



December 18, 2024

Ms. Sophie Shulman
Acting Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue, S.E.
Washington, D.C. 20590

RE: Federal Motor Vehicle Safety Standards; Pedestrian Head Protection, Global Technical Regulation No. 9; Incorporation by Reference [Docket NHTSA-2024-0057]

Dear Deputy Administrator Shulman,

The Alliance for Automotive Innovation (Auto Innovators) appreciates the opportunity to provide comments in response to the September 19, 2024, Notice of Proposed Rulemaking (NPRM) to establish a new Federal Motor Vehicle Safety Standard for pedestrian head protection based on Global Technical Regulation No. 9 (GTR No. 9).^{1,2}

Auto Innovators strongly supports efforts to improve pedestrian safety and shares in the Department of Transportation's (DOT) goals of reducing the number of pedestrian injuries and fatalities a part of a comprehensive National Roadway Safety Strategy (NRSS).³ We recognize that addressing the challenges we face will require a holistic, "Safe System" approach focused on safer roads, safer speeds, safer vehicles, and improved post-crash care. Auto Innovators and its members have been proactive in efforts to develop safer vehicles to help improve safety outcomes for pedestrians. This includes the introduction of Pedestrian Automatic Emergency Braking (Pedestrian AEB or PAEB) to help avoid or reduce the severity of pedestrian impacts, and advanced lighting features to help enhance roadway visibility in low light conditions. Manufacturers and suppliers are also continuously researching, developing, and iterating on their designs to identify new approaches for improving pedestrian protection and crash outcomes for those both inside and outside of the vehicle.

Auto Innovators urges the agency to revise its proposed rule to more closely align with comparable requirements in other parts of the world (e.g. UNECE R127, India AIS 100, Brazil CONTRAN Res. No. 752, etc.). This change would enable NHTSA to ensure well established standards for addressing pedestrian head impact protection while also maintaining regulatory alignment with other nations. Since the GTR was established in 2008, other international markets, including Europe, Japan, India, and Korea have experienced improvements in mitigating fatalities and seriously injured Vulnerable Road Users (VRUs).

¹ Auto Innovators represents the full auto industry, including the manufacturers producing most vehicles sold in the U.S., equipment suppliers, battery producers, semiconductor makers, technology companies, and autonomous vehicle developers. Our mission is to work with policymakers to realize a cleaner, safer, and smarter transportation future and to maintain U.S. competitiveness in cutting-edge automotive technology. Representing approximately 5 percent of the country's GDP, responsible for supporting nearly 10 million jobs, and driving \$1 trillion in annual economic activity, the automotive industry is the nation's largest manufacturing sector.

² 89 FR 76922

³ DOT National Roadway Safety Strategy - <https://www.transportation.gov/NRSS>

For example, pedestrian fatalities in Europe have decreased by more than 20% between 2010 and 2018.⁴ By simply adopting these already established safety changes, NHTSA could increase safety for vulnerable road users more quickly and with less cost than under the provisions of the proposed rule.

We support the development of an FMVSS on pedestrian protection, but not the rule proposed by NHTSA. As outlined in the comments below, there are several fundamental issues with the proposal. These primarily stem from the agency's deviation from the GTR. In addition, the NPRM substantially underestimates the extent of the design changes, lead time, and research and development costs needed to meet the proposed requirements. Because NHTSA is acting so much later and deviating so far from well-established technology, the rule will not provide measurable real-world safety benefit compared to the GTR but will add significant burden to manufacturers.

In our comments, Auto Innovators outlines several key concerns with the NPRM, including:

- **Failure to meet the requirements of the Safety Act.** The rule would impose new requirements that are neither reasonable nor practicable, and would create a conflict with regulations that depend on the structural integrity of the hood system. The test protocols, which differ from established international standards, also introduce repeatability and reproducibility concerns. The NPRM proposes several changes to the GTR that must be addressed in order to ensure the rule meets the requirements of the Safety Act. These include:
 - **Defining the test area and corresponding test zones.** The procedures for defining the test areas for evaluating pedestrian head impacts are inconsistent with the GTR, and will likely have practical implications for vehicle design. For example, the proposed standard inappropriately drives more stringent requirements for smaller vehicles and would have the counterintuitive effect of encouraging larger vehicles. In addition, defining test zones that extend to include the location of supporting hood structures (based on current vehicle designs) raises practicability concerns as these structures are not easily reconfigurable and cannot be addressed through changes to the hood shape alone.
 - **Revising the NHTSA targeting protocol for defining the head impact point.** The test procedure requires injury risk to be assessed using a head impactor to simulate head to hood impacts, with an injury score assigned to each impact point tested. However, the proposed targeting method introduces unnecessary complexity and repeatability issues in terms of how the test is set up and run. Additional steps may be needed to ensure the impact corresponds to a specific location on the hood. There are also issues with what might be considered a "valid" impact based on where the impactor contacts the hood.
 - **Considering impacts outside the defined test areas.** The agency has neither adequately considered the practicability and regulatory impact of expanding the hood test area beyond established GTR requirements, nor the implications of proposing test procedures that involve impacts outside of these defined areas.

⁴ European Commission (2021) Road safety thematic report – Pedestrians. European Road Safety Observatory. Brussels, European Commission, Directorate General for Transport.

- **Misalignment with the GTR.** Because the agency proposes to adopt a unique interpretation of the GTR, the proposed rule does not align with established international standards. This goes against the spirit and intent of the GTR and is in direct opposition to the direction set by Congress in the Bipartisan Infrastructure Law.
- **Underestimation of the regulatory economic impact.** NHTSA has significantly underestimated the impact of its proposal based on several incorrect assumptions, including, the misconception that vehicles designed to meet the GTR will be capable of meeting FMVSS No. 228. They will not. In addition, the NPRM also significantly underestimates the effect that this rule will have on other regulations through conflicting requirements. In effect, substantial research, development, and redesign will be needed, and will likely require US-specific front-end designs and have a negative impact on vehicle affordability. The benefits of crash avoidance technology, including the recent final rule on PAEB, have not been fully considered.
 - **Unreliable basis for the agency's decision.** The agency has substantially overestimated the potential benefits of this proposal by relying on decades-old data that does not appropriately represent current experiences in the field. Based on the analysis of data from other countries (where in-depth data collection on pedestrian crashes is available), there are significant limitations in using police reported data to estimate overall injury risk – particularly as pedestrian crashes do not always result in serious head injuries, and when they do, the head impact may be the result of a secondary impact with the ground.
- **The role of NCAP.** To address the aforementioned technical and regulatory impact concerns, we recommend that NHTSA consider an alternative approach that leverages the New Car Assessment Program (NCAP) to build upon the requirements of GTR No. 9. This is consistent with our recommendation to align FMVSS No. 228 with UNECE R127: the rule would establish a robust set of regulatory requirements consistent with the GTR, and NCAP would incentivize further improvements through data-driven ratings criteria that includes areas that extend beyond the hood (e.g., windshield, a-pillar, etc.). This approach would ensure a more reasonable path forward for both FMVSS and NCAP and would reduce the required lead time for implementing positive safety changes in the U.S.
- **Need for more lead time.** To meet the requirements of the proposed rule and meet the requirements of other provisions of the FMVSS, companies will need to complete significant research to develop and redesign vehicle front ends. Such redesigns will take significantly longer than the two-year lead time established by the agency. Typical automotive product cycles are 5-7 years and even more for Small Volume Manufacturers. Vehicle manufacturers and suppliers require adequate lead time for planning, designing, developing, and testing new systems and vehicles to ensure compliance with regulatory requirement dates. In other words, concepts and planning for a new or redesigned vehicles on sale today began at least five years ago.

1. Failure to meet the requirements of the Safety Act

Auto Innovators has significant concerns about the agency's interpretation of the GTR in light of how the GTR is being implemented in other parts of the world. From an applicability standpoint, we agree on the FMVSS No. 228 proposal in terms of vehicle size (i.e., passenger cars, light trucks and MPV's less than 10,000lbs.). However, as noted in Auto Innovators comments that were submitted to NHTSA in advance of this rulemaking notice, there are multiple problems with the agency's proposal. These concerns

remain relevant in the context of this NPRM, and we again refer NHTSA to these comments as part of our response to this notice (see Appendix B). Additional data reinforcing each of these positions is provided in Appendix A.

2. Misalignment with the GTR

Auto Innovators' overarching concerns with the proposed rule are primarily the result of agency's interpretation of how the GTR *is written*, as opposed to how the GTR *has been implemented* since it was first established more than fifteen years ago. The following sections examine the regulatory impact of NHTSA's decision to diverge from its global safety partners through the proposed FMVSS No. 228, and urges the agency to reconsider its approach.

The importance of the GTR Process

When designing new vehicles, there are many factors that a manufacturer must consider in terms of safety, design, styling, and comfort. But first and foremost, the vehicle must meet any regulatory requirements and performance standards. These regulatory requirements often vary across different parts of the world, can leverage similarities in the approaches to more readily develop global vehicle platforms that can be sold in different markets. This benefits both OEMs and consumers by allowing for consolidation of research and development efforts, increasing the resources available for investment in new safety innovations, and helping control the end purchase price of vehicles – which is becoming increasingly relevant as new vehicle prices continue to rise. In the case of this rulemaking, the development of Global Technical Regulations is intended to provide a basis for increased regulatory alignment, with GTR No. 9 specifically focused on Pedestrian Protection.^{5,6}

NHTSA misalignment with the GTR

The vehicle hood is an integral part of the vehicle that is both directly and indirectly affected by several regulations – including fuel economy, crashworthiness and visibility standards – and may require extensive redesign of vehicles already in development. This is notwithstanding the price impact to consumers as a result of OEMs needing to redesign existing products, and develop vehicles specifically for the U.S. market.

Unfortunately, however, the approach proposed by NHTSA deviates substantially from how the GTR is being implemented in other parts of the world. And while we recognize that there are differences in how the GTR may be interpreted by the contracting parties subject to the UN 1998 agreement, the technical issues and concerns with the agency's direction on this rulemaking were clearly communicated to NHTSA in comments provided by Auto Innovators in advance of this NPRM.^{7,8} Adopting such an approach creates long-term international regulatory misalignment, which is counter to the intent of the GTR process, and the spirit of the directive issued by Congress in the recently passed Bipartisan Infrastructure Law.⁹ We therefore strongly urge the agency to reconsider its approach and instead harmonize any proposed pedestrian protection standard with those already being implemented in other regions.

⁵ "[T]he regulatory framework developed by the World Forum WP.29 allows the market introduction of innovative vehicle technologies, while continuously improving global vehicle safety... The same regulatory framework is also instrumental for fostering and facilitating cross-border trade, since provisions established under the 1958 Agreement include the reciprocal acceptance of approvals of vehicle systems, parts and equipment issued by other Contracting Parties" Source:

<https://unece.org/wp29-introduction> (Accessed November 2024)

⁶ GTR No. 9 [ECE/TRANS/180/Add.9](https://unece.org/TRANS/180/Add.9)

⁷ <https://www.regulations.gov/document/NHTSA-2024-0057-0060>

⁸ 1998 Agreement on UN Global Technical Regulations (UN GTRs) - <https://unece.org/text-1998-agreement>

⁹ Sec. 24211 -- Infrastructure Investment and Jobs Act

Since the GTR was first established, other contracting parties have developed and implemented their own regulations which are largely aligned internationally. This should have been a more predominant factor in the agency's consideration of the NPRM. Each of these sets of regulatory requirements are supported by robust test procedures for evaluating pedestrian head impact protection and include clear processes for defining the hood areas to be tested as well as ensuring appropriate consideration of head impactor testing in boundary conditions at or beyond the edge of the hood structure. In our view, this provides a more practicable foundation upon which the agency should base its regulations, as they are not only consistent with the GTR, but also meet the need for safety. NHTSA's current approach to the development of this regulation is slowing the implementation of safety by adding significant costs, and diverting resources from other important research and development efforts, including those focused on crash avoidance.

3. Underestimation of the regulatory economic impact

We have significant concerns with the approach that the agency has proposed, and the fact that the agency has been selective in its assumptions used to develop its regulatory impact analysis. It is important that NHTSA not only consider the performance requirements that it is developing, but also the type (and practicability) of design countermeasures and changes needed to meet new performance standards. As discussed below, the NHTSA notice and corresponding PRIA incorrectly estimates the cost to meet FMVSS No. 228, even if those vehicles meet UNECE R127 today. The GTR-based regulations proposed by NHTSA are not equivalent to the GTR-based regulations in other parts of the world, and it is not a reasonable assumption to assume that this is the case.

Limitations with real world data in the US

There are limitations in the data used to support the agency's proposed approach. More specifically:

- The referenced police report-based crash databases (FARS, CRSS) do not provide data on sustained injuries, involved vehicle components, or accurate vehicle travel speeds. For example, vehicle travel speed data in figure V.2 (of the NRPM) and associated claims rely on police-estimated travel speeds, often not populated in FARS/CRSS databases and not based on actual vehicle data. The curve for "Injuries" includes all injury levels and types and is not specific to relevant head impacts.¹⁰
- Data used to translate pedestrian KABCO injury scores to MAIS date back to 1980s and do not account for changes in the vehicle fleet, pedestrian population, or environment.
- Detailed head injury data relies on PCDS, a non-representative sample from the 1990s that may not align with the current U.S. crash population.
- Despite NHTSA publishing a final rule on pedestrian crash avoidance, the impact of FMVSS No. 127 has not been well considered, and assumes proportional reduction across crash population rather than assuming mitigation of highest impact events.
- The benefit analysis relies heavily on a very small sample (16 cars, 24 trucks) of NHTSA tested vehicles spanning model years 1994-2021.

Inaccurate evaluation of the anticipated costs and benefits of the proposed rule.

The benefits estimates listed in PRIA are significantly inflated in comparison to GTR No. 9 as implemented. In Table 1, below, the agency expects the number of equivalent lives saved to increase to almost 70% by adopting only the test area requirements based on NHTSA's interpretation of GTR No. 9. We believe this conclusion is substantially overstated.

¹⁰ <https://www.regulations.gov/document/NHTSA-2024-0057-0060>

This assumption is supported by an objective analysis of the German GIDAS crash data, which was also found to align with U.S. data derived from the privately funded Vulnerable road user Injury Prevention Alliance (VIPA) study managed by the University of Michigan. These studies highlighted the prevalence of real world head injuries that occurred due to impacts beyond the hood surface, including secondary impacts to the road surface.¹¹ The agency's reliance on crash data that did not discriminate head injuries from secondary impacts lead to an overestimation of lives saved from the requirements proposed by the agency.

Table 1: NHTSA projected difference in cost based on Table VIII.4 in the NPRM (Comparison of cost per equivalent life saved (ELS) [Millions])

Regulatory approach	Cost		Equivalent lives saved		Cost per equivalent life saved	
	3%	7%	3%	7%	3%	7%
GTR 9 Amendment 3 (PRIA Alternative #1)	\$60.43	48.94	32.28	26.20	\$1.87	\$1.87
Proposed Rule	60.43	48.94	54.87	44.46	1.1.0	1.10

±0% Cost +70% ELS

Similarly, an assumption that the agency's proposal is cost-neutral with GTR No. 9, is inaccurate given the significant changes to GTR No. 9 that the agency has proposed. Even the simple calculations in Table 1 shows that NHTSAs estimate do not match the reality. In fact, using this simplified logic, the incremental cost to solely meet GTR 9 should also be extended to additionally meet the greater coverage in the proposed rule. In other words, the cost of the proposed rule is likely to be double what was assumed, resulting in a less favorable cost-benefit compared to GTR 9. Another concern is the notable disconnect between the agency's proposal and the actual design changes needed to meet the requirements outlined in the NPRM, particularly for existing cars.

Overestimation of the benefits of the NPRM

- Overestimation of benefits based on injured body region.** The anticipated benefits of the proposed rule appear to be based exclusively on the assumption that the majority of pedestrian injury outcomes and fatalities are attributable to head impacts, without consideration of the relative number of injuries to other injuries to other body regions. As a result, the agency's benefits estimates are misaligned with the actual real-world benefits and are likely overstated. Given the focus of the regulation is on pedestrian head impact protection, the agency's analysis is not sufficient to support its justification to deviate from how the GTR is being implemented in UNECE R127. Crash data in the United States typically only provides high-level information on the general severity of pedestrian injuries, but there are limitations when trying to determine the types of injuries that are occurring based on body region. However, based on an analysis of GIDAS data from Germany, approximately 1 in 3 pedestrian injuries occurred to the head, as shown in Figure 1. There may be differences between the European and US markets, but Figure 1 highlights the need for further study and consideration of the estimated benefits based on head impact alone.

¹¹ "Head Injuries from the Vulnerable Road User Injury Prevention Alliance (VIPA): Effect of Vehicle Type on Head Contact Location" - Dr. Stewart Wang - IRCOB 2020 paper

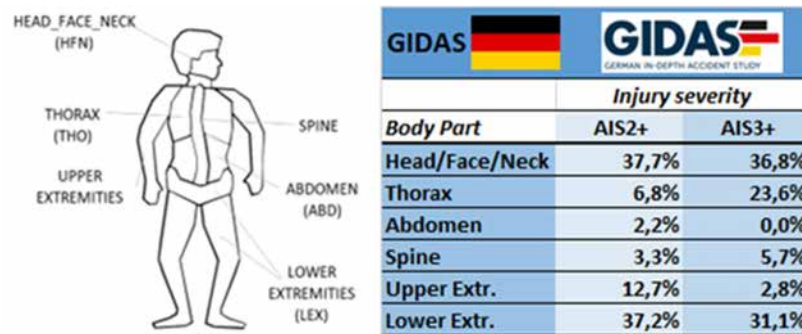


Figure 1: GIDAS data on pedestrian injuries by injured body region

- Overestimation of benefits based on impacts to the vehicle hood.** The PRIA does not fully consider the effects of secondary impacts on pedestrian injury outcomes. Due to a lack of detailed and statistically representative U.S. data, we refer to a German In Depth Accident Study (GIDAS) evaluation focusing on AIS3+ head injuries, where more than 40% of all severe to fatal head injuries (AIS3+) were attributable to ground impact (secondary) impact (see Figure 2). In the absence of clear, statistically significant data demonstrating the measurable benefits of extending the testable area beyond existing GTR-based requirements, we strongly urge NHTSA to reconsider its proposal. This data also highlights the potential limitations of drawing conclusions from crash data without reliable injury source information as a foundation for expanding the protection coverage of the hood, which is again predicated on an overestimation of the projected safety benefits. It may be more effective to look at the overall picture in terms of contacts that are contributing to pedestrian injuries in the real world.

Injury causing part for AIS2+ HeadFaceNeck (HFN) injuries of pedestrians in frontal accidents with passenger cars, year of market introduction ≥ 2000 , collision velocity 0-45 kph

head/face injuries	AIS2+
window frame / A-pillar	5,9%
windscreen	20,6%
bonnet	8,8%
bonnet leading edge	0,0%
fender	0,8%
grill and headlamps	0,0%
bumper	0,0%
other veh. parts / front nfs.	4,6%
own bicycle / other / unknown	11,3%
ground impact	47,9%
total	238 AIS2+ HFN injuries

GIDAS 
GERMAN IN-DEPTH ACCIDENT STUDY



Injury causing part for AIS3+ HeadFaceNeck (HFN) injuries of pedestrians in frontal accidents with passenger cars, year of market introduction ≥ 2000 , collision velocity 0-45 kph

head/face injuries	AIS3+
window frame / A-pillar	5,1%
windscreen	33,3%
bonnet	7,7%
bonnet leading edge	0,0%
fender	0,0%
grill and headlamps	0,0%
bumper	0,0%
other veh. parts / front nfs.	5,1%
own bicycle / other / unknown	5,1%
ground impact	43,6%
total	39 AIS3+ HFN injuries

GIDAS 
GERMAN IN-DEPTH ACCIDENT STUDY



Source:
GIDAS, 12/2022

Figure 2: Pedestrian injury source for AIS 2+ and AIS 3+ injuries based on an analysis of real-world data from GIDAS (2000+MY)

- **Overestimation of benefits based on impacts to expanded test area.** The PRIA benefits analysis is based on an impactor test study that does not accurately reflect real-world conditions, and in our view overstates the expected benefits of the rulemaking proposal. More specifically, as shown in Figure 3, below, the number of contacts to the expanded HIC1000 areas (*green stripe area*) are likely overrepresented as a proportion of the overall vehicle hood impacts that are expected to occur in real-world crashes (i.e., estimated benefits of regulation were based on 3 out of 8 impacts occurring to this expanded area).

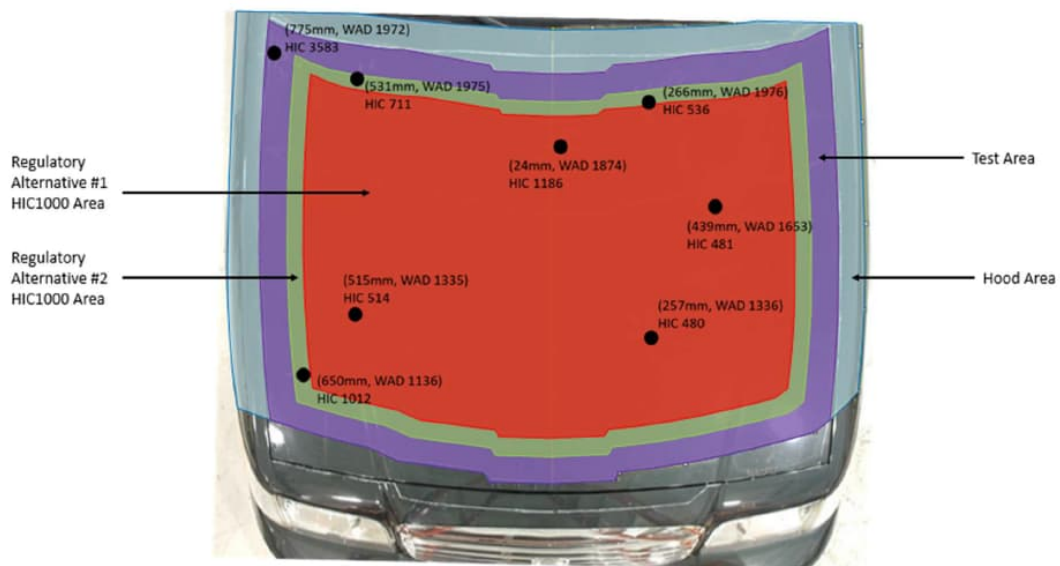


Figure 3: Hood Overlay for 2003 Ford Crown Victoria (From Figure 15 of the NHTSA PRIA (see p.175))

NHTSA underestimates the cost and complexity of meeting the new requirements.

NHTSA presents its interpretation of GTR as “minor additional investment” resulting in “highly increased benefit in safety” (See table 5 below, p.15, PRIA).¹² However, the fleet-wide costs of this rulemaking will be much higher than NHTSA estimates, as the agency’s cost calculations are based primarily on the fuel economy impact of hood mass change for a single late model vehicle, and ignores vehicle variability and all implementation costs.¹³ NHTSA also ignores the required design modifications to existing vehicle fleets, including those currently designed to meet EU standards, to account for the expanded test field for the side and front. These design changes include not only changes to sheet metal and exterior trim like the hood, fender, fascia, grille, and headlamp, but also may require significant structural changes to the body-in-white. They could also include significant changes to the headlamp leading edge height and side reference lines, as well as substantial changes to the hood hinge layout and structure. Additionally, the introduction of active hoods and/or external airbags may be needed.

As an example, Figure 4 shows a regression curve of the child headform stroke (mm) versus HIC values, including corresponding headform stroke (mm) for HIC1700 and HIC1000, from a sample of 3 recent model year vehicles for one manufacturer.

¹² See Table 5 of NHTSA PRIA (Page 15) - <https://www.regulations.gov/document/NHTSA-2024-0057-0360>

¹³ 2011/12 Ford Focus

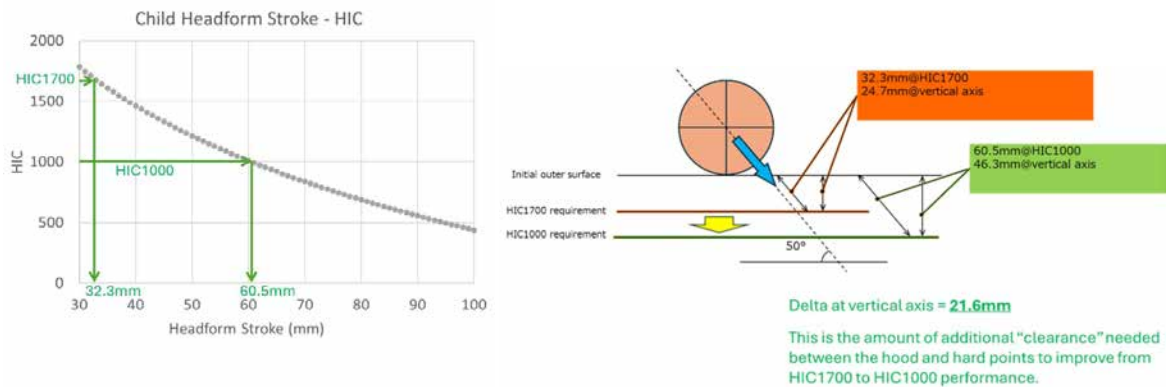


Figure 4: Child headform stroke based on HIC1000 and HIC1700 scores

In this example, to achieve HIC1000 with the child headform, the hood clearance distance – i.e., the distance from the hood from to other hard contact points underneath the hood must be expanded greater than 21.6mm on average from the clearance needed to meet the HIC1700 requirement.¹⁴ This can have significant design implications. As a result of the agency’s decision to allocate HIC1000 and HIC1700 areas based on the “hood area” (rather than the “test area”), vehicle front-end design changes may be necessary. This is particularly relevant in cases where portions of the hood classified as HIC1700 areas under UNECE R127 would now be reclassified as HIC1000 areas in FMVSS No. 228.

The proposal does not consider the impact on other regulatory requirements

We strongly disagree with the agency’s assessment that FMVSS No. 228 would not affect the ability of a vehicle to meet all other FMVSS. In addition, the statement that “vehicles in the U.S. already have hoods that meet GTR 9, which indicates the compatibility of the GTR (and proposed FMVSS No. 228) with applicable FMVSSs” is not a valid argument in support of this rulemaking being either reasonable or practicable given the substantial differences in how the agency has interpreted GTR No. 9 compared to other part of the world. For example, we anticipate that many vehicles currently meeting UNECE R127 will require substantial redesign prior to introduction in the US. This includes structural changes to the hood, as well as to other safety equipment (such as lighting systems) that are in proximity or overlapping with test areas.

As a result, the NPRM is neither feasible nor practicable given the extensive research and development efforts necessary to redesign and implement the placement of key structures and components on the vehicle. Furthermore, given the inaccurate and incomplete assumptions upon which the PRIA is based, more research is needed to understand the effects of the proposed FMVSS No. 228 on safety equipment and design countermeasures needed to meet the proposed requirements.

In addition, if manufacturers are required to provide active hood systems, there are long outstanding conflicts within existing regulations that continue to prioritize bumper damageability over pedestrian safety. Active systems need to have structures and/or other sensors in the front end that yield upon initial contact with a pedestrian; however, 49 CFR Part 581 requires a stiff front end structure that limits bumper stroke under much higher loading levels.

¹⁴ For vehicles that meet the R127 requirements, the difference in how the HIC1000/1700 areas are determined also increases potential the need to redesign certain areas in order to provide additional clearance needed between the hood and underlying structures. This again demonstrates inconsistencies between the NPRM and how the GTR is being implemented, and this has not been fully accounted for in the PRIA.

For example, pedestrian pressure tube sensors that are mounted on the front of the bumper to sense impacts and command active hood deployment, are severely hindered under this requirement. Part 581 dictates that these sensors cannot be functionally damaged when impacted under certain conditions, which often requires a stiffer bumper structure to limit damageability. This requirement creates design challenges particularly as FMVSS No. 228 seeks to increase the sensitivity to pedestrian leg contacts. This tension raises potential practicability concerns for FMVSS No. 228, as the performance of sensors in detecting pedestrian leg impact may be adversely influenced by the overall stiffness requirements in Part 581. The auto industry petitioned the agency to address this issue in 2018 by requesting that the agency address this by aligning with established international standards. We reiterate this request as part of our response to this rulemaking proposal.¹⁵

Concerns about the current vehicle requirements for front-end design are further exacerbated by the NPRM deviating from international regulations for head-to-hood impact protection. Vehicles in the U.S. must already implement an entirely exclusive bumper design to meet Part 581. This NPRM would extend these unique regulatory requirements to the hood areas, and effectively force the entire front-end structure of U.S. vehicles to be exclusive from their international counterparts.

4. NCAP should complement FMVSS requirements.

The NPRM includes several high level details on the agency's approach to pedestrian protection as part of its ongoing updates to the New Car Assessment Program.

In general, Auto Innovators is supportive of NHTSA efforts to modernize the program, and we submitted extensive comments and recommendations in response to the agency's request for comment (RFC) on Pedestrian Protection in NCAP in May 2023.^{16,17} These comments raised similar concerns regarding the potential for misalignment with other NCAP programs, and we advocated that the agency harmonize with the Euro NCAP test protocols which build upon several aspects of the GTR.

However, we have concerns about the potential sequencing of this rulemaking and the extent to which the timing and content of the agency's recent final decision notice on NCAP could potentially prejudice the outcome of this proceeding.¹⁸ Typically, FMVSS sets the performance standards that vehicles are required to meet prior to sale in the United States. The NCAP consumer information program then builds upon regulation by rating vehicle performance based on the extent to which it meets or exceeds these standards. In other words, higher levels of performance yield higher ratings. Regulation and NCAP should be complementary and not create conflicting or impracticable performance criteria. And while we recognize NCAP is a voluntary program and may not require the agency to conduct a regularly impact analysis, it is important to note that the impact on vehicle design can be significant as manufacturers seek to achieve high ratings (which is ultimately the goal of the program). Further misalignment will only further exacerbate the design challenges the manufacturers will encounter if the NPRM is finalized as proposed.

¹⁵ On December 5, 2018, Auto Innovators predecessor organizations, the Alliance for Automobile Manufacturers and the Association of Global Automakers, filed a petition requesting that NHTSA align the current Part 581 bumper test requirements with UNECE R46. This will enable manufacturers to reduce the stiffness of bumper systems that will have the potential to improve pedestrian safety.

¹⁶ 88 FR 34366

¹⁷ <https://www.regulations.gov/comment/NHTSA-2023-0020-2683>

¹⁸ New Car Assessment Program Pedestrian Protection Final announced on November 18, 2024.

As an alternative to this rulemaking proposal, we recommend that NHTSA instead consider an alternative approach that leverages NCAP to further build upon the requirements of GTR No. 9. This is consistent with our recommendation to align FMVSS No. 228 with UNECE R127, whereby the rule would establish a robust set of regulatory requirements consistent with the GTR, and NCAP would incentivize further improvements through data-driven ratings criteria that includes areas that extend beyond the hood (e.g., windshield, a-pillar, etc.). For example, if it can be supported by appropriate crash data, we do not oppose NHTSA establishing NCAP ratings criteria based on a WAD1000.

While this alternative may require reconsideration of the NCAP final decision that was published on November 25, 2024, it would ensure a more appropriate path forward for both FMVSS and NCAP. This would also reduce the required lead time for implementing positive safety changes in the U.S. market. Auto Innovators is still in the process of reviewing the agency's NCAP final decision notice, and may submit supplemental comments in response to this NPRM to the extent there are issues that are relevant to the proposed FMVSS No. 228 requirements.

Consideration of Lower Leg Protection

NHTSA has requested comments on whether to include GTR No. 9 leg protection requirements in FMVSS. While pedestrian leg protection is an important issue, we do not support its inclusion in FMVSS at this time and recommend that the agency instead consider an NCAP-led approach. In the comments Auto Innovators submitted in response to the NCAP Pedestrian Protection RFC, we highlighted several key areas that needed to be addressed before lower leg evaluation could be considered for inclusion as part of the ratings program.^{19,20} These included: unresolved regulatory conflicts with the Part 581 damageability requirements (also discussed above in the context of active hoods); the proposed test devices used for evaluating lower leg injuries and the need for these to be incorporated in Part 572; and the potential for misalignment with established test protocols for assessing lower-leg impacts consistent with UNECE R127 and EuroNCAP. Any decision to include lower leg in FMVSS No. 228 should be data driven and informed by NCAP-driven fleet changes. At a minimum, a supplemental NPRM (and corresponding PRIA) is needed, as there are insufficient data in the subject NPRM to provide comment on or to support a NHTSA decision for inclusion in a final rule. We refer the agency to our comments on the 2023 NCAP notice for more details on the aforementioned regulatory issues that would need to be addressed (see Appendix B).

Active Hoods

As noted in the NPRM, "NHTSA is considering developing a set of compliance test requirements to assure the proper deployment and function of active hoods." In light of the proposed requirements, Auto Innovators supports NHTSA developing a compliance option for active hood systems, provided that the requirements are aligned with recent updates to GTR No. 9. These issues were extensively discussed in the UNECE informal working group for active hoods / deployable pedestrian protection systems (IWG-DPPS) and requirements have already been established through a recent amendment to GTR No. 9, which NHTSA voted for in support.²¹ Given that some vehicles may require active hood systems in order to meet the proposed requirements, it is important that the rule include compliance options that define how the agency will assess vehicles with these systems. We request that the agency publish a supplemental NPRM (with supporting data) to help better ensure that the any final rule is consistent with the GTR amendment and how it is intended to be applied.

¹⁹ 88 FR 34366

²⁰ [Docket No. NHTSA-2023-0020-2683](#)

²¹ ECE/TRANS/180/Add.9/Amend.3 established in the Global Registry on 26 June 2024.

In addition, we also urge the agency to update the current Part 581 requirements, even if FMVSS does not consider lower leg impact at this time.²²

In response to the agency's question on the safety considerations for undeployed hoods and whether there is need to establish separate HIC limits, this has already been addressed through the recent GTR amendment. This prescribes the required levels of safety performance at the lower deployment threshold, as well as performance when the hood is activated. We again urge the agency to seek alignment were possible to avoid any further regulatory misalignment.

5. Additional Lead Time Must be Provided

We disagree with the proposed two-year lead time, as it is neither reasonable nor practicable to implement the necessary design changes needed to meet new front end requirements within the proposed two-year timeframe. Given that the NPRM is substantially different to how the GTR is being implemented worldwide, the agency's proposal will require significant redesign of nearly all applicable vehicles in the U.S. market. It is also not feasible to implement these changes within the proposed lead-time, especially for vehicles that are either in production or late-stage development, and a reasonable phase-in schedule must be provided.

Even with additional lead time, there are limitations on the extent to which underlying hood structures can be reasonably relocated or reconfigured. For example, design countermeasures to increase the space between the hood and critical components under the hood, such as the lowering the engine, adjusting radiator placement, or making structural changes to the body-in-white, all require significant redesign. In some cases, these changes may not be feasible without negatively impacting vehicle performance, and in no instance can they be reasonably or practically implemented within a two year timeframe. Additional time is needed to assess and implement design changes in order to manage the downstream regulatory impact of the rule on other FMVSS requirements. As detailed in Appendix A, requiring substantial changes to the vehicle front-end will not only impact related crashworthiness standards (e.g., FMVSS No. 208) but may also impact vehicle fuel economy due to changes that may affect vehicle aerodynamics.

In the short term, if the rule is finalized as written, it is likely to substantially reduce the number of vehicles that can be offered for sale in the United States. It is not reasonable for the agency to assume a vehicles sold in the U.S. already meet the UNECE R127 requirements, or that that vehicles designed to meet these GTR-based rules will be capable of meeting FMVSS No. 228 as proposed.²³ Based on a partial analysis of current vehicles offered for sale in the U.S., fewer than two-thirds of vehicles meet the current UNECE R127 requirements.²⁴ Furthermore, it is clear based on the NPRM that the proposed rule differs substantially from how GTR No. 9 is being implemented. So even for those vehicle that meet UNECE R127, design changes will be needed.

Historically, NHTSA has recognized the challenges in implementing certain countermeasures, especially where changes to the underlying structure may be required. This has been evident in several recent rulemakings as shown in Figure 5, which summarizes the lead time provided for changes to the regulatory requirements for upper interior head impact (FMVSS No. 201U), roof crush resistance (FMVSS

²² Dec 5, 2018, the Alliance for Automobile Manufacturers and the Association of Global Automakers filed a petition to harmonize the bumper test requirements with R46.

