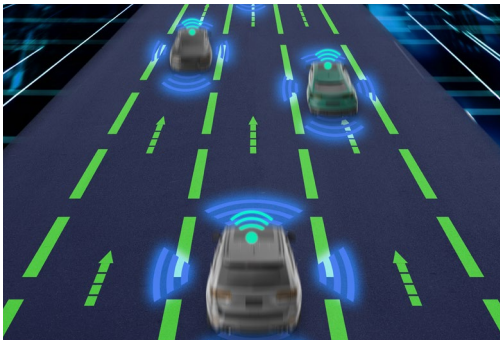
AAMVA

American Association of
Motor Vehicle Administrators

recommendations
REGULATION
driving automation
system technology
framework
STANDARDIZATION



Guidelines for Regulating Vehicles with Automated Driving Systems

Edition 4

March 2024

AUTOMATED VEHICLES SUBCOMMITTEE
VEHICLE STANDING COMMITTEE

Contents

Executive Summary

The American Association of Motor Vehicle Administrators (AAMVA) is a tax-exempt nonprofit organization developing model programs in motor vehicle administration, law enforcement, and highway safety. AAMVA also serves as an information clearinghouse in these areas and acts as the international spokesperson for these interests.

Founded in 1933, AAMVA represents the state, provincial, and territorial officials in the United States and Canada who administer and enforce motor vehicle laws. AAMVA's programs encourage uniformity and reciprocity among the jurisdictions. The association also serves as a liaison with other levels of government and the private sector. Its development and research activities provide guidelines for more effective public service. In addition to jurisdictions, AAMVA's membership includes associations, organizations, and businesses that share an interest in the association's goals.

AAMVA is neutral on the topic of jurisdictional regulation of vehicles equipped with driving automation system technology. The purpose of this report and its recommendations is to provide a framework for standardized regulations among jurisdictions that choose to enact some form or level of regulation. If a jurisdiction chooses to adopt these recommendations, most can be appropriately applied to different types of vehicles, including, but not limited to, passenger vehicles, low-speed shuttles, fleet-owned vehicles, and commercial vehicles.

The AAMVA Automated Vehicle Subcommittee (AVSC) was established in 2014 to provide leadership and guidance to the motor vehicle administration and law enforcement communities in regulating the testing and deployment of vehicles equipped with driving automation systems.

The AVSC first published a guidance report in 2018 followed by updated reports in 2020 (Edition 2) and 2022 (Edition 3). This fourth edition is the result of ongoing efforts by the AAMVA community and the AVSC to help members stay up to date with the evolution of vehicle driving automation system technology and application.

For the purposes of this report, driving automation system includes vehicles equipped with any level of automation including advanced driver assistance systems (ADASs) and automated driving systems (ADSs). ADAS-equipped vehicles contain systems to assist drivers with certain driving tasks to improve safety and reduce driver workload. These vehicle systems consist of Level 0, No Driving Automation; Level 1, Driver Assistance; and Level 2, Partial Driving Automation. ADS-equipped vehicles may not need a human driver to operate the vehicle but could require a human driver to take control of the vehicle. These vehicle systems consist of Level 3, Conditional Driving Automation; Level 4, High Driving Automation; and Level 5, Full Driving Automation. These Levels have been established by the Society of Automotive Engineers (SAE) International, which is addressed in Chapter 2, *Automated Vehicle Classification, Terms, Acronyms, and Technologies.* This chapter also provides explanations for key terms and definitions used throughout the report.

To assist administrators with determining approaches to regulating the use of vehicles with driving automation systems, Chapter 3, *Administrative Considerations*, discusses the importance of establishing a committee of stakeholders to provide oversight for testing and deployment. Areas of oversight to consider include driving licensing, driver testing, vehicle licensing, financial responsibility, infrastructure, rules of the road, and enforcement of traffic laws and regulations. Chapter

3 also addresses the most common vehicle automation technology in use today, ADAS. This is important because ADAS technology impacts how jurisdictions conduct driver testing and provides driver examiner training. Jurisdictions are also encouraged to enhance public education and awareness on the use of ADAS features to improve public and highway safety.

Approaches to regulating the use of vehicles equipped with driving automation systems is discussed in Chapter 4, *Vehicle Considerations*. Jurisdictions wanting to authorize a permitting process are provided resources and recommendations for implementation, including what information to require on permit applications, registration, and title information, as well as the approval process. Knowing if these vehicles comply with national vehicle safety standards and conducting inspections of vehicles equipped with driving automation systems can pose challenges for jurisdictions. Along with these issues, the specific abilities and limitations of driving automation systems are important elements for jurisdictions to understand as they address potential regulations.

Defining who is responsible for the operation of the vehicle equipped with a driving automation system is an important element for jurisdictions to consider. Chapter 5, *Driver Licensing Considerations*, focuses on defining the roles of drivers and passengers, as well as describing the functions of a remote driver and remote driving. These are significant considerations for all phases of the program because most of these vehicles require some level of driver interaction. As discussed in Chapter 2, for lower levels of vehicle automation, driving engagement is required, but as the automation level increases, driver engagement may be reduced but not eliminated. There are many components to consider when looking at driver licensing requirements for someone physically in the vehicle operator's seat and for someone monitoring or operating the vehicle remotely. These components are discussed in detail with recommendations to assist in determining an appropriate course of action.

Chapter 6, *Law Enforcement Considerations*, addresses how vehicles equipped with driving automation system technology will impact enforcement of traffic laws and response to traffic-related incidents. Topics focus on vehicle identification, crash and incident reporting, distracted driving, operational responsibility, interaction plans, training, and platooning. Safe operation of ADAS- and ADS-equipped vehicles on public roadways is paramount, and compliance with traffic laws and rules of the road is at the core of successful testing and deployment of these vehicles. Law enforcement and first responders are key stakeholders to ensure these goals and objectives are met.

This guidance document concludes with a chapter providing considerations and recommendations for several broad categories. With connected automated vehicles comes the potential for cyber-attacks, amplifying the need for cybersecurity measures during the vehicle's life cycle. Because these vehicles capture significant amounts of data, it is important to address upfront what data are available, how the data may be accessed, and what are the permitted uses. Privacy policies should also be reviewed so everyone involved is aware of what data is captured and how it is used. The use of low-speed automated shuttles may an provide opportunity for communities to meet specific transportation needs. Jurisdictions wishing to allow and regulate these vehicles within an automated vehicle program will find this chapter provides valuable insight and ideas to consider. In addition to numerous recommendations, Chapter 7, *Other Considerations*, contains a variety of resources and references to further assist administrators and stakeholders in program development.

A successful path to the safe testing and deployment of automated vehicle technology includes appropriate oversight while realizing the lifesaving benefits this technology can provide when used properly. Intentional collaborative efforts with industry, researchers, academia, and government agencies are important as this technology advances. Many entities are engaged in or affected by these rapidly developing technologies with significant resources and opportunities for dialogue. In addition to partner associations engaging in traffic safety and education,

this topic demands a broad spectrum of collaboration to include an understanding of the roadway and digital infrastructure technology.

AAMVA works closely with and coordinates initiatives involving vehicles equipped with driving automation systems through partnerships with the United States Department of Transportation, Canadian Council of Motor Transport Administrators, and Commercial Vehicle Safety Alliance. These partners provided significant input into the development of this report.

The name of this report has changed from prior editions to be more inclusive with both ADS and ADAS vehicle automation technology and regulation. Many updates are included in this fourth edition to help jurisdictions stay current with advances in vehicle automation technology. Also, with the increasing number of vehicles on the roadway containing some level of driving automation, the need for driver and public education and training continues to increase.

Important Notes to the Reader

Edition 4 replaces Edition 3 of this report and contains global updates as outlined in the Revision Comparison chart below.

	Revision Comparison	
	Edition 3	**Edition 4**
Chapter 1	Introduction	Provides an overview of new information contained in the document.
Chapter 2	Automated Vehicle Classification, Terms, Acronyms, and Technologies	Includes new definitions and acronyms. Describes additional elements to consider with qualifications for remote assistance and remote drivers.
Chapter 3	Administrative Considerations	Links were added to referenced material, and emphasis was placed on inconsistencies with ADAS features. New driver examiner training for advanced driver assistance systems (ADASs) is described.
Chapter 4	Vehicle Considerations	Emphasis is placed on manufacturers and other entities (MOEs) disclosing issues involving automated vehicle (AV) testing in other jurisdictions. The use of over-the-air updates is discussed along with how it can impact the level of automation and how the automation functions. Additional items are included for jurisdictions to consider if permits are required prior to AV testing. Information regarding placing a brand on a vehicle title is discussed, along with the implications of doing so. New information is provided regarding the Commercial Vehicle Safety Alliance (CVSA) Enhanced Commercial Motor Vehicle Inspection Program for Autonomous Motor Carriers. Vehicle safety inspection information is updated, and additional related recommendations for MOE's are included. Three new subchapters were added to Edition 4. The first new subchapter is titled *Automated Driving System-Equipped Vehicles for Transportation of People Living with Disabilities*. This subchapter addresses the benefits and items to consider if jurisdictions are researching the offering of Level 4 or 5 AV transportation for people living with disabilities. The second new subchapter is titled *Shared and Temporary Use of Vehicles with Driving Automation Systems*. This subchapter focuses on how the vehicle operator level of experience with driving automation systems varies significantly and provides areas to take into consideration for these limited use situations. The third new subchapter is titled *Assessment of Driving Automation Systems*. This subchapter addresses the lack of standards for what qualifies for classification levels of vehicle automation and recommends jurisdictions obtain more specific information to determine a vehicles automation capability.

(continued)

Revision Comparison (continued)

	Edition 3	Edition 4
Chapter 5	Driver Licensing Considerations	Addresses the additional elements to consider with qualifications for remote assistance and remote driver. Encourages the use of consistent terminology and standardized training material when instructing and discussing the use of driving automation systems. References and encourages the use of additional resources regarding testing drivers in vehicles with ADAS.
Chapter 6	Law Enforcement Considerations	Stresses the need for a visual indicator to signify when the vehicle is being operated by the automated driving system (ADS) and labeling to indicate the vehicle is ADS equipped. Makes law enforcement aware that the National Traffic Safety Board may conduct a parallel crash investigation when an ADS-equipped vehicle is involved. Provides added detail as to data that should be captured during crash investigations involving ADS-equipped vehicles and reporting of involved crashes. Adds recommendations to not allow overriding of ADS settings to violate traffic laws when in ADS mode and for MOEs to consider the ability for law enforcement to remotely disable an ADS-operated vehicle in an emergency. Platooning is moved to this chapter from Chapter 7, and the resources and references are updated.
Chapter 7	Other Considerations	The cybersecurity subchapter is updated with additional detail and updated recommendations and references. More detail is provided reference data collection, retention, and destruction for vehicles equipped with ADSs. Content is updated, and new recommendations are provided for regulating the use of low-speed ADS shuttles and automated delivery vehicles and devices.
Chapter 8	Next Steps	Verbiage was updated.
Appendices	Appendices A, B, and C	Reflect updated or edited recommendations, and a new subcommittee member roster has been added.

Chapter 1 Introduction

Vehicles with a variety of driving automation systems being operating by drivers that may have limited knowledge of their use and capabilities share the same roadway with pedestrians, bicyclists, and other vehicles and objects, all which can create unique challenges. Motor vehicle and law enforcement agencies need to adapt as vehicles with more advanced driving automation systems become available. These driving automation systems include vehicles with automated driving systems (ADSs) and advanced driver assistance systems (ADASs).

Manufacturers and other entities (MOEs) are testing vehicles with driving automation systems on public roadways, prompting some jurisdictions to explore ways to regulate this emerging technology to ensure public safety is met. Different approaches to regulating these vehicles make it important for updated framework to continue to support a consistent regulatory approach. In addition, introduction of ADS-equipped vehicles into the existing roadway infrastructure requires a transformation some jurisdictions are not currently equipped to manage without assistance from industry, partners, and other community members.

The Automated Vehicles Subcommittee (AVSC) began its work in 2014 by making a significant contribution to the Model State Policy contained in Section II of the *National Highway Traffic Safety Administration's (NHTSA's) Federal Automated Vehicles Policy* and NHTSA's Automated Driving Systems: A Vision for Safety 2.0 and is referenced in NHTSA's Preparing for the Future of Transportation: Automated Vehicles 3.0. Additional information can be found in the United States Department of Transportation's (U.S. DOT's) publication *Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0*. The AVSC also examined the potential impacts of vehicle testing and deployment in jurisdictions with vehicles equipped with driving automation systems and used this information to create and provide updates to this report.

Jurisdictional implementation of the recommendations will facilitate a consistent regulatory framework that balances current public safety with the advancement of vehicle innovations to reduce crashes, fatalities, injuries, and property damage.

1.1 Report Structure

The AVSC developed this report to provide information and voluntary recommended guidelines for motor vehicle administrations, law enforcement, manufacturers, and other entities for the safe testing and deployment of vehicles equipped with driving automation systems. This report is divided into five main chapters:

- Administrative Considerations
- Vehicle Considerations
- Driver Licensing Considerations
- Law Enforcement Considerations
- Other Considerations

Each chapter contains several sections, each discussing specific topics. The sections are organized in a similar format. This includes background information followed by guidelines and recommendations for testing vehicles. Guidelines for Deployed Vehicles are also discussed and continue to evolve. Each section concludes with a discussion of the benefits of

implementing the recommendations and the potential challenges jurisdictions may encounter.

The appendices include:

- Appendix A, Summary of Recommended Jurisdictional Guidelines for Regulating Vehicles with Driving Automation Systems
- Appendix B, Summary of Recommendations for Manufacturers and Other Entities for Regulating Vehicles with Driving Automation Systems
- Appendix C, Automated Vehicles Subcommittee Roster

1.2 Guiding Principles

The principles guiding the development of this report were:

- facilitating a consistent and balanced oversight approach by motor vehicle administrators to avoid inconsistent regulatory practices that could create unnecessary hurdles for vehicle and technology manufacturers;
- supporting the research and development of technology that has the potential to improve traffic safety while providing mobility options for underserved populations;
- supporting the safe testing and deployment of vehicles equipped with driving automation systems; and
- confirming the roles and responsibilities of jurisdictions and the federal government.

1.3 Collaboration Among Stakeholders and Partners

A successful path to the safe testing and deployment of vehicles equipped with driving automation systems includes developing strong partnerships. These partnerships are formed to address the far-reaching impacts of technologies and include representatives from a range of government organizations and associations, industry, research institutes, and advocacy groups.

Because automotive technology development and deployment has worldwide impact, collaboration within jurisdictions, nationally and internationally, is vital to the safe integration of vehicles equipped with driving automation systems. The American Association of Motor Vehicle Administrators (AAMVA) and the AVSC participated in a variety of efforts that helped form the development of this report. Some collaborative examples include the partnership between AAMVA and the Canadian Council of Motor Transport Administrators (CCMTA), which fosters consistent recommendations to U.S. and Canadian Jurisdictions. Another example is the recent addition to the AVSC, the Commercial Vehicle Safety Alliance (CVSA) to provide the commercial vehicle perspective, which has seen significant growth in automated vehicle (AV) testing.

1.4 Current Regulatory Efforts

Some jurisdictions have developed requirements for manufacturers and other entities (MOEs) to test vehicles equipped with driving automation systems on public roadways; others have chosen not to adopt specific requirements until more information is available. Jurisdictional activities were reviewed to learn different oversight approaches. The AVSC used the collective experiences of the jurisdictions to assist in shaping these recommendations.

1.5 Recommendations Are Voluntary

AAMVA is neutral on the topic of jurisdictional regulation of vehicles equipped with driving automation systems. The purpose of these jurisdiction recommendations is for the consideration of jurisdictions choosing to enact some form or level of regulation. If a jurisdiction chooses to adopt these recommendations, most can be appropriately applied to different types of vehicles, including, but not

limited to, passenger vehicles, low-speed shuttles, fleet-owned vehicles, and commercial vehicles.

1.6 Out of Scope

The AVSC determined that several topics were out of scope. Although critical to the testing and deployment of vehicles equipped with driving automation systems, they are not specifically detailed in this report. AAMVA members are encouraged to collaborate with other agencies responsible for these topics to ensure all elements of vehicle operation are addressed prior to testing and deployment. These topics include but are not limited to:

- vehicle import/export considerations;
- enabling infrastructure;
- fiscal impacts to jurisdictions;
- economic considerations; and
- environmental impacts.

Chapter 2 Automated Vehicle Classification, Terms, Acronyms, and Technologies

This chapter provides an explanation of the terms commonly used to identify and differentiate ADAS- and ADS-equipped vehicles of varying capabilities at the time this report was published. Users of this report will benefit from familiarization with the terminology and acronyms.

A wide variety of vehicle technologies are available in the marketplace, and others are continually under development (e.g., forward collision warning, lane departure warning). This report does not attempt to define these specific vehicle technologies. Although there are technologies of a similar nature, some manufacturers use proprietary terms. Various resources, such as www.mycardoeswhat.org, provide information and videos of specific vehicle technologies.

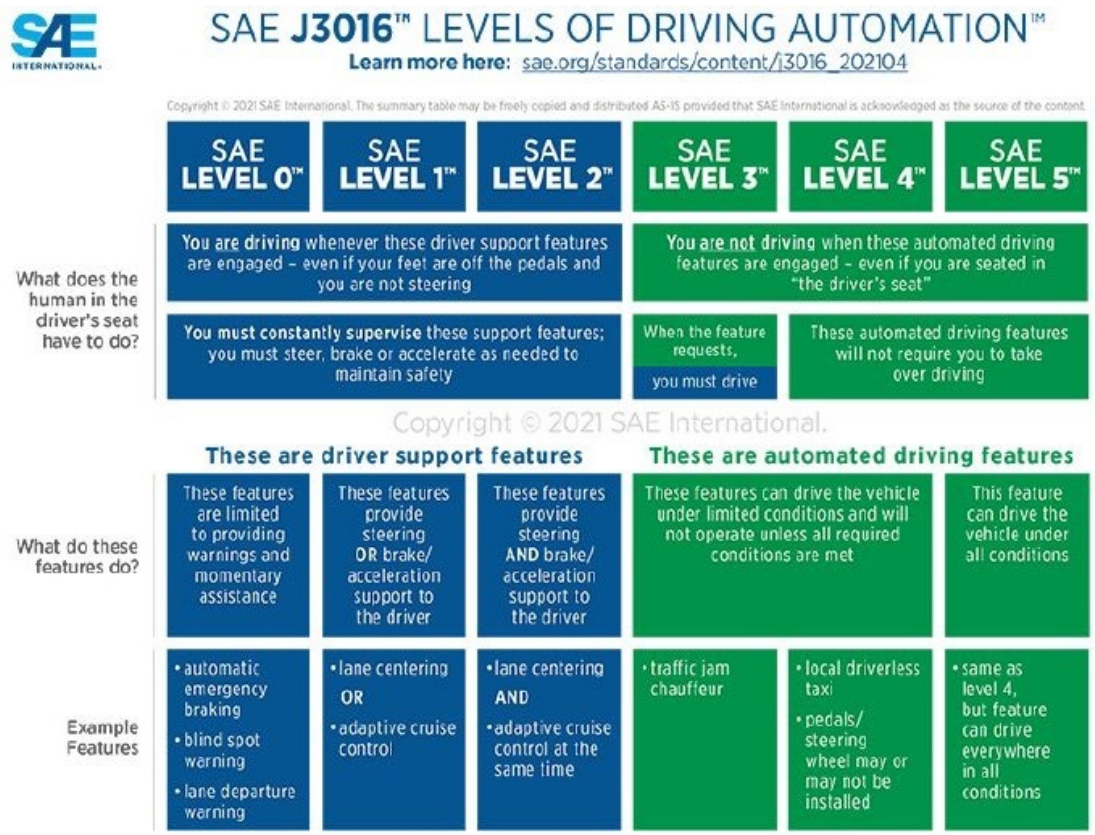
2.1 Vehicle Classification Systems

AAMVA encourages the adoption of terminology developed by SAE International that is used throughout this report. Refer to the SAE taxonomy for additional information on each of the classifications. Please note, some vehicles may be manufactured with the hardware for Level 4 or Level 5 automation capability but may not be deployed pending software updates.

2.2 SAE International Classifications (2021 Edition)

SAE International, which devises consensus standards for the engineering industry, established a six-tier classification system ranging from no vehicle automation to full vehicle automation.

- **Level 0** – No Driving Automation, the performance by the driver of the entire dynamic driving task (DDT), even when enhanced by active safety systems.
- **Level 1** – Driver Assistance, the sustained and operational design domain (ODD)–specific execution by a driving automation system of either the lateral or the longitudinal vehicle motion control subtask of the DDT (but not both simultaneously) with the expectation that the driver performs the remainder of the DDT.
- **Level 2** – Partial Driving Automation, the sustained and ODD-specific execution by a driving automation system of both the lateral and longitudinal vehicle motion control subtasks of the DDT with the expectation that the driver completes the object and event detection and response (OEDR) subtask and supervises the driving automation system.
- **Level 3** – Conditional Driving Automation, the *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* under routine or normal operation with the expectation that the *DDT fallback-ready user* is receptive to *ADS*-issued requests to intervene, as well as to *DDT* performance-relevant *system failures* in other *vehicle* systems and will respond appropriately.
- **Level 4** – High Driving Automation, the sustained and ODD-specific performance by an ADS of the entire DDT and DDT fallback.
- **Level 5** – Full Driving Automation, the sustained and unconditional (i.e., not ODD-specific) performance by an ADS of the entire DDT and DDT fallback.



2.3 SAE International Definitions

The following definitions are also provided by SAE International to establish a baseline for commonly used terms and are used throughout this report:

Automated Driving System (ADS)

The hardware and software that are collectively capable of performing the entire DDT on a sustained basis, regardless of whether it is limited to a specific ODD; this term is used specifically to describe a Level 3, 4, or 5 driving automation system.

NOTE: In contrast to ADS, the generic term "driving automation system" refers to any Level 1 to 5 system or feature that performs part or all of the DDT on a sustained basis. Given the similarity between the generic term "driving automation system" and the Level 3- to 5-specific term "Automated Driving System," the latter term should be capitalized when spelled out and reduced to its acronym, ADS, as much as possible, but the former term should not be.

ADS-dedicated vehicle (ADS-DV)

An ADS-equipped vehicle designed for driverless operation under routine/ normal operating conditions during all trips within its given ODD (if any).

ADS-equipped dual-mode vehicle	An ADS-equipped vehicle designed to enable either driverless operation under routine/normal operating conditions within it given ODD (if any), or operation by an in-vehicle driver, for complete trips.
ADS marker lamp	A device emitting light to indicate when a vehicle's ADS is engaged in the operation of the vehicle.
Driver	A user who performs in real time, part or all of the DDT and DDT fallback for a particular vehicle.
Driving automation system	Hardware and software capable of performing all or a portion of the dynamic driving task. This includes ADS and ADAS capabilities.
Dynamic driving task (DDT)	All of the real-time operational and tactical functions required to operate a vehicle in on-road traffic, excluding the strategic functions such as trip scheduling and selection of destinations and waypoints and including without limitation, the following subtasks: 1. lateral vehicle motion control via steering (operational); 2. longitudinal vehicle motion control via acceleration and deceleration (operational); 3. monitoring the driving environment via object and event detection, recognition, classification, and response preparation (operational and tactical); 4. object and event response execution (operational and tactical); 5. maneuver planning (tactical); and 6. enhancing conspicuity via lighting, sounding the horn, signaling, gesturing, etc. (tactical).
Dynamic driving task fallback	The response by the user to either perform the DDT or achieve a minimal risk condition (1) after occurrence of a DDT performance-relevant system failure(s), or (2) upon operational design domain (ODD) exit, or the response by an ADS to achieve minimal risk condition, given the same circumstances.
(Human) user	A general term referencing the human role in driving automation.
Minimal risk condition	A stable, stopped condition to which a user or an ADS may bring a vehicle after performing the DDT fallback to reduce the risk of a crash when a given trip cannot or should not be continued.

Object and event detection and response (OEDR)	The subtasks of the DDT that include monitoring the driving environment (detecting, recognizing, and classifying objects and events and preparing to respond as needed) and executing an appropriate response to such objects and events (i.e., as needed to complete the DDT and/or DDT fallback).
Operate (a motor vehicle)	Collectively, the activities performed by a (human) driver (with or without support from one or more Level 1 or 2 driving automation features) or by an ADS (Level 3–5) to perform the entire DDT for a given vehicle.
Operational design domain (ODD)	Operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time of day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.
Passenger	A user in a vehicle who has no role in the operation of that vehicle.
Remote assistance	Event-driven provision, by a remotely located human, of information or advice, to an *ADS*-equipped *vehicle* in *driverless operation* in order to facilitate *trip* continuation when the *ADS* encounters a situation it cannot manage.[1]
Remote driver	A driver who is not seated in a position to manually exercise in-vehicle braking, accelerating, steering, and transmission gear selection input devices (if any) but is able to operate the vehicle.[2]
Remote driving	Real-time performance of part or all of the *DDT* and/or *DDT fallback* (including, real-time braking, steering, acceleration, and transmission shifting) by a *remote driver*.
Request to intervene	An alert provided by a Level 3 ADS to a fallback-ready user indicating that s/he should promptly perform the DDT fallback, which may entail resuming manual operation of the vehicle (i.e., becoming a driver again) or achieving a minimal risk condition if the vehicle is not operable.

1 Although the remote assistant may not provide direct operational control over the vehicle, they can provide the vehicle with alternate routes or maneuvers that the vehicle will evaluate to determine the appropriate route. The remote assistant would need knowledge and understanding of the vehicle type and roadway. For example, in the context of a commercial motor vehicle (CMV), the remote assistant would need to know how the size and weight of the vehicle will impact the maneuverability and particular routes the vehicle may be prompted to take. Because of the unique characteristics of vehicles and roadways, a remote assistant may need specific training, skills, and credentials, including up to proper licensing, for the vehicle type they are remotely assisting.

2 In the case of remote driving, the vehicle is controlled by a person who is in a location away from the vehicle. They are operating the vehicle as if they were physically located in a designed location within the vehicle with uninterrupted access to control mechanisms. The remote driver would need knowledge and understanding of the vehicle type and roadway. For example, in the context of a CMV, the remote driver would need to know how the size and weight of the vehicle will impact the maneuverability and particular routes the vehicle may be prompted to take. Because of the unique characteristics of vehicles and roadways, a remote driver may need specific training, skills, and credentials, including up to proper licensing for the vehicle type they are remotely operating.

2.4 Other Key Terms and Definitions

For purposes of this report, the following definitions apply:

ADS-equipped vehicle	A vehicle equipped with an Automated Driving System (ADS).
Advanced driver assistance systems (ADASs)	Systems designed to help drivers with certain driving tasks (e.g., lane keeping assistance, forward collision warning, automatic emergency braking, and blind spot detection). ADASs are generally designed to improve safety or reduce the workload on the driver. With respect to automation, some ADAS features could be considered SAE Level 1 or Level 2, but many are Level 0 and may provide alerts to the driver with little or no automation.
Aftermarket	The market for spare parts, accessories, and components for motor vehicles not manufactured and installed by the OEM at the time of vehicle manufacture.
Alterer, modifier, or upfitter	An individual or company that provides the design or installation of vehicle components after a vehicle is manufactured but before or after the first retail sale or deployment.
Applicant	A person who applies for or requests a driver's license permit or driver's license.
Automated vehicle (AV)	Any vehicle equipped with autonomous technology that has been integrated into that vehicle.
Automated vehicle testing (AVT)	Testing of ADS-equipped vehicles on public roadways.
Automation	The use of electronic or mechanical devices to operate the vehicle.
Background check	Investigation of a candidate's background based on criteria determined by their prospective or current employer, which may include employment, education, criminal records, credit history, motor vehicle, and license record checks.
Connected vehicle (CV)	A vehicle with equipment, applications, or systems that share timely and critical information among vehicles, infrastructures, and road users for safety, system efficiency, or mobility purposes.
Crash (reportable crash)	A collision resulting in a person's injury or death or property damage that reaches the jurisdiction's threshold.
Crash report	A report completed by a law enforcement officer who investigates a motor vehicle crash.

Data collection mechanisms (DCMs)	Include, but are not limited to, recording information such as onboard event data recorders (EDRs), onboard central processing units (CPUs), cloud-based CPUs, and so on. Source: SAE 1660.
Deploy/deployment/ deployed	The operation of an ADS-equipped vehicle on public roads by members of the public or for use by the public who are not employees, contractors, or designees of a manufacturer or other entities or for purposes of sale, lease, providing transportation services for a fee, or otherwise making commercially available outside of a testing program.
Driver history	Record containing all convictions and other licensing actions of each driver maintained by the licensing jurisdiction.
Driver testing	The examination of an applicant to determine if s/he possesses the knowledge, skills, and ability to safely operate a vehicle on public roadways.
Driver training	Instruction provided to an individual on how to operate a vehicle safely.
Endorsement	An authorization to an individual's driver's license permitting the individual to operate certain types of vehicles.
Event data recorder (EDR)	A device installed in a motor vehicle to record technical vehicle and occupant information for a brief period of time (seconds, not minutes) before, during, and after a crash.[1]
Fusion center	State-owned and operated centers that serve as focal points in states and major urban areas for the receipt, analysis, gathering and sharing of threat-related information between state, local, tribal, and territorial; federal; and private sector partners[2]
Human machine interface (HMI)	Software and hardware that allows human operators to monitor the state of a process under control, modify control settings to change the control objective, and manually override automatic control operations in the event of an emergency. The HMI also allows a control engineer or operator to configure set points or control algorithms and parameters in the controller. The HMI also displays process status information, historical information, reports, and other information to operators, administrators, managers, business partners, and other authorized users. Operators and engineers use HMIs to monitor and configure set points, control algorithms, send commands, and adjust and establish parameters in the controller.[3] Source(s): NIST SP 800-82 Rev. 2.

1 NHTSA, *Event Data Recorder*, https://www.nhtsa.gov/research-data/event-data-recorder#overview-10516

2 U.S. Department of Homeland Security, *Fusion Centers*. Last updated 10.27.2022, https://www.dhs.gov/fusion-centers

3 Stouffer K, Pease M, Tang CY, Zimmerman T, Pillitteri V, Lightman S, Hahn A, Saravia S, Sherule A, Thompson M (2023). National Institute of Standards and Technology, Gaithersburg, MD, NIST Special Publication (SP) 800-82r3, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-82r3.pdf#page=27

Incident	An occurrence involving one or more vehicles in which a hazard is involved but not classified as a crash because of the degree of injury and extent of damage.
Jurisdiction	Any state, district, territory, or province of the United States or Canada
Manufacturer	An individual or company that designs, produces, or constructs vehicles or equipment. Manufacturers include original equipment manufacturers (OEMs), multiple and final stage manufacturers, alterer, modifiers, and upfitters.
Manufacturers and other entities (MOE)	An organization responsible for the manufacture of a motor vehicle; alteration of a motor vehicle to add ADS capability; or someone selling, leasing, or renting motor vehicles with ADS capability.
Manufacturer's safety plan	A clearly stated policy to help all employees understand the priority of developing safe and healthy working conditions and appropriate goals and objectives for the program.
Motor vehicle agency (MVA)	The motor vehicle, driver license agency, or both if they are within one agency.
Nondrivers	A user of an automated vehicle who normally would not be able to drive a vehicle (i.e., age limitations, disabilities).
New Vehicle Information Statement (NVIS)	Record of a new vehicle and provides basic information on the vehicle, the manufacturer or importer, the authorized dealer who sells it, and on the initial purchaser.[4]
Occupant	A human in the vehicle, regardless of role or responsibility.
Other entities and educational institutes	Any individual or company, that is not a manufacturer, involved with helping to design, supply, test, operate, or deploy automated vehicles, technology, or equipment.
Over-the-air updates	Software updates delivered to a vehicle through a wireless network.
Rules of the road	Phrase used to describe jurisdictional traffic laws.
Skills test	A test to determine if the driver has a minimum level of skills to drive in most traffic situations while adhering to a jurisdiction's traffic laws.

4 New Vehicle Information Statement and Partial Electronic New Vehicle Information Statement. CCMTA. July 2019, https://www.ccmta.ca/web/default/files/PDF/NVIS_eNVIS_Policy_-_July_2019_final_English.pdf#page=3

Society of Automotive Engineers (SAE) International	An automotive and aerospace standard setting body that coordinates development of voluntary consensus standards. See www.sae.org/about.
Suspension	The temporary withholding of the license to drive, usually for a specified period of time.
Testing	The operation of an ADS-equipped vehicle on public roads by employees, contractors, or designees of a manufacturer or other entities for the purpose of assessing, demonstrating, and validating the ADS capabilities.
Tier 1 supplier	Direct suppliers to the original equipment manufacturer (OEM).
Violation	Dailure to follow jurisdictional laws or regulations.

