

# Research on the Accessibility of Automated Vehicles Report

Senate Report 116-109 accompanying the Further Consolidated Appropriations Act, 2020 (H.R. 1865; Pub. L. 116-94), enacted on December 20, 2019, requested that the National Highway Traffic Safety Administration (NHTSA) research the accessibility of vehicles equipped with Automated Driving Systems (ADS) for people with disabilities:<sup>1</sup>

The Committee directs NHTSA to develop goals and considerations for future amendments to the Federal Motor Vehicle Safety Standards [FMVSS] related to the accessibility of vehicles incorporating automated driving systems. These goals and considerations should ensure that the needs of people with communicative, physical, cognitive, mental, and other disabilities are properly and thoroughly considered. The Committee directs NHTSA to coordinate this research with the [U.S.] Access Board and other relevant stakeholders, and to provide a report to the House and Senate Committees on Appropriations within 1 year of enactment of this act summarizing efforts pursuant to these directives.

The Senate Report noted (at pp. 64-65):

Nearly one in five people in the United States have a disability and face personal challenges regarding access to healthcare, education, housing, or employment. These difficulties are often compounded by a lack of accessible transportation in their communities. As Automated Driving Systems are increasingly incorporated into both personal and commercial vehicles, manufacturers could consider significant changes to vehicle design. This presents a unique opportunity to reconsider both restraint systems and human-machine interfaces to improve the accessibility of vehicles for people with disabilities, as well as for the elderly. Whether people with disabilities or other physically-limiting driving restrictions can benefit from this transportation will depend on how early and to what extent vehicle manufacturers take accessibility into consideration in the design process of their vehicles.

## Introduction

Executive Order (E.O.) 13985 embraces a comprehensive approach to advancing equity for all, including persons with disabilities.<sup>2</sup> Consistent with the E.O., the U.S. Department of Transportation (DOT) has established an Equity Task Force dedicated to considering and pursuing initiatives to enhance accessibility and mobility and remove barriers to transportation

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<sup>1</sup> NHTSA uses the naming conventions prescribed in the SAE International Recommended Practice J3016 “Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles,” revised June 15, 2018. As such, the term “ADS” will be used throughout this document in place of Automated Vehicles. See [https://www.sae.org/standards/content/j3016\\_201806/](https://www.sae.org/standards/content/j3016_201806/)

<sup>2</sup> <https://www.federalregister.gov/documents/2021/01/25/2021-01753/advancing-racial-equity-and-support-for-underserved-communities-through-the-federal-government>

access. DOT is focused on implementing E.O. 13985 through policies and plans that attain safe, accessible, and more inclusive transportation for all.

The following report describes NHTSA’s goals and considerations for ensuring that the needs of persons with disabilities are thoroughly considered in research related to accessibility to vehicles equipped with ADS. This report also describes the agency’s ongoing research and its stakeholder engagement to foster awareness of and progress in the field. In addition, this report provides an overview of NHTSA’s work on FMVSS and alternative processes that are consistent with the Biden-Harris Administration’s values regarding accessibility and ADS.

## Goals and Considerations – Facilitating Inclusion and Collaboration

NHTSA believes it is paramount to include people with disabilities in developing research initiatives and policies supporting future amendments to the FMVSS concerning accessibility of ADS-equipped vehicles. To this end, DOT encourages entities involved in the development of ADS to “seek technical and engineering advice from members of the disabled community and otherwise engage with [the] community to develop designs informed by its needs and experiences”<sup>3,4</sup> – highlighting the commitment to a key tenet of the disability rights movement, “*Nothing About Us Without Us.*”<sup>5</sup> In this same vein, DOT encourages ADS developers and operators to work collaboratively with the disability community to support efforts that focus on the array of accommodations needed for different types of disabilities and that improve mobility as a whole.

DOT has consulted with a diverse set of stakeholders throughout the United States, including members of the disability community, in recognition of the importance of stakeholder engagement to reach accessibility goals. NHTSA is committed to collaborating with the U.S. Access Board, as well as many non-profit social service organizations. The agency’s goal is to include stakeholders in both the planning and execution of related research efforts.

