August 14, 2023

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

RE: Federal Motor Vehicle Safety Standards: Automatic Emergency Braking Systems for Light Vehicles [NHTSA-2023-0021]

Dear Acting Administrator Carlson,

The Alliance for Automotive Innovation (Auto Innovators) appreciates the opportunity to provide comments in response to the June 13, 2023 Federal Register Notice of Proposed Rulemaking (NPRM) to adopt a new Federal Motor Vehicle Safety Standard (FMVSS) to require automatic emergency braking (AEB), including pedestrian AEB (PAEB), systems on light vehicles.[1,2]

Auto Innovators members have been proactive in efforts to advance introduction of AEB and PAEB systems in the US market. Members continue to make significant research and development investment in order to ensure the availability of these Advanced Driver Assistance Systems (ADAS) prior to any regulatory requirements, at levels comparable to those established by FMVSS. This progress is due to the proactive commitments made by industry in 2016, which not only establish baseline levels of systems performance but also made AEB standard equipment no later than September 2022.[3] What is more, several manufacturers have exceeded the initial targets set and, as acknowledged by NHTSA in the NPRM, have developed systems that provide functionality at higher speeds and also include PAEB. These current production systems have demonstrated significant field safety benefits as proven through multiple studies conducted by NHTSA, individual OEM's and suppliers, the Insurance Institute for Highway Safety (IIHS), and through collaborations such as Partnership for Analytics Research in Traffic Safety (*PARTS*) program.[4] While not included in the aforementioned commitment, it is important to note that PAEB was also installed on approximately 83-percent of 2022 Model Year vehicles.[5]

The automotive industry shares the DOT/NHTSA goals of reducing vehicle and pedestrian injuries and fatalities on US roadways, including support for the National Roadway Safety Strategy and Road to Zero Coalition efforts to ensure a more holistic approach to safety that not only encourages safer vehicles, but also promotes a reduction in vehicle crashes, investment in infrastructure and the development of complementary policies to improve safety on our roadways. Policies must be designed to improve safety in a practical and feasible way to ensure

[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 Innova on 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 38632
[3] "Docket Submission of Commitments to Advancing Automatic Emergency Braking Technology" March 25, 2016. See: https://www.regulations.gov/document/NHTSA-2015-0101-0005
[4] https://www.nhtsa.gov/parts-partnership-for-analytics-research-in-traffic-safety
[5] Based on data from Wards Intelligence, Data Sheet, "% Factory Installed Electronic/ADAS Equipment on U.S. Cars and Light Trucks, '22 Model Year," 3/3/23 [Accessed: August 2023]

progress toward reducing the number and severity of crashes. From a safe vehicles perspective, the agency should also consider the relationship between crashworthiness and crash avoidance in reducing the overall number of fatal crashes and the severity of injuries sustained by occupants or pedestrians as the result of a collision. However, this does not obviate the need for continued investment in infrastructure so that pedestrians are not required to be present on the roadway due to the absence of an available, safe walkway.

Auto Innovators recognizes the agency's objectives in establishing a FMVSS for light vehicle AEB and PAEB systems and could be supportive of NHTSA rulemaking to establish a new baseline level of performance that builds upon the industry's commitment to improve safety. However, there are a number of fundamental issues that first must be addressed to ensure the final rule is practicable and reflective of the current pace of technological innovation.[6] Consistent with any FMVSS, efforts to develop regulations in this area must meet the need for improved safety and assure that performance requirements can be evaluated using objective, repeatable, and reproducible test procedures without introducing unintended consequences. If it is not changed from the NPRM, the final rule will cause major stumbling blocks for widespread consumer adoption and acceptance of AEB and PAEB.

To that end, we are concerned with several aspects of the NPRM. These concerns include, but are not limited to, the practicability of the proposed requirements, as well as the flawed assumption that current AEB systems do not require hardware changes and can meet the new standards through software updates alone. Auto Innovators disagrees with the agency basing its decisions on limited data. Such an approach does not adequately consider the potential unintended consequences of establishing a *no contact* requirement – particularly for certain high speed scenarios – and fails to evaluate alternative approaches that may be more reasonable and appropriate based on current levels of technology maturity, particularly when these systems have demonstrated very high levels of safety benefits under their current performance capabilities.

In addition, notwithstanding the residual technical concerns that would be introduced if the proposed rule were adopted in its current form, the notice does not adequately consider the lead time, research and testing efforts, or costs necessary to implement the FMVSS as proposed. There are also several areas where the agency implies in preamble text that certain levels of performance should be met but fails to establish a foundation for the feasibility of meeting the levels of performance or clear requirements for how this would be measured or determined in the real world thereby creating significant uncertainty in terms of product design and development.[7] In addition to concerns related to the AEB/PAEB requirements, the agency's proposal for Forward Collision Warning (FCW) would, in essence, require the installation of a heads-up-display (HUD) – something that was completely missing in the agency's required cost-benefit analysis.

To be clear, the intent of these comments is not to oppose the agency's decision to regulate AEB and PAEB; rather it is to propose constructive alternatives. The agency must first sufficiently weigh the associated benefits against the associated impact. This includes not only the cost of updating hardware and software requirements, but also the unintended consequences of high levels of intervention.

In addition, Auto Innovators recommends that NHTSA reconsider the role of NCAP for driving innovation and setting the foundation for future regulatory standards. By establishing a clear, reasonable, and practical path forward, the agency can begin to raise the bar in terms of current baseline standards and establish a framework

[6] 49 USC 30111

[7] For example, while not requiring that PAEB to be active below 10km/h, the agency "*anticipates that manufacturers will make the system available at the lowest practicable speed.*" In this case, there is ambiguity in terms of what should be considered "the lowest practicable speed" and how related performance might be objectively measured. See: https://www.federalregister.gov/d/2023-11863/p-490

that drives toward meaningful safety outcomes in a more practicable way without creating unnecessary delays in finalizing rulemaking on AEB/PAEB. We also note that there are several outstanding substantive issues that need to be addressed prior to finalizing the NPRM and we urge the agency to do so through a Supplemental Notice of Proposed Rulemaking (SNPRM).

If the rulemaking were finalized as proposed, it would create significant compliance challenges for manufacturers and almost assuredly result in unintended consequences that need to be more thoroughly considered through subsequent analysis. The automotive industry stands ready to provide technical support in addressing these outstanding concerns, and we encourage the agency to consider potential opportunities for collaborative engagement to help us reach our shared goals of reducing serious injuries and fatalities on our roadways.

1 Consideration of Alternatives to the AEB/PAEB Requirements

1.1 The proposed *no contact* requirement is not practicable and increases the potential for unintended consequences at the proposed test speeds.

The underlying technical analysis used by the agency to justify rulemaking appears to be largely similar to the approach used for establishing various levels of performance in NCAP. However, this is not sufficient to ensure that all aspects of the rule and related performance characteristics have been appropriately considered. The implications of establishing a *no contact* requirement in NCAP differ significantly from establishing the same requirements in regulation. If a manufacturer is unable to achieve this target in NCAP, it can still aspire to achieve as high a rating as possible based on available technology options. In a regulation, if the *no contact* requirement cannot be attained, the ability of manufacturers to introduce products into the marketplace is limited. The absence of rigorous analysis in this case puts manufacturers at risk of being unable to sell vehicles, even with high performing systems, as the underlying fundamentals of the proposed rule have not been fully considered.

To that end, a primary concern regarding the NPRM is the practicability of the agency's proposal to establish a *no contact* requirement– particularly at higher speeds. While we share in the agency's goal of preventing high-speed crashes on US roadways, it is expected that significant hardware and software changes will be needed to achieve a level of performance that no production vehicle can currently achieve, despite the agency's unsubstantiated conclusion that modern vehicles can address the proposed test scenarios solely through software upgrades. In the absence of reasonable accommodations related to this requirement, a substantial increase in lead time will be needed to ensure that progress can be implemented. We also note that the agency only considered a simple linear two vehicle system, which is distinct from more complex roadway conditions encountered by drivers under real world conditions. Additional analysis is critical to understand potential unintended consequences that may be introduced as result of these more stringent requirements.

Auto Innovators requests that the agency reconsider its proposal to impose a *no contact* requirement in the near-term, and instead consider one of several alternate approaches that still allow for meaningful safety gains to be achieved while also establishing a framework for continued improvements in safety moving forward.