²³ <https://www.federalregister.gov/d/2024-20653/p-478>

²⁴ Based on a sample of 246 current models.

No. 216a), Ejection mitigation (FMVSS No. 226).²⁵ We urge the same recognition here. Figure 5 reinforces that NHTSA historically accounts for technical feasibility, practicability, and the product development processes followed by vehicles manufacturers when promulgating significant crashworthiness rulemakings.

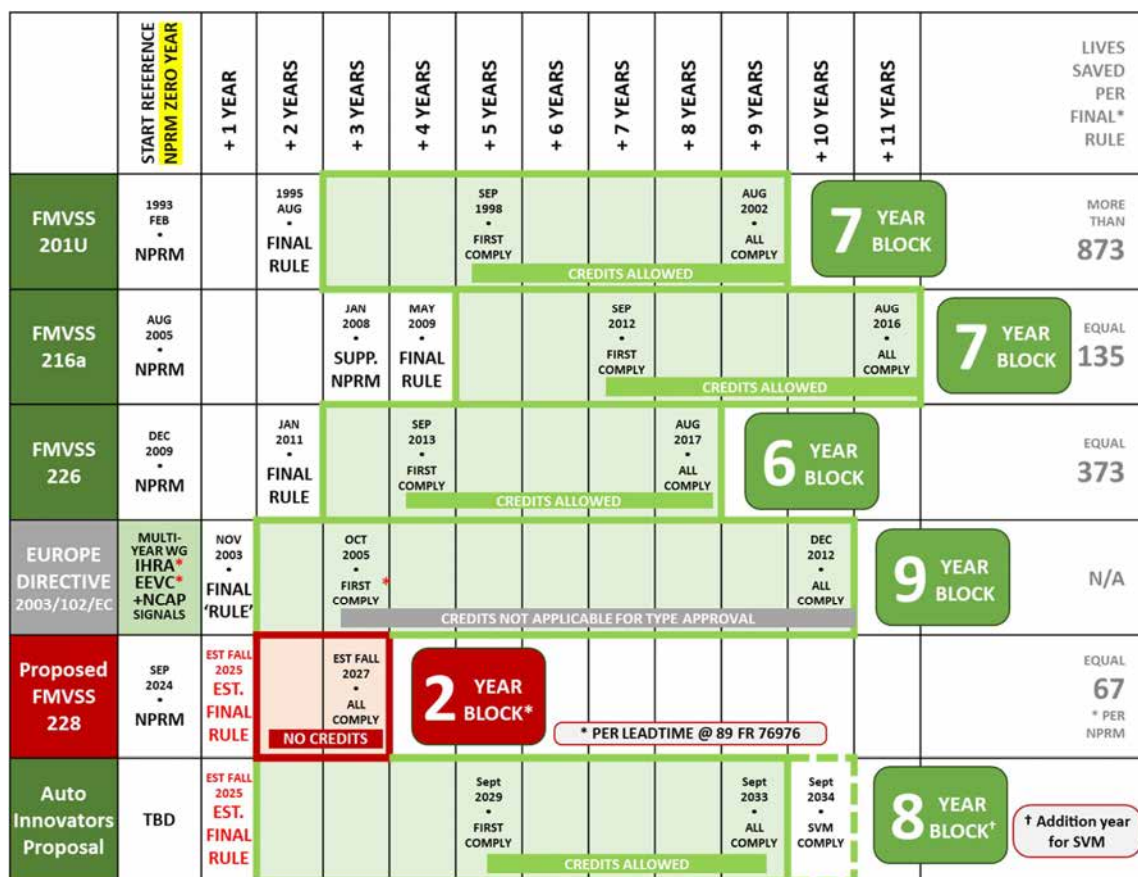


Figure 5: Comparison of the lead time provided for NHTSA rulemakings where significant structural changes were anticipated.

The analysis provided in the NPRM does not provide sufficient justification for a reduced two-year lead time for full compliance with this rulemaking. We therefore recommend a four year lead time (i.e., four years beginning September 1st after publication of the final rule) with an initial phase-in starting no sooner than September 2029 to coincide with the full effective date of the FMVSS No. 127 requirements for AEB and PAEB. Given the impact on other regulatory requirements, we recommend a four-year phase plan that follows 25%, 50%, 75% and 100% vehicle to comply by 2033. To offset the overall regulatory impact on OEMs, NHTSA should also consider providing optional “early compliance credits” if a manufacturer is capable of exceeding the requirements of the phase in. Credits earned in the early stages of the phase in can be applied to meet compliance targets in later years (except in the final year where full compliance would be required). A phase-in is also necessary to account for the number of trim levels (within a given make and model line) that may need to be redesigned, including those not manufactured or offered for sale in Europe or other markets. This is often a complex, multi-year process, even in the absence of the proposed requirements. Auto Innovators proposed timeline for compliance is comparable to previous rulemakings, as shown in Figure 5.

²⁵ FMVSS No. 214 also provided a 3-year lead time with 4-year phase in for both MDB and pole testing.

As an alternative, we suggest a Phase 1 for vehicles under 6,000 lbs. and then phase 2 for vehicles 6,000-10,000 lbs. to comply with FMVSS No. 228 no sooner than September 2029. This lead time is also dependent on NHTSA resolving the aforementioned regulatory conflicts within Part 581 to support the use of active hood systems, where it may not be possible to meet the standard through structural changes alone.

A reduced lead time is more feasible if the agency were to align with UNECE R127. We emphasize, however, that the above recommendations on the need for an extended lead time and phase-in should not be taken as an alternative to resolving the significant technical and regulatory misalignment concerns outlined throughout our comments.

Considerations for Small Volume Manufacturers

The challenges of regulatory misalignment are exacerbated further for small volume manufacturers (SVMs) that, due to lower sales volumes, cannot benefit of cost advantages due to shared platforms among different models/brands. These costs needed to bring existing SVM vehicles into compliance are significant and often not properly considered as part of a robust regulatory impact analysis, particularly for vehicles with unique design characteristics. This is exacerbated further if there is a need to comply with multiple interpretations of the GTR in different regions. In addition, the disproportionate impact this regulation will have on smaller vehicles (due to expanded HIC1000 test area) will have a similarly disproportionate impacts on high-performance vehicles, especially those that have a small hood and the engine placed in the rear of the vehicle. Similar to larger OEMs, SVMs will also need to redesign their hoods and trims components related to the hood itself, all of which can affect aerodynamics, fuel consumption, and external visibility, topics already critical considering the unique design of low profile vehicles. Recognizing these practicability and cost constraints, the EU granted Small Volume Manufacturer an exemption from the compliance with UNECE-R127 until 2034 (EU Regulation 2018/858) and we request that similar accommodations be provided in the final rule. For this reason, NHTSA should align the SVM compliance schedule for FMVSS No. 228 with the lead time provided by Europe for UNECE R127; NHTSA should also provide one additional year beyond the full compliance date proposed for larger OEMs (i.e., nine years depending on when the final rule is issued, full compliance should be required no sooner than September 1, 2034).

6. Conclusion

Auto Innovators supports a wide range of solutions to improve roadway safety for vulnerable road users, including pedestrians. Safer vehicles are a part of a safe-system approach to roadway safety, that will supplement near-term investments in infrastructure, enforcement, and public education which can provide more immediate safety benefits as vehicle design countermeasures will require time to penetrate the market.

Auto Innovators asks NHTSA to revise its proposal to more closely align with comparable requirements in other parts of the world. What is more, appropriate lead time is critical to implement any necessary changes. Auto Innovators proposes a clear path forward that will continue to advance pedestrian safety in a way that is more consistent with the intent of the global technical regulations (GTR).

Auto Innovators continues to review the NPRM in the context of the recent NCAP pedestrian protection final decision notice and may submit additional supplemental comments.²⁶

²⁶ 89 FR 93000

Please let me know if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'SP' followed by a horizontal line.

Sarah Puro
Vice President, Safety and Technology Policy
Alliance for Automotive Innovation

Attachments

Appendix A – Auto Innovators responses to NHTSA technical questions in the NPRM

Appendix B – Auto Innovators comments submitted to NHTSA in advance of NPRM

Appendix C – Auto Innovators comments in response to the NHTSA NCAP Request for Comment (RFC)

APPENDIX A

Auto Innovators Responses to NHTSA Technical
Questions in the NPRM

Appendix A - Auto Innovators Responses to NHTSA Technical Questions in the NPRM

The following appendix outlines Auto Innovators responses to the technical questions that NHTSA is seeking comment on in sections V. through IX. of the NPRM. Given that the NPRM does not include specific question numbers as a point of reference, we have organized our responses based on the heading/subheading structure used in the Federal Register notice.

1. Approach of the Proposed Standard (*Section V. of the NPRM*)

A. Relevance to the Involved Vehicles

Bidirectional vehicles.

As noted in the NPRM, *“FMVSS No. 228 would apply to passenger cars, and to MPVs, trucks, and buses with a GVWR of 4,536kg (10,000lb) or less, except for vehicles with short front ends (a very short front hood area). Proposed FMVSS No. 228 would also apply to bidirectional vehicles, i.e., vehicles that can be operated in either direction.”*

The definition of bidirectional vehicle needs to be further refined to more clearly define the scope of the proposed requirements and the extent to which they apply to certain vehicles. At present it is unclear how *“similar speeds and similar maneuverability”* should be interpreted for the purposes of evaluating vehicle compliance – particularly if a bidirectional vehicle is not fully symmetrical and/or there are differences in the capabilities of the vehicle depending upon its direction of travel (e.g., it has a maximum speed of 25km/h when traveling in one direction, but 50km/h in the other). In addition, it is unclear whether the standard is intended to apply to low speed vehicles, vehicles not capable of traveling at the head impact speeds evaluated as part of this FMVSS, or vehicles that are not designed to carry passengers that may be incompatible with the proposed test procedure. We recommend that these low-speed vehicles be excluded from the requirements.

Vehicles with Short Front Ends.

The proposed regulatory text *“excludes MPVs, trucks, and buses where the distance, measured longitudinally on a horizontal plane, between the transverse centerline of the front axle and the seating reference point (SgRP) of the driver's seat, is less than 1,000 mm”* and that *“NHTSA drafted the regulatory text with this exclusion, but [requests] comments on whether the subject vehicles should be included in FMVSS No. 228.”* [NHTSA] also requested comments on the *“practicability concerns related to these vehicles, specific challenges such vehicles present related to the proposed test procedure, and what adjustments, if any, would be available to apply proposed FMVSS No. 228 to such vehicles.”*

The GTR was established based on the real-world data for majority of injury-inducing pedestrian impacts, and based on detailed crash investigations and analysis of underlying pedestrian kinematics to establish the test procedure. While the simplified approach is to exclude these vehicles, ensuring consistency in how the standard is implemented globally will avoid potential compliance issues in future.

We therefore recommend that NHTSA remain consistent with UNECE R127 and how the GTR No. 9 requirements are being implemented based on a 1,100mm SgRP and the extent to which the appropriate impact angle and speed for a short front-end vehicle can be determined (if possible). We note however that vehicles with short overhangs will likely interact with pedestrians differently than the

test conditions outlined in the GTR (i.e., target points, impact angle, and impact velocities). As such, establishing requirements for vehicles with a short overhang will require additional lead time. In response to potential practicability concerns, we anticipate that many vehicles with GVWR greater than 6,000lbs have front-end designs that are not compatible with the proposed test procedure if the intent is to test head-to-hood and fender impacts.

B. Advantages of Headform Component Tests

Component level testing.

The NPRM proposes using headform component tests rather than full vehicle dynamic tests in which a vehicle would strike a pedestrian dummy. Auto Innovators agrees with this approach as it appears directionally aligned with GTR No. 9. Component level testing is likely to provide greater repeatability and reproducibility compared to full vehicle testing. However, as outlined elsewhere in this comment, the agency's proposed markup procedure and targeting method for conducting headform impactor tests introduces new challenges in terms of repeatability and reproducibility that must be addressed.

C. Head Injury Criterion (HIC)

HIC15 vs HIC36.

The NPRM proposes that *"for any 15ms time window, [the] HIC must be below the [required] HIC criterion (e.g., HIC1000)"* and that *"a 15ms time window is used in proposed FMVSS No. 208 verses a longer window (e.g., using a 36ms timeframe) because the FMVSS No. 228 impact is hard and of short duration."* NHTSA has also requested comment on *"whether a 15ms versus 36ms window could affect HIC measurements when testing active hoods or cowl air bags, features that have appeared in recent years, particularly in non-U.S. vehicles."*

We agree that this 15 millisecond timeframe is reasonable and aligns with GTR No. 9 and UNECE R127. HIC15 is also suitable when testing in combination with an active hood systems or where cowl airbags may be present.

We oppose the use of HIC36 due to the potential for unintended secondary "rebound" impacts that could be inappropriately captured during testing, and ultimately affect overall repeatability and reproducibility of the test. Therefore, we recommend NHTSA maintain consistency with UNECE 127 and how GTR No. 9 is being implemented, regardless of whether or not a vehicle is equipped with an active hood or cowl airbag system.

D. Speed and Angle at Which the Headforms Would Impact the Hood

Headform impact speed.

In the NPRM, "[t]he proposed FMVSS No. 228 would require the launch direction to be entirely within the plane parallel to the vehicle x-z plane (vertical longitudinal plane) and the impact speed for both headforms would be 35 km/h (22 mph)." In general, this proposal is consistent with UNECE R127 and GTR No. 9. However, we encourage NHTSA to conduct more comprehensive analysis to further understand the impact of Pedestrian AEB in reducing the overall severity of potential head impacts to the vehicle hood. This is particularly important as the effectiveness of passive countermeasures become more limited as the speed and kinetic energy involved increases.

Addressing injuries at higher speeds.

NHTSA has requested comment on whether head injuries occurring at higher speeds could be mitigated by hood designs meeting FMVSS No. 228, or if injuries to other body regions could also be reduced. While a reduction in injury risk may be possible under certain conditions, we do not have definitive data to quantify the potential injury risk and/or safety benefits. It is important to note that the effectiveness of a passive countermeasure becomes more limited as kinetic energy increases with increasing velocities. For this reason, we recommend that NHTSA avoid increasing the test speed above the thresholds proposed in the NPRM as this will affect the practicability of the overall requirements. As noted previously, we urge the agency to consider reducing the proposed test speed to account for the positive impact of Pedestrian AEB systems on both the occurrence and severity of pedestrian impacts.

To account for the predicted real-world effectiveness and changes in the passive safety need, the impact speed of headform testing could be decreased to account for the similar percentage (i.e., 70%) of the population of pedestrians that are subject to injurious impact with the vehicle. A lower impact speed will cover a greater percentage of the population of pedestrians (than the current state) due to the expected PAEB effectiveness from FMVSS No. 127.

Increases to the test velocity.

We do not support increasing the test velocity above 35 km/h as the proposed velocity represents the majority of injury-inducing pedestrian impacts (*based on current field data*), is internationally accepted, and provides the basis of the underlying pedestrian kinematics that are used to establish the impact angles and impact/test areas. If test velocities are increased, the other parameters of the test setup will need to be reconsidered (e.g., impact angle, target area). Additional research would also be required to determine the reasonableness of a higher test speed, and therefore likely delay implementation of a head impact regulation and the benefit of its implementation. To the extent that increased test speeds are being considered in NCAP, we urge the agency to ensure that any changes are reasonable, practicable and do not create any inconsistencies or conflicts with FMVSS requirements. We recommend that NHTSA harmonize with UNECE R127 and GTR No. 9, and consider future updates to the requirements given the complementary nature of FMVSS No. 127 and FMVSS No. 228 for contemporary vehicles. Any deviations will increase the amount of time required to meet US-specific design requirements.

Headform impact angle.

As noted in the NPRM, “[c]onsistent with the GTR, NHTSA proposes that, at impact, the velocity vector of the child headform would form a 50-degree angle down from the horizontal ($50^\circ \pm 2^\circ$ at the time of impact). For the adult headform, the angle would be 65 degrees ($65^\circ \pm 2^\circ$ at the time of impact).” Auto Innovators supports this proposal, which is consistent with GTR No. 9 and UNECE R127.

NHTSA requested comments on whether the standard should “increase the impact angles to increase stringency notwithstanding a possible reduction in the representativeness of real-world crashes.” We do not support changing/increasing the impact angles, as the basis of the angles is the underlying kinematics based on the impact speed. The angles are internationally accepted and based on research of available crash data. A 90-degree impact angle is not consistent with real-world impacts. Furthermore, a proposal where the impact angle is prescribed to be 90 degrees from the impacted surface would create a large number of head launch angles for a given hood that may be further affected by the structural design at a given impact point. This creates unnecessary complications in testing and interpretation of the launch/impact condition – especially if considering the 3D POFC that NHTSA has proposed.

2. Defining the Relevant Areas Subject to the Standard

NHTSA's Interpretation of the GTR No. 9 Definitions Unreasonably Expand Testable Areas

Expanding the definition of HIC unlimited areas to include test areas outside of the defined hood area, inappropriately establishes testing requirements for areas not contemplated by the GTR. The head impactor was developed to predict the most common head and brain injuries, which relate to translational impact energy. As the impactor is not mounted to a full-body, oblique or sloped target points result in high rotational energy (i.e. a "glancing blow") – when aiming directly on a "HIC-unlimited-area." Testing or prediction of these areas is neither feasible nor supported by representative real-world crash data. We further note that the "HIC unlimited" areas are not in fact "unlimited" as these are likely to be indirectly tested based on deformation that occurs based on impacts within defined test areas. In other words, deformation of the hood extends to areas much wider than location where the head impacts the vehicle surface and may be affected by the presence of structures in surrounding areas includes.

A. Determining the Hood Top

Auto Innovators opposes the agency's proposal for defining the "hood top," which misaligns with how GTR No. 9 is being implemented in UNECE R127 and other member countries. As discussed previously, and in our comments to the agency in advance of the NPRM, this will have a significant regulatory impact on vehicles designed for the U.S. market. It will limit the ability of a manufacturer to produce and sell vehicles based on a global platform in the United States. This decision will add significant cost to consumers due to the design changes needed to not only meet the new requirements in FMVSS No. 228, but also other FMVSS requirements where the hood is an integral component in terms of overall safety performance. We also provide the following general feedback and questions regarding the areas that the agency is seeking comment:

- **Side Borders / Reference Lines** -- the agency's procedure is inconsistent with the GTR 9 which uses the highest point when multiple or continues impacts occur whereas the NPRM uses the most outboard.
- **Provisions for Front Corners** -- For vehicles with narrow and sharp front ends, there are cases where the semicircular template cannot meet the requirement of tangency outside the arc scribed by C-D points while maintaining points A-C in contact with the side reference line (See Figure A-1).

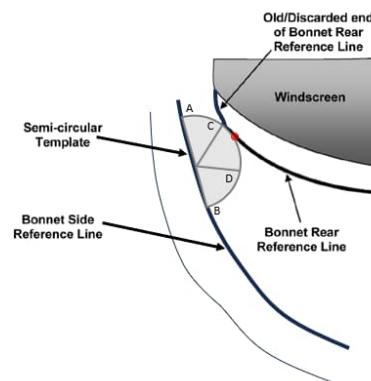


Figure A-1: Point of tangency is inside the arc scribed by points C-D.

Following the procedure in the draft document to increase the radius of the semicircular template to meet the requirements for the point of tangency results the forward corner of the template effectively runs off the front end of the Bonnet Side Reference Line and the contact requirement for both Corners A and B cannot be met (See Figure A-2).

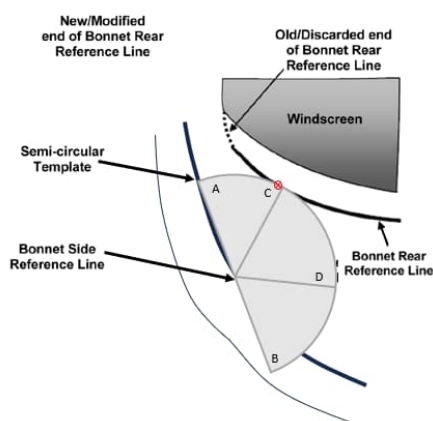


Figure A-2: Increasing the semicircular template radius to comply with the tangency requirement, results in furthestmost corner running off the bonnet.

Therefore, a provision is proposed for when the hood geometry does not allow to comply with the above requirement. In those cases, the rearmost corner (A or B) and the center of the semi-circle must be in contact with the Bonnet Side Reference Line instead.

- **Clarifying the Borders** – NHTSA should harmonize with UN-R127 which bases the requirement on "the highest points of contact" compared to FMVSS No. 228 proposal which seeks to establish a requirement based on "the most outboard contact point for the side boundary."
- **Special Provisions for the Leading Edge of the Hood** – The proposal is unclear. Specifically, clarification is needed regarding the statement "when the vehicle surface is within 0.5 mm of the straight edge for at least 50 mm of the straight edge." Does this imply "a zigzagging final front border is an acceptable result" or that it is adapted after straight edge angle is changed from 40 degree to 50 degree in protocol S6.3.2

In general, the hood markup procedure should be consistent with how GTR No. 9 is being implemented, and therefore align more closely with UNECE R127.

B. Hood Area

NHTSA should align hood markup procedures with GTR No. 9. We request NHTSA investigate the certification processes of other global regions that are implementing the GTR to avoid any discrepancies through alignment with the certification practices for markup procedures. This issue was discussed in detail during a September 28, 2021, UNECE GTR No. Technical Working Subgroup focused on proposed clarification amendments to GTR No. 9, where concerns were raised on the impact of an incorrect interpretation of the GTR markup procedure.²⁷

²⁷ Meeting of Technical Working Subgroup (TWSG) to the Task Force Amendment 3, 28 September 2021 (see [TWSG-01-06 - Pros & Cons_r1.pdf](https://wiki.unece.org/download/attachments/155975804/TWSG-01-06%20-%20Pros%20%26%20Cons_r1.pdf) -- https://wiki.unece.org/download/attachments/155975804/TWSG-01-06%20-%20Pros%20%26%20Cons_r1.pdf?api=v2)

C. Defining the Child Headform Test Area and the Adult Headform Test Area

We oppose NHTSA changing the defined test area borders from the GTR No. 9 as those defined borders were based on field representativeness, reproducibility, and analyses accepted by international groups and governments. While we recognize there are potentially unclear parameters within GTR No. 9, this potential for misalignment was clearly communicated in Auto Innovators comments to the agency in advance of the NPRM.

In addition, it appears that NHTSA is proposing an area calculation based on overall hood area, and not actual child and adult test area.²⁸ Even though the test area is a subset of hood area based on margins lines (*82.5 mm inboard of side reference and rear reference line*), in the regulatory text it appears as though the area calculation for one-third (HIC1700) and two-third (HIC1000) areas is based on the overall hood area, and not defined test area.

We reiterate our prior concerns, and strongly recommend that the proposed FMVSS No. 228 should be harmonized with the current UNECE R127. In addition, the hood top area definition used for the child and adult HIC ratio calculation should be aligned with the previously proposed GTR No. 9 to exclude the HIC unlimited in the Hood ratio calculation.

Headform HIC Unlimited Areas.

The agency's proposal on HIC unlimited zones is unclear, and further clarification is needed on whether the HIC unlimited zone is considered part of overall area calculation. (Hood area vs Test area). More specifically, the term "Unlimited Area" is also not accurate because this area could be contacted by the headform impact and still be assessed with the relevant HIC criteria.

Auto Innovators requests that HIC unlimited zones be excluded from the area calculation and recommends that the agency adopt an approach consistent with by GTR No. 9 and UNECE R127 (i.e., 82.5mm margins). While NHTSA notes that the test area of the NCAP RFC already includes portions of the HIC unlimited area, the NCAP approach is different from that of a regulation. In NCAP testing, the vehicle rating considers overall injury risk based the contribution of HIC scores on multiple test points, which in some cases may exceed HIC1700. In FMVSS No. 228, however, any point within the test area must have a HIC below 1700. GTR No. 9 establishes a boundary of 82.5mm recognizing that there are structures that are likely impractical to meet the HIC 1700 at specific points where other performance requirements make meeting the requirements of FMVSS No. 228 impractical; for example, in the hinge area that must meet the requirements for FMVSS No. 219 windshield zone intrusion.

The GTR has been in effect for more than a decade, with international regulatory agencies applying the requirements consistently across different markets, including a similar process for establishing testable areas and the procedures for aligning the head impactor tests. The definitions used in each region are also largely similar, which supports increased regulatory alignment. However, NHTSA's proposal redefine certain critical definitions impact the practicability and feasibility of conducting head impactor tests on certain parts of the vehicle hood.

²⁸ *NPRM Page 76925-76926: The requisite portions would be derived as a percentage of the overall Hood Area. Generally speaking, the portion of the Child Headform Test Area that must meet the HIC1000 requirement must be at least one-half of the numerical value (numerical value of the area is calculated from a projection onto a horizontal plane) of the Hood Area below what is called the "WAD1700 line."* [20] *Based on data showing the locations of child and adult head impacts, this NPRM proposes that WAD1700 would be the boundary between the Child Headform Test Area and the Adult Headform Test Area.*

For example, expanding the definition of HIC unlimited areas to include test areas outside of the defined “hood area” inappropriately establishes testing requirements for areas not contemplated by the GTR. The head impactor was developed to predict the most common head and brain injuries occurring in the real-world, which relate to translational impact energy. As the impactor is not mounted to a full-body, oblique or sloped target points result in high rotational energy (“glancing blow”) – a result observed when aiming directly on a “HIC-unlimited” area. Testing or prediction of injury in these areas is neither feasible nor supported by representative real world crash data.

We further note that the “HIC unlimited” areas are not in fact “unlimited” as these are likely to be indirectly tested based on deformation that occurs based on impacts within defined test areas. In other words, deformation of the hood extends to areas much wider than location where the head impacts the vehicle surface and may be affected by the presence of structures in surrounding areas includes. This is shown in Figure A-3, where the test target on the left-side image represents the on outermost position within the test area in a simulated environment. The image on the right show the results of a simulated head impact to this point, which demonstrates that the level of deformation that occurs largely outside of test impact point.

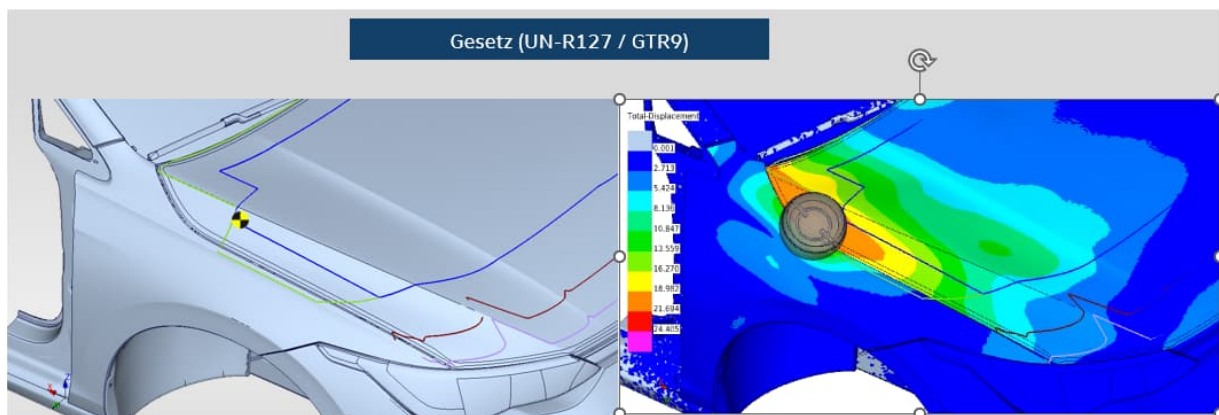


Figure A-3: Front end displacement when impacting the outermost position of test area with headform.

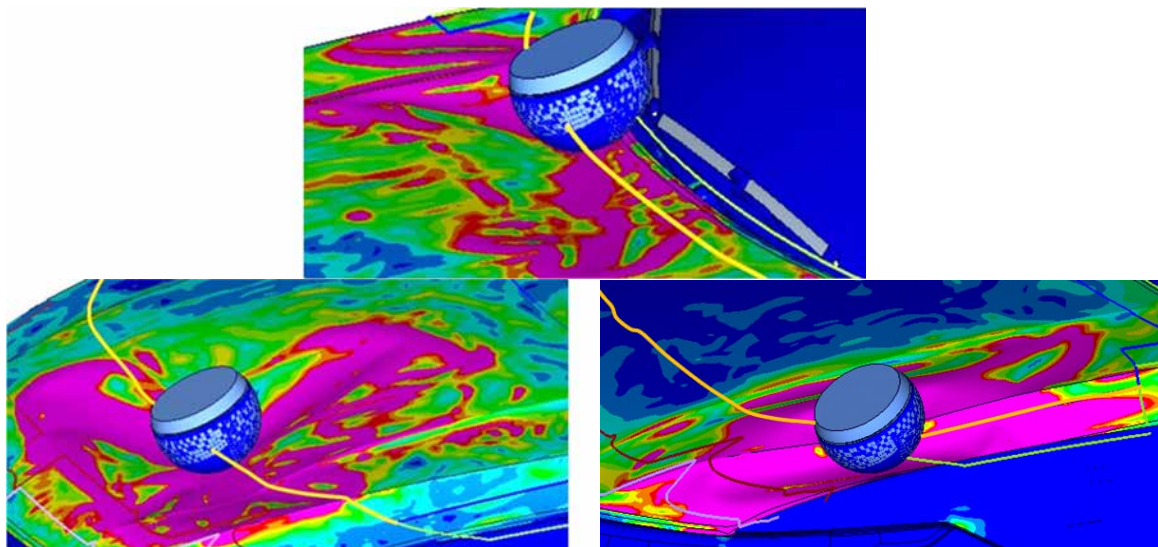


Figure A-4: Front end displacement when impacted by headform at borders of the head test area.

This is demonstrated in Figure A-4, where the yellow lines show the borders of the head test area, and color grading to highlight the extent of deformation at various points across the hood surface and surrounding structures when contacted by a headform impactor. This shows that the concept of an undefined “HIC unlimited area” does not exist, as surrounding structures already have a significant contribution to HIC values when testing near the reference lines (without the need to contact these areas directly).

Front Border of Child Headform Test Area.

Auto Innovators is concerned with the agency’s proposal to amend the requirements of GTR No. 9 with respect to the front border of the testable area. Vehicles that are larger or smaller than what is deemed to be typical size vehicles may include different style features, including variations in the design of safety equipment such as headlamps, which might cause physical conflicts due to their close proximity to the test areas. This creates significant design challenges, and while a WAD1000 may be more suitable in the context of NCAP ratings, where differences in performance would have a negative effect on overall vehicle score, establishing HIC1700 pass/fail criteria based on this WAD would have significant implications on the ability to sell the vehicle.

For vehicles that are smaller than typical size, the front end profile also makes it unlikely that the head will hit the bonnet, and incorporating an injury reduction structure to the part of bonnet may not be meaningful. Additional research based on in-depth crash data is needed to demonstrate the safety need and overall cost-benefit of expanding the front border of the testable area.

Again, the agency should make every attempt to align with UNECE R127. This will allow manufactures to adopt design changes for vehicles based on global platforms that are developed to meet GTR No. 9 in other markets as quickly as possible.

Considerations for the Child Headform Test Area Front Border.

While we understand the agency's perspective that a smaller stature person may impact the grille in some larger vehicles, the GTR is intended to address a wraparound impact to the front structure. However, if the agency extends the impact region to include the grille (WAD1000), the test procedure must be revised, which we anticipate would be a longer-term rule making activity. We recommend that the front border of the testable area be harmonized with GTR No. 9, by extending the straight edge method to contact the vehicle at the more typical front hood location should be used.

- **Extending the Straight Edge.** Inclusion of the grille area in the test area should also be supported by the accident data. Expanding the frontal test zone to include this area creates significant challenges, particularly with respect to the grille and fascia area where electrical and radar sensors are packaged. The positioning of these crash avoidance features will make it substantially more challenging to meet the proposed head impact requirements, and may require extensive redesign, and could result in the agency indirectly requiring suboptimal placement of sensor equipment. This potentially undermines crash avoidance efforts, and may result in the rule having a negative safety impact, and will add substantial research and development costs to address regulatory conflicts in meeting the performance requirements of FMVSS No. 127. These factors have not been considered as part of the agency’s regulatory impact analysis. We again recommend that NHTSA extend the straight edge to remain consistent with the GTR to assess the performance of hoods and fenders.

- **WAD1000 line as the front border.** Auto Innovators opposes the agency proposal to define the LERL based on a WAD1000 for all vehicles (regardless of size). This approach would require not only a reconsideration of impact angle requirements, but also creates a new test condition where energy absorption may not easily be achieved. New structures beyond those that meet UNECE R127 would be required, including for larger vehicles where the WAD1000 may overlap the grille area and it may not be practicable to modify underlying vehicle structures, including those critical for meeting other FMVSS requirements. We recommend aligning with how the GTR is being implemented in regulation (i.e., the front border is always the BLE/LERL if WAD1000 is in a more forward position on the vehicle front end). Another alternative could be increasing the angle of the “straight edge” that is used to make contact with the vehicle to define the LERL.
- **Impact Angle Considerations.** In addition to the comments above, the GTR No. 9 test methods and evaluation criteria were developed for impacts with the hood; therefore, we propose that FMVSS No. 228 use the front leading edge line to define the front of the hood top consistent with the GTR No. 9 approach. The agency’s proposal is more appropriate to consider in the context of NCAP pedestrian protection updates, but should not be considered as part of the FMVSS No. 228 regulation to maintain regulatory harmonization with other regions. The planned NCAP upgrade to include pedestrian protection evaluations will influence the bumper designs because of the upper and lower legform testing. We recommended additional research that considers the design changes that may occur due to NCAP and how it may affect the proposed FMVSS No. 228. For example, adjusting the impact direction to 20° when forward of the LERL so as to produce a more perpendicular impact.
- **Apportioning of Test Area to HIC Levels.** The test method should be aligned with GTR No. 9, and should not include the grille in the test area. However, if NHTSA is to develop requirements to evaluate this area, HIC1700 is likely more appropriate due to technical feasibility and practicability issues. Further research is needed to understand the regulatory impact of such an approach.
- **Shifting the Test Border Forward.** We recommend that, rather than shift the forwardmost border forward in regulation, the agency consider such a requirement through updates to NCAP. As previously mentioned, different types of vehicles that are larger or smaller than typical size vehicles may include certain features and safety equipment such as headlamps, that might cause physical conflicts due to their close proximity to the test areas. This will need to be considered through additional research studies. We recommend aligning with how the GTR is being implemented in regulation (i.e., the front border is always the BLE/LERL if WAD1000 is in a more forward position on the vehicle front end).
- **Testing Forward of WAD1000 for Small Vehicles.** Auto Innovators opposes the agency’s proposal to establish different test protocols for smaller vehicles. It is not reasonable or practicable to establish requirements forward of the WAD1000 areas. Any approach that considers the stature of pedestrians should be consistent across all vehicle types, rather than implementing one approach for smaller vehicle and another for taller vehicles. NHTSA should pick one criterion such as WAD1000 to mark the beginning of test field irrespective of vehicle types. The suggested approach is also inconsistent with GTR No. 9, which is internationally accepted, with representative test procedures that were developed based detailed crash investigations and analysis of the underlying pedestrian kinematics in the majority of injury-inducing pedestrian impacts.

Any proposal developed by the agency should be supported by comprehensive data so that the practical challenges and regulatory impact that such requirements would impose are understood.

- i. **Request for Comment on Modifying the Forward Border.** NHTSA requests comments on several questions related to the modification of the forward border. As previously discussed, we oppose this approach as it raises significant practicability concerns and is inconsistent with GTR No. 9 and how it is being implemented. Given these practicability concerns we also anticipate there will be significant cost implications and redesign requirements for vehicles that are already in production or mid-development which will require additional lead time. While a WAD1000 may be more suitable in the context of NCAP ratings, where differences in performance would have a negative effect on overall vehicle score, establishing HIC1700 pass/fail criteria based on this WAD would have significant implications on the ability to sell the vehicle as a HIC greater than HIC1700 is not permitted (even if increased levels of protection are provided in other parts of the hood). We again recommend alignment with GTR No. 9 and UNECE R127.