NHTSA ensures that its research into future FMVSS that expand access to independent mobility to people with disabilities and older Americans is consistent with safety.<sup>6</sup> For instance, as noted in a section below, in researching the development of an automated system for securing a wheelchair to the vehicle, NHTSA made sure to examine how the prototype restraint system would perform in frontal and side crashes. It was not enough to find whether an automated system could be developed for accessibility purposes; NHTSA sought to ensure the system also meets the agency’s safety goals, so that accessibility is also safe. It is a goal of the agency that its research initiatives focus on expanding transportation equity while anticipating and accounting for the safety implications of mechanisms to enhance access and equity.

NHTSA believes improving its research and regulatory processes will facilitate the Administration’s goal of transportation equity. NHTSA has undertaken initiatives to improve

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<sup>3</sup> [https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0\\_090617\\_v9a\\_tag.pdf](https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf)

<sup>4</sup> Automated Driving Systems (ADS): A Vision for Safety 2.0 replaces Federal Automated Vehicles Policy (2016), <https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf>

<sup>5</sup> Charlton, J. I. (1998). *Nothing about us without us*. University of California Press.

<sup>6</sup> National Traffic and Motor Vehicle Safety Act, 49 U.S.C. Chapter 301 (Safety Act).

data collection and analysis, test procedure development, vehicle testing and evaluation, and regulatory requirements to support increased mobility options to people with disabilities.

## Strategic Planning for Accessibility and Awareness

DOT and NHTSA are committed to raising public awareness about accessibility in transportation, investing in new research, and incentivizing the development and deployment of inclusive, equitable, and affordable new transportation technologies. Innovations like ADS-equipped vehicles have the potential to transform the lives of people with disabilities through increased mobility. DOT's accessibility initiatives focus on working with innovators developing these new technologies early in the process to help create a more inclusive transportation system for everyone.

In 2020, DOT issued an Accessibility Strategic Plan<sup>7</sup> to lay out Departmental objectives to specifically address DOT activities that seek to remove barriers to accessibility in transportation. Feedback from relevant stakeholders, including the disability community, is integral to a strong, executable plan. DOT created a website to solicit feedback directly from the public on both the plan and possible ways in which the individual goals might be met.<sup>8</sup> This feedback will be used to inform a comprehensive approach to advancing equity for all, including persons with disabilities, consistent with E.O. 13985.

## NHTSA Research to Support Considerations for Future Regulatory Amendments

New FMVSS, or modifications to existing FMVSS, must be informed by science, engineering, and data. This section highlights NHTSA research projects and programs that can inform future rulemaking efforts on ADS and accessibility. The agency has considered U.S. Access Board feedback where received.

***People with Disabilities and Considerations Inside and Outside the Vehicle.*** The goal of this project is to identify how ADS could be developed to make vehicles accessible to the various vulnerable road users and disability types (cognitive, sensory, and physical), determine appropriate communication modalities and strategies, identify feedback requirements, and determine how to best elicit trust towards the goal of universal/inclusive end-to-end guidance. The researchers in the project are actively engaging stakeholders from a number of groups, including the National Federation of the Blind (NFB), Transportation Research Board (TRB) Accessibility Committee, National Association of City Transportation Officials (NACTO), National Council on Independent Living, American Association of Retired Persons (AARP), and Center for Inclusive Design and Access (IDeA) of the University of Buffalo. This research will inform NHTSA and the industry about maximizing the accessibility to ADS-equipped vehicles. NHTSA recognizes the value of this research and intends to expand its programmatic focus in the upcoming fiscal year.

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<sup>7</sup> The plan was announced at a July 30, 2020 virtual event, Breaking Down Barriers: Celebrating the 30th Anniversary of the Americans with Disabilities Act. <https://www.transportation.gov/accessibility/ADA30>.