2.5 Acronyms Used in This Document

Advanced driver assistance systems (ADASs)

Advance notice of proposed rulemaking (ANPRM)

American Association of Motor Vehicle Administrators (AAMVA)

American Association of Retired Persons (AARP)

American Association of State Highway and Transportation Officials (AASHTO)

American Automobile Association (AAA)

American Driver & Traffic Safety Education Association (ADTSEA)

Association of National Stakeholders in Traffic Safety Education (ANSTSE)

Automotive Information Sharing and Analysis Center (Auto-ISAC)

Automated driving system (ADS)

Automated vehicle (AV)

Automated Vehicles Subcommittee (AVSC)

Canadian Council of Motor Transport Administrators (CCMTA)

Canada Motor Vehicle Safety Standards (CMVSS)

Center for Internet Security's Critical Security Controls (CIS CSC)

Central processing unit (CPU)

Code of Federal Regulations (CFR)

Colorado State Patrol (CSP)

Commercial driver license (CDL)

Commercial motor vehicle (CMV)

Commercial Vehicle Safety Alliance (CVSA)

Commercial Vehicle Training Association (CVTA)

Connected vehicle (CV)

Council of State Governments (CSG)

Data collection mechanisms (DCMs)

Dedicated short-range communication system (DSRC)

Department of Motor Vehicles (DMV)

Department of Transportation (DOT)

Driving School Association of the Americas (DSAA)

Dynamic driving task (DDT)

Event data recorder (EDR)

Federal Motor Vehicle Safety Standards (FMVSS)

Federal Motor Carrier Safety Administration (FMCSA)

Federal Trade Commission (FTC)

Global Positioning System (GPS)

Governors Highway Safety Association (GHSA)

Human–machine interface (HMI)

International Association of Chiefs of Police (IACP)

International Driver Examiner Certification (IDEC)

Law enforcement interaction plan (LEIP)

Law enforcement protocol (LEP)

License plate reader (LPR)

Manufacturers and other entities (MOE)

Manufacturer's certificate of origin (MCO)

Manufacturer's statement of origin (MSO)

Mobility as a service (MaaS)

Model minimum uniform crash criteria (MMUCC)

Motor vehicle agency (MVA)

National Association of Publicly Funded Truck Driving Schools (NAPFTDS)

National Automobile Dealers Association (NADA)

National Conference of State Legislatures (NCSL)

National Fire Protection Association (NFPA)

National Governors Association (NGA)

National Highway Traffic Safety Administration (NHTSA)

National Institute of Standards and Technology (NIST)

National Motor Vehicle Title Information System (NMVTIS)

National Safety Council (NSC)

National Transportation Safety Board (NTSB)

New Vehicle Information Statement (NVIS)

Noncommercial Model Driver Testing System (NMDTS)

Novice Teen Driver Education and Training Administrative Standards (NTDETAS)

Object and event detection and response (OEDR)

Original equipment manufacturer (OEM)

Over-the-air update (OTA)

Partners for Automated Vehicle Education (PAVE)

Personal delivery devices (PDD)

Remote engine immobilizer (REI)

Society of Automotive Engineers (SAE) International

Test Maintenance Subcommittee (TMS)

Transport Canada (TC)

Transportation Research Board (TRB)

Uniform Law Commission (ULC)

United States Department of Transportation (U.S. DOT)

Vehicle identification number (VIN)

Vehicle-to-everything (V2X)

Vehicle-to-infrastructure (V2I)

Vehicle-to-vehicle (V2V)

Chapter 3 Administrative Considerations

This chapter addresses the overall considerations for the administration of the testing and deployment of vehicles equipped with driving automation systems.

3.1 Administration

Background

To successfully address the safe integration of ADS-equipped vehicles within the transportation system, a collaborative approach should be taken among jurisdictions and stakeholders to gain an understanding of emerging vehicle technologies and the impact to roadway safety, jurisdictional programs, and infrastructure.

Guidelines for Testing Automated Driving System-Equipped Vehicles

A lead agency should be identified within each jurisdiction to address ADS-equipped vehicle testing and deployment within its borders. The lead agency should be charged with establishing a jurisdictional ADS-equipped vehicle committee. The committee should include, but may not be limited to, representatives from the following:

- governor or chief executive office;
- legislature;
- motor vehicle administration;
- department of transportation;
- law enforcement agency;
- office of highway safety;
- office of information technology;
- insurance regulator;
- agency representing the aging and disabled community;
- agency that regulates taxis and rideshare companies
- toll authority;
- transit authority; and
- local government.

Other stakeholders such as transportation research centers or colleges and universities located within the jurisdiction and groups representing vulnerable road users should be consulted as appropriate. The committee should also communicate with the ADS-equipped vehicle manufacturing and technology industries. The designated lead agency should keep the committee informed of requests from manufacturers and other entities to test in their jurisdiction and the status of the designated agency's response.

This committee should also develop strategies for addressing the testing and deployment of such vehicles in their jurisdiction. There are a range of strategies to consider, including testing without active regulation or regulating testing by policy or statute.

Jurisdictions will also need to examine their laws and regulations to address unnecessary or unintentional barriers to safe testing, deployment, and operation of ADS-equipped vehicles in areas such as:

- licensing and registration;
- driver education and training;
- financial responsibility (insurance and liability);

- rules of the road;
- enforcement of traffic laws and regulations; and
- administration of motor vehicle inspections.

AAMVA recommends the following resource to jurisdictions examining their laws and regulations: *Implications of Automation for Motor Vehicle Codes*, developed by the Transportation Research Board under the National Cooperative Highway Research Program (NCHRP 20-102 (07)).

The objective of this research was to provide state transportation and motor vehicle departments with guidance and resources to assist with the legal changes that may be required for the roll out of connected and automated vehicles (AVs). This research:

- Provides a review of applicable existing laws and regulations that may need reconsideration as connected and automated vehicles (connected vehicles [CVs], AVs, or CAVs) become more widely used with a focus on how these codes need to be revised (and how soon).
- Anticipates changes to motor vehicle laws, regulations, and statutes related to CVs and AVs that may affect current driving practices and continuous responsibility for managing traffic safety hazards.
- Identifies barriers to implementation of new rules of the road resulting from the roll out of CVs and AVs and developing strategies to overcome them.
- Addresses processes and stages for modifying relevant motor vehicle code, laws, regulations, and statutes.

The TRB has initiated an effort to harmonize state AV laws. NCHRP 20-06/Topic 26-03 [Pending] Multistate Coordination and Harmonization for AV Legislation can be found at https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5244.

Jurisdictions that regulate the testing of ADS-equipped vehicles are encouraged to take necessary steps to establish statutory authority and to use the following reference material: *Automated Driving Systems: A Vision for Safety 2.0*, *Preparing for the Future of Transportation: Automated Vehicles 3.0*, *Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0*, *Automated Vehicles Comprehensive Plan*, and later updates to frame the guidance.

Several national associations are engaged in the discussion on ADS-equipped vehicles and are available for additional support to jurisdictional government officials. These include, but are not limited to, AAMVA, American Association of State Highway and Transportation Officials (AASHTO), Canadian Council of Motor Transport Administrators (CCMTA), Commercial Vehicle Safety Alliance (CVSA), Council of State Governments (CSG), Governors Highway Safety Association (GHSA), Intelligent Transportation Society of America (ITSA), National Conference of State Legislatures (NCSL), and National Governors Association (NGA).

As technologies emerge, regulators and policy makers will need to continuously increase their knowledge, staying abreast of relevant reports and studies, attending ADS-equipped vehicle forums, and engaging

with industry. This knowledge will help officials recognize when laws, rules, and policies are outdated or proposed prematurely.

Recommendations for Jurisdictions

3.1.1. Identify a lead agency to manage the ADS-equipped vehicle committee and its efforts.

3.1.2. Establish an ADS-equipped vehicle committee.

3.1.3. Develop strategies to address testing and deployment of ADS-equipped vehicles in the jurisdiction.

3.1.4. Examine jurisdictional laws and regulations to consider barriers to safe testing, deployment, and operation of ADS-equipped vehicles.

3.1.5. Jurisdictions that regulate the testing of ADS-equipped vehicles are encouraged to take necessary steps to establish statutory authority and to use the following reference material: *Automated Driving Systems: A Vision for Safety 2.0* and *Preparing for the Future of Transportation: Automated Vehicles 3.0*, *Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0*, *Automated Vehicles Comprehensive Plan* , and later updates to frame the guidance.

3.1.6. ADS-equipped vehicle committee members, regulators, and policy makers are encouraged to perform knowledge-gathering and information-sharing functions.

3.1.7. The motor vehicle agency (MVA) should designate an AV lead staff person if the agency is not the jurisdictional lead AV agency. As the jurisdiction becomes more engaged in the regulation of ADS-equipped vehicles, the lead person may eventually become dedicated to the project. Therefore, funding may be needed in the future for a dedicated position.

Recommendation for Manufacturers and Other Entities

MOE 1. Manufacturers and other entities should interact with and respond to jurisdictional ADS-equipped vehicle committee questions and requests.

Benefits to Implementation

By establishing a lead agency and an ADS-equipped vehicle committee, jurisdictions optimize collaboration among stakeholders as they continue learning about the evolving technologies and as they explore options for the safe testing and deployment of ADS-equipped vehicles. Awareness will assist officials to recognize when and how regulations may need to be developed and updated. A lead agency can provide the appropriate level of government oversight with flexibility to quickly modify regulations if needed. A flexible and consistent approach is beneficial to regulators and supports innovation within the industry.

Challenges to Implementation

Finding the right balance between ensuring roadway safety while supporting technological advancements through the development and testing phases of ADS-equipped vehicles is a challenge. Thorough review of jurisdictional laws and rules to ensure the safe testing of ADS-equipped vehicles in as many situations as possible, including testing without a driver, will require a resource commitment by jurisdictions. After this review is done, the process of changing regulations and laws will also require an allocation of resources.

3.2 Advanced Driver Assistance Systems

Background

ADASs are designed to help drivers with certain driving tasks (e.g., staying in the lane, parking, avoiding crashes, reducing blind spots, and maintaining a safe following distance). ADASs are generally designed to improve safety or reduce the

workload on the driver. With respect to automation, some ADAS features could be considered SAE Level 1 or Level 2, but many are Level 0 and may only provide alerts to the driver with little or no automation. ADASs may also be found in vehicles with higher levels of automation.

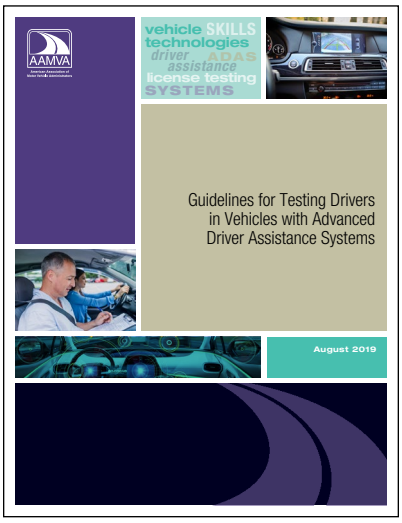
A major concern with ADASs is the lack of consistency among manufacturers, organizations, policy makers, and stakeholders in ADAS terminology, the warning indicators for the specific technology in vehicles, and how the technology works from one vehicle to another. These inconsistencies can confuse drivers and other stakeholders when discussing, researching, and using ADAS technology.

There are currently efforts to minimize the lack of consistency in ADAS terminology. MyCarDoesWhat.org through the National Safety Council and the University of Iowa currently uses terminology for ADASs that is not specific to any one manufacturer. In addition, six leading organizations committed to consumer safety and education—American Automobile Association (AAA), Consumer Reports, J.D. Power, National Safety Council (NSC), Partners for Automated Vehicle Education (PAVE), and Society of Automotive Engineers International (SAE)—have come together to develop the standardized naming conventions for ADAS technologies called *Clearing the Confusion*, which are simple and specific and are based on system functionality.

Drivers need to understand how to use ADAS technology in their vehicles. If drivers are confused, they may turn it off, not use it as intended, use it beyond its limitations, or overly rely on it. To reduce confusion among the public, manufacturers, organizations, and policy makers should adopt consistent terminology for ADAS. The terminology needs to be simple to understand and based on the function of the technology. AAMVA is engaged in national efforts to support consistency in ADAS terminology.

In addition to inconsistencies in the terminology, the inconsistencies in the way the ADAS warns the driver of hazards can be problematic. Some ADAS use an audible warning; others may use haptic or visual warnings. These inconsistencies may negatively impact safety when drivers switch from one vehicle to another and experience an ADAS that does not function as the driver expects. A driver who has never experienced a haptic warning may be confused and not respond appropriately.

The Automated Vehicles Subcommittee has partnered with the AAMVA Test Maintenance Subcommittee (TMS) and other organizations to update model driver's manuals, knowledge tests, and skills tests. The Automated Vehicles Subcommittee (AVSC) also assisted the AAMVA International Driver Examiner Certification (IDEC) Board to update the driver's license examiner training materials to address emerging vehicle technology.



In 2023, TMS and IDEC developed two new modules for driver examiner training specific to ADAS. This is in addition to the document *Guidelines for Testing Drivers in Vehicles with Advanced Driver Assistance Systems*. It is intended to assist members as they review and update their driver examination policies and procedures to address new vehicle technologies. It outlines technologies and implications for testing and provides recommendations for testing procedures and examiner training. Additional information about this guide and the impact of ADASs on driver licensing programs can be found in Chapter 5.

Recommendation for Jurisdictions

3.2.1. Use SAE International terminology to describe ADAS technology in vehicles as national standards are developed.

Recommendation for Manufacturers and Other Entities

MOE 2. Manufacturers and other entities should adopt SAE International terminology to describe ADAS technology in vehicles.

Benefits to Implementation

By using SAE International terminology, drivers and other stakeholders can clearly understand the ADAS technology being referred to and therefore can ensure they are discussing, researching, and using the technology correctly.

Challenges to Implementation

Currently, there is a lack of consistency, and it will be difficult for manufacturers, organizations, policy makers, and other stakeholders to change the terminology currently being used.

Chapter 4 Vehicle Considerations

This chapter addresses vehicle-related topics such as permits to test, registration and titling, inspection, and safety standards for the testing and deployment of ADS-equipped vehicles.

4.1 Application and Permit for Manufacturers and Other Entities to Test Vehicles on Public Roadways

Background

Several jurisdictions have enacted statutes and rules that give qualifying manufacturers and other entities authority to test ADS-equipped vehicles on public roadways. What follows is a recommended framework to achieve consistency among jurisdictions that opt to require a permit for testing ADS-equipped vehicles, including passenger vehicles, low-speed shuttles, fleet-owned vehicles, and commercial vehicles. Jurisdictions may also want to consider permitting other types of ADS-equipped vehicles such as agricultural equipment, public transit, and highway maintenance vehicles. The elements that compose the following framework reflect the need for jurisdictions to ensure safety is the foremost concern in permitting the testing of ADS-equipped vehicles.

Guidelines for Testing Vehicles

Manufacturers and other entities testing ADS-equipped vehicles should apply for and be issued vehicle-specific test permits before testing on public roadways.

The application process for test permits is intended to provide sufficient background information for jurisdiction and law enforcement personnel to interact with the manufacturer and its vehicle(s). In situations when a jurisdiction has opted to establish a program that allows testing, relevant jurisdiction and local officials, including law enforcement, relevant staff should be made aware of who, how, where, and what testing is being conducted. With this information, officials will be better prepared to ensure safety is prioritized during testing and respond appropriately when there is an incident or crash. It is recommended that the permit application process include the completion or attachment of all the following information:

- Name of manufacturer or other entity
- Corporate physical and mailing addresses of manufacturer or other entity
- In-jurisdiction physical and mailing addresses of manufacturer or other entity if different than the corporate address
- Program administrator or director
- Contact information for program administrator or director
- Vehicle-specific information for all vehicles to be permitted, including:
  - Vehicle identification number (VIN)
  - Year (if assigned by the manufacturer)
  - Make (if assigned by the manufacturer)
  - Model (if assigned by the manufacturer)
  - License plate number and jurisdiction of issuance (if applicable)
  - SAE level of testing and description of actual ADS features to be tested (more specific than just level of testing)
  - Indication of intention for testing with or without a human controlling the vehicle from within the vehicle type (passenger, commercial, low speed, etc.)

- List of all drivers of ADS-equipped vehicles, including:
  - Full name
  - Date of birth
  - Driver's license number and jurisdiction or country of issuance
- Summary of training provided to employees, contractors, or other persons designated by the manufacturer or other entity as drivers of test vehicles
- Disclosure of all jurisdictions where application or issuance of testing registration permits has occurred or been denied
- Confirmation that no active safety system (e.g., automatic emergency braking) has been modified (where applicable). If the active safety system has been modified, the capability must still remain.
- Disclosure of all jurisdictions where testing is or has occurred and an application or permit was not required. Require details of what testing occurred and a description of any incidents.
- Self-certification of prior testing of the technology to be used in the test vehicles under controlled conditions that simulate the real-world conditions (including, but not limited to, weather, types of roads, and times of the day and night) the manufacturer intends to subject the vehicle to on public roadways
- Certification from the manufacturers and other entities testing ADS-equipped vehicles within the jurisdiction that the vehicles comply with all applicable Federal Motor Vehicle Safety Standards (FMVSS) or Canada Motor Vehicle Safety Standards (CMVSS) and no required safety devices have been made inoperable; in lieu of the certification, evidence the vehicle(s) received an exemption or waiver from the FMVSS or CMVSS (see Section 4.9)
- Certification that any vehicle used within this program is not subject to open recalls
- Copy of the manufacturer's safety plan for testing vehicles, including a minimal risk condition component
- Routes to be used when testing ADS-equipped vehicles without a human controlling the vehicle from within the vehicle (if applicable)
- Description and details of remotely controlled operation of vehicles (as described in Section 5.3) in the course of testing, including items such as redundancy, latency, location of remote operator(s), and licensure of remote operators
- Evidence of the MOE's ability to respond to damages for personal injury, death, or property damage caused by a vehicle during testing; evidence may be in the form as approved by the jurisdiction (e.g., an instrument of insurance, a surety bond, proof of self-insurance)
- Plan for sharing relevant incidents and crash data regarding the vehicle, driver, and vulnerable road users leveraging provisions of NHTSA's current Standing General Order Incident Reporting for Automated Driving Systems and Level 2 Advanced Driver Assistance Systems
- Acknowledgement from the MOEs that they will disclose any conflict[3] related to the movement of test vehicles in the local jurisdiction. Similarly, the MOEs should disclose any pattern of conflict that is either observed or is being actively investigated in other jurisdictions.

In jurisdictions where MOE's entity-owned vehicles are required to be individually registered, the permit information should be available for verification at time of vehicle registration issuance (new and renewal) either by presentation from the holder or through electronic means. If at any time such a permit is no longer valid, the associated vehicle registration should become void.

3 See the SAE J3206 for definition of the term "conflict."

Test registration permits should be carried in the test vehicle while present on public roadways until or unless an electronic process has been created by jurisdictions that will allow permit information to be made readily available to law enforcement. Jurisdictions should move toward providing electronic access to permit information.

Reciprocity issue: Although test permits should be specific to the jurisdiction where they are issued, there may be opportunities for a jurisdiction to cooperate with an adjoining jurisdiction to develop a consistent or concurrent test permit process for vehicles that might routinely cross jurisdiction borders during testing, such as in multi-state metro areas.

Changes or updates by the manufacturer or other entity impacting the validity and accuracy of information provided for a testing permit may occur. This information could influence the jurisdiction approval process, so having knowledge of these changes or updates before they occur is important.

Recommendations for Jurisdictions

4.1.1. Require all manufacturers and other entities testing ADS-equipped vehicles to apply for and be issued vehicle specific permits before testing on public roadways.

4.1.2. Establish a test registration permit application process for ADS-equipped vehicles that does not create unnecessary barriers for manufacturers and other entities and requires the completion or attachment of the information listed in Section 4.1.

4.1.3. Implement a process for denying an application, as well as an appeal process for anyone whose applications have been denied.

4.1.4. Require test registration permit information be available for verification at the time of vehicle registration issuance (new and renewal) either by presentation from the holder or through electronic means in jurisdictions where manufacturer or other entity-owned vehicles are required to be individually registered.

4.1.5. Require test registration permits to be carried in the test vehicle while present on public roadways until or unless an electronic process has been created by jurisdictions that will allow permit information to be made readily available to law enforcement.

4.1.6 . Require prior authorization to changes or updates impacting the validity and accuracy to information provided for the testing permit.

Guidelines for Deployed Vehicles

Deployed vehicles are not subject to permit issuance.

Benefits of Implementation

ADS-equipped vehicles tested on public roadways must meet minimum testing requirements before authorized operation. In addition, authority granted for on-road testing will be identifiable to law enforcement and MVAs.

Finally, jurisdiction and local officials will have increased awareness of ADS-equipped vehicles through the sharing of permit and testing information. This includes where, when, and by whom testing was conducted as well as the number and types of vehicles tested and if involved in any incidents or crashes. These data elements are valuable when providing information to other government officials and agencies, the public, industry, the media, and other interested stakeholders.

Challenges to Implementation

Some manufacturers may indicate permit issuance is burdensome and not necessary if vehicles being operated are properly registered or plated.

4.2 Actions on the Permit Process

Background

Jurisdictions have significant flexibility in establishing a permitting process as described in Section 4.1. However, although provisions of the permitting process may vary significantly among jurisdictions, public trust and the integrity require a means to enforce any conditions imposed on the testing entity.

Guidelines for Testing Vehicles

The jurisdiction should have the authority to fine, suspend, or revoke any permit to test on public roads, as well as the ability to deny renewal of an application, if permit holders violate permit or safety conditions. Jurisdictions should establish a process for reporting traffic law violations to the permit issuing agency in order for the agency to evaluate the violations and determine if they are cause for action on the testing permit. The jurisdictions should also consider the imposition of further penalties if the testing entity continues to operate or test in violation of that suspension or revocation. Jurisdictions should have an appeal process in the event action is taken against a testing entity.

When creating grounds for suspension, revocation, denial of permit renewal, and fines, jurisdictions should consider:

- incorrect information supplied on the application or documentation pertaining to the application;
- failure to maintain financial responsibility;
- failure to follow the jurisdictions laws regarding testing;
- the ADS and the manufacturer are subject to an investigation by any law enforcement, licensing or permitting agency, or any other government agency;
- failure to follow the jurisdiction's traffic laws;
- failure to timely file required reports with the applicable government agencies; and
- failure to properly monitor its drivers, either as to their driver record or actions on the road.

Recommendations for Jurisdictions

4.2.1. Develop provisions for suspension, revocation, denial of permit renewal, or fining of any permit holder to test on public roads if permit holders violate permit conditions and for reporting such actions to the jurisdiction's lead law enforcement agency.

4.2.2. Consider the imposition of penalties if the testing entity continues to operate or test in violation of a suspension or revocation order.

4.2.3. Establish a process for reporting traffic law and other applicable violations to the permit issuing agency.

4.2.4. Have an appeal process for administrative actions taken against the testing entity.

Guidelines for Deployed Vehicles

Regulations developed to ensure safety during testing would not be applicable to deployed vehicles, unless a jurisdiction has a vehicle safety inspection program (see Section 4.10). Deployed vehicles have been adequately tested, evaluated, and certified for safety and compliance with FMVSS or CMVSS and the appropriate exemptions granted (if applicable).

Benefits of Implementation

By enforcing permit compliance, public safety and the integrity of the permitting process are improved. The purpose of the permitting process is to ensure safety during technology development and improvement. But issuing a permit alone does not ensure safety if a permit holder is not held accountable to the conditions of the permit (i.e., background checks, operating in school zones). There must be consequences for

violating the conditions of the permit to maintain integrity in the testing process.

Challenges to Implementation

Manufacturers may view any permitting process as an impediment to their ability to test and develop ADS-equipped vehicle technology. Jurisdictions may lack adequate resources to monitor and enforce provisions of its permitting process and may find responding to appeals time consuming.

4.3 Automated Driving System-Equipped Vehicle Information on the Manufacturer's Certificate of Origin or Manufacturer's Statement of Origin

Background

Manufacturer's Certificate of Origin (MCO) and Manufacturer's Statement of Origin (MSO) documents are used by the majority of jurisdictions during the titling and registration process of a new motor vehicle. In Canada, jurisdictions use an equivalent document referred to as the New Vehicle Information Statement (NVIS). The MCO, MSO, or NVIS format is not governed by federal statute or rule; however, most jurisdictions have statutes or rules governing their appearance, content, and acceptance. AAMVA provides jurisdictions and manufacturers with general guidance for MCO and MSO paper security and other document features through AAMVA policy positions to promote uniformity among jurisdictions.

Typically, the MCO, MSO, or NVIS contains, at a minimum, the issue date of certificate, control or certificate number, VIN, model, make, series or model, and body style. Furthermore, MCOs, MSOs, and NVISs list engine horsepower, engine displacement or number of cylinders, gross vehicle weight rating (GVWR), and shipping weight, as well as the manufacturer's name and address and the dealership name and address where the vehicle was initially delivered. The back of the document contains sales reassignment areas for the purchaser (whether a retail customer or a subsequent dealer). MCOs, MSOs, and NVISs are generated on security paper similar to jurisdictional title stock.

Guidelines for Testing Vehicles

Manufacturer test vehicles are often not titled. As such, the lack of MCO, MSO, and NVIS documents with ADS-related information will not impact test vehicles in most jurisdictions. However, some jurisdictions have chosen to title test vehicles. In these instances, the jurisdictions have relied on self-reporting during the permitting process in lieu of MCO, MSO, and NVIS documents during the titling process. For instance, California requires the titling of a test vehicle when used in the automated vehicle testing (AVT) program, which ensures the proper tracking and eventual disposal of the vehicle when no longer used for testing.

To assist jurisdictions choosing to title test vehicles, AAMVA has updated the definition of the Test Vehicle brand within NMVTIS to include any test vehicles. This brand is intended to inform any interested parties that the vehicle has been used for testing and should be considered not safe for roadway use after testing is complete. For more information on this test vehicle brand, see the Brand Code Values section in the NMVTIS Batch Specifications 3.1.6 document (requires jurisdiction member log in).

Recommendation for Jurisdictions

4.3.1. Jurisdictions choosing to title test vehicles should indicate, on the title, a brand of Test Vehicle.

Guidelines for Deployed Vehicles

As described in Chapter 3, several resources developed by the U.S. Department of Transportation provide recommendations for government and private industry to collaborate to meet identification goals

for ADS-equipped vehicles entering the marketplace. Developing a process for identifying ADS-equipped vehicle functionality through the VIN directly from the manufacturer is crucial to meeting this goal; however, it requires NHTSA to make rule changes to VIN requirements. In conjunction with a VIN identifier or because of the lack of a VIN identifier, it is recommended vehicle manufacturers indicate "Automated Driving System" on the MCO, MSO, or NVIS. This information should be listed in a new field on the MCO, MSO, or NVIS to avoid confusion with existing content.

Recommendation for Manufacturers and Other Entities

MOE 3. Vehicle manufacturers should indicate it is an ADS-equipped vehicle on the MCO, MSO, or NVIS. This functionality should be listed in a new field on the MCO, MSO, or NVIS to avoid confusion with existing information.

Benefits of Implementation

Using information from a MCO, MSO, or NVIS provides each MVA with certainty that the manufacturer has certified the vehicle includes ADS functionality. Additionally, this information would be available to every jurisdiction in the same format.

Challenges to Implementation

Changing VIN requirements will involve NHTSA adopting a rule change, and some jurisdictions will require software changes to accommodate changes in VIN.

4.4 Designating and Titling New and Aftermarket Automated Driving System-Equipped Vehicles

Background

There has been limited action taken to designate ADS-equipped vehicles as such on titles for testing and deployed vehicles. In anticipation of manufacturers and jurisdictions making this change, AAMVA may consider an enhancement to the AAMVA operated National Motor Vehicle Titling Information System (NMVTIS) to enable including a vehicle's ADS capabilities in the NMVTIS record.

Although the integration of driving automation systems into vehicles is primarily done by the vehicles' manufacturers, some driving automation systems may be retrofitted by third-party vehicle suppliers, vendors, or vehicle owners. The hardware components and software modifications may not have undergone a certification process with the vehicles for its design, construction, performance, and durability. Furthermore, the retrofitted driving automation system may not comply with relevant standards to minimize (if not mitigate) hazards caused by malfunctioning behaviors of these systems. The retrofitting process may involve vehicle conversions by parties that did not demonstrate their credentials or record keeping required to initiate or facilitate recalls.

Guidelines for Testing Vehicles

Even though there may not be a requirement for jurisdictions to title test vehicles that have not been devoted to consumer use, they may choose to do so. Regardless, to better track ADS-equipped vehicles used for testing, jurisdictions should record and maintain the vehicle information in their vehicle records. Jurisdictions can achieve this either through the normal titling process, through a titling exception process unique to ADS-equipped vehicles, or by recording relevant information in the registration record without titling.

Storing information, such as the VIN and ADS capability (based on an SAE level of automation), whether through titling or some other method devised by the jurisdiction:

- provides pertinent information to stakeholders in case of a crash or other interaction with law enforcement or first-responders;

- ensures ownership transfer of the vehicle will be within its laws or policies depending on how a jurisdiction wants to treat a post-test vehicle;
- provides information to the NMVTIS so the status of the vehicle is readily available to other jurisdictions and consumers; and
- provides information to policy makers regarding the number of ADS-equipped vehicles operating within a jurisdiction.

If a jurisdiction chooses to title an ADS-equipped vehicle during testing, the title should carry an appropriate "ADS" designation, test vehicle brand, and the SAE level of automation.

Jurisdictions should be aware that ADS capability of a vehicle may be added, removed, or altered during the vehicle's life. Jurisdictions may wish to track the changes of ADS capabilities in individual vehicles to inform the end-user of a vehicle's capabilities and provide law enforcement with accurate vehicle information.

Recommendation for Jurisdictions

4.4.1. Record and maintain the test vehicle information in the vehicle record through the normal titling process, through a titling exception process unique to ADS-equipped vehicles or record the information in the database without titling. If a jurisdiction titles an ADS-equipped vehicle used for testing, the title should carry an appropriate "ADS" designation, the test vehicle brand, and the SAE level of automation.

Guidelines for Deployed Vehicles

All deployed ADS-equipped vehicles should be titled pursuant to the jurisdiction's laws or policies, and the SAE level of automation should be included, if available, within the titling and/or registration system.

Uniform language, referenced in Section 4.5, is recommended for proper disclosure from jurisdiction to jurisdiction. This guideline is especially significant if exemptions are created for activities currently prohibited (e.g., driving without a license if suspended or revoked privilege; issues related to medical fitness, texting, cell phone use, or display screen content streaming).

For vehicles not equipped with automated technologies by the OEM, identifying vehicles on the registration indicating aftermarket-altered automated technologies is recommended. Vehicles that have a Tier 1 supplier or an aftermarket company alter the vehicle with automated technologies enabling ADS-equipped vehicle functionality should be designated with the SAE level of automation within the titling and/or registration system.

Recommendations for Jurisdictions

4.4.2. Title all ADS-equipped deployed vehicles, pursuant to the jurisdiction's laws or policies; each title should be "ADS" designated, and the SAE level of automation should be included within the titling and or registration system.

4.4.3. Titles for vehicles with added aftermarket components enabling ADS-equipped vehicle functionality should also be "ADS" designated, and the SAE level of automation should be included within the titling and/or registration system, if available. Because there is currently no readily available central source of ADS-equipped vehicle information, jurisdictions should consider requiring self-reporting of this information during the titling and registration process. Jurisdictions should consider capturing information such as the entity that modified the vehicle, the nature and date of the modification, and the hardware and software modified.

Recommendation for Manufacturers and Other Entities

MOE 4. The OEM or the installer of the aftermarket automated technology, either parts or software systems, should notify the MVA when a motor vehicle has been altered by adding or removing an AV technology so the MVA can record the information in their title and registration system, if applicable.

Benefits of Implementation

Traditionally, jurisdictions have used title designation as a mechanism to identify unique events or qualities that impact the value or safety aspects of a vehicle. Using a proven and existing process to identify ADS-equipped vehicles will ease implementation and adoptability for jurisdictions.

Disclosure via title designation allows law enforcement, MVA personnel, and other stakeholders the ability to better identify ADS-equipped vehicles. Additionally, title designation will provide a mechanism for sharing the information between jurisdictions until a national solution, such as a VIN indicator, becomes available.

Challenges to Implementation

Each jurisdiction has its own unique method of titling and registering vehicles. There is no one guideline that will fit all jurisdictional processes. Additionally, making modifications to titling and registration systems to accommodate designating ADS information may require significant work on the part of the jurisdiction to modify information technology systems, forms, procedures, and rules. Jurisdictions should consider manual alternatives as an interim measure.

