DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. NHTSA-2015-0070]

RIN 2127-AL57

Rear Impact Protection,

Lamps, Reflective Devices, and Associated Equipment,

Single Unit Trucks

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

ACTION: Advance notice of proposed rulemaking (ANPRM).

SUMMARY: NHTSA is issuing this ANPRM following a July 10, 2014 grant of a petition for rulemaking from Ms. Marianne Karth and the Truck Safety Coalition (petitioners) regarding possible amendments to the Federal motor vehicle safety standards (FMVSSs) relating to rear impact (underride) guards. The petitioners request that NHTSA require underride guards on vehicles not currently required by the FMVSSs to have guards, notably, single unit trucks, and improve the standards' requirements for all guards, including guards now required for heavy trailers and semitrailers. Today's ANPRM requests comment on NHTSA's estimated cost and benefits of requirements for underride guards on single unit trucks, and for retroreflective material on the rear and sides of the vehicles to improve the conspicuity of the vehicles to other motorists. Separately, NHTSA plans to issue a notice of proposed rulemaking proposing to upgrade the requirements for all guards.

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, M-30, U.S. Department of Transportation, West Building, Ground Floor, Rm. W12-140, 1200 New Jersey Avenue, S.E., Washington, D.C. 20590.
- Hand Delivery or Courier: West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue, S.E., between 9 am and 5 pm Eastern Time, Monday through Friday, except Federal holidays.
- Fax: (202) 493-2251.

Regardless of how you submit your comments, please mention the docket number of this document.

You may also call the Docket at 202-366-9324.

Instructions: For detailed instructions on submitting comments and additional information on the rulemaking process, see the Public Participation heading of the Supplementary Information section of this document. Note that all comments received will be posted without change to http://www.regulations.gov, including any personal information provided.

Privacy Act: Please see the Privacy Act heading under Rulemaking Analyses and Notices.

FOR FURTHER INFORMATION CONTACT:

For technical issues, you may contact Robert Mazurowski, Office of Crashworthiness Standards (telephone: 202-366-1012) (fax: 202-493-2990). For legal issues, you may contact Deirdre Fujita, Office of Chief Counsel (telephone: 202-366-2992) (fax: 202-366-3820). The address for these officials is: National Highway Traffic Safety Administration, U.S. Department of Transportation, 1200 New Jersey Avenue, S.E., West Building, Washington, D.C. 20590.

SUPPLEMENTARY INFORMATION:

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I. Introduction

NHTSA is issuing this ANPRM following a July 10, 2014 grant[1] of a petition for rulemaking from petitioners Ms. Marianne Karth and the Truck Safety Coalition regarding possible amendments to the FMVSSs regulating underride guards. The petitioners request that NHTSA require underride guards on vehicles not currently required by the FMVSSs to have guards, notably, single unit trucks (SUTs),[2] and improve the standards' requirements for all guards, including guards now required for heavy trailers and semitrailers.

The July 10, 2014 grant document announced that NHTSA would be pursuing possible rulemaking through two separate actions. The first action would be an ANPRM pertaining to rear impact guards for SUTs and other safety strategies not currently required for those vehicles. Today's ANPRM completes that step, requesting comment on NHTSA's estimated cost and benefits of requiring underride guards and estimated cost and benefits of requiring retroreflective material on the rear and sides of the vehicles to improve the conspicuity of the vehicles to other motorists. In the near future, NHTSA will be issuing the second action, a notice of proposed rulemaking (NPRM) to upgrade the FMVSSs for underride guards for vehicles subject to the current standards.[3]

II. Overview

NHTSA is undertaking rulemaking to upgrade FMVSS No. 223, "Rear impact guards," and FMVSS No. 224, "Rear impact protection," which together establish rear underride

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[1] 79 FR 39362.

[2] SUTs are trucks with a gross vehicle weight rating (GVWR) greater than 4,536 kilograms (kg) (10,000 pounds (lb)) with no trailer. They are primarily straight trucks, in which the engine, cab, drive train, and cargo area are mounted on one chassis. SUTs are the most commonly used truck, and are used extensively in all urban areas for short-haul operation, generally 321.87 kilometers (km) (200 miles) or less. SUTs are often designed to perform a specific task. Common examples of SUTs are dump trucks, garbage haulers, concrete mixers, tank trucks, trash trucks, and local delivery trucks.

[3] NHTSA is in the process of evaluating petitioners' request to require side guards and front override guards by way of research and will issue a separate decision on those aspects of the petitions at a later date.

protection for vehicles subject to the standards. This ANPRM comprises the first step of a larger agency initiative to upgrade the standards.

Rear underride crashes are those in which the front end of a vehicle impacts the rear of a generally larger vehicle, and slides under the chassis of the rear-impacted vehicle. Underride may occur to some extent in collisions in which a small passenger vehicle crashes into the rear end of a large SUT or trailer because the SUT or trailer bed is higher than the hood of the passenger vehicle. In passenger compartment intrusion (PCI) crashes, the passenger vehicle underrides so far that the rear end of the struck vehicle strikes and enters the passenger compartment. PCI crashes can result in passenger vehicle occupant injuries and fatalities caused by occupant contact with the rear end of the struck vehicle.

FMVSS Nos. 223 and 224 were issued in 1996 to prevent PCI by upgrading then-existing underride guards to make them stronger but energy-absorbing as well. The agency was concerned that overly rigid guards may prevent PCI but could stop the passenger vehicle too suddenly, resulting in excessive occupant compartment deceleration forces which could harm passenger vehicle occupants.

NHTSA established the two-standard approach to underride protection to reduce test burdens on small trailer manufacturers. FMVSS No. 223, an “equipment standard,” specifies performance requirements that rear impact guards must meet to be sold for installation on new trailers and semitrailers. The guard may be tested for compliance while mounted to a test fixture or to a complete trailer. 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. The vehicle standard requires that the guard be mounted on the trailer or semitrailer in accordance with the instructions provided with the guard by the guard manufacturer. Under this approach, a small manufacturer that produces relatively few trailers can certify its trailers to FMVSS No. 224 without feeling compelled to undertake destructive testing of what could be a substantial portion of its production. The two-standard approach provides a practicable and reasonable means of meeting the safety need served by an underride guard requirement.

FMVSS No. 224 only applies to trailers and semitrailers with GVWR greater than 4,536 kg (10,000 lb).[4] The agency excluded SUTs from FMVSS No. 224 requirements because it was concerned that the variety, complexity, and relatively lower weight and chassis strength of many SUTs would require guards that are substantially more costly than the guards for trailers. Additionally, field data indicated that the rear end fatality problem was more prominent in trailers than in SUTs. While SUTs represented 72 percent of the registered heavy vehicle fleet, they only represented 27 percent of the rear end fatalities.

However, there are Federal requirements now in place ensuring that SUTs provide some degree of rear impact protection. Federal Motor Carrier Safety Regulation (FMCSR) No. 393.86(b), “Rear impact guards and rear end protection,” (49 CFR 393.86 (b), “FMCSR 393.86(b)”) has rear impact protection requirements for certain SUTs utilized in interstate commerce.[5] The regulation requires that the horizontal member of the rear impact guard be located such that its bottom surface is not more than 760 millimeters (mm) (30 inches) vertically

[4] Excluded from FMVSS No. 224 are pole trailers, logging trailers, low chassis trailers (trailers where the ground clearance of the chassis is no more than 560 mm (22 inches)), wheels back trailers (trailers with rearmost point of rear wheels within 305 mm (12 inches) of the rear extremity of the trailer), and special purpose trailers (trailers with equipment in the rear and those intended for certain special operations). The exclusions are based on practical problems with meeting the standard or an absence of a need to meet the standard due to vehicle configuration.

[5] FMCSR 393.86(b) excludes SUTs in driveaway-towaway operations, low chassis vehicles (vertical distance between the rear bottom edge of the body and the ground is 762 mm or lower), wheels back vehicles (the rear of tires is less than 610 mm forward of the rear extremity of the vehicle), special purpose vehicles, and vehicles with equipment that reside in the area of the guard and provide the rear impact protection comparable to rear impact guards.

above ground level (ground clearance), its rear surface is not more than 610 mm (24 inches) forward of the rear extremity of the vehicle, and that it laterally extends to within 460 mm (18 inches) of each side of the vehicle. The regulation requires the guard to be "substantially constructed and attached by means of bolts, welding, or other comparable means." FMCSA's regulation also ensures that carriers maintain the mandated device throughout the life of the vehicle.

Current Work

NHTSA's interest in this rulemaking originated from the findings of a 2009 NHTSA study[6] to evaluate why fatalities were still occurring in frontal crashes despite high rates of seat belt use and the presence of air bags and other advanced safety features. NHTSA reviewed all cases of frontal crash fatalities to belted drivers or right-front passengers in model year (MY) 2000 or newer vehicles in the Crashworthiness Data System of the National Automotive Sampling System (NASS-CDS) through calendar year 2007. Among the 122 fatalities examined in this review, 49 (40 percent) were in exceedingly severe crashes that were not survivable, 29 (24 percent) were in oblique or corner impact crashes where there was low engagement of the striking vehicle's structural members (a factor which would have resulted in the striking vehicle absorbing more of the crash energy), and 17 (14 percent) were underrides into SUTs and trailers (14 were rear underride and 3 were side underride).[7] In survivable frontal crashes of newer vehicle models resulting in fatalities to belted vehicle occupants, rear underrides into large SUTs and trailers were the second highest cause of fatality.

[6] Kahane, et al. "Fatalities in Frontal Crashes Despite Seat Belts and Air Bags – Review of All CDS Cases – Model and Calendar Years 2000-2007 – 122 Fatalities," September 2009, DOT-HS-811102.
[7] In addition, 15 (12 percent) were fatalities to vulnerable occupants (occupants 75 years and older), 4 (3.3 percent) were narrow object impacts, and 8 (6.6 percent) were other types of impact conditions.

In 2010, NHTSA analyzed several data sources to determine the effectiveness of trailer rear impact guards compliant with FMVSS Nos. 223 and 224 in preventing fatalities and serious injuries.[8] While the agency's analysis of the Fatality Analysis Reporting System (FARS) could not establish a nationwide downward trend in fatalities to passenger vehicle occupants in impacts with the rear of trailers subsequent to the implementation of FMVSS Nos. 223 and 224, supplemental data collected in Florida and North Carolina showed decreases in fatalities and serious injuries. However, the observed decrease in fatalities in these two States was not statistically significant, possibly due to small sample sizes of the data.

Following these studies, NHTSA undertook research to examine the agency's underride protection requirements, highlighting this program as a significant one in the "NHTSA Vehicle Safety and Fuel Economy Rulemaking and Research Priority Plan 2011-2013 (March 2011)."

One of the resulting research projects began in 2009, as NHTSA initiated research with the University of Michigan Transportation Research Institute (UMTRI) to gather data on the rear geometry of SUTs and trailers, the configuration of rear impact guards on SUTs and trailers, and the incidence and extent of underride and fatalities in rear impacts with SUTs and trailers. UMTRI collected the supplemental information as part of its Trucks Involved in Fatal Accidents (TIFA) survey for the years 2008 and 2009.[9,10] These data enabled NHTSA to obtain national estimates of rear impact crashes into heavy vehicles that resulted in PCI. Details of the UMTRI study, completed in 2013, are discussed in detail below in the next section of this preamble. The findings with regard to SUTs particularly pertain to this ANPRM.

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[8] Allen, Kirk "The Effectiveness of Underride Guards for Heavy Trailers," October, 2010, DOT HS 811 375.
[9] Analysis of Rear Underride in Fatal Truck Crashes, 2008, DOT HS 811 652, August 2012.
[10] Heavy-Vehicle Crash Data Collection and Analysis to Characterize Rear and Side Underride and Front Override in Fatal Truck Crashes, DOT HS 811 725, March 2013.

More data were obtained in 2011 from the Insurance Institute for Highway Safety (IIHS), which had petitioned NHTSA to upgrade FMVSS No. 223 and FMVSS No. 224 to improve the strength and energy-absorbing capabilities of rear impact guards. IIHS provided analyses of data from DOT's Large Truck Crash Causation Study (LTCCS) and from a series of 56 kilometers per hour (km/h) (35 miles per hour (mph)) impact speed passenger car-to-trailer rear impact crash tests IIHS conducted. (We provide a discussion of the IIHS tests in Appendix B to this preamble.)[11] IIHS believes that trailers with rear impact guards compliant with the Canada Motor Vehicle Safety Standard (CMVSS) for underride guards (CMVSS No. 223) were significantly superior to FMVSS No. 224 in mitigating PCI of the striking passenger car. The information submitted by IIHS is particularly pertinent to the upcoming NPRM which will propose upgrades to FMVSS No. 223 and 224.

Purpose of this ANPRM

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 rear of SUTs and/or that increase the likelihood of avoiding a crash into SUTs. Strategies discussed in this ANPRM are possible amendments to the FMVSSs to: (a) expand FMVSS Nos. 223 and 224, to require upgraded guards on SUTs; and (b) amend FMVSS No. 108, "Lamps, reflective devices, and associated equipment," to require the type of retroreflective material on the rear and sides of SUTs that is now required to be placed on the rear and sides of trailers to improve the conspicuity of the vehicles to other motorists.

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[11] Details of the tests are in Brumbelow, M. L., "Crash Test Performance of Large Truck Rear Impact Guards," 22nd International Conference on the Enhanced Safety of Vehicles (ESV), 2011. http://www-nrd.nhtsa.dot.gov/pdf/esv/esv22/22ESV-000074.pdf.

III. Extending FMVSS No. 224, Rear Impact Protection, to SUTs

a. 2013 NHTSA/UMTRI Study

In 2009, the agency initiated an in-depth field analysis to obtain a greater understanding of the characteristics of underride events and factors contributing to such crashes. NHTSA sought this information to assess the need for and impacts of possible amendments to the FMVSSs to reduce severe passenger vehicle underride in truck/trailer rear end impacts.

NHTSA published the first phase of the field analysis in 2012,[12] and published the final report in March 2013. The reports analyze 2008-2009 data collected as a supplement to UMTRI's TIFA survey.[13] The TIFA survey contains data for all the trucks with a GVWR greater than 4,536 kg (10,000 lb) ("medium and heavy trucks") that were involved in fatal traffic crashes in the 50 U.S. States and the District of Columbia. TIFA data contains additional detail beyond the information contained in NHTSA's Fatality Analysis Reporting System (FARS).

NHTSA contracted UMTRI to collect supplemental data for 2008 and 2009 as part of the TIFA survey. The supplemental data included the rear geometry of the SUTs and trailers; type of equipment at the rear of the trailer, if any; whether a rear impact guard was present; the type of rear impact guard; and, the standards the guard was manufactured to meet. For SUTs and trailers involved in fatal rear impact crashes, additional information was collected on: the extent of underride; damage to the rear impact guard; estimated impact speeds; and whether the collision was offset or had fully engaged the guard.

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[12] Analysis of Rear Underride in Fatal Truck Crashes, DOT HS 811 725, August 2012. Also available at http://www.nhtsa.gov/Research/Crashworthi ness/Truck%20Underride, last accessed on November 24, 2014.

[13] Heavy-Vehicle Crash Data Collection and Analysis to Characterize Rear and Side Underride and Front Override in Fatal Truck Crashes, DOT HS 811 725, March 2013. Also available at http://www.nhtsa.gov/Research/Crashworthiness/Truck%20Underride, last accessed on July 24, 2014.

NHTSA derived average annual estimates from the 2008 and 2009 TIFA data files and the supplemental information collected in the 2013 UMTRI study. The agency's review of these files found that there are 3,762 SUTs and trailers involved in fatal accidents annually, among which trailers accounted for 2521 (67 percent), SUTs for 1080 (29 percent), tractor alone for 66 (1.5 percent), and unknown for the remaining 95 (2.5 percent).[14] About 489 SUTs and trailers are struck in the rear in fatal crashes annually, constituting about 13 percent of all SUTs and trailers in fatal crashes. Among rear impacted SUTs and trailers in fatal crashes, 331 (68 percent) are trailers, 151 (31 percent) are SUTs, and 7 (1 percent) are tractors alone.

Presence of Rear Impact Guard on Heavy Vehicles

UMTRI evaluated 2008 and 2009 TIFA data regarding the rear geometry of the trailers and SUTs involved in all fatal crashes (not just those rear-impacted) to assess whether the vehicle had to have a guard under FMVSS No. 224 (regarding trailers) or the Federal Motor Carrier Safety Administration's (FMCSA's) Federal Motor Carrier Safety Regulation (FMCSR) No. 393.86(b) (49 CFR 393.86(b), "FMCSR 393.86(b)") (regarding SUTs).[15] Based on this evaluation, UMTRI estimated that 38 percent of the SUTs involved in fatal crashes were required to have rear impact guards (based on the truck rear geometry according to FMCSR 393.86(b)) (Table 1). However, only 18 percent of SUTs were equipped with rear impact guards (Table 1). It is likely that the remaining 20 percent of the SUTs that were configured such that they would be subject to FMCSR 393.86(b) based on vehicle design, but that did not have a guard, were not used in interstate commerce. Among the 62 percent of SUTs that were excluded

[14] "Bobtail" and "tractor/other" configurations were combined into "others" category and "tractor/trailer" and "straight trucks with trailer" were combined into "trailers" category.
[15] UMTRI only evaluated the rear geometry to determine whether a SUT's configuration qualified the vehicle as subject to FMCSR 393.86(b). It did not determine how the truck was operated and whether it was used in interstate commerce.

from installing rear impact guards by the FMCSR, 27 percent were wheels back SUTs,[16] 9 percent were low chassis SUTs,[17] 2 percent were wheels back and low chassis SUTs, and 16 percent had equipment in the rear that interfered with rear impact guard installation (see Table 1). UMTRI also estimated that 65 percent of trailers had to have a rear impact guard per FMVSS No. 224 and the remaining were excluded because of their rear geometry, equipment in the rear, or type of cargo or operation.