While we recognize that agency's point that *"for many smaller vehicles the forward line where testing is required is at WAD1000, far behind the LERL,"* this is an unreasonable requirement given the stature of the occupants being evaluated for. The agency has also not provided sufficient data on the number of real-world crashes involving persons of 1000mm height to support moving the forward border position, nor conducted an analysis of the practicability challenges in developing countermeasures to address such requirements. Any approach that considers the stature of pedestrians should be a consistent across all vehicle types, rather than implementing one approach for smaller vehicle and another for taller vehicles.

In Figure A-5 and Figure A-6, below, real-world analyzed by VIPA was used to identify pedestrian body region impact locations in crashes involving passenger cars, MPVs, and trucks, at speeds below and above 40 km/h, respectively.²⁹ Based on this data, there were no observed crashes above 40km/h where a head impact was close to the periphery of the hood (approx. 590-1000mm). This data also supports reconsideration of the agency's proposal to expand the test field using 50mm offset lines combined with the 3D POFC targeting method. This issue is discussed in more detail later in Appendix A.

²⁹ Head Injuries from the Vulnerable Road User Injury Prevention Alliance (VIPA): Effect of Vehicle Type on Head Contact Location
- Dr. Stewart Wang - IRCOB 2020

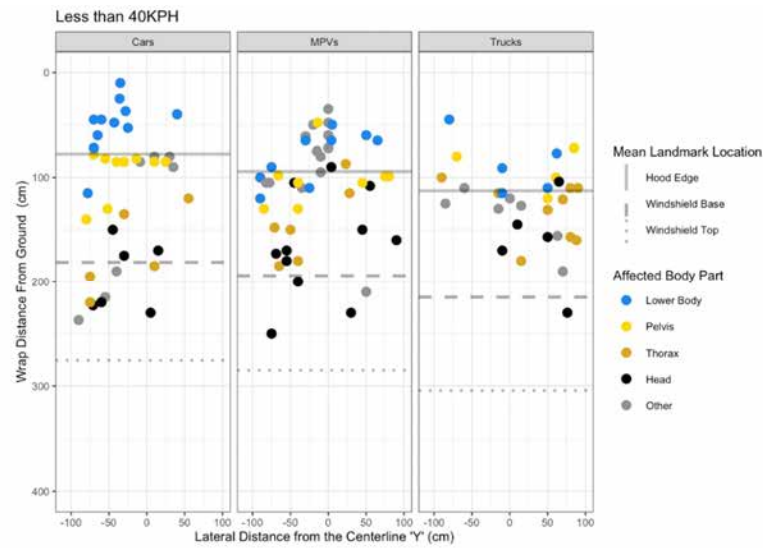


Figure A-5: Summary of Real-world VRU crash data collected as part of VIPA showing head (and other body region) impact locations on vehicle for pedestrian crashes BELOW 40km/h

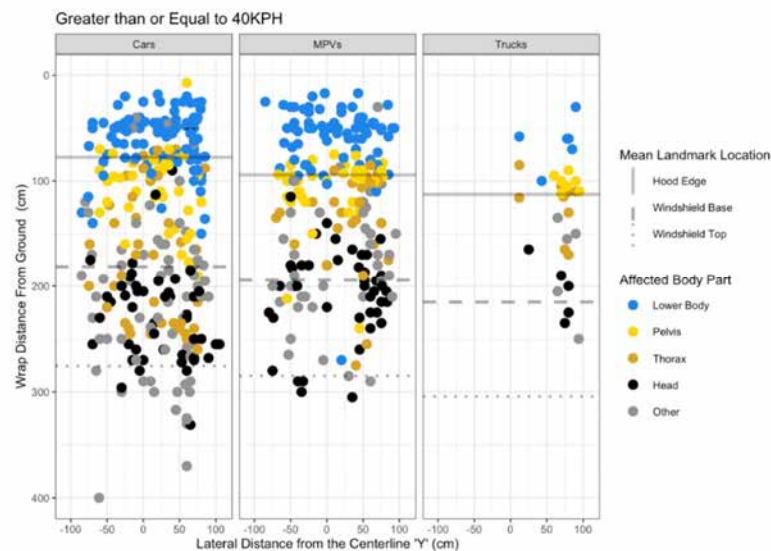


Figure A-6: Summary of Real-world VRU crash data collected as part of VIPA showing head (and other body region) impact locations on vehicle for pedestrian crashes ABOVE 40km/h

Furthermore, due to detrimental effect on sightlines (of the forward roadway) and the required changes to other components that impact overall performance, this approach would also have a substantial impact on small volume manufacturers and other OEMs that produce vehicles with low-profile designs. Testing forward of the WAD1000 line for small vehicles would introduce components such as headlights and their support structures into the test area. These components cannot easily be modified to have deformable or flexible support structures to satisfy the HIC requirements of the regulation without compromising the lighting performance. The alternative would be to raise the hood surface over these components which would have a detrimental effect on forward vision for the driver. In addition, the child head impact sub system test may not

be representative of children of this height in terms of impact angle velocity and mass. The NPRM states that the WAD1000 is just under the average height of a 6 year old child which is a target demographic of the standard. The child head impact sub system tests are designed to represent the impact of the head of a child of this size with the front of the vehicle. One of the justifications for testing forward of the WAD1000 is that it will potentially add to the protection of children with a standing height of less than 1000 mm.

The agency has also requested comments on how the GTR determines the HIC Unlimited Margin for the front and sides. As noted in the NPRM, *"[the] regulatory text reflects the GTR's specification that the margin would be determined using an 82.5 (3.25 inch) mm taut wire, but NHTSA finds merit in using a 50 mm (1.97 inch) taut wire instead to increase the testable area, and reduce the allowable area of the HIC Unlimited Margin."* We are opposed to this proposal. The defined test area borders from the GTR No. 9 were based on field representativeness, reproducibility, and analyses accepted by international groups and governments. In addition, changes to test borders might affect test feasibility and repeatability.

Auto Innovators recommends that the 82.5mm margin be maintained. While the agency points out that other programs, such as EuroNCAP, use a 50mm margin for testing, these are NCAP programs that use the grid method of testing. In this case, tests as specific point in the boundary areas which are not practical to meet can be balanced from a NCAP score standpoint (with consideration for other impact locations), which cannot be done in the regulatory framework proposed in this NPRM. A decision to deviate from the GTR No. 9 and UNECE R127 will have significant design and cost implications, and will likely require a substantial changes to both the hood and underlying structures for both current and planned models.

- ii. **Transition Between Child and Adult Headform Test Areas at WAD1700.** NHTSA has proposed to specify a non-overlapping transition from the Child Headform Test Area to the Adult Headform Test Area at WAD1700 and has requested comments on the merits of this proposal. We disagree with the proposal and suggest the agency align with GTR No. 9 and UNECE R127. This issue has already been considered in the development of the GTR, and the determination was made based on an analysis of injury inducing pedestrian crashes and underlying kinematics. There was no significant safety benefit of this approach vs. the current hard transition line at WAD1700. Further, the basis of the required test areas is because the head of a small adult will impact the front of the WAD1700, and the headform is specified for evaluation at 3.5kg rather than 4.5kg. Even if an adult impacts in the child zone or a child impacts in the adult zone, they will still have the benefit of the hood developed to meet the headform used for the respective test areas. The agency's proposal will only serve to increase the testing burden without any clear benefit.
- iii. **Rear Border of Adult Headform Test Area.** We have concerns that if the rear border is moved back and the cowl or wiper blades are required to be weakened to improve pedestrian performance, it can degrade the performance of these other systems.

D. Considerations for the Adult Headform Test Area Rear Border; Request for Comment.

Windshield Testing.

NHTSA is considering including windshield testing, despite its exclusion in the current regulatory text. As noted by the agency, windshield testing is now included in UNECE R127.03. However, there are challenges with respect to repeatability of glass impacts despite provisions whereby certain impacts can be deemed as “abnormal” (which allows for retesting). For these reasons, further research is likely needed to determine how windshield testing might be incorporated in FMVSS. This should also be proposed in a subsequent rulemaking notice to provide appropriate opportunity for notice and comment. Consistent with our prior comments UNECE R127 should be used as a basis for this research and the agency should seek to maintain alignment where possible. We also support additional consideration of a test exemption area (i.e., the cowl area) to address the aforementioned concerns with moving the rear border of the headform test area. This is consistent with UNECE R127.03.

Adult Headform Test Area Rear Boundary Determination.

NHTSA has requested comments on using the most rearward of the WAD line or offset line to define the rear boundary of the Adult Headform Test Area, rather than using the line that is most forward. We recommend that NHTSA harmonize with UNECE R127. In other words, the 82.5mm offset line should remain, even more so if 2500WAD was introduced. Testing rear of this will result in impacts involving cowl area or A-pillars, which have not been fully considered or researched in the context of potential regulatory requirements for the U.S. market. By using the most rearward line there is an increase in the occurrence of “glancing blows” which lead to unreproducible results. Softening this area may be detrimental to other attributes such as noise, vibration, and harshness (NVH). Harmonization with GTR No. 9 should be maintained. This issue could first be considered for inclusion as part of a future US-NCAP rating to complement any regulatory requirements that are established.

Reducing the HIC Unlimited Area.

NHTSA has requested comments on the merits of the agency’s adopting a 50 mm offset line in the final rule. Auto Innovators does not support this approach as it is not aligned with existing international standards. For some vehicle stylings which have a steep slope front end, it will bring no safety benefit since the head will bounce off laterally. Additionally, the 82.5mm distance is derived from half the diameter of the head impactor. The proposal to move from 82.5mm to 50mm lacks sufficient research to support the deviation from the established GTR No. 9 and UNECE R127 requirements, and as discussed previously, the proposal fails to fully consider the regulatory impact and cost and design implications of such a change. While the agency points out that other programs, such as EuroNCAP, use a 50mm margin for testing, these NCAP programs use the grid method of testing, and do not have established pass/fail criteria based solely on impacts to certain points within the test area. For these reasons, our strong recommendation is for the agency to remain in alignment with GTR No. 9.

Expanding the Testable Hood Area.

NHTSA is considering and request comments on the merits of including the entire Hood Top as the testable area. We are strongly opposed to this approach as it is neither reasonable nor practicable given other competing regulatory requirements. Such an approach essentially removes any level of harmonization with GTR No. 9 and would require significant redesign to the extent such a requirement is feasible. As the agency correctly points out, there are points encompassed in the HIC unlimited area that may not be practical to meet the HIC1700 due to competing requirements (such as the hood hinge or

latch areas). Further, NHTSA needs to support with data any safety-beneficial effects of expanding the areas with additional consideration for the regulatory impact that such a requirement would create. For example, creating a requirement for protective structures in areas where there is a low likelihood of a pedestrian head impact occurring. Again, these potential issues can be addressed through alignment with the GTR No. 9 and UNECE R127 requirements.

E. Corner Reference Point of the Child Headform Test Area

The agency proposes to define a corner reference point for the test areas (specifically the Child Headform Test Area), just as it is for the Hood Area. Auto Innovators supports this proposal to use most outboard intersections when there are multiple intersections that need to be considered. However, as reflected in the Figure A-7, below, additional specificity is needed to clearly define what is considered a testable area. We recommend NHTSA establish the test field based on the innermost contact points as reflected by the blue line in the figure below. This ensures the headform area would be included in the area formed by both the Side Reference Line and the Leading Edge Reference Line. If the agency is to consider an alternative approach, the requirements must be clearly defined.

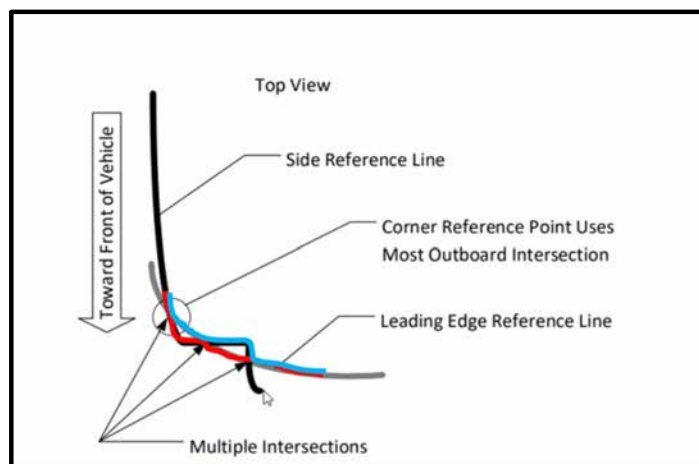


Figure A-7: Test field based on multiple intersections between side reference line and leading edge reference line

3. Proposed Requirements and Assessing Compliance (Section VII of NPRM)

A. Amount of Hood Area That Must Conform to HIC 1000

The NPRM states that, “[c]onsistent with GTR 9, the regulatory text of this NPRM prescribes the amount of the Child and Adult Headform Test Areas that must conform to a HIC1000 limit (HIC1000 Area). The remainder of the Child and Adult Headform Test Areas must be able to conform to a HIC1700 limit (HIC1700 Area). The basis for the minimum HIC1000 Area is the size of the Hood Area. After the Hood Area is determined, the performance requirements [is outlined in the NPRM].”³⁰ We disagree with this interpretation for the HIC1000 area. The agency’s approach requires exclusive construction – even for vehicles that currently meet the UNECE R127 for other markets. It is an incorrect assumption that vehicles that meet the GTR No. 9 requirements as implemented in other parts of the world can meet the requirements that the agency has proposed as they are fundamentally different.

³⁰ <https://www.federalregister.gov/d/2024-20653/p-346>

While we acknowledge that GTR No. 9 may contain potentially unclear parameters, good faith efforts were initiated within WP.29 to address these issues. However, at the agency's request, discussions were ultimately deferred due to the ongoing rulemaking process. We therefore have significant concerns that the agency's proposed approach is not only counter to the intent of the GTR (despite ongoing dialogue between contracting parties), but that it also significantly harms any prospect of regulatory alignment. We therefore reiterate our prior affirmation that due to ambiguities within the GTR, FMVSS should be harmonized to the current UNECE R127 that clarified the procedures to avoid potential ambiguity when defining test areas.

We also note that the proposed amendment unduly favors larger vehicles and fails to recognize the unique design considerations of smaller vehicles. To the extent that the agency is not willing to support regulatory alignment, a proposed alternative is to determine a threshold or formula based on the Headform Test Area/Hood top ratio that provides a consistent HIC1000 requirement for all hood sizes.

In essence, the proposed method of assigning the HIC areas results in inconsistent assessments for different sizes of hoods. This is due to the fact that for smaller, narrower front ends, the proposed way of calculating the 2/3 of the hood area results in a larger area of HIC 1000 which restricts heavily the location of necessary components such as hood hinges, latches, etc. whose size typically does not vary greatly among different types of vehicles. NHTSA recognized the practicality in addressing this challenge and flexibility that is required to package such components in Section I.A of the NPRM which states that *"Because hard areas under the hood are challenging to mitigate, for practicability reasons the HIC limit for the remaining test areas is higher (HIC>1000), but nonetheless limited to HIC1700."*³¹ On the other hand, vehicles with larger hoods and a larger Headform Test Area/Hood top ratio will have more leniency to locate hard components in the front end.

Manufacturer Reporting Requirements

In the NPRM, NHTSA states that *"the borders as set forth in the standard are definitive and NHTSA will use the procedures to determine the relevant areas on the hood without manufacturer input."* In addition, *"[u]pon request, manufacturers must tell NHTSA where the HIC1700 areas are by providing coordinates or decals. If these coordinates or decals conflict with the provisions of FMVSS No. 228, NHTSA would conduct compliance tests using the reference lines of the test area borders as determined by the standard, and not the manufacturer's description of the location of test area borders."*

This issue underscores the importance of not only having objective and clearly defined protocols related to the making procedure and head impact protocols (discussed further below), but also that manufacturers have flexibility to apply engineering judgement when defining HIC1000 and HIC1700 zones. If the vehicle is demonstrated to be compliant based on how the manufacturer has self-certified the vehicle, this should be a sufficient basis for the agency to conduct compliance verification.

To the extent NHTSA believes discrepancies may arise, we request that the agency have a process in place for confirming, at the manufacturer's request, whether there is potential misalignment in how the protocols are being considered. For UNECE R127, for example, test zones and impact points may be discussed between the regulator and OEM to confirm 'worst case' test points prior to testing. In the absence of such engagement, NHTSA should defer to the OEMs engineering judgment in defining HIC1000 and HIC1700 zones.

³¹ Docket No. NHTSA-NHTSA-2024-0057

B. Manufacturer Designations of HIC1700 Areas

NHTSA has requested comments on whether the final rule should require that HIC1700 areas be allocated such that at least some HIC1000 area must be provided in the Adult Headform Test Area. Auto Innovators is strongly opposed to this proposal. GTR No. 9 provides manufacturers with flexibility to determine how to achieve the HIC1000 targets, while also ensuring that all areas of the test area have a HIC below HIC1700. In addition, it is not necessary to assign HIC1000 areas for adult headform testing as the HIC 1000 area for child headform is sufficiently large. We recommend alignment with GTR No. 9 and UNECE R127.

C. First Point of Contact

NHTSA has proposed its 3D Point of First contact method for targeting areas on the hood and assigning HIC values. Auto Innovators strongly disagrees with this proposal, and as discussed extensively in our prior comments to the agency, this introduces repeatability and reproducibility concerns, and is more costly and complex to implement than the alternative 2D method (despite the agency's assertions in the NPRM). The 2D method also provides a means to address situations where it may not be possible to define a point of first contact for a given target point.

The development of this alternative approach is both unnecessary and only serves to delay issuance of a rulemaking that more closely aligns with how the GTR was implemented. We continue to recommend alignment with UNECE R127. The 2D test point determination is well established and understood by both OEMs and other regulatory bodies and is both robust and repeatable, hence its use in all countries who have pedestrian protection requirements.

Number of tests

The proposed FMVSS No. 228 does not specify how many tests NHTSA would conduct on a particular hood or where precisely the headforms would be aimed (such as minimum spacing between the test points on the hood). While we recognize that the agency has discretion over how many tests may be conducted, we request the NHTSA establish some reasonable bounds on repeated tests to minimize any variability that may be introduced as a result of repeatedly testing specific sections of the hood. When a compliance audit information request is sent to a manufacturer, the OEM should have the opportunity to provide information on the number of tests conducted at specific locations. This will assist the agency in making a determination on whether additional points need to be tested. NHTSA should also consider a standardized process for informing the selection of test points for compliance verification to minimize the potential for subjectivity (*e.g., similar to test procedures for FMVSS 201U or 226*).

D. Consideration Related to the Amount of Test Area That Must Meet the HIC1000 and HIC1700 Limits

In the NPRM, NHTSA states that "the analysis of existing NHTSA-performed pedestrian head impact testing indicates that the proposed compliance limits and requirements for proposed FMVSS No. 228 are practicable for U.S. vehicles." We disagree with this conclusion. The agency has significantly underestimated the design impacts of its proposal. Based on preliminary analysis, we also disagree that vehicles that already meet GTR No. 9 / UNECE R127 requirements can easily meet the proposed FMVSS No. 228 requirements. The two sets of requirements are significantly different due to the agency's interpretation of the GTR.

Defining Testable Areas

We urge NHTSA to harmonize with UNECE R127 for marking the test field and test procedure extending the grille area. If the mark-up procedure approach adopted in NHTSA regulation is inconsistent with the current GTR No. 9 test procedure, this could potentially result in undefined HIC 1000 and HIC 1700 zones, and will result in circumstances where the ratio of HIC 1000 zones always exceeds 2/3 of the testable area. This is illustrated in Figure A-8, below, using a simplified 2D representation of the width of a vehicle hood. Miswording in the current GTR No. 9 leads to interpretation of the area requirement that is different from the original concept of GTR No. 9 to prescribe 2/3 and 1/3 area ratios for HIC 1000 and HIC 1700 zones, respectively. Similar issues would also likely arise if the agency were to adopt a hybrid approach that blends requirements from the GTR No. 9 and UNECE R127 test procedure.

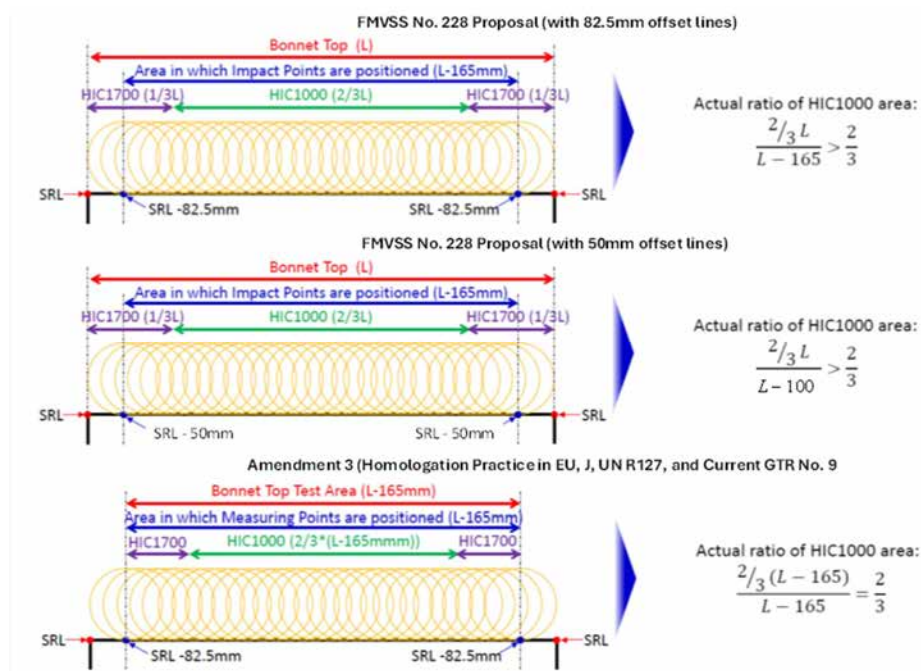


Figure A-8: Comparison of the HIC 1000 area ratios when applying markup procedures from Amendment 3 and the expected NHTSA interpretation of current GTR No. 9 (with both 82.5mm and 50mm offset lines for comparison)

Implications of NHTSA's Proposed Approach for Defining HIC1000 Zones

Vehicles with large hoods as well as vehicles with a very small test area will have a large amount of HIC unlimited area (highlighted area). Prediction based on hood area will result in more stringent requirements for HIC 1000 to 100% of the test area – which may not be technically feasible. This would translate into higher percentage of test areas that require HIC 1000 score as compared to current vehicles designed to fulfil GTR No. 9 / UNECE R127.

For vehicles with smaller, narrower front ends, and rear-engine vehicles usually characterized by smaller hoods, the actual ratio of the HIC 1000 area can become substantially larger than the fundamental 2/3 requirement in GTR 9. This inappropriately drives more stringent requirements for smaller vehicles and would have the counterintuitive effect of encouraging larger vehicles because of the comparatively lower ratio of HIC 1000 to 1700 zones in relation to the overall size of the vehicle front end. Above all, this creates significant concerns for objectivity and departs from the fundamental concept of defining 1/3 and 2/3 ratio zones for HIC 1700 and 1000 areas (see Figure A-9).

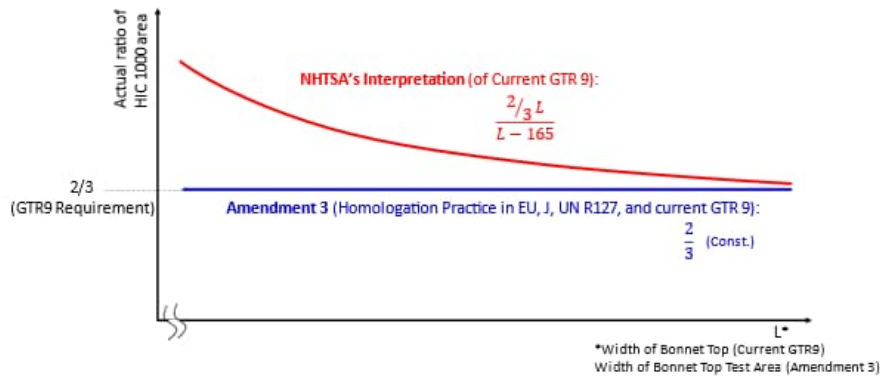


Figure A-9: Sensitivity of the actual ratio of the HIC 1000 area to the width of a vehicle, when comparing markup procedures from Amendment 3 and the expected NHTSA interpretation of current GTR No. 9

This is further demonstrated in Figure A-10, below, which shows the application of the markup procedure relative to vehicles with different size hoods. For vehicles with smaller hoods, the proportion of HIC 1000 areas is notably lower than for larger vehicles. Therefore, the assumption that the deviations away from GTR No. 9 requirements will have little to no impact to vehicle designs for the U.S. market to meet the proposed requirements in FMVSS No. 228 is incorrect, and significant changes may be necessary to meet these proposed requirements (e.g., active hood systems).

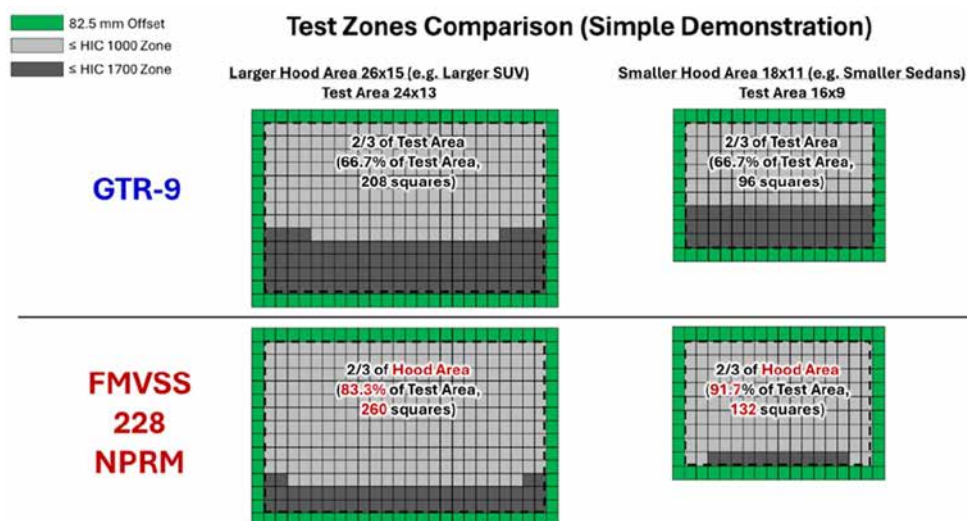


Figure A-10: Comparison of the HIC1000 and HIC1700 zone test areas for “larger” versus “smaller” hood areas

Differences in how the markup procedure is applied to different sized vehicles should also have been considered as part of the agency’s regulatory impact analysis based on the risk of sustaining an AIS 3+ injury based on a HIC1000 or HIC1700 impact.³²

In addition to our prior comments, we also note that there is no description for vehicle height when drawing area lines in NPRM. In order to maintain the validity of the test area information submitted by the manufacturer, the vehicle height conditions should be specified.

³² Based on Table 24 in the NPRM, a HIC1700 would result in an approximate 50% risk of AIS3 head injury, whereas at HIC1000 the risk of an AIS 3+ injury is 23% (see also p.41 of the PRIA)

Aiming Protocol – 3D Point of First Contact Method

Auto Innovators has ongoing concerns related to the NHTSA targeting protocol and methodology for aligning the head impactor used to evaluate pedestrian injury risk. The 3D Point of First Contact (POFC) method also introduces repeatability and reproducibility concerns whereby a “Point of First Contact” could be associated with multiple impactor positions as outlined below.

As noted in the NPRM:³³

“[NHTSA] recognize the possibility that the first contact of the headform could occur at multiple points on the hood simultaneously due to the curvature of the hood and the headform, and that these points could lie in different test areas. For example, one point could lie in the HIC1000 portion of the Child Headform Test Area, and another could lie in the HIC1700 of the Adult Headform Test Area. To address this problem, we propose to use a simple and common-sense approach to cover instances where the first contact occurs in more than one area: when such a situation arises, the more stringent requirement applies. For example, if first contact occurs in a child HIC1000 area and a child HIC1700 area simultaneously, the HIC1000 requirement applies for that particular launch location.” (see NPRM, p.110)

Concerns with repeatability and reproducibility are exacerbated further as the 3D POFC introduces additional complexity in terms of test setup and execution. For each test, it will be necessary to ensure the launch position/angle are clearly defined (relative to the vehicle) and additional steps may be needed to ensure the impact corresponds to a specific location on the vehicle bonnet.

With the 2D method that is common in other areas of the world that use harmonized regulations, a test point can clearly be related to a repeatable impactor position. This method reduces variability for head positioning, and which HIC area the test point belongs to, or if it is actually in the test area. The 2D method is preferred due to increased repeatability and reproducibility over the 3D method as it defines the test area independent from hood design (Figure A-11).

2D-Impactor-Positioning → Test Area **independent** of Hood Design 3D-Impactor-Positioning → Test Area **depends** on Hood Design

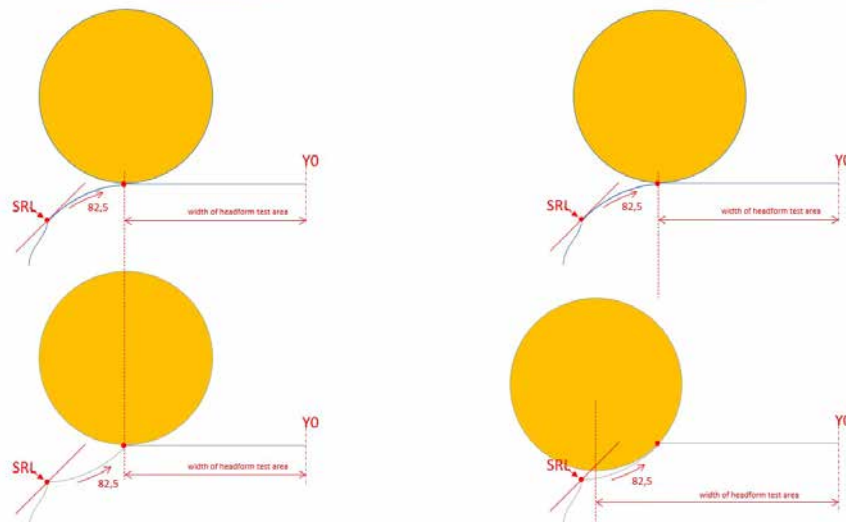


Figure A-11: Comparison of the 2D and 3D impactor positioning protocols. This highlights the potential for subjective when applying the 3D POFC method for positioning the head impactor

³³ <https://www.federalregister.gov/d/2024-20653/p-368>

The 3D method could lead to uncertainties and lack robustness due to increased variability of test points (Figure A-12). From a self-certification, addressing potential subjectivity in how the test is applied is essential.

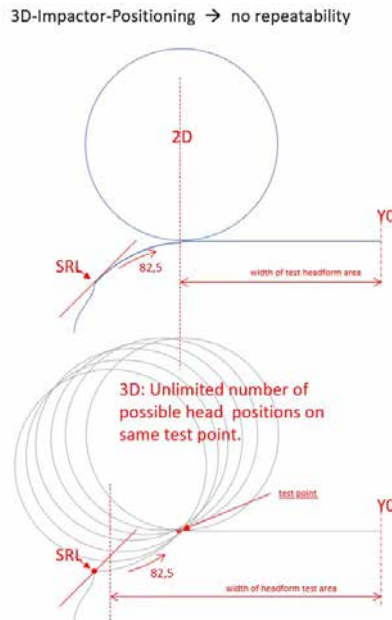


Figure A-12: Comparison of the 2D and 3D impactor positioning. This further highlights the potential variability when positioning the head impactors using the proposed 3D POFC method

The aforementioned issues with the 3D POFC do not exist for the 2D method. We therefore strongly urge the agency to adopt the 2D approach as it is significantly more straightforward, limits unnecessary test burden, ensures repeatability and reproducibility, better guarantees that impacts occur within defined testable areas, and is more closely aligned with the intent of GTR No. 9.

We are supportive of the 2D measuring point method as a means to enhance the positioning of the head impactor for assessing pedestrian injury risk. It provides a straightforward, objective, repeatable, and reproducible method for compliance testing and evaluation. Conversely, the 3D Point of First Contact method (3D POFC and currently in GTR No. 9) does not achieve these goals and likely introduces additional and unnecessary complexity.

Consideration for Impacts Outside the Defined "Child and Adult Test Areas"

Auto Innovators remains concerned that the agency test procedures may not appropriately consider the significant impact on vehicle designs should it require a test procedure that includes impacts outside of the defined HIC 1000/1700 zones. This is of particular relevance for impacts occurring at or near the front, side, and rear borders of the test area as illustrated in Figure A-13, below.

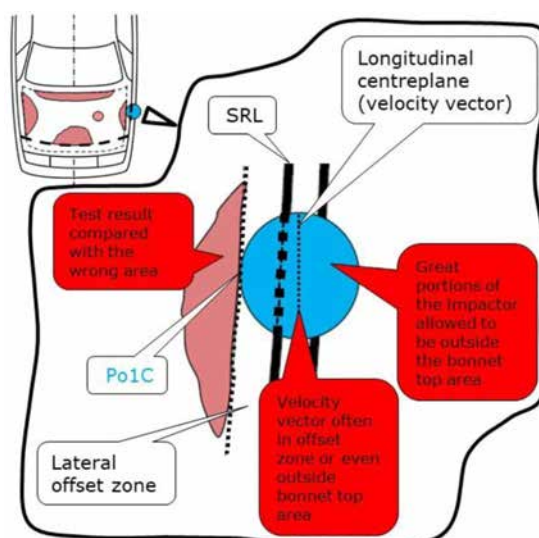


Figure A-13: Example of test where the POFC is within the SRL, but the impactor centerline is outside SRL [Source: 3rd TWSG Amendment 3 Final Minutes TWSG-03-05]

As noted in our 2022 comments, the agency inappropriately expands the testable area beyond the intended scope of GTR No. 9, and based on our assessment, the 3D POFC method further calls into question what is considered a valid test/impact based on defined test zones.

Furthermore, the proposed 82.5mm offset line represents the half diameter (radius) of the head impactor. Testing a position on the side border of the test area will lead to the headform extending up to the 45° SRL, therefore assessing the whole area up to the SRL (Figure A-14).

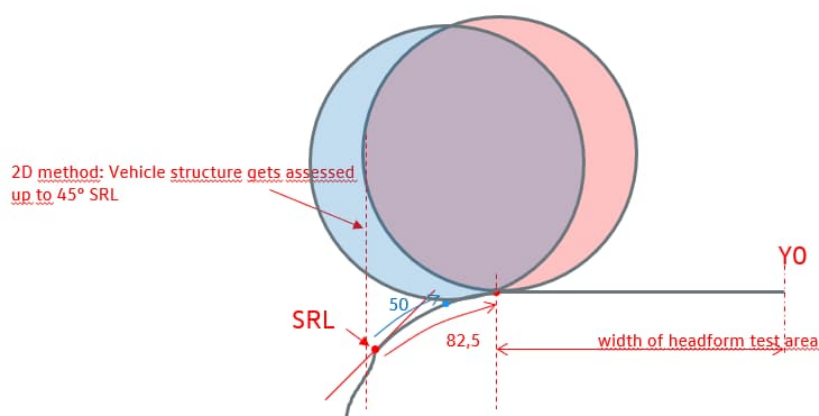


Figure A-14: Difference in the head impact location based on a 50mm versus 85mm offset from the SRL.

Establishing an offset line of 50mm is expected to result in increased head rotation, where injury risk prediction with the impactor becomes invalid (i.e., not biofidelic). It is also questionable whether the additional 32.5mm test area would result in any a measurable improvement related to Equivalent Life Saved (ELS), as suggested in the PRIA – particularly where impacts to the side of the vehicle are expected to result in “glancing” contacts whereby secondary contact with the roadway surface may be unavoidable. We therefore recommend that NHTSA align with the requirements of UNECE R127.

