CANADIAN JURISDICTIONAL GUIDELINES FOR THE SAFE TESTING AND DEPLOYMENT OF VEHICLES EQUIPPED WITH AUTOMATED DRIVING SYSTEMS

VERSION 2.0

CCMTA|CCATM
Canadian Council of Motor Transport Administrators
Conseil canadien des administrateurs en transport motorisé

Canadian Jurisdictional Guidelines
for the Safe Testing and Deployment of Vehicles
Equipped with Automated Driving Systems

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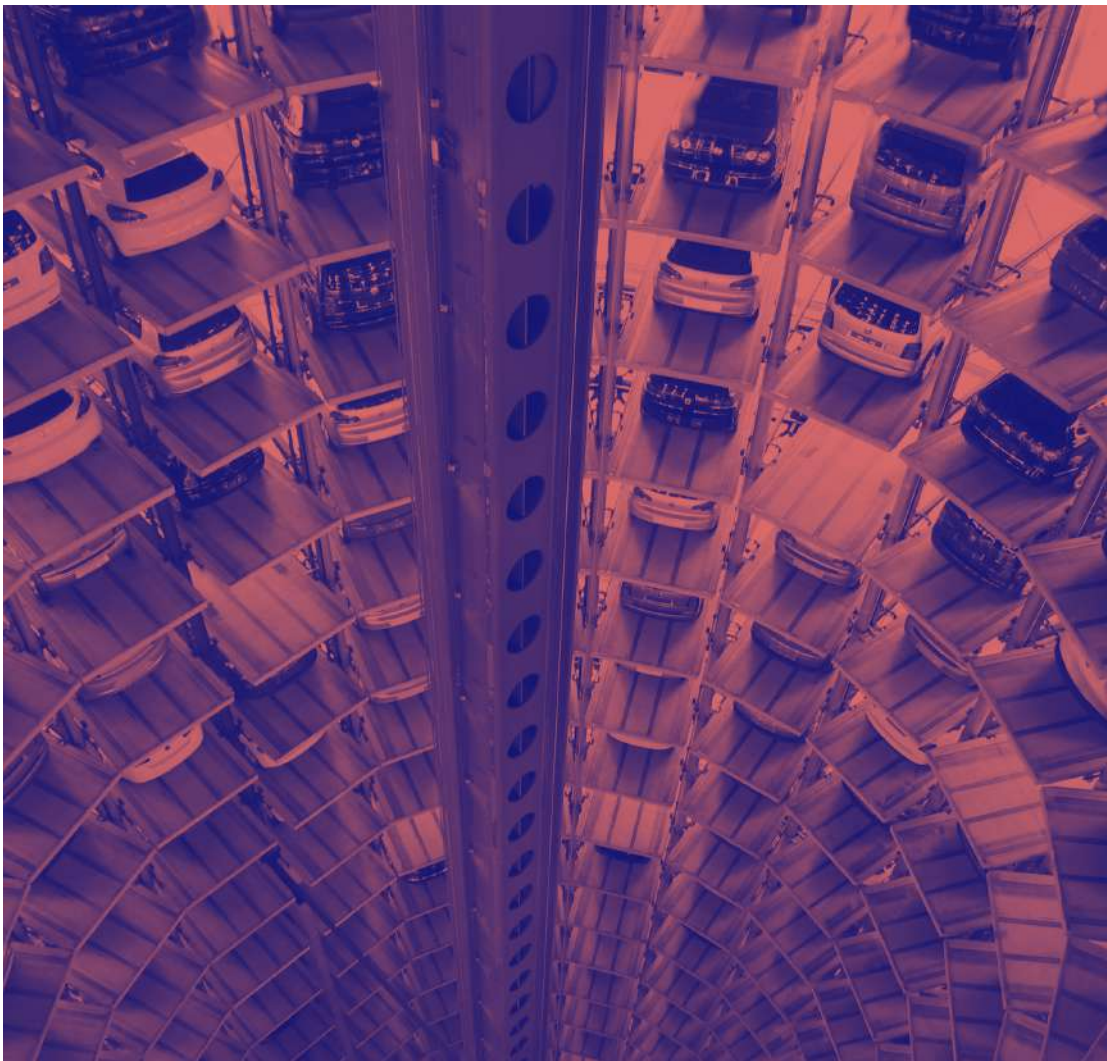
CCMTA would also like to acknowledge the complementary work by Transport Canada. Its document “Guidelines for Testing Automated Driving Systems in Canada Version 2.0” informs the safe conduct of automated vehicle trials in Canada. It sets out a number of definitions that we have adopted to ensure common, clear and consistent language for the discussion of automated vehicle issues in Canada.



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EXECUTIVE SUMMARY

Executive Summary

Automated Driving Systems (ADS) hold potential for significant new benefits for Canada and Canadians. Most importantly, there is hope that these technologies will lead to a significant reduction in traffic collisions and thereby result in a corresponding reduction in fatalities and injuries. This document, *Canadian Jurisdictional Guidelines for the Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems* is focused on ensuring that we can work towards achieving these potential benefits and, at the same time, maintain road safety during testing and deployment of ADS vehicles on public roads.

In order to achieve the dual goals of reaping benefits and maintaining road safety, the membership of CCMTA has recognized that there is a need for a well-planned approach to manage ADS-equipped vehicles' integration within the transportation system. CCMTA has therefore taken a leadership role in crafting new voluntary guidelines for the motor transport administrative and law enforcement communities.

This Guidelines Document provides a series of considerations and recommendations that will support Canadian jurisdictions in their planning, testing and deployment of ADS-equipped vehicles. Overall, it delves into the various disciplines of vehicle registration, driver licencing and law enforcement with the purpose of providing a point-in-time set of voluntary *recommendations* for Canadian jurisdictions to use in developing testing programs (if desired) and preparing for the deployment of the technology.

The development of this document was guided by the following Principles:

- Create a pathway to consistency across jurisdictions
- Encourage and enable the earliest safe introduction of the technology
- Confirm and clarify roles and responsibilities of each level of government
- Demonstrate jurisdictional awareness and understanding of the technology and promote public education, confidence, and adoption
- Create common language and terms
- Work towards interoperability

The Structure of this Document

Like all domains having a technology focus, there is a very important need to ensure that everyone having an interest in the subject matter has a common understanding and associated vernacular to describe systems, technologies, processes, etc. As such, the Preface to this Guidelines Document is critically important as it provides internationally-accepted vehicle classifications and definitions of the terms commonly used to identify and differentiate various automated driving system capabilities on the market or being tested at the time of publishing. These are foundational terms and concepts used throughout the Guidelines Document.

CHAPTER 1 > Introduction

This is a context setter. It sets out the origins of the Document, who was involved in its creation, the scope of the Document, and explains how it complements another key document, "Guidelines for Testing Automated Driving Systems in Canada Version 2.0", work completed under the leadership of Transport Canada to inform the safe conduct of automated vehicle trials in Canada. The chapter concludes with a full explanation of the guiding principles that have framed the approach that underlies the guidelines and recommendations that follow.

CHAPTER 2 > Roles and Responsibilities

This clarifies each level of government's (federal, provincial/territorial and municipal/local) involvement vis-à-vis automated vehicles.

CHAPTER 3 > Guidelines for the Governance of Testing and Deployment of ADS Vehicles

This *Section 3.1 Governance*, recognizes that, to successfully address the safe integration of ADS 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 on roadway safety, jurisdictional programs and infrastructure. It recommends the creation of an ADS Committee comprised of a wide range of both public and private sector members having an interest in automated driving systems. The ADS Committee will perform a variety of functions, chief among them to develop strategies for addressing testing and deployment of ADS in their jurisdiction, balancing the protection of road safety with enabling technological innovation.

Section 3.2 Advanced Driver Assist Systems (ADAS) is new to this version of the Guidelines Document. It explains what they are and stresses the importance of using internationally-accepted terminology for the various types of technologies that are associated with these systems. This common vernacular will be essential to avoiding confusion within the industry, government and the general public.

CHAPTER 4 > Guidelines for Testing of ADS-equipped Vehicles

This contains detailed guidelines and recommendations for jurisdictions, manufacturers and other entities in two main categories: Vehicle Credentialing and Driver Licencing. The main issues covered include applications and permits for vehicle testing; vehicle permitting and registration; licence plates; financial responsibility (i.e., liability for collisions/incidents); compliance with the Motor Vehicle Safety Act; driver licence requirements, and training of motor transport administrators' staff . A new section discusses requirements for remote test drivers.

CHAPTER 5 > Guidelines for Deployment of ADS-equipped Vehicles

Like Chapter 4, this chapter contains detailed guidelines and recommendations for jurisdictions, manufacturers and other entities in the same two main categories: Vehicle Credentialing and Driver Licencing. The difference is that this chapter focuses on ADS-equipped vehicles that are deployed. The main issues covered are: vehicle registration; licence plates; ADS Vehicle information on the New Vehicle Information Statement (NVIS); mandatory liability insurance; compliance with the Motor Vehicle Safety Act; a new section on periodic motor vehicle inspections; driver and passenger roles defined; training for consumers, Motor Transport Administrator Examiners, driver educators and considerations for driver education and training programs; the driver licence skills testing with vehicle technologies; and endorsements and restrictions.

CHAPTER 6 > Law Enforcement and Transportation Safety Considerations

This provides guidelines and recommendations to jurisdictions on: how to identify ADS-equipped vehicles; how and what data should be maintained in crash reports; suggested background checks for persons involved in testing to limit criminal activity; managing distracted driving and fatigue; establishing legal responsibility for every vehicle operating on public roads; establishing new law enforcement protocols for Level 4 and 5 vehicles; first responder safety and training; vehicle response to emergency vehicles, manual traffic controls and atypical road conditions; limiting misuse and abuse of ADS

technologies; adherence to traffic laws; and a new section on cybersecurity for vehicles with ADS.

CHAPTER 7 > Other Considerations

This is a completely new Chapter to this 2nd Edition of the Guidelines. It contains background discussion, guidelines and recommendations for five new issues: data collection; low-speed automated shuttles; micro utility devices and personal delivery devices and other; connected vehicles; and cooperative truck platooning.

CHAPTER 8 > Next Steps

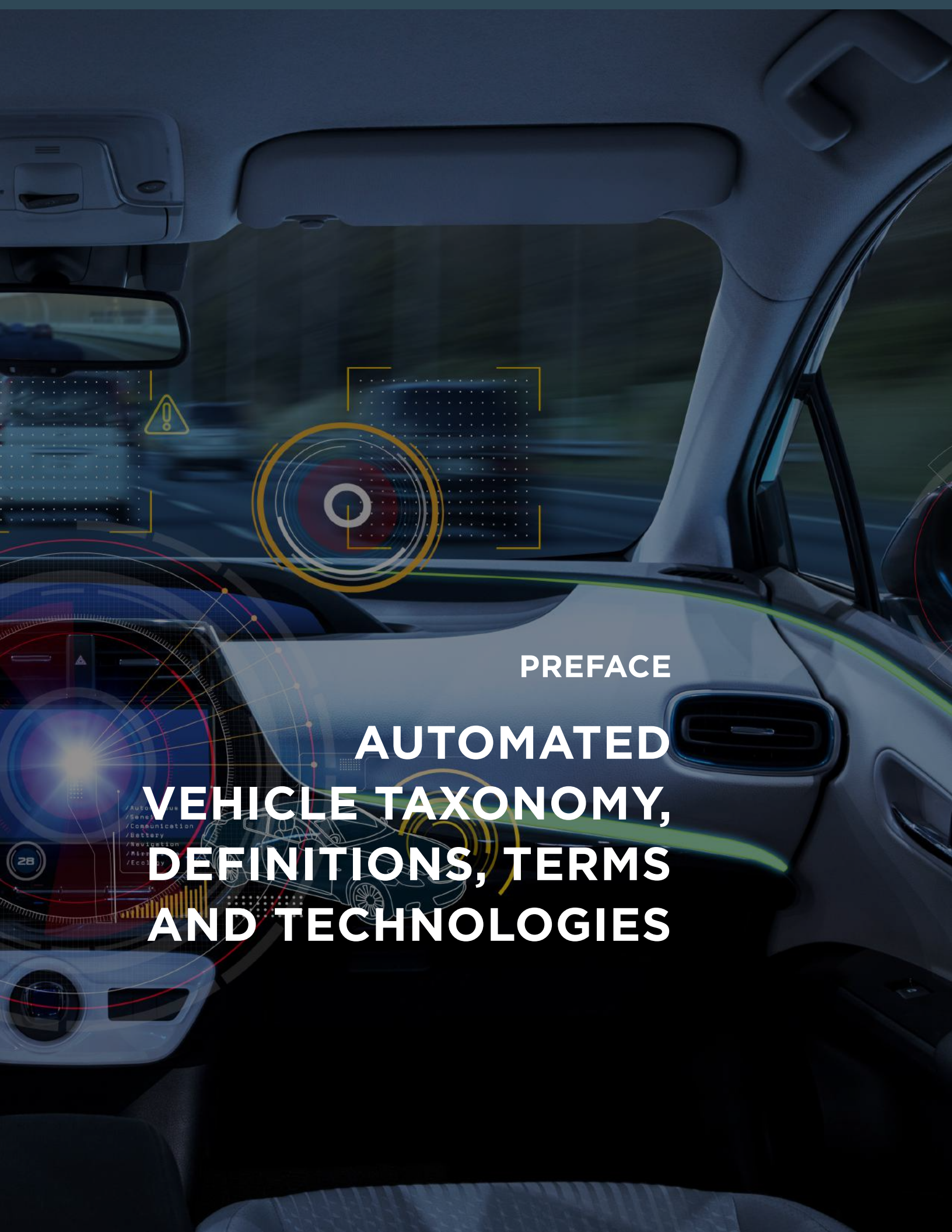
This commits CCMTA to continue to work closely and coordinate ADS initiatives with government entities, industry and Canadian researchers. To keep this report relevant and to provide the best possible guidance to the ADS stakeholder community in Canada, it is expected CCMTA will continually update this report for the foreseeable future.

CCMTA and its members are committed to keeping pace with the evolution of vehicle technology, providing timely information, and sharing their expertise.

Important Notations to the Reader

- **This 2nd Edition replaces the 1st Edition of the Guidelines Document**. It contains global updates to the 1st Edition, updates to specific topics covered in the 1st Edition and includes several new topics.
- **New sections and new recommendations** made in the 2nd Edition are highlighted in Appendix B Summary of Recommendations for Jurisdictions for the Safe Testing and Deployment of ADS-equipped Vehicles and Summary of Recommendations for Manufacturers and Other Entities (MOEs) for the Safe Testing and Deployment of ADS-equipped Vehicles.
- **Global Changes.** The term "Highly Automated Vehicles" referring to SAE Level 3, 4 or 5 vehicles has been retired and replaced by the term "ADS-equipped vehicles", which is consistent with the current industry terminology to describe a Level 3, 4 or 5 driving automation system.

  Several chapters now include information related to Advanced Driver-Assistance Systems (ADAS), which are currently in vehicles and are designed to help drivers with certain driving tasks (e.g., staying in the lane, parking, avoiding crashes, blind spot detection, and maintaining a safe headway).



PREFACE

AUTOMATED VEHICLE TAXONOMY, DEFINITIONS, TERMS AND TECHNOLOGIES

Automated Vehicle Taxonomy, Definitions, Terms and Technologies

An important goal of this Guidelines Document is to establish common, clear and consistent language for the discussion of Automated Driving Systems in Canada. CCMTA has, therefore, chosen to set the stage for the Guidelines with the Preface that provides internationally-accepted vehicle classifications and definitions of the terms commonly used to identify and differentiate various automated driving system capabilities on the market or being tested at the time of publishing.

CCMTA has also supplemented these definitions with some terms that help explain in more detail how the systems will be described in the Canadian context, such as legislation, regulations and guidelines for automated driving systems. Readers are, therefore, encouraged to familiarize themselves with the terminology commonly used herein. See Appendix A for a list of related acronyms.

A wide variety of vehicle technologies are currently 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. While there are technologies of a similar nature, some manufacturers utilize proprietary terms for these. There are various resources that provide information and videos of these specific vehicle technologies such as Canada.ca/driverassistance and www.mycardoeswhat.org.

Automated Driving Systems Taxonomy and Definitions

CCMTA strongly encourages the adoption of terminology developed by SAE International[1] outlined in the Surface Vehicle Recommended Practice: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles J3016, April 2021 which is utilized throughout this report. Adoption of common, clear and consistent language is an important foundation to support discussion among participants and stakeholders, the creation of standards for technology developers, and the development of supporting programs by regulators.

1 SAE International, is a global association of more than 128,000 engineers and related technical experts in the aerospace, automotive and commercial-vehicle industries. Its core competencies are life-long learning and voluntary consensus standards development. Source: SAE International, April 1, 2018 (https://www.sae.org/about/).

SAE Classifications

SAE established a six-tier classification system ranging from no vehicle automation to full vehicle automation. Each vehicle is expected to be classified within the six Levels according to the following:

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.

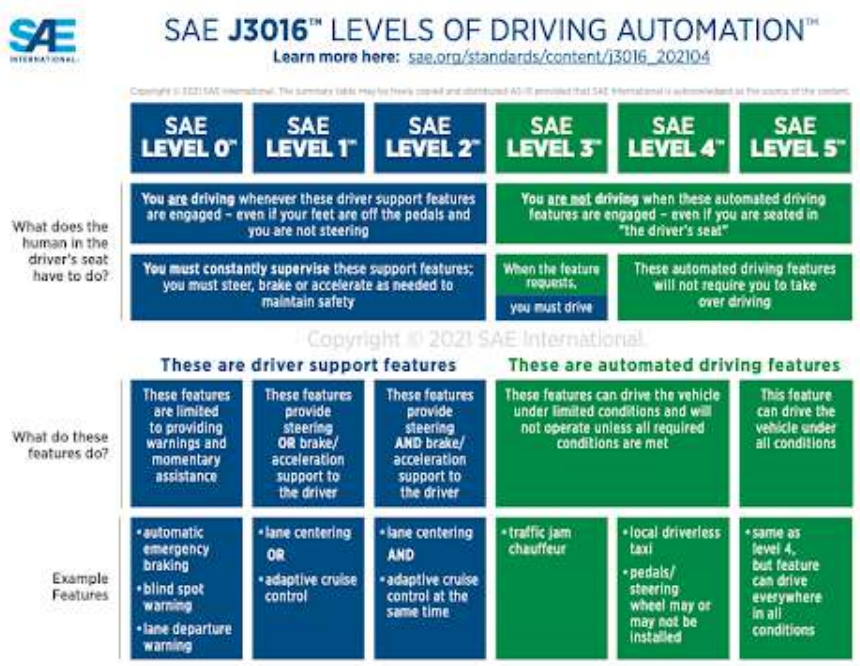
Level 2 — Partial Driving Automation, the sustained and ODD-specific execution by a driving automation system of both the lateral and longitudinal vehicle motion control subtasks of the DDT with the expectation that the driver completes the object and event detection and response (OEDR) subtask and supervises the driving automation system.

Level 3 — Conditional Driving Automation, the sustained and ODD-specific performance by an ADS of the entire DDT 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 without any expectation that a user will respond to a request to intervene.

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 without any expectation that a user will respond to a request to intervene.

Jurisdictions are encouraged to refer to the SAE J3016 taxonomy for additional information on each Level of Automation.



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In some instances, however, we have used additional terms not included in the SAE J3016 standard to supplement key concepts and to ensure accessibility of the text for non-technical audiences.

Jurisdictions also commend efforts by SAE International[2], AAA, National Safety Council, J.D. Power, and Consumer Reports for the creation of **Clearing the Confusion (May 2020)** resource which streamlines the terminology used by manufacturers to describe Advanced Driver Assistance Systems (ADAS). This resource is meant to aid in reducing confusion amongst drivers and other stakeholders by defining the functions of ADAS in a consistent, clear and simple manner. The ADAS specific terminology captured in this report aligns with the list presented by this resource. Jurisdictions are also encouraged to use the terms presented therein to promote consistency of the ADAS taxonomy and to help dispel the confusion amongst drivers and other stakeholders about the capabilities and limitations of these systems.

