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August 28, 2019

Ms. Heidi King
Deputy Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

Re: Advance Notice of Proposed Rulemaking on *Removing Regulatory Barriers for Vehicles with Automated Driving Systems*, Docket No. NHTSA-2019-0036

Dear Deputy Administrator King:

Waymo respectfully submits these comments in response to the Advance Notice of Proposed Rulemaking ("ANPRM") on *Removing Regulatory Barriers for Vehicles with Automated Driving Systems*, published by the National Highway Traffic Safety Administration ("NHTSA" or the "agency") on May 28, 2019.

Waymo appreciates the agency's initiation of rulemaking to remove regulatory barriers for automated driving system-dedicated vehicles ("ADS-DVs")[1] that are not equipped with traditional manual controls. We share NHTSA's goal of ensuring that such vehicles can be deployed safely and in full compliance with the Federal Motor Vehicle Safety Standards ("FMVSS"), as revised to address compliance verification for vehicles without manual controls. The revisions contemplated by the ANPRM will ensure that such vehicles provide a level of safety equivalent to that required of traditional vehicles that comply with current FMVSS.

The ANPRM, which focuses on crash avoidance standards, indicates that NHTSA will issue two more related ANPRMs to address the application to vehicles without manual controls of standards that concern crashworthiness and those that concern telltales, indicators, and warnings. We encourage NHTSA to move with all reasonable speed to the proposed rule stage on these three related rulemakings and then to final rules (or ideally, a single comprehensive final rule, if it can be achieved in a timely fashion) that will remove the regulatory barriers while ensuring that ADS-DVs demonstrate a level of safety equivalent to that provided by the current FMVSS. Completing this entire suite of rulemakings will provide sufficient regulatory clarity and certainty for manufacturers to begin producing vehicles

[1] The ANPRM expressly adopts (84 FR 24434, f.n. 1) the following definition of an ADS-DV from the June 2018 version of SAE J3016, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*: "A vehicle designed to be operated exclusively by a level 4 or level 5 ADS for all trips within its given ODD limitations (if any)." Waymo strongly supports the use of this definition and, to avoid confusion about the scope of the contemplated FMVSS changes, cautions against NHTSA's use of any other definition that might introduce ambiguity about the intended scope of those changes.

without manual controls that are fully compliant with current FMVSS performance requirements.

Waymo has participated actively as a stakeholder in the related research being done for NHTSA by the Virginia Tech Transportation Institute ("VTTI"). This detailed review includes an evaluation of how the current FMVSS text can best be amended to remove regulatory barriers for AVs without manual controls and an exploration of alternative tests for compliance verification. The work being done by VTTI and industry stakeholders will likely provide a useful foundation on which NHTSA can base the revisions to regulatory text and FMVSS test procedures to address vehicles equipped with automated driving systems ("ADS") but lacking manual controls. VTTI's work has included considerable analysis of the alternatives available for test procedures to confirm FMVSS compliance of such vehicles. That work is premised on the concept, which Waymo endorses, that it is feasible to design revised compliance tests capable of ensuring that AVs without manual controls can achieve safety performance equivalent to that required by current FMVSS for conventional vehicles. Waymo encourages NHTSA to take advantage of VTTI's work to accelerate moving to the proposed rule stage with the necessary revisions.[2]

General Comments on the ANPRM

NHTSA should move promptly to remove barriers while ensuring safety

NHTSA should move rapidly to the next stage of rulemaking by proposing a rule amending FMVSS language that requires manual controls or assumes their presence for compliance testing, and which includes new test procedures designed specifically for automated vehicles that have an SAE Level 4 or Level 5 ADS and that do not have manual controls.

The ANPRM addresses two distinct types of standards that create regulatory barriers: (1) those that require certain manual controls (e.g., the requirement for a foot control for the service brake found in FMVSS No. 135); and (2) those that specify how the agency will use particular manual controls in compliance verification tests (e.g., references to a steering wheel in the description of tests for verifying compliance with the electronic stability control standard, FMVSS No. 126). The agency notes that a third type of barrier (i.e., the various uses of the word "driver" in many FMVSS) will be addressed in future rulemakings.