E. Design Implications and Regulatory Impact of Expanding the Test Area When It Is Less Than Two Thirds of the Numerical Value of the Hood Area

NHTSA is considering expanding the test area to encompass at least two thirds of the Hood Area on vehicles when the test area, as currently defined, is smaller than two thirds of the Hood Area. We strongly disagree with this proposal. As discussed in our comments to the agency in 2022, this will essentially require any current reinforced structures, including those designed to maintain the integrity of the hood during normal operation and crash conditions, or “hard” points associated with required safety components (e.g. headlamps) to be subject to HIC1000 requirements. This creates significant practicability requirements for where these structures and components can now be located, which further compounds the challenge in now meeting other regulatory requirements related to the hood. More specifically:

- **FMVSS 113: Hood Latch System Vehicle** -- Vehicle hoods must have a primary latch keep the hood in a closed position, as well as a secondary latch as a redundancy if the primary latch fails or is not fully engaged.
- **FMVSS 208: Occupant Crash Protection** -- Hood design is indirectly influenced because the vehicle structure must absorb and manage crash energy during a frontal collision to protect occupants.
- **FMVSS 214: Side Impact Protection** -- The design of the hood and front-end structure of a vehicle may play a role in the overall crashworthiness of the vehicle during certain side impacts.
- **FMVSS 219: Windshield Zone Intrusion** -- Components outside the occupant compartment must be designed to avoid excessive intrusion into the windshield zone to meet these safety requirements.
- **FMVSS 301: Fuel System Integrity** -- Hood design, along with the overall front-end structure, may influence how the vehicle manages crash energy to protect the fuel system in a frontal crash.
- **FMVSS No. 302: Flammability of Interior Materials** -- Some elements of the hood design, particularly in the context of fire risks, may be influenced by FMVSS No. 302 requirements.

We recommend that NHTSA align with how the GTR is being implemented through UNECE R127. This ensures HIC1000 and HIC17000 ratios are appropriately based on the established test area, not based on hood area.

NHTSA Considered Alternatives

The agency has also requested comments on an additional alternative that would require testing of the entire hood top.³⁴ Auto Innovators does not support this alternative. As the agency notes, the HIC unlimited area exists for practical reasons. In addition, the agency’s cost-benefit analysis for full-hood testing is incomplete, and we do not believe it reasonable to require testing the entire hood top to meet the regulation without comprehensive data.

³⁴ <https://www.federalregister.gov/d/2024-20653/p-344>

F. Comparative Study of UNECE R127 and FMVSS No. 228 NPRM

As discussed above, the cumulative differences between UNECE R127 and FMVSS No. 228 will have a significant regulatory impact on motor vehicle design in the U.S., and will simply impose increased and impractical requirements without measurable safety benefits. To highlight these differences, the following section provides a side-by-side comparison of the current regulatory requirements (based on UNECE R127) and the proposed regulatory requirements (FMVSS No. 228) as they apply to current fleet vehicle.

Figure A-15, below, provides a comparison of vehicle HIC scores based on the proposed FMVSS No. 228 requirements and UNECE R127. This demonstrates notable differences between how the requirements vary based on combined effects of the agency's proposed use of the 3D-POFC method, expanded test area (based on 50mm offset lines), and the use of the hood area calculation for defining HIC1000 and HIC1700 zones, rather than the test area.

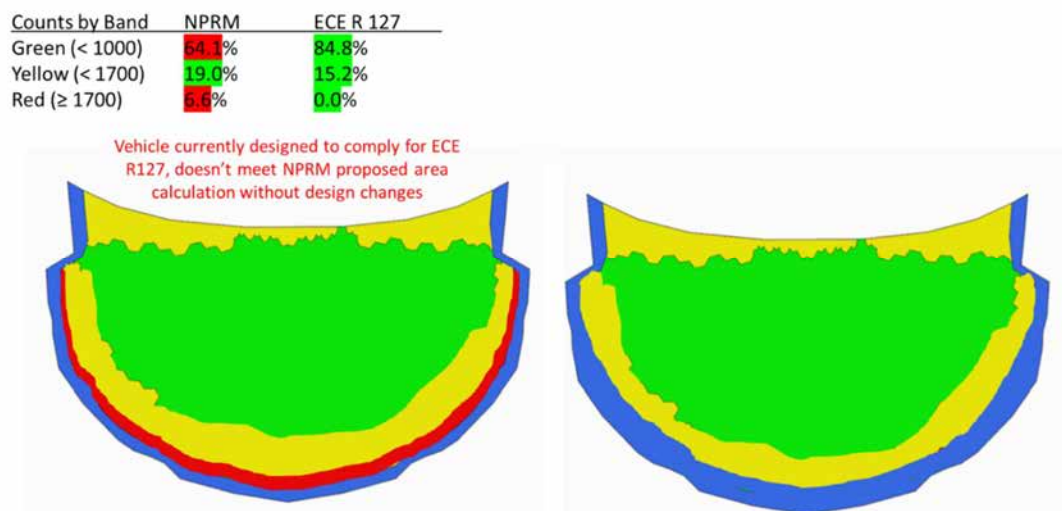


Figure A-15: Comparison of HIC scores based on proposed FMVSS No. 228 and UNECE R127 Requirements

This is further demonstrated in Figure A-16, which shows a comparison of the HIC1000 area ratio for FMVSS No. 228 and GTR No. 9 (as implemented), for a sedan, SUV and pickup truck. In all cases, the relative HIC1000 ratio was substantially lower based on FMVSS No. 228 as proposed in the NPRM.

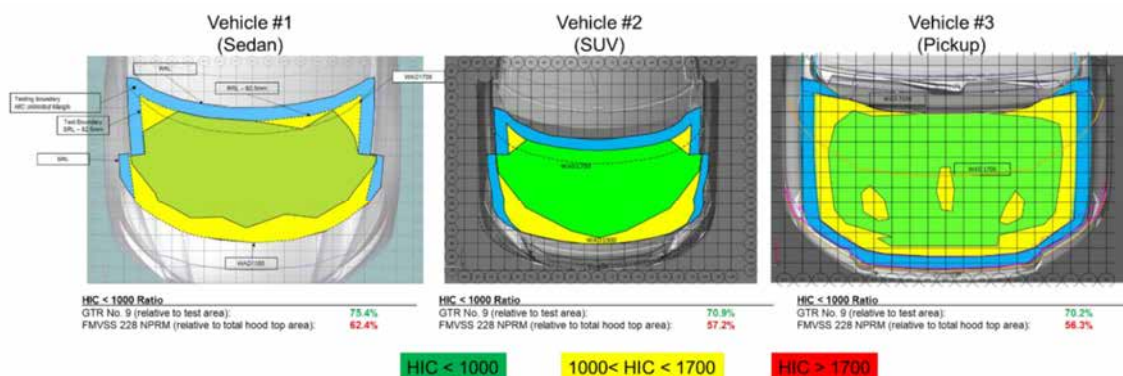


Figure A-16: Comparison of hood HIC1000 ratio for GTR No. 9 vs. FMVSS No. 228 (as proposed)

Figure A-17, below, provides a comparison of the markup procedure when applied to a current U.S. production vehicle. When comparing the application of both sets of requirements (R127 and FMVSS No. 228 NPRM) there are clear differences in where the reference lines and test areas are located relative to the overall hood and surrounding front-end structures.

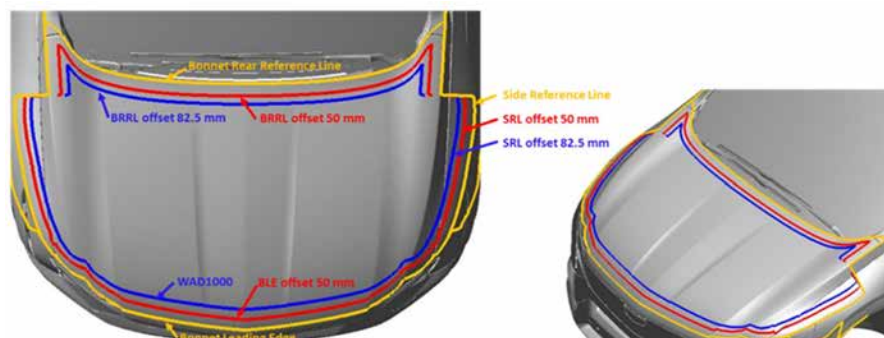


Figure A-17: Comparison of FMVSS No. 228 and UNECE R127 Markup Procedures

We disagree with the NPRM's assumption that the headform does not engage underlying vehicle structures in these areas. This has practical implications, as vehicles designed to meet the UNECE R127 requirements will not automatically meet the requirements of the proposed FMVSS No. 228. The 82.5mm offset is necessary to ensure practicability when designing a hood that addresses both pedestrian protection and overall vehicle crashworthiness. However, the agency's proposal to reduce the margin offset to either a 50mm offset or no offset margin creates conflicting regulatory requirements with other FMVSSs due to the placement and safety performance of other mandated hood structures and components, such as hood hinges and headlights. Additionally, in Figure A-18, the expanded test area again results in the same challenges identified with the HIC1000 ratio (See: Figure A-16).

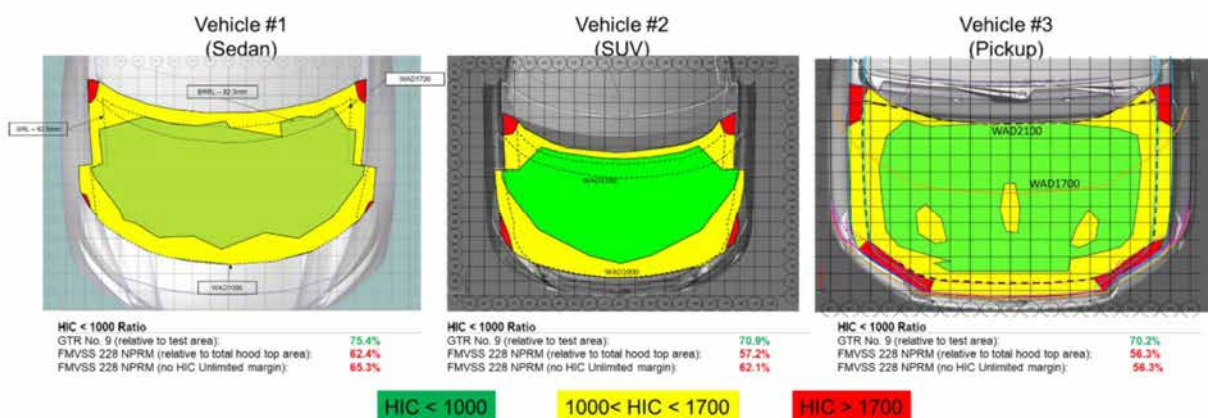
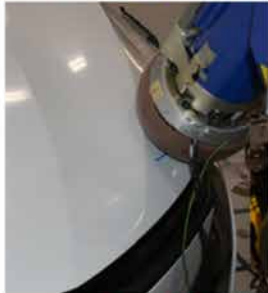
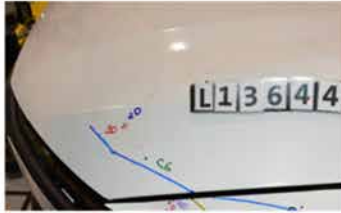


Figure A-18: Comparison of HIC1000 ratio both with and without a defined HIC unlimited margin

The agency has not adequately considered the practicability of expanding the requirements beyond GTR No. 9 to include testing at extreme edges of the vehicle (beyond the top of the hood). We request that NHTSA reconsider its proposal as it deviates from the long-established GTR which recognizes these constraints. As demonstrated further in Figure A-19, below, there are also notable differences in the HIC values recorded when using a side reference line (SRL) offset 50mm and bonnet leading edge (BLE) 50mm offset line (in the NPRM), as opposed to 82.5mm (in UNECE R127), using both 2D and 3D POFC aiming methods.

Intersection of Side Reference 82.5 mm offset and Bonnet Leading Edge 82.5 mm offset – 2D touch point method



HIC = 1060

Intersection of Side Reference 50 mm offset and Bonnet Leading Edge 50 mm offset – 2D touch point method



HIC = 1680

Intersection of Side Reference 50 mm offset and Bonnet Leading Edge 50 mm offset – 3D touch point method



HIC = 2310

Figure A-19: HIC scores based on differences between FMVSS No. 228 and UNECE R127 SRL and BLE offset lines

The interaction between the headform and these underlying hood components and structures that are located at the outermost edge of the test area is highlighted further in Figure A-20, below.

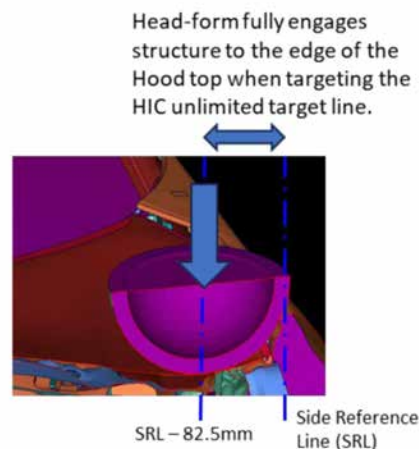


Figure A-20: Headform interaction with hood at edge of test area.

Similarly, as shown in Figure A-21, below, vehicles that meet UNECE R127 will not necessarily meet the proposed FMVSS No. 228 requirements based on differences in the proposed rear reference line (BRRL) 50mm offset and side reference line (SRL) offset 50mm.³⁵ Again, NHTSA has not considered the need for structural reinforcement in certain portions of the hood in order to maintain structural integrity under crash conditions, as well as during normal operation.

³⁵ As noted previously in these comments, there are significant practicability and repeatability concerns with the agency's proposal to expand testable areas beyond established GTR requirements.

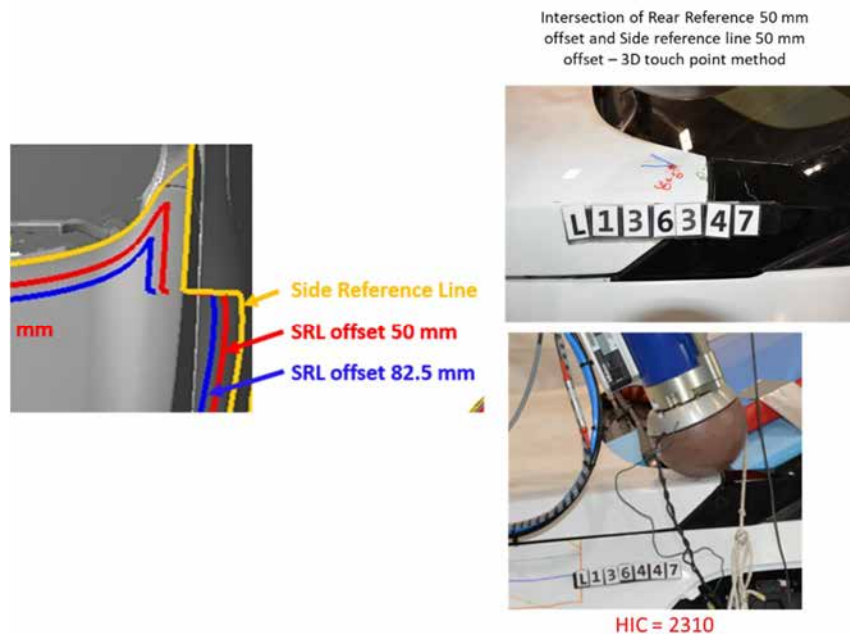


Figure A-21: Difference between UNECE R127 and proposed rear and side reference lines in FMVSS No. 228

As noted previously, the agency's decision to adopt 50mm offset lines is not supported by data and is inconsistent with how the GTR is being implemented based on the characteristics of the headform. Challenges with the 3D targeting method test setup and overall repeatability are discussed previously in this comment.

4. VIII. GTR 9 Terminology and Amendment 3 (Section VIII of NPRM)

A. Comparison of Terminology

NHTSA has proposed to define some terms in a slightly different way than the GTR with the stated objective of meeting the requirements of the Safety Act. These are summarized in Table VIII.3 of the NPRM.³⁶ While we recognize the agency's intent, we are concerned that the approach taken by the NHTSA in developing the table is indicative of the significant modifications that are leading toward misalignment with the GTR. For example, the NHTSA definition of "Hood Area" (S6.5.2) is not equivalent to the GTR combined "child and adult headform test areas" (S3.12 and S3.1) as it extends to side reference lines, and not the 82.5mm offset lines. In addition, the term "unlimited margin" is both introduced and used extensively throughout the proposal and may be inconsistent in terms of how the GTR No. 9 are interpreted and implemented. This is counter to the spirit of the GTR process and the direction of Congress in the Infrastructure Investment and Jobs Act.

We therefore recommend that NHTSA ensure that any definitions maintain alignment with the GTR to more clearly state the requirements in objective and equivalent internationally accepted terms. For example, the term "bonnet/hood leading edge reference lines" (BRERL) with an offset of 82.5mm is well understood and can be measured in a repeatable and reproducible manner. Additionally, references to HIC1000 and HIC1700 areas should be specified as "Test Areas" instead of "Test Areas".

³⁶ <https://www.federalregister.gov/d/2024-20653/p-388>

B. Amendment 3

Change from 3D Method to 2D Targeting Method.

We strongly disagree with the agency's proposal to introduce the 3D targeting method and are opposed to its inclusion in FMVSS No. 228. This is again inconsistent with how the GTR is being implemented in other parts of the world. Concerns about the agency's interpretation of the GTR were discussed extensively within the WP.29, whereby contracting parties presented data on the problems with the NHTSA approach – including issues related to repeatability, reproducibility, and the corresponding markup procedure (see Figure A-22 below).

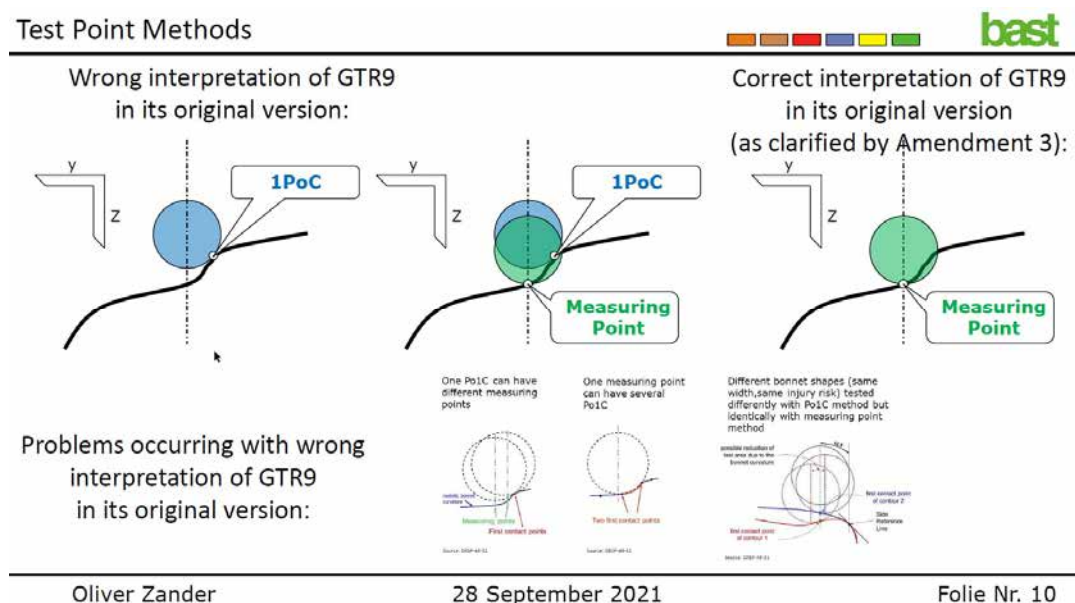


Figure A-22: Challenges with different interpretations of the GTR targeting protocols based on 3DPOFC method [Source: GTR No. 9 Task Force Meeting 28th September 2021]³⁷

The most significant issue with the 3D POFC method is that it introduces unnecessary test complexity, and repeatability and reproducibility cannot be guaranteed. This further adds to the impracticability of the proposal as manufacturers are essentially required to ensure even further compliance margins which may not be achievable given the compound issue with the markup procedure discussed above. This was discussed extensively in Auto Innovators comments in advance of the NPRM, and these concerns are still relevant in the context of this rulemaking proposal.

In addition, the presumption that a 2D aiming method will always create a smaller test area is not always true. For certain styling surfaces, using a 3D aiming method could create a smaller test area than the 2D method. For example, the curvature in a bonnet can lead to divergent touching points and some points may not be able to be reached. This is shown in Figure A-23, below, whereby the ventilation opening of the hood results in contact points that may not be reached based on the 3D POFC method, and would also result in multiple contacts by the head impactor.

³⁷ <https://wiki.unece.org/display/trans/1st+Meeting+-+28+September+2021>

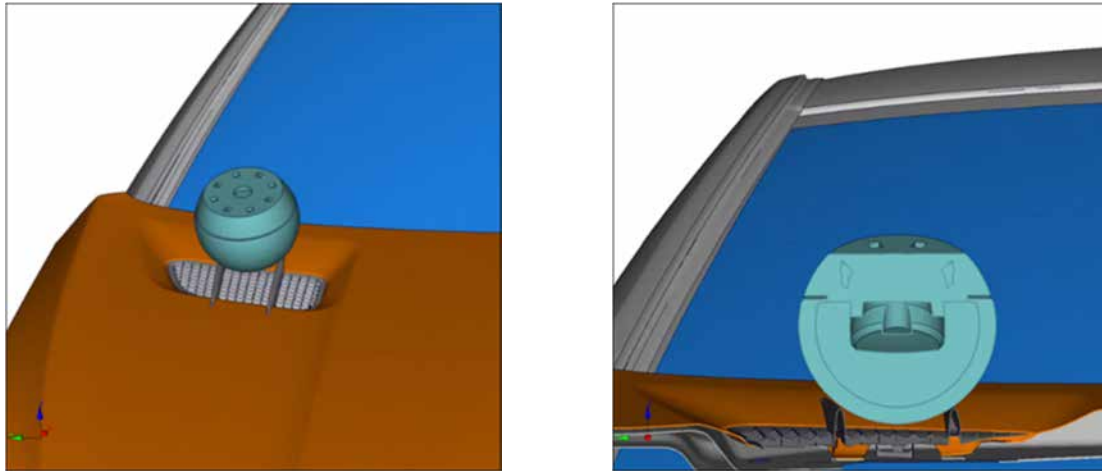


Figure A-23: Example of headform impact to ventilation opening.

The agency has not provided sufficient data to support the expanded test area. While the NPRM states that “As far back as our 1990 era standards development effort, [NHTSA] observed an incidence rate of about 20% along the sides” and that “NHTSA is not aware of research indicating that this rate has gotten or will get lower,” it is not appropriate to make an assumption that, in the absence of more recent data, past trends are still applicable – particularly as data on pedestrian crashes is limited in terms of its ability to discern the cause and contributing factors.

We support use of the 2D Method consistent with how the GTR is being implemented in UNECE R127.

Request for NHTSA to make available its draft test procedure

If the agency is to maintain its proposal to adopt both the alternative markup and 3D method, we request that the agency publish its draft test procedures for FMVSS No. 228 as soon as possible prior to issuing the final rule. Given the uncertainty surrounding the proposal and the impact that the agency’s approach will have on long-term international harmonization, there should at least be an opportunity for independent verification of these controversial changes as the agency proposed they be applied.

5. Headform Characteristics (*Section IX of NPRM*)

A. General

The agency requests comment on the approach taken with the proposed headform drawings outlining specification for the impactor mass, diameter, skin material and thickness, center of gravity, moment of inertia, accelerometer mounting, accelerometer damping, qualification limits and natural frequency. In general, we are supportive of NHTSA providing additional specificity, but note that the headform should be considered for inclusion in Part 572 prior to use in FMVSS.

B. Qualification Limits

The NPRM proposes a set of pre-test qualification limits to ensure the headforms are functioning properly. We have no objections to this proposal.

C. Repeatability and Reproducibility

Headform drop tests.

NHTSA has requested comments on “raising the drop height to a height that would produce HIC scores somewhere between 1000 and 1700” and “changing the qualification bounds of 245-300 g’s for the child headform and 225-275 g’s for the adult headform.” The purpose of qualification testing is to ensure the accuracy and repeatability of the head impactor. As a result, the acceleration, not the HIC, should be evaluated. Determining the drop height using the HIC value could result in the peak G value increasing even further, and there is a possibility that the value will be higher than the peak G value generated in the actual vehicle test.

Instrumentation.

The NPRM proposes a specification for damped accelerometers in the headforms. We support this proposal.

6. Additional Considerations

A. Active Hoods

NHTSA has proposed that for vehicles with active hoods, testing should be conducted with the hood in a “fully deployed” state.³⁸ However, this proposal is not well defined and inconsistent with the intent of an active hood systems, which are designed to provide increased space between potential hard points under the hood in order to reduce the HIC values during head impact.

Depending on the design of the active hood and the WAD, timing of the hood deployment is important for providing sufficient space between the head impact point and underlying structures beneath the hood surface. Figure A-24, below, shows a typical deployment curve of an active hood system during various stages of deployment.³⁹ During the initial deployment phase (marked “A”) the hood is above the non-deployed height, and can often extend beyond the final resting “deployed position” (marked “B”). If the term “fully deployed” is not well defined it creates regulatory uncertainty and it is not clear from the NPRM what NHTSA is proposing. For example, is NHTSA considering the maximum deployment height of the first peak in the deployment curve to be “fully deployed” (at the end of phase “A”) as this is different from the static “fully deployed” position (at the end of phase “B”).

In addition, depending on the definition of “fully deployed,” the agency may be establishing requirements that may be design restrictive and limit the ability to develop systems where the active hood or airbag system can respond dynamically to different impact conditions beyond the requirements of FMVSS No. 228 (including for different size occupants).

Furthermore, for systems with an active lock and hinge, it is important that the hood height at the lock point is high enough to reduce the HIC value for a head impact of a 6yo child pedestrian stature. In these instances, it may not be relevant if the hinge is already fully deployed or not.

³⁸ S5.6 Active hoods...(b) Vehicles with active hoods shall meet the requirements of this standard when the hood is fully deployed.

³⁹ Source: ECE/TRANS/180/Add.9/Amend.3 established in the Global Registry on 26 June 2024

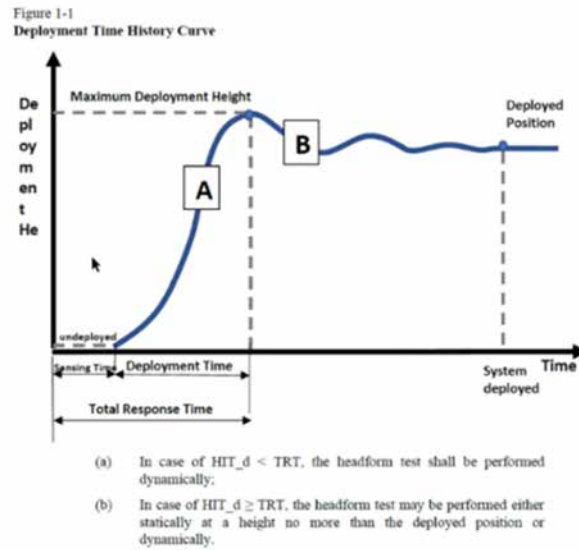


Figure A-24: Active Hood Deployment Time History Curve.³⁷

To address these concerns, we strongly recommend that NHTSA consider aligning the proposed FMVSS No. 228 requirements for active hoods, based on the recent amendment to GTR No. 9. Given the practicability concerns with the agency's proposal, it may be necessary for some vehicle models to install active hood systems to meet the requirements of the FMVSS. It is therefore essential the NHTSA issue a supplemental NPRM to provide a more detailed proposal on how it intends to provide a viable compliance option and alternative for these vehicles. Additionally, the PRIA should be updated to provide a more accurate assessment of the regulatory impact based on the likely number of affected vehicles.

APPENDIX B
**Auto Innovators comments submitted in
advance of the NPRM**

Docket NHTSA-2024-0057



July 7, 2022

Dr. Steven Cliff
Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, D.C. 20590

Dear Deputy Administrator Cliff,

The Alliance of Automotive Innovation (Auto Innovators) is writing to provide comments and policy recommendations to NHTSA in advance of the agency's anticipated pedestrian protection rulemaking proposal that is expected to be published in the coming months.¹ These comments focus on several key issues identified in August 2018 National Highway Traffic Safety Administration ("NHTSA") GTR report entitled "*Vehicle Hood Testing to Evaluate Pedestrian Head Form Reproducibility, GTR No. 9 Test Procedural Issues, And U.S. Fleet Performance*," and emphasize the importance of ensuring international harmonization.² Included is discussion on the impact of NHTSA's potential interpretation of unresolved issues within Global Technical Regulation (GTR) No. 9 that may result in inconsistent requirements between the United States and other parts of the world where similar requirements have already been adopted as part of regulatory or consumer information program evaluations.³ This will likely require U.S.-specific vehicle designs due to the lack of harmonization. Given the potential for regulatory misalignment, and the likelihood that proposed changes will have a significant impact on motor vehicle design, this rulemaking has been incorrectly classified as "nonsignificant," and should instead be considered a "major" rulemaking, which requires additional review by OMB. To address these concerns, we have provided several recommendations for the agency's consideration as it works to finalize its proposed rulemaking based on the Pedestrian Safety GTR.

Introduction

Auto Innovators shares the Department of Transportation's (DOT) safety priority and supports DOT's emphasis on the need for a safe systems approach for improving roadway safety. Our members are investing in the development of innovative technologies including Pedestrian Automatic Emergency Braking (PAEB) systems and advanced lighting features to help enhance roadway visibility in low light conditions. However, recognizing the lead time for new technologies to become widespread within the vehicle fleet, we underscore the importance of continued focus on driver and pedestrian education, the need for appropriate laws and enforcement, and investment in infrastructure improvements designed to enhance pedestrian safety. Safer roads, safer speeds, and safer people are all core components of the safe systems approach. As the automotive industry continues to make advances in vehicle safety, regulatory certainty, and clarity with respect to any potential NCAP requirements become increasingly important as these policies can have a significant impact on vehicle design.

¹ Auto Innovators is the singular, authoritative, and respected voice of the automotive industry, representing motor vehicle manufacturers responsible for nearly 99 percent of cars and light trucks sold in the U.S., original equipment suppliers, technology companies, and others within the automotive ecosystem.

² See docket NHTSA-2018-0026

³ GTR No. 9: ECE/TRAN/2005/124/9

Based on the *Spring 2022 Unified Agenda of Regulatory and Deregulatory Actions* that was recently published by the Office of Information and Regulatory Affairs (OIRA), we understand the agency is currently in the process of developing a Notice of Proposed Rulemaking (NPRM) based on the Pedestrian Safety Global Technical Regulation (GTR) – also referred to as GTR No. 9. Specifically, that NPRM would propose requirements to protect pedestrian heads impacting vehicle hoods.⁴

It remains critical that the agency work to ensure its regulations are closely harmonized with GTR No. 9, particularly with respect to how the requirements are being implemented by those that have adopted them through their respective regulatory and consumer information programs. This *implementation focused* approach is essential, particularly as stakeholders work to provide clarification on aspects of the GTR that are currently open to interpretation. Such an approach is consistent with the intent of the GTR process for ensuring “globally harmonized performance-related requirements and test procedures”.⁵

Just recently, the importance of international harmonization was reinforced in the Bipartisan Infrastructure Investment and Jobs Act (IIJA). If NHTSA is to take a divergent approach on this issue, it would likely require U.S-specific hood designs to meet future regulation and related NCAP test procedures. This would add unnecessary complexity and require additional research on development of new vehicle hood designs instead of those that already meet the pedestrian protection requirements of GTR No. 9 that have been adopted and implemented in other global markets and could be more readily integrated for vehicles sold in the United States. Such action would conflict with the IIJA which indicates a desire for increased harmonization.

NHTSA Interpretation of the GTR

In the aforementioned NHTSA GTR No. 9 report, it is stated that “[t]he first objective was to evaluate the GTR language defining the head impact point.” It is also noted that “The current language could be interpreted in more than one way, and a proposed amendment to the GTR supported by the European industry consortium OICA has been introduced to revise the GTR language to reflect one interpretation.” Auto Innovators supports this proposed amendment and urges the agency to further consider support for its adoption as part of the GTR process.

It is important to note that the NHTSA report (as quoted in the previous paragraph) incorrectly refers to OICA as a “European Industry Association.” In fact, the organization’s membership comprises 36 trade associations around the world, including all major automobile manufacturing countries and covers virtually the entire motor vehicle industry worldwide.⁶ This is a crucial distinction to make because the OICA recommendations represent an *international consensus* recommendation for improving the robustness of existing test procedures to evaluate pedestrian safety.

Unfortunately, the issue of potential multiple interpretations remains unresolved, despite strong international support for a clear path forward. Auto Innovators has significant concerns that this lack of resolution, coupled with a potentially unique NHTSA interpretation, could lead to an indefinite state of regulatory misalignment between regions.⁷ In other words, there may be no clear path forward for resolving this issue through a clarifying amendment.

⁴ *Spring Regulatory Agenda: Pedestrian Safety Global Technical Regulation* ([RIN: 2127 AK98](#))

⁵ <https://unece.org/wp29-introduction>

⁶ <https://www.oica.net/category/about-us/>.

⁷ [TWSG-03-05](#): *Final Minutes of the Technical Working Subgroup on Amendment 3 to GTR9* (December 03, 2021)

NHTSA has additionally noted a diverging interpretation for the “definition of area calculation.” Notably, the proposed amendment 3 to GTR No. 9 does not intend to revise the GTR requirements themselves for the definition of area calculation but rather intends to clarify the language to be consistent with the homologation procedures that have been in practice in Japan and the EU since 2004, and subsequently in UN R127 since 2012.

These issues, which are discussed in more detail below, include: (1) the process for defining the test areas (and corresponding HIC zones); (2) the method for defining the head impact point; and (3) Consideration for Impacts Outside the Defined HIC 1000/1700 Test Zones.

1. Defining the Test Area and Corresponding Test Zones (HIC 1000 and 1700 Areas)

It is important that test procedures are harmonized and aligned. Inconsistency can have a significant, adverse impact on vehicle design. When conducting head impactor tests consistent with GTR No. 9, it is important to first mark up the vehicle to identify valid test areas. We recognize that the current requirements *as written* in GTR No. 9 are potentially open to interpretation with respect to the methodology (or mark-up procedure) for defining the corresponding HIC 1000 and HIC 1700 zones. However, despite this, there is clear alignment *in practice* for how the regulation is being applied through the test procedures that have been implemented in regions that have adopted the GTR. An example of this would be the Republic of Korea where KMVSS 102-2 was crafted per GTR No. 9 but in practice aligns with GTR No. 9 with the adoption of Amendment 3. In an attempt to resolve possible differences between the regulatory text and the corresponding test procedure, a proposed *clarifying amendment* was introduced (referred to as Amendment 3) to update GTR No. 9.⁸ These issues are summarized and described in Figure 1 and 2 below.