2 SAE's position in relation to the updated J3016 that active safety systems such as electronic stability control (ESC) and automatic emergency braking (AEB) and certain types of driver assistance systems, such as lane keeping assistance (LKA) are excluded from the scope of this driving automation taxonomy because they do not perform part or all of the dynamic driving task (DDT) on a sustained basis but rather provide momentary intervention during potentially hazardous situations.

Definitions

The following two sets of definitions are provided to establish a baseline for commonly used terms and are also utilized throughout this guidance document. The first set has been devised by SAE in its taxonomy, the SAE J3016 standard, while the second set of key terms and definitions supplement the SAE terms. The second set has been provided by CCMTA, AAMVA or other external sources.

1. Definitions adopted from SAE J3016 Standard[3, 4]

Automated Driving System (ADS): the hardware and software that are collectively capable of performing the entire Dynamic Driving Task (DDT), on a sustained basis, regardless of whether it is limited to a specific Operational Design Domain (ODD); this term is used specifically to describe a Level 3, 4, or 5 driving automation system. (*J3016 Section 3.2*)

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). (*SAE J3016 Section 3.32.3*)

ADS-equipped Vehicle: a vehicle equipped with an Automated Driving System (ADS).

ADS-equipped Dual-Mode Vehicle: 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. (*SAE J3016 Section 3.32.2*)

Driver:

- **[Human] Driver:** A user who performs in real-time part or all of the Dynamic Driving Task (DDT) and/or DDT fallback for a particular vehicle. (*SAE J3016 Section 3.31.1*)
- **In-vehicle Driver** a driver who manually exercises in-vehicle braking, accelerating, steering, and transmission gear selection input devices in order to operate a vehicle. (*SAE J3016 Section 3.31.1.1*)
- **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. (*SAE J3016 Section 3.31.1.2*)

3 This 2nd Edition of the Guidelines uses the April 2021 revised version of SAE J3016. SAE J3016 is, however, a standard that will continue to evolve over time. Changes will be made in an iterative fashion. The full SAE definitions can be found in detail under Appendix D of this document. In order to ensure readers of this document have the latest version of this standard, CCMTA suggests visiting the following website: https://www.sae.org/standards/content/j3016_201401/

4 Note to the reader: SAE uses italics to highlight defined terms in J3016. As such, the italics are reproduced here.

Driverless Operation Dispatcher: A user(s) who dispatches an ADS-equipped vehicle(s) in driverless operation. (*SAE J3016 Section 3.31.4*)

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). (*J3016 Section 10*)

Dynamic Driving Task (DDT) Fallback: the response by the user or by an ADS 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 ODD exit, or the response by an ADS to achieve minimal risk condition, given the same circumstances. (*SAE J3016 Section 3.12*)

(Human) User: a general term referencing the human role in driving automation. (*SAE J3016 Section 3.31*)

Minimal Risk Condition: a stable, stopped condition to which a user or an ADS may bring a vehicle after performing the *DDT fallback* in order to reduce the risk of a collision when a given trip cannot or should not be continued. (*SAE J3016 Section 3.16*)

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 DDT fallback*). (*SAE J3016 Section 3.19*)

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. (*SAE J3016 Section 3.20*)

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. (*SAE J3016 Section 3.21*)

Passenger: a user in a vehicle who has no role in the operation of that vehicle. (*SAE Section 3.31.2*)

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. (*SAE J3016 Section 3.23*)

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. (*SAE J3016 Section 3.24*)

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. (*SAE J3016 Section 3.25*)

Trip: The traversal of an entire travel pathway by a vehicle from the point of origin to a destination. (*SAE J3016 3.29*)

2. Supplemental Definitions and Key Terms

For the purposes of this Guidelines document, the following definitions apply:

Advanced Driver Assist Systems (ADAS): systems designed to help drivers with certain driving tasks (e.g., staying in the lane, parking, avoiding crashes, reducing blind spots, and maintaining a safe headway). ADAS 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.

Applicant: a person or trial organization that applies for or requests a driver licence permit or driver licence for an ADS-equipped vehicle.

Automated Mode: the mode that is set in the vehicle for the automated actions to take over and the driver/user does not control the functions of the vehicle.

Automated Vehicle (AV): any vehicle equipped with automated technology that has been integrated into that vehicle. An AV uses a combination of sensors, controllers and onboard computers, along with sophisticated software, allowing the vehicle to control at least some driving functions, instead of a human driver (for example, steering, braking and acceleration, and checking and monitoring the driving environment).

Automated Vehicle Technology: technology that has the capability to operate a vehicle without the active physical control, or in some cases, monitoring by a driver.

Automated Vehicle Testing/Trials: the temporary operation of an ADS-equipped vehicle on public roads for the purpose of evaluation, demonstration or exhibition. Testing must be approved by the respective provincial/territorial government and may include limitations on the environment/route where testing may occur.

Automation: the use of electronic or mechanical devices to replace a DDT.

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 licence record checks.

Connected Vehicle: connected vehicles (CVs) use different types of wireless communications technologies to communicate with their surroundings. These vehicles can include personal, transit, and freight vehicles that have the capability of communicating electronically with each other and with the various elements of the modern surface transportation system (e.g., pedestrians, bicyclists, roadside infrastructure, transportation management centers, etc.) on a rapid and continuous basis.

Collision (reportable collision): a collision resulting in a person's injury or death or property damage that reaches the jurisdiction's threshold.

Collision Report: a report completed by a law enforcement officer and other designated authorities who investigate motor vehicle collisions involving ADS-equipped vehicles.

Data Collection Mechanisms (DCM): includes, but is not limited to, recording media such as on-board Electronic Data Recorders (EDR); on-board CPU(s); cloud-based CPU(s), etc.[5]

Deploy/Deployment/Deployed: the operation of a market-ready ADS equipped vehicle compliant with the MVSR, including Canada Motor Vehicle Safety Standards (CMVSS) applicable to its prescribed class (unless an exemption has granted). This could include ADS equipped vehicles manufactured for the purpose of sale or permanent importation, or the management of a fleet of ADS equipped vehicles in the context of transit, taxi or ride-sharing operations

Disengagement: a deactivation of the automated mode when a failure of the ADS is detected or when the safe operation of the ADS-equipped vehicle requires that the driver or remote driver assume immediate operation of the vehicle or, in the case of ADS-equipped vehicles, that the ADS be deactivated for the safety of the vehicle, its occupants, or other road users e.g., vehicle-instigated, user-instigated for emergency reasons, user-instigated for non-emergency reasons.

Event Data Recorder (EDR): a function within one or more vehicle electronic modules that monitors vehicle and occupant protection system time-series data, prior to and during specific events, with the intent of retrieving the data after the event.[6]

Human/Machine Interface (HMI): the human–machine interface (HMI) is a crucial component of every automated driving system (ADS) since it enables and supports the interaction between the driver and the vehicle. The HMI includes various vehicle displays (visual, auditory, haptic) which present information to the driver concerning things such vehicle status for systems and subsystems (e.g., ADS availability, current mode, safety warnings, etc.).

Drivers interact with the vehicle using various input devices (e.g., knobs, levers, touch screens, etc.,) as well as through vehicle controls such as steering and braking. Safe and efficient operation of any motor vehicle requires that the

5 Source: SAE AVSC00004202009.
6 SAE J1698

human-vehicle interaction be designed in a manner that is consistent with driver capabilities limitations, and expectations.

Incident: an occurrence involving one or more vehicles in which a hazard is involved but not classified as a collision due to extent of damage.

Jurisdiction: any province or territory of Canada, or state, district or territory of the United States (US).

Manufacturer: an individual or company who designs, produces or constructs vehicles or equipment. Manufacturers include original equipment manufacturers (OEMs), multiple and final stage manufacturers, alterers (individuals or companies making changes to a completed vehicle prior to first retail sale or deployment), and modifiers (individuals or companies making changes to existing vehicles after first retail sale or deployment).

Safety Management Plan: A written plan that describes potential hazards and the organization's policies, controls, and practices to minimize those hazards.

Motor Transport Administrator (MTA): the jurisdiction's agency responsible for the administration of vehicle registration and driver licencing. In many Canadian jurisdictions this is the Registrar of Motor Vehicles.

NHTSA: National Highway Traffic Safety Administration, part of the United States Department of Transportation. Its mission is to save lives, prevent injuries, and reduce economic costs due to road traffic crashes, through education, research, safety standards, and enforcement.

Non-Drivers: a user of an automated vehicle who normally would not be able to operate a vehicle (e.g., due to age limitations or certain disabilities).

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.

Product Liability: a manufacturer, up-fitter or seller being held liable for placing a defective product into the hands of end-users. Responsibility for a product defect which causes injury lies with all sellers of the product who are in the distribution chain.

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 mosttraffic situations within a jurisdiction's traffic laws.

Suspension: the temporary withholding of the licence to drive, usually for a specifiedperiod of time.

Tier 1 Supplier: direct suppliers to the original equipment manufacturer (OEM).

Trial Organization: a company or organization seeking to test ADS-equipped vehicles in Canada. Trial organizations can include but are not limited to: original equipment manufacturers, technology companies, academic research institutions, and manufacturers of parts, systems, equipment or components of ADS-equipped vehicles.

Up-Fitter: an individual or company that specializes in the design or installation of aftermarket products.

Vehicle Status: adding words or phrases to a vehicle registration document which describe an event that has impacted the value or safety aspects of a vehicle. This process may also be referred to as "branding".

Vulnerable Road Users: pedestrians, motorcyclists, cyclists and persons in personal mobilized devices (e.g., motorized wheelchairs and scooters) that use the roadway.

CHAPTER 1

INTRODUCTION

Chapter 1

Introduction

The rapid pace of technological innovation and advancements in the field of roadway transportation is continually leading to breathtaking new opportunities for change in the way we get around. As we move increasingly toward higher levels of automation in our vehicles, automated driving systems will progressively reduce the role for today's driver.

Automated Driving Systems (ADS) hold potential for significant new benefits for Canada and Canadians. Most importantly, there is hope that these technologies will lead to a significant reduction in traffic collisions and thereby result in a corresponding reduction in fatalities and injuries. Some of the other transformative impacts on today's society and economy may include reduced traffic congestion; fuel cost savings; cost savings from fewer collisions; better allocation of medical and enforcement resources to other priorities; greater efficiency of vehicle and roadway operations, as well as improved mobility and accessibility.

Rationale for the Guidelines

At the same time, there are other important considerations and concerns to be addressed as the technology evolves.

First among these is the realization that automated and non-automated vehicles are sharing the roadway, creating challenges for safe integration of ADS-equipped vehicles into the general transportation system. This reality has prompted jurisdictions to explore ways to regulate this emerging technology to ensure the ongoing safety of all road users. A pressing challenge, therefore, is how best to maintain road safety while allowing for the safe testing and deployment of ADS-equipped vehicles on public roads.

A second consideration is the recognition that driving safety will be improved if the rules and regulations governing the operation of automated vehicles are consistent within a jurisdiction and, ideally, from jurisdiction to jurisdiction. Ensuring a consistent regulatory framework is in place to address public safety concerns is, therefore, critical for all levels of government.

In addition, introduction of ADS-equipped vehicles into the existing roadway transportation system requires a transformation that requires collaboration and input from industry, partners, and other community members. A regulatory framework can set out when and where interactions among these various players need to occur to ensure the safest transition to this higher level of automation.

Some of the key considerations for governments and regulators are:

- How manufacturers should demonstrate vehicle safety;
- How existing driver and vehicle licensing regimes will address ADS-equipped vehicles;
- What type of regulatory framework will ensure safe operations of ADS-equipped vehicles on public roads;
- How government/enforcement/police will address issues of liability, data privacy and cybersecurity; and
- How enforcement regulations (commercial and non-commercial) will be applied to ADS-equipped vehicles.

Purpose

ADS technology is moving swiftly, yet we know legislation takes time and can be a highly consultative process. Being nimble enough to adapt to the technology without unnecessarily delaying testing and deployment is essential. It is clear that there is a need for a well-planned approach to manage ADS-equipped vehicles' integration within the transportation system.

These Guidelines are, therefore, intended to provide a series of considerations and recommendations that will support Canadian jurisdictions for the safe testing and deployment of ADS vehicles.

In Scope

This document addresses how automated vehicle technology will directly affect:

- Vehicle registration and permitting programs;
- Driver training, testing and licencing programs;
- Enforcement of traffic laws; and
- First response to traffic related incidents.

This document sets out voluntary guidelines and recommendations for those Canadian jurisdictions choosing to regulate testing and deployment of ADS-equipped vehicles. Jurisdictions adopting the recommendations will facilitate a consistent regulatory framework which balances current public safety with the advancement of vehicle innovations having the potential to reduce collisions,

fatalities, injuries and property damage. Jurisdictions will continue to develop guidance on ADS as the technology and safety needs evolve; this process will involve updates to this document.

Out-of-Scope

Some of the topics related to testing and deployment of ADS-equipped vehicles are not covered in this document. These include, but are not limited to:

- Enabling infrastructure;
- Fiscal impacts to jurisdictions;
- Socio-economic implications;
- Economic development guidance; and
- Environmental impacts.[7]

The topic of heavy commercial vehicles is also out-of-scope for this 2nd Edition of the Guidelines. The Working Group recognizes that these vehicles pose different risks to public safety and infrastructure than those related to light vehicles. At this time, there is a considerable amount of research being done in Canada and internationally to establish what those risks are and what mitigating steps should be undertaken to address any additional risk to safety. It is a subject that will be considered for future editions of the Guidelines.

Recommendations are Voluntary

The recommendations in this report are voluntary; jurisdictions are not required to adopt them. If a jurisdiction chooses to adopt the 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.

Why is CCMTA preparing the Guidelines?

The Canadian Council of Motor Transport Administrators (CCMTA) coordinates all matters dealing with the administration, regulation and control of motor vehicle transportation and highway safety. Membership includes representation from provincial and territorial governments as well as the federal government of Canada.

7 Some of these topics may be addressed in future versions of this document.

CCMTA supports its members' vision to have the safest and most efficient movement of people and goods by road in the world. We are the custodians of the National Safety Code for Motor Carriers and provide collaborative leadership in the areas of Road Safety Research and Policies, Drivers and Vehicles, and Compliance and Regulatory Affairs.

CCMTA Members are elected from provincial, territorial and federal governments. CCMTA is accountable to:

- the Councils of Ministers and Deputy Ministers of Transportation and Highway Safety for:
  - providing advice and making recommendations on matters relating to transportation and highway safety
- the provinces, territories and the federal government for:
  - promoting a better understanding and cooperation in all matters related to transportation and highway safety among each other, as well as other organizations where there exists a mutual interest
- its stakeholders for:
  - maintaining an ongoing dialogue and consultation to ensure CCMTA is responsive and informative

As part of its overall mandate, CCMTA established an Automated Vehicle Working Group (AVWG) in 2013 and in 2014 was given approval to examine the potential impacts of testing and deployment of ADS. Further impetus was given to the CCMTA's work in the area of ADS in 2018 when the Standing Senate Committee on Transport and Communications issued its report entitled: "Driving Change: Technology and the Future of the Automated Vehicle". This report studied the regulatory and technical issues related to the deployment of automated and connected vehicles. In recognition of CCMTA's mandate on transportation safety, the report recommended that:

> ***"Transport Canada engage with provincial and territorial governments, through the Canadian Council of Motor Transport Administrators, to develop a model provincial policy for the use of automated and connected vehicles on public roads. The department should also involve municipalities in this engagement process."***[8]

As a result of this recommendation, the AVWG of CCMTA prepared the first edition of "*Canadian Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles (Automated Driving Systems Levels 3, 4 and 5)*" which it released in June of 2018.

8 Senate of Canada, "Driving Change: Technology and the Future of the Automated Vehicle", Report of the Standing Senate Committee on Transport and Communications, January 2018.

This work is based directly on a similar set of guidelines issued by CCMTA's American-equivalent organization, the American Association of Motor Vehicle Administrators (AAMVA). It was entitled "*Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles*" (Guidelines), released in May of 2018.

Since that time, the AV Working Group expanded its scope to recognize the importance of connected vehicles (as it effects vehicles and drivers). Now known as the AV/CV Working Group, it has continued to monitor domestic and global developments in the field of ADS. Most recently, representatives from the AV/CV Working Group have taken direct part in AAMVA's work to update its 2018 "*Guidelines*". Edition 2 released in September 2020 incorporates changes that reflect developments in the technology field and introduces several new subjects that have a direct impact on the safe operation of ADS-equipped vehicles.

These developments, along with the newest research findings and practices (e.g., in data collection, connected vehicles, low-speed automated shuttles, and commercial vehicle platooning), provide a solid basis for CCMTA to update its own Guidelines.

In its current iteration, the AV/CV Working Group includes representatives from Transport Canada, ten provinces, two territories and the Canadian Association of Chiefs of Police (CACP). It also benefits from the participation of a representative from AAMVA.

In this 2nd Edition of the Guidelines, the AV/CV Working Group covers the various disciplines of vehicle registration, driver licencing and law enforcement with the purpose of providing a point-in-time set of recommendations for Canadian jurisdictions to use in developing testing programs (if desired) and preparing for the deployment of the technology.

It should be noted that the Transport Canada guidelines respecting the temporary trials of highly automated vehicles in Canada have also been developed. The document, entitled "*Guidelines for Testing Automated Driving Systems in Canada Version 2.0*", is complementary with these testing and deployment Guidelines. Similarities and differences are outlined in Table 1. *Canadian Guideline Documents*. Provinces and territories are encouraged to consult *the Guidelines for Testing Automated Driving Systems in Canada Version 2.0*, in conjunction with this document, to inform the development of their testing and deployment regulations.

TABLE 1. CANADIAN GUIDELINE DOCUMENTS

KEY ELEMENTS	GUIDELINES FOR TESTING AUTOMATED DRIVING SYSTEMS IN CANADA VERSION 2.0	CANADIAN JURISDICTIONAL GUIDELINES FOR THE SAFE TESTING AND DEPLOYMENT OF VEHICLES EQUIPPED WITH AUTOMATED DRIVING SYSTEMS
Purpose	• Highlight Canada as a destination for research and development of ADS • Clarify roles and responsibilities of each level of government for ADS trials • Establish a set of consistent minimum safety requirements for trial organizations operating in Canada	• Provide a series of considerations and recommendations that will support Canadian jurisdictions in their planning and roll-out of ADS vehicles
Target Audience	• Trial Organizations (e.g., manufacturers, academia, technology firms etc.)	• Provincial, Territorial, Municipal jurisdictions Manufacturers and Other Entities
Scope	• Temporary trials of ADS vehicles, not deployment	• Governance • Testing • Deployment • Law Enforcement and Transportation Safety
ADS Taxonomy and Definitions	• From SAE International	• From SAE International
Vehicle Types Included	• All vehicles intended for use on public roads	• All vehicles intended for use on public roads, except heavy commercial vehicles

Collaboration among Stakeholders and Partners

Another important element of a well-managed roll-out of ADS-equipped vehicles is the inclusion of a broad range of key stakeholders from government organizations, government support associations, industry, research institutes and advocacy groups in discussions of these new technologies and their potentially far-reaching impacts. Partnerships and collaboration among these interests will be needed to ensure the safest integration of ADS into the Canadian transportation system.

CCMTA, its members, and the AV/CV WG have participated in several consultative efforts to help form the development of this document.

Guiding Principles

Part of the AV/CV WG's mandate was to define a clear set of guiding principles that would influence the development of this Guidelines Document for the safe testing and deployment of ADS-equipped vehicles. Accordingly, the AV/CV WG drafted guiding principles that reflect the vision, strategic interests, and core values of CCMTA members.

The Guiding Principles are as follows:

1. **Create a pathway to consistency across jurisdictions**
   Consistency in regulatory requirements across jurisdictions will lead to greater certainty and reduced costs for manufacturers and technology developers thereby providing optimum conditions for the efficient and effective testing and deployment of the technology throughout Canada.
2. **Encourage and enable the earliest safe introduction of the technology**
   This principle includes two important concepts. First, the Guidelines are meant to be implemented in a manner that is in line with our primary road safety mandate. Second, they are not meant to present unnecessary obstacles or barriers to testing and deployment, nor to the innovative processes that will be required to achieve full automation over time. The goal is to permit the earliest possible receipt of the associated benefits of the technology in the safest way possible.