Table 1: Percentage of SUTs by their rear geometry and whether a rear impact guard was required according to UMTRI's evaluation of SUTs involved in fatal crashes in the 2008-2009 TIFA data files.

Type of Rear Geometry	Percentage of SUTs
Rear Impact Guard Required	
Guard present	18%
Guard not present	20%
Rear Impact Guard Not Required	
Excluded vehicle	8%
Wheels back vehicle	27%
Low chassis vehicle	9%
Wheels back and low chassis vehicle	2%
Equipment	16%

Since the data presented in Table 1 takes into consideration all SUTs involved in all types of fatal crashes in 2008 and 2009 (total of 2,159 SUTs), we assume that the percentage of SUTs with and without rear impact guards in Table 1 is representative of that in the SUT fleet.

Light Vehicle Fatal Crashes into the Rear of Trailers and SUTs

[16] Wheels back SUTs according to FMCSR 393.86(b) is where the rearmost axle is permanently fixed and is located such that the rearmost surface of tires is not more than 610 mm forward of the rear extremity of the vehicle.

[17] Low chassis SUTs according FMCSR 393.86(b) is where the rearmost part of the vehicle includes the chassis and the vertical distance between the rear bottom edge of the chassis assembly and the ground is less than or equal to 762 mm (30 inches).

Among the types of vehicles that impacted the rear of trailers and SUTs, 73 percent were light vehicles,[18] 18 percent were large trucks, 7.4 percent were motorcycles, and 1.7 percent were other/unknown vehicle types. Since we do not expect trucks and buses to underride other trucks in rear impacts, the data presented henceforth only apply to light vehicles impacting the rear of trailers and SUTs.

Underride Extent in Fatal Crashes of Light Vehicles into the Rear of SUTs

In the UMTRI study of 2008 and 2009 TIFA data, survey respondents estimated the amount of underride in terms of the amount of the striking vehicle that went under the rear of the struck vehicle and/or the extent of deformation or intrusion of the vehicle. The categories were "no underride," "less than halfway up the hood," "more than halfway but short of the base of the windshield," and "at or beyond the base of the windshield." When the extent of underride is "at or beyond the base of the windshield," there is PCI that could result in serious injury to occupants in the vehicle. Rear impacts into heavy vehicles could result in some level of underride without PCI when the rear impact guard prevents the impacting vehicle from traveling too far under the heavy vehicle during impact. Such impacts into the rear of heavy vehicles without PCI may not pose additional crash risk to light vehicle occupants than that in crashes with another light vehicle at similar crash speeds.

The data show that about 319 light vehicle fatal crashes into the rear of trailers and trucks occur annually. UMTRI determined that about 36 percent (121) of light vehicle impacts into the rear of trailers and trucks resulted in PCI. Among fatal light vehicle impacts, the frequency of PCI was greatest for passenger cars and sport utility vehicles (SUVs) (40 and 41.5 percent,

[18] UMTRI categorized passenger cars, compact and large sport utility vehicles, minivans, large vans (e.g. Econoline and E150-E350), compact pickups (e.g., S-10, Ranger), and large pickups (e.g Ford F100-350, Ram, Silverado) as light vehicles.

respectively) and lowest for large vans and large pickups (25 and 26 percent respectively), as shown in Figure 1 below. Since the extent of underride was also determined by the extent of deformation and intrusion of the vehicle, it was observed in a number of TIFA cases that large vans and large pickups did not actually underride the truck or trailer but sustained PCI because of the high speed of the crash and/or because of the very short front end of the vehicle.

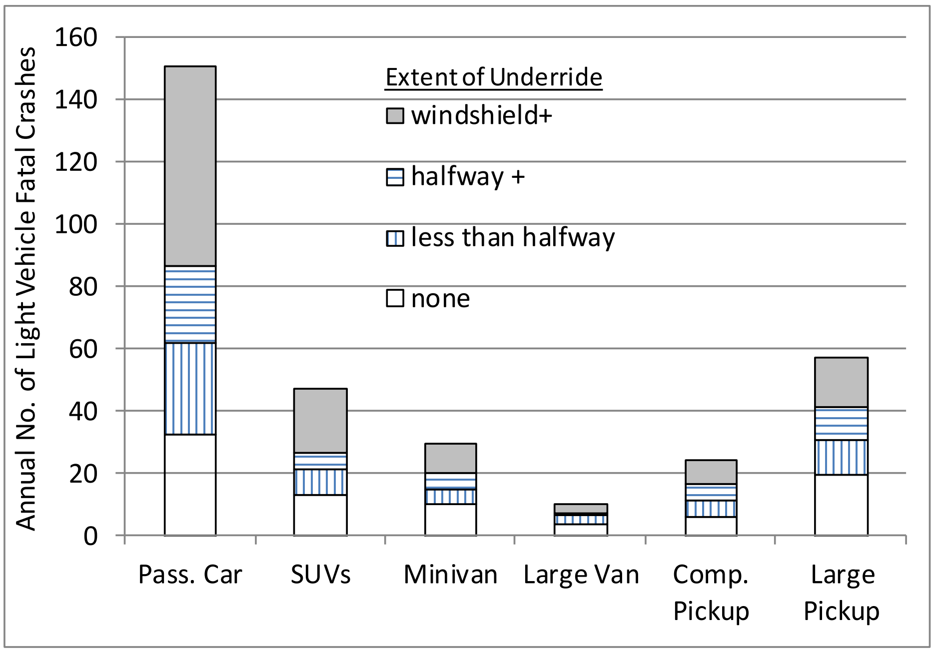


Figure 1: Annual light vehicle fatal crashes into the rear of trailers and SUTs by type of light vehicle and extent of underride[19] (2008-2009 TIFA UMTRI study).

Fatal light vehicle crashes into the rear of trucks and trailers were further examined by the type of truck and trailer struck and whether a guard was required (according to FMCSR 393.86(b) for SUTs and FMVSS No. 224 for trailers) (Figure 2 and Figure 3).

Among the 319 fatal light vehicle crashes into the rear of SUTs and trailers, 79 (25 percent) are into SUTs without any guards, 23 (7 percent) are into SUTs with guards, 115 (36

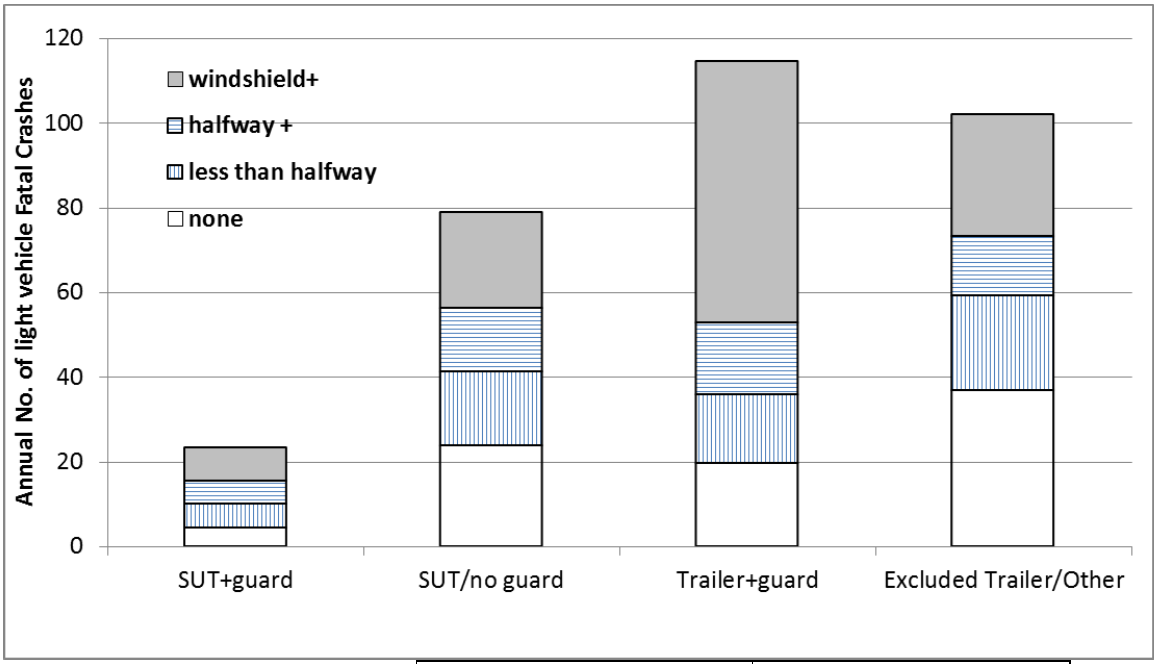
[19] The extent of underride in this and subsequent figures and tables means the following: None means “no underride”; less than halfway means “underride extent of less than halfway up the hood”; halfway+ means “underride extent at or more than halfway up the hood but short of the base of the windshield”; windshield+ means “extent of underride at or beyond the base of the windshield” or PCI.

percent) are into trailers with guards, and 102 (32 percent) are into excluded trailers without guards and other truck/trailer type. (Figure 2).

Figure 2. Percentage of light vehicle fatal crashes into the rear of SUTs and trailers (2008-2009 TIFA UMTRI Study)

Among these annual light vehicle fatal crashes, 121 result in PCI, among which 23 (19 percent) occur in impacts with SUTs without guards, 8 (7 percent) in impacts with SUTs with guards, 62 (51 percent) in impacts with trailers with guards, and 28 (23 percent) with excluded trailers and other truck/trailer type (Figure 3).[20]

[20] Underride extent was determined for 303 light vehicles, about 95 percent of the 319 light vehicle impacts into the rear of trailers and trucks. Unknown underride extent was distributed among known underride levels.



	Light vehicle fatal crashes into the rear of SUTs and trailers		Light vehicle fatal PCI crashes into the rear of SUTs and trailers	
	Annual #	Percentage	Annual #	Percentage
SUT+Guard	23	7%	8	7%
SUT/No Guard	79	25%	23	19%
Trailer+Guard	115	36%	62	51%
Excluded Trailer/Other	102	32%	28	23%
Total	319		121	

Figure 3: Annual light vehicle fatal crashes into the rear of SUTs and trailers by type of truck/trailer and extent of underride.

It is noteworthy that trailers with guards represent 36 percent of annual light vehicle fatal rear impacts but represent 51 percent of annual light vehicle fatal rear impacts with PCI. On the other hand, SUTs (with and without guards) represent 32 percent of annual light vehicle fatal rear impacts but represent 26 percent of annual light vehicle fatal rear impacts with PCI. The field data suggest that there are more light vehicle fatal impacts into the rear of trailers than SUTs and a higher percentage of fatal light vehicle impacts into the rear of trailers involve PCI than those into the rear of SUTs.

Relative Speed of Light Vehicle Fatal Crashes into the Rear of SUTs

Using information derived by reviewing police crash reports,[21] UMTRI estimated the relative velocity of fatal light vehicle crashes into the rear of SUTs and trailers. Relative velocity was computed as the resultant of the difference in the truck velocity and the striking vehicle velocity and could only be estimated for about 30 percent of light vehicle fatal crashes into the rear of trailers and SUTs. Most of the crashes (with known relative velocity) were at a very high relative velocity and many were not survivable. The mean relative velocity at impact into the rear of trailers and SUTs was estimated at 44 mph. Among fatal light vehicle impacts into the rear of SUTs that resulted in PCI, 70 percent were with relative velocity greater than 56 km/h (35 mph). Among the remaining 30 percent fatal light vehicle impacts into the rear of SUTs, 3 percent of the SUTs had rear impact guards, 10 percent of the SUTs could be required to have a guard based on rear geometry but did not have a guard, 3 percent were excluded from requiring a guard (wheels back, low chassis vehicles), and 14 percent had equipment in the rear precluding rear impact guards.

[21] Information included police estimates of travel speed, crash narrative, crash diagram, and witness statements. The impact speed was estimated from the travel speed, skid distance, and an estimate of the coefficient of friction.

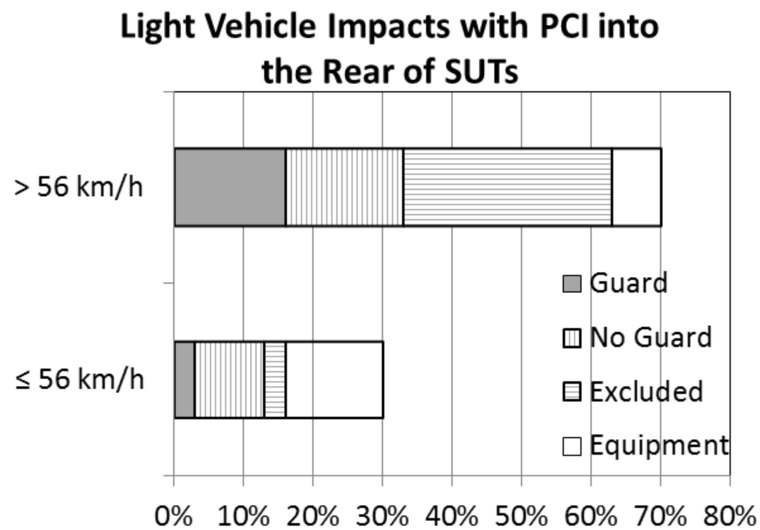


Figure 4: Percentage of fatal light vehicle crashes into the rear of SUTs that resulted in passenger compartment intrusion - categorized by the relative speed of the crash, presence of rear impact guard, exclusion, and equipment in rear of vehicle.

<u>Fatalities Associated with Light Vehicle Crashes into the Rear of SUTs and Trailers</u>

There are about 362 light vehicle occupant fatalities annually due to impacts into the rear of SUTs and trailers.[22] Of these fatalities, 104 (29 percent) are in impacts with SUTs, 125 (35 percent) are in impacts with trailers with guards, and 133 (37 percent) are in impacts with excluded trailers and other truck/trailer type (Figure 5).

Among the 104 light vehicle occupant fatalities resulting from impacts with the rear of SUTs, 80 occurred in impacts with SUTs without rear impact guards while the remaining 24 were in impacts to SUTs with guards. PCI was associated with 33 annual light vehicle occupant fatalities resulting from impacts into the rear of SUTs; 25 of these fatalities were in impacts with SUTs without rear impact guards and 8 with SUTs with guards (see Figure 5).

[22] Thus, the 319 fatal crashes result in 362 fatalities, or 1.13 fatalities per fatal crash.

	Light vehicle fatalities in crashes into the rear of SUTs & trailers		Light vehicle fatalities in PCI crashes into the rear of SUTs & trailers	
	Annual #	Percentage	Annual #	Percentage
SUT+Guard	24	7%	8	5%
SUT/No Guard	80	22%	25	17%
Trailer+Guard	125	35%	72	48%
Excluded Trailer/Other	133	37%	45	30%
Total	362		150	

Figure 5: Annual light vehicle occupant fatalities in impacts into the rear of SUTs and trailers categorized by the geometry of the rear of the impacted vehicle and the extent of underride.[23]

[23] This figure presents the target population for SUTs and trailers for use in determining benefits. The data in this figure cannot be used to determine effectiveness of the current rear impact guards on SUTs since many SUTs that do not have guards have equipment in the rear, or are low chassis or wheels back vehicles. Such rear configurations would limit underride without the need for a guard. In other words, this table in itself does not provide sufficient information to conclude that current rear impact guards on SUTs are not effective in preventing PCI. There are no data that would enable us to compare fatality rates in crashes into the rear of SUTs with guards and crashes into the rear of SUTs that would have needed guards per rear geometry but didn't have them. For this reason we did not make any inferences on the effectiveness of the current guards based on the data in Figure 5.

Among light vehicle occupant fatalities in impacts into the rear of SUTs, approximately 70 percent were in vehicles with no underride, underride less than halfway or underride up to the hood without PCI. The agency found that in a number of TIFA cases reviewed, fatalities occurred due to occupants being unrestrained, other occupant characteristics (e.g. age), and other crash circumstances. Additionally, as shown in Figure 4, only 30 percent of light vehicle impacts with PCI into the rear of SUTs had a relative velocity less than or equal to 56 km/h (35 mph). Since currently manufactured light vehicles are subject to FMVSS No. 208 requirements that ensure adequate occupant crash protection to restrained occupants in a 56 km/h (35 mph) rigid barrier frontal crash test, some light vehicle occupant fatalities in impacts into the rear of SUTs and trailers at speeds less than or equal to 56 km/h (35 mph) that resulted in PCI may be preventable if intrusion into the passenger compartment were mitigated.[24]

b. NHTSA's Cost-Benefit Analysis (Overview)

As part of its evaluation of whether an underride guard requirement should apply to SUTs, NHTSA conducted a cost-benefit analysis of equipping SUTs with rear impacts guards. The analysis is set forth in Appendix A of this preamble, and an overview is provided below. We are requesting comments on the analysis.

