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**DATE:**
05.29.20

Docket Management Facility
National Highway Traffic Safety Administration
U.S. Department of Transportation
Room W12-140
1200 New Jersey Avenue, SE
Washington, DC 20590-0001

**Re: Docket no. NHTSA-2020-0014; NPRM for Occupant Protection for Automated Driving Systems**

Zoox, Inc. submits these comments in response to NHTSA's NPRM for Occupant Protection for Automated Driving Systems.

The need for policies that enable technology to improve safety on our roadways is mission critical for NHTSA. According to the Agency's own data, 36,560 individuals were killed on U.S. roadways in 2018. This death toll is unacceptable.

Safety is foundational to Zoox's mission. Our experienced electro-mechanical and vehicle engineering teams are developing and integrating a fully autonomous battery electric vehicle, the software system to make the vehicle drive, and the service to operate at scale in increasingly dense urban environments. Today, Zoox tests its systems autonomously on conventional Toyota vehicles with safety drivers in the Las Vegas area and the San Francisco Bay Area—across suburban environments, on freeways, and in complex urban areas. We drive autonomously in these domains in the dense fog and heavy rain, during the day and at night. At the same time, we are developing an SAE Level 5 vehicle to operate under SAE Level 4 limitations. The vehicle is optimized for public safety and machine vision instead of human vision.

Although automated mobility-as-a-service is a departure from the way the Agency has traditionally considered motor vehicle safety, it is itself a safety innovation that the Agency should bear in mind as it sets safety parameters. Fully automated vehicles, without any traditional human controls, will first deploy in fleets in constrained geographical environments (likely cities). Fleet operators will have

more control over vehicles and the fleet system, which will increase traceability and allow for faster resolution of safety issues than today's traditional vehicle ownership model allows.

Zoox believes that this NPRM sends an important signal about NHTSA's commitment to setting safety standards that ensure automated driving technology achieves its promise of saving lives and reducing injuries on our roadways. Automotive safety regulation has traditionally focused on occupant protection. The arrival of fully autonomous vehicles and their multi-modal sensors, however, can add an innovative new layer of crash prevention safety. This will lead to a powerful combination of both crash prevention and occupant protection.

We also want to recognize NHTSA's commitment to policy and rule development regarding autonomous driving systems (ADS) as they arrive on U.S. roads. The 2016 Google Interpretation was a very important step in evaluating this technology, and the Agency's adaptation of the term "driver" sent an important signal to developers.

Zoox reminds NHTSA, however, that creating new rules around this technology at this moment comes with risks. First, there is still tremendous innovation taking place in the industry. In this rulemaking, the Agency has only considered conventional seating configurations, which may unintentionally confine innovation. Second, the rulemaking process is time consuming, and by the time this rulemaking concludes, it is entirely possible that new safety innovations could render today's rules obsolete.

In this NPRM, the Agency has specifically requested comment on occupant protection in different kinds of vehicles (SAE level 4-5 systems, dual mode vehicles, buses, and trucks). As noted above, Zoox's first product is a four-passenger vehicle that would be considered an SAE Level 5 vehicle operating under SAE Level 4 limitations. We have not taken the opportunity to comment specifically about dual mode vehicles, buses, or trucks. In this filing, though, we seek to respond to many of the specific questions raised by the Agency. We hope our comments help advance the Agency's mission and agenda.

Additionally, the Agency has asked important questions about how child occupants will use fully autonomous vehicles. Zoox believes this is a very important issue and encourages the Agency to look to existing third-party efforts and convene a conversation about the relationship between child occupants and fully autonomous vehicles. It is entirely possible that certain business models will not allow for the transportation of children until certain data are collected and understood.

## Specific comments regarding text modifications

In general, the proposed updates appear to make wholesale substitutions for terms such as "driver" and "passenger" that do not always comport with the surrounding text. These wholesale substitutions sometimes complicate the regulatory text rather than achieve their intended clarification. Moreover, "front outboard" appears to have been added without considering whether that clarification was necessary, or whether it had already been established in other parts of the rule that reference the updated section. Zoox recommends reviewing the text and evaluating if these substitutions and additions achieve their intended clarity and flexibility.

Additionally, the proposed rule's broad use of the term "any" is often confusing. This is true, for instance, when "any" is applied as a modifier to "dummy." It appears that the proposed rule intends to add flexibility by explaining that a protocol applies to "any" seating position, not to "any dummy." The dummy is in fact specified, so "the" is the appropriate article when addressing the dummy. Zoox recommends reviewing the text to identify cases where the modifying article does not provide its intended flexibility and clarity.

