



SAE International

Accessible Automated Driving System Dedicated Vehicles

White Paper

“This technology has the potential to transform the daily lives of such an important part of our social fabric. And we cannot let this opportunity to meet their transportation needs pass us by.” – The Honorable Congressman Gregg Harper (R-Miss.), U.S. House of Representatives

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Background

Over one billion people, about 15% of the world's population, have some form of disability.¹ In the United States, nearly one in five, or 56.7 million people have a disability.² Of the 15 million Americans who report having difficulties accessing transportation services, 40 percent represents the disability community.³ The lack of a personal vehicle is the most frequently cited reason for being homebound for persons with disabilities.³ Today's ever-evolving and technology-infused mobility landscape presents new mobility opportunities for this community.

Automated Driving System Dedicated Vehicles (ADS-DVs) – vehicles designed to be operated exclusively by level 4 and level 5 Automated Driving Systems (ADS)⁴ – have the potential to yield positive, life-altering mobility benefits for persons with disabilities, including those who are unable to obtain a driver's license. Original equipment manufacturers (OEMs) and technology companies are in a race to be the first to develop, refine, and deploy ADS-DVs for traditional vehicle drivers and transportation service providers. Though this race may foster rapid technology development, it may result in significant accessibility gaps as a by-product that ultimately excludes the participation of the disability community.

Systemic Barriers to Personal Mobility

Over half a million disabled Americans never leave home due to the lack of transportation.³ Almost three decades after the passage of the Americans with Disabilities Act, persons with disabilities continue to face systemic barriers to transportation. The lack of transportation accessibility contributes to unemployment rate being twice as high for persons with disabilities compared to that of those with no disability.⁵ Furthermore, people with disabilities report transportation and affordability as main barriers to receiving needed health care.¹

For those who are unable to obtain a driver's license, transportation options are often limited to walking, public transport, and for-hire services such as taxis. The current model for obtaining personal, accessible vehicles involves aftermarket vehicle modification, which is prohibitively expensive (\$20,000 to \$80,000 per vehicle in addition to the purchase price of a stock vehicle).⁶ In 1997, the National Highway Traffic Safety Administration estimated the number of vehicles modified for those with disabilities to be 383,000.⁷ This number is expected to be much larger today given improvements in assistive technologies and larger population with disabilities. These examples demonstrate how and why a large subset of the disability community is challenged with transportation options that remain either inaccessible, unreliable, or ill-suited toward some or all of their transportation needs.⁸

Accessible ADS-DVs

Accessible ADS-DVs would mean that persons with disabilities are able to independently: (i) get in and out of the vehicle; (ii) safely secure themselves and their mobility aid devices; and (iii) operate the vehicle. In the current technology environment, ensuring that all three of these aspects of accessibility are met does not require a significant technological leap once ADS technology is fully developed; however, it may involve considerable resources for architectural and configuration changes along with new compliance and certification.

With on-road motor vehicle driving automation systems, the user base of vehicles can expand to include those who currently cannot obtain driver's licenses or easily operate conventional vehicles. The level of disability community's participation in the ADS-DV use will depend on how early and to what extent that

OEMs and technology companies will design ADS-DVs with the criteria and user requirements of this community in mind. It is through the design of the vehicles that barriers are created or removed.

In his testimony to the Hearing of the Senate Committee on Commerce, Science, and Transportation, the National Council on Disability Chair, Clyde Terry stated, “Accessibility must be infused in the research and development of [automated vehicles]. Without explicit inclusion of accessibility in the development of [automated vehicle] technologies, the potential for opportunity wanes.”⁹ During the Senate Committee on Commerce, Science, and Transportation’s hearing titled “Paving the Way for Self-Driving Vehicles,” Senator Maggie Hassan of New Hampshire reiterated the importance of “getting upfront input from people who experience disabilities before the product is finalized,” and to streamline the accessible ADS design process by including the disability community sooner than later.¹⁰