Preliminary Estimate of Cost of Requiring CMVSS No. 223 Guards

FMVSS Nos. 223 and 224 requirements were developed to prevent PCI in 48 km/h (30 mph) impacts of compact and subcompact passenger cars into the rear of trailers. CMVSS No. 223 performance requirements were developed to prevent PCI in 56 km/h (35 mph) impacts. The crash tests conducted by IIHS (see Appendix B) indicated the improved performance of rear

[24] Some of the fatalities associated with PCI shown in Figure 2 may also be due to unrestrained status of the occupant.

impact guards designed to CMVSS No. 223 compared to guards designed to FMVSS No. 223. The rear impact guard geometric specifications in CMVSS No. 223 cover a larger portion of the truck rear extremity than those specified in FMCSR 393.86(b). Additionally, there are no strength specifications for rear impact guards in FMCSR 393.86(b). Since a high percentage of crashes into the rear of SUTs are at high speeds, it is unlikely that equipping all SUTs with FMCSR 393.86(b) would sufficiently mitigate light vehicle occupant fatalities in PCI crashes into the rear of SUTs. For these reasons, NHTSA estimated the cost and benefits of requiring SUTs to comply with the requirements of CMVSS No. 223.

We estimate[25] that currently 18 percent of SUTs in the fleet are equipped with rear impact guards meeting the FMCSR regulation, 49 CFR 393.86(b). A requirement for SUTs to comply with CMVSS No. 223, though, would require 59 percent of newly manufactured SUTs to be equipped with CMVSS No. 223 rear impact guards due to that regulation's greater coverage.[26] The estimated incremental minimum to average cost of equipping new covered SUTs with CMVSS No. 223 guards ranges from $307 to $453 per vehicle (See Table A-7 in Appendix A for details). The total annual fleet cost of equipping new SUTs with CMVSS No. 223 guards ranges from $105 million to $155 million. The estimate of minimum to average additional weight of equipping SUTs with CMVSS No. 223 guards is 76.8 kg (169 lb) to 95.5 kg (210 lb) per vehicle. The estimate of minimum to average additional fuel cost during the lifetime

[25] Using the 2008-2009 TIFA data files from the 2013 UMTRI study, it is estimated that 38 percent of the SUTs were configured so as not to be considered among the vehicles excluded from FMCSA 393.86(b) based on vehicle design. However, UMTRI estimated that only 18 percent of these SUTs were equipped with rear impact guards. The remaining 20 percent of SUTs that appeared, based on vehicle design, not to be excluded from the requirement to have a guard but did not have one, was likely comprised of vehicles that were not used in interstate commerce.

[26] Since the definition of wheels back and low chassis vehicles in 393.86(b) allows more vehicles to be excluded from requiring rear impact guards than CMVSS No. 223, when SUTs are required to comply with CMVSS No. 223, a larger percentage would need to have rear impact guards. This is further explained in Appendix A.

of the vehicle due to the additional weight of the guard ranges from $924.7 to $1,505.3. Therefore, the total minimum to average annual cost (including fuel costs) of requiring SUTs to have CMVSS No. 223 rear impact guards is estimated to be $421 million to $669 million.

Preliminary Estimate of Benefits of Requiring CMVSS No. 223 Guards

For estimating the benefits of requiring SUTs to have CMVSS No. 223 guards, NHTSA estimated the annual number of fatalities and injuries in light vehicle rear impact crashes with PCI into the rear of SUTs. Non-PCI crashes were not considered as part of the target population for estimating benefits. This is because the IIHS test data (see Appendix B to this preamble) show that when PCI was prevented, the dummy injury measures were significantly below the injury assessment reference values specified in FMVSS No. 208. In non-PCI crashes into the rear of SUTs and trailers, the IIHS test data indicated that the passenger vehicle's restraint system would mitigate injury.

Although CMVSS No. 223's requirements are intended to mitigate PCI in light vehicle rear impacts at speeds less than or equal to 56 km/h (35 mph),[27] we note that CMVSS No. 223 guards may not be able to mitigate all fatalities in such crashes because some of the crashes may be low overlap (30 percent or less),[28] and because some fatalities are not as a result of PCI but are due to other circumstances (e.g. unrestrained status of occupants, elderly and other vulnerable

[27] Transport Canada testing of minimally compliant CMVSS No. 223 rear impact guards indicated that such guards could prevent PCI in light vehicle impacts with full overlap with the guard at crash speeds up to 56 km/h. See Boucher D., Davis D., "Trailer Underride Protection – A Canadian Perspective," SAE Paper No. 2000-01-3522, Truck and Bus Meeting and Exposition, December 2000, Society of Automotive Engineers.

[28] Overlap refers to the percentage of impacting vehicle front end width that engages the rear impact guard. IIHS's test data showed that 8 of the 9 rear impact guards tested by IIHS could not prevent PCI in a 56 km/h crash with 30 percent overlap of the Chevrolet Malibu.

occupants). In those circumstances, we believe that a rear impact guard would not prevent the fatality.[29]

Preventing Fatalities

For the purpose of this analysis, NHTSA assumed that CMVSS No. 223 compliant guards on SUTs would be able to prevent about 85 percent of light vehicle occupant fatalities with PCI in impacts into the rear of SUTs with crash speeds less or equal to 56 km/h.[30] However, since only 30 percent of the target population of light vehicle crashes with PCI into the rear of SUTs are at speeds less than or equal to 56 km/h, CMVSS No. 223 compliant guards would only be effective for a portion of the target population. Therefore, NHTSA estimated an overall effectiveness of 25 percent (approximately 30% x 85%) for CMVSS No. 223 rear impact guards in preventing fatalities in light vehicle crashes into the rear of SUTs with PCI.[31] We believe this is an upper estimate of CMVSS No. 223 guard effectiveness in preventing fatalities, because (1) there will be real-world crashes of light passenger vehicles into the rear of SUTs at low overlap (30 percent or less) for which IIHS test data indicates that the CMVSS No. 223 compliant guards would not be able to prevent PCI, (2) some restrained occupants of light

[29] CMVSS No. 223 compliant rear impact guards may mitigate the severity of impact into the rear of SUTs at speeds greater than 56 km/h, but NHTSA is unable to quantify this possible benefit at this time. We seek comment on this issue.

[30] This effectiveness estimate is based on current estimates of seat belt use in light passenger vehicles (about 87% per 2014 National Occupant Protection Use Survey (NOPUS)) and on the IIHS test data which indicated that belted occupants of light passenger vehicles in 35 mph impacts into the rear of trailers with CMVSS No. 223 guards with 100 percent and 50 percent overlap would experience similar injury risk as that in 35 mph frontal crashes of two light passenger vehicles of similar size.

[31] In the final regulatory evaluation for the January 24, 1996 final rule establishing FMVSS Nos. 223 and 224 (61 FR 2004), NHTSA assumed an effectiveness range of 10 to 25 percent for rear impact guards in preventing fatalities in crashes with PCI (all speeds) into the rear of trailers. The 25 percent effectiveness estimated for the current analysis (based on 2008-2009 TIFA data and the IIHS crash test data) is the same as the higher value of the assumed effectiveness range of rear impact guards in the 1996 final rule. CMVSS No. 223 requires a higher level of performance than that required by the 1996 final rule, so NHTSA assumes the CMVSS will have an effectiveness level at least as high as our highest assumed rate for the FMVSSs.

passenger vehicles would be killed even if PCI were prevented due to other circumstances (e.g. elderly and other vulnerable occupants), and (3) our review of 2009 TIFA data files of light vehicle impacts with PCI into the rear of SUTs indicated that only 55 percent of the fatally injured occupants were restrained.[32]

The real world data indicated that there are annually 31 light vehicle crashes with PCI into the rear of SUTs resulting in 33 light vehicle occupant fatalities. Since only 59 percent of SUTs would require rear impact guards, the target population is reduced to approximately 20 (=33 x 59%). Applying 25 percent effectiveness of CMVSS compliant guards, the upper bound on lives saved by CMVSS No. 223 compliant rear impact guards on SUTs is about 5.

Preventing Nonfatal Injuries

In our current analysis, we also assumed 20 percent effectiveness of CMVSS No. 223 compliant guards in preventing nonfatal injuries in light vehicle crashes with PCI into the rear of SUTs. CMVSS No. 223 guards are effective in mitigating PCI in light vehicle impacts into the rear of SUTs at speeds less or equal to 56 km/h (35 mph), which is about 30 percent of all such impacts with PCI.[33] Additionally, we expect the effectiveness of rear impact guards for preventing injuries to be lower than that for fatalities since occupant injuries could occur from interior vehicle contacts even if PCI were prevented. The 20 percent effectiveness estimate

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[32] The agency's 2010 study - "The Effectiveness of Underride Guards for Heavy Trailers," October 2010, DOT HS 811 375 – estimated an effectiveness of 27 percent from data collected in Florida and 83 percent from data collected in North Carolina for FMVSS No. 223 compliant rear impact guards in preventing fatalities. These two estimates are considerably different and not statistically significant, possibly due to small sample size, and so associated with some uncertainty. Therefore, these effectiveness estimates were not utilized in the current analysis. Instead, the agency relied on real world crash data and the test data to estimate rear impact guard effectiveness.

[33] As noted earlier, CMVSS No. 223 compliant rear impact guards may mitigate the severity of impact into the rear of SUTs at speeds greater than 56 km/h, but NHTSA is unable to quantify this possible benefit at this time. We seek comment on this issue.

takes into consideration that some injuries are due to factors such as the unrestrained status of the occupants. An improved rear impact guard would not prevent such injuries.

The agency analyzed the National Accident Sampling System – Crashworthiness Data System (NASS-CDS) data files for the year 1999-2012 and estimated a total of 151 – 291 MAIS[34] 1 to 5 severity nonfatal injuries to light vehicle occupants in PCI crashes into the rear of SUTs. Applying a 20 percent effectiveness of rear impact guards in preventing nonfatal injuries, we estimate that 30 – 58 nonfatal injuries would be prevented annually.

Cost Per Equivalent Lives Saved

The benefits analysis in Appendix A estimates the equivalent lives saved (ELS) from a requirement for SUTs to have CMVSS No. 223 guards. The ELS are approximately 5.7 to 6.3 lives. The cost per ELS (3 and 7 percent discounted) is $106.7 million to $164.7 million, for each equivalent life saved. A summary of the analysis estimating incremental costs using low and average estimates, benefits using average and high estimates, and cost per equivalent lives saved is shown below in Table 2.

Table 2: Estimates of material, installation, and fuel costs of equipping applicable SUTs (Class 3-8) with CMVSS rear impact guards, resulting incremental benefits of lives saved and injuries prevented, and cost per equivalent lives saved.

Material + Installation + Fuel Costs	
Minimum to average incremental cost of CMVSS guard per SUT	$307 - $453
Number of SUTs needing guards annually	341,392
Total minimum to average incremental cost of CMVSS guards in SUT fleet	$104.9M - $154.6M
Minimum to average incremental weight of CMVSS guard per SUT	169 lb - 210 lb
Minimum to average incremental lifetime fuel cost per SUT	$924.7 - $1,505.3
Minimum to average incremental fuel cost for SUT fleet	$316M - $514M

[34] MAIS is the maximum severity injury for an occupant according to the Abbreviated Injury Scale (AIS). MAIS 1 are minor injuries, MAIS 2 are moderate injuries, MAIS 3-5 are serious to critical injuries.

Total minimum to average incremental cost of CMVSS guards +fuel for SUT fleet	$421M - $669M
Benefits Estimates	
Target Population (light vehicle occupant fatalities in crashes with PCI into the rear of applicable SUTs) average to high injury estimates	20 lives; 99-182 MAIS 1 injuries; 33-82 MAIS 2 and 17-27 MAIS 3-5 injuries
Estimated effectiveness of CMVSS guards	0.25 for fatalities, 0.2 for injuries
Equivalent lives saved (undiscounted) average to high estimates	5.7 - 6.3
Equivalent lives saved (3% discounted) average to high estimates	4.4 - 4.9
Equivalent lives saved (7% discounted) average to high estimates	3.3 - 3.7
Cost/Benefit Analysis	
Cost per equivalent lives saved (3% discount)	$106.7M - $152.9M
Cost per equivalent lives saved (7% discount)	$113.9M - $164.7M

Guidance from the U.S. Department of Transportation[35] identifies $9.1 million as the value of a statistical life (VSL) to be used for Department of Transportation analyses assessing the benefits of preventing fatalities for the base year of 2012. Per this guidance, VSL in 2014 is $9.2 million. While not directly comparable, the preliminary estimates for rear impact guards on SUTs (minimum of $106.7 million per equivalent lives saved) is a strong indicator that these systems will not be cost effective (current VSL $9.2 million).

Alternatives

NHTSA further considered whether excluding Class 3 SUTs (GVWR 10,000 lb to 14,000 lb) from a requirement to have CMVSS No. 223 guards would make the requirement more cost effective (see Table 3, below). (An exclusion of Class 3 SUTs may also be based on a practical matter, as the vehicles may be too small to withstand the loads imparted from impacts to CMVSS No. 223 guards.) NHTSA analyzed the cost and benefits of a requirement that would

[35] See http://www.dot.gov/sites/dot.dev/files/docs/VSL%20Guidance_2013.pdf. The guidance starts with a $9.1 million VSL in the base year of 2012 and then estimates a 1.07 percent increase in VSL each year after the base year to reflect the estimated growth rate in median real wages for the next 30 years.

require only Class 4-8 SUTs to have CMVSS No. 223 guards. Class 4-8 SUTs comprise approximately 60 percent of annual sales of SUTs. The total annual cost of CMVSS No. 223 compliant rear impact guards on Class 4 -8 SUTs is estimated to be $218 million to $348.5 million. The analysis was conducted with a conservative assumption of no reduction in benefits by not requiring Class 3 SUTs to have the rear impact guards. Even with such a conservative assumption, the cost per ELS (3 and 7 percent discounted) was $55.2 million to $85.9 million, respectively.

Table 3. Estimates of material, installation, and fuel costs of equipping applicable SUTs (Class 4-8) with CMVSS rear impact guards, resulting incremental benefits of lives saved and injuries prevented, and cost per equivalent lives saved.

Material + Installation + Fuel Costs	
Minimum to average incremental cost of CMVSS guard per SUT	$307 - $453
Number of SUTs needing guards annually	204,246
Total incremental cost of CMVSS guards in SUT fleet	$62.7M - $92.4M
Minimum to average incremental weight of CMVSS guard per SUT	169 lb - 210 lb
Minimum to average incremental lifetime fuel cost per SUT	$759.9 - $1,253.8
Minimum to average incremental fuel cost for SUT fleet	$155M - $256M
Total minimum to average incremental cost of CMVSS guards +fuel for SUT fleet	$218M - $348.5M
Benefits Estimates	
Target Population (light vehicle occupant fatalities in crashes with PCI into the rear of applicable SUTs) average to high injury estimates	20 lives; 99-182 MAIS 1 injuries; 33-82 MAIS 2 and 17-27 MAIS 3-5 injuries
Estimated effectiveness of CMVSS guards	0.25 for fatalities, 0.2 for injuries
Equivalent lives saved (undiscounted) average to high estimates	5.7 - 6.3
Equivalent lives saved (3% discounted) average to high estimates	4.4 - 4.9
Equivalent lives saved (7% discounted) average to high estimates	3.3 - 3.7
Cost/Benefit Analysis	
Cost per equivalent lives saved (3% discount)	$55.2M - $79.7M
Cost per equivalent lives saved (7% discount)	$59.0M - $85.9M

As in the analysis for Class 3-8 SUTs shown in Table 2, the preliminary estimates for rear impact guards on Class 4-8 SUTs (minimum of $55.2 million per equivalent lives saved) is a strong indicator that these systems will not be cost effective (current VSL $9.2 million).

IV. Request for Comment on Extension of FMVSS No. 224

NHTSA requests comments that would help the agency assess and make judgments on the benefits, costs and other impacts of requiring SUTs to have underride guards. 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 from weighted NASS-CDS data files (1999-2012). Analysis was conducted with not only the weighted average estimates but also with the upper bound of the injury estimates. We seek comment on the estimated injury target population resulting from underride crashes with PCI into the rear of SUTs.

2. The agency assumed 25 percent effectiveness of CMVSS No. 223 rear impact guards in preventing fatalities in light vehicle crash with PCI into the rear of SUTs. We seek comment on this effectiveness estimate.

3. The agency assumed 20 percent effectiveness of CMVSS No. 223 guards in preventing injuries in light vehicle crashes with PCI into the rear of SUTs. We seek comment on this effectiveness estimate.

