in your comments.

Your comments must not be more than 15 pages long (49 CFR §553.21). We established this limit to encourage you to write your primary comments in a concise fashion. However, you may attach necessary additional documents to your comments. There is no limit on the length of the attachments.

Please submit your comments to the docket electronically by logging onto <http://www.regulations.gov> or by the means given in the ADDRESSES section at the beginning of this document.

Please note that pursuant to the Data Quality Act, in order for substantive data to be relied upon and used by the agency, it must meet the information quality standards set forth in the OMB and DOT Data Quality Act guidelines. Accordingly, we encourage you to consult the guidelines in preparing your comments. OMB's guidelines may be accessed at <http://www.whitehouse.gov/omb/fedreg/reproducible.html>.

How Do I Submit Confidential Business Information?

Confidential Business Information: If you wish to submit any information under a claim of confidentiality, you must submit your request directly to NHTSA's Office of the Chief

Counsel. Requests for confidentiality are governed by 49 CFR part 512. NHTSA is currently treating electronic submission as an acceptable method for submitting confidential business information to the agency under part 512. If you would like to submit a request for confidential treatment, you may email your submission to Dan Rabinovitz in the Office of the Chief Counsel at Daniel.Rabinovitz@dot.gov or you may contact him for a secure file transfer link. At this time, you should not send a duplicate hardcopy of your electronic CBI submissions to DOT headquarters. If you claim that any of the information or documents provided to the agency constitute confidential business information within the meaning of 5 U.S.C. § 552(b)(4), or are protected from disclosure pursuant to 18 U.S.C. § 1905, you must submit supporting information together with the materials that are the subject of the confidentiality request, in accordance with part 512, to the Office of the Chief Counsel. Your request must include a cover letter setting forth the information specified in our confidential business information regulation (49 CFR 512.8) and a certificate, pursuant to § 512.4(b) and part 512, Appendix A. In addition, you should submit a copy, from which you have deleted the claimed confidential business information, to the Docket.

Will the Agency Consider Late Comments?

We will consider all comments that the docket receives before the close of business on the comment closing date indicated above under DATES. To the extent possible, we will also consider comments that the docket receives after that date. If the docket receives a comment too late for us to consider it in developing the next step in this rulemaking, we will consider that comment as an informal suggestion for future rulemaking action.

How Can I Read the Comments Submitted by Other People?

You may read the comments received by the docket at the address given above under ADDRESSES. You may also see the comments on the Internet (<http://regulations.gov>).

Please note that even after the comment closing date, we will continue to file relevant information in the docket as it becomes available. Further, some people may submit late comments. Accordingly, we recommend that you periodically check the docket for new material.

Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the Federal Register published on April 11, 2000 (Volume 65, Number 70; Pages 19477-78).

Authority: 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.95.

Sophie Shulman
Deputy Administrator