Waymo believes that responses to the three related ANPRMs on removing regulatory barriers, combined with the work completed or underway by VTTI, will provide NHTSA the information it needs to move promptly to a comprehensive proposed rule and final rule. VTTI has provided NHTSA with alternatives for revising current FMVSS language to ensure the standards cover AVs without manual controls, suggestions on how to remove any confusion about the meaning of the word "driver" in the standards, and the basis for issuance of test procedures tailored to ADS-DVs without manual controls. Comments received in response to

[2] NHTSA has indicated the importance of VTTI's work in facilitating progress on these related rulemakings, saying: "These efforts are anticipated to inform NHTSA's decisions on updates to the FMVSSs." 84 FR 24436.

the ANPRMs should prove helpful as well in assisting the agency to devise revised test procedures.

The ANPRM notes (84 FR at 24436) with regard to VTTI's research:

> *Phase I, which will include the technical translation of 30 FMVSSs and associated test procedures, concludes by the end of 2019. Phase II, which will focus on the remaining FMVSSs and associated test procedures, is expected to start in 2019 and conclude in mid-2021. These efforts are anticipated to inform NHTSA's decisions on updates to the FMVSSs.*

Waymo urges NHTSA not to await the completion of VTTI's Phase II research in mid-2021 before moving to the next stages of this rulemaking. The 30 FMVSS covered by VTTI in Phase I are, with one exception, all of the standards most in need of revision with regard to ADS-DVs without manual controls. The exception is FMVSS No. 135 (light vehicle brakes), which was not among the first 30 FMVSS analyzed by VTTI with regard to necessary textual revisions, but which includes a requirement for a particular physical control (the foot control for the service brake). Commenters to NHTSA's rulemakings, including Waymo, can offer significant insights on test procedures that do not rely on manual controls such as the foot control for the brake. Moreover, the regulatory text changes (which VTTI calls "translations") that have already been completed in the first 30 FMVSS provide a model of the kinds of text changes that would be needed for FMVSS No. 135, and for the other FMVSS for which VTTI and the stakeholders have not yet done translations. Although VTTI's Phase II may provide some useful insights on the remaining FMVSS, NHTSA's rulemaking can proceed on the entire range of FMVSS prior to completion of that research.

Similarly, Waymo urges NHTSA not to link the FMVSS revisions needed to remove regulatory barriers for ADS-DVs without manual controls to the far more complicated revisions that would be needed to address AVs with alternative seating configurations. NHTSA does not plan to begin rulemaking on that subject until March 2020.[3] That rulemaking is likely to involve extensive changes to the crashworthiness standards to address the angles of impact and directions of crash forces pertinent to seating that faces to the sides or rear and that may pivot from one position to another, the development of new crash dummies, and the possible need for new seatbelt and airbag configurations. In light of the extensive research and test device development that would be required, such issues are likely to take several years to resolve and should not be permitted to delay FMVSS revisions focused on AVs with traditional seating, which are built on platforms that meet the existing FMVSS and have years of demonstrated crashworthiness.

While new seating configurations may be enabled by AVs, such configurations are not vital to the development or deployment of AVs, to realizing the potential safety benefits of ADS technology, or to determining how to effectuate FMVSS compliance of ADS-DVs without manual controls. A rulemaking addressing such seating configurations can and should remain on a separate track from the rulemakings initiated by this ANPRM to remove

[3] Unified Regulatory Agenda, Spring 2019, RIN 2127-AM05.

regulatory barriers. To the extent the agency's resources require prioritization of these efforts, completion of the rulemaking to remove regulatory barriers for ADS-DVs without manual controls deserves higher priority in order to enable the timely deployment of those vehicles. Such a rulemaking will affect the great majority of ADS-DVs likely to be produced in coming years, and NHTSA, VTTI, and stakeholders have already completed a significant amount of work to facilitate such rulemaking.

Selection of fleet vehicles for compliance testing presents unique issues

NHTSA expresses its preference (84 FR 24441) for continuing its policy of buying vehicles from dealer lots and taking them to its labs for compliance testing, but notes (id. at f.n. 33) that the assumption underlying its preference may be incorrect "if the majority of ADS–DVs are used as rideshare vehicles."