4. In estimating benefits, the agency assumed that rear impact guards would mitigate fatalities and injuries in light vehicle impacts with PCI into the rear of SUTs at impact speeds up to 56 km/h (35 mph), since the requirements of CMVSS No. 223 are intended to prevent PCI in

impacts with speeds up to 56 km/h (35 mph). We recognize, however, that benefits may accrue from underride crashes at speeds higher than 56 km/h (35 mph), if, e.g., a vehicle's guard exceeded the minimum performance requirements of the FMVSS. NHTSA requests information that would assist the agency in quantifying the possible benefits of CMVSS No. 223 rear impact guards in crashes with speeds higher than 56 km/h (35 mph).

5. The percentage of SUTs requiring rear impact guards was determined by obtaining details of the rear extremity of SUTs involved in fatal crashes in the 2008-2009 TIFA data files. We seek any other information to corroborate these estimates.

6. The cost-benefit analysis showed that requiring CMVSS No. 223 guards on SUTs would cost more than $100 million per equivalent life saved. The following information was not included in the analysis. NHTSA seeks the information so that the analysis is more complete.

a. The additional cost to install CMVSS No. 223 compliant rear impact guards did not include the cost of strengthening the rear beams, frame rails, and floor of the vehicle. We seek information on the changes to SUTs to accommodate the CMVSS No. 223 rear impact guard and the additional costs resulting from these changes.

b. The additional weight to install CMVSS No. 223 compliant rear impact guards did not include the weight of additional material needed to strengthen the rear beams, frame rails, and floor of the vehicle. We seek information on the changes to SUTs to accommodate the CMVSS No. 223 rear impact guard and the additional weight resulting from these changes.

c. The cost-benefit analysis did not take into consideration the reduction in payload resulting from increased weight of the SUT due to installation of a CMVSS No. 223 guard. We seek comment on what type of SUT operations are affected by the increased weight and the associated cost impacts.

d. The cost-benefit analysis did not take into consideration the aerodynamic effects of rear impact guards on fuel consumption due to paucity of information on this matter. We seek comment on whether aerodynamic effects due to the presence of a rear impact guard would increase or decrease fuel consumption and by how much.

7. The fuel economy for SUTs was obtained from a 2012 market report by Oakridge National Laboratories. However, this report did not distinguish the miles per gallon for different classes of SUTs. We seek more refined information on the fuel economy for different class SUTs so as to refine the cost-benefit analysis.

8. SUTs with equipment in the rear (in the zone where the guard would be located) were excluded from the cost-benefit analysis of a requirement for the guard. We seek comment on whether rear impact guards can be accommodated in such SUTs.

9. We seek information that would help us determine the feasibility, benefits, and costs associated with improving the performance of CMVSS No. 223 guards in low overlap crashes. “Overlap” refers to the portion of the striking passenger vehicle's width overlapping the underride guard.

V. Amending FMVSS No. 108, “Lamps, Reflective Devices, and Associated Equipment,” to Improve the Conspicuity of SUTs

NHTSA seeks to improve safety not just when there is a crash but by reducing the likelihood of a crash occurring in the first place. This is especially important in preventing the types of fatal crashes that NHTSA is addressing in this ANPRM, where most of the fatalities occur in crashes that are either at high speeds that render the crash unsurvivable, or, conversely, involve comparatively minor to no underride but are nevertheless fatal because of other factors, most prominently the presence of unbelted occupants. One strategy relevant to the crashes addressed in today's ANPRM, NHTSA has for years mandated that heavy trailers and truck tractors be equipped with red-and-white tape ("retroreflective tape," "conspicuity tape," or "tape") under FMVSS No. 108. In this ANPRM, the agency requests comments that would help NHTSA assess and make judgments on the benefits, costs and other impacts of amending FMVSS No. 108 to require retroreflective material on the rear and sides of SUTs to improve the conspicuity of the vehicles to other motorists. The retroreflective material would be the same as tape now placed on the rear and sides of heavy trailers[36] and the rear of truck tractors pursuant to FMVSS No. 108 (S8.2.3). This ANPRM is consistent with the National Transportation Safety Board recommendation (H-13-017)[37] that the agency amend FMVSS No. 108 to include a conspicuity tape requirement for SUTs with a GVWR greater than 10,000 lb.

The purpose of retroreflective tape is to increase the visibility of heavy trailers and truck tractors to other motorists, especially in the dark. At those times, the tape brightly reflects other motorists' headlights and warns them that they are closing on a large vehicle. In the dark, without the tape, many trailers and truck tractors do not become visible to other road users until motorists are dangerously close. The alternating red-and-white pattern identifies the vehicle as a large vehicle and at the same time helps other road users gauge their distance and rate of approach.

FMVSS No. 108's conspicuity requirement for heavy trailers applies to vehicles manufactured on or after December 1, 1993. Two types of material are permitted by the standard: (a) retroreflective sheeting, or tape; and (b) reflex reflectors. A combination of the two types is also permissible. Retroreflective tape has been used almost exclusively for meeting the

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[36] "Heavy trailers" are at least 2032 mm (80 inches (in)) wide and have a GVWR greater than 4,536 kg (10,000 lb).
[37] http://www.ntsb.gov/safety/safety-recs/_layouts/ntsb.recsearch/Recommendation.aspx?Rec=H-13-017. Last accessed on March 24, 2015.

standard.[38] Essentially, the retroreflective tape must outline the bottom of the sides of the trailers and the top corners, bottom and underride guard of the rear of the trailers. When the agency issued the final rule adopting the requirement, NHTSA estimated the requirement would be 15 percent effective in preventing nighttime fatalities and injuries resulting from crashes to the sides and rear of trailers.

In 1996, NHTSA amended FMVSS No. 108 to extend the conspicuity requirements to truck tractors manufactured on or after July 1, 1997.[39] Because truck tractors riding bobtail (without pulling a trailer) have poorer rear-end conspicuity compared to trailers, NHTSA used a 15 to 25 percent range to estimate fatality and injury-prevention effectiveness for truck tractors to reflect a potentially greater effectiveness of a conspicuity countermeasure on the vehicles compared to trailers.

In the first part of this section, the agency discusses a 2001 NHTSA evaluation that found conspicuity tape to be “quite effective” in reducing side and rear impacts by other vehicles into heavy trailers in dark conditions. In the second part, based on the findings of effectiveness of the 2001 evaluation and certain assumptions, NHTSA provides preliminary estimates of the cost and benefits of requiring new SUTs to have conspicuity tape. In the third part, the agency requests comments on the data collection techniques used in the 2001 evaluation, NHTSA’s assumptions in applying the findings of that evaluation to SUTs, and other issues.

a. 2001 NHTSA Evaluation

In 2001, NHTSA issued an evaluation of the effectiveness of retroreflective tape in reducing side and rear impacts by other vehicles into heavy trailers during dark conditions.

[38] This ANPRM assumes that tape would be used as the countermeasure on SUTs.
[39] The requirement was not applied retroactively to vehicles manufactured before July 1, 1997.

("The Effectiveness of Retroreflective Tape on Heavy Trailers," March 2001, NHTSA Technical Report, DOT HS 809 222.[40]) Because the crash data at the time (FARS, NASS, or State files) did not identify whether crash-involved heavy trailers had retroreflective tape, NHTSA entered into arrangements with the Florida Highway Patrol and the Pennsylvania State Police to collect data for an analysis. For a two-year period, each time these State agencies investigated a crash involving a tractor-trailer combination[41] and filed a crash report, they also filled out an "Investigator's Supplementary Truck-Tractor Trailer Accident Report" on every trailer in the crash.

The Florida Highway Patrol collected 6,095 crash cases from June 1, 1997, through May 31, 1999. The Pennsylvania State Police collected 4,864 crash cases from December 1, 1997, through November 30, 1999. NHTSA's analysis estimated the reduction of side and rear impacts by other vehicles into conspicuity tape-equipped trailers in dark conditions, relative to the number that would have been expected if the trailers had not been equipped. The analysis tabulated and statistically analyzed crash involvements of tractor-trailers by three critical parameters: (1) whether the trailer was tape-equipped; (2) the light condition, i.e., dark (comprising "dark-not-lighted," "dark-lighted," "dawn" and "dusk") versus daylight; and (3) relevant versus control-group crash involvements.

Given that the tape can help the other driver see and possibly avoid hitting the trailer, NHTSA determined that relevant crash involvements were those in which another vehicle crashed into the side or rear of a tractor-trailer combination. The control group consisted of

[40] The document is available to the public through the National Technical Information Service, Springfield, Virginia, 22161.

[41] A tractor-trailer combination was defined as a truck tractor pulling one or more trailers, i.e., tractor with semi-trailer, full trailer, or two trailers.

single-vehicle crashes of tractor-trailers (where visibility of the tractor-trailer to other road users is not an issue at all) and impacts of the front of the tractor into other vehicles (where conspicuity of the side and rear of the trailer is also not an issue).

The principal conclusion of the study was that retroreflective tape is quite effective, and that it significantly reduces side and rear impacts into heavy trailers in the dark.

Other findings and conclusions are as follows:

• Annual benefits: When all heavy trailers have conspicuity tape, the tape will be saving an estimated 191 to 350 lives per year, preventing approximately 3,100 to 5,000 injuries per year, and preventing approximately 7,800 crashes per year, relative to a hypothetical fleet in which none of the trailers have the tape.

• Crash reductions by lighting conditions: In dark conditions (combining the subsets of “dark-not-lighted,” “dark-lighted,” “dawn,” and “dusk”), the tape reduces side and rear impacts into heavy trailers by 29 percent. The reduction is statistically significant (confidence bounds: 19 to 39 percent).

• The tape is by far the most effective in dark-not-lighted conditions. The tape reduces side and rear impacts into heavy trailers by 41 percent. The reduction is statistically significant (confidence bounds: 31 to 51 percent).

• In dark-lighted, dawn, and dusk conditions, the tape did not significantly reduce crashes. The tape also did not significantly reduce crashes during daylight.

The following effectiveness estimates are the percentage reductions of various subgroups of the side and rear impacts into heavy trailers in dark conditions. As stated above, tape reduces these crash involvements by 29 percent, overall.

• Conspicuity tape is especially effective in preventing the more severe crashes, specifically, injury crashes. Impacts resulting in fatal or nonfatal injuries to at least one driver are reduced by 44 percent.

• The tape is more effective when the driver of the impacting vehicle is under 50. The crash reduction is 44 percent when the driver of the impacting vehicle is 15 to 50 years old, but only 20 percent when that driver is more than 50 years old. A possible explanation of this difference is that older drivers are less able to see, recognize and/or react to the tape in time to avoid hitting the trailer.

• The tape may be somewhat more effective in preventing rear impacts (43 percent) than side impacts (17 percent) into trailers; however, this difference is not consistent in the two States.

• The tape is effective in both clear (28 percent) and rainy/foggy weather conditions (31 percent).

• The tape is especially effective on flatbed trailers (55 percent). It could be that these low-profile vehicles were especially difficult to see in the dark before they were treated with tape.

• Dirt on the tape significantly diminished tape effectiveness in rear impacts. Clean tape reduces rear impacts by 53 percent but dirty tape by only 27 percent.

These findings are evidence that large trailers are difficult to see in dark not lighted conditions and that conspicuity tape improves their visibility and reduces crashes in a dramatic way. Large trailers and large SUTs share a common general appearance and standard lighting requirements (with the exception of tape, which is required on large trailers, but is optional on SUTs). As such, the agency believes that the dramatic increase in safety that has been observed in trailers because of conspicuity tape may also be realized for SUTs. However, while the general appearance and standard lighting equipment is similar for large trailers and large SUTs, the agency recognizes that differences in visibility may exist between the two vehicle types that could result in a different effectiveness for tape applied to SUTs than has been observed thus far in large trailers. The agency seeks comment on such potential differences and the best way to accurately estimate the effectiveness that tape can be expected to have on SUT crash risk.

b. NHTSA's Preliminary Estimate of Cost and Benefits of Requiring Tape on SUTs

NHTSA has preliminarily examined the cost and benefits of requiring new SUTs (SUTs with a GVWR greater than 4,536 kg (10,000 lb)) to have and maintain retroreflective tape on the sides, rear, and upper corners of the vehicles, based on the findings of the agency's 2001 evaluation[42] of the effectiveness of retroreflective tape on heavy trailers. In our analysis, we only considered vehicle crashes into the rear and side of SUTs in dark-not-lighted conditions and used the same effectiveness (41 percent) of retroreflective tape in dark-not-lighted conditions for heavy trailers. Our analysis is discussed in this section.

To obtain a preliminary look at the potential value of conspicuity tape on SUTs, the agency examined fatal crashes involving SUTs over a four-year period (2010 through 2013). We estimate that there was an average of 34 fatalities annually in crashes into SUTs for which conspicuity tape could be an effective countermeasure in terms of assisting to avoid or mitigate these crashes. The 34 fatalities occurred in vehicle crashes in dark not lighted conditions into the rear and sides[43] of SUTs. These are the conditions for which conspicuity tape was shown to be

[42] "The Effectiveness of Retroreflective Tape on Heavy Trailers," March 2001, NHTSA Technical Report, DOT HS 809 222, supra.
[43] Crashes into the rear and side of SUTs were identified by initial contact point (values ranging from 2 o'clock to 10 o'clock) and damaged area (left, right, and/or back) field in FARS data files.

41 percent effective in mitigating crashes into trailers. Among these 34 fatalities, 21 occurred in crashes where the front end of a vehicle impacted the rear end of an SUT.

As described above, conspicuity systems on trailers were most effective in dark-not-lighted condition for side and rear impacts. The target population for the conspicuity systems can be established considering dark-not-lighted crashes for which the SUT is struck in the sides or rear. If we assume an effectiveness of 41 percent (based on the observed effectiveness of these systems on heavy trailers) to these fatalities, we can establish a rough estimate of 14 fatalities annually could be prevented by the application of conspicuity systems to SUTs.

Preliminary Estimate of Cost

NHTSA made a preliminary estimate of the cost of requiring new SUTs to have conspicuity tape. The cost of installing the tape was calculated based on the cost of the material itself and the cost to install the tape.

The cost of the material depends on the length of tape needed for SUTs, which depends on the vehicles' size. NHTSA evaluated data from a U.S. Department of Commerce "Vehicle Inventory and Use Survey" (VIUS),[44] which is a random sample survey of physical and operational characteristics of private and commercial trucks and truck-tractors registered or licensed in the 50 States and the District of Columbia.

The 1997 VIUS survey data, which is the most recent data available, indicates that the weighted average length of SUTs from the front bumper to the rear of the vehicle is 1029 cm (33 feet (ft), 9 inches (in)). A survey of SUTs by NHTSA indicates that the average length from the front bumper to the end of the cab is 229 cm (7 ft, 6 in). Assuming a requirement would not

[44] U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau. The survey sample includes about 131,000 trucks surveyed to measure the characteristics of nearly 73 million trucks registered in the U.S.

apply conspicuity tape to the front cab length of SUTs, the average length that would be covered by conspicuity tape is 800 cm (26 ft, 3 in). In addition, 244 cm (8 ft) of tape would be applied along the width of the SUT at the rear of the vehicle, and two pairs of 30 cm (1 ft) strips would be applied to outline the upper rear of the SUT. The total length of tape applied to an average SUT is estimated to be 1164 cm (38 ft, 2 in).

We estimate that the 2-inch wide conspicuity tape can be purchased by SUT single-stage manufacturers for about $0.53 per linear foot. The distributors that sell the tape to smaller fleets mark up the cost of the tape from about 15 percent to 30 percent, which amounts to $0.61 to $0.69 per linear foot. NHTSA used $0.61 per linear foot for the cost (the average of $0.53 and $0.69) of the conspicuity tape.

As for the cost to apply the tape, NHTSA estimated in the final regulatory evaluation for the FMVSS No. 108 conspicuity rulemaking that 30 minutes is needed to apply conspicuity tape on all categories of trailers. NHTSA has also assumed that it would take 30 minutes to apply the tape to SUTs at an hourly rate of $22.20 per hour.

This yields labor costs of $11.10 (for 30 minutes labor) to apply tape to 50 percent of the length of the sides and the entire rear width and upper rear corners of an average SUT (a total of 1164 cm (38 ft, 2 in) of tape. Tape cost is estimated at $0.61 per linear foot (or per 30.48 cm), resulting in an estimated cost of tape at $23.28 per SUT. The total cost for labor and materials is estimated at ($23.28 + $11.10) x 1.51 consumer markup = $51.91 per SUT. (1.51 is the standard markup NHTSA uses to go from variable costs (labor and material) to consumer costs. The 1.51 markup includes fixed costs, manufacturer profit and dealer markups.)

NHTSA estimates that 578,631 new Class 3-8 trucks (GVWR greater than 4,536 kg (10,000 lb) are sold annually. Thus, the total consumer costs required for applying conspicuity tape to new SUTS is estimated to be approximately $30.0 million annually ($51.91 x 578,631 = $30,036,735).

Table 4. Annual Cost of applying retroreflective tape to the sides, rear, and upper corners of new SUTs

Cost Per Vehicle	$51.91
Annual sales of Class 3-8 SUTs in 2012	578,631
Total Cost All applicable new SUTs	$30.0 million

Preliminary Estimate of Benefits

NHTSA made a preliminary estimate of the benefits of requiring new SUTs to have conspicuity tape. The benefit of the tape is a reduction in the number of crashes and severity of injuries, although in this preliminary analysis we examined fatal crashes only. While any future analysis by the agency would include injuries and property damage, our preliminary evaluation demonstrates the potential for conspicuity tape to be a cost effective solution in preventing and/or mitigating crashes involving SUTs.