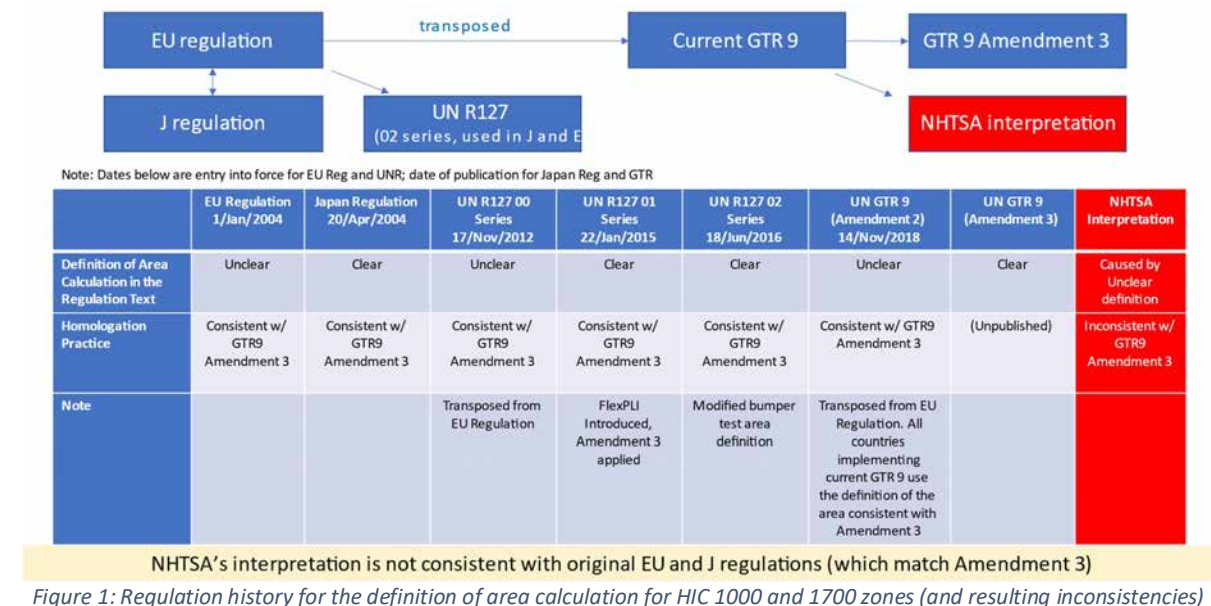


Figure 1: Regulation history for the definition of area calculation for HIC 1000 and 1700 zones (and resulting inconsistencies)

⁸ Amendment 3: ECE/TRANS/WP.29/2021/53

	Current GTR9 (NHTSA Interpretation)	Amendment 3
Side Reference Line(SRL)	 First contact point of 45deg line	 First contact point of 45deg line
Area in which Impact Points (Current GTR9) / Measuring Points (Amendment 3) are positioned	Side Boundary : SRL -82.5 Inconsistent	Side Boundary : SRL -82.5mm Consistent
Definition of Bonnet Top (current GTR9) / Bonnet Top Test Area (Amendment 3)	Side Boundary : SRL	Side Boundary : SRL -82.5mm
Definition of HIC 1000 and 1700 areas	HIC 1000 : 2/3 of Bonnet Top HIC 1700 : 1/3 of Bonnet Top	HIC 1000 : 2/3 of Bonnet Top Test Area HIC 1700 : 1/3 of Bonnet Top Test Area

Figure 2: Comparison of HIC 1000 and HIC 1700 zones between GTR No. 9 (expected NHTSA Interpretation) and Amendment 3.

Auto Innovators recommends that the “mark-up” approach discussed in the agency’s 2018 report should not be pursued.⁹ If the mark-up procedure approach adopted in NHTSA regulation is inconsistent with the current GTR No. 9 test procedure, in practice this could potentially result in undefined HIC 1000 and HIC 1700 zones, or circumstances where the ratio of HIC 1000 zones exceed 2/3 of the testable area. This is illustrated in Figure 3, below, using a simplified 2D representation of the width of a vehicle hood. Miswording in the current GTR No. 9 leads to interpretation of the area requirement that is different from the original concept of GTR No. 9 to prescribe 2/3 and 1/3 area ratios for HIC 1000 and HIC 1700 zones, respectively. Similar issues would also likely arise if the agency were to adopt a hybrid approach that blends requirements from the GTR No. 9 and UN Regulation 127 test procedure.

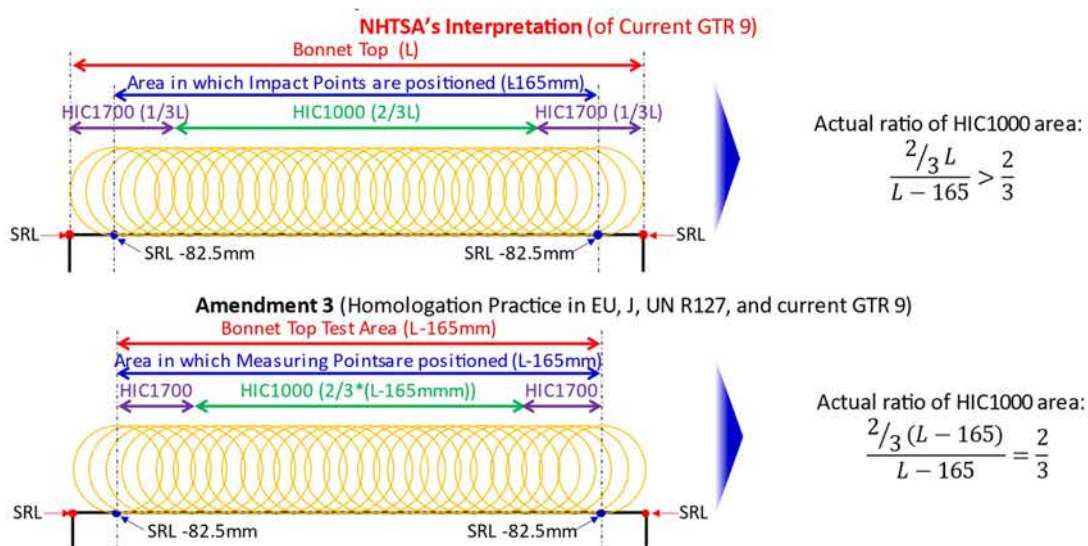


Figure 3: Comparison of the HIC 1000 area ratios when applying markup procedures from Amendment 3 and the expected NHTSA interpretation of current GTR No. 9

⁹ Vehicle Hood Testing to Evaluate Pedestrian Head Form Reproducibility, GTR No. 9 Test Procedural Issues, And U.S. Fleet Performance (Page 50-51)

Figure 4, below, further demonstrates that for vehicles with smaller, narrower front ends, the actual ratio of the HIC 1000 area can become substantially larger than the fundamental 2/3 requirement in GTR 9. This inappropriately drives more stringent requirements for smaller vehicles and would have the counterintuitive effect of encouraging larger vehicles because of the comparatively lower ratio of HIC 1000 to 1700 zones in relation to the overall size of the vehicle front end. Above all, this creates significant concerns for objectivity and departs from the fundamental concept of defining 1/3 and 2/3 ratio zones for HIC 1700 and 1000 areas.

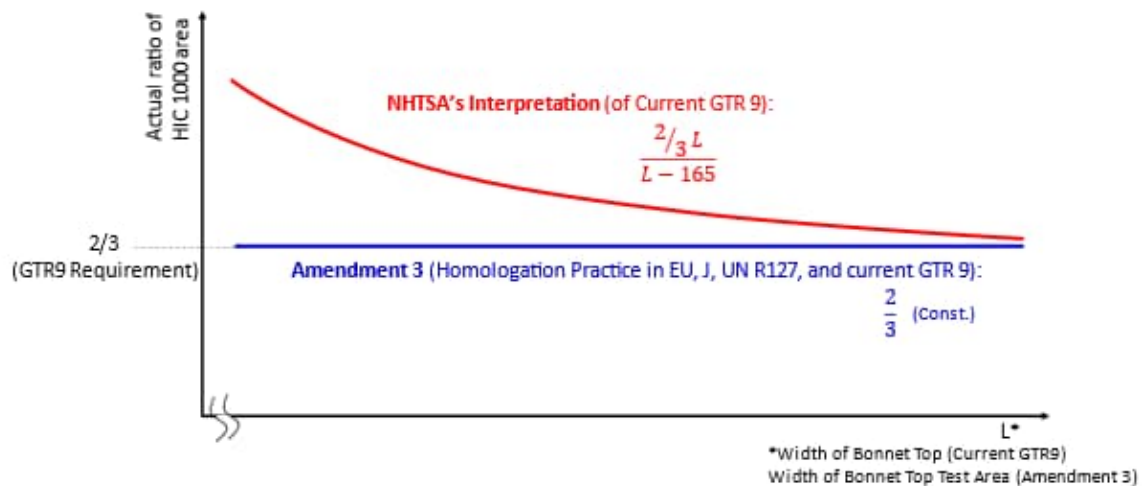


Figure 4: Sensitivity of the actual ratio of the HIC 1000 area to the width of a vehicle, when comparing markup procedures from Amendment 3 and the expected NHTSA interpretation of current GTR No. 9

To ensure greater harmonization, NHTSA should align with how GTR No. 9 is being implemented in other markets in terms of mark-up procedure. We encourage the agency to base its proposal on the GTR 9 with consideration for proposed clarifying Amendment 3, and to work with its international partners to ensure favorable resolution within the UNECE process.

2. Defining the Head Impact Point – Concerns with the NHTSA Targeting Protocol

Auto Innovators has concerns related to the NHTSA targeting protocol and methodology for aligning the head impactor used to evaluate pedestrian injury risk. As noted in the agency's GTR No. 9 report:

With the current GTR language, three different impact point definitions have been put to use by different laboratories: (1) the 3D point of first contact (POFC) (current NHTSA protocol); (2) the aiming point (EuroNCAP protocol); and (3) the point of first contact on the vertical-longitudinal plane containing the center of the headform impactor, which is known as "2D measuring point" (OICA protocol)... clear definition would provide lab- to-lab consistency, ensure that the test zones are not decreased to limit the GTR's benefit, and would provide clear wording for test procedures.¹⁰

The NHTSA report states, "Different interpretations of the head impact point could affect HIC outcome in a test, depending on the geometry/contour and under hood structures in the vehicle."¹¹ This statement is particularly relevant with respect to the proposed use and application of the 3D POFC method, where the interpretation by the agency introduces unnecessary complexity as well as several other issues as described below.

¹⁰ See docket NHTSA-2018-0026

¹¹ See docket NHTSA-2018-0026

Figure 5 illustrates the difference between the definition of “Impact Point” (based on the 3D POFC) and the “Measuring Point” (using the 2D method) ^{12,13}

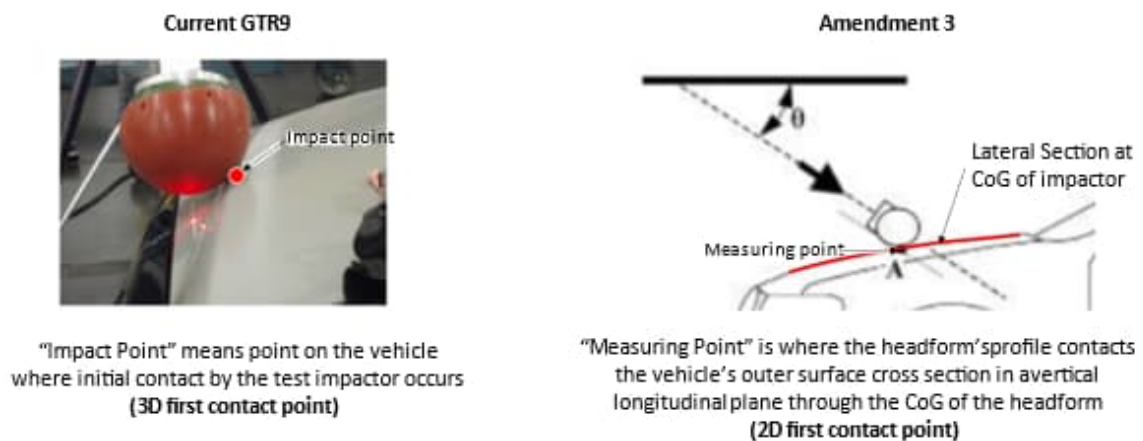


Figure 5: Definition of Impact Point (Current GTR9)¹⁴ and Measuring Point (Amendment 3)¹⁵

In addition to challenges outlined in the previous section, the 3D POFC method also introduces repeatability and reproducibility concerns whereby a “Point of First Contact” could be associated with multiple impactor positions as outlined in Figure 6, below. In some cases, depending upon the structural profile of the hood, areas where multiple POFCs may exist results in zones that cannot be reliably assigned to a single point. Areas where a test cannot be assigned to one single point may need to be considered as “unassignable,” particularly where they overlap HIC 1000 and HIC 1700 zones.

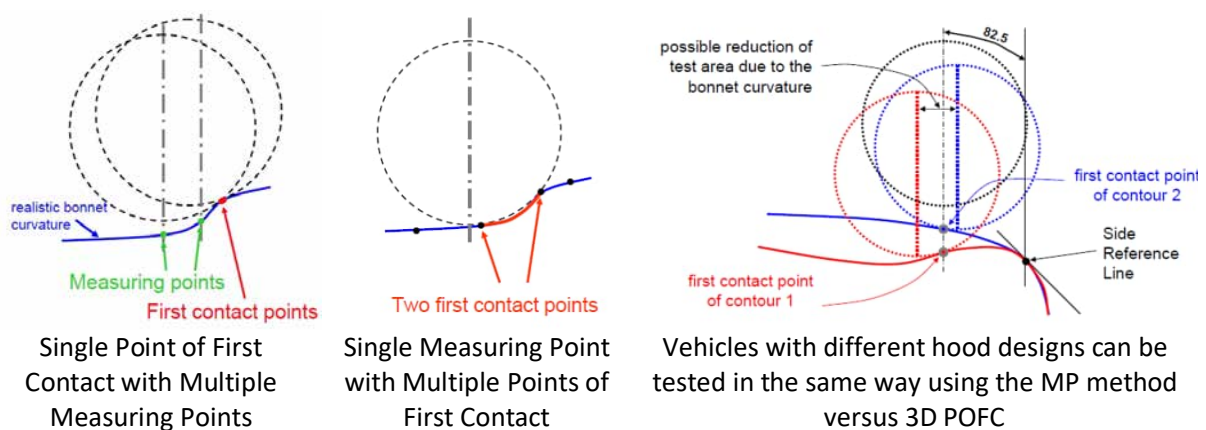


Figure 6: Challenges with 3D POFC Method [Source TFPP3-1-03]

¹² TFPP3-1-06: First session of the GRSP Task Force on Pedestrian Protection GTR Amendment 3” held in 14th and 15th June 2021 (June 14-15, 2021)

¹³ UN-R127 01 series (R127r1e)

¹⁴ Source: “First session of the GRSP Task Force on Pedestrian Protection GTR Amendment 3” held in 14th and 15th June 2021 (please see page 8 of TFPP3-1-06).

¹⁵ Source: UN-R127 01 series (Figure 8B in page 11 of R127r1e)

The aforementioned issues with the 3D POFC do not exist for the 2D method. We therefore strongly urge the agency to adopt the 2D approach as it is significantly more straightforward, limits unnecessary test burden, ensures repeatability and reproducibility, better guarantees that impacts occur within defined testable areas, and is more closely aligned with the intent of GTR No. 9.

3. Consideration for Impacts Outside the Defined "Child and Adult Test Areas"

Diagram illustrating the difference between PoIC and SRL impact tests:

- PoIC (Point of Impact):** The impactor is positioned directly on the longitudinal centreplane (velocity vector).
- SRL (Side Rear Lateral):** The impactor is positioned off the longitudinal centreplane, often in the lateral offset zone or even outside the bonnet top area.
- Test result compared with the wrong area:** The SRL test result is compared with the wrong area (the lateral offset zone or outside the bonnet top area).
- Longitudinal centreplane (velocity vector):** The central line of the impactor's path.
- Great portions of the impactor allowed to be outside the bonnet top area:** This is a characteristic of the SRL test.
- Velocity vector often in offset zone or even outside bonnet top area:** This is a characteristic of the SRL test.
- Lateral offset zone:** The area to the side of the longitudinal centreplane.

¹⁶ Minutes of 2nd Meeting of Technical Working Subgroup on Amendment 3 to GTR9, December 13, 2021.

As noted in the agency's report, the first objective was to "investigate how the front, side, and rear borders of the GTR "launch area" would change if various targeting protocols are used." The report further states that the agency has

*[I]nterpreted the language of the original GTR to mean that as long as any point of the headform touches inside the 82.5 mm bounded test zone as specified in the GTR, it would be considered a valid test point as long as the target point (headform centerline projection) is within the initially drawn front/side/rear boundaries of the test zone.*¹⁷

This interpretation inappropriately expands the testable area beyond the intended scope of GTR No. 9. Based on our assessment, the 3D POFC method further calls into question what is considered a valid test/impact based on defined test zones.

While the agency's rationale is that "this method engages more structural members along the extreme periphery of the prescribed zone and therefore could provide more benefit to pedestrians in harder vehicle areas," it is not reasonable or practicable to adopt such a requirement given that these structures are necessary to support the position of the hood system during normal operation, provide access during maintenance and repair, or maintain reasonable integrity during vehicle crash testing. As such, any cost-benefit analysis should include a comprehensive assessment of the impact of regulation on existing vehicle designs, compared to if the agency were to simply adopt the requirements of GTR No. 9 as implemented in other regions.

Rulemaking Significance

Based on the aforementioned concerns, and the potential for NHTSA to propose rulemaking that is inconsistent with the spirit, intent, and implementation of GTR No. 9, Auto Innovators is concerned that this could result in a situation where regulation may require U.S.-specific hood and front-end designs. Given that the hood is an integral component of the vehicle, this could have downstream impacts on the design of other systems that may be closely integrated with the hood (e.g., fender, bumper system), adding substantial burden to manufacturers, notwithstanding any fuel economy related impacts that need to be considered based on redesign of the vehicle body shape.

Any cost-benefit analysis by the agency should include an assessment of the impact of rulemaking on vehicle hood design in the United States and factor in any U.S.-specific requirements that may alter the cost-benefit analysis. Should the agency proceed in a direction inconsistent with our technical recommendations, we request that the agency provide a comparison of the cost-benefit if it was to simply align with the GTR No. 9 as accepted and implemented in other parts of the world.

Given the potential for regulatory misalignment, and the likelihood that proposed changes will have a significant impact on motor vehicle design, this rulemaking has been incorrectly classified as "nonsignificant." It should instead be considered a "major" rulemaking, which requires additional review by OMB.

Conclusion

We remain supportive of efforts to address pedestrian safety; however, we have significant concerns should the agency seek to implement performance requirements inconsistent with GTR No. 9. While we recognize that the exact language used in the GTR is open to interpretation by the agency, the application and implementation of the standard globally, is not. Adopting an approach that is

¹⁷ See docket NHTSA-2018-0026

inconsistent or based on a unique interpretation of the GTR No. 9 requirements creates the potential for long-term international regulatory misalignment, which is counter to the intent of the GTR process, and the spirit of the directive issued by Congress in the recently passed Bipartisan Infrastructure Law.¹⁸ We therefore strongly urge the agency to harmonize any proposed pedestrian protection standard with those already being implemented in other regions.

Please let me know if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Scott Schmidt', with a stylized, flowing script.

Scott Schmidt
Vice President, Safety Policy
Alliance for Automotive Innovation

¹⁸ Sec. 24211 -- Infrastructure Investment and Jobs Act

APPENDIX C

Auto Innovators comments in response to the NHTSA NCAP Request for Comment

Docket NHTSA-2024-0057



July 25, 2023

Ms. Ann Carlson
Acting Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue, S.E.
Washington, D.C. 20590

RE: New Car Assessment Program [Docket No. NHTSA-2023-0020]

Dear Ms. Carlson,

The Alliance for Automotive Innovation (Auto Innovators) appreciates the opportunity to provide comments in response to May 26, 2023, *Federal Register* Notice and Request for Comment on the agency's planned efforts to upgrade the New Car Assessment Program (NCAP) to provide information about the crashworthiness pedestrian protection (PedPro) of new vehicles.^{1,2}

Auto Innovators members have made significant investments in advancing the safety performance of vehicles. This includes the development of advanced restraint systems and vehicle structural improvements to further enhance occupant protection in the event of a crash, as well as innovative crash avoidance technologies that can help prevent or reduce the impact severity in certain precrash scenarios. However, these innovations are not solely limited to protecting vehicle occupants or avoiding possible vehicle to vehicle collisions, and manufacturers are increasingly exploring new ways to both prevent or reduce the severity of pedestrian impacts – particularly given the increasing trend in fatalities and injuries occurring on US roadways.

Auto Innovators has long been supportive of NHTSA efforts to modernize NCAP as highlighted in our 21st Century Roadmap Recommendations.³ Our support was highlighted in the comments we recently submitted in response to the agency's request for comments on proposed updates to include crash avoidance technologies as part of NCAP evaluations.⁴ The agency must continue to prioritize these efforts to ensure that consumers have access to relevant resources and information on available safety features and related levels of performance when purchasing a new vehicle. Reinforcing consumer understanding of new technologies and highlighting the potential benefits of systems designed to improve both crash avoidance and crash protection (inside and outside of the vehicle) is critical.

We also support DOT's National Roadway Safety Strategy (NRSS). NRSS serves to help ensure that advancements in vehicle safety countermeasures are complemented by policies that support a more comprehensive safe system approach. Safer roads, safer speeds, and safer people are critical for reducing the overall number of crashes, injuries, and fatalities on our roads.

¹ From the manufacturers producing most vehicles sold in the U.S. to autonomous vehicle innovators to equipment suppliers, battery producers and semiconductor makers – Alliance for Automotive Innovation represents the full auto industry, a sector supporting 10 million American jobs and five percent of the economy. Active in Washington, D.C. and all 50 states, the association is committed to a cleaner, safer, and smarter personal transportation future. www.autosinnovate.org.

² 88 FR 34366

³ 21ST CENTURY NCAP: Plan to Advance Safety at the Speed of Innovation
<https://www.autosinnovate.org/about/advocacy/NCAP%20Recommendations.pdf>

⁴ Docket: NHTSA-2021-0002-3788

1.1 NCAP Roadmap and the Integration of Pedestrian Crashworthiness Evaluations

It is first necessary to reiterate the importance of the agency publishing a detailed NCAP roadmap. The roadmap should clearly outline any planned research, key decision points, and anticipated implementation schedule for updating key aspects of the program, including the timeline for proposals put forward in this notice. It is unclear when the agency is proposing to implement changes to the program to include a pedestrian crashworthiness rating; thus, we cannot fully comment on the extent to which certain issues can be reasonably resolved. Despite these unknowns, any delay in incorporating a pedestrian protection rating in NCAP should not delay parallel efforts to update the crash avoidance evaluation aspect of the program. The comments that follow also assume the publication of a detailed roadmap is forthcoming and include several related recommendations for providing additional policy certainty. As exemplified by Euro NCAP, a detailed roadmap is a critical tool for informing not only the direction of the program, but also the underlying research and development of technologies that may be considered for inclusion as part of any future updates to the ratings program. A detailed roadmap will also support long term planning for effectively administering the program and ensuring vehicles are both evaluated and rated in a timely manner, despite the anticipated increase in the number of tests being conducted. This approach is essential for achieving the program's goal of enhancing consumer awareness. In addition, NHTSA should also outline its approach for addressing outstanding regulatory concerns that have a direct impact on the pedestrian crashworthiness rating, including the conflict between the proposed ratings criteria for lower extremity injuries and the bumper damageability requirements in Part 581. We are also strongly opposed to NHTSA using test devices that have not been adopted in Part 572.

2 Pedestrian Protection Ratings

The success of any NCAP can be measured against several different metrics. One, perhaps the most fundamental, is the ability NCAP to drive the introduction of effective vehicle countermeasures that can achieve meaningful safety benefits. A key element in advancement of these technologies, which are above and beyond baseline regulatory requirements, is how the ratings scheme and underlying points allocation prioritizes areas where the most opportunity for safety improvements exists. The following section outlines Auto Innovators' perspectives on the agency's proposed ratings criteria and includes a series of counterproposals that we recommend NHTSA consider when implementing updates to the program.

2.1 Pedestrian Crashworthiness Credit Proposal

Auto Innovators supports NHTSA's proposal to award a pedestrian crashworthiness credit as a near-term alternative to rating vehicles on a scale of 1 to 5 stars. This will help address any potential delay between the agency's final decision on including PedPro in NCAP and ensure consumers can have access to relevant safety information while the implementation of other related program updates is ongoing. However, as noted in the sections below, we have several concerns about how eligibility for this credit is determined based on the agency's proposed scoring system.

2.2 NHTSA Should Reconsider its Apportionment of Pedestrian Impact Test Scores

For the apportionment of pedestrian impact test scores, the agency has proposed an approach similar to Euro NCAP, which assigns a pedestrian protection rating based on the combined performance of the vehicle following a series of component tests to evaluate the potential for head, upper leg, and lower leg injury. In both the Euro NCAP and proposed NCAP rating system outlined in this notice, the maximum score attainable for a given vehicle is 36.00 points, with a set number of points apportioned to each body region.

2.2.1 The proposed points apportionment does not adequately consider the contribution of head impacts to pedestrian injury and fatality outcomes.

While we are generally supportive of the agency's consideration of a points based approach for determining a vehicle's PedPro score, we have concerns with NHTSA's proposed approach for apportioning the maximum number of points that can be attained for each body region. As noted in the RFC, and summarized in Table 24 of the notice, the agency derived its proposed scoring based on the analysis of real-world data and the potential for sustaining a MAIS 3+ injury following a pedestrian impact. Although we do not dispute the number of cases and injuries identified by the agency as part of this analysis, we do not agree with the agency's decision to base the final points determination based on injury rates alone – particularly given the differences in injury severities and fatality risk associated with head versus upper- and lower-leg injuries at the MAIS 3+ level.

In other words, we are concerned that the points apportionment for head impacts is not sufficiently high enough to capture the real world injury risk for head impacts. The proposal for structuring the points apportionment has placed lower extremity injury outcomes over improvements in head injury protection. The former is of course important, but it is unlikely to achieve the same levels of fatality and serious injury reductions in the field when compared to the latter. This lopsided prioritization also sends mixed signals to consumers about the relative safety performance of their vehicle. That is because the points for head injury protection do not accurately reflect real world injury risk potential. Conversely, a vehicle that achieves a high score for lower extremity may not accurately reflect the ability of that vehicle to reduce the most serious injuries observed in the field, which are typically those occurring to the head. As a result, the proposed approach does not best address or prioritize the safety need stemming from the increase in pedestrian injuries and fatalities.

2.2.2 NHTSA should apply a weighting factor to account for differences in injury severities.

Given the aforementioned concerns with the proposed points apportionment, we urge the agency to consider the application of a weighting factor to ensure that both head and lower extremity injuries are more appropriately weighted based on real-world injury and fatality risks.

In April 2021, DOT published updated guidance on the Value of a Statistical Life (VSL), which assigned an average value based on the “disutility” of all injuries sustained by persons with a given MAIS (despite the potential contribution of other injuries to an injured person).⁵ This VSL-based approach provides additional context on the underlying economic costs and quality of life valuations associated with occupant and pedestrian injury.

Table 1: Relative Disutility Factors by Injury Severity Level (MAIS) (adapted from Table 2 of the DOT Guidance on the Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses (March 2021)).

MAIS Injury Severity	Injury Severity (Description)	Fraction of VSL
MAIS 1	Minor	0.003
MAIS 2	Moderate	0.047
MAIS 3	Serious	0.105
MAIS 4	Severe	0.266
MAIS 5	Critical	0.593
Fatal/MAIS 6	Unsurvivable	1.000

⁵ DOT Guidance on the Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses (March, 2021).

While there are several potential approaches that could be leveraged, Auto Innovators recommends that the agency update the findings of its report on the *Relative Frequency of US Pedestrian Injuries Associated with Risk Measured in Component Level Tests* to include a societal cost (i.e., VSL) estimation.⁶ An example of this is provided in Table 2, 3, and 4, below, which shows the estimated VSL associated with head, upper leg, and lower leg MAIS injuries, respectively.⁷

Table 2: VSL factor when applied to head injuries reported in NHTSA study on the Relative Frequency of US Pedestrian Injuries Associated with Risk Measured in Component Level Tests

	Number of Injury Cases	VSL	
		VSL Fraction Factor	VSL Factor * Injury Cases
MAIS 2	7,768	0.047	365.1
MAIS 3	3,517	0.105	369.3
MAIS 4	4,533	0.266	1205.8
Fatal	1,269	1.000	1269.0

Table 3: VSL factor when applied to upper leg injuries reported in NHTSA study on the Relative Frequency of US Pedestrian Injuries Associated with Risk Measured in Component Level Tests

	Number of Injury Cases	VSL	
		VSL Fraction Factor	VSL Factor * Injury Cases
MAIS 2	2,068	0.047	97.2
MAIS 3	5,759	0.105	604.7
MAIS 4	114	0.266	30.3
Fatal	185	1.000	185.0

Table 4: VSL factor when applied to lower leg injuries reported in NHTSA study on the Relative Frequency of US Pedestrian Injuries Associated with Risk Measured in Component Level Tests

	Number of Injury Cases	VSL	
		VSL Fraction Factor	VSL Factor * Injury Cases
MAIS 2	11,522	0.047	541.5
MAIS 3	9,458	0.105	993.1
MAIS 4	0	0.266	0.0
Fatal	65	1.000	65.0

When considering the overall societal costs associated with a MAIS 3+ head, upper leg, or lower leg injury can be calculated by multiplying the total number MAIS injuries to each body region by the VSL Fraction Factor, it is possible to determine a weighing based on the societal cost of injuries to each body region. This is shown in more detail in Table 5 where the societal cost of injury for each body region is expressed relative to the overall societal cost of injuries. In this case, approximately 60% of societal costs were associated with MAIS 3+ head injuries, with MAIS 3+ upper leg injuries contributing 17%, and lower leg injuries representing around 22%. Based on this data, the points apportionments for assessing body region injuries should be 22pts for head, 6pts for upper leg, and 8pts for lower leg.

⁶ Relative Frequency of U.S. Pedestrian Injuries Associated With Risk Measured in Component-Level Pedestrian Tests (DOT HS 812 658)

⁷ Note: the number of injury cases for each body region is determined based on the number of MAIS coded injuries in Tables 4, 5, and 6 of the report on *Relative Frequency of U.S. Pedestrian Injuries Associated With Risk Measured in Component-Level Pedestrian Tests* (DOT HS 812 658)

Table 5: Comparison of VSL by body region for defining points apportionment for head, upper leg and lower leg injuries.

	Head	Upper Leg	Lower Leg	Total
VSL Societal Cost (MAIS3+ Injury)	2844.1*VSL	820.0*VSL	1058.1*VSL	4722.2*VSL
VSL Based Scoring Allocation (Percentage)	61.11%	16.66%	22.22%	100%
Scoring Apportionment (Points/36)	22Pts	6pts	8pts	36pts

In our view, the application of this weighting factor, which is based on prior DOT/NHTSA analysis, more closely represents the real-world injury and fatality risk associated with head versus lower-extremity injuries.⁸ In addition, taking the cost estimates at face value, as shown in Table 6, below, this recommended update to the agency's proposed points apportionment is also more closely aligned with updated Euro NCAP scoring (issued in June 2023). This supports ongoing harmonization and increased affordability for consumers by providing manufacturers with the ability to leverage greater economies of scale when developing design countermeasures that can be introduced across multiple regions.

Table 6: Comparison of body region points apportionment.

Body Region	Points Apportionment			
	NCAP RFC	Euro NCAP (2018)	Euro NCAP (2023) ⁹	Modified RFC VSL Based Approach
Head	13.5pts (37.5%)	24pts (66.67%)	18pts (50%)	22pts (61.11%)
Pelvis	-	-	4.5pts (12.5%)	-
Upper Leg	9.00pts (25.0%)	6pts (16.67%)	4.5pts (12.5%)	6pts (16.66%)
Lower Leg	13.5pts (37.5%)	6pts (16.67%)	9pts (25%)	8pts (22.22%)

2.2.1 The proposed points apportionment increases misalignment with Euro NCAP and prioritizes countermeasures that may not yield the highest safety benefits.

The proposed points apportionment also undermines efforts to ensure greater harmonization by essentially requiring different vehicle design countermeasures in order to achieve high ratings in different markets. By apportioning an overestimated proportion of points for lower extremity injuries, the agency is also potentially creating a situation whereby the actual PedPro safety performance provided by a given vehicle is not accurately represented by the ratings. For example, if a vehicle were to receive a high rating in the Euro NCAP (*which more appropriately apportions head impact performance based on both injury and fatality risk*), that same vehicle may receive a lower rating in U.S. NCAP with any residual levels of performance unaccounted for based on the agency's proposal. We therefore urge the agency to adopt our proposal to reweight the proposed points apportionment to align more closely with Euro NCAP and ensure that the U.S. program continues to incentivize vehicle design that can yield the most sizeable potential safety benefits. Put another way, Auto Innovators recommends that the agency consider the application of a weighting factor to ensure that head impacts are more appropriately accounted for within the ratings.

⁸ The analysis presented in not intended to be an endorsement of the agency's economic impact analysis report or its underlying assumptions.

⁹ Note: The Euro NCAP ASSESSMENT PROTOCOL – VULNERABLE ROAD USER PRTECTION (June 2023) includes the updated points values being used for evaluating pedestrian crashworthiness in Euro NCAP.

<https://cdn.euroncap.com/media/77300/euro-ncap-assessment-protocol-vru-v113.pdf>

2.3 Ratings for vehicles with optional equipment

NHTSA requested information on specific options or features that may affect a vehicle's performance in providing pedestrian protection, and also seeks comment on whether the agency should assign credit to vehicles based on the worst-performing configuration for a specific vehicle model, or if vehicle models with optional equipment should be noted as such.

While we do not have comments on specific options or features that may be present or absent on a vehicle, it is unclear how a determination of *worst/best performing configuration* could be consistently and reliably decided without testing each trim level. We therefore recommend that any ratings information for a particular model clearly state the applicable trim lines to which the score applies. Manufacturers should also have the ability to identify which trim lines are identical and those that may differ based on the presence or absence of optional equipment.

3 Proposed Test Procedures and Related Test Devices

3.1 Support for Harmonizing Test Procedures with Euro NCAP

Auto Innovators supports NHTSA efforts to harmonize with Euro NCAP, as this will help ensure greater policy alignment and support the design of vehicle countermeasures that can be introduced across different markets. Increased harmonization enables consolidated research and development efforts, which can help speed the introduction of new safety technologies, particularly where these systems or design features are already being deployed in other parts of the world. However, it is important to note several aspects of the agency's proposal are based on the 2018 version of the NCAP protocols for evaluating pedestrian safety, which have since been updated for 2023.

There are several aspects of the current proposal that may need to be reconsidered, particularly if ongoing harmonization is to be maintained. In addition, policy certainty regarding test devices used to assess real-world injury risk is critical for ensuring the integrity of the program, by ensuring that any necessary evaluations are performed using consistent, well-defined testing tools that are not subject to changes without appropriate notice and comment. Finally, there are various regulatory requirements that are misaligned with other international regulations and may conflict with the overall goal of NCAP and the NRSS for improving pedestrian protection. Each of these issues is discussed in more detail below.

3.2 Proposed test devices for evaluating lower extremity injuries.

Several aspects of the proposal are based on the 2018 version of the Euro NCAP protocols, including the proposed test devices used for evaluating pedestrian injury. This raises a number of important technical and policy related questions that must be resolved to support ongoing harmonization and ensure that the program remains relevant and up to date. One such area is the agency's proposal to use the FlexPLI for evaluating lower leg injuries when other NCAPs have transitioned to the use of the advanced Pedestrian Legform Impactor (aPLI).

3.2.1 NHTSA should evaluate lower extremity injury using the aPLI instead of the FlexPLI.

Despite the FlexPLI device being fundamental to the agency's current proposal for evaluating pedestrian protection, there are several limitations with the FlexPLI approach that need to be addressed. These are outlined in more detail, below. We urge the agency to act quickly to resolve these concerns in parallel to avoid further delay in administering updates to the program. NHTSA must take immediate actions to initiate parallel research efforts and define key policy milestones for the aPLI.

- ***NHTSA should initiate parallel efforts to adopt the aPLI legform to evaluate lower extremity injury risk.*** Auto Innovators recognizes the agency’s prior research in the development of this RFC has been based on the evaluation of the FlexPLI. However, these efforts have been overtaken by concurrent efforts to develop a more robust test device for evaluating lower extremity risk. Auto Innovators urges the agency to adopt the aPLI, which is designed to evaluate upper leg (femur), knee, and lower leg (tibia) injuries, and is intended to provide a more biofidelic response compared to the FlexPLI.^{10,11} The aPLI also eliminates the need for separate tests using separate impactors for the upper and lower leg. This not only reduces the overall test burden, but also creates time and cost savings associated with the purchase, calibration, and replacement of test devices for vehicle evaluation. The inclusion of the Simplified Upper Body Part on the aPLI also provides a greater degree of biofidelity.
- ***Use of the aPLI legform is needed to ensure ongoing harmonization with Euro NCAP*** -- Although the agency has proposed “using all four test devices currently utilized in Euro NCAP,” it is important to note that the FlexPLI has already been phased out of Euro NCAP and was replaced by the aPLI in January 2023. This means that if agency were to proceed with including the FlexPLI as proposed, the programs would be almost immediately misaligned, undercutting any potential benefits made possible through harmonization.¹² Several other prominent NCAPs have either introduced the aPLI legform (e.g., China), or plan to include as part of future updates to the program (e.g., Japan).¹³ Therefore, Auto Innovators encourages NHTSA to take immediate steps to ensure that the program is not indefinitely trailing these other programs from the outset.
- ***The aPLI will drive greater pedestrian safety improvements to the U.S. fleet***--Auto Innovators is also concerned with the use of the FlexPLI legform because of the limitations its use would create in terms of the number of vehicles that can be evaluated using this test device. As noted in the RFC, due to limitations in the capabilities of the FlexPLI, the agency is proposing that vehicles with a lower bumper reference line (LBRL) greater than 500mm would receive a “default red/no score.” It is not appropriate for the agency to adopt a device that does not meet the needs of the ratings program – particularly where this results in certain vehicles receiving an arbitrary score that is not based on its design characteristics but is rather the byproduct of limitations associated with the proposed test equipment.
- ***More accurate assessment tools will help encourage improvements in safety designs that address real world injury risks*** -- While we recognize and agree with the agency’s concerns regarding the potential for testing to yield artificially high test scores, the proposal put forward by NHTSA essentially results in the same outcome and could yield inaccurate information for consumers. Again, we urge NHTSA to reconsider its proposed use of the FlexPLI as a long-term solution and/or reconsider the criteria upon which the injury score for these vehicles is based (e.g., reweight to base rating solely on upper leg and head injury).