Titling and registration are closely linked. When jurisdictions are considering how to manage titling, they should also review their registration process (see Section 4.5). As technology progresses and the availability of aftermarket automation products increases, the level of autonomy of a registered vehicle may change over time. Vehicle over-the-air (OTA) or other type of software updates or upgrades may complicate the titling process, such as increasing or decreasing the level of automation. Neither the MCO/MSO/NVIS nor the VIN currently provides an ADS-equipped vehicle identifier. Resources such as NHTSA's Product Information Catalog & Vehicle Listing (vPIC)–powered VIN Decoder may provide some information of the vehicle's automation capabilities. However, the VIN Decoder may not be useful for a vehicle with a retrofitted driving automation system by a third-party vehicle automation supplier or vendor. Furthermore, vehicle manufacturers are not required to submit information related to vehicle automation capabilities under the 49 CFR Part 565 requirements.

There may be other challenges related to the titling of vehicles with aftermarket ADS equipment installed or enabled. For instance, aftermarket ADS may feature less labeling, less documentation, less vehicle manufacturer technical support, less rigorous compatibility verification, and less recall coverage compared to vehicles manufactured with ADS. Titling of a vehicle to indicate ADS capabilities related to aftermarket modification may be challenging if these capabilities are unknown or undetected.

Special Considerations

With the increased technological functionality of these vehicles, jurisdictions may need to consider new types of requirements for ADS-equipped vehicles such as the repair of vehicles returning to road use after severe crashes. ADS-equipped vehicles involved in severe crashes may require evaluation and certification by the manufacturers' authorized repair technicians before being authorized to return to service or for the appropriate title designation. See also Section 4.10 for more information on vehicle inspections.

4.5 Vehicle Registration

Background

Vehicle registration credentials and records are basic tools that enable identification of a vehicle and its owner. As testing and deployment of ADS-equipped vehicles expand, the need for owner and vehicle information is necessary to distinguish these vehicles in mixed-fleet operations. Several jurisdictions already require the use of special registrations for ADS-equipped vehicles tested on public roadways.

Throughout the life of the vehicle, the vehicle's driving automation system may undergo changes such as feature subscription expiration or upgrades, system modifications, damage repairs, or end of support by any enabling infrastructures. If the vehicle undergoes transfer of ownership, the buyer of the vehicle will need to understand the nature of the vehicle and its driving automation system to understand its current and potential capabilities and limitations.

Guidelines for Testing Vehicles

A jurisdiction that titles and registers ADS-equipped vehicles used for testing should register these vehicles in a manner consistent with its titling and registration process for ADS-equipped vehicles. This could be its normal process or exception process unique to ADS-equipped vehicles. If a jurisdiction chooses not to title ADS-equipped vehicles during testing, the jurisdiction should record related information in the registration record.

The registration record should indicate "Automated Driving System" and include the test vehicle brand information. These notes should appear on the vehicle registration credential and electronic record. Jurisdictions may also consider using a separate field for such notes.

The registration, title, and license plate issued by the titling jurisdiction for purposes of ADS-equipped vehicle testing should be recognized by other jurisdictions to offer manufacturers process efficiencies and enhance interjurisdictional testing.

Recommendations for Jurisdictions

4.5.1. Record and maintain test vehicle and brand information in the vehicle record through the normal registration process, through a registration exception process unique to ADS-equipped vehicles, or by recording vital information in the database without titling.

4.5.2. Establish uniform language that will benefit law enforcement, the MVA, and other stakeholders for testing ADS-equipped vehicles.

4.5.3. Ensure vehicle registration information is available for other jurisdictions to access.

Guidelines for Deployed Vehicles

Uniform language should be established to aid law enforcement, the MVA, and other stakeholders in identifying these vehicles. Such language should use the common terminology "Automated Driving System." Additionally, jurisdictions should consider using a separate field for this notation. See Section 4.4 for more information.

To promote information transparency during the vehicle's ownership transfer, jurisdictions may consider requiring the sellers, MOEs, and vehicle history providers to disclose the following to the vehicle buyer and the vehicle's ultimate end users:

- History of the vehicle
  - Did the vehicle ever experience a pattern of driving automation system–related defects?
  - If driving automation system components were repaired or replaced, the procedures were completed by qualified personnel, following industry recognized best practices, and using prescribed tools to install components and software.

- State of the vehicle's driving automation system
  - Who is responsible for the integration of the driving automation system features? (e.g., vehicle manufacturer, third-party upfitter or alterer, or the vehicle owner).
  - Full disclosure on any changes or upcoming changes to the driving automation system features such as the subscription expiration, feature deactivation due to lack of connectivity, and end-of-life stage of the system.
  - Seek evidence to suggest that the vehicle may still comply with applicable FMVSS or CMVSS or the jurisdiction's maintenance requirements if any changes were made to the driving automation system.

Jurisdictions may choose to manage driving automation system damages similar to other critical safety technologies such as airbags and the antilock braking system. To look for signs of driving automation system defects, jurisdictions may observe vehicle's systems scan results and the built-in indicator for any signs of malfunction.

Recommendations for Jurisdictions

4.5.4. Establish a policy on how to identify vehicles with Level 4 and 5 vehicle automation on the registration and/or title record for deployed vehicles. See Section 4.4 for more information.

4.5.5. Establish uniform language to aid law enforcement, the MVA, and other stakeholders. Use "Automated Driving System" on the vehicle record.

4.5.6. Implement policies to promote transparency on the history and the alteration of the vehicle's driving automation system during vehicle ownership transfer.

Benefits of Implementation

Disclosure of a vehicle as an ADS-equipped vehicle on the registration credential allows law enforcement to identify vehicles quickly and accurately during a traffic stop or at a vehicle crash scene. Additionally, the ADS-equipped vehicle notation can be maintained until a national solution, such as a VIN indicator, is established. See references for Section 4.3.

Maintaining the use of ADS equipment on a vehicle record can be beneficial during a transfer to the vehicle buyer. This provides a method for interested parties to be informed the vehicle has or previously had ADS equipment installed.

The ADS-equipped vehicle indicator on registration records also improves ADS-equipped vehicle summary data reporting. This could include the total number of ADS-equipped vehicles registered in each jurisdiction and the number of such vehicles involved in crashes and violations. These data can be useful when analyzing the impacts of ADS-equipped vehicle highway safety statistics, adoption rates, and revenue projections.

Challenges to Implementation

Registration and titling are closely linked. When jurisdictions are considering how to manage registrations, they should also review their titling process (see Section 4.4). As technology progresses and the availability of aftermarket automation products increases, the level of automation of a registered vehicle may change over time. Vehicle OTA or other software updates or upgrades may complicate the registration process, such as increasing or decreasing the level of automation. The MCO, MSO, NVIS, and VIN currently do not provide an ADS-equipped vehicle identifier.

With inter-jurisdiction sales of the vehicle, jurisdictions may find it challenging to obtain source of fact related to the vehicle and its driving automation systems. Without tailored legislations and policies,

buyers may end-up with the purchase of vehicle presented "as is" without any recourse.

4.6 License Plates

Background

License plates serve a common purpose—to identify motor vehicles. Any jurisdiction that adopts a license plate design specifically for ADS-equipped vehicles should design the plates for license plate readers (LPRs) and optimal legibility to the human eye. If the indication of an ADS-equipped vehicle is part of the vehicle history and available to law enforcement through LPRs or other methods (see Section 4.5.5), then the visual design of the plate would be less important for the law enforcement community. However, the ability for MVA employees, tolling authorities, and citizens to identify license plates effectively will create an easy method for the general public to identity an ADS-equipped vehicle, especially in the case of a crash or disabled vehicle. For more information on license plate specifications and LPR programs, see the following AAMVA publications: *License Plate Standard, Edition 3* and *License Plate Reader Program Best Practices Guide*.

Recommendation for Jurisdictions

4.6.1. If a jurisdiction chooses to require a special license plate for ADS-equipped vehicles, the plates should adopt the administrative, design, and manufacturing specifications contained in the *AAMVA License Plate Standard, Edition 3*.

Benefits of Implementation

There is limited benefit for implementing a special license plate for ADS-equipped vehicles as long as the jurisdiction follows the recommendation on registration credential and vehicle history notation from Section 4.5.

Challenges to Implementation

Challenges in implementing a new license plate design include the identification of the jurisdiction of issuance; discernibility of the plate design from others it issues; and cost if there is special significance to the license plate design, as in the design for an ADS-equipped vehicle license plate.

4.7 Financial Responsibility (Also Known as Mandatory Liability Insurance)

Background

An important element of the administration and regulation of ADS-equipped vehicles is ensuring adequate insurance is in place to protect not only the occupants of an ADS-equipped vehicle but also other road users. For example, many jurisdictions require minimum financial responsibility, also known as mandatory liability insurance requirements, for each vehicle operating on public roads. Also, Federal Motor Carrier Safety Administration (FMCSA) regulations require specified liability insurance levels for commercial vehicles over 10,000 pounds, those transporting hazardous materials, and passenger carriers (buses).

Motor vehicle regulators should monitor the legal trends ensuring limits stay relevant and appropriate. It is advisable that there be sufficient coverage available for third-party liability in jurisdictional scenarios when there is no explicit distinction in property damage versus personal injury.

Jurisdictions with higher liability insurance requirements for vehicles used for public transportation, including ridesharing and peer-to-peer motor vehicle rentals, should give special consideration to liability insurance requirements for test vehicles that are designed and manufactured to provide similar transportation services.

Guidelines for Testing Vehicles

Different liability insurance requirements among jurisdictions can create incentives for ADS-equipped vehicle testing when the liability insurance requirement is the lowest. The increase in commercial motor vehicle ADS-equipped vehicle testing interest has some jurisdictions considering if the potential for high risk or greater damage in a crash necessitates higher limits for liability insurance.

However, all ADS-equipped vehicles permitted for on-road testing should be required to have at least minimum liability insurance in the form and manner required by the jurisdiction and FMCSA regulations.

Additionally, jurisdictions may want to consider requirements for commercial vehicles not covered by the federal regulations 49 CFR §387.9 that are distinctive from requirements for personal and private vehicles.

Recommendations for Jurisdictions

4.7.1. Require all ADS-equipped vehicles permitted for on-road testing to have a minimum liability insurance (many jurisdictions have implemented a $5 million minimum requirement) in the form and manner required by the jurisdiction and/or FMCSA regulations. Jurisdictions are encouraged to evaluate specific needs in their jurisdiction based on the risk profile and adjust liability insurance coverage accordingly.

4.7.2. Consider minimum liability insurance requirements for commercial vehicles not covered by the federal regulations that are distinctive from the requirements for personal and private vehicles.

4.7.3. Jurisdictions with higher liability insurance requirements for vehicles used for public transportation, including ridesharing and peer-to-peer motor vehicle rentals, should give special consideration to liability insurance requirements for test vehicles that are designed and manufactured to provide similar transportation services. Additional consideration should be given to adjusting insurance liability limits based on vehicle design and application.

Guidelines for Deployed Vehicles

At a minimum, liability insurance requirements should follow current jurisdictional and federal requirements. It is premature to provide additional specific guidance on deployed ADS-equipped vehicles because so much is still unknown. There are many factors to consider as the development of these vehicles progresses, including, but not limited to, the following:

- While a vehicle is in the testing phase, liability insurance responsibility is clearer than in the deployment stage.
- For deployed vehicles, consider all issues related to determining the responsible party. Should liability be transferred wholly or in part to the driver, the manufacturer, the systems developers, or a third-party installer?[4] In the event of a commercial setting, such as ridesharing or a peer-to-peer rentals, the issue becomes even more complicated.
- Consideration should also be given to liability insurance requirements for commercial vehicles not covered by the federal regulations that are distinctive from rates for personal or private vehicles.
- It is unknown if the risks associated with ADS-equipped vehicles is lower or greater than the risks with traditional vehicles.

Recommendations for Jurisdictions

4.7.4. Jurisdictions should consider the challenges described above when establishing minimum insurance liability on deployed ADS-equipped vehicles.

4 This decision should not abrogate any product liability responsibly on the part of the manufacturer.

4.7.5. Consider liability insurance requirements for commercial vehicles not covered by the federal regulations that are distinctive from rates for personal or private vehicles.

Benefits of Implementation

The public will be given some assurance that companies interacting on the public roadways are testing and operating the vehicles in a responsible manner.

Challenges to Implementation

Determining the appropriate minimum coverage for deployed ADS-equipped vehicles is difficult because there are many unknowns on how to assess the associated risks.

4.8 Jurisdictional Approval of the Automated Driving System as the Driver

Note: This section includes recommendations related to the jurisdictional approval of ADS-equipped vehicles for deployment and is closely related to Section 4.10, which examines the issue of periodic vehicle safety inspection programs as they relate to ADS-equipped vehicles.

Background

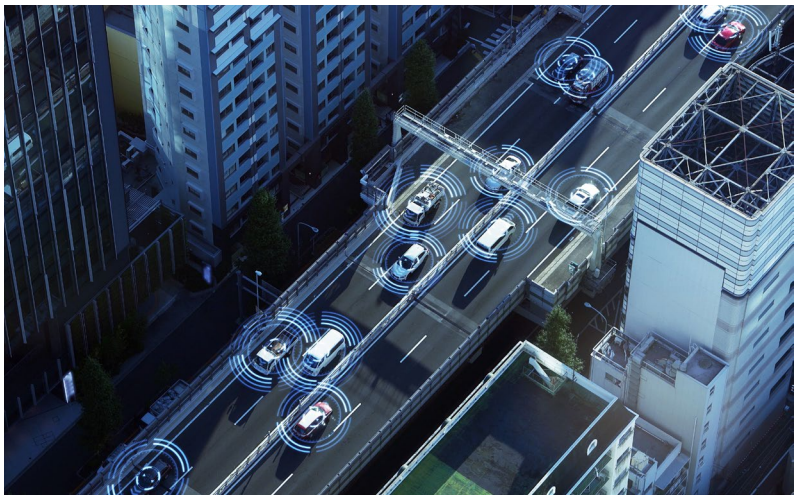
A persistent issue is whether jurisdictions should be responsible for approving the ADS technology prior to deployment. In the absence of a national regulatory structure, jurisdictions have the dilemma of approving the testing of ADS-equipped vehicles on public roadways without assurance that they meet a minimum federal standard of safety. Here are a few examples of approaches jurisdictions have taken:

- California law requires an application to be submitted and approved for the safe operation on California roadways. As a result, the California Department of Motor Vehicles (DMV) initially explored developing a third-party verification system for these new technologies during their first rulemaking process. California shifted direction to a self-certification process.
- The Colorado State Patrol (CSP) has conducted basic safety assessments on ADS-equipped vehicles that have been tested on Colorado's public roadways. These safety assessments did not probe proprietary software but verified that the vehicles were configured with equipment such as lighting, steering, braking, suspension, and collision avoidance systems that enabled the vehicles to navigate various scenarios on public roadways. During the assessments, the CSP additionally verified that when the vehicles were in motion under their own power, they maintained basic lane position and speed, and they reacted to objects in their path of travel.
- Rhode Island requires a general safety inspection along with a safety self-certification from the entity conducting a pilot but does not approve the ADS.

Other ideas have focused on requiring ADS skills testing and therefore possible future licensure of the system before deployment approval of ADS-equipped vehicles for public use. This topic has been raised in the US Department of Transportation's guidance on automated vehicles, in particular in the NHTSA's *Automated Driving Systems: A Vision for Safety 2.0*, Validation Methods section, as well as the subsection Best Practices for State Legislatures in the document *Preparing for the Future of Transportation: Automated Vehicles 3.0*, State, Local, and Tribal Governments and Automation section.

The Commercial Vehicle Safety Alliance's (CVSA) *Enhanced CMV Inspection Program for Autonomous Truck Motor Carriers* addresses the training and implementation of operator-based inspections as well as provides for communication with law enforcement during operation. This program could serve as a model for uniform self-certification programs allowing for AV developers or operators to address safety concerns, as well as provide for streamlined communication. Jurisdictions should continue to monitor the ever-

evolving programs such as this one in order to integrate the options that best meet their jurisdictional needs.



The Uniform Law Commission (ULC) has a different consideration in its model state legislation. A key component of the recommended model legislation is the creation of "an Automated Driving Provider" designation. An Automated Driving Provider would "vouch" (or more appropriately, self-certify) for the ADS functionality and performance (similar to what is envisioned by NHTSA). An entity would identify itself as responsible for the "performance" of the ADS and would validate its development and functionality before it would offer to register as the Automated Driving Provider for the vehicle or system. Specific information about the ULC's report is detailed in the *Automated Operations of Vehicles Act*.

Although ADS licensure or skills testing before approval has been considered in discussions of public safety, the recommendation has practical limitations, such as what to test for, how to test, and who conducts the testing. Creating a series of recommended skills an ADS should perform would not guarantee ADS is ready for open deployment. Like human skills testing, such testing does not assure continuous safe operation in a normal and changing environment.

The counter argument is that ADS vehicles should be subject to the same expectation jurisdictions place on new drivers, who are required to undergo a structured test in which every new driver faces the same number of right and left turns, speed changes, and so forth. However, jurisdictions have varying standards and courses for driver's skills testing. Some are closed courses, others have public roads with closed portions (parallel parking), and others are on public roads for all components.

Guidelines for Deployment

The subcommittee recommends jurisdictions neither put themselves in the position of approving ADS nor imposing a "skills test" on the ADS or its manufacturer at this time. Doing so could create inconsistencies between jurisdictions unless a national test standard were developed and would place a burden on jurisdictions to employ experts in the field of ADS. An ADS-equipped vehicle for sale or use on public roads should follow the existing self-certification process used for other vehicle equipment pending further oversight from the federal government.

The absence of jurisdictional testing of ADS does not preclude development of a federal or third-party certification process. The benefits of creating a third-party certification process would be assurance to the public that an entity has reviewed and assessed the abilities of the product before it is offered for public use.

Benefits of Implementation

There is limited benefit to establishing a jurisdiction-specific ADS technology approval process or ADS vehicle "skills test" currently. Not doing so limits inconsistencies between jurisdictions.

Challenges to Implementation

The longstanding delineation of authority for vehicle design and safety rests with the federal government.

Skills testing, licensure, and rules of the road compliance rest with the jurisdictions. Jurisdiction skills testing and licensure of an ADS are difficult to implement without federal standards. A jurisdictional certification process at this time could create a false sense of security and create liability for the jurisdiction.

4.9 Federal Motor Vehicle Safety Standards and Canadian Motor Vehicle Safety Standards

Background

Title 49 CFR 301 Motor Vehicle Safety (2021) legislatively mandates NHTSA to issue FMVSS and Regulations to which manufacturers of motor vehicle and equipment items must conform and certify compliance. FMVSS 209 was the first standard to become effective on March 1, 1967. New standards and amendments to existing standards are published in the *Federal Register*. These federal safety standards establish minimum safety performance requirements for motor vehicles or items of motor vehicle equipment. These requirements are specified in such a manner "that the public is protected against unreasonable risk of crashes occurring as a result of the design, construction or performance of motor vehicles and is also protected against unreasonable risk of death or injury in the event crashes do occur."

The NHTSA establishes FMVSS, and manufacturers must certify that their motor vehicles comply with all applicable standards.[5] Absent an exemption or exception, vehicles equipped with ADSs must comply with all applicable FMVSS.[6]

Generally, there are two types of temporary exemptions available from NHTSA: an import exemption for research, testing, and demonstration (testing exemption)[7] and a deployment exemption.[8] Testing exemptions are currently only available for imported vehicles, and noncompliant vehicles cannot be imported into the United States unless the importer receives this exemption. The process for requesting a testing exemption is established in 49 CFR part 591. Deployment exemptions are available only to manufacturers. The process for requesting a deployment exemption is established in 49 CFR part 555.

Additionally, in 2015, the Fixing America's Surface Transportation Act added an exception[9] that allows a manufacturer that produced compliant vehicles prior to enactment of the Act to operate noncompliant vehicles on public roads "solely for purposes of testing or evaluation."[10] Because of this exception, these legacy manufacturers are permitted to test noncompliant vehicles on public roadways without applying for an exemption.

As related to used vehicles, the Safety Act also prohibits manufacturers, dealers, rental car companies, and repair facilities from making inoperative a component or system previously installed in compliance with FMVSS.[11] This provision is meant to prevent automotive professionals from disabling safety equipment to ensure the integrity of critical safety systems.

49 U.S.C. § 30101, Purpose and Policy, states: "The purpose of this chapter is to reduce traffic accidents and deaths and injuries resulting from traffic accidents. Therefore, it is necessary -

(1) To prescribe motor vehicle safety standards for motor vehicles and motor vehicle equipment in interstate commerce; and (2) To carry out needed safety research and development."

In 2020, NHTSA released an advance notice of proposed rulemaking (ANPRM) seeking public comment on the potential development of a framework of principles to govern the safe behavior of ADS in the future. NHTSA and others have identified

5 49 U.S.C. § 30115(a).

6 49 U.S.C. § 30112.

7 49 U.S.C. § 30114.

8 49 U.S.C. § 30113.

9 49 U.S.C. § 30112(b) (10).

10 The manufacturer must also meet certain other requirements, including having submitted manufacturer identification information to the agency and agreeing not to sell the test vehicles. 49 U.S.C. § 30112(b)(10).

11 49 U.S.C. § 30122.

elements of a framework necessary for objectively defining and assessing ADS competence. The ANPRM seeks public comment on these elements and how they could most appropriately form a framework that provides for motor vehicle safety while also providing flexibility to develop more effective safety innovations. Furthermore, NHTSA actions include the issuance of a Standing General Order requiring manufacturers and operators of vehicles equipped with SAE Level 2 ADASs or SAE Levels 3 to 5 ADSs to report crashes. This action will enable NHTSA to collect information necessary for the agency to play its role in keeping Americans safe on the roadways even as the technology deployed on the nation's roads continues to evolve.

In 2021, NHTSA expanded the Automated Vehicle Transparency and Engagement for Safe Testing (AV TEST) Initiative from a pilot (started in 2019) to a full program. The Online Tracking Tool provides data on the on-road testing and safety performance of ADSs in cities across the country and with the expansion is available to all stakeholders and the public. The CMVSS serve the same form and function in Canada as the NHTSA FMVSS do in the United States. The ensuing narrative and following recommendations apply to both.

Guidelines for Testing Vehicles

It is critical that manufacturers or other entities testing ADS-equipped vehicles ensure that vehicles either comply with all applicable FMVSS or CMVSS or that the manufacturer or importing entity has an exemption or filed an appropriate temporary importation declaration for any noncompliant vehicles.

Recommendation for Jurisdictions

4.9.1. Consider requiring manufacturers and other entities testing ADS-equipped vehicles within the jurisdiction to certify the vehicles comply with all applicable FMVSS or CMVSS and no required safety devices have been made inoperable. In lieu of the certification, require manufacturers to provide evidence the vehicle(s) have received an exemption from the FMVSS or CMVSS.

Benefits of Implementation

ADS-equipped vehicles tested on public roadways will meet minimum federal safety standards or will have an exemption from the FMVSS or CMVSS, depending on where the vehicle is being tested.

Challenges to Implementation

Some manufacturers, importing entities, or other entities may indicate that FMVSS do not apply to their vehicle technology. Manufacturers or importing entities should provide evidence of an exemption from FMVSS if their vehicles do not comply with FMVSS or CMVSS.

Special Considerations

Jurisdictions need to partner with federal agencies to assist and support the common goal of encouraging technological innovation while increasing safety and mobility.

4.10 Periodic Motor Vehicle Inspections

Background

Some jurisdictions require registered vehicles to undergo periodic motor vehicle safety inspection (not the same as emissions testing). Typically, under these programs, vehicle owners are responsible for periodically validating the safety of their vehicle's structure, equipment, and components (including elements such as brakes, lighting, airbags, steering mechanisms, tires, and so on) through a certified inspection station, technician, or mechanic. Jurisdictions that have established these programs are responsible for setting and maintaining minimum operational safety requirements, which in some cases are federally established, applicable Motor Vehicle Safety Standards. Vehicles that fail to continuously meet minimum requirements cannot be permitted for

use on the road until equipment and components are brought into compliance.

The design and application of safety inspection programs vary among jurisdictions, ranging from requiring all vehicles to pass an annual safety and emissions inspection to requiring an inspection upon change of ownership, upon titling in a change state of record, or when an inspection is ordered by law enforcement at roadside. Although these programs differ, inspection initiatives share the common objective of promoting vehicle safety. Traditionally, these safety inspection programs aim to ensure vehicles maintain mechanical fitness and safety-related functionalities by inspecting components with common designs (e.g., brakes, bulbs).

Because federal regulators establish and prescribe vehicle safety standards, jurisdictions often rely on MOE-issued specifications and MOE-prescribed approach to assess the fitness and roadworthiness of vehicles. As MOEs potentially adopt different approaches to implement driving automation systems, jurisdictions are encouraged to reference MOE issued specifications and component-specific inspection and diagnostic methods. Jurisdictions are encouraged to involve MOEs to verify the status and functionalities of driving automation systems.

Carriers and end users of the driving automation systems must remain aware of the latest development of applicable regulations related to the use of driving automation systems. MOEs should offer updates that are compatible with these regulations as they are revised.

The emergence and proliferation of automated and connected technologies may result in a diminished human role in the driving task but do not diminish the expectation that the vehicles are inherently safe. Vehicles will increasingly fulfill safety-critical functions that today are the primary responsibility of human drivers. This greater reliance on vehicle technology raises important questions about the role of jurisdictions, MOEs, and owners in ensuring that automated technology is properly and regularly maintained. This raises the question of how jurisdictions will ensure safe operation when aftermarket software may change the operating features of a vehicle or what happens with the vehicle when it is no longer used for testing or piloting; will the vehicle be disposed of or potentially put back on the roadway?

Guidelines for Testing Vehicles

It would be difficult for jurisdictions to establish new inspection requirements for ADS-equipped test vehicles given the experimental nature of new and emerging forms of automated technology.

Federal governments have not yet prescribed applicable FMVSS and CMVSS for driving automation systems. The responsibility for ensuring ADS-equipped test vehicles are safe rests with MOEs and testers.

NHTSA and FMCSA announced a Notice of Proposed Rulemaking requiring ADAS to self-diagnose and alert the driver of any system fault. Some MOEs of ADAS already integrate driver alert functionality on deployed vehicles.

Recommendations for Jurisdictions

4.10.1. Jurisdictions should not be expected to create new safety inspection programs for ADS-equipped vehicles during the testing stages. Jurisdictions may choose to inspect whether an ADS-equipped vehicle operates safely in accordance with the vehicle manufacturer's specifications while the vehicle is manually operated.

4.10.2. Consider if the vehicle should be disposed of after testing or piloting is completed or what requirements should be implemented if the vehicle is considered for future roadway use.

Recommendations for Manufacturers and Other Entities

MOE 5. Ensure all technology being tested on public roads is safe.

MOE 6. Provide in writing up-to-date specifications and test vehicle capabilities and limitations to jurisdictions.

MOE 7. Provide data and information sufficient to enable the understanding of test vehicles' capabilities and limitations by jurisdictions.

MOE 8. Provide updates that are compatible with these applicable regulations as they are revised.

MOE 9. Ensure that an indicator clearly communicates any driving automation system malfunction to the driver or operator.

Guidelines for Deployed Vehicles

Integrating new and emerging technologies into inspection programs is a common occurrence in jurisdictions that use such programs. Existing organizational practices such as using working groups, task forces, and subject matter experts can be leveraged to assist in the integration of ADS technology into inspection programs.

However, given the pace of change in ADS technology, it is likely premature for jurisdictions to develop new inspection and maintenance standards for ADS-equipped vehicles, particularly without federal vehicle safety standards for ADS technologies or MOE voluntary consensus on diagnosis strategies.

Federal and jurisdictional governments should continue to work with manufacturers to understand mechanisms for verifying the safety and active functionality of ADS technology components (e.g., through computer diagnostics) and how vehicle safety might be discernable in the future by trained technicians.

CVSA has developed the Enhanced CMV Inspection program for commercial motor vehicles (CMVs) operating in SAE Level 4 or 5 automation. The program consists of a training course that certifies non-enforcement inspectors to conduct vehicle safety inspections according to an enhanced inspection standard. In addition to the required vehicle inspection, the ADS-specific equipment is inspected and maintained in accordance with the specific manufacturer's inspection requirements. The inspections take place at the point of dispatch and while in-transit based on specified time periods. The CMV will electronically communicate a data message set containing information related to the dispatch or in-transit inspection as it bypasses inspection locations. The report creating the need for the program was published in October 2019 and can be found at Developing a Statistically Valid and Principal Method to Compute Bus and Truck Occupancy Data (cvsa.org).

Jurisdictions should regularly review their inspection programs in the context of new and emerging technologies to ensure their inspection programs are up to date.

Recommendations for Jurisdictions

4.10.3. Until a national standard (FMVSS, CMVSS, or established MOE consensus standard) is developed, jurisdictions should not incorporate driving automation system–specific components (e.g., software, sensors) as part of its motor vehicle inspection program. However, any vehicle abnormality noticed should be documented and provided to the vehicle owner.

4.10.4. Continue to work closely with manufacturers and other entities to understand mechanisms for verifying the safety and functionality of current driving automation system technology components and how safety might be discerned in the future.

4.10.5. Recognize that inspections of driving automation systems may require additional resources such as MOE-prescribed diagnostic tools, MOE-developed inspection and repair procedures, and specially trained inspectors.

If the jurisdiction chooses to inspect driving automation systems of a vehicle to ensure safe operation on the roadway as per the system's design, jurisdictions may choose to accept verified diagnostic and inspection results as issued by the MOE or qualified inspection facility.

Challenges of Implementation

As the developments of driving automation systems mature, MOEs may reach a common ground in terms of diagnostic tools required, components used, and system repair procedures. Until such a common ground is reached, it may be costly for jurisdictions (or their authorized representatives) to adopt the inspection equipment, trained technicians, and inspection facilities required to inspect driving automation systems.

It may be challenging to independently inspect and recover incidental data without the involvement of MOEs.

If remote diagnostic results are to be accepted, jurisdictions will need to establish procedures to outline the required content of the accepted results. Authorized representatives (e.g., licensed inspection facilities) may need to conduct verification to ensure the remote diagnostic results are credible and consistent with the physical state of the vehicle being inspected.

4.11 Automated Driving System-Equipped Vehicles for Transportation of People Living with Disabilities

Background

ADS-equipped vehicles offer a promising mode of transportation for people living with disabilities. ADS-equipped vehicles should provide mobility for this population.

Current technology does not offer a one-size-fits-all solution because of factors such as the nature of available user interfaces and limitations to conduct tasks other than driving. User needs should be considered when evaluating and refining the proposed use of ADS-equipped vehicles to transport those with disabilities. Some aspects of the technology may limit widespread use to enable true independent transportation.[12]

MOEs and jurisdictions are encouraged to set realistic expectations on the capabilities and limitations of the technology and communicate this information to the users and interested parties. To enable operational success, ensure safety, and achieve public acceptance, jurisdictions should recognize that the user experience matters. Infrastructure considerations and roadway user behavior changes have been identified as important factors.

In many instances, personnel operating non-ADS vehicles perform duties in addition to driving the vehicle. Those responsible for the management of ADS vehicles should consider changes to operational procedures and provide assistance for incidents requiring intervention.

If an MOE or responsible party concludes that the current technology is not fully capable of providing support for people living with disabilities, they should communicate the limitations and concerns with users and other interested parties. Alternative transportation services with drivers or onboard attendants should be considered.

Recommendations for Jurisdictions

4.11.1. Evaluate the testing and deployment of ADS-equipped vehicles, specifically on topics such as object and event detection and response, the vehicle's ability to achieve minimal risk condition (fallback), the law enforcement interaction plan, and the first responders' guidelines with a focus to enhance user experience and minimize operational incompatibilities.

12 SAE International's J3171 standard, November 2019 edition, titled "Identifying Automate Driving Systems-Dedicated Vehicles (ADS-DVs) Passenger Issues for Persons with Disabilities."

4.11.2. Evaluate the capabilities and limitations of the technology with the MOEs and clearly communicate findings to potential users and other interested parties.

4.11.3. Develop awareness of how the technology is used to transport people living with disabilities with a focus on any limitations of the roadway infrastructure and roadway usage pattern.

Recommendations for Manufacturers and Other Entities

MOE 10. Disclose the suitability of ADS-equipped vehicles and the provided services for people with disabilities to jurisdictions, users, and other interested parties.

MOE 11. Consult users and other interested parties to ensure the routes, configurations, and user interfaces that minimize potential barriers.

MOE 12. Consider accessibility standards when designing and manufacturing vehicles.[13]

MOE 13. Consider designs and procedures to account for possible emergency situations.

Benefits of Implementation

Accessible ADS-equipped vehicles may allow for a more independent lifestyle for people living with disabilities.

Challenges to Implementation

MOEs may be limited on how they serve people living with disabilities due to vehicle design limitations, maturity of the technology, and implementation costs.

4.12 Shared and Temporary Use of Vehicles with Driving Automation Systems

Background

The level of knowledge and experience with driving automation systems varies significantly among vehicle users. Vehicles with driving automation systems being used intermittently for a short-term basis such as rental vehicles or being used in a car sharing environment may bring significant challenges to users with little or no experience with these systems. Those responsible for providing use of these vehicles for purposes described need to take into consideration what information should be disseminated before the vehicles are operated.