3. **Confirm and clarify roles and responsibilities of each level of government**
   Given that federal/provincial/territorial and municipal governments all have responsibilities related to the safety of vehicles and their operation, these Guidelines provide clear explanation of the roles of each. It is important that these are well understood by all, including industry and technology developers.
4. **Demonstrate jurisdictional awareness and understanding of the technology and promote public acceptance, confidence, and adoption**
   Key to enabling the safe and early deployment of ADS is public acceptance of and confidence in the technologies is that they will perform safely, and that there are significant economic and societal benefits in adopting them for everyday use.

   Jurisdictions have an important role to play in building that public confidence and ultimately adoption. They must show that they:

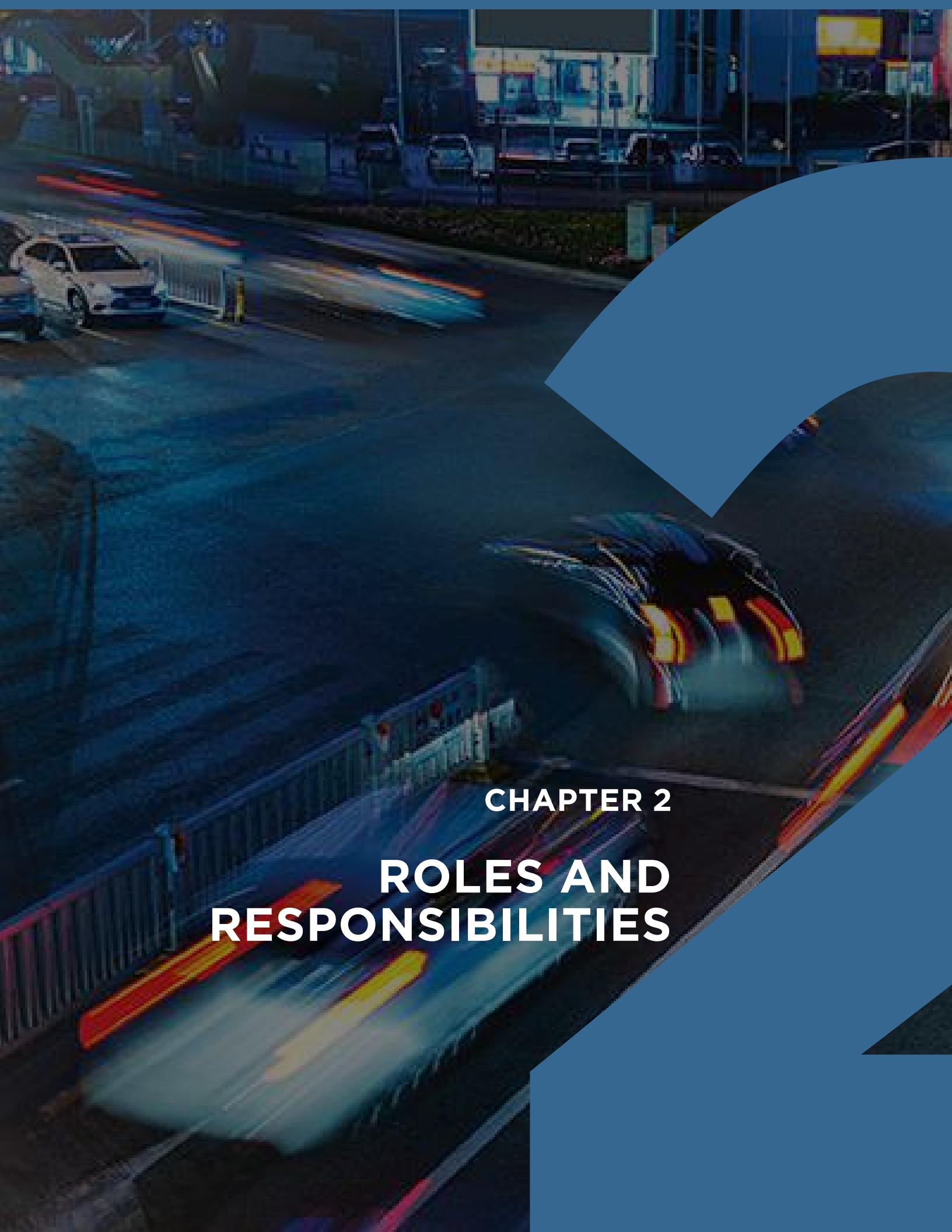
   - are knowledgeable of the technologies and how they operate in both test and real-world circumstances;
   - are understanding of the benefits and limitations of the technologies;
   - are understanding of public concerns about the technologies;
   - are aware that early or prescriptive regulation can risk stifling innovation of the industry;
   - demonstrate that safety is a top priority and that any guidelines introduced on testing and deployment in Canada are transparent and accompanied by a fact-based rationale; and
   - will actively promote these technologies for safety, economic and societal benefits.

   These Guidelines are crafted to incorporate these concepts.
5. **Create common language and terms**
   There are a wide range of players involved in all stages of research, development, testing and deployment of automated vehicle technologies. Within this environment, we have noted that there are numerous terms, expressions and language being used that describe similar functions and operations of the technology.

   Our goal is to be clear in the Guidelines and recommendations so there is a foundation for discussion and for consistent dialogue of these issues in Canada. These Guidelines, therefore, set out definitions for key terms and then apply these terms consistently throughout the text to ensure clarity of meaning.

Work towards interoperability

Align approaches with international best practices and ensure interoperability in cross-jurisdictional testing and deployment of ADS vehicles with key partners in Canada and the US.



CHAPTER 2

ROLES AND RESPONSIBILITIES

Chapter 2

Roles and Responsibilities

In Canada, motor vehicle transportation is a shared responsibility between federal, provincial and territorial governments. Transport Canada, under the Motor Vehicle Safety Act (MVSA), establishes safety regulations and standards that apply to the importation of motor vehicles and designated motor vehicle equipment, and the shipment of newly manufactured motor vehicles and designated equipment across provincial/territorial boundaries. The standards are primarily performance-based, rather than design-based, and set out a minimum threshold level of safety to reduce the risk of death, injury and damage to property and the environment.

Innovation, Science and Economic Development Canada (ISED) is responsible for setting and enforcing compliance with technical standards and licencing requirements related to wireless technologies integrated in vehicles and roadside infrastructure. These standards and licencing requirements are set to minimize harmful interference to radio communication services and to ensure that Canadians are not overexposed to radiofrequency fields from wireless technologies. ISED has various requirements that a trial organization must adhere to when using wireless communication technology to facilitate testing. For more information on ISED, please refer to **http://www.ic.gc.ca/**.

Provinces and territories are responsible for the licencing of drivers, vehicle registration and insurance, as well as laws and regulations regarding the safe operation of vehicles on public roads. As such, provinces and territories are also responsible for approving and overseeing trials of automated vehicles that take place within their jurisdiction. These jurisdictions may choose to engage Transport Canada in this process to seek input and views on applications and trial practices.

Municipal governments in Canada fall under the jurisdiction of provinces and territories. Their responsibilities regarding roadways vary to some degree across the country, but generally can include creating and enforcing by-laws concerning vehicle movement, as well as use of local infrastructure, and public transportation in their respective jurisdictions. Manufacturers and other entities are encouraged to engage municipal authorities, in conjunction with the relevant provincial/territorial road transport agency, to ensure local traffic and infrastructure considerations are addressed and that local law enforcement and emergency response personnel are appropriately informed about testing operations.

Canada also works closely with the international community to ensure alignment with international law, regulations and best practices regarding road transportation and the safe testing and deployment of automated driving

systems. This includes the work of the Global Forum for Road Traffic Safety (Working Party 1 or "WP.1") and the World Forum for Harmonization of Vehicle Regulations (Working Party 29 or "WP.29"). WP 1 is the United Nations body responsible for supporting international road safety and the harmonization of international traffic rules. It also oversees the 1949 and 1968 Conventions on Road Traffic, the former to which Canada is a party.

WP.29 provides a forum for developing globally harmonized vehicle regulations. The WP.29 forum oversees two agreements for adopting uniform UN Regulations signed in 1958 and 1998, the latter to which Canada is a party. Within WP.29, the Working Party on Automated and Connected Vehicles (GRVA) has been established along with a number of informal working groups to establish safety requirements for automated driving systems and vehicle connectivity. Transport Canada represents Canadian jurisdictions at WP.1 and WP.29 proceedings. Jurisdictions are encouraged to work with Transport Canada to ensure their laws and regulations are aligned with international best practices established by these organizations. Transport Canada, in turn, works closely with provinces and territories to ensure Canadian perspectives are incorporated in any globally harmonized regulations, guidance, or other safety tools that may be developed.

TABLE 2. SUMMARY OF JURISDICTIONAL ROLES AND RESPONSIBILITIES[9]

FEDERAL AREAS OF RESPONSIBILITY[10]

Transport Canada

- Setting and enforcing compliance with safety standards for manufactured and imported vehicles (including the import of trial vehicles) as well as motor vehicle equipment (tires and child car seats)
- Investigating and managing the recall and remedy of non-compliances and safety-related motor vehicle defects
- Motor vehicle safety research
- Public education on motor vehicle safety issues

Innovation, Science and Economic Development Canada

- Setting and enforcing compliance with technical standards and licensing requirements related to wireless technologies integrated in vehicles and roadside infrastructure (for trials involving the testing of connectivity technologies)
- Responsible for federal private sector privacy law, which provides rules for how organizations may collect, use, and disclose personal information in commercial activities[11]

PROVINCIAL/TERRITORIAL AREAS OF RESPONSIBILITY

- Approving on-road testing of ADS-equipped vehicles
- Driver licencing
- Vehicle registration
- Enacting and enforcing traffic laws and regulations (including trials)
- Conducting safety inspections
- Regulating motor vehicle insurance and liability
- Public education on motor vehicle safety issues
- Adapting infrastructure to support CAV deployment and after-market vehicle modifications
- Some provinces (BC, AB, QC) have private sector privacy laws that supersede the federal privacy law in respect of commercial activities within a province[12]

MUNICIPALITIES[13]

- Enacting and enforcing bylaws
- Enforcing traffic laws and regulations
- Advocating for and accommodating testing
- Adapting infrastructure to support CAV deployment Managing passenger transportation (including public transit and taxi cabs)
- Parking
- Traffic control
- Public education and motor vehicle safety issues

9 Source: Transport Canada: "Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations", 2018.
10 These are the principle federal authorities relating to road safety. Other laws and regulations outside of this scope may apply to trial vehicles, depending on the technologies and equipment incorporated. Trial organizations are responsible for determining which laws apply to their specific vehicles.
11 To note: At the time of the publication of this guidance document, efforts are underway by Parliament to consider new privacy legislation. Trial organizations and other readers are encouraged to consult www.priv.gc.ca for up-to-date information on privacy legislation in Canada.
12 Currently, the provinces of Alberta, British Columbia, and Quebec have enacted "substantially similar" laws to PIPEDA. In many circumstances, the provincial law applies instead of the federal law. Trial organizations should consult the privacy legislation enacted in these jurisdictions in addition to PIPEDA. It is possible that more than one privacy law could apply to an organization. When more than one law applies, organizations must comply with both.
13 Authorities in these areas may vary depending on the size of the municipality and the powers accorded to it by the provincial or territorial government. Trial organizations should consult with the provincial/territorial road transport agency to determine what municipal consent, approvals or authorizations may be required.

CHAPTER 3

CONSIDERATIONS FOR THE GOVERNANCE OF TESTING AND DEPLOYMENT OF ADS-EQUIPPED VEHICLES AND VEHICLES WITH ADAS

Chapter 3

Considerations for the Governance of Testing and Deployment of ADS-Equipped Vehicles and Vehicles with ADAS

This chapter addresses the overall considerations for the governance of the testing and deployment of ADS-equipped vehicles and vehicles with ADAS. There are 10 recommendations in the following two sections. There are 8 recommendations directed to jurisdictions for implementation consideration, while 2 are directed to MOEs.

3.1 GOVERNANCE

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 the Governance of Testing and Deployment of ADS-Equipped Vehicles

An AV lead agency should be identified within each jurisdiction to address ADS-equipped vehicle testing and deployment within their borders. The lead agency should be charged with establishing a jurisdictional ADS Committee. The ADS Committee should include, but not be limited to:

- Representatives from the jurisdiction's office of the Transportation Minister/Deputy Minister;
- The legislature;
- The law enforcement agencies;
- The office of highway safety;
- The office of information technology;
- The insurance regulator;
- The jurisdictional office(s) representing vulnerable road users;
- The jurisdictional office that regulates taxis and rideshare companies;

- Toll authorities;
- Transit authorities; and
- Local governing bodies.

Other stakeholders such as transportation research centres located within the jurisdiction and other road safety stakeholders should be consulted as appropriate. Communication with the ADS-equipped vehicle manufacturing industry is encouraged.

The ADS Committee should develop strategies for addressing the testing and deployment of ADS-equipped vehicles in their jurisdiction. There are a range of strategies to consider from addressing testing without active regulation; to testing with regulation by policy or statute.

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

- Licencing/registration;
- Driver education/training;
- Insurance and liability;
- Rules of the road;
- Development and enforcement of appropriate traffic laws/regulations; and
- Administration of motor vehicle inspections.

Jurisdictions which regulate the testing of ADS-equipped vehicles are encouraged to take necessary steps to establish statutory authority, and to utilize the documents developed by Transport Canada, including the *Guidelines for Testing Automated Driving Systems in Canada Version 2.0*, as a minimum baseline for these regulations.

The designated lead agency should keep its ADS Committee informed of the requests from manufacturers or other entities to test in their jurisdiction and the status of the designated agency's response.

Several national associations are engaged in the discussion on ADS and are available for additional support to jurisdictional government officials. These include, but are not limited to: CCMTA, the Transportation Association of Canada (TAC), the Federation of Canadian Municipalities (FCM), and the Canadian Association of Chiefs of Police (CACP).

As technologies emerge, regulators and legislators will need to constantly advance their knowledge to stay current. To do so, policy makers should be informed of relevant reports and studies, attend ADS-equipped vehicle forums and be engaged with the industry and Transport Canada. Jurisdictions may wish to establish an advisory committee. As government officials continue to become informed, they will have a better understanding of the technology. This knowledge will help officials to recognize when laws, rules and policies are either outdated or proposed prematurely.

Jurisdictions should also review their laws, regulations and rules regarding vehicle operation to support the testing and deployment of ADS-equipped vehicles on public roads.

In addition to consulting *Guidelines for Testing Automated Driving Systems in Canada Version 2.0* jurisdictions may also wish to consult other Transport Canada resources to help inform their work, including:

- Canada's Safety Framework for Automated and Connected Vehicles (2019) which articulates Transport Canada's vision for safety and provides access to a broad range of guidance and tools that support the safe testing and deployment of connected and automated vehicles in Canada;
- Safety Assessment for Automated Driving Systems in Canada (2019) which assists industry in reviewing the safety of automated driving systems that they intend to manufacture, import, operate and/or sell in Canada. Among its 13 safety outcomes are criteria dealing with user-friendly controls as well as measures to address public awareness and education; and finally,
- Canada's Vehicle Cyber Security Guidance (2020), which provides a set of technology-neutral guiding principles to support industry in strengthening their vehicle cyber resilience throughout the vehicle lifecycle. The cyber guidance identifies vehicle cyber security risks and safeguards, discusses emerging issues, and provides best practices regarding the detection, monitoring, response and recovery from cyber events.

These and other Transport Canada resources can be found at Canada.ca/automatedvehicles.

RECOMMENDATIONS FOR JURISDICTIONS

3.1.1 Establish an ADS Committee to address ADS-equipped vehicle testing and deployment. The Committee should include members from a broad range of governmental and private sector stakeholders having expertise in and/or responsibilities related to ADS.

3.1.2 Identify a Lead Agency to manage the ADS Committee and its work. The ADS Committee should develop strategies for addressing testing and deployment of ADS-equipped vehicles in their jurisdiction, balancing the protection of road safety with enabling technological innovation.

3.1.3 Jurisdictions should review their laws, regulations and rules regarding vehicle operation to:

a) Support the testing and deployment of ADS-equipped vehicles on public roads; and

b) ensure that they do not create unnecessary barriers to the safe testing, deployment and operation of ADS-equipped vehicles in Canada.

3.1.4 Jurisdictions which regulate the testing of ADS-equipped vehicles are encouraged to take necessary steps to establish statutory authority and to consult the document *Guidelines for Testing Automated Driving Systems in Canada Version 2.0* published by Transport Canada in collaboration with CCMTA in 2021 as a minimum baseline to frame the regulations.

3.1.5 Jurisdictions should encourage their regulating bodies and legislators to engage in regular reviews of ADS technologies and to engage with industry to stay current with advancements. This will help officials recognize when laws, rules and policies are either outdated or proposed prematurely.

3.1.6 The lead agency should designate an AV lead staff member.

3.1.7 The motor vehicle agency should also designate an AV lead staff person, if that 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.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 1. Establish an ADS Committee to address ADS testing and deployment. The Committee should include members from a broad range of governmental and private sector stakeholders having interest in and/or responsibilities related to ADS.

Benefits to Implementation

By establishing a lead agency and an ADS Committee, jurisdictions provide an opportunity for collaboration among stakeholders as they become informed of the 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 will 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 regulatory approach is beneficial to regulators and supports innovation within the industry.

Establishing a lead agency offers an additional benefit to stakeholders in that it may act as a single point of contact for enquiries, comments and dialogue.

Challenges to Implementation

Creative thinking and approaches may be necessary to ensure roadway safety while, at the same time, supporting technological advancements through the development and testing phases of ADS-equipped vehicles.

Review of jurisdictional laws and rules to ensure the safe testing and deployment of ADS-equipped vehicles will need to be thorough, and include as many situations as possible, (e.g., enable testing without a driver; examine impaired driving, distracted driving and careless driving laws for deployment). Another dimension that will need to be considered when contemplating regulatory action is the fact that ADS Levels 3, 4 and 5 will be constantly changing – technological innovation is expected to continue. Regulators need to be aware of such changes to assess the need for new or updated regulations.

Ensuring interoperability of the technologies in cross-border testing and deployment situations will also need to be taken into consideration.

3.2 ADVANCED DRIVER-ASSISTANCE SYSTEMS (ADAS)

Background

ADAS 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 headway). ADAS are generally designed to improve safety or reduce the workload on the driver. Some systems are designed to warn you if you are at risk of a collision, while others are designed to take action to help avoid or reduce the severity of a crash. Whatever these systems are intended to do, they are paving the way for vehicles with higher levels of automation.

With respect to SAE's Levels of Automation, many ADAS features fall into Level 0, although there are some that can be considered SAE Level 1 or Level 2 (refer to SAE J3016 Levels of Driving Automation for examples).[14] ADAS may also be found in vehicles with higher levels of automation, although these vehicles are not yet commercially available.

Although numerous ADAS technologies are available in vehicles today, there is a lack of consistency among manufacturers, organizations, legislators and stakeholders how these systems are named and defined. The inconsistent nomenclature creates confusion amongst consumers and other stakeholders about the systems' functionalities, including about their capabilities and limitations.

A 2018 study by AAA found that 93% of new vehicles in the United States offer at least one advanced driver assistance feature, and consumers are faced with as many as 20 names for a single technology (e.g., automatic emergency braking). [15]This inconsistency has created confusion among consumers regarding the capabilities and limitations of these features. Transport Canada's 2019 public opinion poll confirmed that respondents were also confused about the ADAS technologies currently available on the market. Most notably, a significant number of respondents appeared to confuse the difference between features that provide a warning signal to the driver, versus those that assist with the driving task (e.g., forward collision warning versus automatic emergency braking). These are important observations for the following reasons: if drivers are confused by the technologies or do not fully understand their capabilities or intended use, they may not be willing to use them or be at risk of not using them properly. This could even include over-relying on the system (i.e. driver complacency).