For the foreseeable future, it is possible and perhaps quite likely that the majority of ADS-DVs will not be sold to the public for personal ownership but will be sold to transportation companies or retained by the manufacturer for use in passenger service fleets. Therefore, NHTSA's compliance testing may require a new approach in which NHTSA selects individual vehicles for testing that have already been certified by the manufacturer but prior to the individual vehicle's entry into fleet service. This approach would preserve NHTSA's ability to test production vehicles it selects rather than prototypes offered by a manufacturer that may differ from production vehicles. For vehicles that are not intended for sale or lease to the public but are ready for introduction into commerce as part of a fleet, we suggest that NHTSA clarify its intention to test such vehicles after their certification but before entry into fleet service.

Compliance testing of ADS-DVs may need to occur at non-traditional locations

The ANPRM focuses on *how* compliance testing of ADS-DVs can be done, but the agency also needs to address the question of *where* the testing would occur. NHTSA's current compliance testing process involves NHTSA's purchasing a vehicle from a location where it is available for sale to the general public and taking it to a contract test lab that performs the tests for NHTSA. That process may not work well in the context of ADS-DVs. As discussed above, selection of vehicles for testing will necessarily follow a different course for AVs not sold to the public. But whether the AVs are sold to the public or used only in fleets, where the testing occurs will likely need to change as well.

ADS are designed to perform the entire dynamic driving task ("DDT") in specific operational design domains ("ODDs") (except for L5 ADS, which have no ODD) and generally rely today on extensive proprietary mapping of specific roads. Test labs may eventually have AV test areas suitable for common use, but that is not the case today, and responsible vehicle and ADS manufacturers have designated test facilities suitable to their respective ODDs and technical configurations.

Therefore, unless and until independent test facilities are fully capable of conducting compliance verification testing for NHTSA of ADS-DVs without manual controls, we

recommend the agency conduct such tests at the vehicle or ADS manufacturer's test site, making sure such testing occurs with sufficient safeguards to ensure objectivity and employs a commonality of methods to ensure a level playing field for all companies. This more technologically and economically practicable approach may entail performance of the tests at the manufacturer's facility by NHTSA employees, NHTSA's contractors, or by the manufacturer's staff under the supervision of NHTSA or its contractors. The venue of compliance testing should not matter if objectivity, reproducibility, and repeatability of the tests can be assured at the vehicle or ADS manufacturer's fully-mapped test site. A manufacturer test site has detailed mapping of roads and related structures corresponding to the ODD of the ADS. NHTSA's recognition of this point would help provide clarity with regard to expectations for testing.

The appropriate compliance test for ads-dvs will vary by subject matter

No single test methodology is appropriate for all compliance testing of ADS-DVs without manual controls. The appropriate test will vary by the subject matter of the test and the suitability of a particular test type for determining compliance in specific scenarios. As discussed more fully below, we recommend NHTSA take an approach that retains the same test metrics (i.e., the measurement of safe performance) and minimizes deviation from current test procedures.

Some test methods could be combined, perhaps as an interim approach

While certain test methods (e.g., simulation, technical documentation, use of a surrogate non-automated vehicle) may, in isolation, currently present significant challenges when considered as methods for NHTSA's use in compliance verification, they may provide useful test methods when viewed as part of a package approach.

For example, NHTSA could require manufacturers to provide detailed technical documentation, including simulation test results, demonstrating that the ADS-DV's performance in FMVSS tests would meet the relevant standards along with actual physical test results concerning the base, or surrogate, vehicle built with manual controls. (This assumes that the base vehicle is an actual production vehicle subject to FMVSS certification.) The agency could then base its compliance determination on its own tests of the manually-controlled base vehicle combined with its evaluation of the technical documentation and simulation test results that the manufacturer has provided concerning the ADS-DV version of that vehicle without manual controls. This would provide the agency and the public with a very high level of safety assurance that addition of the ADS to the base vehicle had not affected the vehicle's compliance with the FMVSS.

This approach could be used either as a complete alternative to developing detailed test procedures for ADS-DVs without controls for every current FMVSS test or as an interim measure that permits the safe deployment of ADS-DVs without manual controls while the test procedures specific to ADS-DVs are being developed.

Addressing Barriers in the FMVSS

Standards requiring manual controls

The ANPRM seeks comment on four possible approaches (84 FR 24438) for addressing regulatory barriers in the form of FMVSS requirements for manual controls, such as the requirement in FMVSS No. 135 that a vehicle have a foot control for the service brakes.

