April 24, 2017

Ms. Jean Shiomoto, Director  
Dr. Bernard Soriano, Deputy Director  
Mr. Brian Soublet, Deputy Director and Chief Counsel

California Department of Motor Vehicles  
4700 Broadway, 2nd Floor  
Sacramento, CA 95820

Dear Director Shiomoto, Dr. Soriano, and Mr. Soublet:

On March 10, 2017, the California Department of Motor Vehicles (the department) released proposed revisions to the Driverless Testing and Deployment Regulations. In this letter, Zoox provides comments on the proposed regulations, including offering specific changes that would further strengthen these important and groundbreaking rules. Zoox has operated under California’s Autonomous Vehicle Tester Program since March 2016 and further engaged with the department by attending workshops, public meetings, and submitting comments on previous proposals. The department’s actions regarding regulations in this area provide an essential foundation for realizing the potential safety and mobility benefits offered by driverless, highly automated vehicles (HAVs).

The most important benefit offered by HAV technology is safety; the opportunity to save lives and prevent injuries on U.S. roadways. In September 2016, the National Highway Traffic Safety Administration (NHTSA) published the first Federal Automated Vehicles Policy (FAVP). In the policy, NHTSA clearly calls out that “an important promise of HAVs is to address and mitigate” the 94 percent of crashes today that “can be tied to human choice or error.” Across the U.S. in 2015, 6.5 million crashes resulted in 35,092 roadway deaths and more than 2.4 million injuries. In California, the most recent available data show that 3,176 lives are lost on State roads annually and more than 10,000 people suffer serious injuries. California should pursue all means to capitalize on the safety innovation offered by HAV.

In this revised regulatory proposal, the department makes excellent progress by moving beyond testing rules for traditionally-designed semi-autonomous vehicles to proposing both testing and deployment protocols for fully autonomous, truly driverless systems. Zoox commends the department for this significant advancement. The proposed regulations also include meaningful improvements to the definitions and concepts around the roles of simulation and remote vehicle operation. California is home to a fast-growing autonomous mobility innovation ecosystem. These examples of advanced understanding and actions will allow the safe testing and deployment of HAVs, helping to save lives and prevent injuries on California roadways. While advancing safety, California will maintain and advance its role as the global leader in this mobility revolution.

In the following comments, Zoox addresses specific concepts and offers suggestions to enhance the proposed policy in areas related to the remote operation of vehicles, the role of simulation in testing,
notification protocols for local authorities, changes in Operational Design Domain (ODD) capabilities, disengagement reporting, and safety defects reporting.

Remote Operation of Vehicles

For the first time, the department recognizes the important role of remote vehicle operations. Remote operations represent an opportunity for enhanced safety when an autonomous system encounters an uncertain or unknown situation. By monitoring the vehicle’s location and status, a remote human operator can guide the vehicle safely through the encounter.

In the proposed policy, §227.02(l) defines “remote operator” as “a natural person who: possesses the proper class of license for the type of test vehicle being operated; is not inside the vehicle; engages and monitors the autonomous technology; and is able to communicate with occupants in the vehicle through a communication link.” This definition covers many important concepts around remote operations, though given the early stage of design and testing there is an opportunity to broaden the definition and further support innovation in this area. For example, in the testing phase, it is entirely plausible to have the “remote operator” inside the vehicle, engaging and monitoring the autonomous technology, and potentially issuing commands. To support this possibility, the department could include two different definitions of remote operator—one for the testing condition and one for the deployment condition.

Additionally, as currently written, §227.38(e)(1)(A) suggests that there is only one type of remote operator, versed in any scenario that could arise for an autonomous system. Again, given the early stage of design and testing, there may be different types of HAV remote operators with specialized training or operational focus.

The remote operator considerations also would benefit from a focus on operator training rather than the being a “licensed driver.” Determining the training and expertise required to remotely operate autonomous vehicles is in the process of being determined but clearly would exceed the requirements necessary for possessing a driver’s license.

Therefore, incorporating these considerations would provide the following:

- **Remote operator—testing:** a natural person designated by the developer who: possesses the proper class of license training for the type of test vehicle being operated; may or may not be inside the vehicle; engages and monitors the autonomous technology; and is able to communicate with occupants in the vehicle through a communications link.

- **Remote operator—deployment:** a natural person designated by the fleet operator who: possesses the proper class of license training for the type of test vehicle being operated; is not inside the vehicle; engages and monitors the autonomous technology; and is able to communicate with occupants in the vehicle through a communications link.
The Important Role of Simulation in Testing Autonomous Systems

In another important advancement, §227.18(b) recognizes the important role of simulation in testing fully autonomous systems. System testing addresses a variety of important concepts that responsible developers consider before deployment: validating that the system works as intended, uncovering unknowns, analyzing new capabilities, identifying deficits, and one of the most important and safety critical—providing the public with the assurances that the vehicle performs as intended. Responsible developers undertake multiple testing methods to allow for varied examinations of systems and scenarios.