Zoox is providing additional specific comments in table format, attached. Note that some of the comments can be applied across a wide swath of the standard(s), and the table may be used as a guide for the Agency to take further review.

Sincerely,

Bert Kaufman
Head of Corporate and Regulatory Affairs

## Enclosures

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| Current regulation | NHTSA's proposal | Zoox recommendation | Zoox rationale |
|---|---|---|---|
| | Update the seating procedures in FMVSS 208 S10 to account for a vehicle configuration without a driver and with two front outboard passengers | It is unnecessary to add "any front outboard" as a modifier to "the passenger dummy" | S5.1.1(b)(2) requires the specified dummy to be placed in each front outboard designated seating position. Adding "any front outboard" is redundant and increases the word count of an already cumbersome document. "Any" is also unnecessary as S5.1.1(b)(2) specifies you place dummies in the front outboard designated seating positions. The use of "the" in front of "passenger dummy" is appropriate because each seating position has a dummy and it is the dummy. |
| | S10.4.1.2 In vehicles equipped with bucket seats, the upper torso of the driver and passenger dummies shall rest against the seat back. The midsagittal plane of the driver and any front outboard passenger dummy shall be vertical and shall coincide with the longitudinal centerline of the bucket seat. | S10.4.1.2 In vehicles equipped with bucket seats, the upper torso of the dummy shall rest against the seat back. The midsagittal plane of dummy shall be vertical and shall coincide with the longitudinal centerline of the bucket seat. | There is no need to differentiate between the driver and passenger dummy as the procedure is identical. Zoox proposal simplifies the existing text and makes it neutral to the seating position. |
| | S10.4.2.1 H-point. The H-points of the driver and any front outboard passenger test dummies shall coincide within 1 /2 inch in the vertical dimension and 1 /2 inch in | S10.4.2.1 H-point. The H-point of the test dummy shall coincide within 1 /2 inch in the vertical dimension and 1 /2 inch in | There is no need to differentiate between the driver and passenger dummy as the procedure is identical. Zoox proposal simplifies the existing text and makes it neutral to the seating position. |

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|---|---|---|---|
| | the horizontal dimension of a point 1 /4 inch below the position of the H-point determined by using the equipment and procedures specified in SAE Standard J826-1980... | the horizontal dimension of a point 1 /4 inch below the position of the H-point determined by using the equipment and procedures specified in SAE Standard J826-1980... | |
| | S10.5 Legs. The upper legs of the driver and any front outboard passenger test dummies shall rest against the seat cushion to the extent permitted by placement of the feet. The initial distance between the outboard knee clevis flange surfaces shall be 10.6 inches. To the extent practicable, the left leg of the driver dummy and both legs of any front outboard passenger dummy shall be in vertical longitudinal planes. To the extent practicable, the right leg of the driver dummy shall be in a vertical plane. Final adjustment to accommodate the placement of feet in accordance with S10.6 for various passenger compartment configurations is permitted. | S10.5 Legs. The upper legs of the test dummy shall rest against the seat cushion to the extent permitted by placement of the feet. The initial distance between the outboard knee clevis flange surfaces shall be 10.6 inches. To the extent practicable, the left leg of the driver dummy and both legs of the passenger dummy shall be in vertical longitudinal planes. To the extent practicable, the right leg of the driver dummy shall be in a vertical plane. Final adjustment to accommodate the placement of feet in | There is no need to differentiate between the driver and passenger dummy for the upper leg position as the procedure is identical. Zoox proposal simplifies the existing text and makes it neutral to the seating position. Zoox recommends not modifying the language for the lower leg positioning as the existing language is sufficient. |

| Current regulation | NHTSA's proposal | Zoox Recommendation | Zoox Rationale |
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| | | accordance with S10.6 for various passenger compartment configurations is permitted. | |
| | Update the seating procedures in FMVSS 208 S16 to account for a vehicle configuration without a driver and with two front outboard passengers | Remove "any front outboard" as a modifier to "the passenger dummy" | S15.1 requires the specified dummy to be placed in each front outboard designated seating position. Adding "any front outboard" is redundant and increases the word count of an already cumbersome document. "Any" is also unnecessary as S5.1.1(b)(2) specifies you place dummies in the front outboard designated seating positions. The use of "the" in front of "passenger dummy" is appropriate because each seating position has a dummy and it is the dummy. |
| | S16.3.5 Driver and front outboard passenger manual belt adjustment (for tests conducted with a belted dummy) | S16.3.5 Manual belt adjustment (for tests conducted with a belted dummy) | There is no need to differentiate between the driver and passenger dummy as the procedure is identical. Zoox proposal simplifies the existing heading and makes it neutral to the seating position. |
| | S19.2.1 The vehicle shall be equipped with an automatic suppression feature for any front outboard passenger air bag which results in deactivation of the air bag during each of the static tests specified in S20.2 (using the 49 | S19.2.1 The vehicle shall be equipped with an automatic suppression feature at any front outboard passenger seating position which results in deactivation of the associated passenger | The existing text and the proposed text relies on vague language "the air bag". Zoox proposal revises the language for clarity, "associated passenger frontal air bag". The existing language assumes the air bag configuration is traditional. By clarifying that the requirements apply to the "corresponding passenger frontal air bag" this removes doubt for |