1.2 Meeting the requirements of the proposed regulation will require significant hardware and software changes.

Auto Innovators strongly disagrees with the agency's assertation that "*nearly all vehicles subject to [the] proposal would already have the hardware capable of meeting the proposed requirements by the effective date of the final rule*," and sees no basis for this determination. The proposed AEB/PAEB test scenarios would require vehicles to be capable of achieving full crash avoidance for both vehicle-to-vehicle and vehicle-to-pedestrian in a series of low-speed and high-speed scenarios across varying light conditions *for PAEB*. This requires the use of sensors capable of accurately discerning the position and movements of objects under real-world conditions, requiring real-time decisions over both short and longer distances to ensure beneficial system activation while

avoiding false activations. At higher speeds, AEB must activate earlier, with higher situational uncertainty. As a result, it is more critical that sensors have the capability to detect objects at a distance and that the underlying software can classify these objects, their trajectories, and relevant environmental factors quickly and accurately enough in order to make a real time decision on whether or not to respond given limitations in how quickly information flows between vehicle systems. In some cases, this may require a significant, *generational* shift in underlying architecture to support higher levels of functionality – including higher sensing range, processing capabilities, and system redundancies to ensure appropriate levels of functional safety are provided under more complex operating conditions.[8]

As noted in the NPRM, vehicles typically use some combination of radar sensors and cameras to detect objects in the roadway environment. The notice also highlights the importance of software perception systems in processing sensor information to classify vehicles, pedestrians, or other objects and determine the need for potential intervention. The capabilities and limitations of the AEB/PAEB system are dependent on the hardware and software configuration for a given vehicle. In addition, it is important to note that the agency's analysis only focused on performance for sedan, SUV and crossover, and pickup vehicles, failing to consider the constraints associated with the installation of sensors on vehicles with non-conventional vehicle designs (e.g., sports cars), which may affect system capabilities based on their unique design characteristics and low profile.

With respect to the proposed rulemaking, the agency proposes to require AEB systems capable of achieving full crash avoidance in various scenarios at speeds up to 80km/h (50mph) without brake application and up to 100km/h (62mph) with braking. PAEB systems must also be capable of avoidance at speeds up to 65km/h (40mph) in both daylight as well as low light conditions. This combination of scenarios is extremely complex and relies on hardware capable of accurately detecting objects and their projected movements, determining the driver's intended path, processing this information in real time, and determining whether braking is needed and at what level. An incorrect determination can result in "false positives," where the brakes are applied in situations that may not warrant intervention, or "false negatives" when the system fails to detect an object. As noted in the NPRM, "AEB systems need to differentiate between a real threat and a non-threat to avoid false activations." However, in order to do so, the sensor systems must be capable of capturing a significant amount of information (which is time dependent), operating across both long and short range distances (to account for higher speed and continual changes in the roadway environment), and ever more sophisticated software systems that can perform the necessary processing of information to respond in a dynamically changing environment.

1.2.1 The agency's analysis of required hardware and software changes is insufficient.

In providing justification for these requirements, NHTSA conducted a limited comparative analysis of systems in the US market. [9] This research involved the evaluation of twelve MY 2021-22 vehicles equipped with AEB and PAEB based on the proposed test scenarios, test equipment, and environmental conditions as outlined in the NPRM. In addition, the agency also evaluated these vehicles against the two false positive scenarios that were also proposed. While the results of testing demonstrated that certain vehicles were capable of achieving crash avoidance across a range of test speeds in specific scenarios, it also showed that no vehicle was capable of achieving avoidance under all conditions that were tested. The agency also failed to evaluate repeatability and reproducibility of successful tests across multiple trails, and generally only repeated a given trial if the subject vehicle failed to achieve non-contact. In addition, no sensitivity analysis was conducted.

[8] It is also important to clarify that both AEB and PAEB systems are considered advanced driver assistance systems intended to support conventional drivers in the performance of the driving task. This is distinct from the more sophisticated and costly hardware and software implementations currently under development to support current and future automated vehicle deployment.

[9] NHTSA's 2022 Light Vehicle Automatic Emergency Braking Research Test Summary (2023)

Auto Innovators is concerned with the absence of a comprehensive review into the actual differences in the technical capabilities, performance specifications, and integration of sensor technologies between vehicles. We also question how the agency was able to use limited information to decide that improvements (for vehicles with a lower successful crash avoidance rate) can be achieved through software changes alone -- particularly as most variation between vehicles seemed to occur at higher test speeds. We recommend the agency supplement its analysis to include a more detailed technical evaluation of vehicle hardware and software capabilities; it is insufficient to base such an important rulemaking decision on the presumption that "all vehicles are assumed to have the necessary hardware."

1.2.2 NHTSA has not adequately considered the resource investments and lead time needed to update vehicle software systems.

The auto industry is in the midst of a generational shift and the core elements that define a modern vehicle are continually evolving as new and exciting innovations enter the marketplace. With an increasing shift toward electrification, advanced driver assistance systems, enhanced driver interfaces, and vehicle connectivity features, we are seeing significant changes in the underlying architecture and software needed to support automotive grade functionality across all of these interrelated systems. These are complex systems that require exhaustive testing, validation, and verification to ensure that all features work in unison to provide consumers with access to new features and functionality.

This is particularly relevant to the proposed rule given the complexity of the requirements under consideration. Even if the rule were achievable through software changes alone, it would likely require sizeable investment to ensure that vehicles continued to meet all applicable functional safety and related software and cybersecurity standards. Manufacturers are required to develop systems holistically and, while the agency may argue that "systems can achieve the proposed requirements through upgraded software," this cannot be known until a comprehensive system review, analysis, and synthesis has been performed.

The agency has proposed a three year lead time for compliance with the final rule. This compressed timeline could be extremely disruptive of vehicle developments already underway as it may require revisiting previous hardware and software design decisions and redesigning systems with a nexus to the AEB/PAEB system. In addition, existing vehicle electrical architectures may not be capable of handling the additional or upgraded sensors, additional communication bandwidth and processing power to upgrade the vehicle ADAS system to this level of performance. It is likely that the timeline would require substantial product updates that may not be practical or feasible within the proposed timeframe, as multiple aspects of the underlying vehicle architecture will likely be impacted. These proposed changes also come at a time when the industry is making significant investments in transitioning vehicles toward a more electric fleet to address fuel efficiency mandates, which means that sizable amounts of unplanned resources will need to be committed to update vehicles whose architectures are in the process of being phased out.[10] We urge the agency to take these factors into account when finalizing the proposed lead time given the financial impact associated with these independent yet conflicting policy timelines. We anticipate providing a more detailed assessment of the likely impact as part of supplemental comments in response to this notice.

1.3 NHTSA should reconsider the *no contact* requirement at certain test speeds.

The agency based its proposed requirements on the results of research evaluating a linear two-vehicle test track performance of vehicles equipped with AEB systems. While the research indicated that certain vehicles performed better under certain test conditions, the number of tests run, particularly at higher speeds, is

[10] *This includes pending rulemaking on Greenhouse Gas (GHG) Emissions standards, Corporate Average Fuel Economy (CAFE), and Advanced Clean Cars II (ACC2) requirements that are either conflicting or overlapping in nature.*

insufficient to make any reliable determination as to the repeatability and reproducibility of testing. Indeed, in many cases, the agency only ran one test per vehicle at each of the different speed ranges in each scenario, and no vehicle was found to have met all the requirements of the NPRM. These results provide a very limited understanding as to how vehicles will perform in the field and underscore the lack of sufficient testing and validation in the underlying rulemaking document.

1.3.1 Additional analysis is needed to understand unintended consequences.

The agency has not conducted sufficient analysis to address the potential for unintended consequences.

- ***False activations*** - While we recognize that the agency has proposed a series of alternatives for evaluating false positives, this does not negate the complexity of designing systems to meet the proposed requirements and reduce the likelihood of false positives occurring which will have negative impacts with consumer adoption and use of such technologies. This becomes increasingly more complex at higher speeds and in low light conditions where it becomes more challenging to discern the expected movements of objects in and around the roadway environment. Establishing a *no contact* requirement essentially requires a more conservative approach where manufactures need to refine the sensitivity of their systems to require more aggressive braking or potentially update hardware systems to provide greater redundancy in terms of object detection and classification at higher speeds. In both scenarios, this may result in increased warnings and brake activations beyond those that may actually warrant intervention and may cause unintended consequences.

- ***Negative driver acceptance due to increased intervention authority*** – The proposal also does not adequately consider driver steering inputs, including both planned and evasive steering for avoiding possible collisions. For example, if a driver were to encounter stopped or slow moving traffic in their current travel lane and decide to move to an adjacent lane -- where traffic is moving unimpeded -- an overly aggressive braking system may interrupt this maneuver (depending upon the timing of when the maneuver is initiated) and potentially create an unsafe condition due to unexpected or unwanted braking. This is a technically challenging issue to address given the difference between when it becomes necessary to initiate a braking maneuver (based on time to collision) versus initiating a steering avoidance maneuver to achieve crash avoidance, particularly at higher speeds.