The most reasonable approach is to retain the requirement for a foot control only for traditional vehicles and exclude from that requirement ADS-DVs without manual controls, while also inserting alternate test procedures showing how the ADS-DV would demonstrate safety performance equivalence to that of vehicles with manual controls. Requiring certain controls and specifying their location may make sense for vehicles driven by humans as a means of standardizing the human-machine interface. By contrast, there is no need to require installation of standardized ADS-related controls, which would add a new regulatory burden. What matters with regard to safety is whether the ADS-DV can meet a given standard's performance requirements. For example, an ADS-DV that can meet the FMVSS No. 135 brake tests obviously has a means of effectuating control of the service brakes, so there is no need to mandate a particular means of control. This approach is consistent with the agency's goal of drafting more flexible regulations that ensure safety without creating unnecessary barriers as ADS technology evolves in the future.

Standards requiring how a manual control is used in a compliance test

The ANPRM seeks comment on how NHTSA should revise standards that do not require specific manual controls but that contain test procedures that specify how the agency will use certain manual controls for testing. NHTSA offers FMVSS No. 126 (electronic stability control) as the example here. That standard's test procedure uses a steering machine mounted to the steering wheel to apply specific steering inputs during the tests. Waymo has reason to be confident that the currently specified performance can be objectively, repeatably, and reproducibly demonstrated without a steering wheel, so all that needs to change is the test method, not the test metrics. We believe this is true across the FMVSS (i.e., that methods have been or can be devised to conduct the performance tests required for compliance verification in ADS-DVs without manual controls) without having to change the test metrics (i.e., the measurement of safe performance) currently specified in the standard.

Definition of "driver"

The ANPRM notes that one of the three barriers in the crash avoidance FMVSS is "the definition or use of particular terms (*e.g.,* "driver")" that are unclear in their application to ADS-DVs. The FMVSS definition of "driver" in 49 CFR § 571.3 currently states: "*Driver* means the occupant of a motor vehicle seated immediately behind the steering control system."

While we appreciate and agree with NHTSA's allowance in its 2016 Google interpretation letter that it is reasonable in interpreting current text to view the ADS as the driver in the context of some specific FMVSS, broadly re-defining "driver" to include the ADS when

revising the text of the standards could lead to anomalous results (e.g., in those standards that use the driver's position as a reference point or refer to a driver's use of a manual control). Waymo suggests that using the term "automated driving system" where appropriate and defining it as it is defined in SAE J3016 while retaining "driver" as referring to a human occupant is both simpler and less likely to create confusion than re-defining "driver" to include the ADS in the many places it appears in the FMVSS. Of course, the "driver" definition would benefit from a qualifier that acknowledges that some vehicles will not have a human driver (e.g., adding "in a vehicle designed for operation by a human occupant").

Possible Approaches to Revising Crash Avoidance Test Procedures

The ANPRM asks a total of 39 questions concerning possible approaches to test procedures for ADS-DVs without manual controls. Eleven of those questions pertain to all of the six different test methods (i.e., calling for 66 different answers if applied individually), while the remainder are specific to particular test methods. Rather than restate all of the questions here or attempt to respond to each individually, we offer our responses to most of the questions, without specifically citing or quoting them, in the context of each specific test method.

First, however, we note that many of the questions about test methods concern the potential difficulties of performing compliance verification tests at NHTSA's chosen test facilities and using only agency or contractor personnel. For example, NHTSA asks: how the agency's test engineer could access a pre-programmed set of compliance tests; how the agency or its contractor personnel could move the ADS-DV through its test facility to position and prepare it for testing; how the agency or its contractor could overcome geo-fenced limitations of the ADS-DV and operate it outside its ODD; how to develop a universal controller as an interface with the ADS for testing purposes; etc.

As noted above in our general comments, we recommend that the agency, at least in the early years of compliance testing of ADS-DVs, perform the tests at the vehicle or ADS manufacturer's facilities and with the assistance of the manufacturer's employees. We believe this can be accomplished in a manner that is completely objective and transparent and preserves the full integrity of the testing process, while being technologically and economically practicable and avoiding many or all of the logistical problems highlighted in the ANPRM's questions (e.g., how to overcome the fact that NHTSA's contract test facilities are not mapped by each of the ADS-DV manufacturers and are not designed to reflect the appropriate ODDs).