<sup>8</sup> <https://transportationinnovation.ideascale.com/a/index>

***Automated Wheelchair Restraint System.*** The goal of this research effort is to develop, build, and demonstrate an automated system for securing a wheelchair inside of the vehicle and fastening the occupant crash restraints on the person occupying the wheelchair. The research will evaluate prototype restraint system performance in frontal and side safety test conditions. If successful, this work may provide the groundwork for users of wheelchairs to secure themselves safely and more simply in vehicles (with and without ADS) without assistance.

***National Survey on Pedestrian and Bicyclist Attitudes and Behaviors.*** The goal of the National Survey on Pedestrian and Bicyclist Attitudes and Behaviors is to assess current walking and bicycling trends (including e-bikes and e-scooters), behaviors, and attitudes in order to inform where and how ADS-equipped vehicles may best serve people with disabilities. The survey will assess the ability to travel within the community among those with disabilities, health impairments, and conditions that limit walking.

***State of Knowledge on Pedestrian and Bicyclist Safety.*** The goal of this study is to assess the extent to which crashes are associated with motor vehicle driver actions and evaluate a high visibility enforcement program aimed at modifying the behavior of motorists passing bicyclists in two localities with a large number of bicycle crashes attributed to the behavior. People who use mobility scooters often use bicycle facilities (e.g., bike lanes); the findings of this project will provide a foundation for further exploration of safe passing of all users of these facilities. This research may inform the design of ADS-equipped vehicles service locations and travel patterns, in anticipation of increased intermix of ADS vehicles with vulnerable road users.

## Other DOT Research Programs

***Accessible Transportation Technologies Research Initiative (ATTRI).*** The goal of the ATTRI program is to lead efforts to develop and implement transformative applications to improve mobility options for all travelers, particularly those with disabilities. ATTRI is a joint DOT initiative, co-led by the Federal Highway Administration, Federal Transit Administration, and Intelligent Transportation Systems Joint Program Office, with support from the National Institute on Disability, Independent Living, and Rehabilitation Research, and other Federal entities. This program includes projects specifically focused on automation and robotics.<sup>9</sup>

***University Transportation Centers (UTC).***<sup>10</sup> The UTC Program awards and administers grants to consortia of colleges and universities across the United States. The UTC Program advances the state-of-the-art in transportation research and technology. Each UTC is a consortium of two- and four-year colleges and universities that come together to form a unique center of transportation excellence on a specific research topic. Together, they advance U.S. technology and expertise in the many disciplines comprising transportation through education, solutions-oriented research, technology transfer, and the exploration and sharing of cutting-edge ideas and approaches. A number of projects related to accessibility and ADS-equipped vehicles have been awarded. Two such examples are: *Public Acceptance and Socio-Economic Analysis of Shared*

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<sup>9</sup> [https://www.its.dot.gov/research\\_archives/attri/automation.htm](https://www.its.dot.gov/research_archives/attri/automation.htm)

<sup>10</sup> <https://www.transportation.gov/content/university-transportation-centers>

*Autonomous Vehicles: Implications for Policy and Planning and The Connection between Investments in Bus Stops, Ridership, and ADA Accessibility; and, Vehicle-to-Device (V2D) Communications: Readiness of the Technology and Potential Applications for People with Disability.*

## Stakeholder Engagement and Federal Research Funding Opportunities

DOT hosted the *Access and Mobility for All Summit*, the goal of which was to raise awareness of DOT and government-wide efforts to improve access and mobility for people with disabilities, older adults, and individuals of low income. The summit also identified priority Federal and non-Federal activities and innovations that can provide more efficient, affordable, and accessible vehicles and mobility services such as transit and ridesharing. During the summit, DOT made several strategic funding announcements:

***Inclusive Design Challenge***<sup>11</sup> – The Inclusive Design Challenge asks researchers and innovators to develop solutions to solve our most pressing access barriers for people with physical, sensory, and cognitive disabilities. Design teams from academic and research institutions, the business sector, technology companies, and analytics firms were invited to compete for cash prizes. Solutions included both hardware and software solutions aimed to address barriers. The Inclusive Design Challenge is divided into two phases. In the first phase, proposers submitted proof-of-concept design ideas. Semi-finalists were selected in early 2021 to work toward creation of a prototype.<sup>12</sup> Final demonstration and prizes are expected to be awarded in summer 2022.