  In principle, the crash imminent braking (CIB) component of AEB should not intervene with the driver's intentional behavior. This takes away authority or command of the vehicle from the driver. Whether the driver can avoid the collision by braking (with DBS accompanied by an FCW) or evasive steering, the automatic braking (i.e., CIB) should not take over until these two driver-initiated options are no longer possible.

  These scenarios will likely lead to consumer satisfaction issues and a corresponding increase in complaints and Vehicle Owner Questionnaires. This will add significant administrative burden and is ripe to make it more challenging to identify actual performance issues. We urge the agency to further evaluate this issue to identify the extent to which the proposed *no contact* requirements at higher speeds results in unintended consequences in the aforementioned (or similar) driving scenarios where driver steering inputs may be involved.

- ***Change in profile of rear end crashes*** – In the PRIA, NHTSA indicates that "sudden braking as a result of an AEB intervention is not expected to cause additional crashes." While it is the agency's assumption that when an "AEB intervenes, the vehicle behind would also be equipped with AEB that would also engage in response to the sudden braking," it is unlikely that this assumption is reasonable in that it

assumes significant distance between vehicles, a one dimensional travel condition and no lane change maneuvers. In addition, since not all vehicles on the roadway today are so equipped, it will take time for FMVSS compliant systems to achieve sufficient levels of fleet penetration. Even then, this presents potential challenges for the following vehicle. As a result, we anticipate that the rule will likely result in a shift in the profile of rear impact crashes whereby modern vehicles subject to the new requirements may be involved in fewer high severity front-rear crashes but may encounter higher instances of rear impact collisions due to limitation with the avoidance capabilities of the following vehicle. We request that NHTSA update its cost-benefit analysis to further evaluate these potential scenarios to understand potential limitations with the in the suggested hypothesis and more accurately account for anticipated changes in crash outcomes.

1.3.2 NHTSA should account for the complementary safety benefits afforded by advanced lighting.

Auto Innovators notes that the certain low light PAEB tests may not be practical or feasible given current FMVSS lighting requirements that limit the ability to illuminate pedestrians, particularly during higher speed scenarios where the PAEB system must reliably identify and classify the presence of a person in the roadway environment. We therefore propose for all dark lighting conditions that NHTSA allow the use of automatic high beam lights or other advanced lighting technology if available on the model as standard equipment, or to incorporate the use of streetlights to simulate urban traffic conditions. In addition, for vehicles equipped with a headlamp auto-levelizer system that utilizes vehicle acceleration data, we request that NHTSA initialize the system prior to nighttime testing according to the OEM's instructions. By allowing all dark lighting conditions to be tested with the advanced lighting features activated, this aligns with NHTSA's considerations for similar testing in the proposed NCAP upgrade and further promotes the adoption of these advanced lighting systems, which is beneficial to safety.

1.3.3 The expectation of no contact in the real world is not practical.

The current proposal suggests that technology is at the point where technology could avoid all rear-end crashes. While this is certainly an aspirational goal, Auto Innovators disagrees with the agency's characterization of AEB and PAEB systems and contends that this will create unreasonable expectations among consumers and result in potential misuse of these technologies. These are driver assistance systems that <u>are not intended to replace the role of the driver</u> in being attentive and responsive to changes in the roadway environments. NHTSA must be clear on this point. In addition, the final rule should make clear that any requirements related to the performance capabilities of these systems are limited to the test conditions that vehicles are certified against. It is unreasonable to create an expectation that *no contact* can be achieved across all real-world conditions and across all travel speeds, particularly where environmental conditions and other factors within the roadway environment may influence the potential outcome in a given scenario. This also puts manufacturers in an untenable situation whereby every frontal collision involving an AEB/PAEB equipped vehicle may be considered a potential compliance violation, when in fact the conditions encountered in the event of a crash may be different to those encountered during vehicle certification. This is both impractical and unreasonable and imposes a significant post-rule burden on manufacturers with respect to Early Warning Reporting.

1.3.4 The agency has not adequately considered reduction in injury risk that can be directly achieved through speed reduction.

In its comparison of regulatory alternatives, the agency considered four options which differed based on the overall number and complexity of crash avoidance scenarios that would need to be met in order to meet the requirements of the final rule. While we appreciate the agency considering more than one potential pathway forward, each of the options was predicated on maintaining a *no contact* requirement that is not practicable given the proposed timelines and suggested cost of implementation. In doing so the agency has not adequately

considered whether establishing an acceptable level of speed reduction would yield similar safety benefits. This approach is also consistent with other global programs (e.g., Euro NCAP), which encourage crash avoidance, but recognize significant safety benefits can be achieved through speed reduction and allowing for vehicle crashworthiness systems to further reduce any risk of serious injury. This approach will also help reduce the complexity in differentiating between real threats and non-threats to avoid false activations, requiring less lead time for manufacturers to implemented changes, while also achieving comparable safety benefits in terms of occupant injury outcomes.

1.3.5 NHTSA should reconsider the braking requirements at higher speeds to account for driver steering inputs.

In principle, the crash imminent braking (CIB) component of AEB should not intervene with the driver's intentional behavior. Doing so takes away authority or command of the vehicle from the driver. Whether the driver can avoid the collision by braking (with DBS accompanied by an FCW) or evasive steering, the automatic braking (i.e., CIB) should not take over until these two driver-initiated options are no longer possible. According to government/industry collaborative conducted through the Crash Avoidance Metrics Partnership (CAMP) and funded by NHTSA (Kiefer, et al.), the time required to avoid impact by steering or braking are equal at approximately 35 kph and 0.61 seconds.[11] Above 35 kph, avoidance though braking begins to require increasingly more time than steering. These values are, however, very dependent on individual vehicle driving dynamics (e.g., stopping distance and lateral acceleration limits). Driver behavior assessments conducted in this study show drivers are generally more likely to initiate braking to avoid striking an object at speeds below 44 kph and are more likely to initiate steering to avoid impact above 44 kph. In either case, the driver will typically initiate their maneuver before 1.7 seconds TTC. Therefore, any requirements on AEB systems to avoid impacts at higher speeds will necessitate activation of emergency braking before the driver has an opportunity to steer around the threat when a steering maneuver would be more effective. Subsequent analysis by Auto Innovators members estimates that the possibility that a driver could initiate a steering maneuver could occur until the TTC is approximately 1.57s. If a no contact criterion is required for speeds above approximately 60 km/h, the time required to initiate braking would occur conceivably before the TTC of 1.57s. We therefore urge the agency to consider these factors in establishing more reasonable crash avoidance thresholds that consider normal driving behavior and acceptable levels of intervention authority for consumers.

1.3.6 Proposed alternatives to the no contact requirement – AEB.

Auto Innovators recommends that the agency implement a hybrid approach that maintains *no contact* requirements for lower-mid-range speeds while permitting compliance if acceptable speed reductions that reduce the risk of serious injury can be achieved in higher-speed scenarios. This is fundamental for addressing the consumer acceptance issues, as well as reducing instances of false positives, either real or perceived, which have additional unintended consequences associated with them.

- ***Approach #1*** - Auto Innovators supports and recommends harmonization with UN R152, which establishes more reasonable thresholds in terms of crash avoidance and would significantly address the aforementioned practicability concerns. This is a widely accepted alternative that not only ensures greater international harmonization, but also provides the necessary assurances with respect to speed reduction and limiting the potential likelihood of serious MAIS 3+ injuries and fatalities. While we recognize that the requirements of R152 only require systems to be active between 10 km/h and 60km/h, it is possible for the agency to further extrapolate and establish appropriate speed reduction thresholds at travel higher speeds up to 100km/h.[12]

[11] *Forward Collision Warning Requirements Project Final Report - Task 1 (DOT HS 809 574) -- January 2003.*

[12] The documentation in support of the development of UNECE R152 includes a tool that can be used to determine appropriate speed reduction thresholds above 60km/h [See: AEB-05-06 https://wiki.unece.org/pages/viewpage.action?pageId=60362578

While requiring various level braking functionality above 60 km/h introduces some additional complexity in terms of updating systems designed to meet the current R152, this overall approach would likely require substantially less lead time for implementation versus the proposed *no contact* requirements in the NPRM.

- ***Approach #2*** - In addition to Approach 1, another alternative would be to base the requirements on preserving steering intervention at least up until 1.57 seconds before collision (with appropriate tolerances for potential variance in AEB activation timing TTC [up to 20%]). This approach would maintain AEB requirements of no contact up to 42 km/h but would permit some levels of reduced contact above 42 km/h, (i.e., 50, 60, 70 and 80km/h) with relative residual contact speed no greater than an impact speed that correlates to <10% AIS3+ injury risk. In this case, for all final test conditions (especially at higher test speeds) NHTSA should ensure, as a priority, that steering intervention or other intentional driving behavior can be preserved with the TTC intervention times needed to achieve these relative impact speed conditions.