As developers work toward vehicles with higher levels of automation, human factors will remain critical elements. With this in mind, the industry has yet to adopt a consistent approach on various human factors such as driver readiness, HMI, driver engagement, and driver training.[14] With the addition of remote assistance and remote driving, the need for the driver to maintain situational awareness remains a complex issue to resolve. This becomes more apparent when drivers infrequently operate vehicles with driving automation systems.

Guidelines for Testing Vehicles

Test vehicles containing default settings for driving automation system behavior and other vehicle equipment will be beneficial for the testing process. Testing entities may employ administrative controls such as the use of checklists or automated settings to not require human intervention.

If a fleet of test vehicles has remote assistance and remote driving capabilities, the remote personnel may need to transition from one vehicle model to another, providing guidance, assistance, and control inputs. Test entities may need to consider adopting designs and practices aimed to facilitate operational awareness.

13 Examples of standards include Title 49, Subtitle A, Part 38, Subpart B, § 38.23 of the Code of Federal Regulations on Mobility Aid Accessibility, or CSA D409 standard for "Motor Vehicles for the Transportation of Persons with Physical Disabilities."

14 *Ensuring American Leadership in Automated Vehicle Technologies.* National Science & Technology Council & U.S. Department of Transportation. January 2024, https://www.transportation.gov/sites/dot.gov/files/2020-02/EnsuringAmericanLeadershipAVTech4.pdf#page=21

Recommendations for Manufacturers and Other Entities

MOE 14. Testing entities should establish default settings on test vehicles to include driving automation system behavior and other basic vehicles settings for vehicle equipment.

Guidelines for Deployed Vehicles

As technology advances and vehicles with higher levels of automation are produced, rental companies and car sharing fleet operators will likely face responsibilities to provide additional training to drivers and users. Convenience and speed of transaction are important, and companies must decide whether renting vehicles with higher levels of automation requiring driver education would fit into their business model.

Operators of vehicle rental services and car sharing services may need to implement procedures or automated processes to ensure consistent driving automation system behaviors. However, drivers and users should remain informed on these default settings and any deviation of safety-critical driving automation system settings.

Recommendations for Jurisdictions

4.12.1. Review entities' testing procedures as vehicles transition between different users. Jurisdictions may review how remote assistance and remote driving minimizes transition time and effort for remote personnel to transition between different vehicles while maintaining a sufficient level of service and operational awareness.

4.12.2. Jurisdictions that regulate industries where vehicles are transferred among users should engage these industries to discuss how users are notified of driving automation system changes.

Recommendations for Manufacturers and Other Entities

MOE 15. Prioritize the presentation of critical information to drivers or users of the driving automation system that are suitable for the vehicle's surroundings. Critical information includes what is needed for the driver to conduct the DDT or respond to a request for takeover.

MOE 16. Provide training materials on the use of driving automation systems and commit to continuous updates and availability of the training materials to the drivers and the users as the interface and functionality evolve.

MOE 17. Adopt designs and industry best practices to facilitate safe transitions of drivers and users between motor vehicles with differing capabilities.

MOE 18. If the driving automation system is designed to feature multiple drivers or user profiles, manufacturers and other entities should inform the drivers or users of any setting changes as they select their profiles.

Benefits of Implementation

Consistency in driving automation system control interfaces may reduce road safety issues that arise from human behavior. An informative user interface facilitates safer and smoother transitions for remote assist or remote driving personnel. Driver and user training, combined with unaltered driving automation system behavior settings, will provide more confidence within the driver and user during their trip.

Challenges to Implementation

Fleets may consist of different vehicle types and driving automation system versions. Fleet operators may struggle to maintain consistent default settings between vehicles' ADS and equipment.

Manufacturers and fleet operators should provide periodic trainings on ADS, which may be subjected to frequent updates.

Fleet operators may need to inspect and restore default ADS settings, requiring additional human interaction and time.

4.13 Assessment of Driving Automation Systems

Background

Automation classification levels, except for Level 5, may not allow MOEs, regulators, and consumers to understand the ODD constraints of the system. The automation level may not indicate whether the system is capable of detecting circumstances that are relevant to the immediate driving tasks, such as detecting and responding to a pedestrian.[15] The automation classification level by itself does not clarify whether the automation system can safely transition a vehicle into a safe mode should the system malfunction.

As described in the SAE J3016 standard, 2021 edition, automation level does not impose any specifications or performance requirements on the performance of driving automation systems. Furthermore, the J3016 standard indicates that the automation level of a system is assigned and not measured. The automation level merely reflects the design intent of the automation features as defined by its manufacturer.

The SAE J3016 standard has not been adopted by federal regulators responsible for prescribing construction and safety standards for manufactured vehicles. Although contract laboratories may conduct testing procedures outlined under a SAE standard, jurisdictions may not have any awareness, recourse, or oversight on erroneous, misleading, or falsified test reports.

Because of the lack of established standard compliance and verification mechanisms and the level of automation may change throughout the life of the vehicle, jurisdictions should be mindful of establishing policy based solely on automation levels. Policy makers should be mindful that ADS vehicles may still be designed for manual operation.

In addition to the potential fluid nature of automation levels and driving automation capabilities, ODD system constraints are a factor in determining where an ADS vehicle may operate. Depending on the specific ADS capabilities and operating conditions, the ODD may not be what was understood or expected by the vehicle driver. Informing the driver when the vehicle is about to be outside the ODD or is no longer in the ODD is important for vehicle operational safety.

Guidelines for Testing and Deployed Vehicles

Jurisdictions are encouraged to review a subject vehicle's automation capabilities as outlined in the *Automated Driving Systems: A Vision for Safety 2.0* document and Transport Canada's *Guidelines for Testing Automated Driving Systems in Canada*. When reviewing the automation capabilities, jurisdictions are encouraged to verify their findings against MOE published materials, including marketing information and written disclosures from the MOE. Jurisdictions or other interested parties may conduct their review based on other complementary standards, such as the *UL 4600, Standard for Safety, Evaluation of Autonomous Products* by the Underwriters Laboratories. Some technical understanding is required by jurisdictions to ensure technology and its use are consistent with policy intentions.

Recommendations for Jurisdictions

4.13.1. Review vehicles' capabilities and limitations based on all available referenced standards documents; do not rely solely on the declared automation level.

4.13.2. Conduct a review of the vehicle's capabilities by using MOE disclosures and MOE marketing information.

4.13.3. Periodically review all available resources and modify vehicle automation classification systems.

15 *Automated Driving Systems 2.0*. NHTSA, September 2017, https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf#page=13

4.13.4. Discuss with the MOE how and what information will be shared, including how the information can be utilized by the jurisdiction, while respecting proprietary rights.

4.13.5. Discuss with the MOE how the vehicle driver will be informed when the vehicle is about to leave or is no longer in the ODD.

Recommendations for Manufacturers and Other Entities

MOE 19. Establish a contact method for jurisdictions and enforcement agencies to gain and maintain an understanding of a vehicle's automation features.

MOE 20. Establish an internal process to track how the automation features of its products change throughout the life of the vehicle.

MOE 21. Inform jurisdictions, law enforcement, users, and other interested parties of the capabilities, limitations, and changes to the system or ODD.

Benefits of Implementation

Jurisdictions, law enforcement, users, and other interested parties may gain a better understanding of the capabilities and limitations of ADS. Roadway safety and public acceptance of the technology may be improved for a more viable transportation network.

Challenges to Implementation

Consumers may rely on automation levels when assessing a vehicle because of the simplicity of the classification system. Increased efforts are required to educate consumers about the full capabilities and limitations of ADS.

If an MOE restructures or dissolves, the system knowledge, revision tracking, and experiences gained may be lost. Jurisdictions and other interested parties may lose access to verifiable documentation for products released by these MOEs.

Chapter 5 Driver Licensing Considerations

This chapter addresses driver-related topics relative to vehicles with driving automation systems. Other topics discussed include driver's license requirements for testing vehicles, remote driver, endorsements and restrictions for deployed vehicles, and driver training for drivers on vehicle technologies as well as educating MVA staff, driver's license examiners, and driver educators. Commercial Driver Licensing (CDL) is also addressed.

5.1 Driver and Passenger Roles Defined

Background

As described in Chapter 2, this chapter also refers to SAE International's definitions. Universal terms and definitions are critical for jurisdictions, manufacturers, and other entities when discussing AV technologies and ADS-equipped vehicles. Definitions and terms used in this chapter are from J3016 (2021) unless otherwise noted.

Key Terms and Definitions:

Driver — A user who performs in real time part or all the dynamic driving task (DDT) and DDT fallback for a particular vehicle.

Dynamic driving task (DDT) — All of the real-time operational and tactical functions required to operate a vehicle in on-road traffic, excluding the strategic functions such as trip scheduling and selection of destinations and waypoints and including without limitation, the following subtasks:

1. lateral vehicle motion control via steering (operational);
2. longitudinal vehicle motion control via acceleration and deceleration (operational);
3. monitoring the driving environment via object and event detection, recognition, classification, and response preparation (operational and tactical);
4. object and event response execution (operational and tactical);
5. maneuver planning (tactical); and
6. enhancing conspicuity via lighting, sounding the horn, signaling, gesturing, etc. (tactical).

Passenger — A user in a vehicle who has no role in the operation of that vehicle.

Remote assistance — Event-driven provision, by a remotely located human, of information or advice, to an ADS-equipped vehicle in driverless operation to facilitate trip continuation when the ADS encounters a situation it cannot manage.[16]

Remote driver — A driver who is not seated in a position to manually exercise in-vehicle braking, accelerating, steering, and transmission gear selection input devices (if any) but is able to operate the vehicle.

16 Although the remote assistant may not provide direct operational control over the vehicle, they can provide the vehicle with alternate routes or maneuvers that the vehicle will evaluate to determine the appropriate route. The remote assistant would need knowledge and understanding of the vehicle type and roadway. For example, in the context of a CMV, the remote assistant would need to know how the size and weight of the vehicle will impact the maneuverability and particular routes the vehicle may be prompted to take. Because of the unique characteristics of vehicles and roadways, a remote assistant may need specific training, skills, and credentials, including up to proper licensing, for the vehicle type they are remotely assisting.

Recommendations for Jurisdictions

5.1.1. Use the SAE International definitions.

5.1.2. As discussed in Section 3.1, jurisdictions should review the resource *Implications of Automation for Motor Vehicle Codes*, which may be a useful guide for updating laws and regulations.

Recommendation for Manufacturers and Other Entities

MOE 22. Use SAE International definitions provided in Chapter 2, except as noted above.

Benefits of Implementation

Universal definitions of these terms will facilitate communication, understanding, and standardization of the roles and responsibilities for ADS-equipped vehicles.

Challenges to Implementation

Educating all entities on the need for acceptance and implementation of these universal terms and definitions will be an implementation challenge.

Jurisdictions will need to review their laws and regulations ensuring motor vehicle laws permit the operation of ADS-equipped vehicles Level 4 and 5 without a driver. Legislative action amending statutory and regulatory definitions of "driver" and related terms, as well as reviewing and adapting existing rules regarding vehicle operation may pose challenges until more policy makers are versed in the subject matter.

5.2 Driver's License Requirements for Testing by Manufacturers and Other Entities

Background

Numerous manufacturers and other entities are testing ADS-equipped vehicles in multiple jurisdictions. It is anticipated that testing will be expanded to include additional jurisdictions. This section provides guidelines for licensing drivers who test ADS-equipped vehicles by manufacturers and other entities.

Guidelines for Testing by Manufacturers and Other Entities

ADS-equipped vehicles should be operated solely by employees, contractors, or other persons designated by the MOEs, such as universities involved in testing. Test drivers in ADS-equipped vehicles should receive training and instruction related, but not limited to, the capabilities and limitations of the vehicle and should be subject to a background check as described in Section 6.3. Training should be documented and submitted to a jurisdiction's AV lead agency along with other required information. Jurisdictions may need to develop or review and adapt their existing rules for submission of such information and background checks.

Because the design of some Level 4 and 5 ADS-equipped vehicles may not include a driver's seat or equipment that enables actual physical control of the vehicle's operations, jurisdictions will need to plan to support safe testing without a human driver inside the vehicle. In these cases, jurisdictions should require that a user designated by the manufacturer or any such entity involved in the driverless testing of the ADS-equipped vehicle be capable of assuming control of the vehicle's operations or should require that the ADS has the ability to achieve a minimal risk condition. Mandating these features (e.g., driver's seat) may conflict with a federally granted exemption and entail changes to the MOE's design of test vehicles, which is configured differently than those ultimately sold to or used by drivers.

Allowing for the safe testing of ADS-equipped vehicles without a driver's seat or traditional driver equipment is important to the continued research, design, and ultimately deployment of ADS-equipped vehicles.

Jurisdictions will need to take appropriate steps to ensure their motor vehicle laws allow for the testing of ADS-equipped vehicles and for the testing of Level 4 and 5 ADS-equipped vehicles by an occupant who is not a licensed driver when the vehicle does not require manual fallback to achieve a minimal risk condition.

This may require amending statutory and regulatory definitions of "driver" and other related terms.

The guidelines in this section are not relevant to Level 0 to 3 vehicles unless otherwise noted. For Levels 0 to 3, the driver is responsible for the DDT and DDT-fallback and existing requirements for a driver's license will remain applicable. For a Level 4 vehicle, a licensed driver is not required to be in the vehicle while the vehicle is within its ODD. Level 4 vehicles can be complicated if they have accessible in-vehicle controls. Jurisdictions should consider those scenarios carefully with respect to licensing requirements. A Level 5 vehicle is defined as one that operates without any human intervention so there is no requirement that a licensed driver be available in the vehicle to take over operation.

Recommendations for Jurisdictions

5.2.1. Review and develop or adapt existing rules, if applicable, regarding vehicle operation to ensure ADS-equipped vehicle testing is permitted.

5.2.2. Require test ADS-equipped vehicles be operated solely by employees, contractors, or other persons designated by the manufacturer of the ADS-equipped vehicle or any such entity involved in the testing of the ADS-equipped vehicle.

5.2.3. Require test drivers to receive training and instruction related to, but not limited to, the capabilities and limitations of the vehicle and be subject to a background check as described in Section 6.3.

5.2.4. Require training provided to the employees, contractors, or other persons designated by the manufacturer or entity to be documented and a summary of the training be submitted to the jurisdiction's AV lead agency along with other required information.

5.2.5. Support safe testing without a human driver inside of the vehicle by requiring a user designated by the manufacturer of the ADS technology or any such entity involved in the driverless testing of the ADS-equipped vehicle to be capable of assuming control of the vehicle's operations or require that the ADS can achieve a minimal risk condition.

5.2.6. Ensure motor vehicle laws allow for the manufacturer to safely test Level 4 and 5 vehicles without a licensed driver in the vehicle. This provides for situations when a licensed driver designated by the MOE involved in the testing of the ADS-equipped vehicle can assume control of the vehicle's operations or require that the ADS can achieve a minimal risk condition.

Recommendation for Manufacturers and Other Entities

MOE 23. Manufacturers and other entities should complete a background check and provide or ensure appropriate training for ADS-equipped vehicle test drivers. See Section 6.3 on background checks.

Benefits of Implementation

The review of jurisdictional laws and rules regarding vehicle operation to ensure ADS-equipped vehicle testing is permitted will benefit the safe testing and deployment of ADS-equipped vehicles. Test driver training is a key element for the safe testing of ADS-equipped vehicles. Testing of ADS-equipped vehicles by manufacturers and other entities, in as many situations as possible, will support the safe deployment of ADS-equipped vehicles to consumers.

Challenges to Implementation

Challenges to Implementation include the review of jurisdictional laws and rules regarding vehicle operation for the testing of ADS-equipped vehicles and educating manufacturers on the process for submitting required documentation.

5.3 Remote Driver and Remote Driving

Background

Current technologies now enable a driver to completely control a vehicle from a remote location using a virtual driver's seat. There is the potential for remote drivers to operate all types of vehicles from personal to commercial vehicles, including shuttles and delivery vehicles. They may control more than one vehicle at a time because most likely, the vehicles will be part of a fleet of vehicles. The remote driver may be in a company office, may work from home, may be in another vehicle, or may be in a vehicle that does not have traditional manual controls such as a steering wheel or foot pedals.

The remote driver's role is emerging. The Subcommittee developed this information to assist jurisdictions but anticipates updates in the future as this technology progresses.

Remote drivers are defined by SAE International as "A driver who is not seated in a position to manually exercise in-vehicle braking, accelerating, steering, and transmission gear selection input devices (if any) but is able to operate the vehicle."

Although not part of the definition, SAE International also provides the following clarification:

> *NOTE 1:* A remote driver may include a user who is within the vehicle, within line-of-sight of the vehicle, or beyond line-of-sight of the vehicle.
>
> *NOTE 2:* A remote driver is not the same as a driverless operation dispatcher, although a driverless operation dispatcher may become a remote driver if [they have] the means to operate the vehicle remotely.
>
> *NOTE 3:* A remote driver does not include a person who merely creates driving-relevant conditions that are sensed by, or communicated to, the ADS (e.g., a police officer who announces over a loudspeaker that a particular stop sign should be ignored; another driver who flashes [the] head lamps to encourage overtaking, or a pedestrian using a dedicated short-range communication (DSRC) system to announce [their] presence).
>
> *EXAMPLE 1:* A Level 2 automated parking feature allows the remote driver to exit the vehicle near an intended parking space and to cause the vehicle to move into the parking space automatically by pressing and holding a special button on the key fob, while [they are] monitoring the driving environment to ensure that no one and nothing enters the vehicle pathway during the parking maneuver. If, during the maneuver, a dog enters the pathway of the vehicle, the remote driver releases the button on the key fob to cause the vehicle to stop automatically. (Note that the remote driver in this Level 2 example completes the OEDR subtask of the DDT during the parking maneuver.)
>
> *EXAMPLE 2:* Identical situation to Example 1, except that the remote driver is sitting in the back seat, rather than standing outside the vehicle.
>
> *EXAMPLE 3:* A Level 4 closed campus delivery vehicle that has experienced a DDT performance relevant system failure, which forced it to resort to a minimal risk condition by parking on the side of a campus roadway, is returned to its designated marshalling yard by a remote driver who is able to operate the vehicle using wireless means.

As explained by SAE International, a dispatcher or passenger who enters a point of origin and or destination into a system but does not perform the DDT is not a remote driver.

In its April 2021 revisions of the J3016, SAE International added two new related definitions.

Remote Assistance is defined as "Event-driven provision, by a remotely located human of information or advice to an *ADS*-equipped *vehicle* in *driverless operation* in order to facilitate *trip* continuation when the *ADS* encounters a situation it cannot manage."

SAE International provides the following notes and examples:

> *NOTE 1: Remote assistance* does not include real-time *DDT* or *fallback* performance by a *remote driver*. Rather, the *ADS* performs the complete *DDT* and/or *fallback*, even when assisted by a remotely located human.
>
> *NOTE 2: Remote assistance* may include providing an *ADS* with revised goals and/or tasks.
>
> *NOTE 3:* The *remote assistance* function does not include providing strategic instruction regarding selection of destinations or *trip* initiation timing (i.e., *dispatch* functions), even if the same person performs both *remote assistance* and *dispatching* functions.
>
> *EXAMPLE 1:* A Level 4 *ADS-DV* encounters an unannounced area of road construction within its *ODD*. The *ADS-DV* communicates to a remotely located human that it is unable to proceed around the construction. The remotely located human provides a new pathway for the *vehicle* to follow around the construction zone that allows the *ADS-DV* to automatically proceed and complete its *trip*.
>
> *EXAMPLE 2:* A Level 4 *ADS-DV* detects an object in its lane that appears to be too large to drive over and stops. A *remote assistant* uses the *vehicle*'s cameras to identify that the object is an empty bag that can be safely driven through/over and provides the instruction to the *ADS-DV* to proceed.

A second new term, remote driving, is defined as "Real-time performance of part or all of the *DDT* and/or *DDT fallback* (including, real-time braking, steering, acceleration, and transmission shifting), by a *remote driver*." Again, notes are provided for clarification:

> *NOTE 1:* A receptive *remote fallback-ready user* becomes a *remote driver* when they perform the *fallback*.
>
> *NOTE 2:* The *remote driver* performs or completes the *OEDR* and has the authority to overrule the *ADS* for purposes of lateral and longitudinal *vehicle* motion control.
>
> *NOTE 3:* Remote driving is not *driving automation*.
>
> *NOTE 4:* Remote driving of a *vehicle* by a human is sometimes referred to as "teleoperation." However, "teleoperation" is not defined consistently in the literature, and thus, to avoid confusion, is not used herein.

Guidelines for Testing Vehicles

Jurisdictions should recognize remote driving is being developed, tested, and piloted today. A consistent definition will be beneficial as these vehicles move across borders.

The location of the remote driver, in relation to the vehicle they are operating, needs continued conversation with all stakeholders. It is possible that a remote driver could be very close to the vehicle or could be miles away, in another jurisdiction, or even in another country.

Remote drivers must be familiar with the traffic laws in the jurisdictions in which they are driving, just as traditional drivers in vehicles are today. However, the issue becomes more complicated when there is a crash or incident that requires law enforcement interaction with the driver.

It may be difficult for law enforcement to identify the remote driver and determine the remote driver's actual physical location. If the officer is in one jurisdiction but the remote driver is in another, it may become problematic. This can be significant if there is a need to determine if the remote driver was distracted, impaired, or violated other laws. It will also be important to determine the limit on the number of vehicles a remote driver can safely drive and the number of vehicles the remote driver can safely supervise at one time.

The remote driver must be able to determine the vehicle's physical condition and that it can be operated safely. This will require systems, sensors, and mechanisms to be in place to monitor the condition of vehicle equipment.[17]

Recommendations for Jurisdictions

5.3.1. Define "remote driver" in statutes by adopting the SAE International definition and review the SAE International document J3016 dated April 2021, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, for additional information and further explanation of the definition.

5.3.2. Define "remote assistance" in statutes by adopting the SAE International definition and review the SAE International document J3016 dated April 2021, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, for additional information and further explanation of the definition.

5.3.3. Define "remote driving" in statutes by adopting the SAE International definition and review the SAE International document J3016 dated April 2021, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, for additional information and further explanation of the definition.

5.3.4. Require the testing entity to agree in writing that a remote driver would be subject to an operator fitness evaluation by law enforcement in the event of an incident or crash.

5.3.5. Clarify in law that all laws applicable to drivers also apply to remote drivers.

5.3.6. Review current license restrictions and endorsements to determine which apply to a remote driver and when a remote driver must comply with the restriction or endorsement. For example, restrictions that could apply include requiring corrective lenses, hearing devices, and accommodations for missing limbs.

5.3.7. Ensure jurisdictions and law enforcement agencies understand remote driving and are well versed in responding to inquiries.

5.3.8. Require manufacturers and other entities testing vehicles using remote drivers to notify the jurisdiction's lead AV agency, comply with all other testing requirements and to provide the names and driver's license information for all remote drivers.

5.3.9. Require documentation from the manufacturers and other entities that remote drivers have been trained to safely operate the vehicle remotely, including, but not, limited to, appropriate law enforcement and first responder interaction plans.

5.3.10. Provide officers the authority to cite the remote driver with moving violations and cite the registered owner with non-moving violations, as defined by the jurisdiction.

Recommended Requirements for Remote Test Drivers

5.3.11. Comply with all federal and jurisdictional laws unless otherwise exempt.

5.3.12. Hold the class of license for the vehicle they are remotely driving with appropriate endorsements and restrictions.

5.3.13. Be physically located in the same jurisdiction as the vehicle they are remotely driving

17 For information regarding the potential mitigation of risks associated with data connectivity used by the remote driver, see UL 4600, edition 3 standard on the *Evaluation of Autonomous Products.* An account is required for access.

because of limitations to legal authority to conduct multi-jurisdiction investigations.[18]

5.3.14. Inform their employer and/or test entity immediately of any moving violations or testing permit condition violations that occur whether they are remotely driving a vehicle or driving any other vehicle.

5.3.15. Be fit to remotely drive and not be impaired or distracted.

5.3.16. Remotely drive only one vehicle at a time.

5.3.17. Ensure the location, communication method, and control interface can allow uninterrupted control of remotely controlled vehicles.

5.3.18. Make available to law enforcement, upon request, their name, physical location, license number, and jurisdiction of issue, as well as the name and contact information of their employer.

5.3.19. Report a crash immediately to the appropriate law enforcement in the jurisdiction in which the vehicle is located.

Recommended Requirements for Test Vehicle Owners

5.3.20. Post the responsible party's name and contact information within a remotely driven vehicle.

5.3.21. Testing entities should verify remote test driver's driving records at least annually or participate in an employer notification system offered by the jurisdiction.

Guidelines for Deployed Vehicles

There is not enough information on deployed vehicles with a remote driver to provide guidance currently. The working group will continue to explore remote driving, remote driving a dual-mode vehicle, and the possibility of a human remotely supervising a vehicle.

Benefits of Implementation

Standardized understanding, definitions, and license requirements of remote drivers ensure consistency throughout jurisdictions and reinforces that remote drivers hold a valid driver's license and are properly trained. It will also assist law enforcement in determining violations and investigating crashes.

Challenges to Implementation

Several different remote driver scenarios are being developed and tested. Educating the public, jurisdiction staff, and law enforcement will be a challenge. Implementing the recommendations will require resources to conduct educational outreach and staff training. Laws and regulations will need to be updated to include remote driver's licensing requirements. The enforcement of remote driver qualifications and driver fitness along with the complication of the vehicle and driver being in separate locations will need to be considered.

5.4 Endorsements and Restrictions for Deployed Vehicles

Background

Because the driver of Level 0 to 3 vehicles with ADAS is expected to be in control of the vehicle or assume the DDT when required, most current driver's license qualifications will apply to their operation. Therefore, existing driver's license qualifications will remain applicable.

Vehicles with Level 4 and 5 ADS functionality engaged may or may not have a licensed driver in the vehicle or located remotely. One of the goals of ADS technology is to enhance the mobility of those unable to drive or be licensed because of physical or cognitive impairment or other condition. Enabling passengers without a licensed driver in these vehicles while the

18 For example, a subpoena issued by jurisdiction A for a suspected impaired remote driver located in jurisdiction B may not be easily served on the remote driver in jurisdiction B. This often involves going to court to obtain permission to serve a subpoena issued by another jurisdiction. Delays caused by this process could negatively impact the investigation of the suspected impaired remote driver.

ADS is performing the DDT within its ODD would allow everyone to benefit from the technology.

Guidelines for Endorsements and Restrictions

The full implication of endorsements or restrictions for ADS-equipped vehicles is not yet fully understood, particularly for Level 4 and 5 ADS-equipped vehicles. Until these technologies have completely developed, driver's license endorsements and restrictions are not recommended.

Additionally, there is a risk of creating conflicting jurisdictional endorsements and restrictions if jurisdictions consider this licensure regime. This will complicate the exchange of driver's licenses from jurisdiction to jurisdiction in translating codes. It will be important to fully examine the development of standardized codes for endorsements and restrictions if they are warranted.

Jurisdictions should not impose any other requirements, such as licensure, sobriety, or clean driving history, for nondrivers to be passengers in Level 4 and 5 ADS-equipped vehicles if the vehicle cannot be operated in manual mode. Assuming Level 4 and 5 ADS-equipped vehicles will require the passenger to only provide destination or navigation inputs, no special training or qualification should be required. The operation of Level 4 and 5 ADS-equipped vehicles is comparable to taking a taxi, riding a bus, or riding the subway, none of which requires special training or licensure.

There is the potential for unsupervised children to be placed in ADS-equipped vehicles. Jurisdictions should review their laws and regulations related to unsupervised children in motor vehicles to ensure safety.

Recommendations for Jurisdictions

5.4.1. Do not establish endorsements or restrictions on driver's licenses, specifically for ADS-equipped vehicles at this time.

5.4.2. Take steps to ensure jurisdictional motor vehicle laws allow for the operation of Level 4 and 5 ADS-equipped vehicles without a driver only if the vehicles cannot be operated in manual mode.

5.4.3. Do not limit the operation of Level 4 and 5 ADS-equipped vehicles to individuals who are licensed as drivers.

5.4.4. Do not impose any other requirements, such as licensure, sobriety, or clean driving history, for passengers to use Level 4 and 5 ADS-equipped vehicles.

5.4.5. Review jurisdictional laws and regulations related to unsupervised children in motor vehicles to ensure safety.

Benefits of Implementation

By not creating ADS-equipped vehicle endorsements and restrictions, jurisdictions will eliminate conflict of jurisdictional codes and the complications in translating codes when exchanging driver's licenses from jurisdiction to jurisdiction.

Challenges to Implementation

If a jurisdiction implements ADS-equipped vehicle endorsements and restrictions, it will create challenges for other jurisdictions for the exchange of driving privileges.

5.5 Driver Training for Drivers on Vehicle Technologies

As technology continues to advance, it will be critical to ensure training continues to be relevant and accurate. Standard safety features must be incorporated into the training and testing process to assist drivers in understanding what the technologies can and cannot do.

Background

Although most of this report addresses ADS-equipped vehicles, technology described as ADAS also has implications for the driver training and driver's license testing processes. Therefore, Sections 5.5 to 5.9 include discussions on all vehicles with driving automation systems.

The operation of vehicles with driving automation systems will have significant driver implications for driver training. As vehicles with driving automation systems are deployed and become more available to the public, drivers will need to understand the technology and receive proper training on the safe and effective use of these vehicles.

Manufacturers, organizations, and policy makers should adopt consistent terminology for ADAS to reduce confusion among the public. The terminology needs to be consistent and simple to understand and be based on the function of the technology. As described in Section 3.2, efforts are underway by national organizations to support consistency in ADAS terminology.

Drivers need to understand the benefits and limitations of ADAS technology. If drivers are not educated on the purpose of the technology, they may turn it off, not use it as intended, or use it beyond or overly rely on its intended purpose.

Quality training programs will effectively train drivers to operate vehicles with driving automation systems safely and effectively. The training will educate drivers on:

- the benefits, capabilities, and limitations;
- how to engage and disengage the system functions;
- risks of misuse or overreliance;
- risks of accidentally or deliberately disengaging a system;
- how to remain engaged in the driving task; and
- how to deal with emergency situations.

National Safety Council (NSC) has a "My car does what?" Guide by vehicle make and model, as do other entities, that can provide users with information on ADAS technologies in their vehicles.

Training for operating vehicles with driving automation systems may be achieved by one or more of the following:

- drivers seeking appropriate training from a recognized professional (see Section 5.6 for examples);
- manufacturers, dealers, and other appropriate entities providing adequate training to drivers; and
- jurisdictions regulating education and training for drivers.

Communication and education among manufacturers and dealers with drivers about driving automation system functions are critical elements for the safe operation of these vehicles. Manufacturers will need to ensure vehicle information and content contained in the vehicle's "owner's manual," or aftermarket information should be made available to assist the driver. However, familiarity of the information and content is not sufficient and should not replace applicable training on driving automation system vehicle functions.

Establishing a minimum set of training standards, outside of the normal owner's manual or aftermarket information, will have a direct impact on the safe operation and success of vehicles equipped with

driving automation systems. Standardized training should be available to everyone who purchases or has the technology installed on their vehicles. In addition to these jurisdictional guidelines, stakeholder consultation is highly recommended.

Considerations for Implementation

- drivers having an interest in and taking the time to seek training on their vehicles driving automation system functions;
- obtaining buy-in from manufacturers, dealers, and insurance companies to provide training; and
- offering incentives for drivers to seek training.

Recommendations for Jurisdictions

5.5.1. Promote driver training on the use of vehicles with driving automation systems.

5.5.2. Encourage communication between dealers and drivers including, but not limited to, acknowledgement of the sections in the vehicle "owner's manual" related to driving automation systems.

5.5.3. Encourage manufacturers, dealers, and insurance companies to provide incentives for drivers to receive proper training on the use of vehicles with driving automation systems.

5.5.4. Encourage aftermarket system manufacturers and dealers to provide educational materials and resources to drivers.

Recommendation for Manufacturers and Other Entities

MOE 24. Manufacturers and dealers should take steps to make training available to drivers to ensure they understand the functionality of the vehicles and are prepared to properly operate them.

5.6 Training for Driver Educators, Driver Education, and Driver Training Programs

Background

The training of driver educators and the creation of driver education curricula must adapt as driving automation system technologies evolve. New standards and materials must be developed to include information on the proper use of and interaction with these technologies. Behind-the-wheel training should include instruction on the proper use of these safety features.

National organizations that play a key role in the development of driver education and driver training curricula including driver educator training curricula include:

- American Automobile Association (AAA)
- American Driver and Traffic Safety Association (ADTSEA)
- Driving School Association of the Americas (DSAA)
- American Association of Retired Persons (AARP)
- Association of National Stakeholders in Traffic Safety Education (ANSTSE)
- National Highway Traffic Safety Administration (NHTSA)

The ANSTSE develops free standards and resources to assist jurisdictions in their driver education efforts. Each of these organizations and the AAMVA AVSC are available to assist driver educators and driver education programs as they broaden their knowledge of vehicles equipped with driving automation systems.