Also, in assessing the various possible test methods, Waymo has been guided by the ANPRM's summary (84 FR 24435, footnotes omitted) of the Safety Act's requirements concerning compliance tests:

> *FMVSSs, including the tests they specify, must be: Practicable, both technologically and economically; objective, meaning that they must produce identical results when tests are conducted in identical conditions and determinations of compliance must be based on scientific measurements, not subjective opinion; and meet the need for*

> *safety. In addition, in issuing a FMVSS, the agency must consider whether the standard is reasonable, practicable, and appropriate for the types of motor vehicles or motor vehicle equipment for which it is prescribed.*

We believe this summary makes clear that the agency has ample flexibility in choosing test procedures that are appropriate for ADS-DVs without manual controls, so long as those procedures are practical, objective, and meet the need for safety by determining whether the ADS-DV demonstrates the equivalent level of safety that the FMVSS requires of traditional vehicles.

A. Normal ADS-DV operation (test "as is" in the AV's ODD)

Few of the tests necessary to verify compliance with the crash avoidance FMVSS[4] lend themselves well to being conducted on public roads in the ADS-DV's ODD. Conducting many of the tests on public roads would entail unnecessary safety risks. Most require somewhat elaborate test preparation and specific conditions or maneuvers (e.g., braking or steering) that are not practical to achieve on public roads and may not be encountered commonly as part of the vehicle's ODD. FMVSS No. 138 (tire pressure monitoring) may be an exception, but even it would require stops along the route to adjust tire pressure. Devising methods by which test engineers could control (for purposes of performing test-specific maneuvers) an ADS-DV that is designed not to have manual controls would in most cases not be practical and would entail unwarranted expense.

B. Test mode with pre-programmed execution (TMPE)

The ANPRM suggests that each manufacturer could prepare its own "compliance test library" from which pre-programmed testing scenarios can be selected and executed through simple commands without the need for any external controller. We believe this is the most practical method for performing any complicated test maneuvers, reduces or avoids many problems presented by other test methods, and is the method that permits the least deviation from current test procedures, thereby reducing the need for the agency to justify wholly new procedures or test metrics.

We recognize that the method has some limitations, including test procedures requiring vehicle maneuvers that are outside the ODD of the ADS-DV. However, that problem is not unique to this method. If a manufacturer wishes to certify an ADS-DV that, for example, cannot reach the test speeds required by an FMVSS, that manufacturer may need to seek an exemption or, as part of this rulemaking, propose an alternative test. Or where the manufacturer has set its own operating limits that are more restrictive than the test conditions required for a particular FMVSS test, it may have to alter those limits in its test library to permit the full test even though in normal operation the ADS-DV will not experience the test conditions.

[4] Compliance testing of certain controls and displays under FMVSS No. 101 may be practical in the context of normal ADS-DV operation, but that standard will be addressed in a future ANPRM.

To ensure the agency's full understanding of each manufacturer's test library, NHTSA could require submission of a test library summary, including an explanation of each test procedure, in advance of testing to allow resolution of issues before testing. This process would provide NHTSA significant assurance that the library test scenarios developed by the manufacturer adequately replicate the test procedures used for traditional vehicles. As discussed above, for many reasons we think it will be more efficient to rely on the manufacturer to execute each test in NHTSA's presence (or that of NHTSA's contractor), perhaps at a manufacturer's facility, rather than to permit NHTSA to access the ADS directly through an external controller and develop a means for NHTSA to move the vehicle before and after testing. Development of this method will help NHTSA keep the FMVSS current as technology evolves because having a test library that can be updated would mean the agency would not be dependent on specific test equipment that could become obsolete.

We think the ANPRM's suggestion that manufacturers "suspend" geo-fenced operating restrictions during testing is not at all practical. This would essentially require development of test-specific ODDs because the vehicle would have to operate in each new test environment. Developing the software needed to operate in these test-specific ODDs could introduce new problems, such as unintended differences between normal, actual ADS performance and test-specific performance, lessening the usefulness of the test. Instead, having the manufacturer conduct the test at NHTSA's direction within its established ODD would avoid the unnecessary expense and time of developing new ADS capabilities for expanded ODDs just for testing purposes and would avoid the cybersecurity risks mentioned in the ANPRM that simply distributing the test library to test engineers may entail. Of course, an ADS-DV that has an ADS at SAE Level 5 would not be geo-fenced because it would have no ODD. Such a vehicle could conceivably be tested at any facility.