These recommendations are largely consistent with the *speed reduction* approach that have been implemented by other international regulatory bodies (and consumer education programs) and ensure that vehicle speeds are reduced to a level where the crashworthiness features including seatbelts, airbags, and underlying crash structures can provide an additional layer of protection for reducing the severity of occupant and pedestrian injury outcomes by lowering the overall impact speed. This also provides overlapping and complementary layers of protection. Currently, FMVSS No. 208 is intended to provide occupant protection up to 56 km/h, and the proposed 2023 NCAP request for comment proposes increased protection for pedestrians in collisions up to 40km/h. At the proposed contact speed along this test range, the risk of occupants sustaining a serious MAIS 3+ injury is below 10% in combined frontal to rear impacts.

This suggested alternative is significantly more practicable given the current state of technology innovation and would help avoid many of the aforementioned unintended consequences associated with the proposed high-speed requirements. It would also require less lead time for manufacturers to implement, providing the agency with more immediate and attainable safety gains, and raising the baseline standard beyond the levels established as part of the voluntary industry commitment. We urge the agency to consider these alternative proposals and recommendations as a part of an updated SNPRM.

1.3.1 Proposed alternative to the no contact requirement – PAEB.

For the PAEB *no contact* requirement, we recommend a similar hybrid approach that would maintain the no contact requirements at vehicles speeds up to 30 km/h but permit some level of contact if an acceptable speed reduction were achieved at the higher-range speeds (above 30 km/h). The complexity in providing full crash avoidance and higher speeds may not always be practicable, particularly given the increased potential for false positives under real world conditions. To minimize false positives, the PAEB system must have sufficient information upon which to base its decision to apply braking force. However, this is not always straightforward given the sometimes unpredictable movement of pedestrians in and around the roadway environment. Certain scenarios, which were less stringent in terms to the proposed test speeds and lighting conditions in the NPRM, would require activation prior to making a determination as to whether or not the pedestrian had entered the path of the vehicle.[13] This again could lead to circumstances where the driver perceives there to be a malfunction or error with the system, or where bad actors seek to manipulate the AEB system in to activating by imitating the act of entering the roadway environment.[14]

[13] https://www.regulations.gov/comment/NHTSA-2019-0102-0408

[14] For example, in real world scenarios, collision avoidance at 60kph with 25% overlap requires AEB activation very early and could therefore lead to false positive braking if the pedestrian stops or reverses their trajectory in the last moment (i.e., before entering vehicle path)

We recommend that the agency set the requirements of the regulation with the goal of minimizing the risk of serious injury in cases where vehicle to pedestrian contact occur, while providing for more certainty in making a determination to apply the brakes for crash avoidance and mitigation. Based on available research, establishing a residual relative speed contact threshold not to exceed 25km/h would ensure the risks of sustaining a MAIS 3+ injury is well below 10%.[15] This exceeds the acceptable injury thresholds established in NCAP (for achieving a five star rating) as well as the recommendations of Academic Expert Group for the 3rd Global Ministerial Conference on Road Safety.[16]

1.3.2 Role of NCAP to drive incremental improvements.

Auto Innovators disagrees with the agency's assessment regarding the effectiveness of non-regulatory approaches for advancing technology innovations in the marketplace – particularly the role of the NCAP for ensuring a more balanced and practicable approach for both incentivizing and achieving higher levels of performance within the vehicle fleet. From a crashworthiness perspective, FMVSS typically establishes the baseline levels of safety performance, with NCAP requiring manufacturers to go above and beyond the standard to achieve higher ratings. This has been successful with many now achieving four- or five-star safety ratings.

Recognizing the agency is in the midst of modernizing NCAP to provide a greater emphasis on crash avoidance, we recommend that NHTSA consider a similar approach for crash avoidance. More specifically, if the agency were to permit "speed reduction" for higher speed scenarios (to address near-term practicability concerns in the regulation), this could be complimented by updating the NCAP test procedures to harmonize with regulation more closely, with a no-contact requirement (or significant levels of speed reduction) needed to obtain a 5 star rating. This would help facilitate the nearer term implementation of FMVSS given the increased practicability of the standard, while also providing a basis to incentivize manufacturers to begin targeting higher levels of performance. As the number of higher performing vehicles in NCAP increases over time, the agency could potentially revisit rulemaking again based on the level of technological advancement in the future.

1.3.3 NHTSA should allow for multiple tests to demonstrate compliance.

Regardless of whether NHTSA maintains the *no contact* requirement for crash avoidance, the agency must provide manufacturers with the ability to conduct multiple tests to demonstrate compliance in the event of a failed test. More specifically, if a vehicle can demonstrate crash avoidance in 5 out of 7 test runs for a given scenario, then the vehicle should be eligible for certification. While this may add more time to the compliance verification process, this is necessary to account for environmental and other factors that may affect test outcome. This is also particularly relevant at higher speeds (above 60 km/h) where the potential for false positives is increased, and achieving full velocity reduction becomes more challenging. To help further minimize test burden, we propose an alternative compliance option where a vehicle may be certified if it achieves three consecutive "pass" test runs.

Concerns with damage to the bumper during testing should be secondary to ensuring system performance is appropriately evaluated. Any damage sustained during testing should be addressed according to the manufacturer's instructions. Additionally, NHTSA's proposal to adopt the Global Vehicle Target (GVT) for AEB testing will significantly reduce the likelihood of vehicle and/or test target damage in tests where contact occurs. Damage during past NHTSA NCAP tests occurred due to impacts with NHTSA's unique Strikable Surrogate Vehicle (SSV) target which is constructed from rigid carbon fiber. The newer GVT is correlated to real-world

[15] Estimation of Potential Safety Benefits for Pedestrian Crash Avoidance/Mitigation Systems, DOT HS 812 400, April 2017 [See: Figure 4 – Plots of Pedestrian Injury Cumulative Probability Functions]

[16] Saving Lives Beyond 2020: The Next Steps – Recommendations of the Academic Expert Group for the Third Ministerial Conference on Global Road Safety 2020, Publication number: TRV 2019:209

vehicles through collaborative global government/industry testing and verification, in which NHTSA participated, is significantly less likely to cause damage to either the test vehicle or target during testing and is widely accepted by multiple global regulatory and consumer metric organizations. Similar to our recommendations on vehicle damage, any damage to the test devices should be addressed per the manufacturer's instructions.

1.4 NHTSA should reconsider the proposed Forward Collision Warning (FCW) requirements.

1.4.1 FCW Auditory Signal

We agree with the agency's conclusion that the auditory signal should be the primary means of communicating with the driver. However, the FCW auditory signal requirements should be expanded to allow the option of providing an auditory alert that could be consistent with other audible warnings that convey urgency for driver alertness. In other words, the auditory alert may be distinct or shared with other auditory warnings of similar nature. Furthermore, we do not recommend defining the details of the requirements for sound level and characteristics, and to instead allow for the current warnings provided by manufacturers. This is consistent with UN R152 which does not define detailed requirements and provides necessary flexibility for providing alerts consistent with the overall HMI of the vehicle. Systems should be evaluated based on the default setting. We also support NHTSA's proposal that "[a]dditional warning modes, such as haptic, would be allowed," but agree that haptic alerts should not be required. We also support NHTSA providing a compliance option that allows for warnings to be provided using any combination 2 of the 3 of alert modalities.[17]

1.4.2 FCW Visual Signal Characteristics

Auto Innovators has significant concerns about the agency's proposal to require a visual warning within a 10-degree cone of the driver's line of sight. The agency's suggested rationale for this requirement is "based on the possibility that an instrument panel-based visual warning may distract the driver from the hazard ahead." However, NHTSA has not provided sufficient data to support this hypothesis and we disagree that the SAE J2400 information report provides adequate justification for the inclusion of a 10-degree requirement in regulation given that it is not an established industry standard. Furthermore, as noted in the NPRM, this requirement generally implies visual information be provided on top of dashboard or head-up display, both of which will likely result in significant hardware changes that have not been adequately contemplated in the agency's cost-benefit analysis. NHTSA has proposed no evidence that requiring such systems would result in meaningful safety improvements to justify a mandate when compared to how alerts are presented using conventional vehicle configurations. This proposal is also inconsistent with updates to UNECE R125 (*Forward field of vision of drivers*), which specifies that the HUD (*referred to as a Field of View Assistant*) should not be the primary means for communicating information mandated by regulation to the driver.[18] This restriction is primarily due to limitations related to the potential visibility of a heads up warning in adverse weather or lighting conditions where the screen contrast and brightness may affect the extent to which the alert can be seen by the driver.