Considering the safety implications associated with inconsistent ADAS naming conventions, various efforts are underway to help streamline the terminology. In 2019, AAA, Consumer Reports, J.D. Power, and the National Safety Council drafted a brief document entitled **Clearing the Confusion** which listed out generic names and short definitions for common ADAS features. The intent

14 The April 2021 update to SAE J3016 does not include a formal definition of "ADAS" because it is felt that the term is too broad and imprecise for use in a technical definitions context. This Guidelines document, however, is intended as an educational piece (i.e., it is not attempting to define technical standards), and recognizes that the term ADAS is still in wide use internationally to describe an array of features that provide warnings and or momentary intervention to or for the driver.

15 **AAA (September 2018) Vehicle Owners' Experiences with and Reactions to Advanced Driver Assistance Systems**

of that brief is to aid in reducing driver confusion and define the functions of ADAS in a consistent manner. This is critical to ensure that drivers are aware these systems are designed to assist and not replace the driver. SAE International joined in the group's efforts and in May 2020 released an updated version of **Clearing the Confusion**. This document will continue to be updated to include additional terms as new technologies come to market.

Clearing the Confusion was endorsed by the U.S. Department of Transportation in 2020. Transport Canada has also aligned its **Driver Assistance Technologies (DAT)** and **Connected and Automated Vehicles** websites with the most recent version of *Clearing the Confusion* (May 2020). The information presented on those websites help to demystify emerging vehicle technologies, including SAE's Levels of Automation, outline the benefits of these technologies along with safety considerations, and present the testing and research being conducted on CAVs and DAT throughout Canada. The content is updated regularly to ensure it is relevant and aligns with the latest technologies. Transport Canada also ensures all of its other public communiques specific to CAVs and ADAS technologies align with the latest version of *Clearing the Confusion*.

Understanding the importance of consistent naming conventions for ADAS technologies, SAE International has also convened a task force entitled the SAE Active Safety Terms and Definitions Task Force with the intent to update the **Active Safety Systems Terms & Definitions Standard (J3063)** using consumer-friendly language. The purpose of the J3063 update is to align terminology to improve the customer education of ADAS features, and *Clearing the Confusion* is deemed as a key resource for ensuring consistent taxonomy. This standard provides a compendium of terms, definitions, and acronyms to enable common terminology for use in engineering reports, diagnostic tools and publications related to active safety systems. The document provides descriptions of functionality rather than technical specifications. Although it includes warning and momentary intervention systems, it does not include automated driving systems as per SAE J3016.

Noting that when used properly, some ADAS technologies have the potential to significantly reduce the severity and frequency of vehicle collisions, it is important that drivers understand the systems capabilities, while respecting their limitations, in order for those safety benefits to be realized. Establishing a common set of terms for emerging technologies can help Canadian drivers better understand the types of ADAS features available in their vehicles and inform them how to apply them properly. In turn, this will help promote the safe use of emerging vehicle technologies and further advance road safety in Canada.

RECOMMENDATIONS FOR JURISDICTIONS

3.2.1 Use consistent terminology to describe ADAS technology in vehicles as international standards continue to be developed.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

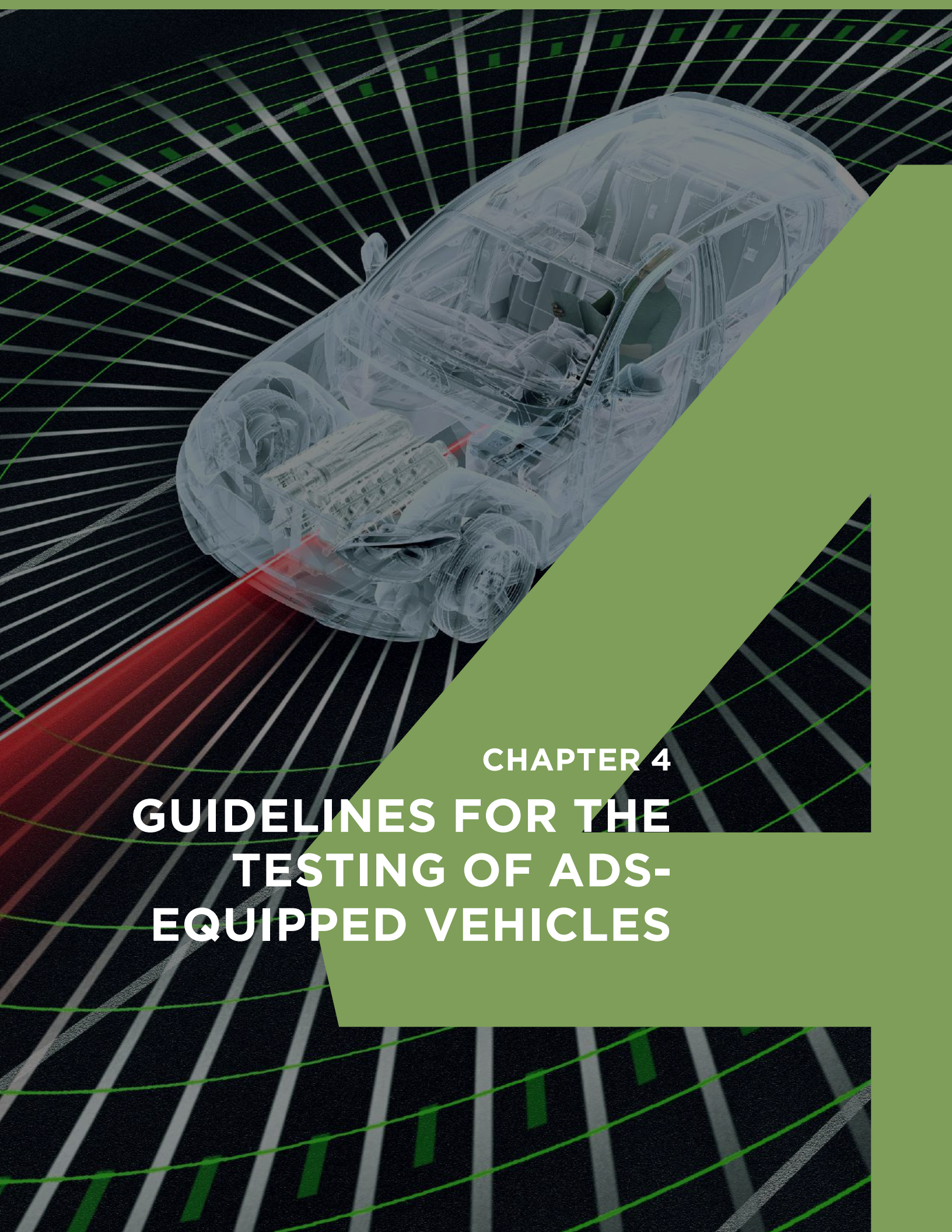
MOE 2. Manufacturers and other entities should adopt consistent terminology to describe ADAS technology in vehicles.

Benefits to Implementation

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

Challenges to Implementation

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



CHAPTER 4

GUIDELINES FOR THE TESTING OF ADS-EQUIPPED VEHICLES

Chapter 4

Guidelines for the Testing of ADS-Equipped Vehicles

This chapter addresses topics related to the testing of ADS-equipped vehicle and vehicles with ADAS. These are grouped into two main categories: vehicle credentialing issues (e.g., applications for permits, the permitting process, licence plates, financial responsibility and compliance with the MVSA), driver licencing considerations, including for remote test drivers and training for MTA staff. There are 11 sections to the chapter, within which are 48 recommendations directed |to jurisdictions for implementation consideration, while 4 are directed to MOEs.

Vehicle Credentialing Considerations

4.1 APPLICATION AND PERMIT FOR MANUFACTURERS OR OTHER ENTITIES TO TEST VEHICLES ON PUBLIC ROADWAYS

Background

Statutes and requirements enacted by several jurisdictions 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 those jurisdictions that opt to require a permit for testing ADS-equipped vehicles. This includes passenger vehicles, low-speed shuttles, fleet-owned vehicles and commercial vehicles. The elements that comprise 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/approvals prior to testing on public roadways.

The application process for test permits is intended to provide sufficient background material for jurisdiction and law enforcement personnel to have the opportunity to interact with the manufacturer and its vehicle(s). In situations where a jurisdiction has opted to establish a program that allows testing, relevant jurisdiction and local officials, including law enforcement, should be made aware of who, how, where, when and what testing is being conducted. With this information, officials will be better prepared to ensure safety is prioritized during testing. The permit application process should require the completion or attachment of 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 corporate address, and if applicable
- Program administrator/director
- Contact information for program administrator/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)
    - Licence plate number and jurisdiction of issuance (if applicable)
    - Indication of intention for testing with or without a human controlling the vehicle from within the vehicle
    - Indication of the SAE Level of the vehicle
    - Vehicle type (e.g., passenger car, truck, low speed, etc.)
- List of all drivers of ADS-equipped vehicles including:
    - Full name
    - Date of Birth
    - Driver licence number and jurisdiction of issuance
- Summary of training provided to employees, contractors, or other persons designated by the manufacturer or other entity as drivers of test vehicles
- Criminal background checks of employees, contractors or other persons designated by the manufacturer or other entity as drivers of test vehicles. The costs for such background checks are to be borne by the applicant

- Disclosure of all jurisdictions where application or issuance of testing registration permits has occurred or been denied
- Disclosure of all jurisdictions where testing is or has occurred and an application or permit was not required
- Submission of a Safety Assessment report by the ADS developer, which describes how the ADS-equipped vehicle meets the 13 safety outcomes identified in TC published tool: *Safety Assessment for Automated Driving Systems in Canada*
- Intended Operational Design Domain
- Self-declaration of prior testing of the technology (e.g., track, simulation and/or previous public road testing,) in the conditions the manufacturer intends to subject the vehicle to on public roadways (e.g., various weather, types of roads, and times of the day and night, etc.)
- Confirms compliance with the requirements of the *Motor Vehicle Safety Act*
- Copy of the trial organization's safety plan for testing vehicles including the minimal risk condition component
- Confirmation that no collision avoidance systems (e.g., automatic emergency braking) have been made inoperable (where applicable)
- Routes to be used when testing ADS-equipped vehicles with a remote driver
- Evidence of the manufacturer's ability to respond to judgments for damages for personal injury, death or property damage caused by a vehicle during testing. Evidence may be in the form of an instrument of insurance, a surety bond, or proof of self-insurance (for more detail on this refer to Section 4.4 – Financial Responsibility)
- Notice to the jurisdiction if there are any changes in SAE Levels of the vehicle being tested
- Indication whether there is intent to include riders from the public. If so, indicate whether there is intent to have an ambassador on board (in addition to the safety operator) to help address the public's questions
- Information about what will be conveyed to the public about the testing, and through what means (e.g., website, apps, social media campaigns etc.,) in order to build public awareness and trust in the technologies

Ideally, the application process would provide for a manufacturer or other entity to submit a single umbrella application for any number of identically equipped vehicles. There are, however, a variety of approaches for applications used by jurisdictions across Canada so an umbrella application may not be possible in all locations.

Such permits should be valid in the jurisdiction of issuance only. Each permit, subject to periodic renewal, should contain the following information:

- Owner name;
- Mailing and physical addresses;
- Jurisdictional-specific limitations (e.g., geographic, environmental, etc.);
- Vehicle Identification Number (VIN);
- Year of vehicle (if assigned by the manufacturer);
- Make of vehicle (if assigned by the manufacturer);
- Model of vehicle (if assigned by the manufacturer);
- Vehicle type (e.g., passenger car, truck, low-speed vehicle, etc.);
- Indication of permit holder's intention for testing with or without a human controlling the vehicle from within the vehicle (Note: if testing with a human driver, the permit should indicate whether the driver is in the vehicle or is a remote driver);
- Indication whether there is intent to include riders from the public and, if so, indicate whether there is intent to have an ambassador on board (in addition to the safety operator) to help address the public's questions; and
- Indication of the SAE Level being tested.

In those jurisdictions where manufacturer or other entity-owned vehicles are required to be individually permitted, 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.

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

Jurisdictions may choose to recognize other jurisdictions' testing programs. This would facilitate those programs that test across jurisdictional borders within Canada or with the United States.

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 permit application process including for approval or denial for ADS-equipped vehicles that does not create unnecessary barriers for manufacturers or other entities and requires the completion or attachment of the information listed in Section 4.1's Guidelines above.

4.1.3 Jurisdictions may consider creating a single umbrella application for test permits for any number of identically equipped vehicles.

4.1.4 Require test permit/approval 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 those jurisdictions where manufacturer or other entity-owned vehicles are required to be individually registered.

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

4.1.6 Jurisdictions should not utilize regulations developed for testing for deployed vehicles since these vehicles will be subject to the *Canada Motor Vehicle Safety Standards* and Federal Motor Vehicle Safety Standards (CMVSS and FMVSS) and other potential federal safety guidance.

Benefits of Implementation

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

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 collisions. 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 PERMIT OR AUTHORIZATION PROCESS

Background

Jurisdictions have significant flexibility in establishing a permitting process as described in Section 4.1 – Application and Permit for MOEs Testing Vehicles on Public Roadways. Though provisions of the permitting process may vary significantly among jurisdictions, public trust and the integrity of the permitting process 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 should permit holders violate permit or safety conditions as well as the ability to deny renewal of an application. 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 establish a process for reporting traffic law violations to the permit issuing agency.

When creating grounds for suspension/revocation/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 is subject to an investigation by any law enforcement, licencing or permitting agency, Transport Canada, or any other government agency;
- failure to follow the rules of the road;
- failure to timely file required reports with the jurisdiction; and
- failure to properly monitor its drivers, either as to their driver record, or actions on the road.

Jurisdictions should also set forth an appeal process from any action taken against a manufacturer or other entity.

RECOMMENDATIONS FOR JURISDICTIONS

4.2.1 Develop provisions for suspension/revocation/fining of any permit holder to test on public roads if permit holders violate permit conditions and 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 violations to the permit issuing agency.

4.2.4 Have an appeal process from any action taken against a manufacturer or other entity.

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 development. But issuing a permit alone does not ensure safety if a permit holder is not held accountable to the conditions of the permit (e.g., background checks, operating in school zones). There must be ramifications for violating the conditions of the permit to ensure 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 the resources to monitor and enforce provisions of its permitting process and may find responding to manufacturers' appeals time-consuming.

4.3 VEHICLE PERMITTING/AUTHORIZATION AND REGISTRATION

Background

Vehicle permitting, registration credentials and records are basic tools which 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 in North America already require the use of special permits/authorizations/registrations/approvals for ADS-equipped vehicles tested on public roadways by a vehicle manufacturer or other entity in their jurisdictions.

Guidelines for Testing Vehicles

While numerous jurisdictions have considered regulating ADS vehicles, only a few have ventured into the field of allowing the testing of such vehicles. Generally, jurisdictions do not require registration of a motor vehicle until it has been sold. There is no reason to change this practice for ADS vehicles.

Even though a jurisdiction may not require a permit for test vehicles, the jurisdiction should record and maintain the vehicle information in its vehicle record database either through the normal process, through a permitting/registration exception process unique to ADS vehicles or recording vital information in the registration record without permitting.

Storing information, such as the VIN and the ADS Level:

- provides pertinent information to stakeholders in case of a collision;
- ensures ownership transfer of the vehicle (if permitted) will be within its laws or policies[16], depending on how a jurisdiction wants to treat a post test vehicle;
- provides information to the Interprovincial Records Exchange (IRE) so the status of the vehicle is readily available to other jurisdictions; and
- provides pertinent information to law enforcement.

Uniform language should be established which will benefit law enforcement, the MTA and other stakeholders. This uniform language includes the use of the acronyms and terms such as “ADS” and “ADS vehicle”.

For the benefit of law enforcement, the MTA and other stakeholders, the uniform notation “ADS Level” for “Automated Driving System Level” should be displayed on the testing permit and/or registration, if issued, and reflected on the jurisdiction’s electronic record (i.e., vehicle database). It is recommended that jurisdictions introduce an ADS “flag” on their registration database and have a supplemental corresponding data field indicating the Level of Automation (i.e., 0-5, according to the SAE standard).

16 Unless information is accessible to all DMV employees, a post-test vehicle may be transferred contrary to the jurisdiction’s laws or policies.

For vehicles not equipped with automated technologies by the original equipment manufacturer (OEM), placing and identifying status on vehicles with aftermarket-altered automated technologies is recommended. In some jurisdictions, when a vehicle is significantly altered with aftermarket components or the vehicle no longer physically represents the manufacturer's vehicle, a vehicle record may be given an "Altered" status. An ADS status could also be added to a vehicle record if aftermarket ADS technology is added to the vehicle. Vehicles which have had a Tier 1 supplier, or an aftermarket company significantly alter the vehicle (e.g. up-fitter) with automated technologies enabling ADS functionalities, should be identified for law enforcement and MTAs. This may be accomplished by placing an "A" in the vehicle's status field.

Additionally, it has been suggested vehicles' ADS functionality may change over the life of the vehicles. Capturing this increased functionality is advised. Jurisdictions should utilize the process described in Section 5.2 - Vehicle Registration to record this information.

The registration permit and plate issued by the permitting jurisdiction for purposes of testing should be recognized by other jurisdictions.

RECOMMENDATIONS FOR JURISDICTIONS

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

4.3.2 Establish uniform language that will benefit law enforcement, the MTA and other stakeholders for testing ADS-equipped vehicles. Use the acronyms and terms such as "ADS" for "*Automated Driving System*", and "ADS-equipped vehicle" on the vehicle registration record.

4.3.3 Place a notation on the permit, registration certificate, approval and/or electronic record, if applicable, by means of an ADS flag and the ADS Level in an additional corresponding field for the ADS Level.

4.3.4 Recognize the permit issued by another jurisdiction for purposes of testing.

4.3.5 Jurisdictions should not begin the process of registering test vehicles if the jurisdiction does not already require this protocol for other technology testing scenarios (e.g., alternate fuel test vehicles).

4.3.6 Test vehicles that have entered Canada through a temporary importation declaration will not be permitted to permanently stay in Canada except as provided for in the Motor Vehicle Safety Regulations (e.g., donation as approved by the Minister). Vehicles should be plated through a means that allows the jurisdiction to prevent the transfer of ownership of the vehicle unless it receives approval for permanent importation into Canada.

4.3.7 If the jurisdiction does issue a registration record/credential, it should consider placing an "Altered" or "A" status on vehicles not equipped with automated technologies by the OEM but have aftermarket automated components.

4.3.8 Require manufacturers and other entities to notify the jurisdiction in the case of:
a) any change to the SAE Level of the vehicle or vehicles being tested; or
b) the addition of another vehicle or vehicles to the testing program.

In the case of such notification, the manufacturers and other entities should be required to provide details on these vehicles to be tested.

4.3.9 When changes to the SAE Level have been made or additional vehicles are added to the testing program, the jurisdiction should promptly update its records accordingly, and issue a new permit for the test vehicle or vehicles reflecting the changes/additions made.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 3. Testing entities should be required to notify the jurisdiction of any change in the SAE Level of vehicles being tested and/or the addition of any vehicles to the testing program.

Benefits of Implementation

Disclosure of a vehicle as an ADS-equipped vehicle on the registration certificate allows law enforcement and MTA personnel the ability to better identify vehicles with automated functionality. As the technology becomes more prominent, law enforcement and first responders will need to approach situations including traffic stops or vehicle collision scenes differently (this is addressed in Section 6.7 – First Responder Safety and Training); readily available vehicle record information will benefit law enforcement. Additionally, this information will ensure the ADS Level notation is maintained until a national solution, such as a VIN check digit or indicator, is common in the industry (see Section 5.4 - ADS Vehicle Information on the New Vehicle Information Statement).

The purpose of the permitting process is to ensure safety during development. But issuing a permit alone does not do that if a permit holder is not held accountable to the conditions of the permit, e.g., background checks, operating in school zones, etc. Ramifications for violating the conditions of the permit are necessary to ensure integrity in the permitting process and in maintaining public safety.