The ANPRM asks about having an E-stop option within the test menu so that a test engineer could always stop the vehicle during a test for safety reasons. We believe including such an option is feasible. However, proper test setup will in nearly all cases obviate any need for such stops. Moreover, the scripts for specific compliance tests would not in any way suspend the ADS-DVs' normal sensing and response capabilities so that, for example, the vehicle would respond safely to unexpected incursions by cross traffic at the test location even while executing a test maneuver.

Most of the potential problems with this method noted by NHTSA in the ANPRM (i.e., agency access to the test library, cybersecurity concerns, movement of the ADS-DV through different test locations, updating the test library based on ADS changes, etc.) would not be present if the compliance verification testing occurred at the manufacturer's test facility, using the test library pre-reviewed by NHTSA in summary form, and performed by manufacturer personnel in the presence of the NHTSA or NHTSA contractor personnel. Such testing would meet the criteria for practicality and objectivity and meet the need for safety by determining the ADS-DV's ability to meet the same performance criteria as required for traditional vehicles. Full documentation and recording of the appropriate test metrics would address any concerns about the integrity of the process.

C. Test mode with external control (TMEC)

Waymo believes this method would require that ADS-DVs be designed to be operated by both the ADS and by a human using an external controller to send commands that would affect longitudinal and lateral movements (e.g., braking, acceleration, transmission, and steering). We believe such a method is very impractical and would, at its root, require that ADS-DVs enable teleoperation (*aka* remote control), if only for test purposes. Teleoperation is fundamentally different from pre-programming the ADS itself to perform the test maneuver. Teleoperation, which entails remote effectuation of dynamic control by a human who does not have access to in-vehicle manual controls, is not an automated operation performed by the ADS.

Mixing teleoperation into the testing of ADS-DVs, in Waymo's view, is not advisable for many reasons. The method would require the ADS design to be receptive to commands "sent to the ADS-DV via an external controller operated by a test engineer." (84 FR 24443) The introduction of external control capability not provided by the ADS-DV's original design would require fundamental design changes that would introduce unwarranted security issues by opening the architecture to hostile intrusions and potentially resulting in an unacceptable increase to the system's attack surface. This teleoperation method would also require significant reworking of some manufacturers' ADS architecture solely for compliance testing and the development of a teleoperation controller, necessitating expenditures that would not be reasonable because other methods to effectuate compliance testing are readily available. Moreover, using teleoperation to effectuate steering, acceleration, and braking involves unique safety concerns that would themselves, separate and apart from automation, need to be resolved to ensure the safety of the tests using this method (e.g., latency issues, human-machine interface, wireless network reliability).

D. Simulation

Simulation is an extremely useful tool in the development of ADS. Simulation allows developers to assess the ADS's capabilities in a much larger range of driving scenarios than those likely to be encountered even in high-volume on-road testing. However, models used for simulation to date tend to be developer-specific, using vehicle and ADS characteristics unique to the developer's own products and ODDs. No broad consensus has yet emerged on how to validate or standardize simulation techniques being used by ADS developers. We believe achieving such a consensus will entail a substantial effort that is just beginning, making simulation, standing alone, an impractical option at this time for compliance verification.[5] In particular, developing of a universal simulation model for current FMVSS tests seems like a very difficult and time consuming exercise that could delay the removal of FMVSS barriers.

[5] Simulation tools differ between companies because they are often specific to each ADS being developed and tested, and they sometimes evolve and change as the ADS technology advances. In these early days of ADS technology, the value of simulation in safely advancing the development of those unique ADS outweighs the interest in and challenge of creating a consensus on simulation tools among ADS developers. However, despite the disparity in such tools, commonality in validation of simulation tools may be possible in the future.

For a small number of tests embodied in the current FMVSS, however, use of the manufacturer's own simulation model in combination with another method (e.g., system documentation) may be practical and objective. This would be true, for example, for FMVSS requirements that are currently met through system documentation, adding an additional layer of confirmation of compliance.