Given that the FCW auditory signal is the primary means for alerting the driver, and that the FCW visual signal is intended to be confirmatory for the majority of drivers, the location is less critical provided that it is reasonably positioned within the peripheral field of view of the driver.[19] Auto Innovators therefore recommends that NHTSA revise the proposed 10-degree requirements to allow for visual warnings to be allowable within a 60-degree cone of the driver's line of sight. This is consistent with research establishing the criteria for "the peripheral

[17] https://www.federalregister.gov/d/2023-11863/p-149
[18] https://unece.org/transport/documents/2022/12/working-documents/grsg-proposal-supplement-2-02-series-amendments-un
[19] https://www.federalregister.gov/d/2023-11863/p-385

visual field, which extends 100 degrees laterally, 60 degrees medially, 60 degrees upward, and 75 degrees downward."[20]

Although Auto Innovators is opposed to NHTSA establishing a de facto requirement for head-up displays as part of this notice, it is important that the agency does not prevent the use of these systems in the near term or in the future. We therefore request that the agency provide enough flexibility within the rule whereby compliance can be measured based on the presentation of the alert within the suggested alternative 60-degree line of sight, but without specifying a particular technology. A 60-degree line of sight would allow for suitable placement of the visual alert in areas such as the meter cluster or multi-information display, which would be considered clearly visible in front of the driver.

Auto Innovators supports NHTSA adopting the ISO 7000-2681 forward collision warning system (FCWS) symbol for visually communicating the status of the FCW system. However, manufacturers should not be precluded from using their choice of FCW visual warning as NHTSA has presented no data to indicate that any one visual alert type or symbol is any more or less effective than another. Further, the steady-burn requirement should be reconsidered to at least allow the option for a flashing state. To date, millions of vehicles equipped with AEB have been sold in the U.S. and customers may be already familiar with the ISO symbol and flashing alert. To maintain these visual alert characteristics that consumers may already be accustomed to, which would be beneficial to safety, NHTSA should allow flexibility for manufacturers to select the visual warnings deemed to be most effective in the context of the overall vehicle HMI, which could include, but not be limited to, ISO or SAE symbols, word based warnings, or other flashing or steady burning illumination as deemed appropriate. If the agency is to require HUD, we request that the NHTSA conduct the necessary analysis to justify its inclusion. This should include a more comprehensive evaluation of conventional alternatives, including the safety cost-benefit of such imposing such a requirement.

1.5 Undefined performance requirements

Auto Innovators has significant concerns with the number of undefined performance requirements and suggested expectations for how NHTSA anticipates AEB, PAEB, and FCW systems should function. This creates significant challenges from a product development perspective as it is unclear whether or how NHTSA might seek to verify compliance given the lack of objective test criteria.

Within the preamble for *PAEB System Requirements*, the agency states that:[21]

> *Not requiring PAEB to be active below 10 km/h (6 mph) should not be construed to preclude making the AEB system active, if possible, at speeds below 10 km/h (6 mph). In fact, the agency anticipates that manufacturers will make the system available at the lowest practicable speed (the manual for 6 of the 11 tested vehicles shows PAEB available at speeds below 10 km/h).*

While we agree with the statement that not requiring PAEB be active below 10km/h (6mph) should not preclude making the AEB system active below those speeds, we disagree with the agency setting undefined performance requirements that are not stated in objective terms consistent with 49 U.S. Code 30111. If the agency is proposing systems be designed to perform in a certain manner, it should be supported by objective, repeatable, and reproducible test procedures with a clearly demonstrated safety need and accompanying safety benefits analysis. The agency must provide clarification when issuing a final rule that compliance verification will only be measured based on the defined test procedures that meet established criteria for rulemaking.

[20] Spector RH. Visual Fields. In: Walker HK, Hall WD, Hurst JW, editors. Clinical Methods: The History, Physical, and Laboratory Examinations. 3rd edition. Boston: Butterworths; 1990. Chapter 116. Available from: https://www.ncbi.nlm.nih.gov/books/NBK220/
[21] https://www.federalregister.gov/d/2023-11863/p-490

This concern also applies to the boundless requirement that AEB systems operate at all speeds above 10 km/h (6mph) and provide "at least some level of AEB system performance" in rear-end crashes even if those speeds are above those tested by NHTSA. We are opposed to NHTSA establishing open-ended performance requirements through regulation without objective test procedures, as it becomes increasingly more challenging to provide significant levels of speed reductions at higher speeds, and the expectation that manufacturers be capable of providing undefined levels of avoidance at *all* speeds is neither practicable nor reasonable. If the agency is to proceed with requirements that exceed the current speed ranges, this must be supported by relevant data to support the practicability and include defined and objective test procedures. The complexity in designing systems capable of going beyond what the agency proposes to test will likely result in significant development costs that have not been accounted for as part of the agency's cost-benefit analysis, and which add unnecessary costs for consumers while diverting research and development efforts from other priority areas that may yield greater improvements in vehicle safety. A defined upper bound or maximum operational speed for the AEB/PAEB system is needed due to the possible unstable vehicle dynamics that can result from hard braking at very high speeds and the effects on vehicle development. Without defined and objective criteria, policy uncertainty creates ambiguity with respect to potential enforcement actions as there are no clear parameters that can be used to reliably measure performance.

1.6 Defining the Environmental, Test Track and Subject Vehicle Test Conditions

Auto Innovators is generally supportive of the agency's efforts to ensure all aspects of the AEB/PAEB testing protocols are clearly defined. While we agree that the agency has for the most part described the necessary pretest conditions with sufficient detail, there are several areas where it is unclear how certain environmental conditions are measured. For example, where the agency is proposing a limitation on the presence of conditions that would obstruct visibility, this should be objectively defined. Additionally, Auto Innovators proposes NHTSA define the tolerance for the required test track surface (i.e., the maximum and minimum friction coefficients). This tolerance would (1) ensure fairness when conducting tests across different test facilities, (2) reduce the cost/burden associated with maintaining a test surface having a specific PFC, particularly since this value can change over time and (3) is consistent with NCAP's Crash Avoidance test procedures (e.g., CIB, DBS, etc.) which currently specify a tolerance. This is not intended as an exhaustive list, and we urge the agency to conduct a thorough review to ensure that any subjectivity with respect to other parameters is appropriately addressed.

2 Cost-benefit analysis and Preliminary Regulatory Impact Analysis (PRIA)

Auto Innovators is still in the process of reviewing the PRIA that was published in conjunction with the NPRM and will likely submit supplemental comments on this matter given the limited 60-day notice for providing comments in response to such a substantial document. However, based on a cursory review of the document, it is likely that many of the concerns that we have with this NPRM will be reflected in our review of that analysis also. We tentatively conclude that if the rulemaking proposal remains unchanged, NHTSA must update the PRIA to address the practicability concerns associated with the proposed requirements, include a more comprehensive analysis on the need for hardware and software changes, and provide a more thorough comparative analysis of alternatives to the *no contact* requirements at higher speed. The analysis should better address the impacts on small volume manufacturers, particularly where there may be additional technical issues to be addressed due to the nature of products being manufactured by certain SVMs (e.g., sports cars). This revised document should also be reviewed by OMB prior to any issuance of a final rule.

3 Consideration for Small Volume Manufacturers (SVM)

The Agency has not adequately considered the additional burden for SVMs. SVMs often produce vehicles with unique design characteristics that present additional compliance challenges. First, low ground clearance and the limited size of the front bumper often requires that radar is installed on the available bumper surface very close

to the ground. This low mounting location means that system designers are required to develop systems capable of managing increased sensor signal noise introduced by ground reflection, which adds to the complexity of object detection and classification, particularly over longer distances. Second, unlike mass-produced vehicles, the shape of the bumper may be more rounded (less flat) and produced using materials such as carbon-fiber which can be more reflective of radar signals. The combination of these two factors creates the potential for multiple path reflections of radar signals, increasing the potential for false positives and/or angular distortion of the target object in vertical and azimuth plane. Therefore, additional lead time is needed to address these outstanding challenges given the unique circumstances faced by SVMs as acknowledged by NHTSA in the NPRM.[22] Further consideration is also needed to ensure that the practicability of the proposed standards is applicable to non-conventional body styles outside of what was included in the proposed rulemaking. This also includes the extent to which the agency's cost benefit analysis may also need to be reevaluated to account for the aforementioned nuances when applying the proposed specifications to SVM vehicles.

4 Lead Time and Effective date

Auto Innovators is concerned with the 3-year lead time proposed in the NPRM. This is based on the practicability of the proposed *no contact* requirements, the agency's underestimation of both the hardware and software changes needed to achieve cash avoidance at higher speeds, and the complexity in addressing potential false positives. Given the significance of the changes needed to meet the requirements as proposed in the NPRM, a more reasonable timeframe for compliance would be seven (7) years or more for large volume manufacturers, with a further four (4) years for SVMs. Alternatively, Auto Innovators members would support a phased compliance schedule beginning five years after the rule is finalized, as is typically provided when dealing with such a significant and complex rulemaking. It should be noted however, that this would still not address the outstanding technical issues and unintended consequences as outlined above.

