

Mention of Injuries in NHTSA Underride Regulatory Analysis

[Advanced Notice of Proposed Rulemaking \(ANPRM\) for Side Impact Guards](#) (4/23)

I see no description of actual specific injuries incurred in underride crashes, with lethal passenger compartment intrusion, beyond the generic use of the word “injury” or “serious injuries.”

7 mentions of the word “injury”:

1. <https://www.federalregister.gov/d/2023-08-451/p-60> - NASS-CDS data from 2006 to 2015 were used to estimate the relative velocity distributions associated with occupant injury severities in side underride crashes.
2. <https://www.federalregister.gov/d/2023-08451/p-77> - 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 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.
3. <https://www.federalregister.gov/d/2023-08451/p-104> - 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.
4. <https://www.federalregister.gov/d/2023-08451/p-67> - 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.

5. <https://www.federalregister.gov/d/2023-08451/p-78> - 18. Wang, J.-S. (2021). *MAIS (05/08) Injury Probability Curves as Functions of Delta-V*. Washington, DC: National Highway Traffic Safety Administration.
6. <https://www.federalregister.gov/d/2023-08451/p-84> - 20. The comprehensive economic costs of **injury** are detailed in the 2022 NHTSA Report.

34 Mentions of “Injuries”:

1. <https://www.federalregister.gov/d/2023-08451/p-37> - 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 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.
2. <https://www.federalregister.gov/d/2023-08451/p-40> - 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.

3. <https://www.federalregister.gov/d/2023-08451/p-41> - 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.
4. <https://www.federalregister.gov/d/2023-08451/p-58> - In order to estimate annual fatalities and **injuries** associated with side underride crashes, NHTSA analyzed crash data involving light passenger vehicles^[9] 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.
5. <https://www.federalregister.gov/d/2023-08451/p-60> - 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.
6. <https://www.federalregister.gov/d/2023-08451/p-62> - 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**.
7. <https://www.federalregister.gov/d/2023-08451/p-64> - 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 × 1.78) **serious injuries** to light passenger vehicle occupants in underride crashes into the side of trailers annually.

8. <https://www.federalregister.gov/d/2023-08451/p-65> - 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.
9. <https://www.federalregister.gov/d/2023-08451/p-70> - 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 side underride crashes, **injuries**, and fatalities or whether the data sources on which NHTSA relied could be improved.
10. <https://www.federalregister.gov/d/2023-08451/p-77> - 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 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.

11. <https://www.federalregister.gov/d/2023-08451/p-80> - 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.
12. <https://www.federalregister.gov/d/2023-08451/p-81> - 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.
13. <https://www.federalregister.gov/d/2023-08451/p-82> - 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).

14. <https://www.federalregister.gov/d/2023-08451/p-85> - 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, 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.
15. <https://www.federalregister.gov/d/2023-08451/p-100> - 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.
16. <https://www.federalregister.gov/d/2023-08451/p-101> - 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.

17. <https://www.federalregister.gov/d/2023-08451/p-102> - 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.
18. <https://www.federalregister.gov/d/2023-08451/p-106> - 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.
19. <https://www.federalregister.gov/d/2023-08451/p-106> - 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.
20. <https://www.federalregister.gov/d/2023-08451/p-107> - 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.