***Mobility for All Pilot Program***<sup>13</sup> – The program seeks to improve mobility options and access to community services for older adults, individuals with disabilities, and people with low incomes. The initiative will fund projects that enhance transportation connections to jobs, education, and health services.

***Complete Trip - ITS4US Deployment Program***<sup>14</sup> – This program will make up to \$40 million available to enable communities to showcase innovative business partnerships, technologies, and practices that promote independent mobility for all. “Complete Trip” means that a user can get from point A to point B seamlessly, regardless of the number of modes, transfers, and connections.

**DOT also engages in events hosted by stakeholders and other Federal agencies. For example:**

***Coordinating Council on Access and Mobility.*** The Coordinating Council issues recommendations and implements activities that improve the availability, accessibility, and efficiency of transportation for people with disabilities (and other targeted populations). The

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<sup>11</sup> <https://www.transportation.gov/accessibility/inclusivedesign>

<sup>12</sup> <https://www.transportation.gov/inclusive-design-challenge/inclusive-design-challenge-semifinalists>

<sup>13</sup> <https://www.transit.dot.gov/funding/grants/grant-programs/mobility-all-pilot-program-grants>

<sup>14</sup> <https://www.its.dot.gov/its4us/index.htm>

Council's current strategic plan<sup>15</sup> specifically identifies the need to implement innovative technologies in the transportation system (ADS-equipped vehicles fall within this category). DOT, through the Federal Transit Administration, leads the Council.

***Industry-Hosted Workshops.*** In 2019, the Alliance of Automobile Manufacturers (now the Alliance for Automotive Innovation) hosted a three-part workshop series on the topic of increased accessibility and ADS-equipped vehicles. DOT participated in the workshop, provided opening remarks, presented DOT research initiatives, and led breakout sessions. The workshop summary<sup>16</sup> provided insights into future goals and considerations for accessibility in ADS-equipped vehicles.

***Accessibility for Passengers with Mobility Disabilities: Part 1.*** The U.S. Access Board hosted a four-part series on making ADS-equipped vehicles accessible to passengers with disabilities in the spring of 2021. The Board provided an open forum for members of the public, and stakeholders discussed considerations, challenges, and solutions in designing accessible ADS-equipped vehicles. Both Secretary of Transportation Pete Buttigieg and DOT Deputy Assistant Secretary for Safety Policy Robin Hutcheson presented at the event. Recordings are available free to the public on the Access Board website.<sup>17</sup>

## FMVSS Works in Progress

At present, NHTSA is undertaking several rulemakings related to ADS-equipped vehicles.<sup>18</sup> While these efforts are not specifically focused on accessibility, they make inroads into the development and eventual deployment of ADS vehicles, for which considerations of accessibility and inclusion are paramount.

### **Selected ADS-related rulemakings of interest:**<sup>19</sup>

***Occupant Protection for ADS Vehicles (2127-AM06).*** NHTSA published a notice of proposed rulemaking proposing whether to amend the occupant protection Federal motor vehicle safety standards to better account for vehicles that do not have the traditional manual controls associated with a human driver, which would be possible if those vehicles were equipped with an ADS (85 FR 17624). The occupant protection standards are currently written for conventional vehicles and use terms such as “driver’s seat” and “steering wheel,” that are not meaningful to vehicle designs that do not have traditional features. The rulemaking would update the standards in a manner that resolves ambiguities in applying the standards to ADS-equipped vehicles without traditional manual controls, and to do so in a

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<sup>15</sup> <https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/regulations-and-guidance/ccam/about/134436/ccam-strategic-plan-2019-2022.pdf>

<sup>16</sup> <https://autoalliance.org/wp-content/uploads/2019/10/AVs-Accessibility-Workshop-Series-Report-16OCT2019.pdf>