3.2.2 Use of the FlexPLI to Expedite Near Term Pedestrian Protection Ratings in NCAP

As outlined above, maximizing the degree of harmonization with other ratings programs is critical, especially when it will drive greater safety improvements. However, it is also important that NCAP be updated in a timely manner to ensure that consumers have access to relevant information regarding the safety performance of their

¹⁰ FlexPLI only supports the evaluation of potential knee and tibia injuries. Though it is capable of measuring femur loads, this measurement has never been used as an injury metric due to the biofidelity concerns,

¹¹ aPLI legform description - <https://www.humaneticsgroup.com/products/anthropomorphic-test-devices/pedestrian/apli-legform> (accessed: July, 2023)

¹² [Euro NCAP Vision 2030: A Safer Future for Mobility: https://cdn.euroncap.com/media/74468/euro-ncap-roadmap-vision-2030.pdf](https://cdn.euroncap.com/media/74468/euro-ncap-roadmap-vision-2030.pdf)

¹³ China update pedestrian testing to include the aPLI in 2022. Japan NCAP plans to implement aPLI in 2024.

vehicle. It remains our primary recommendation that NHTSA also adopt the aPLI in US NCAP for several reasons outlined in more detail throughout this notice, but we also recognize that procedurally, it may take time for the agency to consider the use of an alternate test device to the one proposed in the RFC.

For this reason, Auto Innovators is conditionally supportive of the agency's *near-term* proposal to use the Flexible Pedestrian Leg Form Impactor (Flex-PLI) as a means to avoid potential delays on the inclusion of pedestrian protection. However, we are opposed to the use of this test device as a longer-term solution, and it is critical that the agency expedite efforts to further update the program to replace the FlexPLI with the aPLI legform.

In other words, where NHTSA cannot align with the aPLI immediately, this proposal should only be used to support the near-term ratings of vehicles as part of the agency's "check box" approach. In the mid-to-long-term, Auto Innovators recommends switching to aPLI when the agency updates its star rating methodology to include a more comprehensive Pedestrian Protection rating.

3.2.3 NHTSA must reconsider its proposal to assign a zero score for vehicles with a LBRL greater than 500mm.

Auto Innovators is opposed to the agency's proposal to assign a zero score for vehicles with an LBRL greater than 500mm. By automatically assigning a zero score, the maximum attainable score for these vehicles is reduced from 36pts down to 22.5pts. This means that scoring for the remaining component tests (for the head and upper leg) needs to be almost perfect to achieve the agency's proposed 21.6pts (60%) score for receiving credit for pedestrian crashworthiness.

This further emphasizes the need for NHTSA to adopt the aPLI which is capable of testing vehicles with a higher LBRL. However, recognizing that the agency may continue to pursue use of the Flex PLI in the near term, updates must be made to either the test protocols and/or ratings criteria to provide the opportunity for vehicles to achieve some level of scoring. Assigning an arbitrary score of zero does not support a fair comparison and may underrepresent the actual safety performance of the vehicle, which in turn may adversely impact a consumer's purchasing decision. It also does not provide a fair representation of the comparative safety performance, where a manufacturer may not receive appropriate recognition despite the potential availability of design countermeasures that might meet or exceed those of a vehicle with LBRL less than 500mm. This outcome is contrary to the purposes of NCAP. Auto Innovators recommends the agency adopt the Euro NCAP 2018 Pedestrian Testing Protocol or an alternative proposal, such as the proposal presented in Appendix 3. As another potential alternative, the agency could consider permitting the use of a modified version of the TRL Upper Legform assessment for evaluating vehicles with LBRL greater than 500mm. Both of these alternatives permit use of the TRL upper leg form for assessing leg injury for vehicles with LBRL greater than 500mm.

While neither of these alternative "workaround" approaches would be required if the agency were to adopt the aPLI, it must be emphasized that at least some near-term alternative may be needed to the "no score" proposal. Auto Innovators welcomes further discussion on this matter should the agency have other suggested alternatives.

3.2.4 A clear plan is needed for updating the program to the aPLI in future.

While we recognize the likelihood of the agency proceeding with the near-term adoption of FlexPLI to avoid further delays in updating the program, this is not a workable long term outcome for the program. We therefore request that the agency update its NCAP roadmap in the near-term to include details of any planned actions and a timeline for adopting the aPLI test device as soon as practicable to coincide with the implementation of

updates to the overall vehicle rating. This is important for ensuring eventual harmonization and will likely be necessary to address residual concerns that cannot be fully addressed by adjustments to the test procedure or scoring criteria alone. This should not be a lengthy undertaking given the widespread availability of research that has been used to justify the use of the aPLI in other NCAPs.

3.3 Representativeness of legform.

Equity in crash safety is an important topic, and manufacturers design vehicles to provide crash protection for different age, size, and gender occupants. With respect to pedestrian safety, the same principles apply. We anticipate that the design countermeasures necessary to achieve higher scores in NCAP will have a net benefit for a wide range of pedestrian sizes. Whilst a single size of impactor cannot demonstrate this easily, the varied impact points and applied injury risk functions in the protocols can give confidence to the public that protection is not tuned for only a single road user.

3.4 Addressing Proposed Differences from Euro NCAP tests and assessment protocols

3.4.1 Self-Reported Data

Auto Innovators supports the agency's proposal to allow for manufacturer self-reporting of pedestrian crash test data. This approach will help enhance the potential availability of vehicle ratings information for consumers and reduce the burden on the agency's processes for testing and evaluating vehicles. As NHTSA continues to expand the program to include additional crashworthiness and crash avoidance information, ensuring the correct processes are in place is critical to maintaining the ongoing success of the program as it is not likely practical or feasible for the agency to rate every vehicle produced for a given model year.

Auto Innovators supports NHTSA providing clear guidance on the information that is required to be submitted as part of the self-reporting on pedestrian protection. This should include allowances for both predicted head and leg response data, and the option to provide more comprehensive data as needed (i.e., NHTSA should allow manufacturers to provide the results of either physical testing or CAE modeling). It is important that the agency balances the need for data to verify vehicles meet the intended levels of performance with the ability to review information in a timely manner to ensure ratings information can be made available quickly for consumers. It is particularly important to minimize lead time concerns associated with printing updated Monroney information, and we urge the agency to ensure any process issues can be resolved in the near-term, to avoid critical roadblocks in the future. That said, we are not opposed to the agency requiring additional information on an "as needed" basis, or for the purposes of verification testing.

3.4.2 No "Blue Points" for Predicted Head Impact Test

Auto Innovators is neutral on NHTSA requiring manufacturers to maintain sufficient data to support a predicted point/color value for every head grid point and every upper and lower leg impact test point. However, we urge NHTSA to maintain flexibility should manufacturers choose to submit blue point data where there may be uncertainty regarding the predicted points outcome that may be relevant for verification testing.

3.4.3 Use of FlexPLI on Pickup Trucks and Large SUVs and in the 425-500 mm LRBL range

Auto Innovators has significant concerns regarding long-term use of the FlexPLI in NCAP. These include limitations on the types of vehicles that can be evaluated using the test device. The test devices selected by the agency must allow for the testing and evaluation of all vehicles within the U.S. fleet that are eligible to be rated as part of NCAP. It is counterintuitive to exclude these vehicles given the reported prevalence of pickups and larger SUVs in pedestrian crashes. To address any potential biofidelity limitations of the FlexPLI due to the vehicle design, the agency should, in the short term, reconsider permitting use of the upper legform for

evaluating vehicles with LBRL in the 425-500mm. Based on the GTR, if the LBRL is between 425mm-500mm, a manufacturer can evaluate performance using either the upper leg form to bumper test or using FlexPLI. By adopting a modified version of this approach for vehicles with an LBRL greater than 500mm, the upper leg form score is determined based on the ratio (or degree to which) it overlaps between the bumper test and WAD 775 test (H position). This would ensure at least some level of scoring would be provided even though it may still not be a representation of the full degree of protection provided by a given bumper design. Additional detail on this proposal is included in Appendix 3.

3.4.4 No Bumper Testing When LBRL is Greater Than 500mm.

Auto Innovators is opposed to the agency's proposal to assign a "default red/no points" score for vehicles with a LBRL of greater than 500mm for several reasons, including those stated previously. While it is our recommendation that the agency adopt the aPLI legform instead of the FlexPLI, we recognize that the agency may still choose to proceed with its proposed approach. In this case, we urge NHTSA to reconsider allowing the use of upper legform (TRL) impactor for the bumper test as alternative option in the case of testing vehicles with lower LBRL of 425-500mm (aligning with the global technical regulation), according to the 2018 Euro NCAP guideline or the modified approach as outlined in Appendix 3, and reweighting the points apportionment as described in the earlier sections.

3.4.5 Addressing Artificial Interference in High-Bumper Vehicles

NHTSA requested comment on a proposal to reposition the upper legform +/- 50 mm from the WAD775 target when artificial interference is present, or to conduct multiple impacts within +/- 50 mm from the WAD775 target and use the worst-case result when artificial interference is present. In general, we recommend that NHTSA seek to harmonize with Euro NCAP. At present, it is not clear whether the agency's proposal is repeatable or reproducible, and there are concerns with subjectivity when defining impact points due to the lack of an objective test procedure or approach for addressing this issue. While we understand the need to consider the potential for "artificial interference," the likelihood of differences in how the repositioning procedure will be interpreted and applied between test labs will undoubtedly result in discrepancies whereby additional tests may be required to resolve any conflicts based on the data.

3.4.6 Consideration of test speeds and area of assessment.

NHTSA seeks comment on test speeds and whether the test speeds for either of the head or leg tests should be increased in an attempt to provide better protection to pedestrians in vehicle to pedestrian crashes. Additionally, the agency seeks comment on whether the area of assessment be increased beyond the WAD 2100 mm currently proposed to account for pedestrian heads overshooting the hood and impacting the windshield or the roof of the vehicle.

Overall, the proposed impact velocity of 40km/h and WAD of 2100mm are reasonable and appropriate, and consistent with Euro NCAP and other international ratings programs. In addition, since the biofidelity of the existing legforms are validated at 40 km/h, higher test speeds raise concerns for accurate assessment of leg injury. Any subsequent updates of the evaluation conditions should be investigated based on the research of field data in the U.S. and implemented according to a robust NCAP Roadmap.

It is also worth noting that efforts to develop regulations for pedestrian crash avoidance are complementary and can provide overlapping layers of protection for road users, and further justification for maintaining the current proposed test speeds. For example, some pedestrian crash avoidance systems are capable of significantly reducing impact speeds or avoiding a collision altogether. The proposed pedestrian protection impact speeds of 40 km/h afford substantial injury reduction potential when combined with PAEB and is a significant step towards addressing the pedestrian safety crisis on U.S roadways.

3.4.7 Revised Bumper Corner Definition

NHTSA seeks comment on what procedure it should use for marking the test zone on bumpers, including whether or not the agency should harmonize with the Euro NCAP 60-degree angle method, or follow the GTR 9 and UNECE R127 corner gauge method. We recommend following the GTR 9 and UNECE R127 corner gauge method. This method ensures that pedestrians will be protected in a larger bumper test zone and promotes greater protection performance for vehicles in the U.S. market.

Performing a lower leg impact test at the extreme width of any vehicle creates potential issues in terms of impactor response and durability and increases the possibility of glancing blows. The use of the 60-degree angle method is one way to clarify the procedural concerns presented with an exposed bumper. We recommend that the 60-degree method should remain as the corner gauge method.

The agency also notes that it tentatively plans to use the corner gauge and bumper beam width procedure for corner definition for this NCAP proposal and requests comment on this change. We support this proposal as it enables the evaluation of a larger test zone and aligns with UNECE R127-02. The corner gauge method in UNECE R127 also addresses concerns with bumper design features that could potentially affect the testable area.

3.4.8 FlexPLI Qualification

We recommend that the agency use the latest version of the qualification tests used by Euro NCAP.¹⁴ More specifically, we recommend that NHTSA use the dynamic inverse impact test and the quasi-static tests for evaluating the legform to ensure consistency with Euro NCAP.

3.4.9 Impact of Humidity on Test Devices

With respect to humidity, we recommend the agency not adopt US-specific requirements for what is considered an “acceptable humidity tolerance.” While NHTSA testing may have found that the foams used in the upper legform are sensitive to changes in temperature and humidity, it is not necessary to define these tolerances beyond what is already defined in the user manual.¹⁵ To ensure a harmonized approach, Auto Innovators recommends adopting the requirements from UNECE R127 Annex 5.2.2.

3.4.10 Active Hood Detection Area

Auto Innovators recommends aligning Euro NCAP for determining the detection area for vehicles with active hoods. (i.e., detection area should match the width of the bumper test zone).

In terms of which device should be used for assuring the system activates properly, the manufacturer should be provided with the option to specify which impactor is used in the near term – i.e., either the Flex-PLI or the PDI2.¹⁶ It is important that the test devices are representative of the populations they intend to address. We encourage NHTSA to consider the finding of the IWG-DPPS and conduct any additional research necessary to determine whether the PDI2 is an accurate surrogate for smaller stature pedestrians, or whether there is a need to consider alternate options. Additionally, the Flex-PLI or aPLI is used at 40 km/h and further evaluates the toughness of the sensing system.

In response to the agency’s request for comment on TB 024 and its relevance to the U.S. NCAP, Auto Innovators supports harmonization with Euro NCAP TB 024 as it is a well-established procedure to verify the head impact

¹⁴ <https://cdn.euroncap.com/media/41769/euro-ncap-pedestrian-testing-protocol-v85.201811091256001913.pdf>

¹⁵ <https://www.humaneticsgroup.com/sites/default/files/2020-11/flex-pli-user-manual.pdf>

¹⁶ See Test Matrix in Section 2.2.3.2 of Euro NCAP Test Protocol

times of vehicles with active hoods. TB024 is a reasonable method and would not result in any operational issues based on our Euro NCAP experience.

3.4.11 Proposed Test Devices Must be Incorporated in Part 572.

Auto Innovators is strongly opposed to NHTSA using test devices that have not been adopted in Part 572. Specifying the design and performance criteria is critical for maintaining the integrity of vehicle testing by ensuring that all test equipment, regardless of its application, is defined with “sufficient precision to give repetitive and correlative results under similar test conditions and to reflect adequately the protective performance of a vehicle or item of motor vehicle equipment with respect to human occupants.”¹⁷

Despite the agency’s proposal to rely on “released drawings and qualification procedures to inform stakeholders that NHTSA will be using those test device specifications and procedures as well as the criteria set forth in [the] RFC to award credit to vehicles that meet the Agency’s performance testing criteria,” this is not a suitable alternative to regulation, as it bypasses the protections put in place to ensure the integrity of both regulatory and consumer information test results. It is unclear why the agency has determined such actions are not needed in this case, nor why planned efforts to federalize the proposed test devices are not already underway or under active consideration. In either case, we urge the agency to reconsider its position.

Moreover, incorporating test devices in Part 572 serves to ensure that the appropriate processes are followed when making any changes or modifications to the test devices used for evaluating performance. The proposed approach does not provide these same guarantees, and instead creates significant uncertainty due to the potential for arbitrary changes or adjustments without any opportunity for notice and comment.

This process should not create significant delay in updating the program. While we recognize that this process would undoubtedly require some additional actions prior to any final decision to include a PedPro evaluation in NCAP, there is likely sufficient data and research available to support the near-term integration of relevant test devices into Part 572, including the aPLI, should the necessary resources be assigned to this effort. In addition, we anticipate that efforts to federalize the pedestrian headform are already underway as part of the agency’s anticipated rulemaking on Pedestrian Safety Global Technical Regulation, so this should help minimize any potential delay for this device.¹⁸

3.4.12 NHTSA should publish any proposed test procedures prior to final decision notice.

Auto Innovators supports NHTSA’s efforts to harmonize with Euro NCAP. However, there are several instances throughout the RFC where there is potential for misalignment without suitable opportunity for notice and comment. More specifically, it is stated that “NHTSA plans to generate its own test procedures and associated documents in the near future based on public input received from this notice and release these documents concurrent with the final decision notice.”

We disagree with the suggestion that the agency needs to wait to align its NCAP activities to a single decision point, as this has the potential to add further delay, particularly if there are further concerns associated with how the agency resolves specific issues based on comments received. Auto Innovators therefore urges the agency to make available any specific test procedures as soon as possible for review and comment.

¹⁷ PART 572- Anthropomorphic Test Devices <https://www.ecfr.gov/current/title-49/subtitle-B/chapter-V/part-572>

¹⁸ Pedestrian Safety Global Technical Regulation, 2023 Spring Regulatory Agenda (RIN: 2127-AK98)
<https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202304&RIN=2127-AK98>

3.4.13 Proposed test procedures should be structured based on how test procedures are being applied in other parts of the world.

As noted in the RFC, “a few commenters specifically requested that NHTSA use the Euro NCAP pedestrian crashworthiness test procedures rather than the GTR 9 procedures for the U.S. NCAP because the grid markup method and point scoring method have been shown to be suitable for use to evaluate and score vehicles in that consumer information program.” Auto Innovators agrees with this proposal as we continue to have concerns about the potential for the agency to adopt test procedures based a different interpretation of the GTR 9 language, compared to those being implemented by other established regulatory and consumer information programs. For both NCAP and GTR 9, we urge NHTSA to avoid defining US specific test requirements, mark-up procedures, or equipment, as this can introduce unnecessary complexity and the potential need for redundant testing to account for differences in test equipment. As noted in Auto Innovators July 7, 2022, comments to the agency on this topic, inconsistency between evaluation programs can have a significant adverse impact on vehicle design notwithstanding the repeatability and reproducibility concerns with vehicle testing.¹⁹

3.4.14 NCAP should complement regulation.

Although the RFC includes a discussion on the expected differences between NCAP and the pending NHTSA rulemaking to evaluate pedestrian head impact based on GTR No. 9, this does not provide the necessary assurances with respect to harmonization.²⁰ This includes both international harmonization as well as the degree of alignment or consistency between US regulations and NCAP. We request that the agency conduct a comprehensive review to ensure that NCAP requirements do not unintentionally drive countermeasure designs that conflict with those established in regulation (and vice versa). In other words, regulation should seek to establish baseline levels of safety performance, with NCAP incentivizing manufacturers to develop countermeasures that go above and beyond.

3.5 NHTSA Verification Testing

Auto Innovators agrees that NHTSA verification testing will help maintain the integrity of the program. Auto Innovators also agrees with the agency’s proposal to adjust the head score using a conversion factor determined from laboratory tests and replacing manufacturer supplied upper and lower leg scores with NHTSA laboratory test scores. While it is not practical for NHTSA to conduct verification tests on all the impact points, the agency must still account for potential variation between manufacturers and NHTSA test locations. We encourage NHTSA to support self-reporting as it will allow for more models to be rated and help reduce test burden on the agency.

4 Regulatory Considerations

4.1 NHTSA Must Take Action to Address Conflicts with Part 581 Damageability Requirements.

Auto Innovators has significant concerns with the agency’s limited consideration of the impact of the Part 581 damageability requirements and the limitations it places on manufacturers in modifying bumper designs to address pedestrian injury outcomes. The Part 581 requirements continue to conflict with the overall goals of the Department and NCAP by continuing to prioritize vehicle damageability over pedestrian protection, both in terms of crashworthiness performance but also in the fitment of bumper mounted sensors as standard equipment for addressing vehicle crash avoidance.

¹⁹ See Appendix 1

²⁰ <https://www.federalregister.gov/d/2023-11201/p-200>

These concerns have been highlighted by industry in several written comments and related correspondence over the last several years, and we are discouraged that the agency has not taken a more comprehensive and thoughtful approach to evaluating the potential for safety improvements by modifying current regulatory requirements to align with UNECE R42.²¹ While we recognize that changes to Part 581 cannot be addressed directly through this notice, we urge the agency to initiate parallel efforts to ensure that issues can be resolved in a timely manner and that appropriate near-term accommodations within NCAP be made to account for shortcomings associated with conflicting regulatory requirements that limit the extent to which safety design countermeasures can be implemented and harmonized with those already available in other parts of the world.

4.1.1 NHTSA must initiate near-term action to implement BIL requirements to address Part 581.

The Bipartisan Infrastructure Law (BIL) requires the agency to undertake several actions related to hood and bumper standards.²² This includes a notice for public comment regarding potential updates to the current requirements, as well as a report to Congress on the current status of hood and bumper standards. While we anticipate that these BIL requirements to be addressed separate from this RFC, we disagree that the NHTSA examination of the potential conflicts between the Part 581 requirements and pedestrian crashworthiness leg impact testing are sufficiently comprehensive to make a determination that no action is needed. As noted in the RFC, the agency's evaluation only included a limited number of older model year vehicles and made several assumptions regarding the representativeness of the GTR 9 FlexPLI test procedures and injury criteria and their potential overlap with the Euro NCAP. It is also unclear why NHTSA chose not to refresh the analysis presented in this RFC to include more recent model year vehicles, or to conduct a more comprehensive evaluation of the relationship between Part 581, GTR 9, and the potential for achieving high ratings in Euro NCAP. This information is critical for informing the agency's direction on both US NCAP and Part 581. In our view such analysis is also essential for meeting the requirements of the BIL.

4.1.2 The proposed points assignment for lower leg impact evaluation must be reweighted until NHTSA updates Part 581

In addition to the need for more comprehensive analysis, NHTSA should consider an additional near-term "weighting factor" for calculating the lower extremity injuries when evaluating vehicles subject to Part 581. Auto Innovators is concerned that the maximum number of points apportioned to these injuries may be unobtainable due to the design limitations imposed as a result of the current damageability requirements.

As noted in the RFC, in a NHTSA evaluation of US vehicles including several global platform vehicles, *only one vehicle* obtained a "good" rating of 4.41 out of 6.00 points for lower extremity injuries. This suggests that while it may be possible for a vehicle to achieve a "non-zero score," the points cap may not accurately reflect what is possible in terms of overall level safety performance given that pedestrian protection must also be balanced against regulations that prioritize vehicle damageability. At present, the lowest rated vehicles for pedestrian protection in Euro NCAP scored 5.2, 5.3, and 5.3 for lower extremity injuries – still *notably higher than the best performing vehicle in NHTSA research*. This suggests that there are other factors that may be contributing to pedestrian injury outcomes that warrant further study to explore the potential influence of related regulatory requirements on bumper stiffness – particularly given other NHTSA-involved research that discusses the influence of stiffness on injury outcome.^{23,24} It is not sufficient for the agency to conclude that the ability to achieve a "non-zero" is ample justification for finalizing the injury scoring metric when the maximum score may be unattainable given conflicting requirements.

²¹ See Appendix 2

²² Infrastructure Investment and Jobs Act, Section 24214

²³ <https://unece.org/DAM/trans/doc/2008/wp29/WP29-144-03e.pdf>

²⁴ https://rosap.ntl.bts.gov/view/dot/41841/dot_41841_DS1.pdf

The issue is further exacerbated by the reapportionment of points assigned to the evaluation of lower extremity injuries, which makes it even harder for a vehicle to reach the 21.6 points threshold necessary to receive a pedestrian protection credit as part of the proposed near term updates to the program.

The purpose of NCAP should not be to simply demonstrate that the minimum standards can be met, but to establish reasonable and practicable performance targets that go above and beyond regulatory requirements. This allows consumers to compare and contrast different vehicle based on equivalent levels of safety performance. If the highest attainable score is artificially capped due to conflicting requirements, it sends mixed signals to consumers who may perceive these lower scoring vehicles more negatively due to inappropriate or unfair weighting.

The lack of harmonization between Part 581 and UNECE R42 means that any efforts to harmonize NCAP with the Euro NCAP ratings and related evaluation criteria are essentially undermined and will continue to require different bumper designs for different markets. This is neither a benefit for manufacturers nor consumers, as the status quo will ultimately add unnecessary cost when more homologous solutions would be possible if were not for competing agency priorities.

Until such a time that the bumper requirements can be more closely aligned, we recommend that a weighting factor be applied to ensure vehicles subject to the part 581 requirements are rated in way that considers what is reasonably attainable in terms of levels of pedestrian safety performance. We do not have a specific recommendation for what this weighting factor should be, but support this being included as part of the aforementioned research that we argue is necessary for fulfilling the agency's requirements as part of the BIL.

5 Summary

Auto Innovators supports NHTSA efforts to update NCAP to include a pedestrian crashworthiness rating. However, several changes are needed to ensure that the program is more closely aligned with other established international ratings programs. It is critical that these changes be considered to ensure that relevant test procedures, ratings criteria and related regulatory requirements support the introduction of proven countermeasures and provide appropriate recognition based on levels of vehicle performance. These proposals should not add significant delay in terms of implementing updated pedestrian ratings in NCAP – particularly given the extensive body of research and related documentation available to support near-term agency action on these items.

- Ensure the program prioritizes design improvements that address real-world injuries by reweighting the points apportionment for evaluating different body regions to account for the increased risk posed by more severe head injuries.
- NHTSA should evaluate lower extremity injury using the aPLI instead of the FlexPLI. If the Agency decides to proceed with the FlexPLI, it should only be in the near term for the website rating.
- Incorporate all test devices in Part 572 prior to any final decision.
- Initiate rulemaking to address conflicts with the Part 581 bumper damageability requirements (with reasonable accommodations provided in the interim)
- Include future planned updates to the pedestrian protection ratings program on the agency's roadmap for NCAP.

Auto Innovators is committed to providing additional information and support for advancing this important update to NCAP. Please do not hesitate to contact Auto Innovators staff if you have any questions.

Appendix 1

Auto Innovators Comments on GTR No. 9



July 7, 2022

Dr. Steven Cliff
Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, D.C. 20590

Dear Deputy Administrator Cliff,

The Alliance of Automotive Innovation (Auto Innovators) is writing to provide comments and policy recommendations to NHTSA in advance of the agency's anticipated pedestrian protection rulemaking proposal that is expected to be published in the coming months.¹ These comments focus on several key issues identified in August 2018 National Highway Traffic Safety Administration ("NHTSA") GTR report entitled *"Vehicle Hood Testing to Evaluate Pedestrian Head Form Reproducibility, GTR No. 9 Test Procedural Issues, And U.S. Fleet Performance,"* and emphasize the importance of ensuring international harmonization.² Included is discussion on the impact of NHTSA's potential interpretation of unresolved issues within Global Technical Regulation (GTR) No. 9 that may result in inconsistent requirements between the United States and other parts of the world where similar requirements have already been adopted as part of regulatory or consumer information program evaluations.³ This will likely require U.S.-specific vehicle designs due to the lack of harmonization. Given the potential for regulatory misalignment, and the likelihood that proposed changes will have a significant impact on motor vehicle design, this rulemaking has been incorrectly classified as "nonsignificant," and should instead be considered a "major" rulemaking, which requires additional review by OMB. To address these concerns, we have provided several recommendations for the agency's consideration as it works to finalize its proposed rulemaking based on the Pedestrian Safety GTR.

Introduction

Auto Innovators shares the Department of Transportation's (DOT) safety priority and supports DOT's emphasis on the need for a safe systems approach for improving roadway safety. Our members are investing in the development of innovative technologies including Pedestrian Automatic Emergency Braking (PAEB) systems and advanced lighting features to help enhance roadway visibility in low light conditions. However, recognizing the lead time for new technologies to become widespread within the vehicle fleet, we underscore the importance of continued focus on driver and pedestrian education, the need for appropriate laws and enforcement, and investment in infrastructure improvements designed to enhance pedestrian safety. Safer roads, safer speeds, and safer people are all core components of the safe systems approach. As the automotive industry continues to make advances in vehicle safety, regulatory certainty, and clarity with respect to any potential NCAP requirements become increasingly important as these policies can have a significant impact on vehicle design.

¹ Auto Innovators is the singular, authoritative, and respected voice of the automotive industry, representing motor vehicle manufacturers responsible for nearly 99 percent of cars and light trucks sold in the U.S., original equipment suppliers, technology companies, and others within the automotive ecosystem.

² See docket NHTSA-2018-0026

³ GTR No. 9: ECE/TRAN/2005/124/9

Based on the *Spring 2022 Unified Agenda of Regulatory and Deregulatory Actions* that was recently published by the Office of Information and Regulatory Affairs (OIRA), we understand the agency is currently in the process of developing a Notice of Proposed Rulemaking (NPRM) based on the Pedestrian Safety Global Technical Regulation (GTR) – also referred to as GTR No. 9. Specifically, that NPRM would propose requirements to protect pedestrian heads impacting vehicle hoods.⁴

It remains critical that the agency work to ensure its regulations are closely harmonized with GTR No. 9, particularly with respect to how the requirements are being implemented by those that have adopted them through their respective regulatory and consumer information programs. This *implementation focused* approach is essential, particularly as stakeholders work to provide clarification on aspects of the GTR that are currently open to interpretation. Such an approach is consistent with the intent of the GTR process for ensuring “globally harmonized performance-related requirements and test procedures”.⁵

Just recently, the importance of international harmonization was reinforced in the Bipartisan Infrastructure Investment and Jobs Act (IIJA). If NHTSA is to take a divergent approach on this issue, it would likely require U.S-specific hood designs to meet future regulation and related NCAP test procedures. This would add unnecessary complexity and require additional research on development of new vehicle hood designs instead of those that already meet the pedestrian protection requirements of GTR No. 9 that have been adopted and implemented in other global markets and could be more readily integrated for vehicles sold in the United States. Such action would conflict with the IIJA which indicates a desire for increased harmonization.

NHTSA Interpretation of the GTR

In the aforementioned NHTSA GTR No. 9 report, it is stated that “[t]he first objective was to evaluate the GTR language defining the head impact point.” It is also noted that “The current language could be interpreted in more than one way, and a proposed amendment to the GTR supported by the European industry consortium OICA has been introduced to revise the GTR language to reflect one interpretation.” Auto Innovators supports this proposed amendment and urges the agency to further consider support for its adoption as part of the GTR process.

It is important to note that the NHTSA report (as quoted in the previous paragraph) incorrectly refers to OICA as a “European Industry Association.” In fact, the organization’s membership comprises 36 trade associations around the world, including all major automobile manufacturing countries and covers virtually the entire motor vehicle industry worldwide.⁶ This is a crucial distinction to make because the OICA recommendations represent an *international consensus* recommendation for improving the robustness of existing test procedures to evaluate pedestrian safety.

Unfortunately, the issue of potential multiple interpretations remains unresolved, despite strong international support for a clear path forward. Auto Innovators has significant concerns that this lack of resolution, coupled with a potentially unique NHTSA interpretation, could lead to an indefinite state of regulatory misalignment between regions.⁷ In other words, there may be no clear path forward for resolving this issue through a clarifying amendment.

⁴ *Spring Regulatory Agenda: Pedestrian Safety Global Technical Regulation* ([RIN: 2127 AK98](#))

⁵ <https://unece.org/wp29-introduction>

⁶ <https://www.oica.net/category/about-us/>.

⁷ [TWSG-03-05](#): *Final Minutes of the Technical Working Subgroup on Amendment 3 to GTR9* (December 03, 2021)

NHTSA has additionally noted a diverging interpretation for the “definition of area calculation.” Notably, the proposed amendment 3 to GTR No. 9 does not intend to revise the GTR requirements themselves for the definition of area calculation but rather intends to clarify the language to be consistent with the homologation procedures that have been in practice in Japan and the EU since 2004, and subsequently in UN R127 since 2012.

These issues, which are discussed in more detail below, include: (1) the process for defining the test areas (and corresponding HIC zones); (2) the method for defining the head impact point; and (3) Consideration for Impacts Outside the Defined HIC 1000/1700 Test Zones.

1. Defining the Test Area and Corresponding Test Zones (HIC 1000 and 1700 Areas)

It is important that test procedures are harmonized and aligned. Inconsistency can have a significant, adverse impact on vehicle design. When conducting head impactor tests consistent with GTR No. 9, it is important to first mark up the vehicle to identify valid test areas. We recognize that the current requirements *as written* in GTR No. 9 are potentially open to interpretation with respect to the methodology (or mark-up procedure) for defining the corresponding HIC 1000 and HIC 1700 zones. However, despite this, there is clear alignment *in practice* for how the regulation is being applied through the test procedures that have been implemented in regions that have adopted the GTR. An example of this would be the Republic of Korea where KMVSS 102-2 was crafted per GTR No. 9 but in practice aligns with GTR No. 9 with the adoption of Amendment 3. In an attempt to resolve possible differences between the regulatory text and the corresponding test procedure, a proposed *clarifying amendment* was introduced (referred to as Amendment 3) to update GTR No. 9.⁸ These issues are summarized and described in Figure 1 and 2 below.

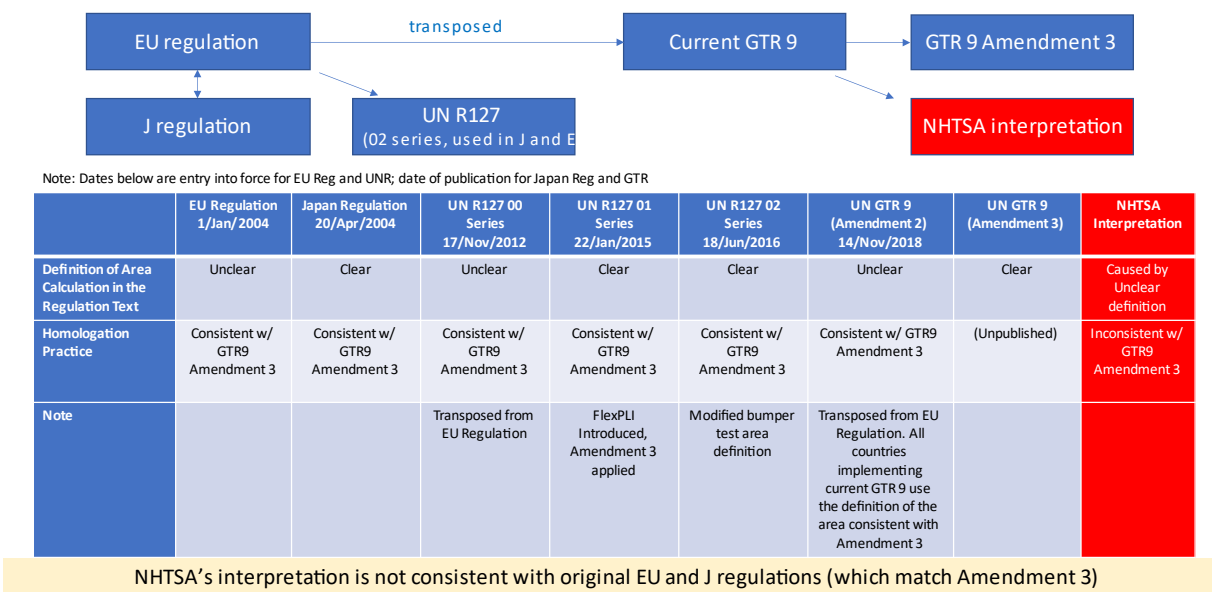


Figure 1: Regulation history for the definition of area calculation for HIC 1000 and 1700 zones (and resulting inconsistencies)

⁸ Amendment 3: ECE/TRANS/WP.29/2021/53

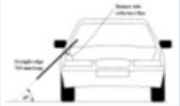
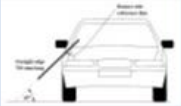
	Current GTR9 (NHTSA Interpretation)	Amendment 3
Side Reference Line(SRL)	 First contact point of 45deg line	 First contact point of 45deg line
Area in which Impact Points (Current GTR9) / Measuring Points (Amendment 3) are positioned	Side Boundary : SRL -82.5 Inconsistent	Side Boundary : SRL -82.5mm Consistent
Definition of Bonnet Top (current GTR9) / Bonnet Top Test Area (Amendment 3)	Side Boundary : SRL	Side Boundary : SRL -82.5mm
Definition of HIC 1000 and 1700 areas	HIC 1000 : 2/3 of Bonnet Top HIC 1700 : 1/3 of Bonnet Top	HIC 1000 : 2/3 of Bonnet Top Test Area HIC 1700 : 1/3 of Bonnet Top Test Area

Figure 2: Comparison of HIC 1000 and HIC 1700 zones between GTR No. 9 (expected NHTSA Interpretation) and Amendment 3.