For commercial vehicle operations, when driving automation system technologies are also evolving rapidly, national organizations that play a key role in training include:

- Commercial Vehicle Training Association (CVTA)
- National Association of Publicly Funded Truck Driving Schools (NAPFTDS)

Standardized materials on the use of vehicles equipped with driving automation systems will need to be created and maintained.

For novice drivers, driver education materials need to be updated and maintained regularly to include information on the proper use and limitations of these technologies. Educators should also consider utilizing various delivery platforms to effectively train novice drivers.

Training standards are developed and maintained by ANSTSE, ADTSEA, and DSAA and are available through the Novice Teen Driver Education and Training Administrative Standards (NTDETAS) posted on the ANSTSE website.

Recommendations for Jurisdictions

5.6.1. Require driver education curricula to contain information on vehicles equipped with driving automation systems.

5.6.2. Require driver educators to provide behind-the-wheel instruction on the use of ADAS if equipped.

5.6.3. Require all definitions and language on vehicles equipped with driving automation systems provided in driver education to use the SAE International or AAMVA's guidelines for consistency.

5.6.4. Implement standards for the training of driver educators on the knowledge of and use of vehicles equipped with driving automation systems.

5.6.5. Require driver educators to continually review materials and revise curricula to incorporate current ADAS features.

5.7 Driver License Skills Testing with Vehicle Technologies

Background

It is important to determine what technologies are permitted during the driver license skills test. These technologies can be grouped into the following categories:

- Convenience technologies are technologies that provide conveniences for the driver (e.g., parking assist feature or auto-cruise control) and do not require the applicant to demonstrate a required skill set. These shall not be permissible for skills testing.
- Safety critical technologies are technologies that may prevent or reduce the severity of a crash. These technologies (e.g., rear or other cameras, alerts, lane departure warning, emergency braking assist) shall be permissible and shall not be disengaged during the testing process.

The purpose of the skills test is to determine an applicant's skill in operating a motor vehicle. Even though a vehicle is equipped with technology features, the applicant must demonstrate the ability to perform the entire dynamic driving task and not solely rely on the technology. Comfort and convenience technologies should not be used during the skills examination. See *Guidelines for Testing Drivers in Vehicles with Advanced Driver Assistance Systems*.

The use of safety-critical technologies should be permitted and not disengaged for skills tests. Safety critical technologies include, but are not limited to:

- Back-up camera
- Blind spot warnings
- Lane keeping assist
- Lane departure warnings
- Automated emergency braking

The skills test and parking maneuvers should be revised to incorporate use of these technologies. In the case of backup cameras or other cameras, the criteria for checking mirrors and blind spots (head-check) while backing up should be updated to evaluate the applicant's behaviors to use cameras in conjunction with mirrors and head-checks, as an example.

The skills test scoring standards should be updated to reflect the proper procedures for examiners to follow when active safety systems activate during the testing process.

SAE International defines a dual-mode vehicle as "An ADS-equipped vehicle designed to enable either driverless operation under routine/normal operating conditions within its given ODD (if any), or operation by an in-vehicle driver, for complete trips."

- A driver must be licensed to operate in manual mode when in a dual-mode vehicle.
- When conducting a skills test in an ADS-equipped dual-mode vehicle, it must be operated in the manual mode.

AAMVA assists jurisdictions with skills testing practices and driver's license examiner training. The AAMVA TMS is responsible for maintaining and updating AAMVA's model driver testing systems, including the AAMVA Noncommerical Model Driver Testing System (NMDTS). The AAMVA International Driver Examiner Certification (IDEC) program is responsible for maintaining and updating examiner training materials. The materials provide uniformity amongst examiners by requiring standardized training which in turn improves the efficiency and effectiveness of driver examining personnel. MVA driver manuals should include up-to-date information on ADAS and ADS-equipped vehicles.

Recommendations for Jurisdictions

5.7.1. Include driving system automation information on vehicle technologies in the jurisdiction's driver manual.

5.7.2. Include questions addressing driving system automation in the jurisdictional knowledge test.

5.7.3. Jurisdictions shall not allow the applicant to use convenience technologies, such as the parking assist feature, for skills tests.

5.7.4. Allow the applicant to use safety-critical technologies during skills tests.

5.7.5. Jurisdictions should not require applicants to deactivate safety-critical technologies during the skills testing process.

Recommendation for Manufacturers and Other Entities

MOE 25. Manufacturers and other entities that develop an ADS-equipped dual-mode vehicle should consider taking steps to prevent the manual mode from being engaged in error.

5.8 Training Motor Vehicle Agency Examiners on Vehicle Technologies

Background

The AAMVA TMS and IDEC Board collaborate with other organizations to update the model driver testing system (e.g., NMDTS) and examiner training

materials to address the use of vehicle technology in support of the driver testing process.

The TMS and IDEC Board, along with the AVSC, developed AAMVA's *Guidelines for Testing Drivers in Vehicles with Advanced Driver Assistance Systems*. It outlines technologies and implications for testing and provides recommendations for testing procedures and examiner training.

As driving automation system technologies continue to advance, the training of driver license examiners will need to evolve. AAMVA's *Guidelines for Testing Drivers in Vehicles with Advanced Driver Assistance Systems* will assist jurisdictions to revise or enhance their driver testing programs. The TMS and IDEC Board released the *ADAS and the Role of the Driver Examiner* training materials in 2023 (available by contacting AAMVA at drivertesting@aamva.org). The training materials are designed to educate driver examiners on their role for testing applicants in vehicles equipped with ADAS. Appropriate MVA staff should also be aware of testing procedures for ADAS-equipped vehicles to respond to customer inquiries.

Recommendations for Jurisdictions

5.8.1. Provide training to driver license examiners on vehicle technologies. AAMVA's *Guidelines for Testing Drivers in Vehicles with Advanced Driver-Assistance Systems* resource guide, published in 2023, should be used in examiner training.

5.8.2. Require driver license examiners to use the definition and language on vehicles equipped with driving automation systems from AAMVA's guidelines.

5.8.3. Provide information to appropriate MVA staff on vehicle technologies, including policies on driver testing in ADAS-equipped vehicles.

5.9 Commercial Driver Licensing

FMCSA regulates the safety of commercial motor carriers operating in interstate commerce, the qualifications and safety of CMV drivers, and the safe operation of commercial trucks and motor coaches. FMCSA continues to study the need to amend its existing regulations to accommodate the integration of ADS into commercial vehicle operations. Many of FMCSA's current regulations can be readily applied in the context of ADS-equipped CMVs.

Because there are differences between human operators and ADS, FMSCA is determining how best to integrate ADS-equipped CMVs and their operation into existing regulations. FMCSA acknowledged that federal and jurisdiction enforcement officials may need additional specialized training to identify defects with ADS-equipped CMVs, but it is not the FMCSA's goal to have these officials responsible for conducting diagnostic tests of a CMV's ADS. FMCSA discourages inspectors from delaying the movement of ADS-equipped CMVs unless there are clear indications of safety-critical violations, ADS faults, or ADS malfunctions.

Guidelines for Testing Vehicles

All existing jurisdiction and federal laws, rules, and regulations should remain in effect unless specific exemptions or authorizations are granted to the testing entity.

Recommendations for Jurisdictions

The following recommendations pertain to commercial vehicles regulated by the jurisdictions. Vehicles regulated by the federal government will be addressed in the future as federal regulations are established.

5.9.1. Drivers operating or testing an ADS-equipped commercial motor vehicle must have the appropriate license and endorsements to operate that class of vehicle.

5.9.2. Drivers operating or testing an ADS-equipped commercial motor vehicle must be located inside the vehicle unless specifically approved to operate or test the vehicle with the driver outside the vehicle or remotely located.

Guidelines for Deployed Vehicles

CDL laws, rules, and regulations will need to be updated to address ADS-equipped vehicles. Currently, however, jurisdictions should work with FMCSA to ensure that jurisdictional and federal regulations are aligned.

Recommendations for Jurisdictions

5.9.3. Engage in the review and development of federal regulations by FMCSA.

5.9.4. Review and adopt amendments to jurisdictional laws as federal regulations are updated.

Benefits of Implementation

Jurisdictions will have input into updated federal regulations through the usual notice-and-comment rulemaking process and can assist in continuing to align jurisdictional and federal regulations.

It is anticipated that automated technologies in commercial vehicles, as in automobiles, will reduce the errors and poor decisions made by humans and improve safety.

Challenges to Implementation

It is important to recognize that the FMCSA, which has regulatory authority over CDLs and interstate commercial vehicles, is in the process of developing regulations that will need to be considered as they are introduced.

Updating federal regulations is a lengthy process, and FMCSA may not be able to react to the testing and deployment of the technology at the same pace as the technology emerges. However, FMCSA has the authority to grant waivers and exemptions and to conduct pilot programs per 49 CFR part 381. FMCSA discussed this in its previous *Federal Register* notices seeking public comment. These waivers and pilot programs allow FMCSA to react at a much faster pace than rulemaking.

Another challenge is ensuring uniformity across jurisdictions during their implementation process.

Chapter 6 Law Enforcement Considerations

This chapter outlines the leading concerns to law enforcement for vehicles equipped with driving automation systems operated on public roadways.

6.1 Vehicle Identification

Background

Identification of a motor vehicle as an ADS-equipped vehicle is necessary for law enforcement officers and other first responders (police, fire, emergency medical services, and tow and recovery services) to fulfill their duties. These duties include ensuring safety at the scene if the occupant(s) is incapacitated in a crash, taking appropriate enforcement action when violations are observed, and aiding in the recovery of stolen vehicles.

From a law enforcement perspective, traditional means for identifying a vehicle via a license plate check may not be the optimal method to identify a vehicle equipped with ADS. License plates are susceptible to theft, only allow identification from the rear in one-plate jurisdictions, and may be obscured in crashes involving front or rear damage. In addition, jurisdictions currently issue a vast array of unique plate designs; one more plate design will not aid in the identification of an ADS vehicle if a similar model vehicle exists in the marketplace.

In contrast, vehicle labeling or permanent marking to identify the vehicle equipped with ADS allows for redundant marking in multiple locations (exterior and interior), improving conspicuity from multiple vantage points. SAE International, the International Organization for Standardization (ISO), and NHTSA have all developed ADS labeling guidelines or have issued proposed rules for labeling of alternative fuel vehicles. These guidelines, or in the case of NHTSA's proposed rule, have varied purposes. Each provides guidance for accepted labeling. An additional consideration includes the use of an ADS marking lamp to provide law enforcement the means to identify whether a vehicle is being operated by the ADS (SAE Levels 3–5) or the driver (SAE Levels 0–2). This would mitigate enforcement stops for perceived distracted driving violations when the ADS is engaged and performing the DDT. SAE J3134 specifies the color of an ADS marking lamp as blue-green.

Vehicle identification strategies should be considered to improve safety and facilitate motor vehicle administration practices and law enforcement efforts. The VIN conveys significant information regarding the characteristics of the motor vehicle to which it is issued. A new VIN system should be considered. VIN information must include information relative to ADS onboard the vehicle. This information should be tied to registration and user credentialing (see references in Sections 4.4 and 4.5).

The following information was provided by the CVSA:

> Specific to commercial motor vehicles (CMV), CVSA is pursuing the establishment of a universal electronic vehicle identifier, which could be integrated with a new VIN system. In 2018, CVSA submitted a petition to NHTSA to require that CMV's be manufactured to wirelessly broadcast a universal electronic vehicle identifier. The petition outlines the need for universal electronic vehicle identification to enhance inspection screening and prepare for deployment of ADS technology. These two concepts would combine to facilitate

identification and safety assessment of ADS-equipped CMV.

Guidelines for Testing and Deployed Vehicles

ADS-equipped vehicles will be comingled with vehicles operated by human drivers for decades and will be susceptible to being involved in crashes. In addition, there may be laws specific to the operation of ADS-equipped vehicles that require law enforcement officers to identify vehicles as being ADS equipped. For the safety of law enforcement and other first responders, an ADS-equipped vehicle should be readily and clearly identifiable from other vehicles on the roadway. The optimal means for accomplishing identification is through vehicle labeling. An alternative may include providing an ADS-equipped indicator on the Federal Safety Certification Label displaying the ADS manufacturer information.

Because jurisdictions have authority over vehicle registration, a unique ADS identifier on the vehicle registration and title can provide a means of identifying ADS-equipped vehicles for law enforcement purposes during testing (see Sections 4.4 and 4.5).

ADS-equipped vehicles will allow occupants to disengage from the DDT and conduct other activities that divert their attention from driving. As such, it is likely law enforcement officers will observe greater numbers of vehicle occupants, seated in the traditional driver's seat, conducting other activities such as utilizing cellular telephones in violation of jurisdiction laws. However, if the ADS is conducting the DDT, there would be no violation. It would be difficult for a law enforcement officer to make this determination without a visual indicator, possibly leading to unnecessary enforcement stops.

Recommendations for Jurisdictions

6.1.1. Enact requirements for the identification of ADS-equipped vehicles by law enforcement and other first responders. This could be accomplished through vehicle labeling providing an easy means for identifying ADS-equipped vehicles.

6.1.2. Encourage the passage of legislation (or provide a waiver if legislation is not needed) to allow MOEs to implement the use of ADS marking lamps for Level 3 and 4 ADS vehicles. The color should comply with SAE J3134.

Recommendation for Manufacturers and Other Entities

MOE 26. When authorized to do so, install ADS marking lamps to allow law enforcement to identify if an ADS-equipped vehicle is being operated by the ADS or by the driver to mitigate enforcement stops for driver-centric violations, such as distracted driving. Visual or other cues should be included in the law enforcement interaction plan.

Benefits of Implementation

The vehicle registration and titling recommendations, if adopted, will allow law enforcement and other first and secondary responders to readily identify a vehicle as one with driving automation system capabilities in a standardized manner.

With the addition of a visual indicator or other cues to allow law enforcement to identify when a vehicle is being operated by the ADS, unnecessary enforcement stops would be avoided.

Challenges to Implementation

Development of a standardized VIN nomenclature or labeling system incorporating SAE level and modifying all applicable DMV systems to incorporate a new VIN nomenclature. In addition, aftermarket applications may change the SAE level postproduction.

The addition of visual indicators may lead to changes in the behavior of other road users.

Jurisdictional laws may need to be revised to allow driving automation system visual lighting indicators to be installed in vehicles. In addition, achieving standardization among MOEs on visual indicators or other cues to identify when a vehicle is operated by the driving automation system will be a challenge.

6.2 Crash and Incident Reporting

Background

Crash reporting should occur when there are crashes or incidents involving ADS-equipped vehicles and other vehicles, persons, animals, or objects whether or not the ADS is the proximate cause. Other reportable incidents may include a person falling from a vehicle or a rollover event in which no other object is struck.

Safety and crash avoidance are priorities of automobile manufacturers and other entities. Regardless of the level of safety engineering, crashes are inevitable during testing and deployment on public roads. Crash and incident reporting are important for the purposes of identifying and documenting safety concerns and establishing liability. Crash report information is not only of importance to manufacturers and the engineering community but also to a variety of public constituencies, including regulators and policy makers. Analysis of crash data may be used to evaluate the performance of ADS during an event, which may lead to safety best practices to prevent future crashes or incidents. Full disclosure of information concerning how a crash occurred will be essential to the crash investigation, technological advancement, regulation, and public acceptance of ADS.

An additional resource for law enforcement specific to crash reporting and reconstruction is *Law Enforcement, First Responder and Crash Investigation Preparation for Automated Vehicle Technology*.

Law enforcement should be aware that the National Traffic Safety Board (NTSB) may conduct a parallel crash investigation when an ADS-equipped vehicle is involved.

Guidelines for Testing Vehicles

When testing occurs on public roadways, ADS manufacturers and other entities should collect, retain, and secure data elements and submit to jurisdictions incident or crash-related information to support crash investigations and event reporting, expand research, and expand ADS development. Information should include relevant data from a crash or event when ADS-equipped vehicles are operating in automated or manual mode and when ADS technology was disengaged (by the user or by the system). The information should include status of the ADS leading up to, during, and until the end of the crash event. The information should also include incidents in which the users of ADS-equipped vehicles are unexpectedly prompted to transition into manual mode because of a failure of the automated system. Manufacturers and other entities should be required to submit a summary of their analysis of the incident.

Requiring manufacturers and other entities to report incidents and crashes to the jurisdiction provides transparency between jurisdictional agencies, manufacturers, and other entities throughout the testing phase. Sharing these data and the manufacturer's analysis of the incident would be beneficial to jurisdictional policy makers.

When an ADS-equipped vehicle is involved in a crash, the information obtained from the ADS recorded data could prove important to determining whether an ADS malfunction or programming caused the crash or contributed to the crash or if the crash could otherwise have been avoided. Additionally, the data collected from the vehicle(s) involved could potentially provide insight into how the ADS reacts to given scenarios. The data recorded should include, but not be limited to, the mode of operation (ADS vs. manual control), vehicle control (what the ADS did), vehicle location, speed, steering input, throttle or brake application, impact speed, vehicle lighting, and a 360-degree video sample of the vehicle surroundings if so designed or equipped. Law enforcement should be provided with

access to this information as well as a minimum of 30 seconds pre-crash through the end of the crash event for completing a proper investigation. ADS-logged data should be provided in a standardized manner in conjunction and consistent with other event data recorder (EDR) information formats to allow clarity and understanding of the relevant crash factors.

Recommendations for Jurisdictions

6.2.1. Require ADS test entity to submit to the jurisdiction, at a minimum, the NHTSA crash reporting requirements for vehicles with driving automation systems (NHTSA Standing General Order 2021-01 (Amended April 2023).[19]

Guidelines for Deployed Vehicles

The U.S. DOT Model Minimum Uniform Crash Criteria (MMUCC) includes guidance for capturing AV data on crash reports to assist in crash investigation to determine causation to support further ADS development and improve safety. U.S. jurisdictions should adopt the MMUCC recommendation as soon as practicable.

Large amounts of data are captured by the vehicle's data collection mechanisms (DCMs). Such information would aid a crash investigation by revealing pre-and post-crash causative factors and actions. This information may include vehicle equipment status, whether ADS or a human is controlling dynamic driving tasks, ADS or driver actions, ADS mode, ADS status to include ADS disfunction or failure, ADS request to intervene, crash causation factors, and external conditions or factors.

Manufacturers should ensure relevant event data is captured, stored, and secured. Data from sensors, such as cameras, radar, and LiDAR information captured by data loggers relevant to ADS status, as well as vehicle behavior sensor data and the HMI will be important for crash reconstruction. Data should include time stamping and Global Positioning System (GPS) location and should be synchronized with EDR in the DCM data. In addition, to ensure effective crash investigation and safety analysis, manufacturers should make DCM information retrievable in a standardized, nonproprietary format for ready access by those duly authorized in accordance with laws protecting data privacy.

Recommendations for Jurisdictions

6.2.2. U.S. jurisdictions should adopt the MMUCC as soon as practicable.

6.2.3. Jurisdictions and regulators should determine best practices and pursue legislation related to the duty to report ADS involved crashes to adequately document the relevant facts. Consideration should also be given to emerging technologies and areas of significance such as how to identify the driver or operator of an ADS and other legal considerations such as enforcement of traffic laws.

Recommendations for Manufacturers and Other Entities

MOE 27. Design ADS data loggers to record data using standards such as SAE International J3197 to record ADS data, vehicle, behavior sensor data, and the HMI. ADS data loggers should synchronize with EDM modules. Manufacturers should record 360-degree video data of the vehicle's operating environment. Law enforcement should be provided with access to this information as well as a minimum of 30 seconds pre-crash through the end of the crash event (cessation of involved vehicle movement) for completing a proper investigation.

19 *Standing General Order 2021-01 Incident Reporting for Automated Driving Systems (ADS) and Level 2 Advanced Driver Assistance Systems*. NHTSA, 2021, https://www.nhtsa.gov/sites/nhtsa.gov/files/2023-04/Second-Amended-SGO-2021-01_2023-04-05_2.pdf

MOE 28. In addition to complying with the requirements of 49 CFR Part 563, manufacturers should make DCM information retrievable in a standard, nonproprietary format for ready access by those duly authorized.

MOE 29. Manufacturers and other entities should include time stamping and GPS location in DCM data.

Benefits of Implementation

Collection of crash and incident data is beneficial to manufacturers and developers during the testing and developmental stages. In addition to manufacturers and developers, regulatory agencies, policy makers, and law enforcement agencies benefit from data recorded before the crash, during the crash event, and after the crash to aid in crash investigation, determining causation factors, identifying crash prevention strategies, technology development, roadway safety, and proven best practices.

Challenges to Implementation

Because ADS technology is continuously evolving and much of manufacturers' ADS technology is proprietary, manufacturers may be resistant to all or part of recommended guidelines. Regulations or statutes vary among jurisdictions which may impede implementation.

6.3 Criminal Activity

Background

There are both substantial opportunities and risks presented by automated driving that will increase the tactical performance of physical tasks over manually driving a vehicle. ADS-equipped vehicles have the potential to improve driving safety and make mobility more efficient. However, they will also create greater possibilities for dual-use applications and ways for a vehicle to be used to further criminal enterprises, or worse, be used as a tool for the delivery of explosives, contraband, or other means of causing harm. This is not only a clear and present danger but also further complicates any subsequent criminal investigation.

Additionally, criminals will be able to take advantage of the ADS-equipped vehicle to engage in multitasking criminal activities that require the use of both hands, such as firing a weapon from a vehicle at a pursuing patrol vehicle. This not only presents a clear danger to the public but also complicates criminal investigations.

New technologies that will be available in vehicles present opportunities to prevent certain vehicle-related crimes from being committed and assisting law enforcement in interdicting crimes. Technological advancements also present an opportunity to aid in the investigation of crimes that have been committed. Tools such as data loggers and data capture software applications enhance law enforcement efforts in investigation when ADS-equipped vehicles are used in the commission of criminal enterprises.

Guidelines for Testing Vehicles

Prior to authorization to operate an ADS-equipped test vehicle, the employees, contractors, and other persons designated by the manufacturer or other entities should be required to pass background checks, including, but not limited to, a driver history review and a criminal history check. In the interest of safety, it may be prudent to disqualify persons with poor driving records or criminal records from operating ADS-equipped vehicles as agents or contractors of manufacturers and other entities in a test environment.

Recommendations for Jurisdictions

6.3.1. Jurisdictions that have ADS-equipped vehicle permitting requirements as described in Section 4.1 should require the designated test users (employees, contractors, and other persons) to pass background checks, including, but not limited to, a driver history review and a

criminal history check, prior to authorization to operate an ADS-equipped test vehicle.

6.3.2. Jurisdictions that have ADS-equipped vehicle permitting requirements as described in Section 4.1 should establish provisions that disqualify a test user who has a criminal record or a driving history that includes driving under the influence, reckless driving, or other significant conviction history from operating an ADS-equipped test vehicle in a test environment.

Recommendations for Manufacturers and Other Entities

MOE 30. The manufacturer or other entity, operating in jurisdictions not requiring ADS-equipped vehicle permits, should require the designated test user to pass a background check, including, but not limited to, a driver history review and a criminal history check, prior to authorization to operate an ADS-equipped test vehicle.

MOE 31. The manufacturer or other entity, operating in jurisdictions not requiring ADS-equipped vehicle permits, should disqualify a test user who has a criminal record or poor driving history from operating an ADS-equipped test vehicle in a test environment.

Guidelines for Deployed Vehicles

ADS-equipped test vehicles may also be a target for criminal activity, such as carjacking, because they may not be capable of intuitive reaction or evasive maneuvers a human user could employ.

To assist law enforcement in investigating criminal activity when an ADS-equipped test vehicle was implicitly involved as a tool for committing a crime, manufacturers should ensure ADS leave an electronic fingerprint that can allow tracing of input data to whomever initiated them.

Recommendations for Manufacturers and Other Entities

MOE 32. Manufacturers and other entities should ensure ADS-equipped vehicles leave an electronic fingerprint that can allow tracing of input data to whomever initiated the activity.

Benefits of Implementation

Requiring manufacturers to program software which creates an electronic fingerprint of HMI will mitigate the risk of an AV being used as a tool to assist in the commission of or escape from a crime.

Challenges to Implementation

Inherent issues of privacy are recognized, and legislative action or administrative rulemaking will be required to implement the recommended guideline.

6.4 Distracted Driving

Background

The potential for reducing or eliminating distracted driving is a common topic when discussing ADS-equipped vehicles. The term "distraction" as used by NHTSA is a specific type of inattention that occurs when drivers divert their attention away from the driving task to focus on another activity. These distracting tasks can affect drivers in different ways and can be categorized into the following types:

- Visual distraction: tasks that require the driver to look away from the roadway to visually obtain information
- Manual distraction: tasks that require the driver to take hand(s) off the steering wheel to manipulate a device or other distracting activity
- Cognitive distraction: tasks that are defined as the mental workload associated with a task that involves thinking about something other than the driving task

Many activities involve a combination of these types of distractions, including texting, which can involve all three. The impact of distractions on driving is determined not just by the type of distraction but also by the frequency and duration of the task. Because drivers often have a choice regarding when and how often to multitask when driving, their exposure to risk is typically within their control. Additional distracted driving information, including the latest research, can be found on the NHTSA website: Distracted Driving Dangers and Statistics | NHTSA.

In September 2023, the AAMVA Automated Vehicles Subcommittee published *Strengthening Distracted Driving Education, Legislation, and Enforcement Edition 2*, which provides more detailed information on this issue.

Guidelines for Testing Vehicles

When testing any ADS-equipped vehicle, the user is an active participant in the testing process; therefore, all distracting activities should be prohibited.

Recommendations for Manufacturers and Other Entities

MOE 33. Manufacturers and other entities should minimize distractions in ADS-equipped vehicles.

MOE 34. Manufacturers and other entities should prohibit users from all added distracting activities when testing ADS-equipped vehicles.

MOE 35. Manufacturers and other entities should incorporate technology to alert the "driver" when the ADS cannot maintain or complete the driving task and the "driver" needs to assume control of vehicle operation.

Guidelines for Deployed Vehicles

Jurisdictions should consider at what level of automation distracted driving laws continue to apply.

A vehicle operator may still need to maintain a level of awareness when an ADS-equipped vehicle is assuming control of the vehicle because they may need to re-engage with the driving function if prompted by the vehicle. Because the operation of some ADS-equipped vehicles may require no participation by the driver, distracting activities may not be relevant, and distracted driving laws may not apply. Consistent with NHTSA's call for ADS-equipped vehicles to communicate information related to the road users outside the vehicle, manufacturers should incorporate means of identifying whether the driver or the ADS is assuming control of the vehicle's movement.[20] Such implementation will allow a law enforcement officer to assess whether there is a road safety concern.

Manufacturers should design ADS-equipped vehicles with a means of identifying when a vehicle is in automated mode to facilitate effective enforcement of distracted driving laws (e.g., so an officer knows if using a hand-held device is legal at the time of observation).

Recommendations for Jurisdictions

6.4.1. Consider strengthening a jurisdiction's distracted driving laws by utilizing the model legislation provided in the AAMVA *Strengthening Distracted Driving Education, Legislation, and Enforcement, Edition 2* as a template.

6.4.2. Utilize the best available distracted driving educational materials in proactive public education efforts.

Recommendations for Manufacturers and Other Entities

MOE 36. Manufacturers and other entities should design ADS-equipped vehicles with a means of identifying when the ADS is assuming control of the vehicles

20 *Automated Driving Systems 2.0*. NHTSA, September 2017, https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf#page=16

movements to facilitate effective enforcement of distracted driving laws (e.g., so an officer knows if using a hand-held device is legal at the time of observation).

MOE 37. Manufacturers and other entities should minimize distractions in ADAS-equipped vehicles with part-time self-driving features.

MOE 38. Manufacturers should incorporate technology that monitors the driver's awareness (monitoring eyes or hand placement) with the vehicle prompting disengagement of activated self-driving mode if the driver is not paying sufficient attention to the DDT.

Benefits of Implementation

It is anticipated there would be a reduction in crashes caused by driver distraction.

Challenges to Implementation

Many jurisdictions need to pass or strengthen existing distracted driving laws and may meet resistance to passing comprehensive legislation such as AAMVAs model distracted driving legislation found in *Strengthening Distracted Driving Education, Legislation, and Enforcement Edition 2*. An additional challenge will be for industry to develop consistent methodologies for systems that allow law enforcement to determine the level of the driving automation system and what mode the vehicle is in when they observe a user potentially violating distracted driving laws.

6.5 Establishing Operational Responsibility and Law Enforcement Implications

Background

Jurisdictions have legal authority to regulate vehicle operation by humans but may not have established authority over nonhuman operation. This uncertainty presents significant challenges to enforcement of traffic laws and to establishing legal responsibility when Level 3 to 5 vehicles are involved in motor vehicle crashes on public roads. Jurisdictions will need to address the following issues:

- Is the driver of a vehicle with automated features engaged still responsible for the operation of that vehicle even if they are not performing the DDT?
- In such instances, how will law enforcement officers know when the human is actively driving or if the ADS is in control?

Although this may appear to be less of an issue as vehicle technologies approach Level 5, from an enforcement perspective, the issue is still confounding because many jurisdictions lack any procedural enforcement mechanism against any entity other than the human driver operating the vehicle at the time of the offense or crash. In many jurisdictions, traffic tickets or violation notices may not be issued to registered owners or corporate entities, and with the exception of parked vehicles, crash reports require a human driver for each involved vehicle. This may not apply to automated enforcement. Jurisdictions may need to define what enforcement actions can be taken and who or what is responsible when there is no human onboard.

Guidelines for Testing Vehicles

Jurisdictions will need to clearly establish legal responsibility for every vehicle operating on public roads. If a licensed driver is required to be onboard the vehicle during testing, that driver is responsible for the safe operation of the vehicle at all times and should be accountable for any violations of law and be considered the "driver" of the vehicle regardless of their degree of actual control of the DDT.

When Level 4 and 5 ADS-equipped vehicles, with or without a human onboard, are tested on public roads, the permitting process, described in Section 4.1, should

clearly identify the person or entity legally responsible for the safe operation of the vehicle at all times. Before any testing permits are issued, the legal mechanism and authority to hold the responsible entity accountable for violations of laws and crashes that may occur during testing should be clearly established.

Recommendation for Jurisdictions

6.5.1. Define what enforcement actions can be taken and who or what is responsible when there is no human onboard an ADS-equipped test vehicle.

Guidelines for Deployed Vehicles

Legal responsibility for every vehicle operated on public roads should be clearly established. Currently, the licensed drivers of Level 0 to 2 vehicles are responsible for their safe operation at all times and are held legally responsible for any violation of law that may occur during operation. The same should be the case with Level 3 ADS-equipped vehicles. Although the licensed driver of a Level 3 ADS-equipped vehicle may cede control of the DDT to the vehicle under certain circumstances or driving conditions, such a vehicle by definition still requires the driver to monitor the DDT and to take control as necessary. A licensed driver, therefore, is still responsible for the safe operation and liable for violations of the law during operation.

ADS-equipped vehicles classified as Level 4 or 5, which may be operated without a licensed driver onboard and in which the DDT may be performed independent of human control, warrant consideration of new rules to establish similar responsibility and liability for violations of traffic laws. Registered owners of such vehicles should be responsible for properly maintaining all vehicle equipment and systems, including, but not limited to, the prompt completion of any required updates impacting their operation. It is anticipated therefore that registered owners of such vehicles, as the agents of the operation of such vehicles on public roads, should be responsible for their adherence to applicable laws and subject to legal process as determined by the jurisdiction. Product liability issues arising from such cases may be matters of civil process ex post facto but should not impact the enforcement of laws contemporaneously with operation.

Recommendation for Jurisdictions

6.5.2. Clearly establish legal responsibility for Level 3, 4, and 5 ADS-equipped vehicles operating on public roadways.

Recommendation for Manufacturers and Other Entities

MOE 39. Manufacturers and other entities, in partnership with law enforcement, should ensure the DCM records and stores vehicle data for interactions between the driver and the ADS to identify who or what was controlling the vehicle at a given time or whether the driver was prompted to take over the control of the vehicle.

Benefits of Implementation

These guidelines ensure there is a clearly identified party who is legally responsible for the operation of all vehicles at all times and provides law enforcement with a mechanism to enforce traffic safety laws. This will provide clarity to manufacturers, technology developers, law enforcement officers, courts, and vehicle owners of legal responsibility for vehicles of varying automated capabilities.

Challenges to Implementation

The insurance industry may oppose holding registered owners responsible for the operation of the vehicle as opposed to the manufacturer or technology upfitter. Industry may oppose these guidelines as unnecessary regulation that may hinder development and public acceptance of technology adoption.