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| | CFR part 572 Subpart R 12-month-old CRABI child dummy in any of the child restraints identified in sections B and C of appendix A or A-1 of this standard, as appropriate and the 49 CFR part 572 subpart K Newborn Infant dummy in any of the car beds identified in section A of appendix A or A-1, as appropriate), and activation of the air bag system during each of the static tests specified in S20.3 (using the 49 CFR part 572 Subpart O 5th percentile adult female dummy). | frontal air bag during each of the static tests specified in S20.2 (using the 49 CFR part 572 Subpart R 12-month-old CRABI child dummy in any of the child restraints identified in sections B and C of appendix A or A-1 of this standard, as appropriate and the 49 CFR part 572 subpart K Newborn Infant dummy in any of the car beds identified in section A of appendix A or A-1, as appropriate), and activation of the associated passenger frontal air bag system during each of the static tests specified in S20.3 (using the 49 CFR part 572 Subpart O 5th percentile adult female dummy). | configurations where side curtains or other types of air bags may be in use. |
| | S19.2.2 The vehicle shall be equipped with telltales for each front outboard passenger seat | S19.2.2 The vehicle shall be equipped with telltales for each front outboard | The telltale(s) are intended to be visible to all occupants seated in a front outboard seat. Zoox proposal simplifies by removing references to "driver" |

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| | which emits light whenever the associated front outboard passenger air bag system is deactivated and does not emit light whenever the associated front outboard passenger air bag system is activated, except that the telltale(s) need not illuminate when the associated front outboard passenger seat is unoccupied. Each telltale:<br>(a) Shall emit yellow light;<br>(b) Shall have the identifying words "PASSENGER AIR BAG OFF" or "PASS AIR BAG OFF" on the telltale or within 25 mm (1.0 in) of the telltale; and<br>(c) Shall not be combined with the readiness indicator required by S4.5.2 of this standard.<br>(d) Shall be located within the interior of the vehicle and forward of and above the design Hpoint of both the driver's and any right front outboard passenger's seat in their forwardmost seating positions and shall not be located on or adjacent to a surface that can be used for | passenger seat which emits light whenever the associated passenger frontal air bag system is deactivated and does not emit light whenever the associated passenger frontal air bag system is activated, except that the telltale(s) need not illuminate when the associated passenger seat is unoccupied. Each telltale:<br>(a) Shall emit yellow light;<br>(b) Shall have the identifying words "PASSENGER AIR BAG OFF" or "PASS AIR BAG OFF" on the telltale or within 25 mm (1.0 in) of the telltale; and<br>(c) Shall not be combined with the readiness indicator required by S4.5.2 of this standard.<br>(d) Shall be located within the interior of the vehicle and forward of and above the design Hpoint of the | and "any passenger". Zoox notes that NHTSA's proposal did not address the use of "right front passenger" in S19.2.2(e). Zoox has added "frontal" to "passenger air bag" to increase clarity on which air bag is being monitored. Consider if "front outboard" is needed, suggest removing to streamline because S19.1 states "Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S19.2 or S19.3, under the test procedures specified in S20." and S14 clarifies that the requirements apply to the front outboard designated seating positions. |