Auto Innovators recommends that the “mark-up” approach discussed in the agency’s 2018 report should not be pursued.⁹ If the mark-up procedure approach adopted in NHTSA regulation is inconsistent with the current GTR No. 9 test procedure, in practice this could potentially result in undefined HIC 1000 and HIC 1700 zones, or circumstances where the ratio of HIC 1000 zones exceed 2/3 of the testable area. This is illustrated in Figure 3, below, using a simplified 2D representation of the width of a vehicle hood. Miswording in the current GTR No. 9 leads to interpretation of the area requirement that is different from the original concept of GTR No. 9 to prescribe 2/3 and 1/3 area ratios for HIC 1000 and HIC 1700 zones, respectively. Similar issues would also likely arise if the agency were to adopt a hybrid approach that blends requirements from the GTR No. 9 and UN Regulation 127 test procedure.

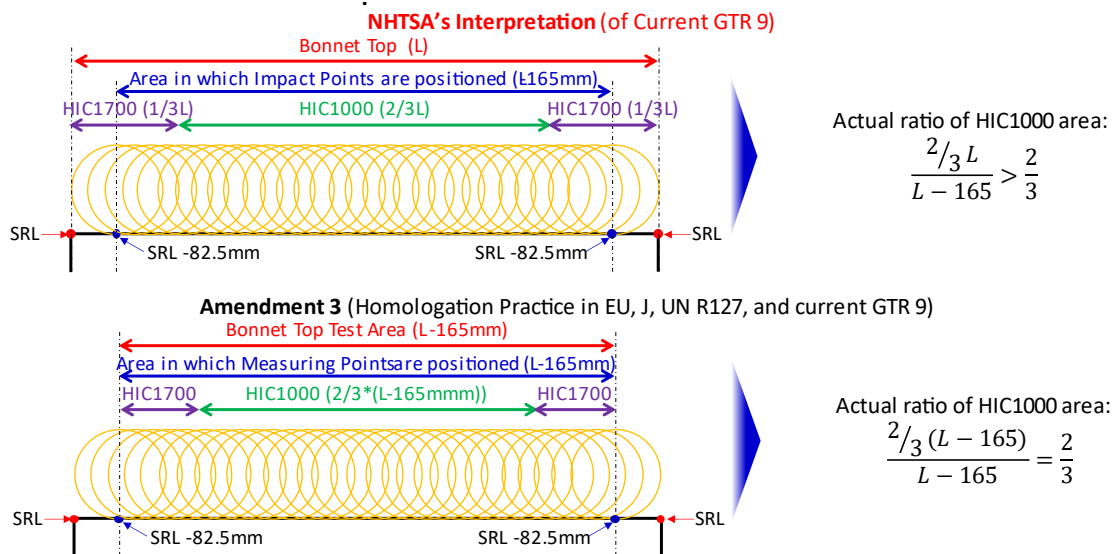


Figure 3: Comparison of the HIC 1000 area ratios when applying markup procedures from Amendment 3 and the expected NHTSA interpretation of current GTR No. 9

⁹ Vehicle Hood Testing to Evaluate Pedestrian Head Form Reproducibility, GTR No. 9 Test Procedural Issues, And U.S. Fleet Performance (Page 50-51)

Figure 4, below, further demonstrates that for vehicles with smaller, narrower front ends, the actual ratio of the HIC 1000 area can become substantially larger than the fundamental 2/3 requirement in GTR 9. This inappropriately drives more stringent requirements for smaller vehicles and would have the counterintuitive effect of encouraging larger vehicles because of the comparatively lower ratio of HIC 1000 to 1700 zones in relation to the overall size of the vehicle front end. Above all, this creates significant concerns for objectivity and departs from the fundamental concept of defining 1/3 and 2/3 ratio zones for HIC 1700 and 1000 areas.

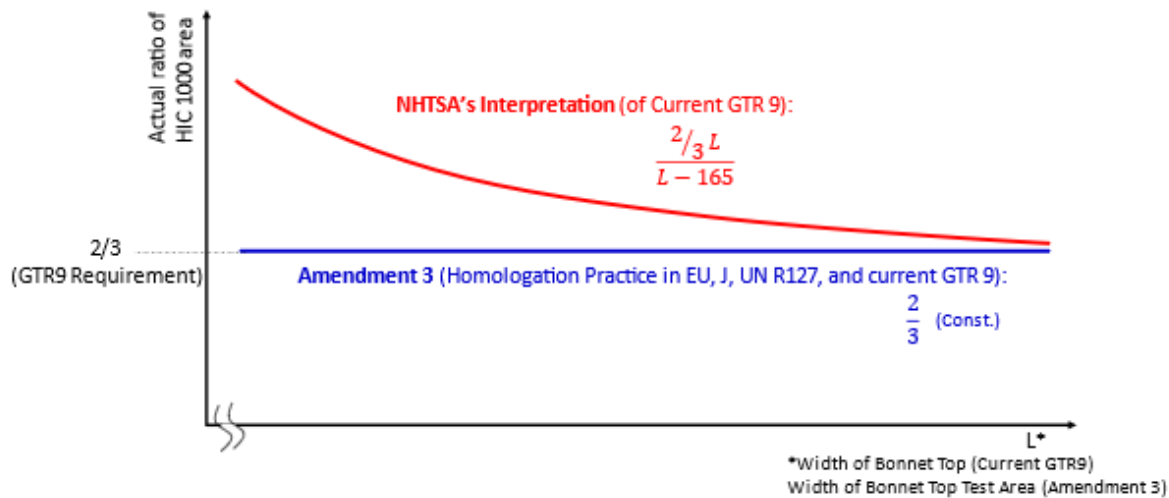


Figure 4: Sensitivity of the actual ratio of the HIC 1000 area to the width of a vehicle, when comparing markup procedures from Amendment 3 and the expected NHTSA interpretation of current GTR No. 9

To ensure greater harmonization, NHTSA should align with how GTR No. 9 is being implemented in other markets in terms of mark-up procedure. We encourage the agency to base its proposal on the GTR 9 with consideration for proposed clarifying Amendment 3, and to work with its international partners to ensure favorable resolution within the UNECE process.

2. Defining the Head Impact Point – Concerns with the NHTSA Targeting Protocol

Auto Innovators has concerns related to the NHTSA targeting protocol and methodology for aligning the head impactor used to evaluate pedestrian injury risk. As noted in the agency's GTR No. 9 report:

With the current GTR language, three different impact point definitions have been put to use by different laboratories: (1) the 3D point of first contact (POFC) (current NHTSA protocol); (2) the aiming point (EuroNCAP protocol); and (3) the point of first contact on the vertical-longitudinal plane containing the center of the headform impactor, which is known as "2D measuring point" (OICA protocol)... clear definition would provide lab- to-lab consistency, ensure that the test zones are not decreased to limit the GTR's benefit, and would provide clear wording for test procedures.¹⁰

The NHTSA report states, "Different interpretations of the head impact point could affect HIC outcome in a test, depending on the geometry/contour and under hood structures in the vehicle."¹¹ This statement is particularly relevant with respect to the proposed use and application of the 3D POFC method, where the interpretation by the agency introduces unnecessary complexity as well as several other issues as described below.

¹⁰ See docket NHTSA-2018-0026

¹¹ See docket NHTSA-2018-0026

Figure 5 illustrates the difference between the definition of “Impact Point” (based on the 3D POFC) and the “Measuring Point” (using the 2D method) ^{12,13}

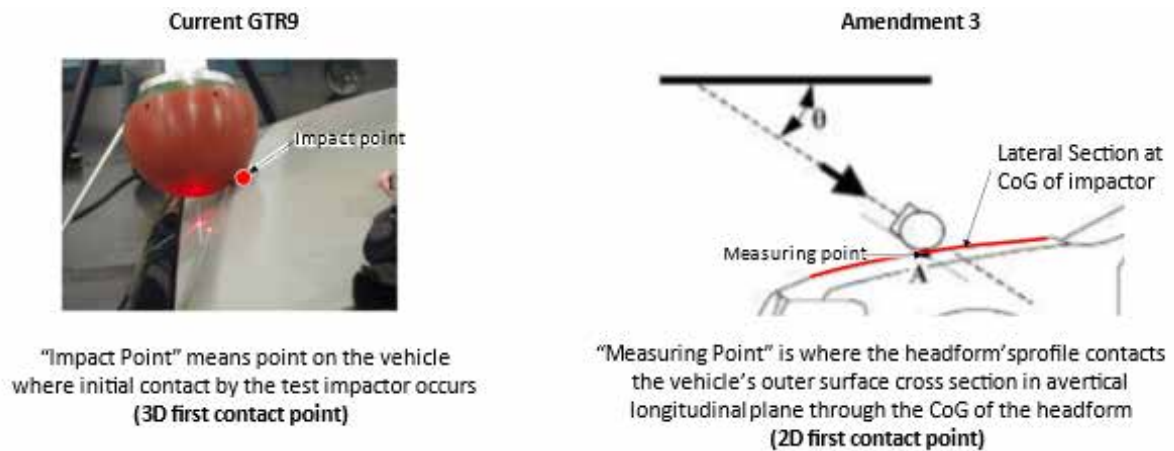


Figure 5: Definition of Impact Point (Current GTR9)¹⁴ and Measuring Point (Amendment 3)¹⁵

In addition to challenges outlined in the previous section, the 3D POFC method also introduces repeatability and reproducibility concerns whereby a “Point of First Contact” could be associated with multiple impactor positions as outlined in Figure 6, below. In some cases, depending upon the structural profile of the hood, areas where multiple POFCs may exist results in zones that cannot be reliably assigned to a single point. Areas where a test cannot be assigned to one single point may need to be considered as “unassignable,” particularly where they overlap HIC 1000 and HIC 1700 zones.

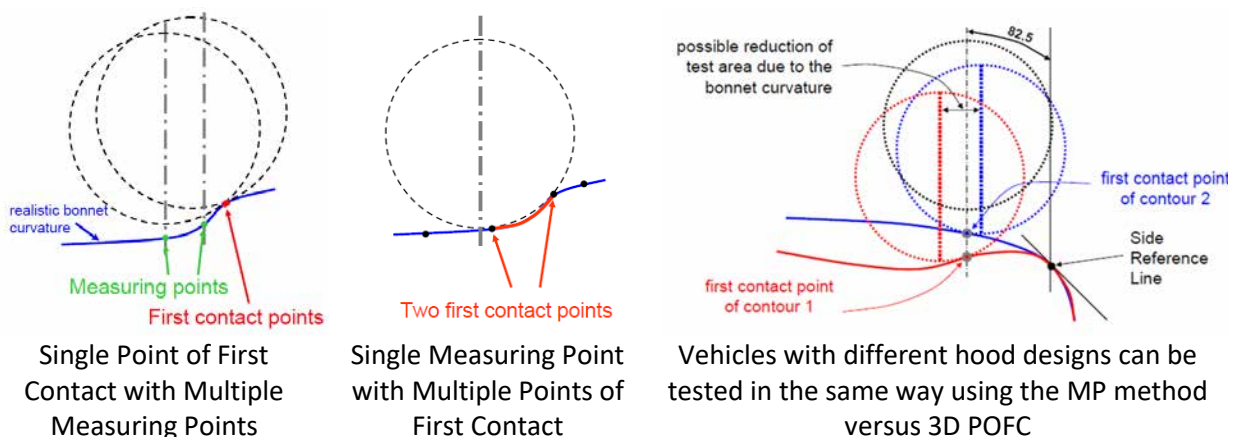


Figure 6: Challenges with 3D POFC Method [Source TFPP3-1-03]

¹² TFPP3-1-06: First session of the GRSP Task Force on Pedestrian Protection GTR Amendment 3” held in 14th and 15th June 2021 (June 14-15, 2021)

¹³ UN-R127 01 series (R127r1e)

¹⁴ Source: “First session of the GRSP Task Force on Pedestrian Protection GTR Amendment 3” held in 14th and 15th June 2021 (please see page 8 of TFPP3-1-06).

¹⁵ Source: UN-R127 01 series (Figure 8B in page 11 of R127r1e)

Concerns with repeatability and reproducibility are exacerbated further as the 3D POFC introduces additional complexity in terms of test setup and execution. For each test, it will be necessary to ensure the launch position/angle are clearly defined (relative to the vehicle) and additional steps may be needed to ensure the impact corresponds to a specific location on the vehicle bonnet.

The aforementioned issues with the 3D POFC do not exist for the 2D method. We therefore strongly urge the agency to adopt the 2D approach as it is significantly more straightforward, limits unnecessary test burden, ensures repeatability and reproducibility, better guarantees that impacts occur within defined testable areas, and is more closely aligned with the intent of GTR No. 9.

We are supportive of the 2D measuring point method (proposed by OICA and in GTR No. 9 Amendment 3) as a means to enhance the positioning of the head impactor for assessing pedestrian injury risk. It provides a straightforward, objective, repeatable, and reproducible method for compliance testing and evaluation. Conversely, the 3D Point of First Contact method (3D POFC and currently in GTR No. 9) does not achieve these goals and likely introduces additional and unnecessary complexity.

3. Consideration for Impacts Outside the Defined "Child and Adult Test Areas"

Auto Innovators is concerned that the agency test procedures may not appropriately consider the significant impact on vehicle designs should it propose a test procedure that includes impacts outside of the defined HIC 1000/1700 zones (*i.e. where the point of first contact is along the side reference line, but a substantial portion of the head impactor engages with structures outside the established test zone*). This is illustrated in Figure 7, from the 3rd TWSG Amendment 3 final minutes, as shown below.¹⁶

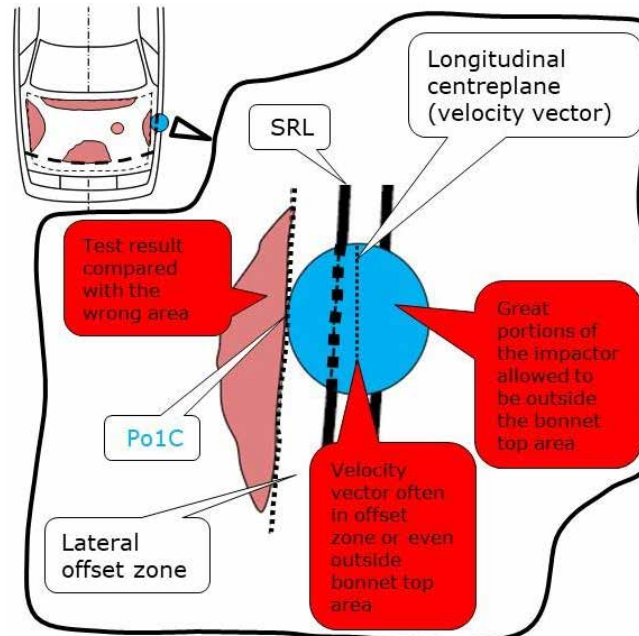


Figure 7: Example of test where the POFC is within the SRL, but the impactor centerline is outside SRL [Source: 3rd TWSG Amendment 3 Final Minutes TWSG-03-05]

¹⁶ Minutes of 2nd Meeting of Technical Working Subgroup on Amendment 3 to GTR9, December 13, 2021.

As noted in the agency's report, the first objective was to "investigate how the front, side, and rear borders of the GTR "launch area" would change if various targeting protocols are used." The report further states that the agency has

*[I]nterpreted the language of the original GTR to mean that as long as any point of the headform touches inside the 82.5 mm bounded test zone as specified in the GTR, it would be considered a valid test point as long as the target point (headform centerline projection) is within the initially drawn front/side/rear boundaries of the test zone.*¹⁷

This interpretation inappropriately expands the testable area beyond the intended scope of GTR No. 9. Based on our assessment, the 3D POFC method further calls into question what is considered a valid test/impact based on defined test zones.

While the agency's rationale is that "this method engages more structural members along the extreme periphery of the prescribed zone and therefore could provide more benefit to pedestrians in harder vehicle areas," it is not reasonable or practicable to adopt such a requirement given that these structures are necessary to support the position of the hood system during normal operation, provide access during maintenance and repair, or maintain reasonable integrity during vehicle crash testing. As such, any cost-benefit analysis should include a comprehensive assessment of the impact of regulation on existing vehicle designs, compared to if the agency were to simply adopt the requirements of GTR No. 9 as implemented in other regions.

Rulemaking Significance

Based on the aforementioned concerns, and the potential for NHTSA to propose rulemaking that is inconsistent with the spirit, intent, and implementation of GTR No. 9, Auto Innovators is concerned that this could result in a situation where regulation may require U.S.-specific hood and front-end designs. Given that the hood is an integral component of the vehicle, this could have downstream impacts on the design of other systems that may be closely integrated with the hood (e.g., fender, bumper system), adding substantial burden to manufacturers, notwithstanding any fuel economy related impacts that need to be considered based on redesign of the vehicle body shape.

Any cost-benefit analysis by the agency should include an assessment of the impact of rulemaking on vehicle hood design in the United States and factor in any U.S.-specific requirements that may alter the cost-benefit analysis. Should the agency proceed in a direction inconsistent with our technical recommendations, we request that the agency provide a comparison of the cost-benefit if it was to simply align with the GTR No. 9 as accepted and implemented in other parts of the world.

Given the potential for regulatory misalignment, and the likelihood that proposed changes will have a significant impact on motor vehicle design, this rulemaking has been incorrectly classified as "nonsignificant." It should instead be considered a "major" rulemaking, which requires additional review by OMB.

Conclusion

We remain supportive of efforts to address pedestrian safety; however, we have significant concerns should the agency seek to implement performance requirements inconsistent with GTR No. 9. While we recognize that the exact language used in the GTR is open to interpretation by the agency, the application and implementation of the standard globally, is not. Adopting an approach that is

¹⁷ See docket NHTSA-2018-0026

inconsistent or based on a unique interpretation of the GTR No. 9 requirements creates the potential for long-term international regulatory misalignment, which is counter to the intent of the GTR process, and the spirit of the directive issued by Congress in the recently passed Bipartisan Infrastructure Law.¹⁸ We therefore strongly urge the agency to harmonize any proposed pedestrian protection standard with those already being implemented in other regions.

Please let me know if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Scott Schmidt', with a stylized, flowing script.

Scott Schmidt
Vice President, Safety Policy
Alliance for Automotive Innovation

¹⁸ Sec. 24211 -- *Infrastructure Investment and Jobs Act*

Appendix 2

Auto Innovators 2018 Petition on Part 581



December 5, 2018

Ms. Heidi King
Deputy Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue S.E., West Building
Washington D.C. 20590-0001

Re: Part 581 Petition for Rulemaking

Dear Deputy Administrator King:

The Alliance of Automobile Manufacturers (Alliance), Association of Global Automakers (Global Automakers), and Motor & Equipment Manufacturers Association (MEMA) submit this petition to modify aspects of the Bumper Standard, 49 C.F.R. Part 581, as it relates to the installation of sensors necessary for the operation of advanced crash avoidance systems and to ultimately harmonize it with ECE R42.

In May 2015, Secretary Anthony Foxx announced that the Department was working to identify obstacles in the current regulatory framework that may be hindering the accelerated implementation of safety innovations. This initiative is in line with the current Administration's efforts to streamline regulations and eliminate unnecessary barriers to investment and innovation as well as comply with regulatory reform cost burden guidelines.

Also in 2015,¹ NHTSA added automatic emergency braking (AEB) to the New Car Assessment Program's (NCAP) list of recommended technologies, which will help stimulate consumer demand for this technology. Our collective members are proud of their role in developing and implementing this technology; we look forward to these technologies becoming widely available as standard equipment on an ever-increasing number of vehicle models.

Unfortunately, for many currently available systems, NHTSA's Bumper Standard 49 C.F.R. Part 581 and a 1995 interpretation,² which was recently reaffirmed,³ inhibit the timely conversion of this important technology from optional equipment to standard equipment. Similarly, it inhibits the speed at which other advanced crash avoidance and mitigation technologies are deployed. This includes those that may include pedestrian detection and facilitate greater levels of vehicle automation.

¹ <https://www.nhtsa.gov/ratings>

² Interpretation to William Shapiro of Volvo Cars of North America, Inc. (December 11, 1995).

³ Interpretation to Alliance of Automobile Manufacturers and Global Automakers (July 13, 2016).

Given these interpretations, rulemaking is necessary to modify the requirements of Part 581 to promote the wide-spread adoption of advanced crash avoidance technologies, which provide significant vehicle crash and damage-mitigation benefits that are in alignment with the goals of the 1972 Motor Vehicle Information and Cost Savings Act, from which Part 581 was promulgated.

In 1972, Congress enacted the Motor Vehicle Information and Cost Savings Act (Public Law 92-513), which included a provision requiring NHTSA to establish bumper standards for passenger motor vehicles.⁴ This provision, now codified in Title 49 of the United States Code as Chapter 325, was intended “to reduce the incidence of property loss resulting from motor vehicle accidents.”⁵ The legislative history reflects congressional intent to “eliminate or substantially reduce property damage in low-speed collisions.”⁶ However, Congress also cautioned NHTSA that “considerations of safety would take precedence” over the cost-saving benefits of the bumper standard.⁷ The Conference Report accompanying enactment of the Cost Savings Act observes that the bumper standard must “seek the maximum feasible reduction in costs to the public and the consumer,” and that “[i]t is likely that a bumper standard which requires protection of the external sheet metal of motor vehicles in low speed collisions would provide the maximum cost savings to the public.”⁸

To put this issue in context for AEB technologies, we note that vehicles equipped with AEB and other advanced crash avoidance technologies are already contributing to the overall goals of the Bumper Standard, which are to reduce property damage to the front and rear ends of passenger vehicles, and to reduce the costs of repairing such damage. While not all AEB systems rely on bumper-mounted sensors or other equipment, a substantial number do. AEB will not eliminate all damage from close, low-speed encounters; however, it will help to mitigate the damage in many collisions and will avoid any damage in instances in which a collision is averted altogether. The Highway Loss Data Institute’s (HLDI) most recent insurance claim frequency analysis found that vehicles equipped with AEB are associated with a 2 percent reduction in collision claim frequency, 13 percent reduction in property damage claim frequency and a 17 percent reduction in bodily injury liability claim frequency.⁹ Furthermore, when IIHS examined state crash files they found that the benefits for forward collision warning with AEB in police-reported data show a 50 percent reduction in police-reported rear-end striking crash rates and a 56 percent reduction in rates of police-reported rear-end striking crashes with injuries.

Recently IIHS has evaluated the efficacy of backing crash avoidance technologies currently available on General Motors vehicles and determined that “the combination of Rear Vision Camera and Rear Parking Assist reduced backing crash involvement rates by 42%, and

⁴ In 1994, Congress recodified the Motor Vehicle Information and Cost Savings Act into Title 49, United States Code. The recodification was intended to be enacted without substantive change. Accordingly, the original legislative history is still relevant. See the recodification at Public Law 103-272 (July 5, 1994).

⁵ Senate Report 92-413 at page 18

⁶ House Report 92-1033 at page 14

⁷ S. Rept. 92-413 at page 20

⁸ House Report 92-1476 at page 18.

⁹ Cicchino JB. 2017. Effectiveness of forward collision warning and autonomous emergency braking systems in reducing front-to-rear crash rates. *Accident analysis & Prevention*, 99A, 142-152.

adding Rear Automatic Braking to these two systems reduced rates by an additional 62%. Taken together, vehicles with all three systems had backing crash involvement rates that were 78% lower than vehicles with none of the systems.”¹⁰

The future evolution of advanced crash avoidance systems, including pedestrian detection and increased levels of vehicle automation, should further increase both safety and property damage mitigation benefits beyond current levels.

In addition to the property damage reduction potential, AEB technologies have shown impressive safety benefits in helping to prevent and mitigate injury-causing crashes. As the legislative history of the Cost Savings Act makes clear, “considerations of safety would take precedence” over the cost-saving aspects of a bumper standard, and the language of the statute itself compels NHTSA to consider “health and safety” when setting or amending a bumper standard. 49 U.S.C. §32502(d)(4). NHTSA should be encouraging, not discouraging, the installation of these AEB technologies as standard equipment. For all of these reasons, the amendments sought by this petition are consistent with the goals of the Cost Savings Act, as well as with the plain language of the Act itself.

When considering the benefits of expanded fleet penetration (from fitment as standard equipment) of advanced crash avoidance technologies, “cost reduction” is much more than simple low speed crash damage repair costs. In the context of this regulation, we believe it may be appropriate to examine and consider the reduced economic costs both in terms of crashes avoided and reduced impact severity. Indeed, such costs could include losses due to lost productivity, medical costs, legal and court costs, property damage, and workplace losses. While we have not conducted a detailed analysis of these factors, we believe the crash prevention/mitigation benefits from these technologies will address a significant portion of the estimated annual economic cost from motor vehicle crashes.

Other advanced crash avoidance technologies that may rely on bumper-mounted sensors or other bumper-mounted technologies, now and in the future, include adaptive cruise control, forward collision warnings, reverse warning, rear AEB, lane change assist, blind spot detection, pedestrian detection, and features to enable certain autonomous driving capabilities, as well as other technologies that are still under development or will subsequently be added to NHTSA’s crash avoidance NCAP. The current interpretation of Part 581 places at risk the manufacturers’ ability to offer these features as standard equipment, at least without costly redesign and relocation of the sensors or other bumper-mounted components.

Practicability Limitations for Designing Bumper/Sensor Systems to Comply with Part 581 Requirements

Advanced collision-avoidance technologies are rapidly evolving. As a result, the type, size, and placement of sensors for such systems are also evolving. In order to optimize performance (i.e., sensor field of view) for some advanced systems, sensors are located in the

¹⁰ Cicchino JB. 2018. Real-world effects of General Motors Rear Automatic Braking, Rear Vision Camera, and Rear Parking Assist systems.

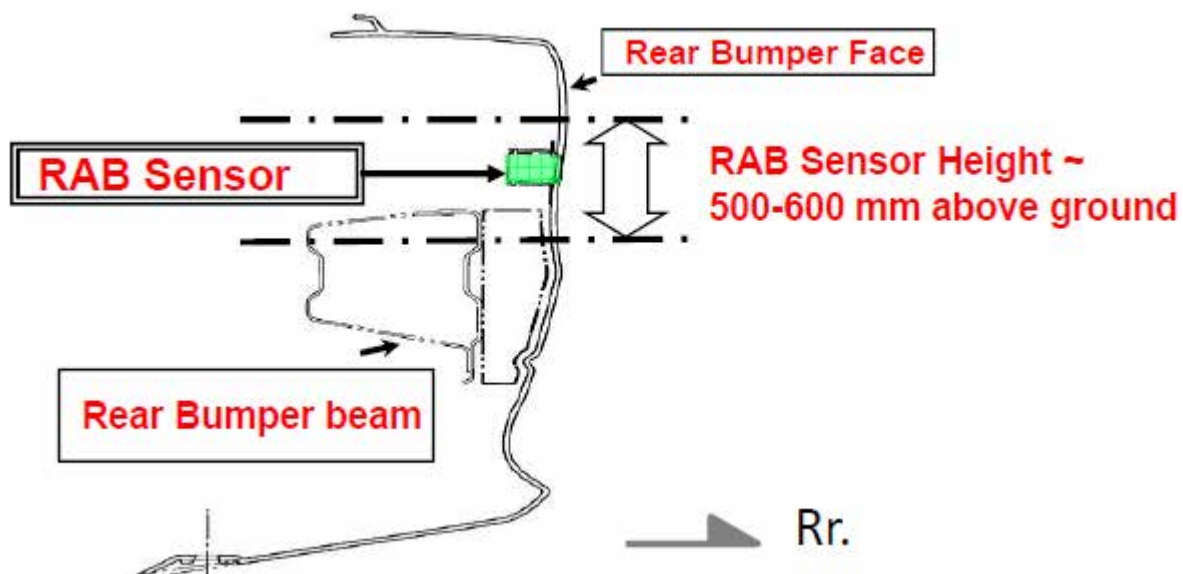
pendulum impact zone – between 16 and 20 inches to ground and mounted nearly flush with the bumper cover's surface. If these sensors were recessed into the bumper beam for greater impact protection, they would likely experience a restricted sensing field of view, which might create sensing blind zones.

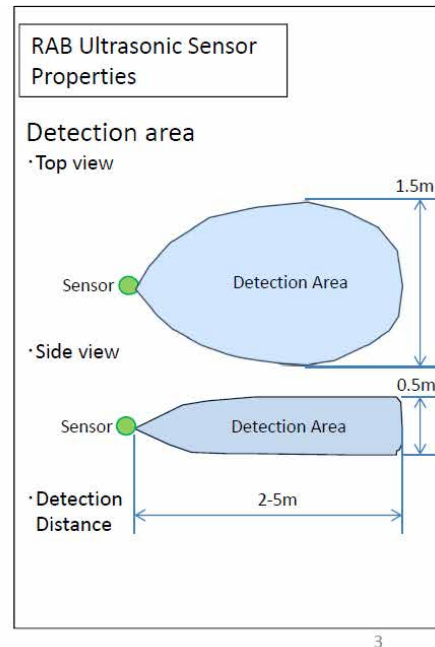
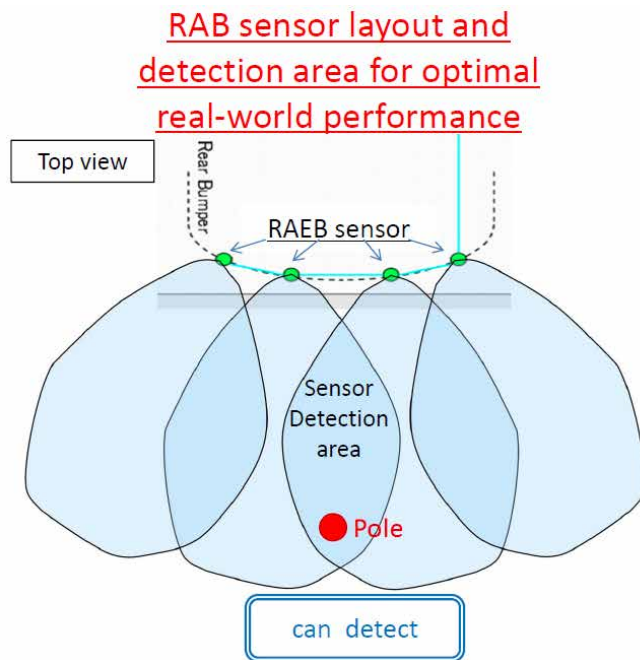
Currently, if sensors are mounted on the bumper, but are optional equipment (not provided as standard equipment), they can be removed prior to Part 581 testing. However, in order to provide such systems as standard equipment, sensors currently mounted on the bumper would need to be relocated to other areas of the vehicle or deeply pocketed into the bumper structure in order to comply with Part 581 requirements. Either of these adjustments in position would likely reduce sensor field of view and have commensurate degradations in overall system safety and vehicle damage mitigation performance.

With respect to AEB systems, there are some systems that use forward-facing stereo-cameras instead of bumper-mounted sensors although there are other systems that utilize a fusion of camera and bumper mounted sensors. However, for rear AEB systems, typical employment includes bumper mounted ultrasonic sensors.

To ensure proper functioning, ultrasonic sensors must be located along the perimeter/edge of the vehicle, preferably along the surface of the rear bumper. Further, the sensors should be positioned approximately 500-600 mm above ground to avoid false positives from detection of the road surface, etc. These design constraints result in sensors that are located in the test zone/impact areas of Part 581, which in turn makes it difficult to meet the “no damage” criteria of Part 581.5(c)(8). If the sensors were re-located to areas of the vehicle to avoid damage from the Part 581 test(s), system performance would suffer.

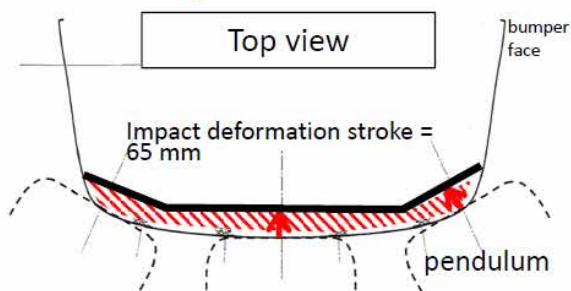
For example, consider the following rear AEB system:



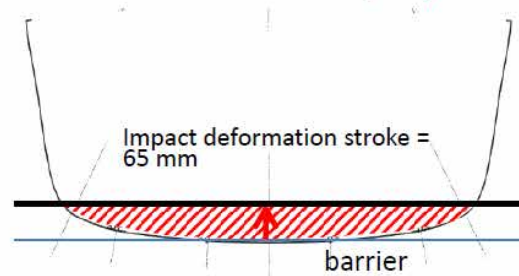


Part 581 impact-affected areas are detailed in the following illustration.

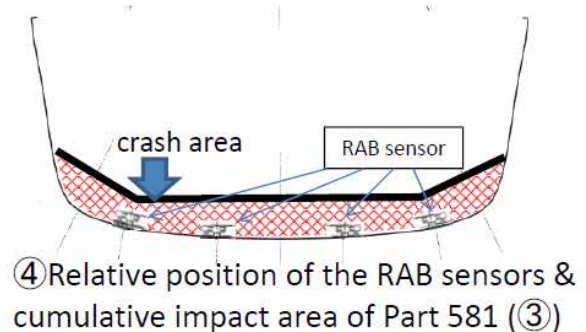
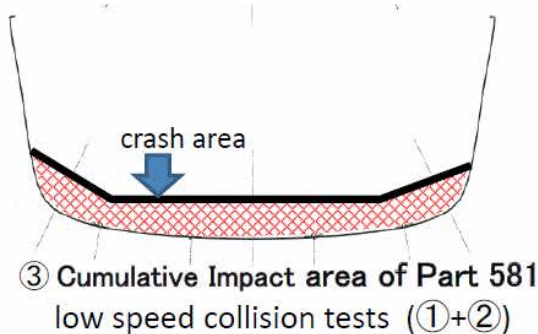
Relationship between RAB sensor location vs. Part 581 test zone/impact areas



① Pendulum test impact area

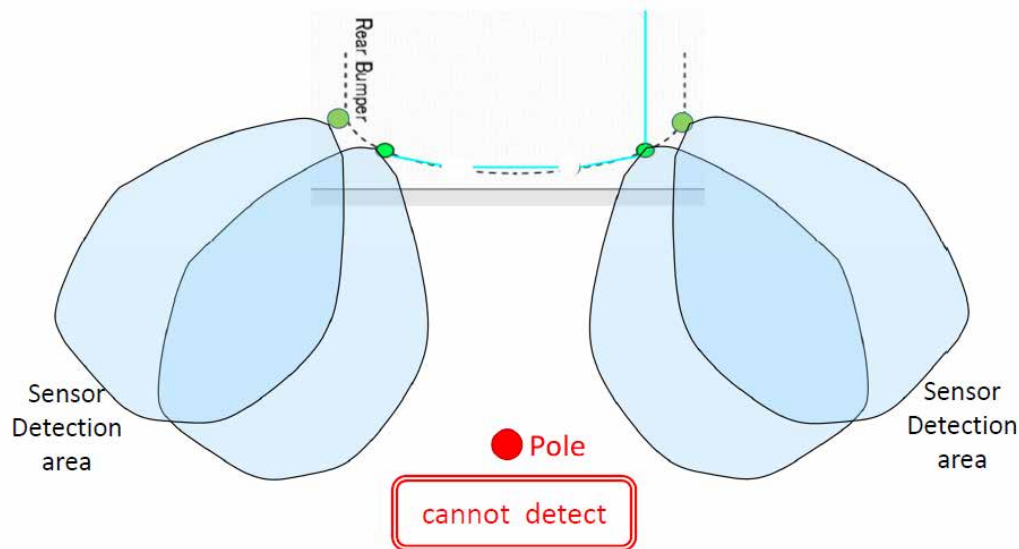


② Barrier test impact area



The sensors could be re-located to areas of the vehicle (i.e., side of the vehicle) that would avoid damage from the Part 581 test(s). However, real-world performance may suffer

because of a large blind zone created towards the center of the vehicle (see below). Such performance degradations could reduce both real-world safety and damage reductions as well as NCAP ratings.