6.6 Law Enforcement and First Responder Interaction Plans

Background

Law enforcement and first responders engaging with ADS-equipped vehicles will face unique challenges. It is imperative that law enforcement officers and other first responders understand how to safely interact with these vehicles during a traffic enforcement contact or emergency incident. In an emergency, it is imperative first responders have the ability to render the vehicle safe to protect themselves and the public alike. Law enforcement must also be able to immediately contact those responsible for the vehicle's operation to gather pertinent information about the vehicle. The law enforcement interaction plan (LEIP) is developed by the manufacturer or other entity and should be developed in collaboration with law enforcement.

Guidelines for Testing Vehicles

LEIPs should be developed for each unique ADS-equipped vehicle model or aftermarket ADS and provided to all agencies within the vicinity of the ODD of the test vehicle; training outlined in Section 6.8 of this guide should include all information provided in the LEIP. The LEIP should identify the applicable vehicle and system and include the following minimum set of elements:

- Introduction
- Description of ODD
- Fleet Operations
- Identifying ADS-DVs
- Contact information (available 24/7/365)
- Disabling ADS-DV
- Accessing required information
- De-powering ADS-DV
- Moving ADS-DV from roadway
- Determining presence of passengers
- Extracting passengers
- Firefighting on or around ADS-DV
- Safe towing ADS-DV
- ADS-DV Data Integrity

In addition, jurisdictions should also consider:

- How to verify that the remote driver (if applicable) is a licensed driver (see Section 5.3)
- Any additional information the manufacturer deems necessary regarding hazardous conditions or public safety risks associated with the operation of the AV

The LEIP should be reviewed on a regular basis by the manufacturer and updated as necessary but at least annually.

Recommendation for Jurisdictions

6.6.1. Maintain communication with manufacturers to ensure the latest version of the applicable LEIPs are available to law enforcement and other first responders.

Guidelines for Deployed Vehicles

All first responders will require immediate access to the LEIP upon encountering an ADS-equipped vehicle in the field. This may include first responders in remote areas without internet access. As manufacturers publish each LEIP, there should be an established procedure for disseminating new and updated LEIPs.

Recommendation for Jurisdictions

6.6.2. Designate the lead law enforcement agency in the jurisdiction as a liaison to vehicle manufacturers and other entities for the distribution of the LEIP to all law enforcement agencies and other first responders within that jurisdiction.

Recommendations for Manufacturers and Other Entities

MOE 40. Manufacturers and other entities, in partnership with law enforcement and other first responders, should develop a LEIP in a standardized format for each ADS-equipped model deployed.

MOE 41. The LEIP should be reviewed regularly and updated as necessary but at least annually.

Benefits of Implementation

A LEIP for all ADS-equipped vehicles will protect law enforcement and other first responders, enhance public safety, and prevent unnecessary traffic delays.

Challenges to Implementation

Currently, there is no standardized format for LEIPs or a process for maintaining the most current LEIPs. Without a standardized format, law enforcement and other first responders may have difficulty finding the necessary information quickly.

6.7 Law Enforcement Protocols for Level 4 and 5 Automated Driving System-Equipped Vehicles

Background

Level 4 and 5 ADS-equipped vehicles represent unique challenges to law enforcement and other first responders traditionally focused on human behavior because of their inherent driverless nature and the potential for operation without a human occupant. Protocols should be devised and established to guide law enforcement officers and other first responders in their interactions with Level 4 and 5 ADS-equipped vehicles to better ensure safety and uniform application of the laws.

These protocols should outline appropriate procedures to be followed during emergencies and traffic enforcement situations, including, but not limited, to investigating crashes, traffic or criminal violations, and incidents involving a vehicle with no operator present. It should be noted that although some entities may develop a law enforcement protocol (LEP) that may be agency or law enforcement–specific entities may want to include development of protocols that are inclusive of considerations faced by the entire first responder community. The LEP is different from the LEIP (see Section 6.6) in that the LEP is a document authored by the lead law enforcement agency in a jurisdiction, if one has been designated, for the broader law enforcement community within that jurisdiction.

The LEP is different from the LEIP (see Section 6.6) in that the LEP is a document authored by the lead law enforcement agency in a jurisdiction, if one has been designated, for the broader law enforcement community within that jurisdiction.

Guidelines for Testing and Deployment

LEPs should be developed in cooperation with vehicle manufacturers and test entities as guidance or policy for law enforcement officers in the performance of their duties when interacting with Level 4 and 5 ADS-equipped vehicles. The LEP should identify and include the following details:

- Any applicable policies of the jurisdictions lead agency as a model for other law enforcement agencies in that jurisdiction to consider adopting. Terms used within the document that may be unfamiliar to officers in the field.
- A list of all the LEIPs within that jurisdiction
- Crash documentation requirements for crashes involving ADS vehicles
- Applicable laws and regulations pertaining to ADS vehicles

The LEP should be reviewed continually to ensure consistency with new laws and regulations, recommendations of the manufacturer, and enforcement guidelines and updated as necessary, but not less than annually.

Recommendations for Jurisdictions

6.7.1. LEPs should be developed by the lead law enforcement agency in cooperation with

the vehicle manufacturer and test entity and may be vehicle specific. In addition, the protocols should outline any specific federal, jurisdictional, or local laws, regulations, or policies governing Level 4 and 5 ADS-equipped vehicles operating within the law enforcement agency's jurisdiction.

6.7.2. Designate a liaison within the lead law enforcement agency to be responsible for developing and maintaining the LEP and ensuring its distribution to the law enforcement and first responder community. The liaison should review the LEP continually and ensure consistency with:

- Jurisdictional laws and regulations
- Recommendations from the manufacturer
- Enforcement guidelines

6.7.3. Ensure the LEP and LEIP are available to law enforcement officers and first responders with or without an internet connection.

Benefits of Implementation

LEPs provide consistent direction to law enforcement officers and other first responders allowing them to enhance public and first responder safety, prevent unnecessary traffic delays, and take appropriate enforcement action in accordance with federal, jurisdictional, and local laws and regulations.

Challenges to Implementation

A challenge is providing training for all law enforcement officers and first responders to ensure they are knowledgeable prior to coming into contact with a Level 4 or 5 vehicle. See Section 6.8 for more details.

Jurisdictions without specific political direction or legal requirement may be challenged to establish a LEP.

6.8 Law Enforcement and First Responder Safety and Training

Background

Law enforcement officers may encounter vehicles equipped with driving automation systems during traffic stops or during other law enforcement–related contacts. It is essential that law enforcement and other first responders receive specific training regarding the potential hazards they may face and how vehicles equipped with driving automation systems may impact their duties. These duties may vary by profession and therefore require profession-specific training. Law enforcement officers, for example, may require training specific to how jurisdictional laws apply to vehicles equipped with driving automation systems that other professions do not.

Although vehicles equipped with driving automation systems may provide significant safety benefits by reducing human errors, they will inevitably be involved in traffic crashes, especially during the years of initial introduction and integration with existing human driven vehicles. Because of the potential for unique operational characteristics of ADS, responders to these crashes may be placed at risk if they are not trained for the unique hazards they may encounter. These hazards include but may not be limited to:

- silent operation,
- self-initiated or remote ignition,
- alternate fuel propulsion systems,
- high voltage,
- unexpected movement, to include movement directed by a remote operator, and
- thermal runaway or stranded energy

A resource for law enforcement specific to training is *Law Enforcement, First Responder and Crash Investigation Preparation for Automated Vehicle Technology*.

The GHSA report offers a wide range of training considerations but recommends six core training topics:

1. Understanding the differences between and capabilities of vehicles equipped with driving automation systems
2. Identifying ADS technologies on the road today
3. Understanding governmental responsibilities regarding vehicle oversight
4. Anticipating deployment of vehicles equipped with driving automation systems
5. Interacting with ADS-equipped vehicles
6. Understanding and accessing data

Many of these areas are further developed in the following subsections of this chapter.

ADAS-Specific Caution for Law Enforcement

ADAS technologies (Levels 1 and 2) are evolving with the release of each passing model year. It is critically important to officer safety that agency fleet managers are well informed of technology capabilities of new model year vehicles that are issued for law enforcement use by their officers. Some "safety" features can have unintended consequences that may be harmful to officer safety in emergency situations. For example, some vehicles will no longer allow a vehicle to operate in reverse if the driver's door is open. Another example is some vehicles equipped with back-up sensors may not allow the vehicle to move if it senses an obstruction even if the obstruction is not a fixed object. Both these examples illustrate potential dangers to an officer who is in the midst of an emergency situation.

Recommendation for Jurisdictions

6.8.1. Law enforcement agency fleet managers should be aware of technology advancements and new safety features not present on previous law enforcement fleet vehicle model years and communicate this information to the director of training for that agency. Training directors should integrate any vital information into training bulletins and emergency vehicle operations course training.

Guidelines for Testing Vehicles

The ability of first responders to identify ADS-equipped vehicles is essential to the safe and effective performance of their specific duties. For the safety of all first responders, manufacturers should permanently label ADS-equipped vehicles that will be tested on public roadways, at a minimum, on the rear and sides of the vehicle (see Section 6.1). For the safety of vehicle occupants and first responders, manufacturers should ensure ADS-equipped vehicles have safety systems or procedures that allow first responders to immobilize or otherwise disable the vehicle post-crash to prevent movement or subsequent ignition of the vehicle. Information regarding these systems and procedures should be made available to law enforcement and other first responders in the jurisdiction where the vehicle will be operated (see Section 6.7).

In addition, law enforcement should receive training specific to jurisdictional laws and their application. When training and educational tools become available, they should be disseminated through jurisdiction-level established training bodies. The use of approved training materials allows for uniformity across jurisdictions and their law enforcement agencies. Training should be updated as laws and rules change and when manufacturers make substantive operational design changes. Primary stakeholders to develop and disseminate training may include associations such as AAMVA, NFPA, CVSA, and International Association of Chiefs of Police (IACP).

Guidelines for Deployed Vehicles

For the safety of law enforcement and other first responders, manufacturers should permanently label

ADS, at a minimum, on the rear and sides of the vehicle. Manufacturers should also ensure that ADS-equipped vehicles have safety systems or procedures that allow first responders to immobilize or otherwise disable a vehicle post-crash or during certain law enforcement contacts to prevent movement or subsequent ignition of the vehicle.

National or international standardized law enforcement and other first responder training on safely interacting with vehicles and users should be developed.

Recommendations for Jurisdictions

6.8.2. Work with manufacturer driver training programs to make ADS training available to law enforcement and other first responders at no cost to agencies.

6.8.3. Law enforcement agencies should ensure that enforcement members receive training in the six core topics listed in this section. Of particular importance is the on-scene interaction with ADS-equipped vehicles and the possibility of unexpected movement directed by the ADS or a remote operator. Understanding how to disable an ADS is paramount.

Recommendations for Manufacturers and Other Entities

MOE 42. Manufacturers and other entities should ensure ADS-equipped vehicles have safety systems or procedures that allow law enforcement and other first responders to immobilize or otherwise disable the vehicle post-crash or during emergency incidents to prevent movement or subsequent ignition of the vehicle. Industry standardization of such systems is important to ensuring first responder safety.

MOE 43. Manufacturers and other entities, in partnership with highway safety stakeholders, should develop national or international standardized first responder training on safely interacting with vehicles and users in both the testing and deployment of ADS-equipped vehicles.

Benefits of Implementation

Training will help prevent injuries or deaths of emergency personnel who respond to crashes and persons involved in or near crash scenes or during law enforcement contacts with ADS-equipped vehicles.

Challenges to Implementation

The lack of standardized ADS systems and standardized training is exacerbated by the absence of a training delivery system that services all law enforcement and other first responders.

6.9 Adherence to Traffic Laws

Background

Traffic laws are the purview of jurisdictions, although local jurisdictions may enact additional traffic and parking laws. Most traffic laws are similar from jurisdiction to jurisdiction; however, some are jurisdictional specific. For example, although all jurisdictions have enacted laws regarding speed limits, minimum and maximum speed limits may vary significantly between jurisdictions (e.g., roads in some jurisdictions have no specified minimum speed limits). Similarly, traffic laws governing vehicle movements commonly referred to as "rules of the road," such as changing lanes, turning left and right, yielding right of way, stopping, passing, and movements in adherence to traffic control devices and pedestrian crossings, may also vary between jurisdictions.

Where posted speed limits are concerned, it is commonly known that compliance with speed limits is sometimes low, and drivers often adjust vehicle speeds to the speed of the prevailing traffic flow. Drivers frequently set the vehicle cruise control to speeds that exceed posted speed limits. In light of this common

practice, there is concern that future drivers of ADS-equipped vehicles may desire similar discretionary control of their vehicles' operating speed, leading manufacturers to develop ADS-equipped vehicles capable of violating speed limits and potentially other traffic laws. This would be legally imprudent and could lead to unsafe vehicle operation. However, manufacturers should give consideration to exigent circumstances when it may be necessary for a vehicle to perform maneuvers that may otherwise violate traffic laws, such as following the directions of police officers or flaggers to cross double yellow lines or drive onto a sidewalk to avoid hazards such as at a crash scene, a flooded road, or road debris.

Please note impaired driving and distracted driving are addressed in other areas of this document.

Guidelines for Testing and Deployed Vehicles

Jurisdictions should ensure that all vehicles under their authority are required to adhere to all traffic laws and rules of the road, except in legally acceptable exigent circumstances. Jurisdictions will need to examine their traffic laws to identify laws that may not be relevant to or adequate for ADS-equipped vehicles and amend them as necessary. For example, the New York traffic law requiring, in part, that a user maintain at least one hand in control of the steering mechanism at all times may not be appropriate where ADS are concerned. As ADS technology continues to evolve, modifications will be needed to existing traffic laws and regulations to accommodate SAE Level 5 ADS-equipped vehicles. Jurisdictions should ensure legislative bodies are informed of emerging ADS technologies and recommend legislative actions to govern the safe operation of ADS vehicles.

Jurisdictions are encouraged to review SAE International J3016 Standard, *Taxonomy and Definitions for Terms Related to Driving/Autonomous Systems for On-Road Motor Vehicles*. To provide a seamless transition between jurisdictions, it is important that not only the traffic laws have continuity but also legal definitions. The J3016 Standard provides definitions that can be adopted and incorporated into law.

In October 2018, the TRB published the document NCHRP20-102(07), *Implications of Automation for Motor Vehicle Codes*, to assist jurisdictions with updating their motor vehicle codes as ADS technology continues to evolve.

Recommendations for Jurisdictions

6.9.1. Refer to Transportation Research Board NCHRP20-102(07), *Implications of Automation for Motor Vehicle Codes*, to identify traffic and other laws that may need to be repealed or revised to accommodate ADS technology.

6.9.2. Jurisdictions should not modify current traffic laws specifically to accommodate SAE Level 5 ADS-equipped vehicles until their development advances to the extent that such amendments and statutes are warranted.

6.9.3. Jurisdictions should conduct a comprehensive review of legal definitions related to their traffic laws and adopt definitions from SAE J3016 Standard as applicable. This effort should be ongoing with the continued advancement of vehicle technology.

6.9.4 Support legislation that allows an officer to charge a remote driver with a violation. And, for nondriving violations, such as defective equipment, the registered owner should be charged with the violation.

6.9.5 Jurisdictions should require ADS-testing entities to inform them of the scope of ADS operations and the operation design domain of their ADS vehicles operating within their jurisdiction.

Recommendations for Manufacturers and Other Entities

MOE 44. Manufacturers or other entities should ensure users of ADS-equipped vehicles do not feature settings to allow the ability for overriding the ADS settings, without transitioning out of automated mode into manual mode, unless faced with a legally acceptable exigent circumstance.

MOE 45. When designing vehicles capable of operating in either automated mode or manual mode, manufacturers should ensure ADS-equipped vehicles are not allowed to override ADS settings to violate existing traffic laws, such as speed limits, and ensure the vehicle only has the capability to violate traffic laws when it is being operated in manual mode.

Benefits of Implementation

Ensuring that ADS-equipped vehicles are programmed to comply with all jurisdictional and local traffic laws will contribute to the safe operation of ADS by avoiding the human decision-making process, which currently contributes to most crashes.

Challenges to Implementation

Some drivers may demand more control over the functions of their ADS-equipped vehicles, and manufacturers often defer to consumer demand. Additionally, it will be a challenge to ensure the ADS is updated with new and amended traffic laws each legislative session from jurisdiction to jurisdiction.

6.10 Vehicle Response to Emergency Vehicles, Manual Traffic Controls, and Atypical Road Conditions

Background

Traffic safety is often dependent on the ability of a driver to recognize and respond appropriately to a wide variety of hazards and traffic controls in an ever-changing roadway environment. Hazards include but are not limited to:

- moving or stopped emergency vehicles;
- emergency workers and other pedestrians manually directing traffic;
- changing traffic patterns or conditions in roadway construction and maintenance zones;
- crash or incident scenes;
- animals, road debris, or other obstructions; and
- severe weather or limited visibility conditions.

Object and event detection and response (OEDR) refers to the detection by the driver or ADS of any circumstance that is relevant to the immediate driving task, as well as the implementation of the appropriate driver or system response to such circumstance.

Guidelines for Testing and Deployment

Manufacturers should ensure that vehicles operated on public roads, both during testing and deployment, are able to recognize and properly respond to all hazards, environmental conditions, and temporary traffic controls in the roadway environment. Temporary traffic controls include cones, flare patterns (including LED traffic flares), and barricades, as well as human hand directions and flagging. In addition, vehicles should properly identify, differentiate, and respond appropriately to both moving and stopped emergency vehicles and hazard vehicles, such as road maintenance

vehicles bearing flashing lights, and comply with move-over and slow-down laws, as applicable.

Recommendation for Manufacturers and Other Entities

MOE 46. Manufacturers and other entities should ensure that vehicles operated on public roads, both during testing and deployment, are able to recognize and properly respond to all temporary traffic controls and hazards in the roadway environment. Toward this end, manufacturers should use publicly available traffic data such as crash notifications, traffic congestion, and construction zone information.

Benefits of Implementation

Vehicles that adequately respond to changing road conditions will increase the safety of first responders, roadway workers, and the public.

Challenges to Implementation

It may not be practicable to replicate every possible road restriction or hazard that may be encountered during ADS-equipped vehicle testing in the real world, and under extraordinary circumstances, it may be necessary for vehicles to operate outside established rules of the road to safely navigate some hazards safely (e.g., driving on shoulders, disobeying lane markings or signs). In addition, manual traffic control gestures are not universally consistent and may be performed by professionals or nonprofessionals alike. Move-over and other traffic laws are not currently uniform among jurisdictions, and adherence to these laws may require geographic awareness.

6.11 System Misuse and Abuse

Background

Misuse of an AV system may be defined as operating automated features improperly or inappropriately, such as failure to take affirmative control of a vehicle when directed to do so by the automated system. Issues of misuse may be linked to training and credentialing and may have a major role in determining crash causation, which may distinguish fault and criminal or civil liability. Law enforcement has the responsibility of determining crash causation whenever possible, but partial or complete automation may make these determinations more difficult to discern from traditional human user errors.

Abuse of an AV system may be defined as the intentional or malicious use of ADS capabilities for some unlawful purpose. Issues of abuse (or intentional misuse as defined above) will likely involve criminal behavior and may have vast implications on public safety. Examples of abuse range from criminal transportation, such as drug running, to cybersecurity breaches or terrorism. Strategies to address both misuse and abuse must consider the myriad ways to perpetrate each.

One issue is whether new laws or regulations are necessary to deter these behaviors or to assist law enforcement in performance of their duties in prevention and after an incident. The elements of law violations inherent to misuse or abuse already exist, whether or not vehicle technology was employed in the violation of law. For example, a speeding violation is still a speeding violation if cruise control was active at the time of the offense, and vehicles are widely used to enable, commit, and further criminal activities. In some foreseeable instances, such as vehicular assault or homicide, culpability may be an issue.

Crash and criminal investigation would be greatly aided by electronic records of the HMI. FMVSS codified in 49 CFR/Part 563 currently specifies that certain information be recorded by vehicle EDRs, but the data stored may be inadequate for the forensic need in determining misuse or abuse. In addition to the EDR, the vehicle's central processing unit (CPU) stores data not resident in the EDR and may also need to be accessed, under certain circumstances, by law enforcement. Lack of standard data formatting in a nonproprietary format hinders its usefulness for law enforcement or public safety purposes.

Law enforcement may require additional capabilities for mitigating crime that can be furthered by utilization of an ADS. Technology that allows law enforcement to remotely disable an ADS is one such capability. A remote engine immobilizer (REI) could assist police not only with preventing an imminent criminal act but also with responding to a suspected emergency within a HAV and/or ensuring the safety of responders and bystanders present at the scene of an incident involving a HAV.

Guidelines for Testing Vehicles

It could be assumed that it is less likely misuse or abuse of ADS would occur in a test environment where users are intimately familiar with the vehicle capabilities and use is highly controlled, recorded, and researched. Nonetheless, because extensive testing occurs on public roads, the public interest demands that researchers and developers record the behavior of the vehicle and the driver–vehicle interface at all times during operation.

Recommendation for Manufacturers and Other Entities

MOE 47. Manufacturers and other entities, such as researchers and developers, should always record the behaviors of the vehicle and the HMI during operation because extensive testing occurs on public roads.

Guidelines for Deployed Vehicles

Manufacturers should design ADS-equipped vehicles to record both vehicle behavior and the driver–vehicle interface to identify the actions of the vehicle and the actions (or lack thereof) by the driver at all times. This recording mechanism should include GPS and time information to allow investigators to ascertain what occurred, where, and when. Precedent is currently established for standardization of data recording in 49 CFR 563 (FMVSS) relative to EDR information, but this information is not time or geostamped and is only triggered by the airbag module when the airbag is deployed.

The EDR and CPU information should be stored and retrievable in some recognized, standard, nonproprietary format with a commercially available tool making the data readily accessible by those duly authorized.

Recommendations for Manufactures and Other Entities

MOE 48. Manufacturers and other entities should design ADS-equipped vehicles to record both ADS behaviors and the driver–vehicle interface to identify the actions attributed to the ADS and the actions (or lack thereof) by a human operator at all times.

MOE 49. Manufacturers and other entities should ensure the EDR and CPU information that accomplishes *Recommendation MOE 29* is stored and retrievable in some recognized, standard, nonproprietary format with a commercially available tool making the data readily accessible by those duly authorized.

MOE 50. Manufacturers and other entities should consider making REI technology available to law enforcement in some manner to ensure that imminent criminal activity and life-threatening situations can be expeditiously mitigated.

Benefits of Implementation

These recommendations will assist law enforcement in determining crash causation and criminal investigation, including, but not limited to, whether system misuse or abuse was a factor by providing behavioral information and vehicle performance information in the most serious cases. Users of ADS may be deterred from engaging in misuse or abuse knowing their actions are recorded by the vehicle and that information is accessible by law enforcement or others duly authorized.

Challenges to Implementation

Such requirements may be perceived as an overreach of governmental authority. EDRs have operated and stored data in proprietary formats for proprietary purposes. Manufacturers may oppose requirements that dictate what information is captured and accessible to the authorized investigator.

6.12 Platooning

Background

Vehicle platooning is the linking of two or more vehicles using vehicle-to-vehicle (V2V) communication technology. The first vehicle in the platoon sets the speed and direction for the rest of the vehicles, enabling them to follow at a close distance on highways. Platooning has the potential to improve safety, create efficiencies, reduce fuel consumption, and improve travel time and road capacity. The role of the driver in a following vehicle is dependent on the level of automation in the vehicles.

Currently, some jurisdictions regulate the following distance of vehicles by indicating the minimum number of feet or meters required between vehicles. Other jurisdictions do not have an actual numeric value as a minimum following distance but indicate there must be a safe or reasonable and prudent distance between vehicles.

Require an identifier on the outside of the vehicle to indicate when the platoon technology is actively engaged.

Guidelines for Testing Vehicles

The emphasis on the development of the technology is currently placed on commercial truck platooning; however, other applications of platooning technology being explored include military transportation and busing. Platooning will likely include vehicles with ADAS equipment that require a driver or may include ADS-equipped vehicles, making automated following a possibility.

To limit safety risks associated with testing, the following recommendations are provided.

Recommendations for Jurisdictions

6.12.1. Review and update statutes to allow vehicles that are platooning to follow at a reasonable and prudent distance.

6.12.2. Require platoon testing entities to submit an application packet for testing as described in Section 4.1 and issue a permit to test when satisfied with the application and other submitted information.

6.12.3. Require the motor carrier's safety rating to be in good standing.

6.12.4. Allow testing only on approved routes, including limited-access highways.

6.12.5. Require ADS to respond and adjust as necessary to allow vehicles to enter or exit the highway, in work zones, in tunnels, in weigh stations, traveling past an incident scene, or through toll plazas.

6.12.6. Do not allow testing in lanes where trucks are prohibited.

6.12.7. Jurisdictions should reserve the right to suspend testing for any reason.

6.12.8. Prohibit carrying hazardous materials, oversize or overweight loads, fluids, unsecured loads, and livestock.

6.12.9. Consider limiting the number of vehicles allowed in a platoon.

6.12.10. Each vehicle combination should be limited to a truck or tractor and one trailer combination unit.

6.12.11. Require an identifier on the outside of the vehicle to indicate when the platoon technology is actively engaged.

6.12.12. Commercial transportation of passengers (i.e., school bus or motor coach) should not be permitted.

6.12.13. Require all drivers to hold an appropriately endorsed and valid CDL.

6.12.14. Require all drivers to receive appropriate training provided by the testing entity.

6.12.15. Drivers must comply with all applicable jurisdictional and federal regulations.

6.12.16. Require a driver be in each platoon vehicle, seated in the driver's seat, to continual monitoring the driving environment and prepared to take over control of the vehicle at any time.

6.12.17. Require route planning take into consideration prevention of driver fatigue, task monotony, and highway hypnosis.

6.12.18. Require platoon formation be initiated when speed variability between the lead and following vehicles can be standardized to reduce safety risks.

6.12.19. Review following-too-close laws and consider exemptions for platooning vehicles as long as there is an external identifier to show when the vehicles are actively platooning.

Guidelines for Deployed Vehicles

While advanced platooning is being tested, it is premature to provide guidance for deployed vehicles.

Benefits of Implementation

These recommendations will facilitate communication between jurisdictional officials and entities engaged in platoon operations on their roadways and address many of the associated risks with platooning.

Challenges to Implementation

Jurisdictional laws may need to be updated. Policy makers and jurisdiction regulators may need to be educated on platooning to understand the benefits and risks. A process should be established to permit platoon testing.

References

The following are recommendations or resources from leading entities.

Ontario Ministry of Transportation. https://www.ontario.ca/page/cooperative-truck-platooning-pilot-program-conditions

Pennsylvania Department of Transportation. https://www.penndot.pa.gov/ProjectAndPrograms/ResearchandTesting/Autonomous%20_Vehicles/Pages/Platooning.aspxU.S. Department of Transportation. https://rosap.ntl.bts.gov/view/dot/1038

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Chapter 7 Other Considerations

This chapter outlines other considerations to address for ADS-equipped vehicles operated on public roadways, including cybersecurity, data collection, low-speed automated shuttles, CVs, and platooning.

7.1 Cybersecurity for Vehicles with Automated Driving Systems

Cybersecurity must be a priority in the design, operation, and maintenance of all nodes, including motor vehicles, and any relevant infrastructure to ensure safe operation, traffic and public safety, and national security and should remain a priority for the entire life cycle of ADS-equipped vehicles. This priority must extend to all entrants in the supply chain. Ideally, cybersecurity measures should be designed to protect the safety of the ADS and provide for data privacy (see Section 7.2). This presents significant challenges for MOEs adding ADS to existing vehicle platforms.

The following are recommendations or resources from leading entities:

- NHTSA recommends industry undertake a layered approach to harden ADS-equipped vehicles' electronic architecture against possible attacks, both wireless and wired, to reduce the chances of a successful attack and mitigate any effects of unauthorized access. This layered approach isolates operation critical systems and databases to compartmentalize ramifications of successful security breaches.
- The National Institute of Standards and Technology (NIST) has created a cybersecurity framework that provides a systematic and comprehensive layered cybersecurity approach. Although developed initially for critical infrastructure, it can be used by any sector to improve cybersecurity risk management. The NIST framework specifies five principal pillars: identify, protect, detect, respond, and recover. Similarly, industry should review and consider information technology security standards and best practices such as the Center for Internet Security's Critical Security Controls (CIS CSC) for Effective Cyber Defense.
- The Automotive Information Sharing and Analysis Center (Auto ISAC) serves as a central node for its members for sharing, tracking, and analyzing related intelligence and creates a forum for collaboration for participating entities to share solutions. As such, all cyber threats, vulnerabilities, and incidents should be reported to the Auto ISAC as soon as practical.
- Mobility as a Service (MaaS) operations, platooning operations, vehicle-to-infrastructure. (V2I) interfaces, and other ADS integrators present additional cyber and data security considerations that must be considered and addressed.

Recommendations for Jurisdictions

7.1.1. The jurisdiction's lead law enforcement agency's cyber investigators should collaborate with the jurisdiction's chief information security technology officer to ensure appropriate policy development related to connected and autonomous vehicle cyber security.

7.1.2. Those responsible for managing infrastructure in support of ADS-equipped vehicle operations need to address vulnerabilities to cybersecurity incidents.

7.1.3. Jurisdictions should facilitate education for the public on cybersecurity awareness and the potential impact on vehicle automation.

Recommendations for Manufacturers and Other Entities

MOE 51. MOEs should use best practices, design principles, and guidance based on or published by NIST, NHTSA, Auto ISAC, Transport Canada (TC), and recognized standards-setting bodies such as SAE International standard J3061_202112 Cybersecurity Guidebook for Cyber-Physical Vehicle Systems.

MOE 52. All cyber threats, vulnerabilities, or incidents should be reported to the fusion center, and the lead law enforcement agency, including the cybersecurity office in the affected jurisdiction if one has been so designated.

MOE 53. MOEs should communicate with jurisdictions, vehicle owners, and interested parties that interact with vehicles on product and services lifecycle information. This information includes when technical support and component availability for the ADS ends and how the end of support may impact the ADS-equipped vehicles' operation in conjunction with any component.

MOE 54. MOEs should inform the public on the importance of installing updates on vehicles' ADS.

Benefits of Implementation

Ensure cybersecurity industry best practices are incorporated in ADS design and throughout the entire supply chain and life cycle of the ADS-equipped vehicle. Communication throughout the life cycle will aid in preventing incidents and mitigate potential exploitation and subsequent risks to traffic and public safety as well as national security.

Challenges to Implementation

As cybersecurity threats, attacks, and data security breaches evolve, mitigation efforts meeting the pace of change is likely to become increasingly difficult. There is a need to ensure safe, timely, and necessary security related system updates are performed as well as identifying the party or entity legally responsible for performing such updates.

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Transport Canada. Transport Canada's Vehicle Cyber Security Strategy. https://tc.canada.ca/sites/default/files/2021-08/transport-canada-vehicle-cyber-security-strategy.PDF

7.2 Data Collection

Background

Vehicles equipped with driving automation systems rely on the collection and use of data. ADAS collect data about the driver, their driving habits, and the vehicle. This information is necessary to optimize and personalize the performance of these systems. Additionally, data about the performance of ADS are vital to the evolving technology and improving the systems performing DDTs. EDRs, for instance, were integrated into cars in the 1990s and currently are installed in 90% of vehicles. They can provide valuable information about the vehicle operation and conditions regarding a traffic incident. Onboard diagnostic information was required to be included on all vehicles manufactured after 1996. These systems primarily assisted vehicle technicians with service, maintenance, and diagnostics. This information is now being accessed for additional reasons. An example is the collection of information about geolocation data and driver behavior such as speed or aggressive braking habits. This information may even be used to qualify for insurance discounts. The plethora of data collected, the sensitive nature of it, and the potential for both the advancement of safety and potential harm from misuse must be considered.

Large amounts of data are captured by the vehicle's DCMs. Such information may aid a crash investigation by revealing pre-and post-crash causative factors and actions. As vehicles and driving automation systems are equipped with enhanced sensors to conduct real-time driving decisions, MOEs and jurisdictions should give consideration to data availability, processing, evidence management, retention, and eventual destruction.

MOEs are selective in the data they record or maintain. As such, jurisdictions may benefit from working with MOEs to understand the sensors involved and the data generated from the driving automation system and other systems interacting with the vehicle. Jurisdictions can then determine what type of information to require from the MOE, how the data should be captured, how the data may be used, and how the data are stored.

NHTSA is working closely with the Federal Trade Commission (FTC), which is the primary federal agency that protects drivers' privacy and personal information. ADS technologies generate and share a significant amount of vehicle data that are likely to be considered by private citizens as sensitive and personal. NHTSA reiterated that "privacy considerations are critical to driver acceptance of ADS and should be taken into account throughout the design, testing and deployment process."[21] The agency also indicated that it would continue to work closely with the FTC when motor vehicle safety matters have potential driver privacy implications.