Alternatively, if the agency were to consider our recommendation to more closely harmonize with the requirements of R152, the lead time needed for compliance and realized safety benefits of improved AEB performance could occur sooner. The required lead time would be closer to the current proposal; however, Auto Innovators would still request a reasonable phase-in period to allow companies to conduct the necessary research and development needed to meet the new standard. We anticipate providing additional details on this alternative approach as part of a supplemental comments.

5 Additional Regulatory Considerations

Auto Innovators has identified five additional critical areas of concerns that must be addressed prior to the issuance of an SNPRM or final rule. These are defined below and are fully discussed in Appendix 1:

(1) **AEB specific issues** – These comments address issues related to the AEB test target selection for AEB, agreement on with the agency's suggestion to not require false activation tests, the need for flexibility in terms of how AEB performance is communicated to consumers, and recommendations for redefining the criteria for what should be considered "test completion."
(2) **PAEB specific issues** – These comments address issues related to the PAEB test target selection, the need to account for the complementary safety benefits afforded by advanced lighting; and a recommendation to remove the proposed stationary pedestrian test in nighttime conditions.
(3) **Malfunction detection requirements** – These comments address the need to reconsider the definition of what is considered a "malfunction," the need for flexibility in communicating malfunction warnings, recommendations on when surrounding system status warnings should be provided to drivers, the need to ensure complementary public education efforts to raise general awareness factors that may result in

[22] https://www.federalregister.gov/d/2023-11863/p-772

system limitations, and the need for flexibility terms of how system status warnings are provided to consumers.

(4) **AEB/PAEB Deactivation** – These comments address the need to ensure that deactivating the AEB system should not be contingent upon the deactivation of other safety systems, and that NHTSA should provide manufacturers with the ability to define automatic deactivation criteria.

(5) **Related Regulatory Concerns** – These comments address the need for the agency to consider the impact of FMVSS No. 127 AEB/PAEB rulemaking on other regulations, as well as the potential for creating potential barriers to the deployment of emerging technologies. More specifically, this section addresses longstanding concerns related to the Part 581 bumper damageability requirements, considerations for vehicles equipped with an Automated Driving System (or Automated Vehicle) without manual controls, concerns regarding electronically modulated braking systems, and consideration of the impact of vehicle weight and related braking requirements.

6 Conclusion

As always, Auto Innovators shares in NHTSA's goal of reducing impact of motor vehicle crashes. However, we are concerned with several elements of the agency's current proposal. These include the practicability of the proposed *no contact* requirements, the significant hardware and software changes needed to provide crash avoidance capabilities under all test conditions, the unsupported justification for requiring a heads up display, and the unreasonable lead time provided given the complexity of meeting the requirements of the rule.

Given that resolving these issues will likely require substantive, essential changes to the rule, we urge the agency to issue a SNPRM to address the aforementioned challenges, including those listed in the Appendix. This next step is critical for ensuring a more reasonable and practicable path forward that reduces the likelihood of serious injuries and fatalities in both frontal and pedestrian collisions and continues to build on the progress made possible through the more widespread introduction of ADAS technology. We recommend that the agency consider harmonization with UN R152 to help resolve these concerns.

Please contact Auto Innovators staff if you have any questions related to these comments, and we look forward to providing any input to help resolve outstanding issues in a timely manner.

Sincerely,

David Schwietert
Chief Policy Officer

Cc: Mr. Ryan Posten

Appendix 1

Additional Regulatory Considerations

1 AEB/PAEB NPRM -- Additional regulatory considerations.

1.1 AEB Specific Issues

1.1.1 NHTSA test target selection for AEB

Auto Innovators supports NHTSA's decision to adopt the Global Vehicle Target (GVT) for evaluating AEB performance. This device is more robust with respect to damageability and is more closely aligned with other regulatory and consumer information programs. We agree with NHTSA that the vehicle test device be based on specifications defined in ISO 19206–3:2021. We oppose the use of real vehicles for compliance verification as this presents significant challenges for test repeatability and reproducibility due to potential differences in vehicles selected for testing, and it may be expensive and time consuming repairs if contact occurs.

1.1.2 False activation tests

Auto Innovators agrees with the agency's suggestion to remove the false activation tests completely. The proposed track tests cannot replicate the complex roadway and traffic environments that can lead to false activations and, as a result, these tests provide no useful indication of a product's likelihood of generating or avoiding false activations while increasing the test burden on both manufacturers and NHTSA.

Manufacturers are already incentivized to address false positive scenarios that may be reasonably encountered under real-world conditions. However, we disagree with the need to establish documentation requirements; such a requirement will increase the administrative burden on manufacturers with no added safety benefit. Furthermore, the development of requirements for how manufacturers should structure and maintain documentation on false activations is outside of the scope of FMVSS, which is self-certified, and should be left to the discretion of the OEM. NHTSA already has existing tools and authority to investigate potential safety defects.

Auto Innovators is also strongly opposed to the suggested requirement for targeted data recording and storage of significant AEB activations. First, we question the appropriateness of the agency proposing a significant expansion of existing Event Data Recorder (EDR) requirements in the context of the AEB/PAEB rulemaking; any update to the EDR requirement should be done through a separate and distinct rulemaking. What is more, the agency has not provided <u>any</u> analysis on the technical feasibility of the proposal under consideration, nor has sufficient justification been made as to the practical utility of any data obtained as part of such a widespread information collection effort or the overall safety benefit to consumers. Second, the agency has not clearly identified why it should have ready access to any data given potential sensitivities regarding personally identifiable information such as location data and camera image data. NHTSA already has established means for obtaining Early Warning Reporting (EWR) information from manufacturers and, as with EDR, it is inappropriate to seek to expand those requirements through this rulemaking. Finally, it is unclear why non-crash AEB events that result in 20 km/h speed reduction are of interest to NHTSA and why the agency would want to require data related to these incidents be stored until accessed.

1.1.3 AEB System Performance Information

NHTSA has requested input on potential requirements that manufacturers provide information to *vehicle operators* about how AEB systems work. Although the agency has described in general terms the type of information that could potentially be communicated to a vehicle operator, it does not provide sufficient details in terms of the anticipated medium for conveying information, or how a "vehicle operator" may differ from a "vehicle owner." It is therefore not possible to determine the potential safety impacts or costs associated with any potential requirements, or if there is a safety need depending upon the potential options available. For example, is NHTSA considering options beyond typical owner's manual requirements? We are therefore opposed to NHTSA establishing detailed requirements related to system performance information until such time that the agency develops a supplemental notice of proposed rulemaking outlining a more specific proposal.

1.1.4 NHTSA should reconsider how the test completion criteria is defined.

The agency indicates that "The test run is complete when the subject vehicle comes to a complete stop without making contact with the lead vehicle or when the subject vehicle makes contact with the lead vehicle."[23] However, for the approaching a slow moving vehicle scenario, imposing a full braking requirement may not be appropriate if the target vehicle were to continue to move (or if a stopped vehicle were to move again under real-world conditions). Auto Innovators suggests test completion be defined as "the instance when the subject vehicle speed is equal or less than the target vehicle speed without making contact with the lead vehicle, or when the subject vehicle makes contact with the lead vehicle."

1.2 PAEB-Specific Issues

1.2.1 NHTSA test target selection for PAEB

Auto Innovators supports the agency's proposal to use test mannequins that are representative of the 50th percentile male and 6-7 year old child as defined in ISO 19206-2:2018 and agree that the change from using static mannequin to mannequins equipped with articulated moving legs will be more representatives of actual pedestrians. Auto Innovators also supports the agency's efforts to reduce test variability by defining the color and reflectivity (ISO 19206-2:2018) and radar cross section (ISO 19206-2:2018 characteristics of the test mannequin. We also support NHTSA's current proposal to use a child test mannequin in daytime scenarios only.

Regarding the representativeness of the proposed pedestrian test mannequins, both the child and adult test devices proposed for use should provide a reasonable assessment of the performance of PAEB systems across a broad spectrum of occupant sizes. The use of additional test devices is not recommended until there is a demonstrated need based on limitations with the current proposed test devices.