NHTSA analyzed the Fatality Analysis Reporting System (FARS) data files for the years 2010 through 2013. The analysis determined that on average 34 lives per year are lost annually in vehicles striking the sides or rear of SUTs in dark-not-lighted conditions (see Table 5). If conspicuity systems are as effective in these crashes as they have been on heavy trailer crashes, there is a potential to prevent 14 fatalities a year.

Table 5. Preliminary Benefits of Conspicuity systems on SUTs

Target Population	34
Effectiveness	41%
Fatalities Prevented	14

Estimated Cost Per Fatality Prevented

The estimated costs per fatality prevented for a retroreflective tape requirement for SUTs are shown in Table 6.

Table 6. Cost per Fatality Prevented

	3 percent
Total Cost	$30 Million
Fatality Prevented	14
Cost / Fatality Prevented	$2.1 million

Guidance from the U.S. Department of Transportation[45] identifies $9.1 million as the value of a statistical life (VSL) to be used for Department of Transportation analyses assessing the benefits of preventing fatalities for the base year of 2012. Per this guidance, VSL in 2014 is $9.2 million. While not directly comparable, the preliminary estimates for conspicuity systems on SUTs ($2.1 million per fatality prevented) is a strong indicator that these systems will be cost effective (current VSL $9.2 million).

VI. Request for Comment on Requiring Retroreflective Tape on SUTs

NHTSA requests comments that would help the agency assess and make judgments on the benefits, costs and other impacts of requiring SUTs to have retroreflective tape. 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.

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[45] See http://www.dot.gov/sites/dot.dev/files/docs/VSL%20Guidance_2013.pdf. The guidance starts with a $9.1 million VSL in the base year of 2012 and then estimates a 1.07 percent increase in VSL each year after the base year to reflect the estimated growth rate in median real wages for the next 30 years.

1. The agency assumed retroreflective tape would be 41 percent effective in preventing side and rear crashes into SUTs in dark-not-lighted conditions, based on the effectiveness NHTSA found for the tape in reducing side and rear impacts into heavy trailers. We seek comment on this effectiveness estimate. How effective are conspicuity systems at reducing crashes when applied to SUTs? Are there effectiveness studies specific to SUTs or statistical methods that could provide evidence that the effectiveness will be similar to that observed on heavy trailers?

2. While some fleet operations may be voluntarily applying conspicuity tape to their SUTs, our current crash databases do not include information on whether an SUT involved in a crash has conspicuity tape. The agency seeks input on ways that our analysis can better account for the voluntary installation of tape on SUTs.

3. Should all types of SUTs (box trucks, tow trucks, dual-wheeled pickups, etc.) be required to have conspicuity tape or only particular types of SUTs? What are the distinguishing characteristics of an SUT that make conspicuity tape needed?

4. What would be the cost of applying conspicuity tape on SUTs, including installation and materials?

5. Does conspicuity tape need to be replaced during the lifetime of the vehicle? How often and what sections of the vehicle need reapplication of conspicuity tape?

6. Are there any reasons that the agency should consider different patterns of application for SUTs as compared to trailers (different colors or locations)?

7. Should conspicuity tape be required on both the sides and the rear of the applicable SUTs, or should the agency consider application of the tape on the rear only?

8. Should NHTSA consider requiring current vehicles to be retrofitted with conspicuity tape? In March 1999, the Federal Highway Administration (FHWA) directed motor carriers engaged in interstate commerce to retrofit heavy trailers manufactured before December 1993 with some form of conspicuity treatment by June 1, 2001. In 2000, the Federal Motor Carrier Safety Administration (FMCSA) was established to perform motor carrier safety functions and operations, and authority for issuing and enforcing Federal Motor Carrier Safety Regulations was transferred to FMCSA. In 2000, NHTSA was delegated authority to promulgate safety standards for commercial motor vehicles and equipment already in use when the standards are based upon and similar to an FMVSS. See 49 CFR 1.95.[46]

VII. Rulemaking Analyses

Executive Orders 12866 and 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 rear of SUTs and/or that increase the likelihood of avoiding a crash into SUTs. Strategies discussed in this ANPRM are possible amendments to the FMVSSs to: (a) expand FMVSS Nos. 223 and 224, to require upgraded guards on SUTs; and (b) amend FMVSS No. 108, to require the type of retroreflective material on the rear and sides of SUTs that is now required to be placed on the rear and sides of heavy trailers to improve the conspicuity of the vehicles to other motorists.

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[46] FMCSA is delegated the authority to promulgate safety standards for commercial motor vehicles and equipment already in use when the standards are not based upon and similar to an FMVSS. 49 CFR 1.87.

The agency has made preliminary estimates of the costs and benefits of the two above strategies. 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 SUTs.

On Requiring SUTs to Have Underride Guards

A requirement for SUTs to comply with CMVSS No. 223 would require 59 percent of newly manufactured SUTs to be equipped with CMVSS No. 223 rear impact guards.[47] The estimated incremental minimum to average cost of equipping newly covered SUTs with CMVSS No. 223 guards ranges from $307 to $453 per vehicle. The total annual fleet cost of equipping new SUTs with CMVSS No. 223 guards ranges from $105 million to $155 million. The estimate of minimum to average additional weight of equipping SUTs with CMVSS No. 223 guards is 76.8 kg (169 lb) to 95.5 kg (210 lb) per vehicle. The estimate of minimum additional fuel cost during the lifetime of the vehicle due to the additional weight of the guard ranges from $316 million to $514 million. Therefore, the total minimum to average annual cost (including fuel costs) of requiring SUTs to have CMVSS No. 223 rear impact guards is estimated to be $421 million to $669 million.

For estimating the benefits of requiring SUTs to have CMVSS No. 223 guards, NHTSA estimated the annual number of fatalities in light vehicle rear impact crashes with PCI into the rear of SUTs. The real world data indicated that there are annually 33 light vehicle occupant fatalities in impacts into the rear of SUTs that resulted in PCI. Only 30 percent of these impacts

[47] Since the definition of wheels back and low chassis vehicles in 393.86(b) allows more vehicles to be excluded from requiring rear impact guards than CMVSS No. 223, when SUTs are required to comply with CMVSS No. 223, a larger percentage would need to have rear impact guards. This is further explained in Appendix A.

are at closing speeds less than or equal to 56 km/h (35 mph) for which CMVSS No. 223 compliant rear impact guards could prevent PCI.

The benefits analysis also included an estimate of the annual number of injuries in light vehicle crashes with PCI into the rear of SUTs. Non-PCI crashes were not considered as part of the target population for estimating benefits. This is because the IIHS test data (see Appendix B to this preamble) show that when PCI was prevented, the dummy injury measures were significantly below the injury assessment reference values specified in FMVSS No. 208. In non-PCI crashes into the rear of SUTs and trailers, the IIHS test data indicated that the passenger vehicle's restraint system would mitigate injury.

The benefits analysis in Appendix A estimates the equivalent lives saved (ELS) from a requirement for SUTs to have CMVSS No. 223 guards. The ELS are approximately 5.7 to 6.3 lives. The cost per ELS (3 and 7 percent discounted) is $106.7 million to $164.7 million, for each equivalent life saved. A summary of the analysis estimating incremental costs, benefits, and cost per equivalent lives saved is shown below in Table 7.

Table 7: Estimates of material, installation, and fuel costs of equipping applicable SUTs (Class 3-8) with CMVSS rear impact guards, resulting incremental benefits of lives saved and injuries prevented, and cost per equivalent lives saved.

Material + Installation + Fuel Costs	
Minimum to average incremental cost of CMVSS guard per SUT	$307 - $453
Number of SUTs needing guards annually	341,392
Total incremental cost of CMVSS guards in SUT fleet	$104.9M - $154.6M
Minimum to average incremental weight of CMVSS guard per SUT	169 lb - 210 lb
Minimum to average incremental lifetime fuel cost per SUT	$924.7 - $1,505.3
Minimum to average incremental fuel cost for SUT fleet	$316M - $514M
Total minimum to average incremental cost of CMVSS guards +fuel for SUT fleet	$421M - $669M
Benefits Estimates	

Target Population (light vehicle occupant fatalities in crashes with PCI into the rear of applicable SUTs) average to high injury estimates	20 lives; 99-182 MAIS 1 injuries; 33-82 MAIS 2 and 17-27 MAIS 3-5 injuries
Estimated effectiveness of CMVSS guards	0.25 for fatalities, 0.2 for injuries
Equivalent lives saved (undiscounted) average to high estimates	5.7 - 6.3
Equivalent lives saved (3% discounted) average to high estimates	4.4 - 4.9
Equivalent lives saved (7% discounted) average to high estimates	3.3 - 3.7
Cost/Benefit Analysis	
Cost per equivalent lives saved (3% discount)	$106.7M - $152.9M
Cost per equivalent lives saved (7% discount)	$113.9M - $164.7M

On Requiring SUTs to Have Retroreflective (Conspicuity) Tape

NHTSA made a preliminary estimate of the cost of requiring new SUTs to have conspicuity tape. The cost of installing the tape was calculated based on the cost of the material itself and the cost to install the tape. The total cost for labor and materials is estimated at $23.28 + $11.10 x 1.51 consumer markup = $51.91 per SUT. NHTSA estimates that 578,631 new Class 3-8 trucks (GVWR > 10,000 lb) are sold annually. Thus, the total consumer costs required for applying conspicuity tape to new SUTs is estimated to be approximately $30.0 million annually ($51.91 x 578,631 = $30,036,735).

NHTSA made a preliminary estimate of the benefits of requiring new SUTs to have conspicuity tape. The agency estimates that a requirement would prevent 14 fatalities. The estimated costs per fatality prevented for a retroreflective tape requirement for SUTs are shown in Table 8.

Table 8. Cost per Fatality Prevented

	3 percent discounted
Fatality Prevented	14
Cost / Fatality Prevented	$2.1 million

Regulation Identifier Number

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.

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 rule clearly stated?
- Does the rule contain technical language or jargon that isn't clear?
- Would a different format (grouping and order of sections, use of headings, paragraphing) make the rule 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 rule easier to understand?

If you have any responses to these questions, please write to us with your views.

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.

VIII. 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?

If you wish to submit any information under a claim of confidentiality, you should submit three copies of your complete submission, including the information you claim to be confidential business information, to the Chief Counsel, NHTSA, at the address given above under FOR FURTHER INFORMATION CONTACT. In addition, you should submit a copy from which you have deleted the claimed confidential business information to the docket. When you send a comment containing information claimed to be confidential business information, you should include a cover letter setting forth the information specified in our confidential business information regulation. (49 CFR Part 512.)

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).

Note: the following Appendices will not appear in the CFR.

APPENDIX A TO PREAMBLE;

Cost-Benefit Evaluation Of

Requiring Single Unit Trucks (SUTs) to Have CMVSS No. 223 Guards

Introduction

This appendix provides NHTSA's analysis of the cost and benefits of requiring new SUTs to have CMVSS No. 223 rear impact guards. The analysis's findings, which are discussed in detail in this appendix, are summarized in the following Table A-1.[48]

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[48] Earlier in the preamble, NHTSA requested comment on this analysis and posed a series of questions seeking information to help make the analysis more complete. For example, the agency noted that this analysis did not include the cost of changes to SUTs to accommodate CMVSS No. 223 guards, such as strengthening of rear beams,

Table A-1: Estimates of material, installation, and fuel costs of equipping applicable SUTs with CMVSS rear impact guards, resulting incremental benefits of lives saved and injuries prevented, and cost per equivalent lives saved.

Material + Installation + Fuel Costs	
Minimum to average incremental cost of CMVSS guard per SUT	$307 - $453
Number of SUTs needing guards annually	341,392
Total incremental cost of CMVSS guards in SUT fleet	$104.9M - $154.6M
Minimum to average incremental weight of CMVSS guard per SUT	169 lb - 210 lb
Minimum to average incremental lifetime fuel cost per SUT	$924.7 - $1,505.3
Minimum to average incremental fuel cost for SUT fleet	$316M - $514M
Total minimum to average incremental cost of CMVSS guards +fuel for SUT fleet	$421M - $669M
Benefits Estimates	
Target Population (light vehicle occupant fatalities in crashes with PCI into the rear of applicable SUTs) average to high injury estimates	20 lives; 99-182 MAIS 1 injuries; 33-82 MAIS 2 and 17-27 MAIS 3-5 injuries
Estimated effectiveness of CMVSS guards	0.25 for fatalities, 0.2 for injuries
Equivalent lives saved (undiscounted) average to high estimates	5.7 - 6.3
Equivalent lives saved (3% discounted) average to high estimates	4.4 - 4.9
Equivalent lives saved (7% discounted) average to high estimates	3.3 - 3.7
Cost Per Equivalent Lives Saved	
Cost per equivalent lives saved (3% discount)	$106.7M - $152.9M
Cost per equivalent lives saved (7% discount)	$113.9M - $164.7M

Estimating the Population of Covered SUTs

Currently, rear impact protection for SUTs is regulated by FMCSR regulation 49 CFR 393.86(b), which requires that certain SUTs used in interstate commerce have a guard if there is no vehicle parts or equipment within the area where the rear impact guard location is prescribed. (The bottom plane of the area is not more than 762 mm (30 inches) above the ground, the forward-most plane of the area is not more than 610 mm (24 inches) forward of the rear

frame rails, and the floor of vehicles, or cost resulting from the reduction in payload resulting from increased weight of the SUT due to installation of a CMVSS No. 223 guard.

extremity, and the lateral planes of the area are not more than 457 mm (18 inches) from the side extremity of the SUT.)

CMVSS No. 223 requires rear impact guards on trailers[49] that do not have equipment or vehicle parts within the area where the rear impact guard is prescribed to be located. (The bottom plane of the area is not more than 560 mm (22 inches) above the ground, the forward-most plane of the area is not more than 305 mm (12 inches) forward of the rear extremity, and the lateral planes of the area are not more than 100 mm (4 inches) from the side extremity of the trailer.)

The geometric requirements for the guards in CMVSS No. 223 are similar to that in FMVSS No. 224. The contrast between the geometric requirements of the guards in FMCSR 393.86(b) and CMVSS No. 223 is shown in Figure A-1.

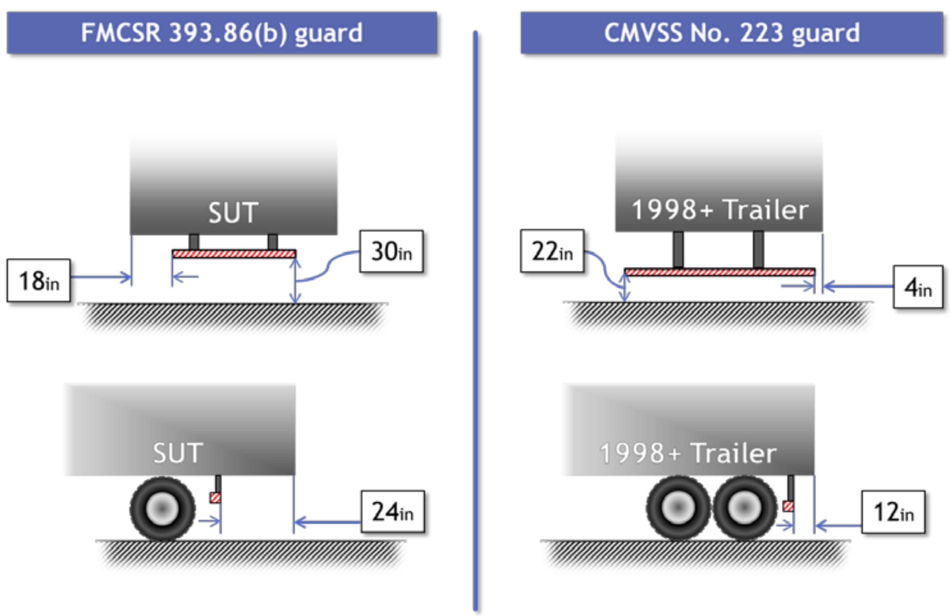


Figure A-1: Depiction of rear impact protection requirements for single unit trucks and trailers (not to scale).

[49] Pole trailers, pulpwood trailers, horizontal discharge trailers, and some other types of trailers are excluded.

The various underride guard standards exclude certain vehicles from their requirements due to reasons such as impediments to equipping a guard in a specified area or because the design of the vehicle renders a guard unnecessary to prevent underride. FMVSS No. 224 and CMVSS No. 223 have similar exclusions of vehicles, in contrast to FMCSA 393.86(b). For example, in FMCSR 393.86(b), a "wheels back vehicle" is one where the vehicle's rearmost axle is not more than 610 mm forward of the rear extremity of the vehicle, while in FMVSS No. 224 and CMVSS No. 223, a "wheels back" trailer is one where the rearmost axle is not more than 305 mm forward of the rear extremity of the vehicle. Another example is definitions of a "low chassis" vehicle. In FMCSR 393.86(b), a "low chassis vehicle" is one where the ground clearance of the bottom edge of the chassis which extends to the rearmost part of the vehicle is less than or equal to 762 mm, while in FMVSS No. 224 and CMVSS No. 223, a low chassis trailer is one where the ground clearance of the bottom edge of the chassis which extends to the rearmost part of the vehicle is less than or equal to 560 mm. If NHTSA were to require SUTs to comply with CMVSS No. 223, then some SUTs that were previously excluded by the FMCSR from having guards because they were considered wheels back or low chassis vehicles under FMCSR 393.86(b) would no longer qualify as wheels back or low chassis vehicles under CMVSS No. 223. These vehicles therefore would have to be equipped with rear impact guards in accordance with CMVSS No. 223.