The FTC has the authority to bring actions against companies or individuals that engage in unfair or deceptive acts or practices that include vehicle data

21 *Automated Driving Systems*. NHTSA. NHTSA Data Privacy.

privacy and security. The FTC has authority to use law enforcement, policy initiatives, and driver and business education to accomplish its mission. In the motor vehicle context, for example, the FTC could use its enforcement authority in appropriate circumstances to bring an action against a manufacturer that uses a driver's data in a way that violates the manufacturer's stated privacy policies.

Guidelines for Testing Vehicles

Automated features in vehicles today may include technologies such as navigation, blind spot detection, automatic emergency braking, parking assist, and lane departure warnings. Other features include "infotainment," in-car apps, telephone and text connectivity, and in-vehicle internet connectivity.

Many of these features depend on collecting certain data about the driver, the vehicle, and driving habits to perform effectively. Some of these data may be collected automatically, and some drivers may choose to provide these data to enable certain functions. For example, for a driver to benefit from navigation and traffic services, the location of the vehicle is generally needed. Similarly, to enable easy hands-free dialing, the driver may choose to sync their phone address book to the vehicle.

Drivers may not realize the connection between the use of the technology and the collection, storage, retrieval, and dissemination of data and the potential impact it has on their privacy.

It is important for drivers to be aware they should review and understand the privacy policies of the manufacturer, as well as any third party with access to the vehicle data. These policies will serve as the main legal mechanism regulating the use of data. Drivers may have the right to "opt out" or request additional information not be gathered or not be shared. However, opting out may also limit the functionality of some of the features available.

It is also important for drivers to keep in mind that these commitments regarding data collection and use by automobile manufacturers may not extend to other third parties that may also access data in vehicles such as cell phones, apps, or other vehicle devices. Drivers should consult the owner's manual and work with the vehicle dealer to reset and remove information from the vehicle system.

Recommendations for Jurisdictions

7.2.1. Conduct a thorough review of jurisdictional laws pertaining to the collection and dissemination of data. Particular attention should be given to personally identifiable information and under what circumstances it may appropriately be recorded, maintained, and released. In addition, the issue of transparency should be evaluated: what data are permitted to be collected, how the individual is informed about the collection and use of the data, and whether an affirmative consent be considered.

7.2.2. Provide information about vehicle data collection resources on the jurisdiction's website.

7.2.3. Conduct a thorough review of the MOEs data collection and retention policies.

Guidelines for Deployed Vehicles

As manufacturers and technology providers move toward deployment of these vehicles either in a ride-share model or for public sale, they should provide drivers with a baseline understanding of the data being used and their potential privacy implications. The manufacturers or technology providers should work jointly to provide users with information on how these data are being protected. This could be done with data-sharing agreements, outlined when an individual chooses to participate or enroll in a ride-share program or as part of an owner's manual provided at a retail sale.

Recommendation for Manufacturers and Other Entities

MOE 55. Manufacturers and other entities should comply with industry privacy principles relating to data collection and sharing. Guidelines may include those developed by trade associations that represent vehicle manufacturers and the Automotive Privacy Principles published by the National Automobile Dealers Association (NADA), which affirms commitments in three key areas: transparency, affirmative consent for sensitive data, and limited sharing with government and law enforcement.

Benefits of Implementation

It is important to increase awareness of data that is being collected in vehicles, by whom, and how it is being used and shared. Drivers are better protected when vehicle manufacturers follow consistent methods of securing and sharing data.

Challenges to Implementation

Data collection in a vehicle is necessary to ensure the technology in a vehicle can function as it was designed. Therefore, more and more data are being collected and used at the time of collection, but these data are also stored and can be very valuable to many entities. Drivers may not realize the privacy impact of the collection, storage, retrieval, and dissemination of information.

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7.3 Low-Speed Automated Shuttles

Background

Many entities, including local governments, universities, and private communities, have expressed interest in using low-speed automated shuttles to meet specific transportation needs. Low-speed automated shuttles, as envisioned in deployment, may provide low-cost, flexible, and relatively safe transportation in areas such as closed campuses, gated communities, and first-last-mile transportation. This flexibility resulted in low-speed shuttles being operated on multi-use paths and unpaved surfaces.[22] As the capabilities of low-speed shuttles are explored and better understood, it is expected that they will be tested and implemented in a wide variety of situations. However, the sheer number of vehicles in development and pilots underway have made condensing the discussion of low-speed automated shuttles challenging. Examples of low-speed shuttles in service include the work done at Lake Nona, Florida.[23]

The ability of low-speed shuttles to fulfil a variety of functions should be considered by jurisdictions. A single low-speed shuttle could be configured to transport people, cargo, or a combination of the two and to transition between passenger and freight or delivery service. The flexibility of this evolving technology will require careful alignment of regulations to ensure that change of use does not lead to conflicting requirements.

According to the *Low-Speed Automated Shuttles: State of the Practice Final Report*, low-speed automated shuttles can vary widely in design but generally carry between 4 and 15 passengers, have a top speed of around 25 mph, and are automated at SAE Level 4. However, manufacturers are still trying to identify the best design for a deployable low-speed automated shuttle. As a

22 Milo Pilot Program. City of Arlington, TX, https://viewer.joomag.com/milo-pilot-program-closeout-report-milo-pilot-program-closeout-report/0151013001665505973?short&

23 Beep Autonomous Vehicle: Move Nona. Lake Nona, Florida Project, https://www.lakenona.com/thing/autonomous-vehicles-move-nona/#:~:text=The%20Move%20Nona%20is%20the,The%20shuttles%20operate%20daily

result, many pilots and tests currently involve low-speed automated shuttles that carry more, fewer, or no passengers or operate at speeds above 25 mph. Some government entities are leading tests and pilots. About the only aspect of low-speed automated shuttles consistent at this time is a desire for the low-speed automated shuttle to operate at a Level 4 or above. Some examples of studies and research involving low speed shuttles include Utah Autonomous Shuttle Pilot[24]; University of Iowa Driver Safety Research Institute[25]; and Bear Tracks Shuttle Project in White Bear Lake, Minnesota[26].

Currently, low-speed automated shuttles are considered noncompliant motor vehicles because they do not fall under existing FMVSS or CMVSS definitions. Specifically, these shuttles do not generally qualify as low-speed vehicles (LSVs) under the FMVSS or CMVSS because they do not meet existing design standards that apply to LSVs (e.g., top speed, vehicle weight, exterior mirrors). An exemption through NHTSA or Transport Canada is necessary to bring vehicles into the U.S. and Canadian markets. Jurisdictions may also not have an existing registration process in place to accommodate this vehicle type.

As technology evolves, it should be expected that a single vehicle may be capable of operating in multiple ODDs based on the needs of the environment. This may lead to vehicles transitioning between ODDs during operation, creating a potential for ambiguity with the operator, regulators, and the public.

Jurisdictions should be mindful of this versatility as these vehicles are utilized. See Section 4.13 for more information regarding ODD limitations.

It is important to recognize, as well, that certain low-speed automated shuttles may not be FMVSS compliant. The safety and crashworthiness of these vehicles when used in mixed traffic on public roads is unproven, and any jurisdiction considering accommodating on-road applications of these vehicles should do so only after careful consideration.

Guidelines for Testing Vehicles

Low-speed automated shuttles are a subset of AVs designed to meet specific transportation needs. As such, jurisdictions should require low-speed automated shuttles to meet the same registration, titling, and permitting requirements for testing as other AVs.

Recommendations for Jurisdictions

7.3.1. Treat low-speed automated shuttles similar to other AVs for the purposes of permitting and on-road testing (see Section 4.1).

7.3.2. Give special consideration to the application of additional measures to ensure safety is preserved in test applications (e.g., slow-moving vehicle

24 *Automated Shuttle Pilot Project*. Utah Department of Transportation, https://transportationtechnology.utah.gov/automatedshuttlepilotproject/

25 *Driving Safety Research Institute*. University of Iowa, https://dsri.uiowa.edu/ and *ADS for Rural America*. University of Iowa, https://adsforruralamerica.uiowa.edu

26 *Bear Tracks Pilot Project*. Minnesota Department of Transportation. June 15, 2023, https://www.whitebearlake.org/ourcommunity/page/bear-tracks-self-driving-shuttle-connected-and-automated-vehicles-test-pilot#:~:text=Bear%20Tracks%20is%20a%2012,City%20of%20White%20Bear%20Lake.

signage, requirement for shuttles to travel in designated lanes or along the far right-hand side of the roadway, restriction of the shuttle to low-speed municipal roads).

7.3.3. Understand the capabilities, limitations, and performance standards of shuttles before shuttles are tested on public roadways or shared-use paths, including, but not limited to, safety mechanisms and features, prior testing, vehicle crashworthiness and crash testing, ODD and OEDR, emergency fallback, and the ability of vehicles to operate in mixed traffic.

7.3.4. Require testing entities to confirm that shuttles are constructed to meet all applicable vehicle equipment laws and standards set by federal, state, and provincial governments; shuttles must continue to meet these laws and standards while operated on roadway.

7.3.5. Work closely with the testing entity or manufacturer throughout testing to address technical issues, receive relevant hardware and software upgrades, and receive technical support.

Require testing entities to:

7.3.6. Confirm the vehicle can operate safely on public roadways or shared-use paths.

7.3.7. Only operate the shuttle in accordance with the manufacturer's instructions.

7.3.8. Only operate the shuttle on routes that conform to the manufacturer's instructions and account adequately for weather, traffic, and road conditions; physical infrastructure; and other factors that might compromise safety.

7.3.9. Ensure information on law enforcement interaction is adequately distributed and understood by all relevant parties. (This may include the creation and distribution of a law enforcement interaction plan.)

7.3.10. Confirm that safety drivers are adequately trained in all aspects of shuttle operation and are fully capable of safely operating the shuttles as intended by the manufacturer.

7.3.11. Confirm that safety drivers have been trained to abide by all applicable jurisdictional laws while operating or overseeing the operation of shuttles, including those related to driver licensing and rules of the road.

7.3.12. Outfit the shuttle with appropriate equipment to protect occupants' safety, which may include, but not be limited to, occupant restraints, hand holds, and appropriate lighting.

7.3.13. Require test registration permits to be carried in the test vehicle.

Guidelines for Deployed Vehicles

Low-speed automated shuttles are currently considered noncompliant vehicles because they do not conform to an existing vehicle class or definition under the FMVSS or CMVSS. For these vehicles to be deployed on a broad scale in North America, federal governments would need to develop safety standards specific to low-speed automated shuttles or to provide exemptions from current safety standards.

Recommendations for Jurisdictions

Be cautious to accommodate the use of low-speed automated shuttles absent federal safety standards and a corresponding definition for this vehicle type.

7.3.14. Be cautious to accommodate the use of low-speed automated shuttles absent federal safety standards and a corresponding definition for this vehicle type.

7.3.15. Statutes and regulations should be reviewed and updated as technology evolves.

Benefits of Implementation

Low-speed automated shuttles offer jurisdictions the opportunity to realize the benefits of AVs in a manner that is safe and friendly to the public. Low-speed automated shuttles operate at very low speeds and within specific ODDs, which limits operation to safer environments. Additionally, the 2019 AAA study[27] found that although the public was still very uncomfortable with the idea of AVs, the public was more accepting of low-speed automated shuttles. By using low-speed automated shuttles, jurisdictions can help their citizens overcome some of the uncertainty and fear surrounding automated technologies.

Challenges to Implementation

Low-speed automated shuttles are difficult to define because of their rapidly changing designs.

The public may be resistant to change, particularly with regard to safety, privacy, data security, and equity concerns.

The operation of low-speed shuttles can add to the complexity of issues as they may share spaces with other roadway users (particularly vulnerable road users).

Until federal regulations define and develop a classification for these unique vehicles, jurisdictions may encounter obstacles to registering and titling these vehicles.

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27 AAA. Edmonds, Ellen (2019, March). *Three in Four Americans Remain Afraid of Fully Self-Driving Vehicles.* https://newsroom.aaa.com/2019/03/americans-fear-self-driving-cars-survey

7.4 Connected Vehicles

Background

CVs communicate with other vehicles, infrastructure, and potentially, vulnerable road users such as bicycles and pedestrians. Potential applications of connected technology are widespread and promise broad benefits related to safety, traffic flow optimization, congestion reduction, and emissions reductions. For example, a connected vehicle could communicate with a traffic signal to determine when the signal would turn green or an app on a pedestrian's phone to determine when the person is in the crosswalk. Connected technologies may warn drivers that they are approaching a work zone, warn bus drivers of passing vehicles at a bus stop, and inform road users of inclement weather or roadway conditions ahead.

Connected and automated technologies can exist independent of each other. A vehicle can be connected, automated, or connected and automated. Although it is not necessary for a vehicle to be both automated and connected, many experts believe vehicles with both connected and automated technologies will result in the greatest safety benefits. Therefore, connected vehicle technologies should be considered when developing a jurisdiction's approach to AVs.

It will be largely up to manufacturers and the federal government to support V2V, vehicle-to-infrastructure (V2I), and vehicle-to-everything (V2E or V2X) communications because this will be dependent on the vehicles' designs. However, jurisdictions can play an important role in encouraging the joint use of connected and AVs through the development of infrastructure. Jurisdictions can support the combined use of connected and automated technologies by facilitating communication between jurisdictional and local officials concerning the intersection of automated and connected vehicle technologies and including both

automated and connected vehicle technologies in a jurisdiction's transportation planning efforts.

Guidelines for Testing Vehicles

Jurisdictions should require AVs, with or without connected vehicle technologies, to follow the same permitting and registration process (see Section 4.1). CVs with no or little automated technologies (Levels 0–2) should follow the regular registration process, or if the jurisdiction has one, a registration process specifically for CVs. The deciding factor for AVs should be the level of automated technologies present in the vehicle and not the vehicle's connected technologies.

Recommendations for Jurisdictions

7.4.1. Jurisdictions should require vehicles with connected and automated technologies to follow the permitting and registration process for AVs of the same SAE Level.

7.4.2. Jurisdictions with an ADS-equipped vehicle committee should require the committee members to stay abreast of connected vehicle technologies deployed in the jurisdiction and to inform jurisdiction and local officials involved in connected vehicle technology infrastructure planning and implementation.

Guidelines for Deployed Vehicles

Even after deployment, jurisdictions should keep in mind the capabilities of deployed AVs when continuing plans for improving connected vehicle technology infrastructure.

Recommendation for Jurisdictions

7.4.3. Jurisdictions with an ADS-equipped vehicle committee should require the committee to continue providing updates on ADS-equipped vehicles to jurisdiction and local officials involved in planning and implementing connected vehicle technologies.

Benefits of Implementation

A connected and automated vehicle has the benefit of additional information through connected technologies and advanced, non-impaired decision making by automated technologies. This combination can address two of the most basic factors impacting vehicle safety: knowledge of the road environment and driver awareness. By supporting the simultaneous introduction and deployment of connected and automated vehicle technologies, jurisdictions should see significantly more safety improvements from the use of both types of technology as opposed to the use of just one.

Challenges to Implementation

Significant barriers exist to implementing the transportation environment necessary to support CVs. First, infrastructure updates to allow for the communication between vehicle and infrastructure fixtures is time consuming and costly. It is difficult for jurisdictions to know what infrastructure changes to support in light of rapidly changing technology.

Second, coordination between manufacturers such that numerous vehicle types could communicate with each other fluidly will likely be very challenging to achieve. Although there has been an increase in company partnerships in recent years, this has yet to result in vehicle systems that communicate easily across multiple manufacturers.

Finally, jurisdictions, localities, and private entities may not have the same goals when implementing connected vehicle technology. This will make it difficult for jurisdictions to know what projects to support.

Because implementing connected vehicle technologies alone is challenging, managing the combined

integration of connected and AVs will prove difficult for jurisdictions.

7.5 Automated Delivery Vehicles and Devices

Automated delivery vehicles, sometimes known as personal delivery devices (PDDs), are equipped with automated driving technology that typically operate in pedestrian and bicycle spaces. They serve a variety of functions, including, but not limited to, the transportation and delivery of small cargo, inspection of sidewalks, and maintenance of road surfaces.

These devices do not typically meet jurisdictional definitions and requirements of a motor vehicle. This could lead to the same PDD being classified differently across jurisdictions. PDDs present a unique challenge to federal and state, provincial, territorial, and local government regulators to integrate into their transportation networks. PDDs aim to fill existing gaps in last-mile product delivery and courier services, promise to make product delivery more efficient and convenient for consumers, and save time and money for businesses.

PDDs come in various sizes and dimensions, with diverse potential applications. PDDs are designed for shorter distance off-road trips along trails and sidewalks and can transport items such as groceries and packages. These vehicles typically feature a relatively low speed limit. Some PDDs may utilize remote assist and remote driving capabilities, which may help the devices in navigating challenging scenarios.

Jurisdictions should review where PDDs may operate. Although they may be designed to best operate on multi-use paths and sidewalks, gaps in existing infrastructure may require these delivery vehicles to operate on roadway shoulders or in lanes of traffic. The commingling of automated delivery vehicles and vehicular traffic may result in confusion by drivers who encounter these devices. Jurisdictions should be aware of potential conflicts and safety concerns as PDDs are deployed.

PDDs may also impact infrastructure accessibility. Commonly proposed use of these devices take place on or near sidewalks. These devices may pose additional challenges for vulnerable road users and people living with disabilities. The time and the space required to load and unload the cargo may reduce the accessibility of wheelchair users and other users of the sidewalk. The speed and its less-audible propulsion method may render the sidewalk more hazardous for its existing users. These issues require jurisdictions' further considerations to ensure compatibility of the technology with existing road users, without compromising accessibility.

Guidelines for Testing and Deployed Vehicles

Jurisdictions should understand the capabilities and limitations of the PDDs and their operation. Measures should be considered to ensure minimal disruption with other road users and sufficient compatibility with road infrastructure. Not only should the MOEs demonstrate their commitment to continuously refine their operations and response plans, but MOEs should also be receptive to address any detriments to any issues such as safety and accessibility matters.

Recommendations for Jurisdictions

7.5.1. Understand which statutes and regulations apply to the use of PDDs and how PDDs interact with pedestrians.

7.5.2. Review the characteristics and limitations of automation technology, including its remote assist and remote driving capabilities as outlined in Section4.13, and establish parameters related to the use of the PDDs (e.g., rules of the road, route, vehicle and load dimensional limits, overall mass, and operation speed limit).

7.5.3. Review the compatibility of the devices to the existing transportation network in areas such as traffic control device recognition, signal

receptions, sightline at intersections, roadway and sidewalk surface maintenance plans, sidewalk and crosswalk accessibility, and curbside management issues (e.g., loading and unloading zone, wait time).

7.5.4. Consider prescribing basic equipment requirements (e.g., lighting and conspicuity equipment, cargo securement requirement), physical dimensions and characteristics, and device performance requirements (e.g., braking performance, weather resistance, latency requirement, speed range) for these devices.

7.5.5. Require MOEs responsible for PDDs to develop and provide to the jurisdiction the law enforcement interaction plan, first responders' guidelines, and abnormal event response plan.

Recommendations for Manufacturers and Other Entities

MOE 56. Provide jurisdictions with information relevant to where and how the device may be operated.

MOE 57. Collaborate with jurisdictions, local authorities, first responders, law enforcement, users, and other impacted roadway users to refine its operation described in Section 7.6.5.

Benefits of Implementation

Implementation of these recommendations may promote public acceptance as businesses and local governments expand services to a wide range of areas. PDDs provide a resource for those unable to access traditional methods of product and service delivery.

Challenges to Implementation

Because of the physical attributes of the PDDs, existing infrastructure may hinder the use of some PDDs. Construction and safety standards are the responsibility of the jurisdiction and not regulated under existing federal law. Without common requirements and testing mechanisms, jurisdictions may struggle to prescribe consistent and sufficient performance requirements.

Infrastructure may be insufficient to accommodate PDDs. For example, sidewalk accessibility may be limited for all types of users. Significant efforts may be required to ensure the aforementioned plans are implemented.

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Chapter 8 Next Steps

The foundation of this report and the recommendations herein are based on a combination of research, experience, and knowledge accumulated over the past several years by the members of the AVSC. Because the technology is rapidly evolving, it is critical that the AVSC continues to learn and share its expertise for the benefit of AAMVA members and the community. Their continued efforts are supported by the AAMVA Board of Directors and federal, jurisdictional, and other stakeholder partners.

The AVSC is committed to keeping pace with the evolution of vehicle technology, providing timely information, and sharing its expertise. To advance its knowledge of the progression of technology for vehicles equipped with driving automation systems, the Subcommittee will:

- continue to work closely with government entities, industry, and research stakeholders'
- maintain collaboration with jurisdiction government officials and national and international associations supporting transportation agencies'
- work closely with federal, jurisdiction, and local transportation agencies to understand the impacts on government programs and responsibilities and to share their expertise'
- follow up with manufacturers and NHTSA to discuss recommendations made within this report'
- attend conferences, seminars, and other forums focused on technology and public policy'
- continue to assist the AAMVA TMS to update model driver's manuals, knowledge tests, and skills tests to address the use of vehicle technology during driver testing' and
- continue to assist the AAMVA IDEC Board to update driver's license examiner training materials to address vehicle technology as it emerges.

Members of the AVSC are available to assist jurisdictions to better understand the guidance of regulating vehicles equipped with driving automation systems, its impact on government programs, and the recommendations in this report.

To keep this report relevant and to provide the best possible guidance to the AAMVA community, it is expected the AVSC will continue to update this report periodically. Updates will continue to address MVA and law enforcement concerns related to the testing and deployment of vehicles equipped with driving automation systems.

Appendix A Summary of Recommended Jurisdictional Guidelines for Regulating Vehicles with Driving Automation Systems

The following is a summary of guidelines to support a framework of consistent regulation and oversight of vehicles equipped with driving automation systems throughout the jurisdictions for their safe testing and deployment and to encourage uniformity among jurisdictions. Jurisdictions are not required to follow these guidelines; they are provided as Recommendations for Jurisdictions that choose to regulate vehicles equipped with driving automation systems.

Chapter 3. Administrative Considerations

3.1 Administration

Recommendations for Jurisdictions

3.1.1. Identify a lead agency to manage the ADS-equipped vehicle committee and its efforts.

3.1.2. Establish an ADS-equipped vehicle committee.

3.1.3. Develop strategies to address testing and deployment of ADS-equipped vehicles in the jurisdiction.

3.1.4. Examine jurisdictional laws and regulations to consider barriers to safe testing, deployment, and operation of ADS-equipped vehicles.

3.1.5. Jurisdictions that regulate the testing of ADS-equipped vehicles are encouraged to take necessary steps to establish statutory authority and to use the following reference material: *Automated Driving Systems: A Vision for Safety 2.0* and *Preparing for the Future of Transportation: Automated Vehicles 3.0*, *Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0*, *Automated Vehicles Comprehensive Plan* , and later updates to frame the guidance.

3.1.6. ADS-equipped vehicle committee members, regulators, and policy makers are encouraged to perform knowledge-gathering and information-sharing functions.

3.1.7. The motor vehicle agency (MVA) should designate an AV lead staff person if the agency is not the jurisdictional lead AV agency. As the jurisdiction becomes more engaged in the regulation of ADS-equipped vehicles, the lead person may eventually become dedicated to the project. Therefore, funding may be needed in the future for a dedicated position.

3.2 Advanced Driver Assistance Systems

Recommendation for Jurisdictions

3.2.1. Use SAE International terminology to describe ADAS technology in vehicles as national standards are developed.

Chapter 4. Vehicle Considerations

4.1 Application and Permit for Manufacturers and Other Entities to Test Vehicles on Public Roadways

Recommendations for Jurisdictions

4.1.1. Require all manufacturers and other entities testing ADS-equipped vehicles to apply for and be issued vehicle specific permits before testing on public roadways.

4.1.2. Establish a test registration permit application process for ADS-equipped vehicles that does not create unnecessary barriers for manufacturers and other entities and requires the completion or attachment of the information listed in Section 4.1.

4.1.3. Implement a process for denying an application, as well as an appeal process for anyone whose applications have been denied.

4.1.4. Require test registration permit information be available for verification at the time of vehicle registration issuance (new and renewal) either by presentation from the holder or through electronic means in jurisdictions where manufacturer or other entity-owned vehicles are required to be individually registered.

4.1.5. Require test registration permits to be carried in the test vehicle while present on public roadways until or unless an electronic process has been created by jurisdictions that will allow permit information to be made readily available to law enforcement.

4.1.6 Require prior authorization to changes or updates impacting the validity and accuracy to information provided for the testing permit.

4.2 Actions on the Permit Process

Recommendations for Jurisdictions

4.2.1. Develop provisions for suspension, revocation, denial of permit renewal, or fining of any permit holder to test on public roads if permit holders violate permit conditions and for reporting such actions to the jurisdiction's lead law enforcement agency.

4.2.2. Consider the imposition of penalties if the testing entity continues to operate or test in violation of a suspension or revocation order.

4.2.3. Establish a process for reporting traffic law and other applicable violations to the permit issuing agency.

4.2.4 Have an appeal process for administrative actions taken against the testing entity.

4.3 Automated Driving System-Equipped Vehicle Information on the Manufacturer's Certificate of Origin or Manufacturer's Statement of Origin

Recommendation for Jurisdictions

4.3.2. Jurisdictions choosing to title test vehicles should indicate, on the title, a brand of Test Vehicle.

4.4 Designating and Titling New and Aftermarket Automated Driving System-Equipped Vehicles

Recommendation for Jurisdictions

4.4.1. Record and maintain the test vehicle information in the vehicle record through the normal titling process, through a titling exception process unique to ADS-equipped vehicles or record the information in the database without titling. If a jurisdiction titles an ADS-equipped vehicle used for testing, the title should carry an appropriate "ADS" designation, the test vehicle brand, and the SAE level of automation.

4.4.2. Title all ADS-equipped deployed vehicles, pursuant to the jurisdiction's laws or policies; each title should be "ADS" designated, and the SAE level of automation should be included within the titling and or registration system.

4.4.3. Titles for vehicles with added aftermarket components enabling ADS-equipped vehicle functionality should also be "ADS" designated, and the SAE level of automation should be included within the titling and/or registration system, if available. Because there is currently no readily available central source of ADS-equipped vehicle information, jurisdictions should consider requiring self-reporting of this information during the titling and registration process. Jurisdictions should consider capturing information such as the entity that modified the vehicle, the nature and date of the modification, and the hardware and software modified.

4.5 Vehicle Registration

Recommendations for Jurisdictions

4.5.1. Record and maintain test vehicle and brand information in the vehicle record through the normal registration process, through a registration exception process unique to ADS-equipped vehicles, or by recording vital information in the database without titling.

4.5.2. Establish uniform language that will benefit law enforcement, the MVA, and other stakeholders for testing ADS-equipped vehicles.

4.5.3. Ensure vehicle registration information is available for other jurisdictions to access.

4.5.4. Establish a policy on how to identify vehicles with Level 4 and 5 vehicle automation on the registration and/or title record for deployed vehicles. See Section 4.4 for more information.

4.5.5. Establish uniform language to aid law enforcement, the MVA, and other stakeholders. Use "Automated Driving System" on the vehicle record.

4.5.6. Implement policies to promote transparency on the history and the alteration of the vehicle's driving automation system during vehicle ownership transfer.

4.6 License Plates

Recommendation for Jurisdictions

4.6.1. If a jurisdiction chooses to require a special license plate for ADS-equipped vehicles, the plates should adopt the administrative, design, and manufacturing specifications contained in the *AAMVA License Plate Standard, Edition 3*.

4.7 Financial Responsibility (Also Known as Mandatory Liability Insurance)

Recommendations for Jurisdictions

4.7.1. Require all ADS-equipped vehicles permitted for on-road testing to have a minimum liability insurance (many jurisdictions have implemented a $5 million minimum requirement) in the form and manner required by the jurisdiction and/or FMCSA regulations. Jurisdictions are encouraged to evaluate specific needs in their jurisdiction based on the risk profile and adjust liability insurance coverage accordingly.

4.7.2. Consider minimum liability insurance requirements for commercial vehicles not covered by the federal regulations that are distinctive from the requirements for personal and private vehicles.

4.7.3. Jurisdictions with higher liability insurance requirements for vehicles used for public transportation, including ridesharing and peer-to-peer motor vehicle rentals, should give special consideration to liability insurance requirements for test vehicles that are designed and manufactured to provide similar transportation services. Additional consideration should be given to adjusting insurance liability limits based on vehicle design and application.

4.7.4. Jurisdictions should consider the challenges described above when establishing minimum insurance liability on deployed ADS-equipped vehicles.

4.7.5. Consider liability insurance requirements for commercial vehicles not covered by the federal regulations that are distinctive from rates for personal or private vehicles.

4.9 Federal Motor Vehicle Safety Standards and Canadian Motor Vehicle Safety Standards

Recommendation for Jurisdictions

4.9.2. Consider requiring manufacturers and other entities testing ADS-equipped vehicles within the jurisdiction to certify the vehicles comply with all applicable FMVSS or CMVSS and no required safety devices have been made

inoperable. In lieu of the certification, require manufacturers to provide evidence the vehicle(s) have received an exemption from the FMVSS or CMVSS.

4.10 Periodic Motor Vehicle Inspections

Recommendations for Jurisdictions

4.10.1. Jurisdictions should not be expected to create new safety inspection programs for ADS-equipped vehicles during the testing stages. Jurisdictions may choose to inspect whether an ADS-equipped vehicle operates safely in accordance with the vehicle manufacturer's specifications while the vehicle is manually operated.

4.10.2. Consider if the vehicle should be disposed of after testing or piloting is completed or what requirements should be implemented if the vehicle is considered for future roadway use.

4.10.3 Until a national standard (FMVSS, CMVSS, or established MOE consensus standard) is developed, jurisdictions should not incorporate driving automation system–specific components (e.g., software, sensors) as part of its motor vehicle inspection program. However, any vehicle abnormality noticed should be documented and provided to the vehicle owner.

4.10.4. Continue to work closely with manufacturers and other entities to understand mechanisms for verifying the safety and functionality of current driving automation system technology components and how safety might be discerned in the future.

4.10.5. Recognize that inspections of driving automation systems may require additional resources such as MOE-prescribed diagnostic tools, MOE-developed inspection and repair procedures, and specially trained inspectors. If the jurisdiction chooses to inspect driving automation systems of a vehicle to ensure safe operation on the roadway as per the system's design, jurisdictions may choose to accept verified diagnostic and inspection results as issued by the MOE or qualified inspection facility.

4.11 Automated Driving System-Equipped Vehicles for Transportation of People Living with Disabilities

Recommendations for Jurisdictions

4.11.1. Evaluate the testing and deployment of ADS-equipped vehicles, specifically on topics such as object and event detection and response, the vehicle's ability to achieve minimal risk condition (fallback), the law enforcement interaction plan, and the first responders' guidelines with a focus to enhance user experience and minimize operational incompatibilities.

4.11.2. Evaluate the capabilities and limitations of the technology with the MOEs and clearly communicate findings to potential users and other interested parties.

4.11.3. Develop awareness of how the technology is used to transport people living with disabilities with a focus on any limitations of the roadway infrastructure and roadway usage pattern.

4.12 Shared and Temporary Use of Vehicles with Driving Automation Systems

Recommendations for Jurisdictions

4.12.1. Review entities' testing procedures as vehicles transition between different users. Jurisdictions may review how remote assistance and remote driving minimizes transition time and effort for remote personnel to transition between different vehicles while maintaining a sufficient level of service and operational awareness.

4.12.2. Jurisdictions that regulate industries where vehicles are transferred among users should engage these industries to discuss how users are notified of driving automation system changes.

4.13 Assessment of Driving Automation Systems

Recommendations for Jurisdictions

4.13.1. Review vehicles' capabilities and limitations based on all available referenced standards documents; do not rely solely on the declared automation level.

4.13.2. Conduct a review of the vehicle's capabilities by using MOE disclosures and MOE marketing information.

4.13.3. Periodically review all available resources and modify vehicle automation classification systems.

4.13.4. Discuss with the MOE how and what information will be shared, including how the information can be utilized by the jurisdiction, while respecting proprietary rights.

4.13.5. Discuss with the MOE how the vehicle driver will be informed when the vehicle is about to leave or is no longer in the ODD.

Chapter 5. Driver Licensing Considerations

5.1 Driver and Passenger Roles Defined

Recommendations for Jurisdictions

5.1.3. Use the SAE International definitions.

5.1.4. As discussed in Section 3.1, jurisdictions should review the resource *Implications of Automation for Motor Vehicle Codes*, which may be a useful guide for updating laws and regulations.

5.2 Driver's License Requirements for Testing by Manufacturers and Other Entities

Recommendations for Jurisdictions

5.2.7. Review and develop or adapt existing rules, if applicable, regarding vehicle operation to ensure ADS-equipped vehicle testing is permitted.

5.2.8. Require test ADS-equipped vehicles be operated solely by employees, contractors, or other persons designated by the manufacturer of the ADS-equipped vehicle or any such entity involved in the testing of the ADS-equipped vehicle.