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

Challenges to Implementation

When jurisdictions are considering how to manage registrations, they should also review their registration/vehicle status change process, as these recommendations will add complexity. Additionally, there may be inaccuracies in the recording of this data due to the reliability of human entry and the potential for error.

4.4 LICENCE PLATES

Background

The identification of ADS test vehicles is a topic that is being discussed and debated in various international and domestic forums.

Identification of the ADS test vehicle in a specific or recognizable manner, through licence plates or other markings, may cause drivers to behave differently around those vehicles, which may have an impact on the testing itself, including other road users who engage in unsafe driving behaviours. It will also be important for police officers and first responders, however, to easily identify ADS test vehicles, for example, in the event of an emergency or other incident.

The creation of a special licence plate for ADS test vehicles is one identification option but may pose challenges which include: the costs of new plate design; complications related to the identification of the jurisdiction of issuance of the plate; and discernibility of the plate design from the other plates issued by the jurisdiction. Another approach to identifying an ADS test vehicle is to require labels on the body of the vehicle.

In spite of these challenges, a jurisdiction may still opt for special plates. It may be their view that the ability for motor vehicle agency employees, police officers, tolling authorities and citizens to quickly and easily identify licence plate numbers is fundamental to the safe operation of road networks, as well as being able to respond quickly and effectively in emergency situations.

Guidelines for Testing Vehicles

Special licence plates for the specific purpose of testing ADS-equipped vehicles are not recommended. Means of marking other than special licence plates should be found if a jurisdiction decides to require ADS test vehicles to be identified in some way that is visible to road users. For example, consideration could be given to adopting the administrative, design and manufacturing specifications contained in the *AAMVA License Plate Standard*.

Other means of identification are also suggested in Chapter 6 - Law Enforcement and Transportation Safety Considerations, to support law enforcement's efforts to identify vehicles involved in crashes.

RECOMMENDATIONS FOR JURISDICTIONS

4.4.1 Jurisdictions should not require a special licence plate for ADS-equipped vehicles. If a jurisdiction does, however, choose to require a special licence plate for ADS-equipped vehicles, the jurisdiction may consider adopting the administrative, design and manufacturing specifications contained in the *AAMVA License Plate Standard*.

4.4.2 Jurisdictions are also encouraged to monitor international research and best practices as they evolve, to help inform approaches for appropriately identifying ADS-equipped test vehicles through licence plates or other means.

Benefits of Implementation

Identifying ADS test vehicles can help other road users become familiar with new vehicle technologies and promote safer driving behaviours. In addition, law enforcement/first responders may prefer to have visual identification of ADS-equipped vehicles to assist them in the case of a vehicle collision (see further discussion in Chapter 6).

Challenges to Implementation

Challenges in implementing a new licence plate design for testing include: adverse impacts on the testing of ADS-equipped vehicles; the identification of the jurisdiction of issuance; discernibility of the plate design from others the jurisdiction issues; and cost if there is special significance to the licence plate design – as in the design for an ADS-equipped vehicle licence plate. In addition, law enforcement may prefer to have special plates for ADS-equipped vehicles to assist them in the case of a vehicle collision.

4.5 FINANCIAL RESPONSIBILITY

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. All jurisdictions require a minimum financial responsibility requirement for each vehicle operating on public roads.

Vehicle insurance regulators should monitor the legal trends ensuring limits stay relevant and appropriate. It would also be advisable that there is sufficient coverage available for third party liability, in jurisdictional scenarios where there is no explicit distinction in property damage versus personal injury.

Jurisdictions with higher liability insurance requirements for vehicles used today for public transportation should give special consideration to liability insurance requirements for test vehicles that are designed and manufactured to provide similar transportation services. These vehicles are often built to accommodate a minimum of eight passengers.

Guidelines for Testing Vehicles

Different liability insurance requirements among jurisdictions can create incentives for ADS-equipped vehicle testing where 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 collision necessitates higher limits for liability insurance.

All ADS-equipped vehicles permitted for on road testing should be required to have minimum liability insurance, in the form and manner required by the jurisdiction and the MTA authority.

RECOMMENDATIONS FOR JURISDICTIONS

4.5.1 Require all ADS-equipped vehicles permitted for on road testing to have a minimum of $5 million in liability insurance, in the form and manner required by the MTA authority or other relevant agency.

4.5.2 Jurisdictions should consider requiring additional liability insurance, beyond the $5 million minimum, for vehicles with a large seating capacity (e.g., for 8 or more passengers).

4.5.3 For the testing of driverless ADS-equipped vehicles, jurisdictions should consider including a requirement that stipulates, as part of the application process, that

a) testing entities must accept full liability/responsibility for damages caused by their vehicles or drivers, and
b) their insurers must agree to respond to damage claims whether the driver or vehicle is deemed to be at fault.

Benefits of Implementation

Requiring a minimum of $5 million liability insurance level for ADS-equipped vehicles testing provides consistency between non-ADS-equipped vehicles currently in operation and ADS-equipped vehicles. This prevents prospective companies from seeking out jurisdictional testing locations which have lower minimum liability coverage limits. Furthermore, the public will be given some assurance that companies, interacting on the public roadways, are testing in a responsible manner.

Challenges to Implementation

Different liability limits between jurisdictions can create incentives for ADS-equipped vehicle testing where the liability level is the lowest, placing the public at risk and possibly dissuading adoption of this technology by the public. Although not in scope for these recommendations, the increase in commercial motor vehicle ADS-equipped vehicle testing interest has many jurisdictions considering if the potential for greater vehicle damage, or death or injury in a collision necessitates a higher minimum insurance liability limit.

4.6 COMPLIANCE OF ADS TRIAL VEHICLES WITH THE MOTOR VEHICLE SAFETY ACT (MVSA)

Background

Transport Canada, under the *Motor Vehicle Safety Act* (MVSA), establishes regulations for the manufacture and importation of motor vehicles as well as prescribed motor vehicle equipment (e.g., tires and child car seats). The objective of this Act is to reduce the risk of death, injury, and damage to property and the environment.

The MVSA allows for the temporary importation of vehicles that may not comply with the *Motor Vehicle Safety Regulations* (MVSR) or the *Canada Motor Vehicle Safety Standards* (CMVSS) for special purposes, including demonstration, evaluation and testing. For additional information on federal importation requirements, please visit Transport Canada's Importing a Vehicle webpage: https://tc.canada.ca/en/road-transportation/importing-vehicle

Questions relating to temporary importations can be directed to:

Telephone: 1-800-333-0371 (toll-free), 1-613-998-8616 (outside North America)

Email: TVIS-SITV@tc.gc.ca

Paragraph 7(1)(a) of the MVSA allows persons or companies to temporarily import a vehicle that does not meet the *Canada Motor Vehicle Safety Standards* (CMVSS) if, at the time of importation, the person importing the vehicle declares that the purpose for importing the vehicle is for exhibition, demonstration, evaluation or testing.

To import a vehicle for one of these purposes, the applicant must complete and submit the necessary declaration forms (Schedule VII of the Motor Vehicle Safety Regulations (MVSR)) to Transport Canada for review prior to importation. If the information is accurate and complete, the vehicle will be permitted entry into the country for the purpose stated by the applicant.

The MVSA prohibits a company from shipping from one province to another or delivering to any person for the purpose of being so shipped, any vehicle of a prescribed class manufactured in Canada unless it has a national safety mark (NSM) applied to it.

Section 5.1 of the MVSR provides a means for vehicle manufactured in Canada that does not have a NSM applied to it to be shipped from one province to another for the purpose of exhibition, demonstration, and evaluation or testing. A declaration must be filed with the Federal Minister of Transport and must include prescribed information outlined in Section 5.2(2) of the regulation, including whether and when the vehicle will be returned to the province of origin or destroyed after the trial/demonstration, etc.

It is important to note that vehicles that enter a province or territory under a Schedule VII or MVSR 5.1 declaration have not been assessed by Transport Canada to determine what level of safety they provide. See recommendations found in section 4.1 for measures to address this.

Guidelines for Testing Vehicles

It is critical that manufacturers or other entities testing ADS-equipped vehicles ensure those vehicles comply with the MVSA, including where applicable, filing a completed “Declaration of Vehicles Imported Temporarily for Special Purposes” form to Transport Canada.

RECOMMENDATIONS FOR JURISDICTIONS

4.6.1 Consider requiring manufacturers or other entities that seek to conduct trials for ADS-equipped vehicles within their jurisdictions to confirm compliance with the MVSA including federal importation requirements. Consider requiring manufacturers or other entities that seek to conduct trials for ADS-equipped vehicles within their jurisdictions to confirm compliance with the MVSA including the submission of any declarations that may be applicable as per Section 7(1)(a) of the MVSA and Section 5.1(1) of the MVSR as applicable.

4.6.2 As noted in section 4.1, as part of their trial permitting process, jurisdictions are encouraged to ask for the submission of a Safety Assessment report from the ADS-developer based on Transport Canada's published tool: Safety Assessment for Automated Driving Systems in Canada (2019). Jurisdictions are encouraged to consult with Transport Canada when reviewing the information they receive and to share a copy of the safety assessment.

Benefits of Implementation

Jurisdictions will have confirmation that ADS-equipped vehicles tested on public roadways comply with applicable federal laws.

Requesting the submission of a Safety Assessment will inform jurisdictions about the functionality of the automated driving system, its capabilities and limitations, and the safety validation process undertaken to date. This can help to inform jurisdictions about any conditions or safety considerations to apply to the trial.

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.

4.7 PERIODIC MOTOR VEHICLE INSPECTIONS

Background

Several jurisdictions utilize motor vehicle inspection programs. Typically, under inspection 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, etc.)

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 based on those prescribed by the federal government for the manufacture and sale of new vehicles under the Canadian Motor Vehicle Safety Standards (CMVSS) and the US Federal Motor Vehicle Safety Standards (FMVSS). Vehicles that fail to meet minimum requirements cannot be permitted for use on the road until equipment and components are brought into compliance. Recognizing the early stage of development of these emerging technologies Transport Canada continues to work with the international community to develop standards that can be incorporated in the future, as appropriate, within the CMVSS.

The design and application of motor vehicle inspection programs vary greatly between jurisdictions that have one. Prince Edward Island, for example, requires all vehicles to pass an annual safety and emissions inspection, while Nova Scotia requires an inspection after the first three years for a new vehicle and every two years thereafter. In Ontario, conversely, vehicle inspections are required only when a used vehicle is being prepared for sale, or alternatively where an inspection is ordered by law enforcement at roadside. While these programs differ, inspection initiatives share the common objective of promoting vehicle safety.

The emergence and proliferation of automated and connected technologies will result in a diminished role for in-vehicle drivers in the driving task. 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 consumers in ensuring that automated technology is properly and regularly maintained.

Guidelines for Testing Vehicles

It is not realistic or desirable for jurisdictions to establish inspection requirements for test vehicles since:

- MOEs, through testing programs, aim to trial and experiment with new and emerging forms of automated technology;
- The international community continues to work to develop standards for ADAS and ADS technologies; and
- It is not clear how the safety of ADAS and ADS technology can be verified (e.g., through computer diagnostics).

The onus remains, however, on MOEs/testers to ensure the vehicles they are testing are safe.

RECOMMENDATIONS FOR JURISDICTIONS

4.7.1 Do not impose safety inspection requirements to verify the safety of ADAS and ADS technology, for vehicles being tested under AV pilot programs.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 4. Manufacturers and other entities should ensure all technology being tested on public roads is safe.

Benefits of Implementation

Adoption of ADAS and ADS technology into inspection programs may provide jurisdictions with an opportunity to ensure vehicle safety in the future. Given the early state of ADS technology and the development of international safety requirements and best practices, it is not yet definitively known whether inspection programs will be necessary to verify vehicle safety. The working group will continue to explore this topic.

Challenges to Implementation

Given the early state of technology development and international safety requirements/best practices, the adoption of inspection stations is a possible long-term goal for jurisdictions. It is currently not feasible to utilize inspection programs to verify ADS technology safety since uniform standards have not been developed and benchmarks and procedures for verification of technological functionality have not been created. As stated above, the working group will continue to explore this topic.

Driver Licencing Considerations

4.8 DRIVER AND PASSENGER ROLES DEFINED

Background

To be clear, the definitions for "driver" and "passenger" that this report uses are repeated below from the SAE International definitions provided in the Preface:

Driver:

- **[Human] Driver:** a *user* who performs in real-time part or all of the Dynamic Driving Task (DDT) and/or DDT fallback for a particular vehicle.
- **In-vehicle Driver:** a *driver* who manually exercises in-*vehicle* braking, accelerating, steering, and transmission gear selection input devices in order to operate a vehicle.
- **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.

Passenger: a *user* in a vehicle who has no role in the operation of that vehicle.

RECOMMENDATIONS FOR JURISDICTIONS

4.8.1 Utilize the SAE International definitions provided in the Preface.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 5. Manufacturers and other entities should utilize the SAE International definitions provided in the Preface.

Benefits of Implementation

Universal definitions of these terms will facilitate communication, understanding and standardization of 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 jurisdiction laws and regulations ensuring motor vehicle laws are in alignment with SAE International definitions of "driver" to permit the testing of Level 4 and 5 vehicles 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.

4.9 DRIVER LICENCE REQUIREMENTS FOR TESTING BY MANUFACTURERS AND OTHER ENTITIES

Background

Currently there are numerous manufacturers and other entities testing ADS-equipped vehicles in multiple jurisdictions. It is anticipated testing will be expanded to include most jurisdictions. This section provides guidelines for testing 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 ADS-equipped vehicle manufacturer or other entities, such as universities involved in the testing.

Test drivers should have the appropriate class of licence associated with the particular vehicle being tested (e.g., a driver in a Quebec trial holds a Class 5 licence to test passenger vehicles). Test drivers in ADS-equipped vehicles should receive training and instruction related to, but not limited to, the capabilities and limitations of the vehicle and undergo a background check as described in Section 6.3 - Criminal Activity. Manufacturers are in the best position to determine what is appropriate training. As further guidance on this question, MOE's may wish to consider the information on "driver training" provided in SAE standard J3018 and the Automated Vehicle Safety Consortium (AVSC) best practices for driver training. Training provided should be documented and submitted to the 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.

Jurisdictions may wish to include remote and/or driverless operations within their scope of their testing programs. In this case, the jurisdiction should require that the manufacturer of the ADS technology, or any such entity involved in the driverless and/or remote testing of the ADS-equipped vehicle, ensures that safety management plans have been established to manage risks and that the ADS is capable of operating safely in the proposed testing environment based on results from previous testing.

Jurisdictions will need to take the appropriate steps to ensure that their motor vehicle laws/regulations allow for the testing of driverless or remote driving of ADS-equipped vehicles. This may require amending statutory and regulatory definitions of "driver" and other related terms.

Jurisdictions will also need to review and adapt their existing rules regarding vehicle operation to ensure ADS-equipped vehicle testing is permitted.

RECOMMENDATIONS FOR JURISDICTIONS

For ADS-equipped vehicles, the following guidelines are provided:

4.9.1 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.

4.9.2 Require the test driver to have the appropriate and valid class of licence associated with the particular vehicle being tested (e.g., Class 5 licence to test a passenger vehicle).

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

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

4.9.5 Consider allowing testing of driverless or remote operations of ADS-equipped vehicles, provided that the manufacturer can demonstrate that the ADS can operate safely and achieve a minimal risk condition based on results from previous testing. Other risks associated with remote driving should also be accounted for by the trial organization (see Section 4.10 - Remote Test Driver below).

4.9.6 Take steps to ensure their motor vehicle laws allow for the manufacturer testing of ADS Levels 4 and 5 vehicles without a licenced driver.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 6. Manufacturers and other entities should complete a background check and provide/ensure appropriate training for ADS-equipped vehicle test drivers. See Section 6.3 - Criminal Activity on background checks. Manufacturers are in the best position to determine what is "appropriate" training. As further guidance on this question, MOE's may wish to consider the information on "driver training" provided in the SAE J3018 standard.

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. Thorough 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.

4.10 REMOTE TEST DRIVER

Background

Currently some ADS developers and technology firms are working to develop systems that provide varying degrees of remote support and in some cases, allow a remote driver to take over the dynamic driving task from an ADS-equipped vehicle. It is envisioned that in some cases, remote support may be used to overcome certain limitations of ADS technologies as they continue to be refined and developed. For example, remote support may provide assistance when the ADS-equipped vehicle encounters a rare or particularly complex scenario it has not been designed to navigate. For further information, please refer to the definition of "Remote Driver" provided in the Preface.

Some trial organizations in Canada may eventually seek to test ADS-equipped vehicles with the support of a remote driver, rather than having a safety driver who can take over manual control of the vehicle. While such efforts may help to further the development of ADS-equipped vehicles and validate new use-cases

and business models, appropriate precautions need to be taken to ensure risks associated with this type of testing are managed. These risks include signal loss or interruption, latency, distraction, automation bias, task-induced fatigue, among others.

There is limited evidence currently available to establish specific guidelines related to remote driving. Jurisdictions are encouraged to monitor international trends and best practices that may be used to support the safe testing of remote driving as these continue to evolve.

If a jurisdiction is considering allowing testing with remote drivers to occur during a trial, they should exercise caution and request information from the trial organization, including proof of previous testing in controlled conditions and information regarding how the aforementioned safety risks will be managed throughout the trial.

Guidelines for Testing Vehicles

Jurisdictions should recognize this type of vehicle operation is being developed, tested and piloted today and need to begin preparing. 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 and/or in line of sight of the vehicle or could be beyond line of sight at varying distances, including in another jurisdiction or even in another country.

The remote driver must be familiar with the traffic laws in the jurisdiction in which they are driving as traditional drivers in vehicles are today. The issue becomes more complicated, however, when there is a collision or incident that requires law enforcement interaction with the driver.

It will be difficult for the officer to identify the remote driver and determine their actual physical location. If the officer is in one jurisdiction but the remote driver is in another, it becomes problematic. This can be significant if there is a need to determine if the remote driver was distracted or 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.

Other challenges exist with a remote driver. The remote driver must be able to determine the vehicle's physical condition and that it can be operated safely. It will require systems, sensors and mechanisms to be in place to monitor vehicle equipment.

RECOMMENDATIONS FOR JURISDICTIONS

4.10.1 Define remote driver in the jurisdiction's statutes by adopting the SAE definition and review the SAE 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.

4.10.2 Require the testing entity to agree in writing that a remote driver would be subject to an operator fitness evaluation by law enforcement if there is an incident or collision.

4.10.3 Clarify in law that all laws applicable to drivers, apply to remote drivers.

4.10.4 Review licence 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 corrective lenses, hearing devices, and accommodations for missing limbs.

4.10.5 Driver licence program staff and law enforcement need to understand remote driving and be well versed in responding to inquiries.

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

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

4.10.8 Require documentation from the manufacturers and other entities that remote drivers have been trained to safety operate the vehicle remotely. Evidence that other risks associated with remote driving (e.g., signal loss/latency, other human factors considerations etc.) have been sufficiently addressed and validated through previous testing in the vehicle's ODD, should also be provided.

4.10.9 Require Remote Test Drivers to:

a) Comply with all federal and jurisdictional laws unless otherwise exempt.
b) Hold the class of licence issued by the jurisdiction in which the vehicle is being operated for the vehicle they are driving.
c) Be physically located in the same jurisdiction as the vehicle they are driving.
d) Inform their employer immediately of any moving violations.
e) Not be impaired or distracted. They must be fit to drive.
f) Only remotely drive one vehicle at a time.
g) Be at a specific location and not driving remotely from another vehicle.
h) Make available to law enforcement, upon request, their name, physical location, licence number and jurisdiction of issue, as well as the name and contact information of their employer.
i) If the vehicle is involved in a collision, report it immediately to the appropriate law enforcement in the jurisdiction in which the vehicle is located.

4.10.10 Require Test Vehicle Owners to:

a) Post the responsible party's name and contact information within a remotely operated vehicle.
b) Verify remote test drivers' driving records at least annually.

Benefits of Implementation

Remote support of an ADS-equipped vehicle may help overcome certain limitations of ADS technologies as they continue to be refined and developed. It could also facilitate the development of new business applications for many industries (e.g., resource extraction, agriculture, delivery services).