UMTRI[50] evaluated the rear geometry of SUTs involved in fatal crashes in the 2008 and 2009 TIFA data files and estimated that 38 percent of SUTs were configured so as to be included under FMCSA 393.86(b) based on vehicle design, as shown below in Table A-2. However,

[50] Heavy-Vehicle Crash Data Collection and Analysis to Characterize Rear and Side Underride and Front Override in Fatal Truck Crashes, DOT HS 811 725, March 2013.

UMTRI estimated that only 18 percent of SUTs were equipped with rear impact guards. The remaining 20 percent of the SUTs that appeared, based on vehicle design, to be included in the requirement to have a guard but did not have one, likely were not used in interstate commerce and so not covered by FMCSR 393.86(b).

Table A-2: Percentage of SUTs by their rear geometry and whether a rear impact guard was required according to UMTRI's evaluation of SUTs involved in fatal crashes in the 2008-2009 TIFA data files.

Type of Rear Geometry	Percentage of SUTs
Rear Impact Guard Required	
Guard present	18%
Guard not present	20%
Rear Impact Guard Not Required	
Excluded vehicle	8%
Wheels back vehicle	27%
Low chassis vehicle	9%
Wheels back and low chassis vehicle	2%
Equipment	16%

NHTSA examined the rear geometry of SUTs in the 2008 and 2009 TIFA data files from the 2013 UMTRI study to determine the vehicles that would need to have rear impact guards in accordance with CMVSS No. 223 and the vehicles that would be excluded (as within an excluded type of vehicle, i.e., wheels back, low chassis, rear equipment, special vehicles). The examination (Table A-3) shows that 59 percent of SUTs would need rear impact guards according to CMVSS No. 223.

Since UMTRI's evaluation (Table A-2) indicates that only 18 percent of SUTs that had a rear geometry that did not outwardly qualify as an excluded vehicle under FMCSR 393.86(b) had guards,[51] 18 percent of SUTs (those now with guards meeting FMCSR 393.86(b)) would need upgraded CMVSS No. 223 guards, and 41 percent (=59 –18) of SUTs now without rear impact guards would need CMVSS No. 223 guards.

Table A-3. Percentage of SUTs by their rear geometry in the 2008-2009 TIFA data files and whether a guard would be required according to current FMCSR 393.86(b) specifications and to CMVSS No. 223 specifications.

Type of Rear Geometry	Classification per FMCSR 393.86(b)	Classification per CMVSS No. 223
Rear impact guard required	38%	59%
Wheels back and/or low chassis vehicle	38%	20%
Equipment in rear and/or excluded vehicle	24%	21%

The agency evaluated SUTs of Classes 3 to 8 (SUTs with a GVWR greater than 10,000 lb) as shown in Table A-4 for upgrading to CMVSS No. 223 requirements. The annual truck sales for 2012 were obtained from the Ward's Automotive Yearbook 2013 by the Ward's Automotive Group[52] and are presented in Table A-5.

Table A-4. SUT classification and examples[53]– Weight category definitions from 49 CFR 565, "Vehicle identification number (VIN) requirements."

Vehicle Class	Weight Range (lb)	Examples
3	10,000 – 14,000	Walk-In, Box Truck, City Delivery, Heavy-Duty Pickup
4	14,001 – 16,000	Large Walk-In, Box Truck, City Delivery
5	16,001 – 19,500	Bucket Truck, Large Walk-In, City Delivery
6	19,501 – 26,000	Beverage Truck, Rack Truck
7	26,001 – 33,000	Refuse truck, Furniture truck
8	33,001 and over	Cement Truck, Dump Truck

Table A-5. Annual sales of SUTs in 2012.

SUT Class	Sales in 2012

[51] UMTRI estimated that although 38 percent of the SUTs involved in fatal crashes were required to have rear impact guards (based on the truck rear geometry according to FMCSR 393.86(b)), only 18 percent were equipped with them. It is likely that the remaining 20 percent of the SUTs that were configured so as not to be considered among the vehicles excluded from FMCSA 393.86(b) based on vehicle design, but that did not have a guard, were not used in interstate commerce.
[52] Ward's Automotive group, ISBN Number 978-0-910589-31-4, Southfield, MI 2013. http://wardsauto.com/
[53] Source: Oak Ridge National Laboratory, Center for Transportation Analysis, Oak Ridge, TN http://cta.ornl.gov/vtmarketreport/heavy_trucks.shtml

3	232,755
4	9,431
5	54,898
6	39,978
7	46,854
8	194,715
Total Class 3-8 truck sales in 2012 =	578,631

The total sales volume of SUTs of Class 3-8 in 2012 was 578,631. Assuming that the classification of SUTs in the 2008-2009 TIFA data files as shown in Table A-3 is representative of the SUT fleet, then 59 percent of the SUTs sold annually would require CMVSS No. 223 guards. Therefore, applying CMVSS No. 223 to SUTs would affect approximately 341,692 (=0.59 x 578,631) SUTs sold annually.[54]

Costs

Cost of rear impact guards

In 2013, NHTSA conducted a study to develop cost and weight estimates for rear impact guards on heavy trailers.[55] Using the cost estimates for rear impact guards obtained from this study, in this section we estimate the cost of equipping SUTs with the guards.

In the 2013 study, the researchers estimated the cost and weight of FMCSR 393.86(b) rear impact guards, FMVSS No. 223 rear impact guards, and CMVSS No. 223 rear impact guards (Table A-6). All costs are presented in 2012 dollars. In estimating the cost and weight of guards, an engineering analysis of the guard system for each trailer was conducted, including material composition, manufacturing and construction methods and processes, component size, and attachment methods. We note, however, that the authors did not take into account the

[54] I.e., these vehicles would be required to be equipped with rear impact guards meeting CMVSS No. 223.
[55] Cost and weight analysis for rear impact guards on heavy trucks, Docket No. NHTSA-2011-0066-0086, June 2013.

construction, costs, and weight changes in the trailer structure that would be needed to withstand loads from the stronger guards. Thus, a limitation of this analysis is the fact that the authors did not evaluate the changes in design of the rear beam, frame rails, and floor of the trailer when replacing a rear impact guard compliant with FMCSR 393.86(b) with an FMVSS No. 224 compliant guard and then to a CMVSS No. 223 compliant guard.

Table A-6. Cost (2012 dollars) and weight of different types of rear impact guards.

Type of Rear Impact Guard	Trailer Model Year/Make	*Guard Assembly*	*Installation Cost*	*Total Cost*	Weight (lb)
FMCSR 393.86(b)	*1993 Great Dane*	$64.35	$41.31	$105.66	78
FMVSS No. 224	*2001 Great Dane*	$150.97	$108.14	$259.11	172
CMVSS No. 223	*2012 Great Dane*	$188.36	$151.00	$339.36	193
	2012 Manac	$297.62	$245.09	$542.72	307
	2012 Stoughton	$244.38	$219.11	$463.49	191
	2012 Wabash	$440.49	$152.93	$593.42	243

The average cost of a CMVSS rear impact guard is $485, which is $226 more than an FMVSS No. 224 guard and $379 more than an FMCSR 393.86(b) guard. In comparing the Great Dane rear impact guards, the 2012 Great Dane guard (the least expensive CMVSS No. 223 guard studied) is $234 more expensive than the 1993 guard (FMCSR 393.86(b) guard).

NHTSA used the incremental cost of $234 to $379[56] (from Table A-6) to estimate costs of upgrading SUTs presently with FMCSR 393.86(b) guards to CMVSS No. 223 guards. The agency used the incremental cost of $339 to $485[57] (from Table A-6) to estimate costs of equipping SUTs presently without guards with CMVSS No. 223 guards. These incremental costs do not take into account additional construction, costs, and weight changes needed in the

[56] $234 is the lowest incremental cost to upgrade from an FMCSR 393.86(b) guard to a CMVSS No. 223 guard and $379 represents the average incremental cost.
[57] $339 is the lowest incremental cost to upgrade from no guard to a CMVSS No. 223 guard and $485 represents the average incremental cost.

SUT structure to withstand loads from the upgraded guards. Thus, the agency believes that the lower cost estimates may not represent the true incremental cost of equipping SUTs with rear impact guards. An analysis was therefore also conducted using the average incremental costs.

In the new SUT fleet, 18 percent of the fleet now equipped with FMCSR guards would be upgraded to CMVSS guards, and 41 percent of the fleet now without guards would need CMVSS guards. Therefore, the weighted incremental cost of CMVSS guards for applicable SUTs is $307 to $453, as shown in Table A-7.

Table A-7. Estimating the weighted incremental cost of equipping CMVSS No. 223 guards on applicable SUTs

	Cost
Minimum cost of CMVSS No. 223 compliant guard (a1) =	$339
Average cost of CMVSS No. 223 compliant guard (a2) =	$485
Incremental minimum cost of CMVSS guard over FMCSR guard (b1) =	$234
Incremental average cost of CMVSS guard over FMCSR guard (b2) =	$379
Percentage of SUTs that have FMCSR guards and would need CMVSS guards (c1) =	18%
Percentage of SUTs that do not have guards and would need CMVSS guards (c2) =	41%
Weighted minimum cost per SUT to equip Canadian guard (c1*b1+c2*a1)/(c1+c2) =	$307
Weighted average cost per SUT to equip Canadian guard (c1*b2+c2*a2)/(c1+c2) =	$453

Based on these data, the agency estimated the total annual incremental material and installation cost of requiring new applicable SUTs to be equipped with CMVSS No. 223 rear impact guards (shown in Table A-8).

Table A-8. Annual incremental material and installation cost of requiring CMVSS No. 223 guards on new SUTs

Total No. of SUTs Needing CMVSS Guards (a)	341,692	
	Lower bound	Average
Incremental Cost of CMVSS Guard (b)	$307	$453

Total cost for truck fleet (axb)	$104,942,055	$154,619,794

Lifetime Fuel Costs

Using the data in Table A-6, the average weight of a CMVSS No. 223 compliant guard is 234 lb, which is 156 lb greater than an FMCSR 393.86(b) guard. In comparing the Great Dane rear impact guards, the 2012 Great Dane guard is 115 lb heavier than the 1993 Great Dane guard.

In the new SUT fleet, 18 percent equipped with FMCSR guards would be upgraded to CMVSS guards and 41 percent without any guards would need CMVSS guards. The weighted incremental increase in the weight of SUTs was obtained in a similar manner as the weight incremental cost shown in Table A-9.

Table A-9. Estimating the weighted incremental weight increase of equipping CMVSS No. 223 compliant guards on applicable SUTs.

	weight (lb)
Minimum weight of CMVSS No. 223 compliant guard (a1) =	193
Average weight of CMVSS No. 223 compliant guard (a2) =	234
Incremental minimum weight of CMVSS guard over FMCSR guard (b1) =	115
Incremental average weight of CMVSS guard over FMCSR guard (b2) =	156
percentage of SUTs that have FMCSR guards and would need CMVSS guards (c1) =	18%
percentage of SUTs that don't have guards and would need CMVSS guards (c2) =	41%
Weighted minimum weight increase per SUT to equip Canadian guard (c1*b1+c2*a1)/(c1+c2) =	169
Weighted average weight increase per SUT to equip Canadian guard (c1*b2+c2*a2)/(c1+c2) =	210

Therefore, the minimum to average increased weight of equipping CMVSS guards for applicable SUTs is 169 lb to 210 lb. The added weight would increase the fuel consumption costs during the lifetime of the vehicle, costs that have to be discounted to present rate to determine the total present value annual cost of equipping SUTs with CMVSS No. 223 rear impact guards.

The vehicle miles of travel and the fuel economy for heavy vehicles is shown in Table A-10.

Table A-10. Annual vehicle miles of travel and fuel economy per SUT (2008 to 2011)[58]

	2008	2009	2010	2011
Average miles traveled per SUT	15,306	14,386	13,469	13,239
Average fuel economy per SUT (mpg)	7.4	7.4	7.3	7.3

Using the base fuel economy of 7.3 miles per gallon (mpg) shown in Table A-10 for the year 2011, the reduced new fuel economy for Class 3-8 SUTs due to the minimum to average added weight of 169 lb - 210 lb (for CMVSS No. 223 guards) was computed (as shown in Table A-11) using the standard formula:[59]

New fuel economy = (base vehicle weight/[base vehicle weight+added weight])^0.8*(base fuel economy)

The average weight of Class 3, Class 4-6, Class 7, and Class 8 SUTs (shown in Table A-11) was estimated from Table A-4. The average weight of Class 4-6 SUTs was weighted by their respective sales volume shown in Table A-5. The average weight of Class 8 (weight range 33,001 and over) trucks was assumed to be 40,000 lb.

Table A-11. Estimating new fuel economy (mpg) using the standard formula.

SUT Class	Average Weight (lb)	Average Weight + 169 lb	Average Weight + 210 lb	Base Fuel Economy (mpg)	New Fuel Economy (+169 lb) (mpg)	New Fuel Economy (+210 lb) (mpg)
3	12,000	12169	12210	7.3	7.218686	7.199288
4-6	19418	19587	19628	7.3	7.249507	7.237390
7	29500	29669	29710	7.3	7.266675	7.258652
8	40000	40169	40210	7.3	7.275390	7.269455

[58] Data from Oakridge National Laboratories (ORNL) market report at http://cta.ornl.gov/vtmarketreport/pdf/chapter3_heavy_trucks.pdf (see Figure 78 on page 100).
[59] This standard formula for estimating the impact of marginal weight increases on fuel economy is based on light vehicle data. However, it is the best available method for estimating changes in fuel economy due to weight increases at this time and so is used here for heavy vehicles.

The method of deriving discount rates is presented in Table A-12 for Class 3 SUTs as an example. The 3 percent and 7 percent discount rates for Class 3, Class 4-6, Class 7, and Class 8 SUTs are summarized in Table A-13.

Table A-12. Derivation of discount rates (for Class 3 SUTs as an example).

							Weighted	Weighted
Age	VMT	Surv.	Wgt. VMT	% of VMT	3%	7%	3%	7%
1	30222	1	30222	7.98%	0.9853	0.9667	0.079	0.077
2	29072	1	29072	7.67%	0.9566	0.9035	0.073	0.069
3	27966	0.997	27882	7.36%	0.9288	0.8444	0.068	0.062
4	26901	0.992	26686	7.04%	0.9017	0.7891	0.064	0.056
5	25878	0.983	25438	6.71%	0.8755	0.7375	0.059	0.050
6	24893	0.969	24121	6.37%	0.85	0.6893	0.054	0.044
7	23945	0.951	22772	6.01%	0.8252	0.6442	0.050	0.039
8	23034	0.929	21399	5.65%	0.8012	0.602	0.045	0.034
9	22158	0.901	19964	5.27%	0.7778	0.5626	0.041	0.030
10	21314	0.869	18522	4.89%	0.7552	0.5258	0.037	0.026
11	20503	0.832	17058	4.50%	0.7332	0.4914	0.033	0.022
12	19723	0.791	15601	4.12%	0.7118	0.4593	0.029	0.019
13	18972	0.746	14153	3.74%	0.6911	0.4292	0.026	0.016
14	18250	0.698	12739	3.36%	0.671	0.4012	0.023	0.013
15	17556	0.648	11376	3.00%	0.6514	0.3749	0.020	0.011
16	16888	0.596	10065	2.66%	0.6324	0.3504	0.017	0.009
17	16245	0.543	8821	2.33%	0.614	0.3275	0.014	0.008
18	15627	0.49	7657	2.02%	0.5961	0.306	0.012	0.006
19	15032	0.438	6584	1.74%	0.5788	0.286	0.010	0.005
20	14460	0.388	5610	1.48%	0.5619	0.2673	0.008	0.004
21	13910	0.339	4715	1.24%	0.5456	0.2498	0.007	0.003
22	13380	0.294	3934	1.04%	0.5297	0.2335	0.005	0.002
23	12871	0.251	3231	0.85%	0.5142	0.2182	0.004	0.002
24	12381	0.212	2625	0.69%	0.4993	0.2039	0.003	0.001
25	11910	0.177	2108	0.56%	0.4847	0.1906	0.003	0.001
26	11457	0.146	1673	0.44%	0.4706	0.1781	0.002	0.001
27	11021	0.119	1311	0.35%	0.4569	0.1665	0.002	0.001
28	10601	0.095	1007	0.27%	0.4436	0.1556	0.001	0.000
29	10198	0.075	765	0.20%	0.4307	0.1454	0.001	0.000
30	9810	0.059	579	0.15%	0.4181	0.1359	0.001	0.000
31	9437	0.045	425	0.11%	0.4059	0.127	0.000	0.000
32	9077	0.034	309	0.08%	0.3941	0.1187	0.000	0.000
33	8732	0.025	218	0.06%	0.3826	0.1109	0.000	0.000
34	8400	0.019	160	0.04%	0.3715	0.1037	0.000	0.000
35	8080	0.013	105	0.03%	0.3607	0.0969	0.000	0.000
			378907	1.000			0.7917	0.6120

The overall discount rate for Class 3-8 SUTs was determined as the weighted average of the discount rates shown in Table A-13 (weighted by the sales volume shown in Table A-5).