5.2.9. Require test drivers to receive training and instruction related to, but not limited to, the capabilities and limitations of the vehicle and be subject to a background check as described in Section 6.3.

5.2.10. Require training provided to the employees, contractors, or other persons designated by the manufacturer or entity to be documented and a summary of the training be submitted to the jurisdiction's AV lead agency along with other required information.

5.2.11. Support safe testing without a human driver inside of the vehicle by requiring a user designated by the manufacturer of the ADS technology or any such entity involved in the driverless testing of the ADS-equipped vehicle to be capable of assuming control of the vehicle's operations or require that the ADS can achieve a minimal risk condition.

5.2.12. Ensure motor vehicle laws allow for the manufacturer to safely test Level 4 and 5 vehicles without a licensed driver in the vehicle. This provides for situations when a licensed driver designated by the MOE involved in the testing of the ADS-equipped vehicle can assume control of the vehicle's operations or require that the ADS can achieve a minimal risk condition.

5.3 Remote Driver and Remote Driving

Recommendations for Jurisdictions

5.3.1. Define "remote driver" in statutes by adopting the SAE International definition and review the SAE International document J3016 dated

April 2021, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, for additional information and further explanation of the definition.

5.3.2. Define "remote assistance" in statutes by adopting the SAE International definition and review the SAE International document J3016 dated April 2021, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, for additional information and further explanation of the definition.

5.3.3. Define "remote driving" in statutes by adopting the SAE International definition and review the SAE International document J3016 dated April 2021, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, for additional information and further explanation of the definition.

5.3.4. Require the testing entity to agree in writing that a remote driver would be subject to an operator fitness evaluation by law enforcement in the event of an incident or crash.

5.3.5. Clarify in law that all laws applicable to drivers also apply to remote drivers.

5.3.6. Review current license restrictions and endorsements to determine which apply to a remote driver and when a remote driver must comply with the restriction or endorsement. For example, restrictions that could apply include requiring corrective lenses, hearing devices, and accommodations for missing limbs.

5.3.7. Ensure jurisdictions and law enforcement agencies understand remote driving and are well versed in responding to inquiries.

5.3.8. Require manufacturers and other entities testing vehicles using remote drivers to notify the jurisdiction's lead AV agency, comply with all other testing requirements and to provide the names and driver's license information for all remote drivers.

5.3.9. Require documentation from the manufacturers and other entities that remote drivers have been trained to safely operate the vehicle remotely, including, but not, limited to, appropriate law enforcement and first responder interaction plans.

5.3.10. Provide officers the authority to cite the remote driver with moving violations and cite the registered owner with non-moving violations, as defined by the jurisdiction.

Recommended Requirements for Remote Test Drivers

5.3.11. Comply with all federal and jurisdictional laws unless otherwise exempt.

5.3.12. Hold the class of license for the vehicle they are remotely driving with appropriate endorsements and restrictions.

5.3.13. Be physically located in the same jurisdiction as the vehicle they are remotely driving because of limitations to legal authority to conduct multi-jurisdiction investigations.[28]

5.3.14. Inform their employer and/or test entity immediately of any moving violations or testing permit condition violations that occur whether they are remotely driving a vehicle or driving any other vehicle.

5.3.15. Be fit to remotely drive and not be impaired or distracted.

5.3.16. Remotely drive only one vehicle at a time.

5.3.17. Ensure the location, communication method, and control interface can allow uninterrupted control of remotely controlled vehicles.

28 For example, a subpoena issued by jurisdiction A for a suspected impaired remote driver located in jurisdiction B may not be easily served on the remote driver in jurisdiction B. This often involves going to court to obtain permission to serve a subpoena issued by another jurisdiction. Delays caused by this process could negatively impact the investigation of the suspected impaired remote driver.

5.3.18. Make available to law enforcement, upon request, their name, physical location, license number, and jurisdiction of issue, as well as the name and contact information of their employer.

5.3.19. Report a crash immediately to the appropriate law enforcement in the jurisdiction in which the vehicle is located.

Recommended Requirements for Test Vehicle Owners

5.3.20. Post the responsible party's name and contact information within a remotely driven vehicle.

5.3.21. Testing entities should verify remote test driver's driving records at least annually or participate in an employer notification system offered by the jurisdiction.

5.4 Endorsements and Restrictions for Deployed Vehicles

Recommendations for Jurisdictions

5.4.1. Do not establish endorsements or restrictions on driver's licenses, specifically for ADS-equipped vehicles at this time.

5.4.2. Take steps to ensure jurisdictional motor vehicle laws allow for the operation of Level 4 and 5 ADS-equipped vehicles without a driver only if the vehicles cannot be operated in manual mode.

5.4.3. Do not limit the operation of Level 4 and 5 ADS-equipped vehicles to individuals who are licensed as drivers.

5.4.4. Do not impose any other requirements, such as licensure, sobriety, or clean driving history, for passengers to use Level 4 and 5 ADS-equipped vehicles.

5.4.5. Review jurisdictional laws and regulations related to unsupervised children in motor vehicles to ensure safety.

5.5 Driver Training for Drivers on Vehicle Technologies

Recommendations for Jurisdictions

5.5.1. Promote driver training on the use of vehicles with driving automation systems.

5.5.2. Encourage communication between dealers and drivers including, but not limited to, acknowledgement of the sections in the vehicle "owner's manual" related to driving automation systems.

5.5.3. Encourage manufacturers, dealers, and insurance companies to provide incentives for drivers to receive proper training on the use of vehicles with driving automation systems.

5.5.4. Encourage aftermarket system manufacturers and dealers to provide educational materials and resources to drivers.

5.6 Training for Driver Educators, Driver Education, and Driver Training Programs

Recommendations for Jurisdictions

5.6.1. Require driver education curricula to contain information on vehicles equipped with driving automation systems.

5.6.2. Require driver educators to provide behind-the-wheel instruction on the use of ADAS if equipped.

5.6.3. Require all definitions and language on vehicles equipped with driving automation systems provided in driver education to use the SAE International or AAMVA's guidelines for consistency.

5.6.4. Implement standards for the training of driver educators on the knowledge of and use of vehicles equipped with driving automation systems.

5.6.5. Require driver educators to continually review materials and revise curricula to incorporate current ADAS features.

5.7 Driver's License Skills Testing with Vehicle Technologies

Recommendations for Jurisdictions

5.7.1. Include driving system automation information on vehicle technologies in the jurisdiction's driver manual.

5.7.2. Include questions addressing driving system automation in the jurisdictional knowledge test.

5.7.3. Jurisdictions shall not allow the applicant to use convenience technologies, such as the parking assist feature, for skills tests.

5.7.4. Allow the applicant to use safety-critical technologies during skills tests.

5.7.5. Jurisdictions should not require applicants to deactivate safety-critical technologies during the skills testing process.

5.8 Training Motor Vehicle Agency Examiners on Vehicle Technologies

Recommendations for Jurisdictions

5.8.1. Provide training to driver license examiners on vehicle technologies. AAMVA's *Guidelines for Testing Drivers in Vehicles with Advanced Driver-Assistance Systems* resource guide, published in 2023, should be used in examiner training.

5.8.2. Require driver license examiners to use the definition and language on vehicles equipped with driving automation systems from AAMVA's guidelines.

5.8.3. Provide information to appropriate MVA staff on vehicle technologies, including policies on driver testing in ADAS-equipped vehicles.

5.9 Commercial Driver Licensing

Recommendations for Jurisdictions

5.9.1. Drivers operating or testing an ADS-equipped commercial motor vehicle must have the appropriate license and endorsements to operate that class of vehicle.

5.9.2. Drivers operating or testing an ADS-equipped commercial motor vehicle must be located inside the vehicle unless specifically approved to operate or test the vehicle with the driver outside the vehicle or remotely located.

Guidelines for Deployed Vehicles

5.9.3. Engage in the review and development of federal regulations by FMCSA.

5.9.4. Review and adopt amendments to jurisdictional laws as federal regulations are updated.

Chapter 6. Law Enforcement Considerations

6.1 Vehicle Identification

Recommendations for Jurisdictions

6.1.1. Enact requirements for the identification of ADS-equipped vehicles by law enforcement and other first responders. This could be accomplished through vehicle labeling providing an easy means for identifying ADS-equipped vehicles.

6.1.2. Encourage the passage of legislation (or provide a waiver if legislation is not needed) to allow MOEs to implement the use of ADS marking lamps for Level 3 and 4 ADS vehicles. The color should comply with SAE J3134.

6.2 Crash and Incident Reporting

Recommendations for Jurisdictions

6.2.1. Require ADS test entity to submit to the jurisdiction, at a minimum, the NHTSA crash reporting requirements for vehicles with driving automation systems (NHTSA Standing General Order 2021-01 (Amended April 2023).[29]

29 https://www.nhtsa.gov/sites/nhtsa.gov/files/2023-04/Second-Amended-SGO-2021-01_2023-04-05_2.pdf

6.2.2. U.S. jurisdictions should adopt the MMUCC as soon as practicable.

6.2.3. Jurisdictions and regulators should determine best practices and pursue legislation related to the duty to report ADS involved crashes to adequately document the relevant facts. Consideration should also be given to emerging technologies and areas of significance such as how to identify the driver or operator of an ADS and other legal considerations such as enforcement of traffic laws.

6.3 Criminal Activity

Recommendations for Jurisdictions

6.3.1. Jurisdictions that have ADS-equipped vehicle permitting requirements as described in Section 4.1 should require the designated test users (employees, contractors, and other persons) to pass background checks, including, but not limited to, a driver history review and a criminal history check, prior to authorization to operate an ADS-equipped test vehicle.

6.3.2. Jurisdictions that have ADS-equipped vehicle permitting requirements as described in Section 4.1 should establish provisions that disqualify a test user who has a criminal record or a driving history that includes driving under the influence, reckless driving, or other significant conviction history from operating an ADS-equipped test vehicle in a test environment.

6.4 Distracted Driving

Recommendations for Jurisdictions

6.4.1. Consider strengthening a jurisdiction's distracted driving laws by utilizing the model legislation provided in the AAMVA *Strengthening Distracted Driving Education, Legislation, and Enforcement, Edition 2* as a template.

6.4.2. Utilize the best available distracted driving educational materials in proactive public education efforts.

6.5 Establishing Operational Responsibility and Law Enforcement Implications

Recommendations for Jurisdictions

6.5.1. Define what enforcement actions can be taken and who or what is responsible when there is no human onboard an ADS-equipped test vehicle.

6.5.2. Clearly establish legal responsibility for Level 3, 4, and 5 ADS-equipped vehicles operating on public roadways.

6.6 Law Enforcement and First Responder Interaction Plans

Recommendations for Jurisdictions

6.6.1. Maintain communication with manufacturers to ensure the latest version of the applicable LEIPs are available to law enforcement and other first responders.

6.6.2. Designate the lead law enforcement agency in the jurisdiction as a liaison to vehicle manufacturers and other entities for the distribution of the LEIP to all law enforcement agencies and other first responders within that jurisdiction.

6.7 Law Enforcement Protocols for Level 4 and 5 Automated Driving System-Equipped Vehicles

Recommendations for Jurisdictions

6.7.1. LEPs should be developed by the lead law enforcement agency in cooperation with the vehicle manufacturer and test entity and may be vehicle specific. In addition, the protocols should outline any specific federal, jurisdictional, or local laws, regulations, or policies governing Level 4 and 5 ADS-

equipped vehicles operating within the law enforcement agency's jurisdiction.

6.7.2. Designate a liaison within the lead law enforcement agency to be responsible for developing and maintaining the LEP and ensuring its distribution to the law enforcement and first responder community. The liaison should review the LEP continually and ensure consistency with:

- Jurisdictional laws and regulations
- Recommendations from the manufacturer
- Enforcement guidelines

6.8 Law Enforcement and First Responder Safety and Training

Recommendations for Jurisdictions

6.8.1. Law enforcement agency fleet managers should be aware of technology advancements and new safety features not present on previous law enforcement fleet vehicle model years and communicate this information to the director of training for that agency. Training directors should integrate any vital information into training bulletins and emergency vehicle operations course training.

6.8.2. Work with manufacturer driver training programs to make ADS training available to law enforcement and other first responders at no cost to agencies.

6.8.3. Law enforcement agencies should ensure that enforcement members receive training in the six core topics listed in this section. Of particular importance is the on-scene interaction with ADS-equipped vehicles and the possibility of unexpected movement directed by the ADS or a remote operator. Understanding how to disable an ADS is paramount.

6.9 Adherence to Traffic Laws

Recommendations for Jurisdictions

6.9.1. Refer to Transportation Research Board NCHRP20-102(07), *Implications of Automation for Motor Vehicle Codes*, to identify traffic and other laws that may need to be repealed or revised to accommodate ADS technology.

6.9.2. Jurisdictions should not modify current traffic laws specifically to accommodate SAE Level 5 ADS-equipped vehicles until their development advances to the extent that such amendments and statutes are warranted.

6.9.3. Jurisdictions should conduct a comprehensive review of legal definitions related to their traffic laws and adopt definitions from SAE J3016 Standard as applicable. This effort should be ongoing with the continued advancement of vehicle technology.

6.9.4. Support legislation that allows an officer to charge a remote driver with a violation. And, for nondriving violations, such as defective equipment, the registered owner should be charged with the violation.

6.9.5. Jurisdictions should require ADS-testing entities to inform them of the scope of ADS operations and the operation design domain of their ADS vehicles operating within their jurisdiction.

6.12 Platooning

Recommendations for Jurisdictions

6.12.1. Review and update statutes to allow vehicles that are platooning to follow at a reasonable and prudent distance.

6.12.2. Require platoon testing entities to submit an application packet for testing as described in Section 4.1 and issue a permit to test when satisfied with the application and other submitted information.

6.12.3. Require the motor carrier's safety rating to be in good standing.

6.12.4. Allow testing only on approved routes, including limited-access highways.

6.12.5. Require ADS to respond and adjust as necessary to allow vehicles to enter or exit the highway, in work zones, in tunnels, in weigh stations, traveling past an incident scene, or through toll plazas.

6.12.6. Do not allow testing in lanes where trucks are prohibited.

6.12.7. Jurisdictions should reserve the right to suspend testing for any reason.

6.12.8. Prohibit carrying hazardous materials, oversize or overweight loads, fluids, unsecured loads, and livestock.

6.12.9. Consider limiting the number of vehicles allowed in a platoon.

6.12.10. Each vehicle combination should be limited to a truck or tractor and one trailer combination unit.

6.12.11. Require an identifier on the outside of the vehicle to indicate when the platoon technology is actively engaged.

6.12.12. Commercial transportation of passengers (i.e., school bus or motor coach) should not be permitted.

6.12.13. Require all drivers to hold an appropriately endorsed and valid CDL.

6.12.14. Require all drivers to receive appropriate training provided by the testing entity.

6.12.15. Drivers must comply with all applicable jurisdictional and federal regulations.

6.12.16. Require a driver be in each platoon vehicle, seated in the driver's seat, to continual monitoring the driving environment and prepared to take over control of the vehicle at any time.

6.12.17. Require route planning take into consideration prevention of driver fatigue, task monotony, and highway hypnosis.

6.12.18. Require platoon formation be initiated when speed variability between the lead and following vehicles can be standardized to reduce safety risks.

6.12.19. Review following-too-close laws and consider exemptions for platooning vehicles as long as there is an external identifier to show when the vehicles are actively platooning.

Chapter 7. Other Considerations

7.1 Cybersecurity for Vehicles with Automated Driving Systems

Recommendations for Jurisdictions

7.1.1. The jurisdiction's lead law enforcement agency's cyber investigators should collaborate with the jurisdiction's chief information security technology officer to ensure appropriate policy development related to connected and autonomous vehicle cyber security.

7.1.2. Those responsible for managing infrastructure in support of ADS-equipped vehicle operations need to address vulnerabilities to cybersecurity incidents.

7.1.3. Jurisdictions should facilitate education for the public on cybersecurity awareness and the potential impact on vehicle automation.

7.2 Data Collection

Recommendations for Jurisdictions

7.2.1. Conduct a thorough review of jurisdictional laws pertaining to the collection and dissemination of data. Particular attention should be given to personally identifiable information and under what circumstances it may appropriately be recorded, maintained, and released. In addition, the issue of transparency should be evaluated: what data are permitted to be collected, how the individual is informed about the collection and use of the data, and whether an affirmative consent be considered.

7.2.2. Provide information about vehicle data collection resources on the jurisdiction's website.

7.2.3. Conduct a thorough review of the MOEs data collection and retention policies.

7.3 Low-Speed Automated Shuttles

Recommendations for Jurisdictions

7.3.1. Treat low-speed automated shuttles similar to other AVs for the purposes of permitting and on-road testing (see Section 4.1).

7.3.2. Give special consideration to the application of additional measures to ensure safety is preserved in test applications (e.g., slow-moving vehicle signage, requirement for shuttles to travel in designated lanes or along the far right-hand side of the roadway, restriction of the shuttle to low-speed municipal roads).

7.3.3. Understand the capabilities, limitations, and performance standards of shuttles before shuttles are tested on public roadways or shared-use paths, including, but not limited to, safety mechanisms and features, prior testing, vehicle crashworthiness and crash testing, ODD and OEDR, emergency fallback, and the ability of vehicles to operate in mixed traffic.

7.3.4. Require testing entities to confirm that shuttles are constructed to meet all applicable vehicle equipment laws and standards set by federal, state, and provincial governments; shuttles must continue to meet these laws and standards while operated on roadway.

7.3.5. Work closely with the testing entity or manufacturer throughout testing to address technical issues, receive relevant hardware and software upgrades, and receive technical support.

Require Testing Entities

7.3.6. Confirm the vehicle can operate safely on public roadways or shared-use paths.

7.3.7. Only operate the shuttle in accordance with the manufacturer's instructions.

7.3.8. Only operate the shuttle on routes that conform to the manufacturer's instructions and account adequately for weather, traffic, and road conditions; physical infrastructure; and other factors that might compromise safety.

7.3.9. Ensure information on law enforcement interaction is adequately distributed and understood by all relevant parties. (This may include the creation and distribution of a law enforcement interaction plan.)

7.3.10. Confirm that safety drivers are adequately trained in all aspects of shuttle operation and are fully capable of safely operating the shuttles as intended by the manufacturer.

7.3.11. Confirm that safety drivers have been trained to abide by all applicable jurisdictional laws while operating or overseeing the operation of shuttles, including those related to driver licensing and rules of the road.

7.3.12. Outfit the shuttle with appropriate equipment to protect occupants' safety, which may include, but not be limited to, occupant restraints, hand holds, and appropriate lighting.

7.3.13. Require test registration permits to be carried in the test vehicle.

7.3.14. Be cautious to accommodate the use of low-speed automated shuttles absent federal safety standards and a corresponding definition for this vehicle type.

7.3.15. Statutes and regulations should be reviewed and updated as technology evolves.

7.4 Connected Vehicles

Recommendations for Jurisdictions

7.4.4. Jurisdictions should require vehicles with connected and automated technologies to follow the permitting and registration process for Avs of the same SAE Level.

7.4.5. Jurisdictions with an ADS-equipped vehicle committee should require the committee members to stay abreast of connected vehicle technologies deployed in the jurisdiction and to inform jurisdiction and local officials involved in connected vehicle technology infrastructure planning and implementation.

7.5 Automated Delivery Vehicles and Devices

Recommendations for Jurisdictions

7.5.1. Understand which statutes and regulations apply to the use of PDDs and how PDDs interact with pedestrians.

7.5.2. Review the characteristics and limitations of automation technology, including its remote assist and remote driving capabilities as outlined in Section4.13, and establish parameters related to the use of the PDDs (e.g., rules of the road, route, vehicle and load dimensional limits, overall mass, and operation speed limit).

7.5.3. Review the compatibility of the devices to the existing transportation network in areas such as traffic control device recognition, signal receptions, sightline at intersections, roadway and sidewalk surface maintenance plans, sidewalk and crosswalk accessibility, and curbside management issues (e.g., loading and unloading zone, wait time).

7.5.4. Consider prescribing basic equipment requirements (e.g., lighting and conspicuity equipment, cargo securement requirement), physical dimensions and characteristics, and device performance requirements (e.g., braking performance, weather resistance, latency requirement, speed range) for these devices.

7.5.5. Require MOEs responsible for PDDs to develop and provide to the jurisdiction the law enforcement interaction plan, first responders' guidelines, and abnormal event response plan.

Appendix B Summary of Recommendations for Manufacturers and Other Entities for Regulating Vehicles with Driving Automation Systems

The following recommendations are for manufacturers and other entities for the safe testing and deployment of vehicles equipped with driving automation systems. These guidelines come from the recommendations provided in the report and are provided to ensure the safe testing and deployment of vehicles equipped with driving automation systems.

Chapter 3. Administrative Considerations

3.1 Administration

Recommendation for Manufacturers and Other Entities

MOE 1. Manufacturers and other entities should interact with and respond to jurisdictional ADS-equipped vehicle committee questions and requests.

3.2 Advanced Driver Assistance Systems

Recommendation for Manufacturers and Other Entities

MOE 2. Manufacturers and other entities should adopt SAE International terminology to describe ADAS technology in vehicles.

Chapter 4. Vehicle Considerations

4.3 Automated Driving System-Equipped Vehicle Information on the Manufacturer's Certificate of Origin or Manufacturer's Statement of Origin

Recommendation for Manufacturers and Other Entities

MOE 3. Vehicle manufacturers should indicate it is an ADS-equipped vehicle on the MCO, MSO, or NVIS. This functionality should be listed in a new field on the MCO, MSO, or NVIS to avoid confusion with existing information.

4.4 Designating and Titling New and Aftermarket Automated Driving System-Equipped Vehicles

Recommendation for Manufacturers and Other Entities

MOE 4. The OEM or the installer of the aftermarket automated technology, either parts or software systems, should notify the MVA when a motor vehicle has been altered by adding or removing an AV technology so the MVA can record the information in their title and registration system, if applicable.

4.10 Periodic Motor Vehicle Inspections

Recommendations for Manufacturers and Other Entities

MOE 5. Ensure all technology being tested on public roads is safe.

MOE 6. Provide in writing up-to-date specifications and test vehicle capabilities and limitations to jurisdictions.

MOE 7. Provide data and information sufficient to enable the understanding of test vehicles' capabilities and limitations by jurisdictions.

MOE 8. Provide updates that are compatible with these applicable regulations as they are revised.

MOE 9. Ensure that an indicator clearly communicates any driving automation system malfunction to the driver or operator.

4.11 Automated Driving System-Equipped Vehicles for Transportation of People Living with Disabilities

Recommendations for Manufacturers and Other Entities

MOE 10. Disclose the suitability of ADS-equipped vehicles and the provided services for people with disabilities to jurisdictions, users, and other interested parties.

MOE 11. Consult users and other interested parties to ensure the routes, configurations, and user interfaces that minimize potential barriers.

MOE 12. Consider accessibility standards when designing and manufacturing vehicles.

MOE 13. Consider designs and procedures to account for possible emergency situations.

MOE 14. Testing entities should establish default settings on test vehicles to include driving automation system behavior and other basic vehicles settings for vehicle equipment.

MOE 15. Prioritize the presentation of critical information to drivers or users of the driving automation system that are suitable for the vehicle's surroundings. Critical information includes what is needed for the driver to conduct the DDT or respond to a request for takeover.

MOE 16. Provide training materials on the use of driving automation systems and commit to continuous updates and availability of the training materials to the drivers and the users as the interface and functionality evolve.

MOE 17. Adopt designs and industry best practices to facilitate safe transitions of drivers and users between motor vehicles with differing capabilities.

MOE 18. If the driving automation system is designed to feature multiple drivers or user profiles, manufacturers and other entities should inform the drivers or users of any setting changes as they select their profiles.

4.13 Assessment of Driving Automation Systems

Recommendations for Manufacturers and Other Entities

MOE 19. Establish a contact method for jurisdictions and enforcement agencies to gain and maintain an understanding of a vehicle's automation features.

MOE 20. Establish an internal process to track how the automation features of its products change throughout the life of the vehicle.

MOE 21. Inform jurisdictions, law enforcement, users, and other interested parties of the capabilities, limitations, and changes to the system or ODD.

Chapter 5. Driver Licensing Considerations

5.1 Driver and Passenger Roles Defined

Recommendation for Manufacturers and Other Entities

MOE 22. Use SAE International definitions provided in Chapter 2, except as noted above.

5.2 Driver's License Requirements for Testing by Manufacturers and Other Entities

Recommendation for Manufacturers and Other Entities

MOE 23. Manufacturers and other entities should complete a background check and provide or ensure appropriate training for ADS-equipped vehicle test drivers. See Section 6.3 on background checks.

5.5 Driver Training for Drivers on Vehicle Technologies

Recommendation for Manufacturers and Other Entities

MOE 24. Manufacturers and dealers should take steps to make training available to drivers

to ensure they understand the functionality of the vehicles and are prepared to properly operate them.

5.7 Driver's License Skills Testing with Vehicle Technologies

Recommendation for Manufacturer and Other Entities

MOE 25. Manufacturers and other entities that develop an ADS-equipped dual-mode vehicle should consider taking steps to prevent the manual mode from being engaged in error.

Chapter 6. Law Enforcement Considerations

6.1 Vehicle Identification

Recommendation for Manufacturers and Other Entities

MOE 26. When authorized to do so, install ADS marking lamps to allow law enforcement to identify if an ADS-equipped vehicle is being operated by the ADS or by the driver to mitigate enforcement stops for driver-centric violations, such as distracted driving. Visual or other cues should be included in the law enforcement interaction plan.

6.2 Crash and Incident Reporting

Recommendations for Manufacturers and Other Entities

MOE 27. Design ADS data loggers to record data using standards such as SAE International J3197 to record ADS data, vehicle, behavior sensor data, and the HMI. ADS data loggers should synchronize with EDM modules. Manufacturers should record 360-degree video data of the vehicle's operating environment. Law enforcement should be provided with access to this information as well as a minimum of 30 seconds pre-crash through the end of the crash event (cessation of involved vehicle movement) for completing a proper investigation.

MOE 28. In addition to complying with the requirements of 49 CFR Part 563, manufacturers should make DCM information retrievable in a standard, nonproprietary format for ready access by those duly authorized.

MOE 29. Manufacturers and other entities should include time stamping and GPS location in DCM data.

6.3 Criminal Activity

Recommendations for Manufacturers and Other Entities

MOE 30. The manufacturer or other entity, operating in jurisdictions not requiring ADS-equipped vehicle permits, should require the designated test user to pass a background check, including, but not limited to, a driver history review and a criminal history check, prior to authorization to operate an ADS-equipped test vehicle.

MOE 31. The manufacturer or other entity, operating in jurisdictions not requiring ADS-equipped vehicle permits, should disqualify a test user who has a criminal record or poor driving history from operating an ADS-equipped test vehicle in a test environment.

MOE 32. Manufacturers and other entities should ensure ADS-equipped vehicles leave an electronic fingerprint that can allow tracing of input data to whomever initiated the activity.

6.4 Distracted Driving

Recommendations for Manufacturers and Other Entities

MOE 33. Manufacturers and other entities should minimize distractions in ADS-equipped vehicles.

MOE 34. Manufacturers and other entities should prohibit users from all added distracting activities when testing ADS-equipped vehicles.

MOE 35. Manufacturers and other entities should incorporate technology to alert the "driver" when the ADS cannot maintain or complete the driving task and the "driver" needs to assume control of vehicle operation.

MOE 36. Manufacturers and other entities should design ADS-equipped vehicles with a means of identifying when the ADS is assuming control of the vehicles movements to facilitate effective enforcement of distracted driving laws (e.g., so an officer knows if using a hand-held device is legal at the time of observation).

MOE 37. Manufacturers and other entities should minimize distractions in ADAS-equipped vehicles with part-time self-driving features.

MOE 38. Manufacturers should incorporate technology that monitors the driver's awareness (monitoring eyes or hand placement) with the vehicle prompting disengagement of activated self-driving mode if the driver is not paying sufficient attention to the DDT.

6.5 Establishing Operational Responsibility and Law Enforcement Implications

Recommendation for Manufacturers and Other Entities

MOE 39. Manufacturers and other entities, in partnership with law enforcement, should ensure the DCM records and stores vehicle data for interactions between the driver and the ADS to identify who or what was controlling the vehicle at a given time or whether the driver was prompted to take over the control of the vehicle.

6.6 Law Enforcement and First Responder Interaction Plans

Recommendations for Manufacturers and Other Entities

MOE 40. Manufacturers and other entities, in partnership with law enforcement and other first responders, should develop a LEIP in a standardized format for each ADS-equipped model deployed.

MOE 41. The LEIP should be reviewed regularly and updated as necessary but at least annually.

6.8 Law Enforcement and First Responder Safety and Training

Recommendations for Manufacturers and Other Entities

MOE 42. Manufacturers and other entities should ensure ADS-equipped vehicles have safety systems or procedures that allow law enforcement and other first responders to immobilize or otherwise disable the vehicle post-crash or during emergency incidents to prevent movement or subsequent ignition of the vehicle. Industry standardization of such systems is important to ensuring first responder safety.

MOE 43. Manufacturers and other entities, in partnership with highway safety stakeholders, should develop national or international standardized first responder training on safely interacting with vehicles and users in both the testing and deployment of ADS-equipped vehicles.

6.9 Adherence to Traffic Laws

Recommendations for Manufacturers and Other Entities

MOE 44. Manufacturers or other entities should ensure users of ADS-equipped vehicles do not feature settings to allow the ability for overriding the ADS settings, without transitioning out of automated mode into manual mode, unless faced with a legally acceptable exigent circumstance.

MOE 45. When designing vehicles capable of operating in either automated mode or manual mode, manufacturers should ensure ADS-equipped vehicles are not allowed to override ADS settings to violate existing traffic laws, such as speed limits, and ensure the vehicle only has the capability to violate traffic laws when it is being operated in manual mode.

6.10 Vehicle Response to Emergency Vehicles, Manual Traffic Controls, and Atypical Road Conditions

Recommendation for Manufacturers and Other Entities

MOE 46. Manufacturers and other entities should ensure that vehicles operated on public roads, both during testing and deployment, are able to recognize and properly respond to all temporary traffic controls and hazards in the roadway environment. Toward this end, manufacturers should use publicly available traffic data such as crash notifications, traffic congestion, and construction zone information.

6.11 System Misuse and Abuse

Recommendations for Manufacturers and Other Entities

MOE 47. Manufacturers and other entities, such as researchers and developers, should always record the behaviors of the vehicle and the HMI during operation because extensive testing occurs on public roads.

MOE 48. Manufacturers and other entities should design ADS-equipped vehicles to record both ADS behaviors and the driver–vehicle interface to identify the actions attributed to the ADS and the actions (or lack thereof) by a human operator at all times.

MOE 49. Manufacturers and other entities should ensure the EDR and CPU information that accomplishes Recommendation MOE 29 is stored and retrievable in some recognized, standard, nonproprietary format with a commercially available tool making the data readily accessible by those duly authorized.

MOE 50. Manufacturers and other entities should consider making REI technology available to law enforcement in some manner to ensure that imminent criminal activity and life-threatening situations can be expeditiously mitigated.

Chapter 7. Other Considerations

7.1 Cybersecurity for Vehicles with Automated Driving Systems

Recommendations for Manufacturers and Other Entities

MOE 51. MOEs should use best practices, design principles, and guidance based on or published by NIST, NHTSA, Auto ISAC, Transport Canada (TC), and recognized standards-setting bodies such as SAE International standard J3061_202112 Cybersecurity Guidebook for Cyber-Physical Vehicle Systems.

MOE 52. All cyber threats, vulnerabilities, or incidents should be reported to the fusion center, and the lead law enforcement agency, including the cybersecurity office in the affected jurisdiction if one has been so designated.

MOE 53. MOEs should communicate with jurisdictions, vehicle owners, and interested parties that interact with vehicles on product and services lifecycle information. This information includes when technical support and component availability for the ADS ends and how the end of support may impact the ADS-equipped vehicles' operation in conjunction with any component.

MOE 54. MOEs should inform the public on the importance of installing updates on vehicles' ADS.7.2 Data Collection: Recommendations for Manufacturers and Other Entities

MOE 55. Manufacturers and other entities should comply with industry privacy principles relating to data collection and sharing. Guidelines may include those developed by trade associations that represent vehicle manufacturers and the Automotive Privacy Principles published by the National Automobile Dealers Association (NADA), which affirms commitments in three key areas: transparency, affirmative consent for sensitive data, and limited sharing with government and law enforcement.

7.5 Automated Delivery Vehicles and Devices

Recommendations for Manufacturers and Other Entities

MOE 56. Provide jurisdictions with information relevant to where and how the device may be operated.

MOE 57. Collaborate with jurisdictions, local authorities, first responders, law enforcement, users, and other impacted roadway users to refine its operation described in Section 7.6.5.

Appendix C Automated Vehicles Subcommittee Roster (FY2024)

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