Challenges to Implementation

At this time there is little evidence to demonstrate the safety of remote driving in certain circumstances (e.g., beyond line of sight, mixed traffic at highway speeds). Trial organizations will need to be prepared to provide sufficient evidence of previous testing to authorizing jurisdictions when seeking approval to conduct testing with remote driving applications.

Collisions or incidents involving a remote-controlled ADS-equipped vehicle present a problem for law enforcement since their responsibilities require interaction with the driver in these situations. Further work will be required to establish a procedure by which the investigating officer may determine if the remote driver was distracted, impaired or violated other laws.

Research may be required to establish a limit on the number of vehicles a remote driver can operate or supervise safely. New systems, sensors and mechanisms may also be required for the remote driver to monitor the vehicle's physical condition and to operate it safely. These could be costly to develop and implement.

4.11 TRAINING MOTOR TRANSPORT ADMINISTRATOR STAFF FOR ADAS AND ADS-EQUIPPED VEHICLES

Background

ADAS and ADS-equipped vehicle technologies have the potential to impact most MTA driver programs. Therefore, it is important to provide information and training to the MTA staff as the technology evolves. Managers should begin to understand the technology to help them anticipate and prepare for impacts on their program areas. Staff is also beginning to hear and see information in the media about "self-driving" or "autonomous vehicles" and therefore more knowledge can help them to understand the realities of the testing of the vehicles.

Guidelines for Testing Vehicles

While most MTA staff will not be impacted by manufacturers and other entities testing ADS-equipped vehicles, senior level managers will benefit from understanding their jurisdiction's approach to the regulation of testing. By understanding the progression of testing, the managers will be better prepared to make adjustments to the programs under their responsibility.

RECOMMENDATIONS FOR JURISDICTIONS

4.11.1 MTA senior managers should be aware that ADS-equipped vehicles are being tested and should be aware of their jurisdiction's approach to testing.

4.11.2 MTA staff responsible for approving the testing proposals need to have holistic understanding of the test vehicles (including the risks involved), and its impact to the road users and traffic pattern.

4.11.3 MTA staff responsible for approving test proposals are encouraged to stay up-to-date for testings in other jurisdictions.

Benefits of Implementation

As developers of ADS technologies push for the limit with their innovations, there will be scenarios in which calibrations, validations, and testings of the technologies are required. While there are pushes to conduct these activities virtually to reduce the cost and increase the repeatability of the results, physical

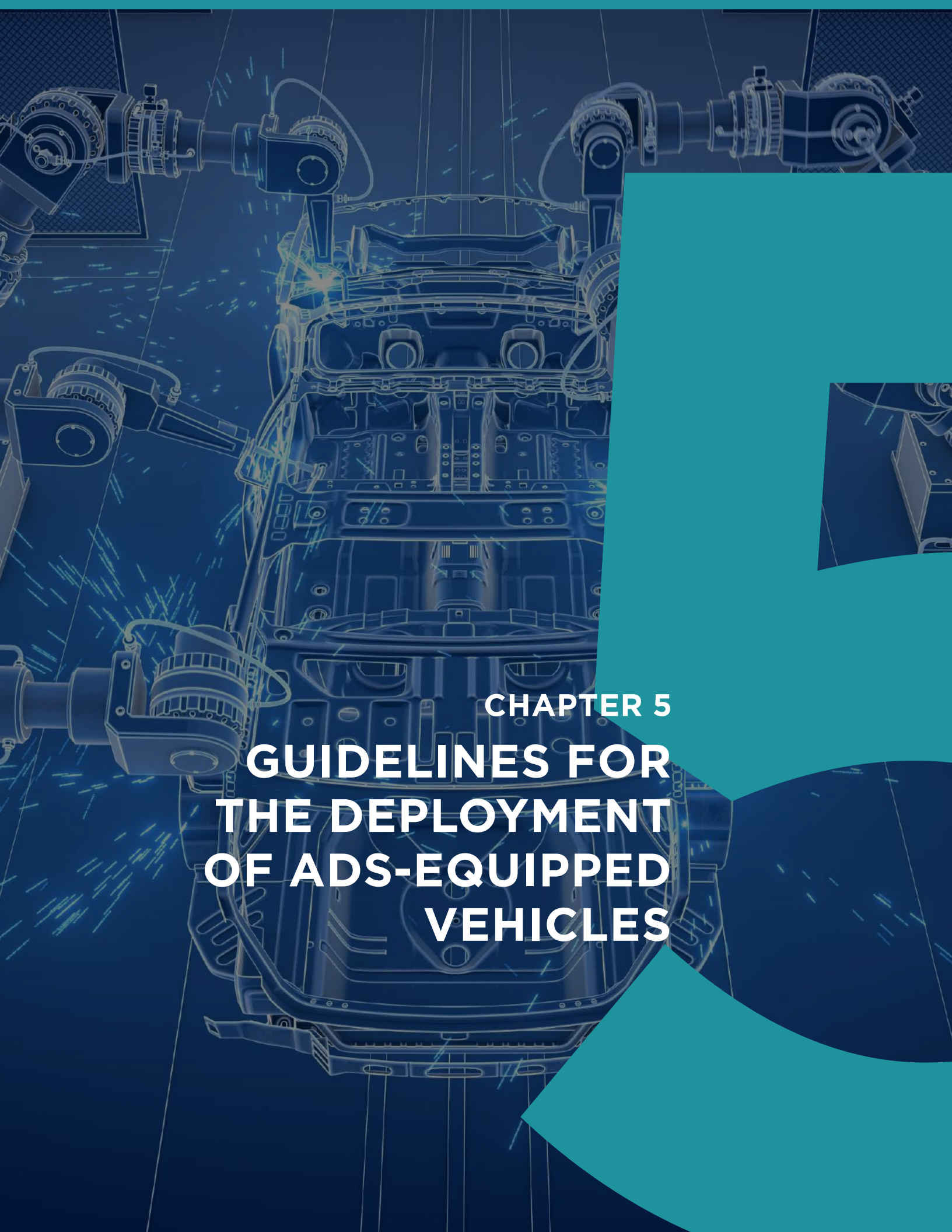
testings of the ADS-equipped vehicles exposed to road users and existing road infrastructures are unavoidable. MTA staff are encouraged to stay aware of these local testing initiatives.

This may lead to a consistent and coordinated response among provincial/territorial government, Transport Canada, local municipality, and enforcement agency with jurisdiction when testings of such technologies have gone wrong. The same awareness of the scope of the testings, test area's traffic pattern, and the limitations of the ADS technologies may allow sufficient oversight by regulatory bodies on how the testings may be conducted.

Training for MTA staff will ensure they are familiar with ADAS and ADS-equipped vehicles and other concepts such as ODD, OEDR, and post-crash behaviours. Standardization of permitting procedures for test vehicles will ensure consistent information on vehicle technologies is provided to MTA staff. By introducing ADAS technology, staff can be better informed and more aware of the safe operation and limitation of the technology. The public expects MTA staff to be versed in highway safety. Part of this is understanding new advancements in vehicle safety, including ADAS and ADS-equipped vehicles.

Challenges to Implementation

It is always a challenge to find the time and resources to provide training to staff as so much of their time is spent providing service to the public. A lack of understanding of vehicle technology available today in the driver licencing programs can lead to inconsistencies among staff and across jurisdictions.



CHAPTER 5

GUIDELINES FOR THE DEPLOYMENT OF ADS-EQUIPPED VEHICLES

Chapter 5

Guidelines for the Deployment of ADS-Equipped Vehicles

This chapter addresses topics related to the deployment of ADS-equipped vehicles and vehicles with ADAS. These are grouped into two main categories: vehicle credentialing considerations (e.g., registration, ADS information on the New Vehicle Information Statement, licence plates, financial responsibility, compliance with the MVSA and motor vehicle inspections) and driver licencing considerations (e.g., licencing, training, educating consumers, MTA staff, driver licence examiners and driver educators). It also addresses approval of the ADS as the driver, remote drivers and Commercial Driver Licences (CDL). There are 41 recommendations in the following 14 sections. There are 35 recommendations directed to jurisdictions for implementation consideration, while 6 are directed to MOEs.

Vehicle Credentialing Considerations

5.1 VEHICLE PERMITS FOR DEPLOYED ADS VEHICLES

Guidelines for Deployed Vehicles

Deployed vehicles may be subject to permit issuance in some jurisdictions.

5.2 VEHICLE REGISTRATION

Background

Vehicle registration and supporting records enable identification of a vehicle and its owner. With deployment of ADS-equipped vehicles, the need for accurate owner and vehicle information is necessary to distinguish these vehicles in mixed-fleet operations.

Guidelines for Deployed Vehicles

Jurisdictions should record and maintain the fact that a vehicle has ADS functionality in its vehicle record database through the normal process of registration and licencing.

Storing information, such as the VIN and the ADS Level:

- provides pertinent information to stakeholders in case of a collision;
- provides information to the Interprovincial Records Exchange (IRE) so the status of the vehicle is readily available to other jurisdictions; and
- provides pertinent information to law enforcement.

Uniform language should be established that will benefit law enforcement, the MTA and other stakeholders. This uniform language should use the common terminology “Automated Driving System (ADS)”.

For the benefit of law enforcement, the MTA and other stakeholder’s, “ADS Level” should be displayed on the registration and reflected on the jurisdiction’s electronic record (i.e., vehicle database). It is recommended that jurisdictions introduce a data field indicating the Level of Automation (i.e., 0 to 5, in accordance with the SAE standard).

For vehicles not equipped with automated technologies by the original equipment manufacturer (OEM), placing and identifying status on vehicles with aftermarket-altered automated technologies is recommended. In some jurisdictions, when a vehicle is significantly altered with aftermarket components or the vehicle no longer physically represents the manufacturer’s vehicle, a vehicle record may be given an “Altered” status. Vehicles which have had a Tier 1 supplier, or an aftermarket company significantly alter the vehicle with automated technologies enabling ADS functionalities, should be identified for law enforcement and MTAs. This may be accomplished by placing an “A” in the vehicle’s status field in addition to the ADS flag and SAE number corresponding to the ADS Level.

Vehicles with lower ADS functionality (Levels 3 or less) may have the ability for upgrading to a higher ADS functionality (move to Levels 3, 4 or 5). In these scenarios, capturing this increased functionality will be necessary.

RECOMMENDATIONS FOR JURISDICTIONS

5.2.1 Establish uniform language that will benefit law enforcement, the MTA and other stakeholders for ADS-equipped vehicles. Use "Automated Driving System" on the vehicle registration record. This uniform language should include the use of the acronyms and terms such as "ADS" for "Automated Driving System", and "ADS vehicle".

5.2.2 Establish a field on the registration and electronic record by means of an ADS flag that indicates the motor vehicle is ADS-equipped and by indicating the motor vehicle's ADS capability Level.

5.2.3 For vehicles not originally equipped with automated technologies by the OEM but have added aftermarket automated components, place an "Altered" or "A" status in the field in addition to the ADS Flag and ADS Level.

5.2.4 If a jurisdiction receives a notification from a manufacturer or other entity (as in MOE 3 or 7), it should update its records, accordingly, and issue a new registration for the vehicle reflecting the change in ADS Level.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 7. Manufacturers and other entities should notify the jurisdiction of any subsequent change in the ADS Level of the vehicles.

Benefits of Implementation

Disclosure of a vehicle as an ADS-equipped vehicle on the registration certificate allows law enforcement and MTA personnel the ability to quickly and accurately identify vehicles with automated functionality during a traffic stop or at a vehicle collision scene. As the technology becomes more prominent, law enforcement will need to approach situations including traffic stops or vehicle crash scenes differently; readily available vehicle record information will benefit law enforcement. Additionally, this information will ensure the ADS Level information is maintained in vehicle registries until a national solution, such as a VIN check digit or other indicator is common in the industry (see Section 5.4 -ADS Information on the New Vehicle Information Statement).

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

Challenges to Implementation

When jurisdictions are considering how to manage registrations, they should also review their registration/vehicle status changes process, as these recommendations will add complexity. Additionally, there may be inaccuracies in the recording of this data due to the reliability of human entry and the potential for error.

As technology progresses and the availability of aftermarket automation products increases, the level of autonomy of a registered vehicle may change over time. Vehicle software updates or upgrades may complicate the registration process, such as increasing the Level of Automation or decreasing the Level of Automation. Neither the New Vehicle Information Statement (NVIS) nor the VIN currently provides an ADS-equipped vehicle identifier.

5.3 LICENCE PLATES

Background

Licence plates serve a common purpose, to identify motor vehicles and to display evidence that the vehicle is authorized for highway operation. Any jurisdiction that adopts a licence plate design specifically for ADS-equipped vehicles, should design those plates for automated licence plate readers (ALPR) and optimal legibility to the human eye. The ability for motor vehicle agency employees, police officers, tolling authorities and citizens to quickly and easily identify licence plate numbers is fundamental to accurate vehicle registration data creation, maintenance, retrieval and eyewitness reporting.

It should be noted, however, that identification of the ADS vehicle in a specific or recognizable manner, through special licence plates or other markings, may have certain challenges: increased costs of new plate design; complications related to the identification of the jurisdiction of issuance of the plate; and discernibility of the plate design from the other plates issued by the jurisdiction. It may even make the vehicle an easy target for vandalism, theft and other crimes (e.g., cyber-crimes). The AV WG will continue to monitor what research

shows about human interaction around ADS-equipped vehicles as this is likely to evolve over time.

In spite of these challenges, a jurisdiction may still opt for special plates. It may be their view that the ability for motor vehicle agency employees, police officers, tolling authorities and citizens to quickly and easily identify licence plate numbers is fundamental to the safe operation of road networks, as well as being able to respond quickly and effectively in emergency situations.

Guidelines for Deployed Vehicles

There is growing recognition that it will be important for other road users to be able to visually identify ADS equipped vehicles. Special licence plates and requiring labels on the body of the vehicle are just some means of identification, among others.

At this stage in ADS technologies' development, it is too early to determine what approach will be most effective. Further research and collaboration with industry and the international road safety community are recommended to identify best practices as ADS technology continues to evolve.

If a jurisdiction opts to issue special plates, consideration should be given to adopting the administrative, design and manufacturing specifications contained in the *AAMVA License Plate Standard*, if applicable.

While it is not recommended to require special plates for ADS-equipped vehicles at this time, other potential means of identification are also suggested in Chapter 6 - Law Enforcement and Transportation Safety Considerations, to support law enforcement's efforts to identify vehicles involved in collisions.

RECOMMENDATIONS FOR JURISDICTIONS

5.3.1 At this time, it is too early to recommend that a jurisdiction require a special licence plate for ADS-equipped vehicles. If a jurisdiction does choose to require a special licence plate for ADS-equipped vehicles, however, the jurisdiction should adopt the administrative, design and manufacturing specifications contained in the *AAMVA License Plate Standard*.

Benefits of Implementation

There is limited benefit for implementing a special licence plate for ADS-equipped vehicles, as long as the jurisdiction follows the recommendation regarding registration documents from Section 5.2 -Vehicle Registration.

Challenges to Implementation

Challenges in implementing a new licence 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 licence plate design – as in the design for an ADS-equipped vehicle licence plate. Law enforcement may prefer to have special plates for ADS-equipped vehicles to assist them in the case of a vehicle collision.

5.4 LEVEL OF AUTOMATION ON THE NEW VEHICLE INFORMATION STATEMENT (NVIS)

Background

The New Vehicle Information Statement (NVIS) is a manufacturer-produced document that is used by Canadian jurisdictions for the registration process of a new motor vehicle. The NVIS format is not governed by federal statute or rule; however, most jurisdictions have statutes or rules governing their appearance, content and acceptance. CCMTA provides jurisdictions and manufacturers with general guidance through CCMTA's *New Vehicle Information Statement and Partial Electronic New Vehicle Information Statement (eNVIS) Policy Manual* to promote uniformity between jurisdictions.

Typically, the NVIS contains, at a minimum, issue date of certificate, control/certificate number, VIN, model year, make, model, series, and body type. The NVIS document also contains fields for manufacturers to list motive power (fuel type or electric), number of cylinders, gross vehicle weight rating (GVWR) and shipping weight, wheelbase, and for motorcycles the electric motor output and engine displacement. A completed NVIS will show the manufacturer's name, 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). The NVIS is generated on security paper similar to jurisdictional registration stock.

Guidelines for Deployed Vehicles

It is recommended that various levels of government and private industry continue to collaborate and cooperate in meeting identification goals for ADS-equipped vehicles entering the marketplace, including exploring potential updates to the NVIS. It is also recommended that vehicle manufacturers consider investigating how to identify automated capabilities on the NVIS.

RECOMMENDATIONS FOR JURISDICTIONS

5.4.1 Jurisdictions should consider changes to their vehicle registry systems so that they can begin recording vehicle Levels of Automation when the information becomes available on NVIS forms.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 8. Various levels of government and private industry should continue to collaborate and cooperate in meeting identification goals for ADS-equipped vehicles entering the marketplace, including exploring potential updates to the NVIS.

Benefits of Implementation

When available, utilizing information from a NVIS provides each MTA with certainty that the manufacturer has certified the vehicle's SAE Level 0, 1, 2, 3, 4 or 5 functionality level. Additionally, this information would be available to every jurisdiction in the same format. We will be able to make important registration, insurance and safety decisions based on using actual data.

Challenges to Implementation

Some jurisdictions will require software changes to accommodate the added digits. In addition, jurisdictions may need to determine how to collect information on changes in Automation Level. This may require regulatory changes.

5.5 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, all jurisdictions require a minimum level of mandatory liability insurance for each vehicle operating on public roads.

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

The AV/CV WG recognizes this is a complex and emerging issue and CCMTA will be consulting with the insurance industry to ensure appropriate guidance is provided to jurisdictions in the future.

Guidelines for Deployed Vehicles

At a minimum, liability insurance requirements should follow current jurisdictional requirements. It is premature to provide additional specific guidance on deployed ADS-equipped vehicles as so much is still unknown. There are many factors to consider as the development of these vehicles progresses, including but are 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 of the issues related to determining the responsible party should liability be transferred wholly or in part to the consumer, the manufacturer, the systems developers or a third-party installer.[17] In the event of a commercial setting, such as a car sharing situation, the issue becomes even more complicated.
- Additional consideration must be given to when a public or semi-public entity has purchased a vehicle for use by consumers, irrespective of whether the consumers are paying for that use.
- It is unknown if the risks associated with ADS-equipped vehicles is lower or greater than the risks with traditional vehicles.

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

- There may also be risks associated with the timeliness of the installation of new firmware issued by the manufacturer that is used to update the ADS. If new firmware is not installed promptly upon its issuance, a question could arise as to which party (e.g., the vehicle owner or the manufacturer) would be responsible in the event of an accident. Risk may also arise if the firmware, sensors and hardware of the ADS are not maintained to the ADS developers' specifications.

RECOMMENDATIONS FOR JURISDICTIONS

5.5.1 While it is still premature to provide specific insurance liability recommendations to jurisdictions, it is not too early for jurisdictions to start considering the new challenges described above when establishing minimum insurance liability on deployed ADS-equipped vehicles.

5.5.2 Consider whether the owner, manufacturer, after market installer or some other person or entity will be the required insured with responsibility for liability insurance.

5.5.3 Consider when a public or semi-public entity has purchased a vehicle for use by consumers, irrespective of whether the consumers are paying for that use.

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

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 9. Manufacturers should be aware of the potential liability that may arise if issuance and installation of firmware to update the operating systems of the ADS are not done in a timely manner by the vehicle owner. Every effort should be made to encourage vehicle owners to install the new update as soon as possible after issuance. In addition, manufacturers should take appropriate steps to ensure that firmware, sensors and hardware of the ADS are maintained to the manufacturers' specifications.

5.6 COMPLIANCE OF DEPLOYED ADS-EQUIPPED VEHICLES WITH THE MOTOR VEHICLE SAFETY ACT (MVSA)

Background

Transport Canada, under the Motor Vehicle Safety Act (MVSA), establishes regulations for the manufacture and importation of motor vehicles as well as prescribed motor vehicle equipment (e.g., tires and child car seats). The objective of these regulations is to reduce the risk of death, injury, and damage to property and the environment.