1.2.2 NHTSA should remove the proposed stationary pedestrian test in nighttime conditions.

It is important that any rulemaking is developed with consideration for real-world safety benefits and the necessary design changes needed to improve real-world injury outcomes. With respect to nighttime pedestrian crashes, we request that the agency reconsider the inclusion of the stationary pedestrian test in nighttime conditions (*S8.4*), for several reasons. First, based on an analysis of real-world data from FARS (shown in Appendix 2), fewer than 5% of nighttime pedestrian crashes occur in dark or low light condition, which is substantially lower than the other scenarios being evaluated. Second, the complexity in designing countermeasures is increased, particularly for vision based systems in discerning non-moving objects that may resemble the human form in low light conditions at high speed. Given the additional potential for false positives that this creates, we have concerns that this requirement would force the installation of additional sensors (e.g., radar) to verify the presence of an object in the roadway. This again has additional cost implications and underscores that meeting the requirements of the rule is not as straightforward as the agency would suggest based on its limited analysis.

1.3 Malfunction detection requirements

Auto Innovators has concerns with the suggestion that the definition of malfunction include "any condition in which the AEB fails to meet the proposed performance requirements." While it is important that consumers are provided with relevant information regarding potential malfunctions related to the AEB system, this definition is overly broad and does not adequately distinguish between instances where the vehicle encounters changes in the external roadway environment that may limit the functionality of the AEB systems on a *temporary* basis, versus a mechanical or software issue that preludes the proper functioning of the system and may require repair or maintenance.

[23] *S7.3.4., S7.4.4, and S7.5.4.*

NHTSA further proposes that "the driver must be warned in all instances of component or system failures, sensor obstructions, environmental limitations (like heavy precipitation), or other situations that would prevent a vehicle from meeting the proposed AEB performance requirements." This is again overly broad in its application and could result in misleading or ambiguous information being communicated to the consumer with such frequency that the information becomes almost meaningless. Auto Innovators therefore provides the following recommendations for agency consideration.

1.3.1 NHTSA should limit the definition of what is considered a "malfunction."

The definition of malfunction should be limited to specific failures related to the hardware or software components that comprise an AEB system. This could include damage to sensors, wiring issues, or corrupted software modules. Although AEB systems may encounter changes in the environment that may limit the ability of a vehicle to meet the performance requirements defined within the standard, such as heavy fog or snow, these are more limitations of the system sensors and not a failure (or malfunction) of the system itself. We therefore recommend creating separate definitions for "malfunction warning" and "system availability warning" to characterize these two sets of warning conditions more accurately.

1.3.2 Manufacturers should be provided with flexibility for communicating malfunction warnings.

The agency has indicated that it is considering specifying test procedures that would describe how the agency would test a malfunction indicator and the level of detail that the regulation should require for a malfunction indicator. Auto Innovators recommends that NHTSA continue to provide manufacturers with flexibility for how malfunction warnings are communicated to the driver. However, should the agency decide to regulate in this area, it is important that NHTSA define a finite set of scenarios that could be reasonably defined as a malfunction (based on the revised definition above), to ensure that relevant scenarios are being addressed, and that other factors that may influence AEB performance are evaluated independently. Any simulated malfunction conditions included in a compliance verification test should be indicative of system or component level malfunctions observed based on real world data.

1.3.3 System status warnings should only be required when the system is manually or automatically set to "off."

NHTSA has proposed a warning be provided in *all instances* or situations that would prevent a vehicle from meeting the proposed AEB performance requirements. We disagree with this proposal for two reasons. First, the requirements of the rulemaking are limited to certain test speeds and scenarios, with compliance verification performed when specific environmental conditions are met. It is not reasonable or practicable to require a manufacturer to detect minute changes in the roadway environment (*e.g., road surface condition*) or the extent to which these changes may affect the performance of a vehicle in meeting the requirements of the rule. Second, it will likely result in excessive notifications to consumers, and also notifications do not accurately communicate the status of the system and its ability to provide at least some levels of crash avoidance or mitigation protection and may be misleading as to the actions required on the part of the driver to remedy the situation. For example, if a vehicle encounters mild fog or light precipitation that could limit a *no contact* requirement from being met in an 80km/h stopped vehicle scenario, providing a malfunction warning is not helpful. It is also not indicative of what the driver needs to do (if anything) to resolve the issue. There are, however, situations that may require the system to be turned off, as discussed in more detail below. Auto Innovators therefore recommends that system status notifications only be required if the system is automatically turned "off" due to limitations with sensors in detecting changes in the roadway environment as defined by the manufacturer. This should be supported by consumer education to ensure awareness of system limitations as a general matter.

1.3.4 Implementation of the Final Rule should be supported by parallel consumer education efforts.

Auto Innovators recommends NHTSA consider the development of complementary consumer education materials to educate the public on the capabilities and limitations of AEB and PAEB systems, as well as the continued role of the driver in maintaining safe operation of the vehicle. As stated previously, it is unreasonable to set an expectation of *no contact* outside of normal test conditions, and consumers should not be presented with the misconception that ADAS can be used as a fallback for persistent engagement in unsafe driving behaviors. While manufacturers likely play an ongoing role in educating the public in the near term, we urge the agency to work closely with state Departments of Motor Vehicles to update state driver education and licensing processes to include information on ADAS, the impact of weather and other environmental factors on system performance, and the importance of vehicle maintenance to ensure ongoing functionality. These activities are particularly relevant to the agency now that systems are being mandated as standard equipment in new vehicles.

1.3.5 NHTSA should maintain flexibility for how malfunction and system status information is communicated to drivers.

While NHTSA is not proposing the specifics of the telltale, the agency anticipates that the characteristics of the alert will be documented in the vehicle owner's manual and provide sufficient information to the vehicle operator to identify it as an AEB malfunction. Auto Innovators agrees with the agency's conclusion that the specifics of a telltale for malfunction (and related system status) should be defined by the manufacturer. However, any requirements to expand the current owner's manual requirements should be included as part of the rulemaking notice to ensure that it is appropriately accounted for as part of the regulatory impact analysis. We recommend that any requirements established through rulemaking, at a minimum, permit manufacturers to express the performance characteristics of the AEB/PAEB systems in general terms, with reference to the anticipated speed ranges and conditions that the system may be capable of providing crash avoidance functionality, the process for disengaging/reengaging the system, and any related telltale information. If the agency were to require overly prescriptive details on the capabilities of the system, without allowances for potential limitations, the result may be consumers engaging in unsafe behaviors based on overuse or reliance on such a system.

1.4 AEB/PAEB Deactivation

1.4.1 Deactivating the AEB system should not be contingent upon the deactivation of other safety systems.

Auto Innovators disagrees with the agency's decision to prohibit manual AEB/PAEB disablement as there are likely several circumstances where the deactivation of the system may be needed to ensure safe vehicle operation, including those referenced in the NPRM, such as when a light vehicle is towing a trailer with no independent brakes, or brakes that do not include stability control functions. In many cases, these circumstances warranting AEB deactivation are already described in vehicle Owner's Manuals or other information sources, and we wholly support the continuation of describing such circumstances to the user. For example, NHTSA is considering allowing the AEB system to be placed in a nonfunctioning mode whenever the vehicle is placed in 4-wheel drive low or when ESC is turned off, and whenever equipment such as a snowplow is attached to the vehicle that might interfere with the AEB system's sensors or perception system. However, there are other situations whereby the consumer may choose to deactivate the system on a temporary basis (e.g., track usage, off road driving), and connecting the disablement of AEB to ESC may have unintended consequences. While not encouraged, a driver seeking to disable AEB may be left with no option but to turn both AEB and ESC systems off under the current proposal, undoing any potential safety benefits from having ESC system remain active. Also, as discussed previously, there will likely be consumer backlash from false activation caused by the high speed performance requirements that may cause vehicle drivers to want to turn off the systems – particularly if the system is adversely affecting their ability to drive uninterrupted without unnecessary or overly conservative alerts provided by the AEB/PAEB system.

We therefore recommend that the agency harmonize to the extent possible with the deactivation requirements defined in UNECE R152. This requires "two deliberate actions" by the driver to deactivate the system, which avoids accidental disengagement. It also creates a multistep process to discourage drivers from turning off the system arbitrarily. This is further supported by a requirement that AEB function be reinstated at the initiation of each new ignition cycle. Auto Innovators is neutral on whether the process for manual deactivation for an AEB system should be allowed at speeds above 10 km/h (6 mph) but maintain that it should be allowed to ensure consumer acceptance and provide a means for addressing unforeseen circumstances that may necessitate system disablement.