Harmonization with ECE R42

Pedestrian Protection Improvements

Both NHTSA and industry research and analysis has identified pedestrian protection safety benefits for vehicles designed to ECE R42. In NHTSA research presented by Jason Stammen at the 2014 SAE Government & Industry meeting¹¹, data comparing the FLEXGTR test results for the legform Tibia Bending Moment, MCL Elongation, and ACL/PCL Elongation for five vehicles with both US and European versions recorded significantly higher injury values for North American Vehicles compared to their European counterparts. This result also held true for North American vehicles equipped with stiffer lower leg aprons (lower “leg catchers”). Such test results agree with engineering information detailing the challenges trying to engineer bumper systems for both Part 581 compliance and leg impact¹². Specifically:

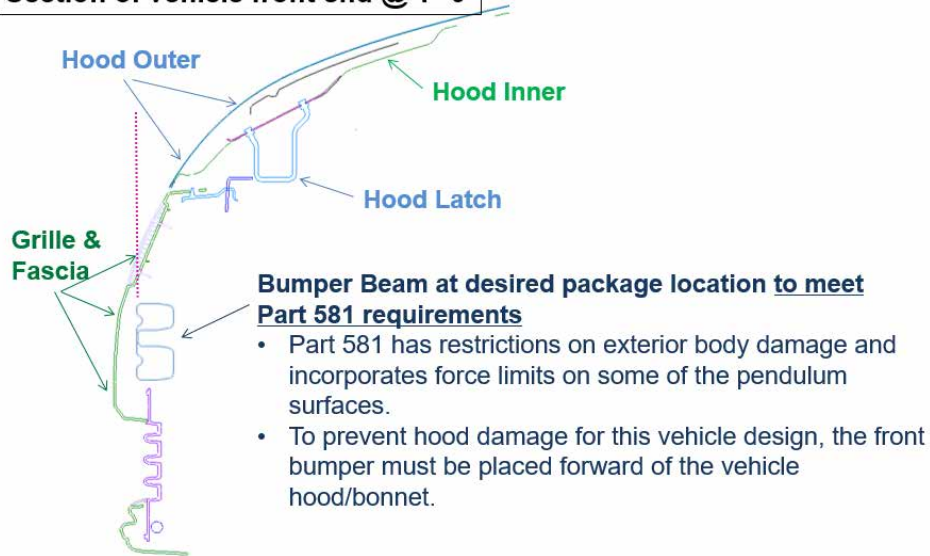
For Part 581 compliance, the design of the bumper system attempts to absorb the relatively higher bumper impact test energy with a high stiffness bumper which limits the impact stroke and resultant damage to bumper and surrounding components.

However, for pedestrian protection, the bumper attempts to absorb the relatively lower leg form impact energy with a low stiffness bumper to limit the loads (force and bending) applied to the leg form.

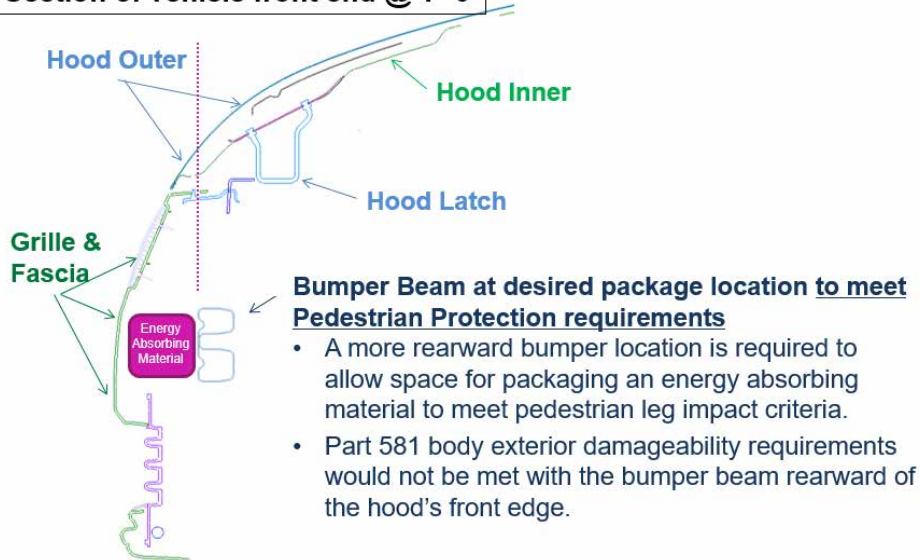
¹¹ Performance of Bumper System with Respect to Pedestrian Protection and Bumper Damageability Requirements, Jason Stammen, NHTSA, Brian Suntay, Transportation Research Center Inc., 2014 SAE Government Industry Meeting

¹² Pedestrian Protection Challenges in the U.S. Market, Jennifer Buckman on behalf of the Alliance of Automobile Manufacturers, 2014 SAE Government Industry Meeting

Section of vehicle front end @ Y=0



Section of vehicle front end @ Y=0



The above figure illustrates the design differences between bumpers designed to meet Part 581 impacts and bumpers designed to mitigate pedestrian leg injuries. As you can see from the figure above, Part 581 requirements drive the placement of the bumper beam or other stiff structures in front of the hood, or more forward in the vehicle, while systems meeting international pedestrian protection requirements have the bumper beam or solid structural components located behind the front of the hood or more rearward in the vehicle. Because of this rearward placement of the vehicle structure, pedestrian impact energy absorbing material can be placed on the bumper beam while still maintaining a front-end geometry that is optimized for pedestrian leg impact.

Harmonization Regulatory Reform Cost Reduction

In addition to the potential pedestrian safety benefits, adoption of R42 requirements and test procedure will result in significant cost reductions and are in line with the current administration's regulatory reform guidance.

Recommended Regulatory Approach

In order to achieve the ability and incentive for vehicle manufacturers to fit advanced crash avoidance technologies (with commensurate safety and damage reduction benefits) as standard equipment, improve pedestrian leg impact protection and cost reduction due to harmonization with ECE R42, the eventual adoption of ECE R42 impact requirements and test procedure is the preferred approach.

However, rulemaking to adopt/harmonize with R42 will require the development of additional data and analysis detailing pedestrian protection safety improvement and cost reduction benefits. While the petitioners plan to provide additional information to assist in those assessments, it will take time for it to be assembled and the agency to review it. In order to address the immediate need to remove the technical impediment on the implementation of advanced crash avoidance systems (e.g., AEB) as standard equipment, we recommend that a two-step approach be pursued.

Two-Step Approach

Step – 1: Permit Removal of Bumper-Mounted Advanced Crash Avoidance Technology -

Given the urgency and safety importance associated with meeting voluntary commitments to provide AEB as standard equipment, we recommend that Part 581 requirements be modified to permit removal of bumper mounted or contained advanced crash avoidance system components prior to bumper impact as soon as possible. Specifically, the Part 581 Regulatory text should be modified as follows:

S 581.4 Definitions

Advanced crash avoidance technology means a system that detects and (i) warns, (ii) assists the driver, (iii) provides a signal to the brake system to stop the vehicle without brake pedal input from a human driver, or (iv) engages an automatic action, in order to avoid or mitigate a collision.

A definition for “advanced crash avoidance technology” is provided to clarify the type of sensors that are permitted to be removed prior to bumper impact.
--

Bumper mounted or contained components means components that are either part of the bumper system, mounted to the bumper system, contained within the bumpers system, or located within the impact deformation stroke area.

A definition for “bumper mounted or contained components” is provided to include components that are either mounted to the bumper or contained within the bumper system (e.g., sensors mounted to the frame, but placed in a cutout in the bumper).

S 581.5(c) (5) The vehicle’s propulsion, suspension, steering, and braking systems shall remain in adjustment and shall operate in the normal manner. For purposes of this subsection, the term “braking systems” means the components installed on a motor vehicle to enable compliance with FMVSS 135 (49 C.F.R. 571.135) and does not include any advanced crash avoidance technology.

Underlined text is provided to clarify that the braking system functional requirement only applies to aspects of brake performance necessary to comply with the applicable brake standard (e.g., FMVSS 135).

S 581.6 (a) (5) Trailer hitches, license plate brackets, headlamp washers, and bumper mounted or contained components of any advanced crash avoidance technologies may be removed from the vehicle. Any advanced crash avoidance technology is turned off prior to the pendulum test. Illumination of the brake system warning indicator required by FMVSS 135 S.5.5 shall not by itself constitute a failure of this provision. Running lights, fog lamps, and equipment mounted on the bumper face bar are removed from the vehicle if they are optional equipment.

Underlined text is provided to:

- Add bumper mounted components of any crash avoidance system to the list of components permitted to be removed prior to bumper impact.
- Clarify that advanced crash avoidance technologies are turned off prior to impact and that the illumination of a brake warning indicator as a result of sensor removal does not violate the requirements of this section (S 581.6 (a) (5)).

Step-2: Adoption of ECE R42 Bumper Impact Requirements and test procedure with Addition of Primary Braking System Definition - In order to facilitate the implementation of advanced crash avoidance technologies and more fully realize both the safety and damage reduction benefits from these technologies, the petitioners recommend that NHTSA harmonize its Part 581 performance requirements with the bumper impact requirements currently specified in ECE R42 consistent with the regulatory revisions described above regarding the removal of advanced crash avoidance technology from the bumper prior to impact (specific regulatory text recommendations detailed in Appendix A).

Adoption of the above recommendation, would provide three key benefits: ability and incentive for vehicle manufacturers to fit advanced crash avoidance technologies (with commensurate safety and damage reduction benefits) as **standard equipment**, design flexibility

to provide bumper systems with improved pedestrian leg impact protection, and cost reductions due to harmonization with ECE R42 requirements employed by most of the other major markets (that require bumper impact protection).

We look forward to your prompt response and stand prepared to provide you with any additional information you may need. Given the fact that members have already made commitments to voluntarily make AEB standard on their light duty vehicles by the 2023MY, it is vital that rulemaking consideration of this petition be a priority for the agency.

Sincerely,

A handwritten signature in blue ink, appearing to read "Robert Strassburger".

Robert Strassburger
Vice President
Safety and Harmonization
Alliance of Automobile Manufacturers, Inc.

A handwritten signature in blue ink, appearing to read "Stephen G. Gehring".

Stephen G. Gehring
Vice President
Vehicle Safety and Connected Automation
Association of Global Automakers, Inc.

A handwritten signature in black ink, appearing to read "Leigh S Merino".

Leigh Merino
Senior Director, Regulatory Affairs
Motor & Equipment Manufacturers
Association (MEMA)

cc: Ryan Posten, Associate Administrator for Rulemaking

Appendix A.

ECE R42 Performance Requirements to Be Incorporated into Part 581

§ 581.1 Scope.

.....

§ 581.2 Purpose.

.....

§ 581.3 Application.

.....

§ 581.4 Definitions.

All terms defined in 49 U.S.C. 32101 are used as defined therein.

~~*Bumper face bar* means any component of the bumper system that contacts the impact ridge of the pendulum test device.~~

Advanced crash avoidance technology means a system that detects and (i) warns, (ii) assists the driver, (iii) provides a signal to the brake system to stop the vehicle without brake pedal input from a human driver, or (iv) engages an automatic action, in order to avoid or mitigate a collision.

Bumper mounted or contained components means components that are either part of the bumper system, mounted to the bumper system or contained within the bumpers system, or located in the impact deformation stroke area.

Laden test weight means the weight of a motor vehicle with standard equipment; maximum capacity of engine fuel, oil, and coolant; and, if so equipped, air conditioning and additional weight optional engine; plus the weight of the passengers (taking 75 kg. per passenger) distributed as follows:

<u>Number of seating positions</u>	<u>Number of passengers</u>	<u>Distribution</u>
<u>2 and 3</u>	<u>2</u>	<u>2 in the front seats</u>
<u>4 and 5</u>	<u>3</u>	<u>2 in the front seats</u> <u>1 in the back seat</u>
<u>6 and 7</u>	<u>4</u>	<u>2 in the front seats</u> <u>2 in the rearmost seats</u>
<u>8 and 9</u>	<u>5</u>	<u>2 in the front seats</u> <u>3 in the rearmost seats</u> <u>When the rear row of seats has only two seating positions, one person shall be on the second row from the rear</u>

Reference height means the height above the ground at which the vehicle should embody sufficient protective devices at "laden test weight". This reference height is that of the horizontal plane passing through the reference line of the impactor described in paragraph 2.3. of annex 3 to this Regulation.

Reference line means a line outside the impactor at the intersection of the horizontal plane of symmetry of the impact contour with the impact contour itself, plane A of the impactor being vertical.

Vehicle corner means the vehicle's point of contact with a tangent vertical plane which makes an angle of 60° with the longitudinal median plane of the vehicle.

[42 FR 24059, May 12, 1977, as amended at 64 FR 2862, Jan. 19, 1999]

§ 581.5 Requirements.

(a) — ~~Each vehicle shall meet the damage criteria of §§ 581.5(c)(1) through 581.5(c)(9) when impacted by a pendulum-type test device in accordance with the procedures of § 581.7(b), under the conditions of § 581.6, at an impact speed of 1.5 m.p.h., and when impacted by a pendulum-type test device in accordance with the procedures of § 581.7(a) at 2.5 m.p.h., followed by an impact into a fixed collision barrier that is perpendicular to the line of travel of the vehicle, while traveling longitudinally forward, then longitudinally rearward, under the conditions of § 581.6, at 2.5 m.p.h.~~

(b) — [Reserved]

(c) — Protective criteria-

(1) ~~Each lamp or reflective device except license plate lamps shall be free of cracks and shall comply with applicable visibility requirements of S5.3.1.1 of Standard No. 108 (§ 571.108 of this~~

chapter). The aim of each headlamp installed on the vehicle shall be adjustable to within the beam aim inspection limits specified in Table 1 of SAE Recommended Practice J599 AUG97, measured with the aiming method appropriate for that headlamp.

(2) — The vehicle's hood, trunk, and doors shall operate in the normal manner.

(3) — The vehicle's fuel and cooling systems shall have no leaks or constricted fluid passages and all sealing devices and caps shall operate in the normal manner.

(4) — The vehicle's exhaust system shall have no leaks or constrictions.

(5) — The vehicle's propulsion, suspension, steering, and braking systems shall remain in adjustment and shall operate in the normal manner.

(6) — A pressure vessel used to absorb impact energy in an exterior protection system by the accumulation of gas pressure or hydraulic pressure shall not suffer loss of gas or fluid accompanied by separation of fragments from the vessel.

(7) — The vehicle shall not touch the test device, except on the impact ridge shown in Figures 1 and 2, with a force that exceeds 2000 pounds on the combined surfaces of Planes A and B of the test device.

(8) — The exterior surfaces shall have no separations of surface materials, paint, polymeric coatings, or other covering materials from the surface to which they are bonded, and no permanent deviations from their original contours 30 minutes after completion of each pendulum and barrier impact, except where such damage occurs to the bumper face bar and the components and associated fasteners that directly attach the bumper face bar to the chassis frame.

(9) — Except as provided in § 581.5(c)(8), there shall be no breakage or release of fasteners or joints.

(a) After each impact test made in accordance with the conditions and procedure specified in sections 581.6 and 581.7 of this Regulation, the vehicle shall meet the following requirements:

(1) The lighting and signaling devices shall continue to operate correctly and to remain visible. Should the adjustment of the factory-fitted lighting devices be disturbed, it may be corrected to conform to the required specifications, provided this can be done by the normal means of adjustment. Bulbs may be replaced in the event of filament failure.

(2) The vehicle's hood, trunk lid and doors shall be operable in the normal manner; in addition, the side doors of the vehicle shall not be able to open under the effect of the impact.

(3) The vehicle's fuel and cooling systems shall have neither leaks nor constricted fluid passages which prevent normal functioning; their sealing devices and caps shall be operable in the normal manner.

(4) The vehicle's exhaust system shall not suffer any damage or displacement which would prevent its normal function.

(5) The vehicle's propulsion, suspension (including tires), steering and braking systems shall remain in adjustment and shall operate in a normal manner. For purposes of this subsection, the term "braking systems" means the components installed on a motor vehicle to enable compliance with FMVSS 135 (49 C.F.R. 571.135) and does not include any advanced crash avoidance technology.

[42 FR 24059, May 12, 1977, as amended at 42 FR 38909, Aug. 1, 1977; 43 FR 40231, Sept. 11, 1978; 47 FR 21837, May 20, 1982; 64 FR 16360, Apr. 5, 1999; 64 FR 49092, Sept. 10, 1999]

§ 581.6 Conditions.

The vehicle shall meet the requirements of § 581.5 under the following conditions.

(a) General:

- (1) The vehicle is at un-loaded vehicle weight.
- (2) The front wheels are in the straight ahead position.
- (3) Tires are inflated to the vehicle manufacturer's recommended pressure for the specified loading condition.
- (4) Brakes are disengaged and the transmission is in neutral.
- (5) Trailer hitches, license plate brackets, and headlamp washers are removed from the vehicle. Running lights, fog lamps, and equipment mounted on the bumper face bar are removed from the vehicle if they are optional equipment.

(b) Pendulum test conditions. The following conditions apply to the pendulum test procedures of § 581.7 (a) and (b).

- (1) The test device consists of a block with one side contoured as specified in Figure 1 and Figure 2 with the impact ridge made of A1S1 4130 steel hardened to 34 Rockwell "C." The impact ridge and the surfaces in Planes A and B of the test device are finished with a surface roughness of 32 as specified by SAE Recommended Practice J449A, June 1963. From the point of release of the device until the onset of rebound, the pendulum suspension system holds Plane A vertical, with the arc described by any point on the impact line lying in a vertical plane (for § 581.7(a), longitudinal; for § 581.7(b), at an angle of 30° to a vertical longitudinal plane) and having a constant radius of not less than 11 feet.
- (2) With Plane A vertical, the impact line shown in Figures 1 and 2 is horizontal at the same height as the test device's center of percussion.
- (3) The effective impacting mass of the test device is equal to the mass of the tested vehicle.
- (4) When impacted by the test device, the vehicle is at rest on a level rigid concrete surface.

~~(c) — Barrier test condition. At the onset of a barrier impact, the vehicle's engine is operating at idling speed in accordance with the manufacturer's specifications. Vehicle systems that are not necessary to the movement of the vehicle are not operating during impact.~~

(a) Testing ground

The test area shall be large enough to accommodate the impactor (striker) propulsion system and to permit after-impact displacement of the vehicle impacted and installation of the test equipment. The vehicle shall be placed on a horizontal and level rigid smooth surface.

(b) State of the vehicle

(1) The vehicle shall be at rest.

(2) The front wheels shall be in the straight-ahead position.

(3) The tires shall be inflated to the pressure recommended by the vehicle manufacturer.

(4) The brakes shall be disengaged and the transmission control shall be in neutral position.

(5) Vehicles equipped with hydro pneumatic, hydraulic or pneumatic suspension or a device for automatic levelling according to load shall be tested in the normal running conditions specified by the manufacturer.

(6) Trailer hitches, license plate brackets, headlamp washers, and bumper mounted or contained components of any advanced crash avoidance technologies may be removed from the vehicle. Any advanced crash avoidance technology is turned off prior to the pendulum test. Illumination of the brake system warning indicator required by FMVSS 135 S.5.5 shall not by itself constitute a failure of this provision. Running lights, fog lamps, and equipment mounted on the bumper face bar are removed from the vehicle if they are optional equipment.

(c) Impactor (striker)

(1) The impactor shall be of rigid construction, the impact contour being of hardened steel.

(2) The impacting surface shall conform to the diagram in the figure.

(3) The effective mass shall be equal to the mass corresponding to the "curb weight" of the vehicle to be tested.

(4) With plane A of the impactor vertical, the reference line shall be horizontal.

(5) The first contact of the impactor with the vehicle shall be by the impact contour on the protective device. In the two vehicle loading conditions the protective device between the corners, as defined in paragraph 3.1.5. of this Regulation, shall be intersected by the horizontal plane passing through the reference line.

(6) The reference height is 445 mm.

(d) Propulsion of the impactor

The impactor may either be secured to a carriage (moving barrier) or form part of a pendulum.

(1) Special provisions applicable where a moving barrier is used

(1.1) If the impactor is secured to a carriage (moving barrier) by a restraining element, the latter must be rigid and be incapable of being deformed by the impact; the carriage shall at the moment of impact be capable of moving freely and no longer be subject to the action of the propelling device.

(2) Special provisions applicable where a pendulum is used

(2.1) The distance between the pivot and the center of percussion shall be at least 3.3 m. The reference line shall coincide with the center of percussion.

(2.2) Plane A of the pendulum shall remain parallel with its axis of rotation throughout the test.

(2.3) In the case of a parallelogram-suspended pendulum, the trajectory described by any point on the reference line shall be constant with a radius of at least 3.3 m.

(Authority: Sec. 102, Pub. L. 92-513, 86 Stat. 947 (15 U.S.C. 1912); secs. 103, 119, Pub. L. 89-563, 80 Stat. 718 (15 U.S.C. 1392, 1407); delegation of authority at 49 CFR 1.50 and 501.7)

[42 FR 24059, May 12, 1977, as amended at 42 FR 38909, Aug. 1, 1977; 48 FR 43331, Sept. 23, 1983]

§ 581.7 Test procedures.

(a) Longitudinal impact test procedures.

~~(1) Impact the vehicle's front surface and its rear surface two times each with the impact line at any height from 16 to 20 inches, inclusive, in accordance with the following procedure.~~

~~(2) For impacts at a height of 20 inches, place the test device shown in Figure 1 so that Plane A is vertical and the impact line is horizontal at the specified height.~~

~~(3) For impacts at a height between 20 inches and 16 inches, place the test device shown in Figure 2 so that Plane A is vertical and the impact line is horizontal at a height within the range.~~

~~(4) For each impact, position the test device so that the impact line is at least 2 inches apart in vertical direction from its position in any prior impact, unless the midpoint of the impact line with respect to the vehicle is to be more than 12 inches apart laterally from its position in any prior impact.~~

~~(5) For each impact, align the vehicle so that it touches, but does not move, the test device, with the vehicle's longitudinal centerline perpendicular to the plane that includes Plane A of the test device and with the test device in-board of the vehicle corner test positions specified in § 581.7(b).~~

~~(6) Move the test device away from the vehicle, then release it to impact the vehicle.~~

~~(7) Perform the impacts at intervals of not less than 30 minutes.~~

(1) This test consists of two impacts on the front surface and two impacts on the rear surface of the vehicle. On each surface, one impact is made with the vehicle at "curb weight", and the other is made with the vehicle at "laden test weight", as defined in section S 581.4.

(2) For the impacts on the front and rear surfaces, the choice of location of the impactor for the first impact is free, but for the second impact the median plane of the impactor shall be at a distance at least 300 mm from the first, provided that during these impacts the extremities of the impactor do not pass outside a zone defined by two planes parallel to the longitudinal median plane and passing through the corners of the vehicle.

(3) The impactor shown in the figure should be placed so that plane A is vertical and the reference line is horizontal at the reference height of 445 mm.

(4) The vehicle should be aligned so that a point between the vehicle corners touches, but does not move, the impactor, the longitudinal median plane of the vehicle being perpendicular to plane A of the impactor.

(5) The vehicle should be impacted at a speed of 4 (+0.25 to -0) km/h

(b) Corner impact test procedure.

~~(1) Impact a front corner and a rear corner of the vehicle once each with the impact line at a height of 20 inches and impact the other front corner and the other rear corner once each with the impact line at any height from 16 to 20 inches, inclusive, in accordance with the following procedure.~~

~~(2) For an impact at a height of 20 inches, place the test device shown in Figure 1 so that Plane A is vertical and the impact line is horizontal at the specified height.~~

~~(3) For an impact at a height between 16 inches and 20 inches, place the test device shown in Figure 2 so that Plane A is vertical and the impact line is horizontal at a height within the range.~~

~~(4) Align the vehicle so that a vehicle corner touches, but does not move, the lateral center of the test device with Plane A of the test device forming an angle of 60 degrees with a vertical longitudinal plane.~~

~~(5) Move the test device away from the vehicle, then release it to impact the vehicle.~~

~~(6) Perform the impact at intervals of not less than 30 minutes.~~

(1) This test consists of an impact at one front corner and an impact at one rear corner of the vehicle, which is at "curb weight", and an impact at the other front corner and the other rear corner with the vehicle at the "laden test weight" defined in section 581. 4.

(2) The impactor shown in the figure should be placed so that plane A is vertical and the reference line is horizontal and at the reference height of 445 mm.

(3) The vehicle should be aligned so that a corner of the vehicle touches the impactor without moving it. In addition, the following conditions shall be met:

(3.1) plane A of the impactor shall make an angle of $60 \pm 5^\circ$ with the longitudinal median plane of the vehicle;

(3.2) the point of the first contact shall be in the vertical median plane of the impactor (within a tolerance of ± 25 mm).

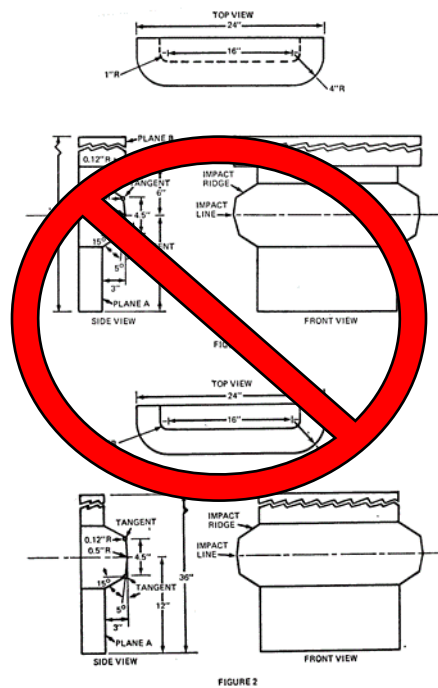
(4) The vehicle should be impacted at a speed of 2.5 (+0.1 to -0) km/h

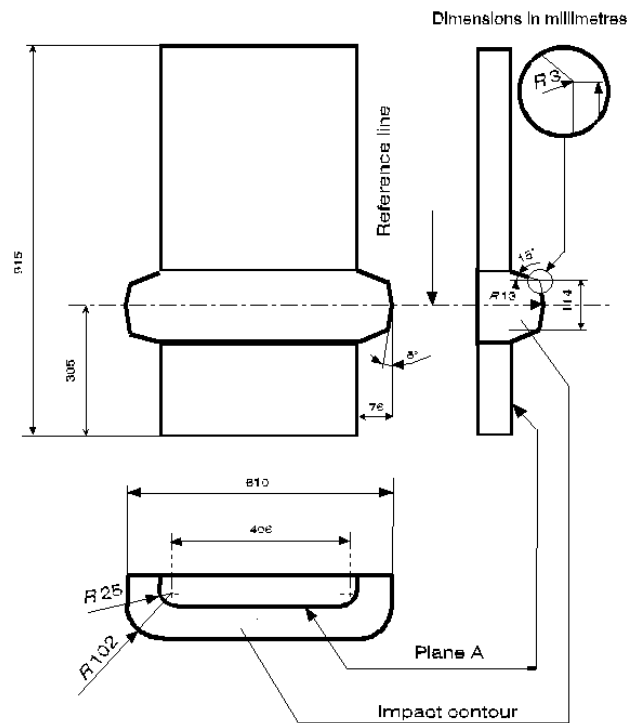
(c). Conditions governing repair, replacement and measurement

(1) The protective devices and the mountings attaching them to the vehicle structure may be repaired or replaced between the tests.

(2) If the protective devices include self-restoring materials, the permitted recovery time between tests shall be as stated by the manufacturer.

(3) If the manufacturer so requests, a vehicle of the same type may be used for each test.





[42 FR 24059, May 12, 1977, as amended at 42 FR 38909, Aug. 1, 1977]

§ 581.8 Exemptions.

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Appendix 3

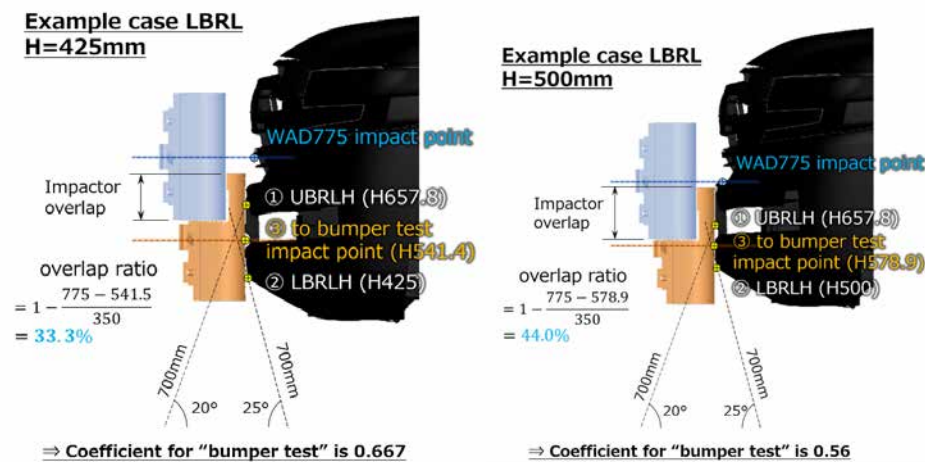
Alternative Method for Lower Legform Testing

Alternative to NCAP RFC Proposal for Lower Legform Testing

The following provides an alternative method to the two proposed conditions in the RFC of the lower legform testing, specifically, (1) the sole use of the FlexPLI in the 425-500mm lower bumper reference line (LBRL) range, and (2) the agency's proposal to assign a "zero score" for lower leg bumper testing when evaluating vehicles with an LBRL greater than 500mm. We strongly recommend NHTSA reconsider proposed conditions in the RFC which potentially disadvantage vehicles particularly with higher bumper heights, as measured according to the LBRL.

(1) Modified proposal for bumper testing for 425-500mm LBRL vehicles

In line with the Euro NCAP protocols, we recommend allowing the use of either the FlexPLI impactor or TRL upper legform impactor for bumper testing in the LBRL range of 425-500mm. The reason is to account for biofidelity concerns of the FlexPLI with certain high bumper height situations, as described in more detail in the U.N. Global technical regulation No. 9 on PEDESTRIAN SAFETY, addendum 9 established on 12 November 2008¹: "The reason that the lower legform test would not be applied to certain vehicles is due to the height limitations of the impactor, and the feasibility limitations of high-bumper vehicles to meet the test. The contact point between impactor and bumper should be below the knee, due to the impactor's structure and characteristics." However, understanding NHTSA's concern not to "double count" impact zones (i.e., avoid redundancy) that could be covered by the WAD775 "upper legform" test for the LBRL range of 425-500mm, we propose using a coefficient factor (of less than 1) that would lessen the score of the bumper test – only if the upper legform (TRL) is used for this range – based on the overlap ratio between the distances covered by the upper legform in the upper legform test (WAD775) and the upper legform (TRL) in the bumper test. This is depicted in the figures below for a "representative" (example) model for the 425mm and 500mm LBRL:



This approach balances NHTSA's concern about "a situation where a high-bumper vehicle, such as a pickup truck, receives a similar score as a low-bumper vehicle," yet affording an option for testing (and thus designing effective countermeasures) when the FlexPLI is not suitable in the 425-500mm LBRL range. The FlexPLI may not be suitable and less biofidelic when certain bumper design characteristics, such as a bumper skirt, are not present for the high-bumper vehicles. On the other hand, the TRL upper legform impactor is capable of assessing countermeasures that suppress the force around the human knee area in those types of vehicles.

¹ GLOBAL REGISTRY, Created on 18 November 2004, pursuant to Article 6 of the AGREEMENT CONCERNING THE ESTABLISHING OF GLOBAL TECHNICAL REGULATIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES (ECE/TRANS/132 and Corr.1), Done at Geneva on 25 June 1988, Addendum, Global technical regulation No. 9 PEDESTRIAN SAFETY (Established in the Global Registry on 12 November 2008), See: <https://unece.org/fileadmin/DAM/trans/main/wp29/wp29wgs/wp29gen/wp29registry/ECE-TRANS-180a9e.pdf>

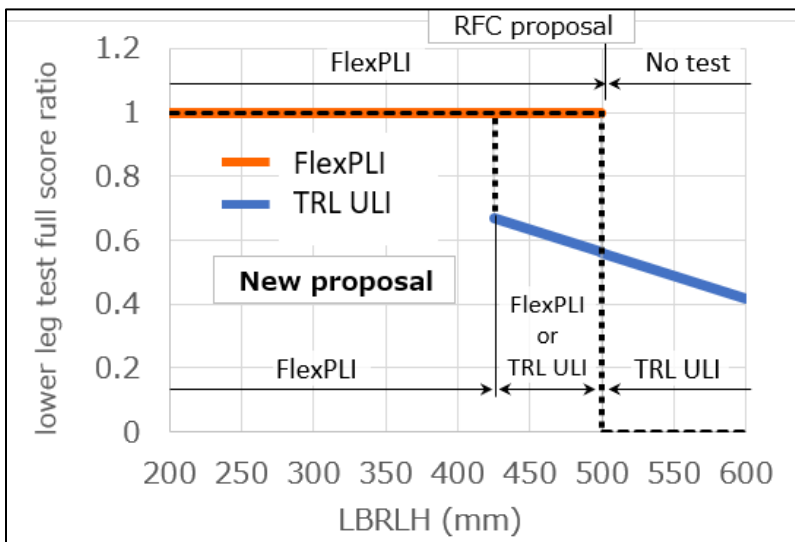
(2) Modified proposal for bumper testing for 500mm and above LRBL vehicles

As previously noted, Auto Innovators opposes the agency's proposal to assign an automatic zero score for vehicles with an LBRL greater than 500mm because it has the effect of discrediting any countermeasures and features that could be beneficial for mitigating leg injuries. By automatically assigning a zero score, the maximum attainable score for these vehicles is reduced from 36pts down to 22.5pts. This means that scoring for the remaining component tests (for the head and upper leg) needs to be almost perfect to achieve the agency's proposed 21.6pts (60%) score for receiving credit for pedestrian crashworthiness.

This further emphasizes the need for NHTSA to adopt the aPLI to support the testing of vehicles with a higher LBRL. Alternatively, if the agency continues to pursue use of the Flex PLI in the longer term, updates must be made to either the test protocols and/or ratings criteria to provide the opportunity for vehicles to achieve some level of scoring. Assigning an arbitrary score of zero does not support a fair comparison and may underrepresent the actual safety performance of the vehicle, which in turn may adversely impact a consumer's purchasing decision.

The TRL upper legform impactor is capable of assessing countermeasures that suppress the force around the human knee area for high bumper vehicles. Therefore, we recommend continuing to apply the aforementioned "overlap ratio" method as a suitable alternative. This approach provides some credit for the bumper features that improve pedestrian protection in those high bumper vehicles. This method would apply for the TRL legform for vehicles with LBRL heights greater than 500mm. Multiplying a coefficient less than 1 depending on the ratio of overlap of the TRL legform in the bumper test vs. the upper leg WAD 775 test, as described previously, means no vehicle receives "full credit" (due to the concern of "double counting" similar impact points), but at least some credit is provided for offering pedestrian protection features in the bumper area.

For visualization only, the plot below shows the resulting weighting of how the bumper test score would be calculated (i.e., what the coefficient value would be as the multiplier of the score) for the representative (example) case above in section (1). The TRL legform plot is based on the "overlap ratio" of the legform as a function of the LBRL height. For comparison, the RFC proposal is also shown, which shows a drop-off from 1.0 to 0 at 500mm.



We emphasize that our preferred approach is for the agency to adopt the aPLI test device and reweight the proposed points apportionment for lower leg injury.