A company, as defined in the MVSA, may seek an exemption from a standard under Section 9 of the MVSA. Such an exemption could be used for example, when an incompatibility exists between existing standards and a newly manufactured or imported ADS-equipped vehicle that is planned for deployment. As part of this process, an exemption must only be granted for a model if the exemption would not substantially diminish the overall safety performance of the model. The exemption could be used to manufacture or import vehicles only for the period specified by the Minister of Transport. Vehicles which are subject to the exemption order under Section 9 of the MVSA could remain in Canada indefinitely. However, a Transport Canada assessment and granting of the exemption request would be necessary as approved by the Minister. For additional information on the exemption process, please consult Transport Canada's publication **Process for Seeking Exemptions from Canada Motor Vehicle Safety Standards**.

Guidelines for Deployed Vehicles

Companies, as defined in the MVSA, that seek to apply the national safety mark to an ADS-equipped vehicle must conform to all relevant MVSA requirements unless specifically exempted by Transport Canada, as established under section 9 of Canada's *Motor Vehicle Safety Act*. An exemption will only be granted for a model if the exemption does not substantially diminish the overall safety performance of the model.

RECOMMENDATIONS FOR JURISDICTIONS

5.6.1 Require all ADS-equipped vehicles, available to the public, to conform to all applicable Canada Motor Vehicle Safety Standards, unless specifically exempted by Transport Canada.

Benefits of Implementation

Jurisdictions will have confirmation that ADS-equipped vehicles deployed on public roadways comply with applicable federal laws and regulations.

5.7 PERIODIC MOTOR VEHICLE INSPECTIONS

Background

Several jurisdictions utilize motor vehicle inspection programs. Typically, under inspection 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, etc.) 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 based on those prescribed by the federal government for the manufacture and sale of new vehicles under the Federal Motor Vehicle Safety Standards (FMVSS) and Canadian Motor Vehicle Safety Standards (CMVSS). Vehicles that fail to meet minimum requirements cannot be permitted for use on the road until equipment and components are brought into compliance.

The design and application of motor vehicle inspection programs vary greatly between jurisdictions that have one. Prince Edward Island, for example, requires all vehicles to pass an annual safety inspection. In Ontario, conversely, vehicle inspections are required only when a used passenger or light-duty vehicle is being prepared for sale, or alternatively where an inspection is ordered by law enforcement at roadside. While these programs differ, inspection initiatives share the common objective of promoting vehicle safety.

The emergence and proliferation of automated and connected technologies will result in a diminished role for in-vehicle drivers in the driving task. 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 consumers in ensuring that automated technology is properly and regularly maintained.

Guidelines for Deployed Vehicles

Integrating new and emerging technologies into inspection programs is a common occurrence in jurisdictions that utilize such programs. Existing organizational practices may exist (working groups, task forces, etc.) that can be leveraged to assist in the integration of ADAS and ADS-equipped technology into inspection programs.

However, given the state of ADAS and ADS-equipped technology, it is likely premature for jurisdictions to develop inspection and maintenance standards for ADAS and ADS-equipped vehicles -particularly being that federal vehicle safety standards for these technologies have not been developed.

Federal and jurisdictional governments should continue to work with manufacturers to understand mechanisms for verifying the safety and active functionality of ADAS and ADS-equipped technology components (e.g., through computer diagnostics), and how vehicle safety might be discernable in the future by trained technicians. Jurisdictions should also consider vehicle age and cybersecurity compliance prior to their deployments.

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

5.7.1 Integrate ADAS and ADS-equipped technology maintenance requirements into inspection programs after federal safety standards have been developed; minimum program requirements should reflect federal safety standards where possible. At that point, establish a committee or task force to lead and explore integrating AV technology into jurisdictions' inspection programs.

5.7.2 Jurisdictions should continue to work closely with manufacturers and other entities to understand mechanisms for verifying the safety and functionality of ADAS and ADS-equipped technology components, and how safety might be discerned in the future.

Benefits of Implementation

Adoption of ADAS and ADS-equipped technology into inspection programs may provide jurisdictions with an opportunity to ensure vehicle safety in the future. However, it is not yet definitively known – given the existing state of AV technology and lack of federal standards – whether inspection programs will be necessary to verify vehicle safety. The working group will continue to explore this topic.

Challenges to Implementation

Absence of federal standards and the early state of technology development make the adoption of inspection stations a possible long-term goal for jurisdictions. It is currently not feasible to utilize inspection programs to verify ADAS and ADS-equipped technology safety being that uniform standards have not been developed and benchmarks and procedures for verification of technological functionality have not been created. As stated above, the working group will continue to explore this topic.

Driver Licencing Considerations

5.8 DRIVER AND PASSENGER ROLES DEFINED

Background

As in the Preface (Definitions) and Chapter 4 for testing ADS-equipped vehicles, the following definitions for driver and passenger will be used for deployment of ADS-equipped vehicles.

Driver:

- **[Human] Driver:** a *user* who performs in real-time part or all of the Dynamic Driving Task (DDT) and/or DDT fallback for a particular vehicle.
- **In-vehicle Driver:** a *driver* who manually exercises in-*vehicle* braking, accelerating, steering, and transmission gear selection input devices in order to operate a vehicle.
- **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.

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

RECOMMENDATIONS FOR JURISDICTIONS

5.8.1 Utilize the SAE International definitions provided in the Preface.

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

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 10. Manufacturers and other entities should utilize the SAE International definitions provided in the Preface.

Benefits of Implementation

Universal definitions of these terms will facilitate communication, understanding and standardization of roles and responsibilities for 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 jurisdiction laws and regulations ensuring motor vehicle laws are in alignment with SAE International definitions of "driver" to permit the operation of Level 4 and vehicles without a driver. Legislative action amending statutory and regulatory definitions of "driver" and related terms and reviewing and adapting existing rules regarding vehicle operation may pose challenges until more policy makers are versed in the subject matter.

5.9 DRIVER TRAINING FOR CONSUMERS FOR DEPLOYED VEHICLES

Background

Although most of this report addresses ADS-equipped vehicles, technology described as ADAS also has implications for the driver license training and testing process. Therefore, sections 5.3 - 5.7 include discussions on ADS-equipped vehicles as well as ADAS equipped vehicles.

The operation of ADAS and ADS-equipped vehicles by consumers will have significant implications for driver training. As ADAS and ADS-equipped vehicles are deployed and become available to the public, drivers will need to understand the technology and receive proper training on the operation and limitations of their ADAS and ADS-equipped vehicles.

Transport Canada's 2019 public opinion survey on consumer awareness of AVs and ADAS found that a majority of respondents were largely unfamiliar and skeptical of AVs and that a significant number tend to confuse different ADAS features, particularly those that provide a warning versus those that assist with the driving task (e.g., forward collision warning versus automatic emergency braking). That survey also found that only about a quarter of owners/drivers reported using the owner's manual to learn about ADAS features. Friends and family, manufacturer's website and dealership were among the top picks for learning options. Notably, a significant portion of respondents indicated that they had made no efforts to learn about the features at all. A similar study published by the AAA in September 2018 found that when respondents were asked to report all the sources they had used to learn about 4 ADAS features, approximately 45% of respondents reported using the owner's manual as their top choice. Approximately 29% of AAA study respondents indicated they had not sought any information regarding their systems at all.

TC's findings (as well as those of the CAA, AAA, and others) highlight the importance of addressing consumer knowledge and awareness of ADAS features and ADS-equipped vehicles, particularly with a view towards improving road safety.

A key aspect is determining who has the responsibility for training the consumer.

Drivers should make efforts to ensure they understand the functionality, capabilities and limitations of different features in the vehicles they use. Jurisdictions should encourage drivers to consult manufacturer resources such as the owners' manual, and the manufacturer's website. Other opportunities for consumers to inform themselves may include seeking private training from a recognized professional.

In addition to consumers educating themselves, other parties should also play a role in supporting consumer training for ADAS and ADS-equipped vehicles. Some options may include:

- Manufacturers, dealers, rental agencies and other appropriate entities providing adequate driver training and education/information directly to the consumer for ADAS and ADS-equipped vehicles; and
- Jurisdictions mandating driver training for consumers of ADAS and ADS-equipped vehicles. Some options that can be considered are:
    - Mandatory training for beginner drivers.
    - Mandate dealers to provide information or training to buyers under the Motor Vehicle Dealers Act (MVDA).
    - Jurisdictions may also want to consider consumer awareness campaigns to support the safe use of emerging vehicle technologies. Where possible, messaging should be aligned to support the use of consistent terms and safety best practices across jurisdictions. The following Transport Canada website: www.canada.ca/driverassistance provides material that could be leveraged for this purpose.

The appropriate entities need to develop quality training programs that will effectively train consumers to operate ADAS and ADS-equipped vehicles safely and reasonably. The training should educate consumers on the limitations and capabilities of ADAS and ADS-equipped vehicles, how to engage and disengage the system functions, risks of misuse and how to deal with emergency situations. The training should encompass all safety features to ensure consumers understand the systems, along with their intended use, capabilities, and limitations.

Guidelines for Deployed Vehicles

Communication and education between new, used and aftermarket dealers, manufacturers, and consumers on ADAS and ADS-equipped vehicle functions are critical elements for the safe operation of these vehicles. Manufacturers and dealers should ensure vehicle information and content contained in the vehicle “owner’s manual” is fully available and assist the consumer with reviewing it. However, familiarity of the information and content is not sufficient and should not replace applicable driver training on ADAS and ADS-equipped vehicle functions.

Jurisdictions will need to encourage manufacturers and dealers to provide proper training to the fullest extent for consumers. Jurisdictions may also need to encourage manufacturers and dealers to offer incentives to consumers to

seek training from a fully qualified driving instructor. Insurance companies may also provide discount incentives.

Agreement upon a minimum set of training requirements, outside of the normal owner's manual, will have a direct impact on the success of ADAS and ADS-equipped vehicle technology. Many dealerships already provide personal training classes on features of the vehicle for their customers. Standardized training should be available to everyone who purchases or has the technology installed on their vehicle. In addition to these jurisdictional guidelines, stakeholder consultation is highly recommended.

RECOMMENDATIONS FOR JURISDICTIONS

5.9.1 Promote consumer training on the use of ADAS and ADS-equipped vehicle functions.

5.9.2 Consider conducting public awareness campaigns to support safe consumer use of emerging vehicle technologies as they enter the market.

5.9.3 Encourage communication between dealers and consumers including, but not limited to, acknowledgement of the sections in the vehicle "owner's manual" that relate to the ADAS and ADS-equipped vehicle functions. The owner's manual and/or other consumer education resources should contain easy to understand information for the consumer.

5.9.4 Encourage manufacturers, dealers and insurance companies to provide incentives for consumers to receive proper training on the use of ADAS and ADS-equipped vehicle functions.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 11. Manufacturers should take steps to make training available to licenced drivers to ensure they understand the functionality of the vehicle and are prepared to operate it properly. Manufacturers and Other Entities should consider implementing learning tools, such as online/in-person/in-vehicle tutorials and training programs.

Benefits of Implementation

Consumers who are properly educated on ADS-equipped vehicle functions, limitations and capabilities of their vehicle, including how to engage and disengage the system, risks of misuse and how to deal with emergency situations will support the safe deployment of these vehicles.

Challenges to Implementation

Challenges to implementation include educating consumers on the importance of obtaining training on their ADAS and ADS-equipped vehicle functions and buy-in from manufacturers, dealers and insurance companies to provide training or to offer incentives to consumers to seek training.

Educating the public on the safety and services that ADS technology provides will be critical to public acceptance of ADS Level 4 and 5 vehicles and the idea that a vehicle user need not be a driver.

The use of rental vehicles and other unfamiliar vehicles can result in the driver or user not understanding the technology, how to use it and its limitations or benefits. The working group will continue to explore this topic.

5.10 TRAINING MOTOR TRANSPORT ADMINISTRATOR STAFF FOR ADAS AND ADS-EQUIPPED VEHICLES

Background

ADAS and ADS-equipped vehicle technologies have the potential to impact most MTA driver programs. Therefore, it is important to provide information and training to the MTA staff as the technology evolves. Managers should begin to understand the technology to help them anticipate and prepare for impacts on their program areas. Staff is also beginning to hear and see information in the media about “self-driving” or “autonomous vehicles” and therefore more knowledge can help them understand the realities of the testing and deployment of the vehicles.

Guidelines for Deployed Vehicles

As automated vehicle technologies continue to advance, the training of MTA staff will need to keep pace. Some basic subjects for study could include: what the technology does and how it works; and a review of the SAE and CCMTA Guidelines definitions of ADAS and ADS-equipped vehicles. This will provide a common understanding of the technology as well as eliminating any confusion

around usage of the various technical terms. In this regard, jurisdictions may wish to consult the 2019 AAMVA resource guide entitled, *Testing Drivers in Vehicles with Advanced Driver-Assistance Systems*. There are many other on-line resources, including those on the Transport Canada website, that can be accessed to provide videos and pictures of vehicles equipped with ADAS and ADS, as well as information on latest developments with the technology in Canada and around the world.

RECOMMENDATIONS FOR JURISDICTIONS

5.10.1 Provide general training to MTA staff on vehicle technologies, including what the technology does and how it works. AAMVA's *Testing Drivers in Vehicles with Advanced Driver-Assistance Systems* resource guide, published in 2019, could be utilized.

5.10.2 Require all definitions and language on ADAS and ADS-equipped vehicles provided to MTA staff to be taken from SAE or CCMTA's guidelines for consistency.

5.10.3 Begin to expose staff to vehicle technology by incorporating some general education about vehicles in staff meetings. This could include showing videos and pictures of vehicles equipped with ADAS and ADS.

Benefits of Implementation

Training for MTA staff will ensure they are familiar with ADAS and ADS-equipped vehicles. Standardization of licencing procedures will ensure consistent information on vehicle technologies is provided to MTA staff. By introducing ADAS technology, staff can be better informed and more aware of the safe operation and limitation of the technology, as they operate vehicles provided by the jurisdiction and purchase vehicles for their personal use. The public expects MTA staff to be versed in highway safety. Part of this is understanding new advancements in vehicle safety, including ADAS and ADS-equipped vehicles.

Challenges to Implementation

It is always a challenge to find the time and resources to provide training to staff as so much of their time is spent providing service to the public. A lack of understanding of vehicle technology available today in the driver licencing programs can lead to inconsistencies among staff and across jurisdictions.

5.11 TRAINING MOTOR TRANSPORT ADMINISTRATOR EXAMINERS ON ADAS AND ADS-EQUIPPED VEHICLES

Background

ADAS and ADS technologies have developed at a rapid pace. The training of driver licence examiners on these technologies should keep pace with this evolution. ADAS and ADS technologies have many implications for the driver licence testing process.

Additionally, the training of driver education teachers and instructors, as well as driver education curricula, should evolve with these technologies. Most driver training in Canada is provided by private driver training schools and community colleges.

CCMTA and AAMVA play a key role in the development of driver training curricula and driver instructor training standards in Canada:

- CCMTA's *National Safety Code Standard 2 Knowledge and Performance Tests (Drivers)* sets out the process for standardized testing of all drivers, including commercial drivers in Canada. It is recommended that CCMTA work in collaboration with the AAMVA Test Maintenance Subcommittee of the AAMVA Driver Standing Committee, responsible for the development and maintenance of all AAMVA model licensing test systems including model driver manuals, knowledge and skill tests to address the use of vehicle technology during driver testing. Changes to the driver licence examiner training requirements would need to be considered by CCMTA for possible inclusion in NSC 2; and,
- CCMTA's *National Safety Code Standard 3 Driver Examiner Training Program* is designed to upgrade the skills and knowledge of driver examiners and ensure they are consistent across Canada. AAMVA's International Driver Examiner Certification Program establishes standards for driver examiner training and helps to ensure that examiners have met the minimum knowledge and skills training requirements for conducting licensing tests. It is recommended that CCMTA will work in collaboration with the AAMVA International Driver Examiner Certification (IDEC) Board with updating the driver licence examiner training materials to address vehicle technology as it emerges. Changes to the driver licence examiner training requirements would need to be considered by CCMTA for possible inclusion in NSC 3.

The Canada Safety Council publishes and disseminates educational programs and information relating to driver safety. The Canadian Automobile Association promotes driver education programs.

American organizations that play a role in the development and dissemination of driver training curricula include the:

- American Automobile Association (AAA)
- American Driver and Traffic Safety Association (ADTSEA)
- Driving School Association of the Americas (DSAA)

Other resources may be found in the work of AAMVA's Test Maintenance Subcommittee (TMS) and the International Driver Examiner Certification (IDEC) Board. These organizations recognize that vehicle technologies are emerging faster than driver licence test design and examiner training can keep pace. ADAS and ADS-equipped vehicle technologies have many implications for driver licencing and driver testing programs. AAMVA assists jurisdictions with driver testing standards and driver licence examiner training.

AAMVA's Automated Vehicles Subcommittee has partnered with the TMS and other organizations to update model driver manuals, knowledge tests, and skills tests in the future to address the use of vehicle technology to support the driver testing process. The Automated Vehicles Subcommittee is also assisting the IDEC Board to update driver licence examiner training materials to address emerging vehicle technology. In the interim, the TMS and IDEC along with the AAMVA Automated Vehicles Subcommittee, developed a guide *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 within driver testing.

Guidelines for Deployed Vehicles

- **Jurisdictional Examiners**

  It is important that jurisdictions ensure driver licence examiners are familiar with vehicle technologies. As automated vehicle technologies continue to advance, the training of driver licence examiners will need to keep pace with these advancements. This training will need to be updated on a regular basis as the technologies continue to evolve. Refer to AAMVA's International Driver Examiner Certification (IDEC) model training materials which will be updated in the future to include ADS technologies. Changes to the driver licence examiner training requirements would need to be considered by CCMTA for possible inclusion in NSC 2 and 3.

RECOMMENDATIONS FOR JURISDICTIONS

5.11.1 Provide training to driver licence examiners on vehicle technologies including the operation of ADAS and ADS vehicles.

5.11.2 Align with future iterations of AAMVA's International Driver Examiner Certification model training materials that include ADAS and ADS vehicles. Changes to the driver licence examiner training requirements would need to be considered by CCMTA for possible inclusion in NSC 2 and 3, to continue alignment with AAMVA.

Benefits of Implementation

Training for driver licence examiners will ensure they are familiar with ADAS and ADS technologies. Standardization of content in driver education curricula and training for driver education instructors will ensure consistent information on automated vehicle technologies is delivered to new and experienced drivers.

Challenges to Implementation

There are inconsistencies between jurisdictions on standardized curricula content and instructor training standards. Some MTA staff and some driver licence examiners have not received sufficient training on new vehicle technologies and the impacts it has on driver education and testing. The rate of acceptance of AV/CV technological advances by the jurisdictional regulatory regime will determine the rate at which training needs to be reviewed and updated.

5.12 TRAINING FOR DRIVER EDUCATORS AND CONSIDERATIONS FOR DRIVER EDUCATION AND DRIVER TRAINING PROGRAMS

Background

The training of driver educators and the creation of driver education curricula should evolve with ADAS and ADS technologies. ADAS and ADS-equipped vehicle technologies have many implications for driver education. National organizations who play a key role in the development of driver education and driver training and driver educator training curricula include the:

- Canada Safety Council (CSC)
- Canadian Automobile Associations (CAA)
- Canadian Association of Road Safety Professionals

- American Automobile Association (AAA)
- American Driver and Traffic Safety Association (ADTSEA)
- Driving School Association of the Americas (DSAA)
- American Association of Retired Persons (AARP)

The Association of National Stakeholders in Traffic Safety Education (ANSTSE) develops free standards and resources to assist jurisdictions in their driver education efforts. ANSTSE and the AVWG of AAMVA are available to assist driver educators and driver education programs as they broaden their knowledge of ADAS and ADS-equipped vehicles.