Page 23 of the U.S Department of Transportation’s Federal Automated Vehicles Policy (September 2016) states that “manufacturers and other entities should design their HMI to accommodate people with disabilities (e.g., through visual, auditory, and haptic displays)”, and “[e]ntities are encouraged to seek technical and engineering advice from members of the disabled community and otherwise engage with that community to develop designs informed by its needs and experiences.”¹¹

As Congressman Gregg Harper of Mississippi stated, with accessible ADS, “Simple things that most of us take for granted is getting to and from work or across town to visit family will no longer present insurmountable obstacles for those who cannot currently drive.”¹²

Role of Standards

Standards development is an essential element of the development of ADS and related enabling technologies. Standards are vital for establishing interoperability of complex, highly integrated vehicle systems, including the human-machine interface. New ADS-DV accommodations must be engineered and validated to facilitate use of ADS-DVs by new/non-traditional user communities, including a subpopulation of the disability community. These new solutions must be accompanied by consensus, open standards to ensure the safety, reliability, and performance requirements of ADS-DVs for the new user community. Specifically, standards may focus on entry/exit, pre-, during, and post-incident management, and failure mode protection.

Activities at SAE International

As a leader in developing open, consensus standards in mobility, SAE continues its mission to identify and fill gaps in research and standards. SAE is leading the development of standards on automated driving systems. SAE’s levels of automation are adopted by the U.S. Department of Transportation.

- SAE J3016: Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems
- SAE J3018: Guidelines for Safe On-Road Testing of SAE Level 3, 4, and 5 Prototype Automated Driving Systems
- SAE J3061: Active Safety Systems Terms & Definitions

In late 2016, SAE established the “Identifying ADS-DV User Issues for Persons with Disabilities Task Force”. This task force is dedicated to gathering and developing information on user issues specific to disability population of ADS-DV users. The main activities of the task force are literature review and stakeholder interviews, which will inform the Information Report that summarizes ADS-DV user issues for this community. This represents one of SAE’s initial steps to conduct research and develop Technical Reports to facilitate full utilization of ADS-DVs by the disability community.

In addition, SAE houses the “Adaptive Devices Standards Committee,” which is responsible for developing and maintaining Technical Reports related to defining minimum acceptable design requirements and performance criteria for adaptive equipment that is used by people with disabilities for their personal transportation. Several standards have been published under this committee, including the following.

- J1725: Structural Modification for Personally Licensed Vehicles to Meet the Transportation Needs of Persons with Disabilities
- J1903: Automotive Adaptive Driver Controls, Manual
- J2092: Testing of Wheelchair Lifts for Entry to or Exit from a Personally Licensed Vehicle
- J2093: Design Considerations for Wheelchair Lifts for Entry to or Exit from a Personally Licensed Vehicle
- J2094: Vehicle and Control Modifications for Drivers with Physical Disabilities Terminology
- J2249: Wheelchair Tiedown and Occupant Restraint Systems for Use in Motor Vehicles
- J2603: Recommended Practice for Powered Gas Brake Control Systems

SAE will continue to advance its standards and our other activities to facilitate safe design of ADS-DVs for use by a broad user community.

Next Steps

Designing an inclusive, accessible ADS-DV requires a series of considerations. In the case of paratransit services, drivers’ duties extend well beyond the driving task to include assisting passengers when entering and exiting the vehicle, ensuring that passengers’ seatbelts are fastened and mobility devices are secured, as well as providing door-to-door service. If there was no driver, then new accommodations need to be in place to fill the void of the driver’s non-driving duties. Such accommodation could include independent wheelchair securement.

The benefits of ADS-DVs apply to those beyond individuals who are unable to obtain driver’s licenses. For example, ADS-DVs may allow enormous flexibility for interior seating configuration and passenger orientation as the need for steering wheels and pedals is eliminated. In this thought, the need for vehicle modifications to facilitate driving task, such as hand controls, may become obsolete.