Table A-13. Discount Rates for Class 3, Class 4-6, Class 7, and Class 8 SUTs and the discount rates for the aggregate Class 3-8 (weighted by sales volume)

Discount Rate	Class 3	Class 4-6	Class 7	Class 8	Overall discount rate (Class 3-8 weighted average)
3 Percent	0.79165	0.78643	0.77162	0.74705	0.77408
7 Percent	0.61196	0.60759	0.58533	0.54827	0.58758

The cost of diesel fuel during the lifetime of an SUT (2017 to 2051) was obtained from the Annual Energy Outlook 2014 AEO2014 worksheet in 2012 dollars.[60] The tax for diesel fuel (estimated at $0.54 per gallon) was obtained from the American Petroleum Institute (API).[61] The calculation for the incremental lifetime cost of fuel due to minimum increase in weight of the vehicle (169 lb) due to installing CMVSS No. 223 compliant guards is shown in Table A-14 for Class 3 SUTs as an example.

[60] Annual Energy Outlook 2014, U.S. Energy Information Administration, http://www.eia.gov/forecasts/aeo/.
[61] http://www.api.org/statistics/fueltaxes/upload/State_Motor_Fuel_Excise_Tax_Update.pdf

Table A-14. Calculation of increased lifetime fuel costs per SUT requiring CMVSS No. 223 compliant guards (for Class 3 SUTs with 169 lb increased weight as an example).

				3% discount		7% discount	
Cost of diesel	Fuel Consumption per year		Difference	fuel costs		fuel costs	
fuel - taxes	base (a)	new (b)	(a) - (b)	base	new	base	new
(2012 dollars)	gallons	gallons					
$3.3475	4,140.00	4,186.63	46.63	$10,971.31	$11,094.89	$8,480.97	$8,576.51
$3.4058	3,982.47	4,027.33	44.86	$10,737.65	$10,858.61	$8,300.36	$8,393.86
$3.3393	3,819.47	3,862.49	43.02	$10,096.93	$10,210.67	$7,805.07	$7,892.99
$3.1433	3,655.59	3,696.77	41.18	$9,096.67	$9,199.14	$7,031.85	$7,111.06
$3.0041	3,484.67	3,523.92	39.25	$8,287.35	$8,380.70	$6,406.24	$6,478.40
$2.9552	3,304.29	3,341.51	37.22	$7,730.43	$7,817.51	$5,975.73	$6,043.04
$2.9571	3,119.41	3,154.55	35.14	$7,302.64	$7,384.90	$5,645.04	$5,708.63
$2.9939	2,931.31	2,964.33	33.02	$6,947.53	$7,025.79	$5,370.53	$5,431.03
$3.0706	2,734.84	2,765.65	30.81	$6,648.03	$6,722.92	$5,139.02	$5,196.91
$3.1319	2,537.24	2,565.82	28.58	$6,290.74	$6,361.60	$4,862.83	$4,917.61
$3.2007	2,336.78	2,363.10	26.32	$5,921.05	$5,987.74	$4,577.05	$4,628.61
$3.2758	2,137.11	2,161.18	24.07	$5,542.10	$5,604.53	$4,284.12	$4,332.38
$3.3280	1,938.78	1,960.62	21.84	$5,107.97	$5,165.51	$3,948.53	$3,993.01
$3.3781	1,745.00	1,764.66	19.66	$4,666.60	$4,719.17	$3,607.35	$3,647.99
$3.4370	1,558.40	1,575.95	17.55	$4,240.27	$4,288.03	$3,277.79	$3,314.71
$3.4843	1,378.80	1,394.33	15.53	$3,803.20	$3,846.04	$2,939.93	$2,973.04
$3.5430	1,208.36	1,221.97	13.61	$3,389.22	$3,427.40	$2,619.91	$2,649.42
$3.5771	1,048.94	1,060.75	11.82	$2,970.40	$3,003.85	$2,296.16	$2,322.02
$3.6233	901.92	912.08	10.16	$2,587.04	$2,616.18	$1,999.82	$2,022.34
$3.6641	768.56	777.22	8.66	$2,229.34	$2,254.45	$1,723.31	$1,742.73
$3.7128	645.96	653.23	7.28	$1,898.66	$1,920.04	$1,467.69	$1,484.22
$3.7643	538.87	544.94	6.07	$1,605.81	$1,623.90	$1,241.32	$1,255.30
$3.8184	442.55	447.54	4.99	$1,337.77	$1,352.83	$1,034.11	$1,045.76
$3.8891	359.56	363.61	4.05	$1,107.03	$1,119.50	$855.75	$865.39
$3.9271	288.78	292.03	3.25	$897.77	$907.89	$693.99	$701.81
$3.9694	229.14	231.72	2.58	$720.04	$728.15	$556.60	$562.87
$4.0028	179.66	181.68	2.02	$569.30	$575.71	$440.08	$445.03
$4.0433	137.96	139.51	1.55	$441.59	$446.57	$341.36	$345.20
$4.1130	104.77	105.95	1.18	$341.15	$344.99	$263.71	$266.69
$4.1911	79.29	80.18	0.89	$263.06	$266.03	$203.35	$205.64
$4.2456	58.17	58.83	0.66	$195.52	$197.72	$151.14	$152.84
$4.3008	42.28	42.75	0.48	$143.94	$145.56	$111.27	$112.52
$4.3567	29.90	30.24	0.34	$103.14	$104.30	$79.73	$80.63
$4.4133	21.86	22.11	0.25	$76.39	$77.25	$59.05	$59.71
$4.4707	14.39	14.55	0.16	$50.93	$51.50	$39.37	$39.81
Total costs				$134,318.56	$135,831.58	$103,830.13	$104,999.71
Difference					$1,513.02		$1,169.59

Tables A-15(a) and A-15(b) present the summary analysis for determining the total incremental lifetime fuel cost of equipping Class 3-8 SUTs with CMVSS No. 223 guards that results in increase in SUT weight by a minimum of 169 lb to an average of 210 lb. The discounted incremental lifetime fuel cost per SUT for the different class SUTs shown in columns 2 and 3 of Table A-15(a) and Table A-15(b) was obtained as shown in Table A-14 for Class 3 SUTs. The annual number of SUTs in each class requiring CMVSS No. 223 guards was estimated to be 59 percent (as shown in Table A-3) of the annual sales volume. The total minimum incremental fuel cost for each SUT class (last two columns of Table A-15(a)) is the product of the number of SUTs of the class requiring CMVSS No. 223 guards and the increased fuel cost per SUT for that Class of SUTs (e.g. for Class 3 SUTs with 169 lb weight increase, 3 percent discounted total minimum incremental fuel costs = $1,513.02 x 137,446). A similar analysis of total average incremental fuel cost for average weight increase of 210 lb is shown in able A-15(b).

The total minimum incremental fuel cost for all SUTs (second to last row in Table A-15(a)) is the sum of the total minimum incremental fuel cost for each SUT class shown in the last two columns of Table A-15(a). The average incremental fuel cost per SUT for all Class 3-8 SUTs (last row in Table A-15(a)) with 169 lb weight increase is obtained by dividing the total minimum incremental fuel cost for the annual SUT fleet by the total number of SUTs with CMVSS guards (e.g. for 3 percent discount, average incremental fuel cost per SUT (Class 3-8) = $1,212 = $414,129,456/341,692). The average incremental fuel cost per SUT for all Class 3-8 SUTs with 210 lb weight increase is shown in Table A-15(b).

Table A-15. Incremental lifetime fuel costs per SUT, sales volume per SUT class, annual number of SUTs requiring CMVSS No. 223 guards, total incremental fuel costs by class of SUT and for all SUTs requiring CMVSS guards, and the incremental fuel cost per class 3-8 SUTs.

(a) (For weight increase = 169 lb)

	Increased minimum lifetime fuel cost per SUT	Annual sales	SUTs that would have	Total minimum incremental lifetime fuel costs (169 lb

	(169 lb weight increase)		volume	CMVSS No. 223 guards	weight increase)	
Class	3 percent	7 percent			3 percent	7 percent
3	$1,513.02	$1,169.59	232,755	137,446	$207,958,428	$160,754,780
4-6	$1,345.48	$1,039.50	104,307	61,595	$82,875,115	$64,028,366
7	$1,004.81	$762.22	46,854	27,668	$27,801,137	$21,089,132
8	$830.51	$609.53	194,715	114,983	$95,494,776	$70,085,316
Total Number of SUTs with CMVSS guards=				341,692		
Total minimum incremental fuel cost for Class 3-8 SUTs proposed to have CMVSS guards=					$414,129,456	$315,957,594
Average minimum incremental fuel cost per Class 3-8 SUTs proposed to have CMVSS guards =					$1,212.00	$924.69

(b) (For weight increase = 210 lb)

	Increased average lifetime fuel cost per SUT (210 lb weight increase)		Annual Sales Volume	SUTs that would have CMVSS No. 223 guards	Total average incremental lifetime fuel costs (210 lb weight increase).	
Class	3 percent	7 percent			3 percent	7 percent
3	$1,879.01	$1,452.50	232,755	137,446	$258,261,947	$199,640,105
4-6	$1,671.16	$1,291.12	104,307	61,595	$102,935,155	$79,526,524
7	$1,248.11	$946.78	46,854	27,668	$34,532,905	$26,195,655
8	$1,031.65	$757.15	194,715	114,983	$118,622,180	$87,058,930
Total Number of SUTs with CMVSS guards=				341,692		
Total average incremental fuel cost for Class 3-8 SUTs proposed to have CMVSS guards=					$514,352,187	$392,421,214
Average incremental fuel cost per Class 3-8 SUTs					$1,505.31	$1,148.46

The weighted minimum incremental increase in lifetime fuel cost per SUT (for Class 3-8 SUTs) at 3 percent discounting is $1,212 and that at 7 percent discounting is $924.7.[62] The weighted average incremental increase in lifetime fuel cost per SUT (for Class 3-8 SUTs) at 3 percent discounting is $1,505 and that at 7 percent discounting is $1,148.5. The total minimum incremental increase in lifetime fuel cost in the Class 3-8 SUT fleet is $414.1M a 3 percent discount rate and $315.9M at 7 percent discount rate. The total average incremental increase in

[62] The incremental fuel costs at 3 percent and 7 percent discounting include tax for diesel fuel.

lifetime fuel cost in the Class 3-8 SUT fleet is $514.3M a 3 percent discount rate and $392.4M at 7 percent discount rate.

Table A-16 presents the total fleet incremental cost (sum of incremental equipment and installation cost in Table A-8 and fuel cost in Table A-15) to the new applicable SUTs to be equipped with CMVSS No. 223 compliant rear impact guards.

Table A-16. Total incremental fleet cost of equipping applicable new SUTs with CMVSS No. 223 rear impact guards (equipment/installation cost in Table A-8 + minimum fuel cost in Table A-15).

	Equipment + Installation costs	Fuel cost		Total costs	
		3%	7%	3%	7%
Low Estimate	$104,942,055	$414,129,456	$315,957,594	$519,071,511	$420,899,649
Average Estimate	$154,619,794	$514,352,187	$392,421,214	$668,971,981	$547,041,007

NHTSA estimated an average maintenance and repair expense for a rear impact guard over the vehicle's lifetime of $15.[63] This maintenance and repair cost is relatively small compared to the lifetime fuel cost and was not taken into consideration in the present analysis. Reduced revenue from reduced payload of commercial operations due to increase in vehicle weight was not taken into consideration because the percentage of SUTs that are currently operating at their GVWR limit is not known. Taking into consideration the reduced revenue that could result from increase in vehicle weight would further increase the cost of requiring rear impact guards on SUTs. Therefore, this analysis is a conservative estimate of the cost.

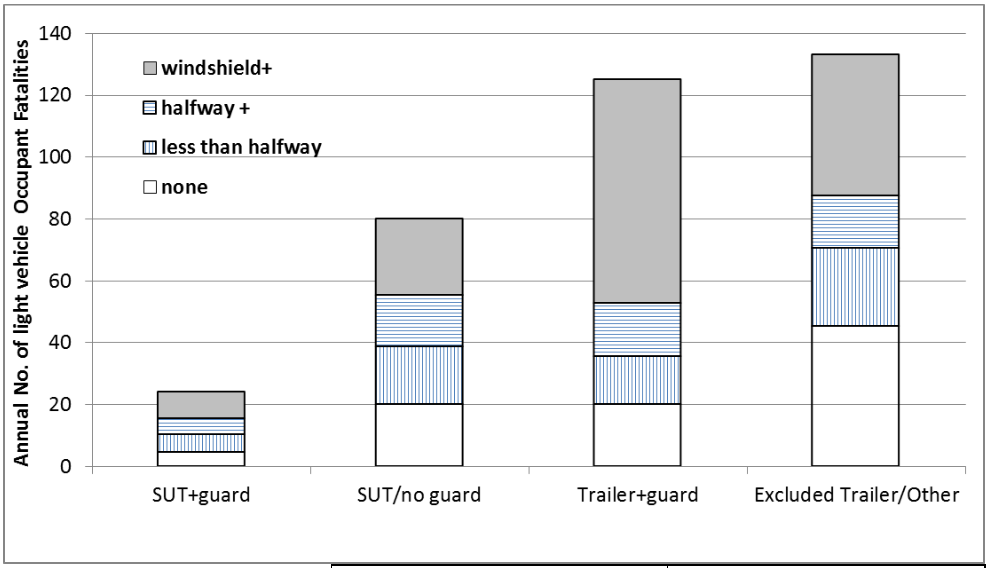
Benefits

For estimating the benefits of requiring covered SUTs to be equipped with CMVSS No. 223 guards, NHTSA estimated the annual number of fatalities in light vehicle rear impact

[63] Allen, Kirk, "An In-Service Analysis of Maintenance and Repair Expenses for the Anti-Lock Brake System and Underride Guard for Tractors and Trailer," March 2009, DOT HS 811 109.

crashes with PCI into the rear of SUTs. Additionally, NHTSA estimated the annual number of injuries in light vehicle crashes with PCI into the rear of SUTs. Non-PCI crashes were not considered as part of the target population for estimating benefits. This is because the IIHS test data (see Appendix B to the preamble) show that when PCI was prevented, the dummy injury measures were significantly below the injury assessment reference values specified in occupant crash protection standards. In non-PCI crashes into the rear of SUTs and trailers, the IIHS test data indicated that the passenger vehicle's restraint system would mitigate injury.

Among the 104 light vehicle occupant fatalities resulting from impacts with the rear of SUTs, 80 occurred in impacts with SUTs without rear impact guards while the remaining 24 were in impacts to SUTs with guards. PCI was associated with 33 annual light vehicle occupant fatalities resulting from impacts into the rear of SUTs; 25 of these fatalities were in impacts with SUTs without rear impact guards and 8 with SUTs with guards (see Figure A-2 below).



	Light vehicle fatalities in crashes into the rear of trailers & SUTs		Light vehicle fatalities in PCI crashes into the rear of trailers & SUTs	
	Annual #	Percentage	Annual #	Percentage
SUT+Guard	24	7%	8	5%
SUT/No Guard	80	22%	25	17%
Trailer+Guard	125	35%	72	48%
Excluded Trailer/Other	133	37%	45	30%
Total	362		150	

Figure A-2: Annual light vehicle occupant fatalities in impacts into the rear of SUTs and trailers categorized by the geometry of the rear of the impacted vehicle and the extent of underride.

As explained earlier in this analysis, if CMVSS No. 223 were to apply to SUTs, 59 percent of new SUTs would be required to have a CMVSS No. 223 guard (see Table A-3, supra). The 41 percent of SUTs that would be excluded from meeting CMVSS No. 223 requirements would be wheels back and low chassis vehicles that have vehicle structure in the rear that could prevent PCI or vehicles with equipment in the rear for which installing rear impact guards may not be practicable and may interfere with equipment operation. Since the extent of underride was determined by the extent of deformation and intrusion of the vehicle, based on our examination of TIFA cases it is likely that some light vehicle crashes into the rear of excluded SUTs that resulted in PCI did not actually underride the truck but sustained PCI because of other circumstances such as crash speed or short front end of the vehicle. Therefore, the target population of light vehicle occupant fatalities with PCI which may be addressed by equipping SUTs with CMVSS No. 223 compliant rear impact guards is estimated to be 19.5 (=33x0.59).

Approximately 30 percent of the impacts into the rear of SUTs with PCI are less than or equal to 56 km/h (35 mph) (See Figure A-3 below).