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| | temporary or permanent storage of objects that could obscure the telltale from either the driver's or any front outboard passenger's view, or located where the telltale would be obscured from the driver's view or the adjacent front outboard passenger's view if a rear-facing child restraint listed in appendix A or A-1, as appropriate, is installed in any right front outboard passenger's seat.<br>(e) Shall be visible and recognizable to a driver and right front passenger during night and day when the occupants have adapted to the ambient light roadway conditions.<br>(f) Telltales need not be visible or recognizable when not activated.<br>(g) Means shall be provided for making telltales visible and recognizable to the driver and any front outboard passenger under all driving conditions. The means for providing the required visibility may be adjustable manually or automatically, except that the | front outboard designated seating position(s) in their forwardmost seating positions and shall not be located on or adjacent to a surface that can be used for temporary or permanent storage of objects that could obscure the telltale from an occupant's view when seated in a front outboard seat, or located where the telltale would be obscured from the front outboard occupant's view if a rear-facing child restraint listed in appendix A or A-1, as appropriate, is installed in any front outboard passenger seat.<br>(e) Shall be visible and recognizable to an occupant seated in a front outboard seat during night and day when the occupants have adapted to the ambient light roadway conditions. | |

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| | telltales may not be adjustable under any driving conditions to a level that they become invisible or not recognizable to the driver and any front outboard passenger.<br>(h) The telltale must not emit light except when any passenger air bag is turned off or during a bulb check upon vehicle starting. | (f) Telltales need not be visible or recognizable when not activated.<br>(g) Means shall be provided for making telltales visible and recognizable to an occupant in a front outboard seat under all driving conditions. The means for providing the required visibility may be adjustable manually or automatically, except that the telltales may not be adjustable under any driving conditions to a level that they become invisible or not recognizable to an occupant seated in a front outboard seat.<br>(h) The telltale must not emit light except when any passenger frontal air bag is turned off or during a bulb check upon vehicle starting. | |

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| | S22.5.1 The test described in S22.5.2 shall be conducted with an unbelted 50th percentile adult male test dummy in the driver's seating position according to S8 as it applies to that seating position and an unbelted 5th percentile adult female test dummy either in any front outboard passenger vehicle seating position according to S16 as it applies to that seating position or at any fore-aft seat position on any passenger side. | S22.5.1 The test described in S22.5.2 shall be conducted with an unbelted 50th percentile adult male test dummy in the driver's seating position according to S8 as it applies to that seating position and an unbelted 5th percentile adult female test dummy either in the front outboard passenger vehicle seating position according to S16 as it applies to that seating position or at any fore-aft seat position on the passenger side. If there is no driver's seating position, an unbelted 5th percentile adult female test dummy is in any front outboard seat. | Zoox proposal makes explicit that the 5th female replaces the 50th male in the left front designated seating positions when there is no driver's seat. |
| S25.1 Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified | No proposal | S25.1 Each vehicle, with a driver's designated seating position, certified as complying with S14 shall, at the option of the manufacturer, meet the | Zoox proposal clarifies that the 5th female low risk deployment or dynamic suppression requirements only apply to vehicles with a driver's designated seating position. |

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| in S25.2 or S25.3 under the test procedures specified in S26 or S28, as appropriate. | | requirements specified in S25.2 or S25.3 under the test procedures specified in S26 or S28, as appropriate. | |
| FMVSS 212 S3. *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks, and buses having a gross vehicle weight rating of 4536 kilograms or less. However, it does not apply to forward control vehicles, walk-in van-type vehicles, or to open-body type vehicles with fold-down or removable windshields. | No proposal | Revise "trucks" to "trucks with at least one designated seating position" | NHTSA has proposed to exclude occupantless trucks from compliance with FMVSS 205. FMVSS 212's purpose is to provide occupant protection from ejection. The same rationale that supports the carve out for FMVSS 205 applies to FMVSS 212. |
| FMVSS 219 S3. *Application.* This standard applies to passenger cars and to multipurpose passenger vehicles, trucks and | No proposal | Revise "trucks" to "trucks with at least one designated seating position" | NHTSA has proposed to exclude occupantless trucks from compliance with FMVSS 205. FMVSS 219's purpose is to provide occupant protection from components entering the vehicle through the windshield. The same rationale that supports the carve out for FMVSS 205 applies to FMVSS 219. |

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| buses of 4,536 kilograms or less gross vehicle weight rating. However, it does not apply to forward control vehicles, walk-in van-type vehicles, or to open-body-type vehicles with fold-down or removable windshields. | | | |
| | FMVSS 214 S5(c)(4) Vehicles in which the seat for the driver or any front outboard passenger has been removed and wheelchair restraints installed in place of the seat are excluded from meeting the vehicle-to-pole test at that position; and | Vehicles in which a front outboard seat has been removed… | Zoox proposal simplifies the text by not specifying "driver" or "passenger" and replacing it with "front outboard seat". |
| | FMVSS 214 S8.3.1.3 Seat position adjustment. If the driver and any front outboard passenger seats do not adjust independently of each other, the struck side seat shall control the final position of the nonstruck side seat. If the driver and any front outboard passenger | S8.3.1.3 Seat position adjustment. If the front outboard seats do not adjust independently of each other, the struck side seat shall control the final position of the non-struck side seat. If the front | Zoox proposal simplifies the text by not specifying "driver" or "passenger" and replacing it with "front outboard seat". |