As the leading standards development organization in ground vehicles, SAE recognizes the significant contribution it can provide in supporting the development and use of accessible ADS-DVs. SAE invites experts from all disciplines (e.g. human factors, disability advocacy, assistive technologies) to drive standards development to establish the foundation needed to facilitate the development of accessible ADS-DVs.

Contact Information

To learn more or get involved in SAE's activities in accessible ground vehicles, please contact:

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About SAE International

SAE International is a global association of over 145,000 engineers, business executives, educators, and students from more than 110 countries which form our network of membership to share information and exchange ideas for advancing the engineering of mobility systems in the automotive, aerospace and commercial-vehicle industries.

Through SAE International, thousands of engineers and scientists from around the world develop technical information on all forms of self-propelled vehicles including automobiles, trucks and buses, off-highway equipment, aircraft, aerospace vehicles, marine, rail, and transit systems. SAE International's technical committees have developed over 35,000 aerospace and ground vehicle standards. SAE International disseminates information through its meetings, books, technical papers, magazines, online publications, standards, reports, pre-professional and professional development programs, and electronic databases.

SAE has a long history helping the automotive community move toward a common goal that serves the public, government, and industry. One of SAE's core competencies is the development and maintenance of mobility related standards. Managing a portfolio of 9,000 current standards and a historical database of more than 20,000 standards, SAE has the largest single collection of consensus, industry standards in the mobility industry. Thousands of industry experts, government officials, and academics work through hundreds of TCs to develop high-value standards, many of which find their way into regulations around the world.

¹ World Health Organization (2016). Disability and Health. <http://www.who.int/mediacentre/factsheets/fs352/en/>

² Census (2012). Nearly 1 in 5 People Have a Disability in the U.S., Census Bureau Reports.

<https://www.census.gov/newsroom/releases/archives/miscellaneous/cb12-134.html>

³ Bureau of Transportation Statistics (2003). Transportation Difficulties Keep Over Half a Million Disabled at Home. BTS Issue Brief No. 3.

https://www.bts.gov/sites/bts.dot.gov/files/legacy/publications/special_reports_and_issue_briefs/issue_briefs/number_03/pdf/entire.pdf

⁴ SAE International Surface Vehicle Recommended Practice. Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles, SAE Standard J3016, Rev. Sept. 2016.

⁵ Bureau of Labor Statistics (2017). Persons with a Disability: Labor Force Characteristics Summary.

<https://www.bls.gov/news.release/disabl.nr0.htm>

⁶ National Highway Traffic Safety Administration (2015). Adapting Motor Vehicles for People with Disabilities.

https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/adapting_motor_vehicles_brochure_810733.pdf

⁷ Bureau of Transportation Statistics (2004). Update on Safety Issues for Vehicles Adapted for Use by People with Disabilities. <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/adaptedisability.pdf>

⁸ Claypool, H., Bin-Nun, A., and Gerlach, J. 2017. Self-driving Cars: The Impact on People with Disabilities. Washington, DC.

⁹ National Council on Disability. Written Submission of Chair Clyde Terry to Senate Commerce Committee on Autonomous Vehicles. March 15, 2016. <https://ncd.gov/newsroom/2016/SenateCommerceAVWrittenTestimony>

¹⁰ U.S. Senate Committee on Commerce, Science & Transportation. Paving the Way for Self-Driving Vehicles. June 14, 2017. <https://www.commerce.senate.gov/public/index.cfm/hearings?ID=7875A7F4-B547-4E91-BEC9-1ED7DD3616FD>

¹¹ National Highway Traffic Safety Administration (2016). Federal Automated Vehicles Policy. <https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf>

¹² Energy and Commerce Committee Vote on H.R. 767; H.R. 772; H.R. 880; H.R. 931; H.R. 2422; H.R. 3387; and H.R. 3388. July 27, 2017. <https://energycommerce.house.gov/hearings-and-votes/markups/energy-and-commerce-committee-vote-hr-767-hr-772-hr-880-hr-931-hr-2422-hr>