E. Technical documentation for system design and/or performance

In discussing whether technical documentation may suffice as a method of verifying compliance with the current FMVSS, the ANPRM distinguishes between requirements that have no performance specifications and those that do include performance specifications. The agency notes that the FMVSS contain at least one example of reliance on technical documentation to substantiate compliance (i.e., the understeer test for electronic stability control systems in FMVSS No. 126). That isolated example involves a requirement of the first type (i.e., one that contains no performance specification). Waymo concurs that technical documentation may, in possible combination with relevant simulation results, provide an acceptable basis for compliance verification with regard to such requirements.

Waymo further suggests that technical documentation plus relevant simulation results may suffice, whether as a permanent or an interim measure, to permit compliance verification even with regard to FMVSS that include specific performance requirements. As discussed below, technical documentation and simulation could be combined with testing of a surrogate vehicle as part of an approach to compliance verification under the current FMVSS. Testing of the base vehicle with manual controls would provide the baseline information, and the additional documentation, with simulation results, would address how removal of manual controls and addition of the ADS affected compliance. NHTSA could specify the necessary technical documentation to ensure objectivity across manufacturers with regard to this process. This would permit manufacture, certification, and deployment of ADS-DVs with a reasonable basis for verifying compliance without having to wait until every single test procedure in the current FMVSS had been redesigned to address physical testing of ADS-DVs without manual controls. For example, the approach may be particularly useful where NHTSA is encountering substantial delays in developing a specific test method for ADS-DVs (e.g., a brake test involving a particular brake component failure).

F. Use of surrogate vehicle with human controls

This approach would involve the use of a surrogate vehicle that has the same platform as the ADS-DV but is equipped with manual controls for testing purposes. As the ANPRM notes, this approach, used in isolation, faces many challenges in meeting the statutory criteria that NHTSA must meet in developing compliance tests. The surrogate vehicle would not in all cases perform identically to the ADS-DV as a result of differences in weight (e.g., due to the ADS hardware, redundant braking or steering), controller actuation timing, etc.

However, as noted above, when combined with technical documentation and simulation testing this method might provide an important alternative method of compliance verification, either permanently for some FMVSS requirements or as an interim solution while

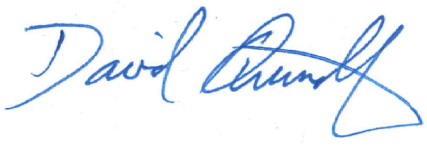
NHTSA is developing test procedures tailored to ADS-DVs without controls. For example, a manufacturer's FMVSS technical documentation for the ADS-DV could describe every specific difference between the ADS-DV without manual controls and the surrogate (or base) vehicle with those controls that is its non-automated twin and include specific engineering analysis, supported by simulation or even physical test results performed by the manufacturer, showing that the performance of the base vehicle would not be affected (or how it would be affected within the permissible performance range) by removal of the manual controls and addition of the ADS. NHTSA could perform the range of compliance tests on the base vehicle and then carefully review the technical documentation on differences between it and the companion ADS-DV. This would provide the agency with a rational basis for determining whether the ADS-DV is compliant. Adoption of this approach could significantly hasten removal of barriers to ADS-DV deployment currently found in the FMVSS while permitting adequate time for development of more tailored test procedures for ADS-DVs without controls.

Conclusion

Waymo appreciates the opportunity to offer its views on this important rulemaking. Among the six different test methods proposed in the ANPRM, Waymo sees particular merit in TMPE as a reasonable, practicable, and appropriate tool in many situations to demonstrate ADS-DV compliance with FMVSS. We also believe that NHTSA and its compliance testing contractors can perform objective, repeatable, and reproducible tests on an ADS-DV without manual controls at the facilities of the vehicle or ADS manufacturer under conditions that ensure the full integrity of the process. The agency performing compliance verification tests at those locations would avoid many or all of the practical challenges the agency has described with regard to doing such tests at NHTSA's normal test locations.

We urge NHTSA to move ahead promptly to remove the regulatory barriers the agency has identified. We believe the agency can meet that goal while ensuring ADS-DVs meet the same performance requirements as traditional vehicles and that doing so will expedite the arrival of the substantial crash reduction and improved mobility benefits that ADS-DVs promise to provide.

Sincerely,



David Quinalty
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