1.4.2 NHTSA should provide manufacturers with the ability to define automatic deactivation criteria.

NHTSA is considering restricting the automatic deactivation of the AEB system generally and providing a list of situations in which the vehicle is permitted to automatically deactivate the AEB or otherwise restrict braking authority granted to the AEB system. Auto Innovators disagrees with this approach as it introduces additional complexity in terms of demonstrating compliance with the standard. We therefore again recommend that the agency harmonize with the deactivation requirements of UNECE R152 which provides manufacturers with the ability to define the conditions and criteria for automatically turning off AEB functionality.[24]

1.5 Related Regulatory Concerns

1.5.1 Part 581

In addition to the significant technical issues and practicability concerns noted above, there are additional outstanding regulatory issues that, if left unresolved, will create new and ongoing challenges to the installation of AEB sensor technology as standard equipment. More specifically, we reiterate the automotive industry's prior concerns with the bumper damageability requirements established in Part 581, and request that the agency take immediate action to update the standard to harmonize with the requirements of UNECE R42.[25] As noted in our recent comments in response the agency's NCAP request for comment to include a pedestrian protection rating in NCAP, we are concerned that the agency continues to inappropriately prioritize vehicle damageability above pedestrian protection through the requirements of Part 581. Furthermore, the agency has not adequately considered the related cost implications for manufacturers in meeting both the existing bumper standard as well as the newly proposed FMVSS No. 127. As noted by a 2020 Government Accountability Office report on Pedestrian Protection, this has already forced some manufacturers to relocate the sensors to other parts of the vehicle to avoid conflicts with the bumper standard. [26] However, this may not be possible in all cases – due to costs or other practicability constraints which have not been discussed in sufficient detail as part of this rulemaking proposal. The absence of a comprehensive study on this issue is concerning with respect to this rulemaking given the recent mandate by Congress to undertake several actions related to hood and bumper standards.[27]

1.5.2 Consideration for ADS vehicles without manual controls

As a general matter, Auto Innovators is concerned about the potential for agency rulemaking actions to introduce new barriers to the deployment of ADS equipped vehicles, particularly as efforts to address standards where the requirements are outdated or do not consider the unique design characteristics of automated vehicles remain ongoing. This rulemaking is no different. ADS equipped vehicles without manual controls should be exempt from the driver warning and DBS requirements of this standard because these provisions are only relevant in the

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[24] *https://unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/2020/R152am1e.pdf*

[25] Part 581 Petition for Rulemaking submitted by the Auto Alliance, Global Automakers, and MEMA on December 5, 2018.

[26] GAO Report: "PEDESTRIAN SAFETY NHTSA Needs to Decide Whether to Include Pedestrian Safety Tests in Its New Car Assessment Program," April 2020 (GAO-20-419).

[27] Infrastructure Investment and Jobs Act, Section 24214

presence of a human driver. The DBS requirements should also only be applicable if a brake pedal is installed or required to be installed in the vehicle. We also recommend that compliance testing be limited to the maximum speed that the vehicle is capable of achieving within its operational design domain.

1.5.3 Concerning Electronically Modulated Braking Systems

The NPRM indicates a potential misunderstanding regarding AEB activation when solely initiated by an Electronic Stability Control (ESC) system. ESC systems are able to apply brakes via an AEB request. However, some higher-performing brake technologies incorporate electronic power brake actuators, replacing traditional brake boosters and can function independently from the device which performs the ESC function. These actuators provide higher pressure build rates and can optimize the AEB function. Auto Innovators is concerned that as drafted one could erroneously think that AEB can only be initiated via an ESC system.

1.5.4 Gross Vehicle Weight Rating (GVWR) and the impact of existing braking requirements

GVWR plays an important role when considering the performance effectiveness of AEB systems and should be accounted for in AEB testing procedures. All other characteristics being equal, as GVWR increases, a significantly higher braking power will be necessary to achieve the same stopping distance. The sensory devices being the same across platforms may likely be insufficient to achieve compliance with the requirements. Increasing vehicle mass may lead to the need for potential higher-performing brake hardware to meet the requirements. As a result, we have concerns that the proposed requirements of FMVSS No. 127 conflict with the braking requirements established in FMVSS No. 105 and FMVSS No. 135, by essentially requiring that heavier vehicles be equipped with braking systems that exceed the requirements of either regulation in order to meet the *no contact* requirements based on the higher speed tests proposed in the NPRM. Two aspects of brake performance must be considered.

First, the peak deceleration capability of the vehicle is generally limited by the tire adhesion and is therefore not likely to be impacted by brake hardware changes. However, performance today typically exceeds the mandated performance from FMVSS No. 135 or FMVSS No. 105. The full extent of this stopping performance may be necessary for collision avoidance at the higher speeds proposed by NHTSA in this rulemaking.

The second aspect of brake performance which must be considered is the time factor to reach the target deceleration. As vehicle mass increases, the requisite larger brake components consume increasing amounts of brake fluid, which must be supplied by the brake actuator. Therefore, higher levels of actuator flow capability are necessary to minimize pressure build time. It is this brake pressure build time which begins to strongly influence the stopping distance achievable during an AEB event. Unlike the maneuvers within the braking regulations, AEB systems must complete this brake fill without human driver input, which in conventional brake systems helps to push the fluid to the calipers quickly. It should firstly be recognized that not all ESC systems have the same volume flow capability, so some vehicles may require a migration to a higher performance ESC. But furthermore, electrohydraulic actuators, which are often designed to deliver equivalent performance with or without driver input, are well-suited to support the highest level of AEB performance and may be necessary as vehicle GVW increases to achieve compliance to this proposal.

We recommend that the agency conduct a comprehensive review of the impact of this rulemaking on FMVSS No. 105 and FMVSS No. 135 and ensure that appropriate accommodations to exclude or include a cap on the applicability of the proposed rule (and corresponding heavy duty AEB rule) based on vehicle weight.

Appendix 2

Analysis of pedestrian crashes from 2014-2021

Appendix 2

The following pie chart in Figure 1 shows the distribution of pedestrian crashes from 2014-2021 FARS occurring in Dark-Unlighted conditions. Data is from 2014-2021 FARS concerning only light vehicles (BODY TYPE = 1,2,3,4,5,6,7,8,9,10,14,15,16,17,18,19,20,30,31,33,34,48,49) that occurred in Dark – not lighted conditions.

Note: To simplify, consideration was given only to data elements there were at least 1% of the total group size. The 21 data elements included make up 87% of the total query. These were then grouped into simpler representative groups. As shown, a standing pedestrian makes up only 4% of this chart.

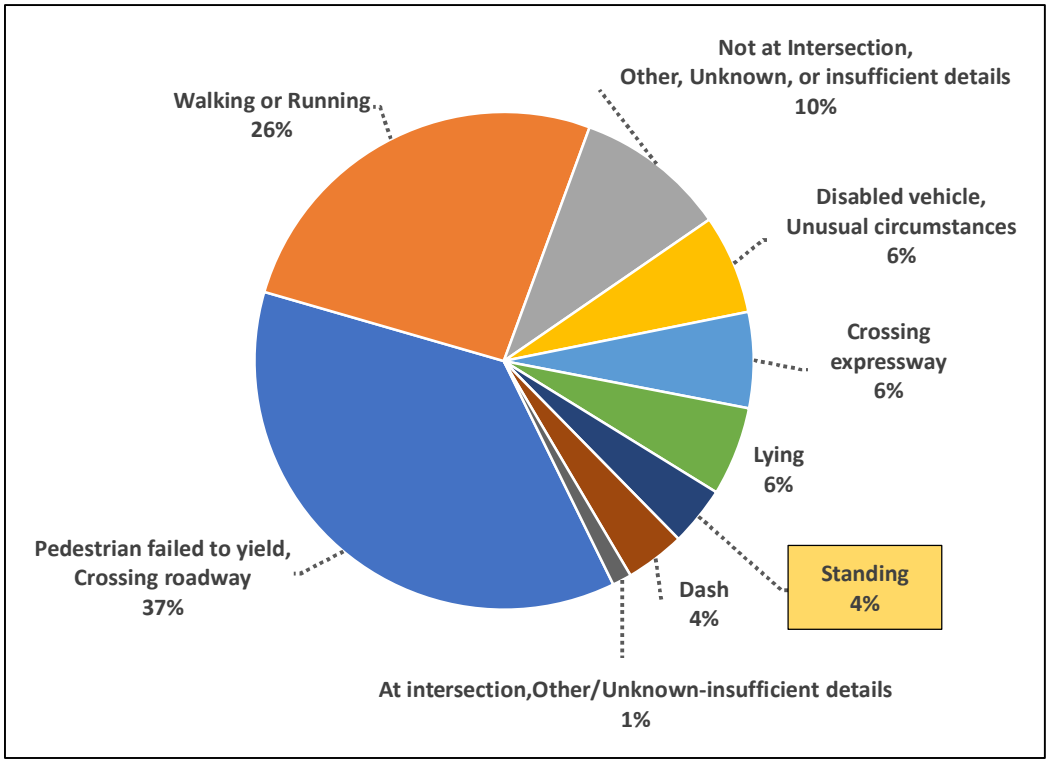

Figure 1: 2014-2021 FARS Pedestrian Crash Type in Dark - Unlighted Light Condition [Data comprised of PEDCTYPE data elements that are > 1% of subset, n=11,974]