<sup>17</sup> <https://www.access-board.gov/av/>

<sup>18</sup> [https://www.transportation.gov/sites/dot.gov/files/2020-02/February%202020%20Sign\\_rulemaking%20report02072020r.pdf](https://www.transportation.gov/sites/dot.gov/files/2020-02/February%202020%20Sign_rulemaking%20report02072020r.pdf)

<sup>19</sup> A full list of NHTSA's planned regulatory actions may be found in the Spring 2021 Unified Agenda at <https://www.reginfo.gov/public/do/eAgendaMain>.

way that is intended to maintain the level of occupant crash protection currently provided to occupants in traditionally-designed vehicles.

***Considerations for Telltales, Indicators and Warnings in ADS Vehicles (2127-AM07).*** This notice would seek comments on amending the FMVSS to address the applicability and appropriateness of safety messaging (telltales, indicators, and warnings) in ADS-equipped vehicles without conventional manual controls (e.g., steering wheel, pedals, etc.). NHTSA is interested in whether safety messaging reaches all occupants, including those with disabilities.

***Framework for Automated Driving System Safety (2127-AM15).*** NHTSA has published a notice seeking comments on possible regulatory approaches to motor vehicles equipped with ADS (85 FR 78058). The agency requested public input on a potential safety framework for objectively and transparently assessing and validating the success of each ADS vehicle manufacturer or developer in designing safety into its vehicles. The agency requested comments on ideas for developing and establishing a regulatory approach, such as amending FMVSS or developing alternative safety regulations relating to ADS vehicle performance. Again, an important issue in ADS regulation is ensuring access and inclusion for all road users.

### **Alternatives to FMVSS Amendments**

In some cases, the best path to reach an accessibility-related ADS goal may not be through FMVSS amendments. In this case, there are alternatives to facilitate meeting these goals, described below.

**Voluntary Commitments and Standards.** Executive Order 12866, Regulatory Planning and Review,<sup>20</sup> directs agencies to “identify and assess available alternatives to direct regulation.” One such alternative is a voluntary agreement or voluntary pledge made by vehicle manufacturers and suppliers to improve accessibility for all road users.

DOT and NHTSA recognize that standards development organizations, such as SAE International, are also dedicating resources to consider the accessibility of ADS.<sup>21</sup> In 2019, SAE issued “Identifying Automated Driving Systems-Dedicated Vehicles (ADS-DVs) Passenger Issues for Persons with Disabilities.”<sup>22</sup> This document provides accessibility design guidance to on-demand, shared-mobility providers. NHTSA will consider such publications during the development of policy and other considerations involving mobility needs for people with disabilities.

Similarly, under the National Technology Transfer and Advancement Act of 1995,<sup>23</sup> Federal agencies are to consider voluntary consensus standards, when available and applicable, to carry out regulatory objectives. In accordance with this statute, NHTSA has incorporated voluntary consensus standards into some FMVSS. NHTSA has also

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<sup>20</sup> <https://www.archives.gov/files/federal-register/executive-orders/pdf/12866.pdf>

<sup>21</sup> [https://www.sae.org/standardsdev/news/mobility\\_benefits.htm](https://www.sae.org/standardsdev/news/mobility_benefits.htm)

<sup>22</sup> [https://www.sae.org/standards/content/j3171\\_201911/](https://www.sae.org/standards/content/j3171_201911/)

<sup>23</sup> Pub. L. 104-113

previously evaluated third-party standards issued by organizations including the International Organization for Standardization, the American National Standards Institute, and the American Society for Testing and Materials, among others. NHTSA will interact with standards-development organizations to develop ADS goals and considerations for people with disabilities.

## **FMVSS Exemptions**

**General exemptions.** If an automaker is unable to comply with FMVSS in the process of improving accessibility, companies may petition NHTSA for exemption from the FMVSS through a general exemption petition process.<sup>24</sup> This process involves an agency determination on the adequacy of the petitioner’s justification of safety equivalence with respect to the performance standard from which exemption is sought. NHTSA will review the research, design, and test data submitted as part of the exemption petition and will request public comment on the petitioner’s request.