| Current regulation | NHTSA's proposal | Zoox Recommendation | Zoox Rationale |
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| | seats adjust independently of each other, adjust both the struck and non-struck side seats in the manner specified in S8.3.1. | outboard seats adjust independently of each other, adjust both the struck and non-struck side seats in the manner specified in S8.3.1. S10.3.2.3 should be revised in the same way. | |
| | FMVSS 214 S12.2.1(c) Arms. For the driver's seating position and for any front outboard passenger seating position, place the dummy's upper arms such that the angle between the projection of the arm centerline on the mid-sagittal plane of the dummy and the torso reference line is 40° ±5°. The torso reference line is defined as the thoracic spine centerline. The shoulder-arm joint allows for discrete arm positions at 0, 40, and 90 degree settings forward of the spine. | Remove, "For the driver's seating position and for any front outboard passenger seating position,". | Zoox proposal simplifies the text by removing the first clause that specifies 'driver' and 'passenger'. The procedure is the same regardless of the seating position of the dummy. Currently, the upper torso and pelvis portions of S12.2.1 do not specify the seating position because the procedure is the same. Updating the arm positioning procedure, as suggested, aligns with these other parts of S12.2.1. |
| | FMVSS 214 S12.3.1(d) *Driver and any front outboard passenger dummy manual belt adjustment.* Use all | Revise to "Dummy manual belt adjustment." | Zoox proposal simplifies the heading by removing "driver" and "front outboard passenger". The |

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| | available belt systems. Place adjustable belt anchorages at the nominal position for a 5th percentile adult female suggested by the vehicle manufacturer. | | procedure is the same regardless of the seating position. |
| FMVSS 225 S3 *Definitions*: *Seat outline* means the outer limits of a seat projected laterally onto a vertical longitudinal vehicle plane. | None | Zoox recommends moving the definition of seat outline to 571.3. | NHTSA proposes moving the definition of "row" from FMVSS 226 to 571.3. The definition of "row" uses the term "seat outline". Moving "row" without moving "seat outline" may lead to confusion. |
| | FMVSS 226 S4.2.2 Vehicles that have an ejection mitigation countermeasure that deploys in the event of a rollover must have a monitoring system with a readiness indicator. The indicator shall monitor its own readiness and must be clearly visible from the driver's designated seating position and clearly visible from any designated seating position if no driver's seating position is occupied or present. The same readiness indicator required by | Zoox proposal, do not update the requirements for the telltale in FMVSS 226. | NHTSA discussed that this NPRM was not going to address the broad subject of telltales, with the exception of the FMVSS 208 telltale for air bag suppression. In attempting to update this requirement, the scope of the readiness indicator for autonomous vehicles is significantly increased beyond what is required in human-driven vehicles. The wording change requires the telltale to be visible at all seating positions for AVs while maintaining the requirement for the driver seating position only for non-AVs. This change goes beyond what is contemplated in this rulemaking. |

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| | S4.5.2 of FMVSS No. 208 may be used to meet the requirement. A list of the elements of the system being monitored by the indicator shall be included with the information furnished in accordance with S4.2.3. | | |

Although this NPRM focuses on the occupant protection protocols, Zoox is encouraged by NHTSA's interest in "removing barriers" to the deployment of these vehicles. As such, we have identified a few additional areas that could benefit from some straightforward updates:

- Zoox recommends that NHTSA consider similar 'word translation' updates for Part 563 and 567.
- Part 563 provides Tables I and II where the names of the data channels include "driver" and "passenger" where those terms could be translated to "left" and "right", similar to what has been done in the 200-series updates.
- Part 567 specifies that the certification label is placed on the door opening structure next to the driver's seating position. Zoox recommends replacing "driver" with "left front".
- Zoox would like to raise an item that goes beyond a simple translation but needs to be addressed to reduce ambiguity for manufacturers of occupantless trucks. Part 565 describes where the VIN must be located. Specifically stating, "...shall be located inside the passenger compartment." Further, it 'must be readable by a person standing outside the vehicle adjacent to the left windshield pillar'. In the case of occupantless trucks, where is the VIN placed? There may not be a windshield and there is not an occupant compartment. Zoox recommends that NHTSA consider prompt updates to Part 565 to address occupantless trucks.