For autonomous systems, there are four main methods—each offering advantages and disadvantages: driving on a closed test-track, testing on public roads, simulation, and silent-feature testing following deployment. The department has highlighted the idea that simulation is a critical element to testing, because without simulation, it would be impractical to accrue sufficient miles through test-track or public road testing. There are more than 265 million motor vehicles on U.S. roads, and each day, they travel more than a combined 11 billion miles across the country. It is unknown how many closed track loops could create equivalency to testing miles driven on public roads. Simulation combined with the other methods provides the opportunity to collect data and determine system safety and effectiveness.

Notification of local authorities

Another enhancement in the proposal is found in §227.38(a) to provide testing notification to local authorities, especially law enforcement and first responders. This same approach to notification would also presumably extend to deployment.

Operational Design Domain (ODD)

Notification of changes. §227.38 would require the manufacturer to inform the department of the intended ODDs of the autonomous vehicle, and agree to provide updates if those ODDs change. This section would be enhanced by explicitly defining what types of ODD changes would require reporting updates. Also, the department should determine and explicitly state whether ODD updates would require a modification fee under §227.38(j).

Allowances for deviating from ODD for safety related reasons. It is possible that safe operations may dictate that in some situations vehicles should deviate from the ODD in order to maintain safety or to follow a detour. This should be addressed in the following sections:

- In §227.38 and §227.42(b)(3), the department should consider inserting language that would permit ODD deviations for safety-related reasons.
- In §228.06(a)(1), the department should consider including language that would permit ODD deviations for safety-related reasons. For example:
The manufacturer shall identify in the application the operational design domain in which the subject autonomous vehicles are designed to operate and certify that the vehicles are designed to be incapable of operating in the autonomous mode in areas outside of the disclosed operational design domain, unless needed to maintain operational safety and the vehicle is capable of entering a fallback safe state when the ODD is violated, designed to be incapable of operating in the autonomous mode in areas outside of the disclosed operational design domain.

**Disengagement Reporting**

The primary HAV safety goal is to avoid disruptive contact with people and objects. It has become unclear how reporting disengagements contributes to that goal. At this time, the unintended consequences of the current disengagement reporting include: comparisons drawn across different operating environments with each developer testing systems in different environments (e.g., rural, suburban, urban, freeway) at different times of day, and under different weather conditions. While developers often view disengagements as an opportunity to learn and improve system performance, media will portray disengagements as a "problem" or “trouble.”

Transparency is an important public policy goal and reporting safety metrics can engender public and government trust and assurance regarding the safety of HAVs. Balanced reporting requirements also would contribute to public trust, such as identifying preventive actions that reduced risk or avoided a negative outcome. That is, not every hard brake event is the same: a hard brake that prevented a crash is a positive outcome that could be confused with a hard brake that connotes a negative action. Unfortunately, disengagements have been labeled and communicated as negative events without any context for operating environment or circumstances.

Therefore, the department is encouraged to explore new safety metrics that more accurately represent the positive and negative events associated with HAVs. The department could coordinate working groups to develop new safety metrics, challenge developers to propose and test new metrics, and engage industry safety, engineering, and science organizations to create new approaches. Most importantly, the department should consider a mechanism to expand safety metrics beyond disengagements to evaluate the safety and effectiveness of autonomous systems.

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1 A recent report in *Wired* noted that disengagement reports are “unscientific because each disengagement involves all sorts of variables, which the reports log inconsistently. They don’t reveal the impact of weather, or where exactly these “problems” occurred. They don’t note if the cars are following detailed maps, or exploring an area for the first time. They don’t account for the proclivities of human operators, who likely have different thresholds for when they’ll take over.” See “The Numbers Don’t Lie: Self-Driving Cars Are Getting Good” available at https://www.wired.com/2017/02/california-dmv-autonomous-car-disengagement/
Other issues

Some additional comments on the proposal:

- **Renewal fees.** §227.22. The department should clarify its intent. Zoox supports the two-year testing permit as described in Section (a). However, section (b) enumerates a “$3,600 annual renewal fee.” The department should clarify whether it expects renewal applicants to pay $7,200 on a biennial basis, or $3,600 on a biennial basis.

- **Safety Defects Reporting.** §228.12. Zoox believes that the requirements of Part 573, Title 49 of the Code of Federal Regulations are sufficient for reporting safety defects, and should provide the basis for notice, including to State and local jurisdictions. The State should develop a coordination mechanism with federal authorities to ensure that they receive proper and sufficient notice.

- **“Exception” vs. NHTSA “Exemption”:** §228.06(a)(6). The department should change the word “exception” to the proper term of art used by NHTSA: “exemption.”

- §228.06(c)(6). The department should clarify its expectations by use of the word “responsibilities” given that the current NHTSA policy is voluntary.

- §228.08 states that the review of the application for deployment would take 180 days, or six months. Please consider significantly shortening this period (e.g., 90 days) or at a minimum changing language to “up to 180 days” allowing for shorter review times.

These revised proposals clearly illustrate that the department understands that HAV technology continues to mature rapidly. Zoox encourages the department to develop a broad set of regulatory tools that will allow the successful deployment of HAVs and their associated safety innovations. By maintaining a nimble and flexible approach, the department will allow the potential safety benefits of HAVs to translate effectively and efficiently on to California roadways.

Sincerely,

Mark R. Rosekind, Ph.D.
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