**Make inoperative exemptions.** The need to alter or remove Federally required safety equipment may pose a problem for businesses seeking to modify a vehicle to accommodate persons with disabilities because of a Safety Act provision prohibiting making such features inoperative (49 U.S.C. § 30122). However, NHTSA has established a “make inoperative exemption” regulation that allows commercial entities to modify point of sale safety equipment to better accommodate modifications and aftermarket devices to improve vehicle accessibility.<sup>25</sup> Specifically, 49 CFR part 595 – requirements for vehicle modifications to accommodate people with disabilities – permits a modifier to be exempted from the make inoperative prohibition of 49 U.S.C. § 30122 when modifications that affect compliance with certain FMVSS enable a person with a disability to operate or ride as a passenger in the motor vehicle, provided the modification is consistent with the Safety Act.

As part of the 49 CFR Part 595 make inoperative exemptions, NHTSA has published a notice of proposed rulemaking (NPRM)<sup>26</sup> and a supplemental NPRM (SNPRM)<sup>27</sup> collectively detailing three proposed exemptions to provide accessibility-enabling modifications to improve mobility. The NPRM pertains to FMVSS No. 216, “Roof crush resistance,” which establishes the strength requirements of passenger compartment roofs. This standard may cause difficulties for modifiers replacing a vehicle’s original roof after first sale with a raised or altered roof to accommodate the needs of people with disabilities (e.g., to provide sufficient space to properly accommodate a person in a wheelchair). NHTSA recognizes there is a need to accommodate people with special mobility needs. For example, NHTSA proposed a school bus roof crush standard as an alternative to vehicles modified in this manner.

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<sup>24</sup> 49 CFR 555.7 - Part 555, Temporary Exemption From Motor Vehicle Safety and Bumper Standards.

<sup>25</sup> 49 CFR Part 595, Make Inoperative Exemptions.

<sup>26</sup> <https://www.govinfo.gov/content/pkg/FR-2016-03-11/pdf/2016-05372.pdf>

<sup>27</sup> <https://www.federalregister.gov/documents/2020/12/28/2020-28648/make-inoperative-exemptions-vehicle-modifications-to-accommodate-people-with-disabilities>

The SNPRM addresses two additional standards. The first is FMVSS No. 111, “Rear visibility,” which requires that vehicles be equipped with a system that provides the driver with an image of the area directly behind the vehicle. A manufacturer of apparatuses that carry personal mobility devices (e.g., wheelchairs or powered scooters) asked NHTSA to permit installation of the apparatuses although they may obstruct a rear visibility camera. NHTSA proposed to allow the temporary installation of such apparatuses to facilitate the mobility needs of persons with disabilities.

Second, the SNPRM proposes to expand Part 595<sup>25</sup> for the first time to rental car companies, to facilitate the temporary installation of hand controls in rental vehicles equipped with knee bolster air bags. Hand controls consist of a metal bar that connects to the accelerator and brake pedals of a vehicle to enable operation by a person unable to control the pedals with their feet. Since knee bolster air bags could interact with a hand control during deployment, NHTSA proposed to enable rental companies to install hand controls when requested by a customer and temporarily make inoperative the knee bolster air bag during the time the vehicle is rented.

NHTSA will continue to use this exemption authority to ensure safety and increased mobility as the agency develops ADS goals and considerations for persons with disabilities.

## **Summary**

DOT and NHTSA are committed to advancing equity comprehensively, as set forth in E.O. 13985, for all people, including people with disabilities. NHTSA developed goals and considerations for research on the accessibility of vehicles to ensure that vulnerable, those with a disability, and older persons are considered at every point in the transportation ecosystem.

Research on both ADS-equipped vehicles and accessibility help lay the groundwork to achieve strategic plan goals and considerations. Similarly, both accessibility and equity considerations are incorporated into rulemaking. Active and continuous stakeholder engagement is vital to the success of both the development and execution of research goals – this has included and will continue to include collaboration with the U.S. Access Board.