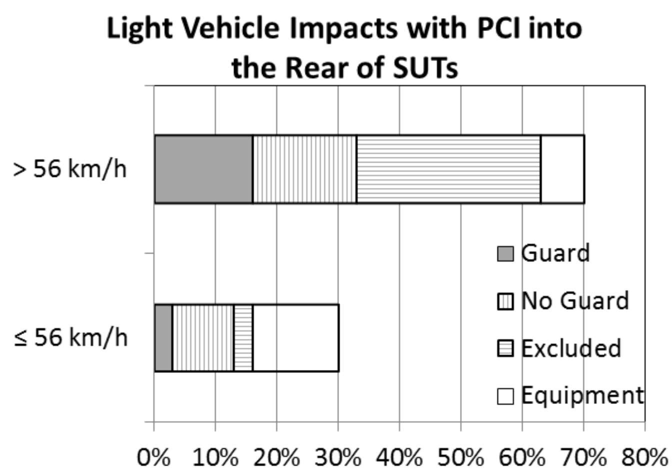


Figure A-3: Percentage of fatal light vehicle crashes into the rear of SUTs that resulted in passenger compartment intrusion - categorized by the relative speed of the crash, presence of rear impact guard, exclusion, and equipment in rear of vehicle.

While CMVSS No. 223 requirements are intended for mitigating PCI in light vehicle rear impacts at speeds less than or equal to 56 km/h (35 mph),[64] CMVSS No. 223 rear impact guards may not be able to mitigate all fatalities in such crashes because some of the crashes may be low overlap (30 percent or less).[65] The IIHS data indicated that 8 of the 9 CMVSS No. 223 guards

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[64] Transport Canada testing of minimally compliant CMVSS No. 223 rear impact guards indicated that such guards could prevent PCI in light vehicle impacts with full overlap of the guard at crash speeds up to 56 km/h. See Boucher D., David D., "Trailer Underride Protection – A Canadian Perspective," SAE Paper No. 2000-01-3522.

[65] Overlap refers to the percentage of impacting vehicle front end width that engages the rear impact guard.

were not able to prevent PCI in a 56 km/h crash with 30 percent overlap of a Chevrolet Malibu. Also, the guards may not be able to prevent fatalities even if PCI is prevented because some fatalities may not be a result of PCI but are due to other circumstances (e.g. unrestrained status of occupants, elderly and other vulnerable occupants) which would be unaffected by an improved rear impact guard.[66]

For the purpose of this analysis, NHTSA assumed that CMVSS No. 223 compliant guards on SUTs would be able to prevent about 85% of light vehicle occupant fatalities with PCI in impacts into the rear of SUTs at crash speeds less than or equal to 35 mph. However, since only 30 percent of the target population of light vehicle crashes with PCI into the rear of SUTs are at speeds less than or equal to 56 km/h, CMVSS No. 223 compliant guards would only be effective for a portion of the target population. Therefore NHTSA estimated an overall effectiveness of 25 percent (≈30%x85%) for CMVSS No. 223 rear impact guards in preventing fatalities in light vehicle crashes into the rear of SUTs.[67] We believe this is an upper estimate of CMVSS No. 223 guard effectiveness in preventing fatalities.[68]

In the final regulatory evaluation for the January 24, 1996 final rule establishing FMVSS Nos. 223 and 224 (61 FR 2004), NHTSA assumed an effectiveness range of 10 to 25 percent for rear impact guards in preventing fatalities in crashes with PCI (all speeds) into the rear of

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[66] CMVSS No. 223 compliant rear impact guards may mitigate the severity of impact into the rear of SUTs at speeds greater than 56 km/h, but NHTSA is unable to quantify this possible benefit at this time. We seek comment on this issue.

[67] The agency's 2010 study - "The Effectiveness of Underride Guards for Heavy Trailers," October, 2010, DOT HS 811 375 – estimated an effectiveness of 27 percent from data collected in Florida and 83 percent from data collected in North Carolina for FMVSS No. 223 compliant rear impact guards in preventing fatalities. These two estimates are considerably different and not statistically significant, possibly due to small sample size, and so associated with some uncertainty. Therefore, these effectiveness estimates were not utilized in the current analysis. Instead the agency relied on real world crash data and the test data to estimate rear impact guard effectiveness.

[68] Review of 2009 TIFA data files of light vehicle impacts with PCI into the rear of SUTs indicated that only 55 percent of the fatally injured occupants were restrained.

trailers. The 25 percent effectiveness estimated for the current analysis (based on 2008-2009 TIFA data and the IIHS crash test data) is the higher value of the assumed effectiveness range of rear impact guards in the 1996 final rule.

To estimate the incidence and characteristics of nonfatal injuries to light vehicle occupants in impacts to the rear of SUTs resulting in underride, the agency analyzed the NASS-CDS data files for the years 1999-2012. Specifically, the cases examined were light vehicle frontal impacts into the rear of SUTs with a GVWR greater than or equal to 10,000 lb, where the light vehicle underrides the SUT resulting in PCI of the windshield or A-pillar of the light vehicle.

The analysis showed that rear underride crashes of a light vehicle into the rear of SUTs with a non-fatal injury to light vehicle occupants represent only 0.3 percent of the population of all crashes involving SUTs. The analysis estimated annualized weighted injuries of different severity levels in light vehicle impacts into the rear of SUTs resulting in underride with PCI. Table A-17 presents the results of this analysis of 1999-2012 NASS-CDS data files. There were a total of 150 injuries of MAIS 1-5 severity.

Table A-17. MAIS[69] injury distribution and annualized weighted estimates of injuries to light vehicle occupants in frontal impacts into the rear of SUTs with underride resulting PCI. (1999-2012 NASS-CDS data files).

MAIS Level	**Occupant Count**	**Weighted Count**	**Annualized Weighted Count**	**95% Confidence Interval for Annualized Weighted Count**	**Percent of Total**
1	13	1,398	99	(17, 182)	66%
2	5	459	33	(0, 82)	21.7%

[69] MAIS is the maximum severity injury for an occupant according to the Abbreviated Injury Scale (AIS). MAIS 1 is of minor severity, MAIS 2 of moderate severity, MAIS 3-5 are serious to critical injuries, MAIS 7 are injuries of unknown severity.

3	9	145	10	(1, 20)	6.8%
4	2	105	7	sample too small	5%
5	0	0	0	sample too small	0%
7	1	11	1	sample too small	0.5%
Total	30	2,118	151	(57, 245)	100%

NHTSA examined each case individually to obtain more information about the injuries. The files showed that many of the injuries shown in Table A-17 were not directly attributable to PCI resulting from underride. For example, one case involved a passenger van with six separate injured occupants. Only two of these injured passengers were seated in the front row were subject to possible injury from PCI. Thus, we believe that Table A-17 likely provides an overestimate of the number of annual light vehicle occupant injuries resulting from SUT underride with PCI.

NHTSA assumed 20 percent effectiveness in preventing injuries in light vehicle crashes with PCI into the rear of SUTs. CMVSS No. 223 guards are effective in mitigating PCI in light vehicle impacts into the rear of SUTs at speeds less or equal to 56 km/h (35 mph), which is about 30 percent of all such impacts with PCI.[70] Additionally, we expect the effectiveness of rear impact guards for preventing injuries to be lower than that for fatalities since occupant injuries could occur from interior vehicle contacts even if PCI is prevented. The 20 percent effectiveness estimate takes into consideration that CMVSS No. 223 requirements are intended for mitigating PCI in light vehicle rear crashes (with greater than 30 percent overlap) at speeds less than or equal to 56 km/h (35 mph). It also takes into account that some injuries are due to circumstances

[70] As noted earlier, CMVSS No. 223 compliant rear impact guards may mitigate the severity of impact into the rear of SUTs at speeds greater than 56 km/h, but NHTSA is unable to quantify this possible benefit at this time. We seek comment on this issue.

(e.g. unrestrained status of occupants, elderly and other vulnerable occupants) which would not be affected by an improved rear impact guard.

Table A-18 presents the target population (estimated fatalities and injuries addressable by CMVSS No. 223 guards on applicable SUTs), the effectiveness estimates, and the estimated benefits of equipping applicable SUTs with CMVSS No. 223 guards.

Table A-18. Target population, effectiveness, and benefits estimates

	Fatality	MAIS 1	MAIS 2	MAIS 3	MAIS 4	MAIS 5
Target population (a)	19.5	99	33	10	7	0
Effectiveness (b)	0.25	0.2	0.2	0.2	0.2	0.2
Benefits (a x b)	4.9	19.8	6.6	2	1.4	0

NHTSA monetized the benefits, converting nonfatal injuries into portions of a fatality to calculate the number of equivalent fatalities (equivalent lives saved) (ELS) that are prevented by SUTs with CMVSS No. 223 guards. This involves dividing the value of each injury severity category by the value of fatality to determine how many injuries equal a fatality. Comprehensive values, which include both economic impacts and loss of quality (or value) of life considerations, developed by NHTSA[71] were used to determine the relative value of nonfatal injuries to fatalities. The comprehensive costs and the relative fatality ratio developed by NHTSA for each injury severity are listed in Table A-19. The reported costs are in 2000 dollars, but the relative values between injuries and fatalities would not change if costs are adjusted to present value.

Table A-19. Comprehensive costs and relative fatality ratios

Injury Severity	Comprehensive Costs (2000 $)	Relative Fatality Ratio
MAIS 1	$15,017	0.0028
MAIS 2	$157,958	0.0436

[71] Blincoe, L., et al., The Economic Impact of Motor Vehicle Crashes, 2000, Washington, DC, DOT HS 809 446, May 2002

MAIS 3	$314,204	0.0804
MAIS 4	$731,580	0.1998
MAIS 5	$2,402,997	0.6656
Fatality	$3,366,388	1.0000

Table A-20 presents the undiscounted ELS using the relative fatality ratios shown in Table A-19.

Table A-20. Undiscounted Equivalent lives saved (ELS) using average number of annualized injuries in Table A-15

	Fatality	MAIS 1	MAIS 2	MAIS 3	MAIS 4	MAIS 5
Fatality/injury reduced	4.9	19.8	6.6	2	1.4	0
Relative fatality ratio	1	0.0028	0.0436	0.0804	0.1998	0.6656
ELS	4.9	0.0554	0.2878	0.1608	0.2797	0.0000
Total ELS	5.65					

Since there is some uncertainty in the target population of injuries, the upper bound 95 percent confidence interval estimates of the weighted injury counts shown in Table A-17 were also considered in estimating benefits and total equivalent lives as shown in Table A-21.

Table A-21. Target population, benefits, and undiscounted equivalent lives saved using the upper bound of injury estimates in Table A-17.

	Fatality	AIS 1	AIS 2	AIS 3	AIS 4	AIS 5
Fatality+max injury (a)	19.5	182	82	20	7	0
Effectiveness (b)	0.25	0.2	0.2	0.2	0.2	0.2
Benefits (a x b)	4.9	36.4	16.4	4	1.4	0
Relative fatality ratio	1	0.0028	0.0436	0.0804	0.1998	0.6656
ELS	4.9	0.1019	0.7150	0.3216	0.2797	0.0000
Total ELS	6.29					

Since fatalities and injuries occur during the lifetime of the vehicle, they are discounted to present value using the discount rates determined in Table A-13. The 3 percent and 7 percent discounted benefits in terms of ELS are presented in Table A-22.

Table A-22. 3 and 7 percent discounted ELS

Discount Rate	Undiscounted	3%	7%
Discount Factors (from Table A-10)		0.7741	0.5876
Total ELS from Table A-18 (using average injury estimates)	5.65	4.37	3.32
Total ELS from Table A-19 (using upper bound of injury estimates)	6.29	4.87	3.69

The cost per equivalent lives saved was determined using the total costs in Table A-16 and the discounted ELS in Table A-22 and is presented in Table A-23. The cost per ELS is in the range of $106.7 million to $164.7 million.[72]

Table A-23. Costs per ELS at 3 percent and 7 percent discount rates

3 percent discount rate		
	Benefits (average)	Benefits (High)
Total cost (low estimate)	$118,658,542	$106,679,764
Total cost (average estimate)	$152,925,441	$137,487,362
7 percent discount rate		
	Benefits (average)	Benefits (High)
Total cost (low estimate)	$126,755,433	$113,959,260
Total cost (average estimate)	$164,743,353	$148,112,236

Guidance from the U.S. Department of Transportation[73] identifies $9.1 million as the value of a statistical life (VSL) to be used for Department of Transportation analyses assessing the benefits of preventing fatalities for the base year of 2012. Per this guidance, VSL in 2014 is $9.2 million. The cost per ELS of a rule to require SUTs to have CMVSS No. 223 guards ($106.7 million to $164.7 million) is far greater than the current VSL ($9.2 million).

APPENDIX B TO PREAMBLE;

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[72] Note that this analysis uses low and average estimates of the costs, and average and high estimates of the benefits of equipping CMVSS No. 223 compliant guards on applicable SUTs.

[73] See http://www.dot.gov/sites/dot.dev/files/docs/VSL%20Guidance_2013.pdf. The guidance starts with a $9.1 million VSL in the base year of 2012 and then estimates a 1.07 percent increase in VSL each year after the base year to reflect the estimated growth rate in median real wages for the next 30 years.

Summary of IIHS's Evaluation of Rear Impact Guards

In 2011, IIHS published results of crash tests in which the front of a model year (MY) 2010 Chevrolet Malibu (a midsize sedan) impacted the rear of trailers equipped with a rear impact guard (full overlap of the rear impact guard with the front end of the Sedan).[74] A 50th percentile male Hybrid III dummy (HIII 50M) was in each of the front outboard seating positions of the Malibu. Two trailer/guard designs (2007 Hyundai and 2011 Wabash trailers) were evaluated. The two guard designs were certified to FMVSS No. 223 requirements, and the Wabash also met the more stringent CMVSS No. 223 requirements. A 2010 Chevrolet Malibu was crashed into a trailer at 56 km/h (35 mph).

The test results showed that the full overlap 56 km/h (35 mph) crash test of the Malibu with the guard of the Hyundai trailer (built to only FMVSS No. 223 requirements) resulted in catastrophic underride (underride almost to the B-pillar) with PCI of the Chevrolet Malibu. On the other hand, the rear impact guard on the Wabash trailer, also certified to meet CMVSS No. 223 requirements, prevented PCI in 35 mph crash tests.

Table B-1 summarizes the results of the initial two IIHS 56 km/h (35 mph) full-width crash tests. In the first test, the 2007 Hyundai guard was ripped from the trailer's rear cross member early in the crash, allowing the Malibu to underride the trailer almost to the B-pillar. The heads of both dummies were struck by the hood of the Malibu as it deformed against the rear surface of the trailer. Under the same test conditions, the main horizontal member of the 2011 Wabash guard bent forward in the center but remained attached to the vertical support members, which showed no signs of separating from the trailer chassis.

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[74] Details of the tests and test results are available at Brumbelow, M. L., "Crash Test Performance of Large Truck Rear Impact Guards," 22nd International Conference on the Enhanced Safety of Vehicles (ESV), 2011. http://www-nrd.nhtsa.dot.gov/pdf/esv/esv22/22ESV-000074.pdf.

Table B-1: Results of IIHS initial round of 56 km/h crash tests of the 2010 Chevrolet Malibu into the rear of trailers

Conditions	Trailer	Guard performance	Underride	Max. longitudinal A-pillar deformation (cm)
100% overlap	2007 Hyundai	Attachments failed	Catastrophic	80
	2011 Wabash	Good	None	0

Table B-2 summarizes the peak injury measures[75] of the HIII 50M dummies in the front seating positions of the Malibu. For comparison purposes, Table B-2 also presents the HIII 50M dummy injury measures in the full frontal 56 km/h rigid barrier crash test of the 2010 Chevrolet Malibu conducted as part of NHTSA's New Car Assessment Program (NCAP). Head injury measures recorded by the dummies in the tests with severe underride were much higher than those reported for the Malibu's NCAP rigid wall test at the same speed. Chest acceleration and deflection measures were generally higher in tests without PCI than those with PCI.[76] The driver and passenger injury measures in the Malibu full overlap crash test with the Wabash trailer (where the guard prevented PCI) was similar to the injury measures in the Malibu NCAP frontal crash test.

[75] HII 50M dummy injury measures are those applicable to current model passenger vehicles as specified in FMVSS No. 208, see http://www.ecfr.gov/cgi-bin/text-idx?SID=77e2aab5d088f2e9b46d15606090f9b0&node=se49.6.571_1208&rgn=div8.
[76] When PCI was prevented by the rear impact guard, the accelerations on the vehicle are higher which results in higher chest injury measures.

Table B-2: IIHS initial round of testing – Injury measures of dummies in front seating positions of the Malibu.

Test			Head Resultant acceleration (g)	Head Injury Criterion (15 ms)	Chest Resultant Acceleration (3 ms clip, g)	Chest Displacement (mm)	Left Femur Force (kN)	Right Femur Force (kN)
Injury Assessment Reference Values				**700**	**60 g**	**63 mm**	**10 kN**	**10 kN**
Full-width	Hyundai	*Driver*	128	754	21	19	0.3	0.3
		Passenger	107	557	14	20	0.1	0.1
	Wabash	*Driver*	54	328	36	38	2.2	1.2
		Passenger	50	319	36	37	2.3	1.8
	NCAP (rigid wall)	*Driver*	49	330	43	40	2.0	1.2
		Passenger	55	389	42	32	0.5	0.8

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

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