Guidelines for Deployed Vehicles

- **Driver Education and Private Instructors**

  Driver education instructors should play a key role in educating students/consumers on the functions of ADAS and all ADS Levels. Additionally, driver education materials will need to be updated to include information on the use of and interaction with ADAS technologies and ADS vehicles; and for programs to provide hands on training on ADAS features and other ADS vehicle technologies.

  Standards for curricula and instructor training will need to be developed and updated on a regular basis as ADAS and ADS technologies continue to evolve.

RECOMMENDATIONS FOR JURISDICTIONS

5.12.1 Require driver education curricula to contain information on ADAS and ADS-equipped vehicles and to provide behind-the-wheel instruction using this technology.

5.12.2 Require all definitions and language on ADAS and ADS-equipped vehicles provided in driver education to be taken from SAE or CCMTA guidelines for consistency.

5.12.3 Establish standards for the conduct and training of driver educators and private instructors for the training of drivers on the use of ADAS and ADS-equipped vehicles.

Benefits of Implementation

Training for driver educators will ensure they are familiar with ADAS and ADS-equipped vehicles. Standardization of content in driver education curricula will ensure consistent information on vehicle technologies is provided to driver educators and all drivers.

Educating the driving public on the safety benefits and functionality of ADAS and ADS-equipped vehicles will enhance safety and public acceptance.

Challenges to Implementation

Driver educators may not be well informed of vehicle technologies; therefore, there may be inconsistencies in driver education. Inconsistencies among jurisdictions on standardized content for driver educator and driver education curricula, impact how driver education is delivered.

Another challenge facing driver training and driver training instructor providers is the cost of adding an ADS-equipped vehicle and vehicles with ADAS technologies to the fleet, and the differences or lack of consistency in the user interfaces with the technology.

5.13 DRIVER LICENCE SKILLS TESTING WITH VEHICLE TECHNOLOGIES

Background

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

- **Convenience Technologies –** for purposes of this Guidelines Document are technologies that provide conveniences for the driver (e.g., parking assist feature or adaptive cruise control, lane keeping assistance) and do not require the applicant to demonstrate a required skill set and should not be permissible for testing.
- **Safety Critical Technologies –** for purposes of this Guidelines Document are technologies that may prevent or reduce the severity of a collision. These technologies (e.g., backup or other cameras, alerts, lane departure warning, automatic emergency braking) could prevent or lessen the severity of a collision and should be permissible and not be disengaged for testing.

Guidelines for Driver Testing Using Deployed Vehicles

The purpose of the driver licence skills test is to determine an applicant's proficiency in operating a motor vehicle in most road situations. The applicant should not be assisted by vehicle convenience technologies. Skills testing evaluates the applicant's abilities, not the vehicle's technology.

Applicants should only use a vehicle that requires them to exhibit proper driving behaviours (driven in manual mode) and proficiency in operating a motor vehicle. Even though a vehicle has technology features, the applicant must demonstrate the ability to operate the vehicle in manual mode and not solely rely on the technology should the technologies require the driver to engage them manually or they become inoperable.

As technologies evolve, there may be a need to test drivers on their ability to operate specific vehicle technologies. Guidance in this area will be considered in future iterations of this report.

Some technologies cannot be disengaged and should be permissible during the testing process (e.g., lane departure warnings). The applicant should demonstrate proper responses to the technologies, while ensuring all required skills for a test component/maneuver are demonstrated.

The use of safety critical technologies for off-road skills tests or parking maneuvers during the road test should be permitted. These technologies, such as backup or other cameras should not be disengaged for off-road testing. Transport Canada will require all new vehicles produced after May 2018 to have rear view video systems (RVS) also known as backup cameras.

The off-road skills test or parking during the road test should be reviewed to evaluate the incorporation of these technologies. In the case of backup cameras or other cameras, the criteria for checking mirrors and blind spots should be reviewed to evaluate the applicant's behavior to utilize cameras in conjunction with mirrors and head-checks, as an example.

The use of safety critical technologies should be permitted during the road skills test. These technologies should not be disengaged during skills tests. In fact, some safety critical technologies cannot be deactivated. Safety critical technologies include, but are not limited to:

- Cameras
- Blind spot warnings

- Lane departure warnings
- Automatic Emergency braking

The road test scoring standards should be updated to reflect the proper procedures for examiners to follow when a safety critical function activates during the testing process.

A driver must be licenced to operate an ADS-equipped vehicle that has the option to switch from an automated to a manual mode (primarily Level 3 and 4 vehicles). When conducting a skills examination in an ADS-equipped vehicle, all non-safety critical technologies should be in the manual mode, if possible, to ensure the driver can operate the vehicle safely.

A driver's licence, and thus driver testing, should be required for any person to drive or operate an ADS-equipped vehicle with driver controls, as a driver may be required to take control or be allowed to take control of the vehicle.

A passenger should not be required to have a driver's licence to be an occupant in an ADS-dedicated vehicle with no driver controls.

MTA driver manuals may not contain information on ADAS or ADS technologies. These manuals will need to be updated and maintained to include pertinent and up-to-date information on ADAS and ADS-equipped vehicles

CCMTA in collaboration with AAMVA will need to continue to play a role in assisting jurisdictions with driver testing practices and driver licence examiner training. The AAMVA Test Maintenance Subcommittee (TMS) is responsible for maintaining and updating AAMVA's model driver testing systems including the AAMVA Non-commercial Model Driver Testing System (NMDTS).

RECOMMENDATIONS FOR JURISDICTIONS

5.13.1 Include ADAS and ADS information on vehicle technologies in the jurisdiction's driver's manual, when provided by the AAMVA TMS, as appropriate.

5.13.2 Include questions addressing ADAS and ADS in the jurisdictional knowledge test, when provided by the AAMVA TMS, as appropriate.

5.13.3 Jurisdictions should not allow the applicant to utilize convenience technologies, such as the parking assist feature, for off-road skills tests or parking maneuvers during the road test. For example, the applicant should be required to demonstrate the ability to park the vehicle.

5.13.4 Allow the applicant to utilize safety critical technologies for skills tests or parking maneuvers during the road test. These technologies, such as backup or other cameras should not be disengaged for off-road testing.

5.13.5 Jurisdictions should not require applicants to deactivate safety critical technologies during the testing process.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 12. Manufacturers that develop an ADS-equipped vehicle that can be fully operated by a human or fully operated by an ADS should consider taking steps to prevent the ADS to be engaged in error. The working group is concerned that a passenger in a dual-mode ADS-equipped vehicle who does not have a driver's licence could engage the mode that requires a human driver to intervene.

Benefits of Implementation

Standardized testing procedures and driver's manual language will ensure consistent driver testing practices for ADAS and ADS technologies. AAMVA's NMDTS and the AAMVA TMS may facilitate this standardization.

Challenges to Implementation

Agreement between jurisdictions on standardized procedures for testing drivers in vehicles with technologies will be essential to achieve consistency across Canada and internationally. Additionally, agreement on standardized information

to be included in jurisdictional driver's manuals on the operation of vehicle technologies will be a challenge.

It is important to ensure licencing restrictions are not unnecessarily placed on a driver, if the vehicles can be designed to prevent manual operation for occupants unable to operate a vehicle safely.

There may be some resistance to requiring a driver's licence to operate an ADS-Equipped Dual-Mode Vehicle. MTAs will need to work with manufacturers/designers to better understand the appropriate safeguards for the public and the occupants.

The working group will continue to explore the dual-mode vehicle as the technology progresses.

5.14 ENDORSEMENTS AND RESTRICTIONS FOR DEPLOYED VEHICLES

Background

Since vehicles with SAE Level 0 – 3 technology are expected to remain in the care and control of the driver, most current driver licence qualifications will apply to their operation. Therefore, existing driver licence qualifications will remain applicable.

Vehicles with Level 4 functionality that may be operated in non-automated mode will continue to require a qualified, licenced driver.

Vehicles with Level 4 and 5 ADS functionality will have the ability to enhance the mobility of those unable to drive or to be licenced due to physical disability, age or some other condition. Permitting passengers without a licenced driver in these vehicles, while the ADS is performing the DDT within its ODD, would allow these populations to reap the benefits of the technology. Level 4 and 5 ADS-equipped vehicles may not have a driver or passengers (e.g., empty vehicle or cargo).

Guidelines for Endorsements/Restrictions

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

Additionally, there is a risk of creating conflicting jurisdictional endorsements and restrictions should jurisdictions consider this licensure regime. This will complicate the exchange of driver's licences from jurisdiction to jurisdiction in translating the driver licencing codes. CCMTA and the jurisdictions will need to examine the development of standardized codes for endorsements and restrictions should they be warranted.

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

Jurisdictions will need to review their laws and regulations related to persons with physical or mental disabilities and unsupervised children in motor vehicles and adopt appropriate laws and regulations to ensure safety for this population at each Level of Automation.

RECOMMENDATIONS FOR JURISDICTIONS

5.14.1 Jurisdictions should not establish endorsements and/or restrictions on the driver licence at this time, specifically for ADS-equipped vehicles.

5.14.2 Review laws and regulations related to a passenger of a motor vehicle, such as unsupervised children, or persons with physical or mental disabilities and adopt appropriate laws and regulations to ensure safety at each Level of Automation.

Benefits of Implementation

Conflicting jurisdictional ADS-equipped vehicle codes and the complications in translating codes when exchanging driver's licences from jurisdiction to jurisdiction is eliminated by not creating ADS-equipped vehicle endorsements and restrictions.

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 and enforcement.

CHAPTER 6

LAW ENFORCEMENT AND TRANSPORTATION SAFETY CONSIDERATIONS

Chapter 6

Law Enforcement and Transportation Safety Considerations

Introduction

This chapter outlines the leading concerns to law enforcement for ADS-equipped vehicles operated on public roadways, including vehicle identification, collision/incident reporting, criminal activity, distracted driving, law/enforcement/first responder interaction plans, adherence to traffic laws and more. There are 48 recommendations in the following 11 sections. There are 21 recommendations directed to jurisdictions for implementation consideration, while 27 are directed to MOEs.

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, EMS and tow and recovery services) to fulfill their duties. These duties include ensuring the occupant(s) is properly credentialed (if required), ensuring safety at the scene if the occupant(s) is incapacitated in a collision and aiding in the recovery of stolen vehicles.

From a law enforcement perspective, traditional means for identifying a vehicle via a licence plate check may not be the optimal method to identify the vehicle as having an ADS. Licence plates are susceptible to theft, only allow identification from the rear in one plate jurisdictions and may be obscured in most collisions 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-equipped 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 and the International Organization for Standardization (ISO) have developed labeling guidelines. These guidelines have varied purposes and provide some recommendations for accepted labeling.

SAE and ISO provide guidance for OEMs relative to first and second responder safety for vehicle collisions involving electric and hydrogen fueled vehicles (xEVs) and include reference to labeling to assist emergency responders to identify the drive system of the vehicle at a safe distance. This is important as many of these vehicles have virtually silent motors or drive systems that can result in unexpected vehicle movements. Though the SAE recommended practices (J2990 and J2990/1) and ISO recognized symbol usage are non-binding, they already have a certain level of acceptance among the OEMs. However, to date, no unique symbols or identification for automated vehicles have been standardized by either organization.

ISO symbols are unique to the particular drive system, i.e., a different symbol for hybrid electric, plug in electric, hydrogen fuel cell, etc. In contrast, SAE J2990 and 2990/1 provide consensus standards for a variety of labeling strategies and designs. By following J2990, OEMs may adopt the ISO symbols, but to date, few have done so. Vehicle drive systems may also be identified by badges indicating "hybrid" or a unique descriptive term, such as "CH2." Alternatively, J2990 and 2990/1 provides as an alternative that manufacturers may use a unique brand name, such as Chevrolet's "Volt" or Nissan's "Leaf," which are unique to a single type of drive system that will allow for easy identification by first responders.

In Canada, one example of labelling comes from the Canadian Standard Association's (CSA) requirement for propane vehicles and compressed natural gas (CNG) vehicles be affixed with a diamond shaped label identifying the fuel type (CSA B149.5 and B109 respectively). These standards are referenced at a provincial level for aftermarket conversions and as alternatives to federal crash test requirements. However, provincial and territorial jurisdictions are authorized to make additional requests or restrictions to the standards as deemed necessary.

In addition to vehicle labeling, other vehicle identification strategies could be considered to improve safety and facilitate motor vehicle administration practices and law enforcement efforts. The VIN for example conveys significant information regarding the characteristics of the motor vehicle to which it is issued. A new VIN system could potentially be considered to support ADS deployment which in turn could support registration and user credentialing.

Guidelines for Testing Vehicles

Whenever an ADS-equipped vehicle is operated on a public road, it is susceptible to a collision and theft. In addition, there may be laws specific to the operation of ADS-equipped vehicles that requires law enforcement officers to identify the vehicle as ADS-equipped. For the safety of law enforcement and other first responders, an ADS vehicle should be readily and clearly identifiable from other vehicles on the roadway. One current means for accomplishing identification is through vehicle labeling.

Since jurisdictions have authority over vehicle registration, a unique ADS identifier on the vehicle registration may provide an alternative, (see Section 4.3 – Vehicle Permitting and Registration) albeit less effective, means of identifying ADS for law enforcement purposes during testing.

Guidelines for Deployment

As ADS technologies are deployed, manufacturers should ensure ADS-equipped vehicles have permanent labeling on the rear and sides of the vehicle or use other proven means to clearly and readily communicate that a vehicle is equipped with an ADS, including for the purposes of law enforcement and first responders. Refer also to MOE's 30 and 31.

RECOMMENDATIONS FOR JURISDICTIONS

6.1.1 There is growing recognition that it will be important for other road users to be able to visually identify ADS-equipped vehicles. Special licence plates and requiring labels on the body of the vehicle are just some means of identification. Other innovative options may emerge as ADS technology continues to evolve (e.g., special lighting systems etc.).

6.1.2 At this stage in ADS technologies' development, it may be too early to determine what approach will be most effective. Further research and collaboration with industry and the international road safety community are recommended to identify best practices as ADS technology continues to develop. Jurisdictions should seek to align any future statutory requirements pertaining to ADS identification based on international best practices.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 13. Manufacturers should develop international consensus standards for a system of external facing permanent labeling and/or other means of visual identification of ADS-equipped vehicles.

Benefits of Implementation

These recommendations, if adopted, will allow law enforcement and other first and secondary responders to readily identify a vehicle from a distance as one with automated capability in a standardized manner. They will enhance the safety of collision scenes, identify the credentialing necessary of users and owners, and aide in the recovery of stolen vehicles.

Challenges to Implementation

The labeling of vehicles has historically been the purview of vehicle manufacturers, which have significant interest in retaining the identity and integrity of their brand. OEMs may oppose efforts to standardize how the capability of their vehicles is conveyed to the motoring public. Historically, OEMs have named features in a proprietary manner, to further distinguish their brand or model, or they have chosen not to differentiate model-specific features from other models in their lineup that would signify equal levels of quality or reliability across the brand.

6.2 COLLISION/INCIDENT REPORTING

Background

For the purposes of this guidance document, collision reporting should occur when there are collisions or incidents between ADS-equipped vehicles and other vehicles, persons, animals or objects whether or not the ADS-equipped vehicle is responsible.

Safety and collision avoidance are priorities of all vehicle manufacturers. Regardless of the level of safety engineering, collisions are inevitable during testing and deployment on public roads. Collision and incident reporting are important for purposes of establishing liability and identifying and documenting safety concerns. Collision report information is not only of importance to manufacturers, emergency management personnel, insurers and the engineering community but to a variety of public constituencies, including regulators and legislators. Full disclosure of information concerning how a collision occurred

and why, will be essential to future development, regulation, subrogation of damages and public acceptance of ADS-equipped vehicles.

Guidelines for Testing Vehicles

ADS-equipped vehicle manufacturers or other entities should submit to the jurisdiction incident and collision-related information to expand ADS data and research upon request by the jurisdiction. The information should include instances of a collision/incident when ADS-equipped vehicles are operating in automated mode or disengaged (by the user or by the system). The information should also include incidents in which the users of ADS-equipped vehicles are unexpectedly prompted to transition into non-automated mode, due to a failure of the automated system or the ADS-equipped vehicle contravenes a law that poses significant risk to safety. Examples of these types of situations could include excessive speeding or a red-light violation. The information should also include details of the circumstances or testing conditions of the disengagement, including the location, time of day, as well as the weather, traffic, and road surface conditions. Manufacturers and other entities should be required to submit a summary analysis of the incident. There is also value in collecting data that captures events in which the automated function correctly detected and identified an unsafe maneuver by another road user and executed an appropriate response that successfully avoided a collision.

Requiring manufacturers or other entities to report unexpected incident failures and collisions to the jurisdiction provides transparency between agencies and manufacturers or other entities throughout the testing phase. Sharing this data and their analysis of the incident would be beneficial to jurisdictional policy makers.

When an ADS-equipped vehicle is involved in a collision, the information obtained from the ADS recorded data could prove important to determine whether an ADS malfunction caused the collision, contributed to the collision, or if the collision could otherwise have been avoided. Additionally, the data collected from the vehicle(s) involved could potentially provide insight into how ADS-equipped vehicle(s) react to given scenarios. Manufacturers are encouraged to monitor international research and best practices to help inform what data should be collected. This may include, but is not limited to, the mode of operation, location, speed, throttle/brake application, steering input, ADS sensors and any degraded behavior and/or malfunctions of these sensors, etc. Manufacturers should make this information retrievable in a timely manner by law enforcement and regulating entities.

Consistent with the directions found in the national trial guidelines document "*Guidelines for Testing Automated Driving Systems in Canada Version 2.0*", testing entities should submit a preliminary report to the provincial/territorial road transport agency that provided the permit within 24 hours of the collision (or as otherwise required under provincial law or regulations) and immediately postpone trial activities involving any of the persons or vehicles involved until further direction is provided from the road transport agency.

Jurisdictions are encouraged to share collision/incident reports with Transport Canada. Transport Canada, as the federal regulator, will act as a central repository for the ADS disengagement and/or incident reports. Transport Canada will work with jurisdictions to develop best practices for collision/incident reporting involving ADS-equipped vehicles.

RECOMMENDATIONS FOR JURISDICTIONS

6.2.1 Jurisdictions should require ADS-equipped vehicle manufacturers or other test entities to:

a) submit a periodic disengagement report to the MTA with sufficient information for regulators. Jurisdictions may require the testing plans to be altered by trial organizations if the cause of the disengagement is recurring.

b) provide to jurisdictions, ***within 24 hours of the collision*** or as otherwise required under provincial/territorial law or regulations, a preliminary report on the incident and any relevant information that the manufacturer may be able to share at the time, regarding potential causes of the collision;

c) postpone immediately any testing activities involving any of the persons or vehicles involved until further direction is provided from the MTA or relevant agency; and

d) provide to the jurisdiction a summary analysis of the incident in order to expand the amount of ADS data and research.

Guidelines for Deployed Vehicles

The U.S. Department of Transportation (USDOT) Model Minimum Uniform Crash Criteria (MMUCC), 5th Edition (August 2017) includes guidance on the capturing of automated vehicle data on crash reports to assist in crash causation determination and support further automated vehicle development and safety. Transport Canada will explore options to update the National Collision Database Dictionary (Version 2), or its successor, to support similar data collection practices in Canada.

Large amounts of data are captured by the vehicle Data Collection Mechanisms (DCM). In certain instances, the EDR information may aid a crash investigation by revealing pre-and post-crash causative factors and actions. This information may include both the driver and automated system actions when the users of automated vehicles are prompted to transition into non-automated mode due to a failure or dysfunction of the automated system.

Manufacturers are encouraged to monitor international research and best practices as they evolve to help inform what incident and collision data should be collected by DCMs and the approaches to use to make the information retrievable by those duly authorized in accordance with laws protecting data privacy.

RECOMMENDATIONS FOR JURISDICTIONS

6.2.2 Transport Canada should explore options to update the National Collision Database Dictionary (NCDB2) to support the identification and collection of ADS Level vehicle information in Canada. Canadian jurisdictions should adopt the NCDB2 or its successor, as soon as practicable.

6.2.3 Jurisdictions should develop and standardize the reporting process to document ADS collisions/incidents beyond the Provincial Highway Traffic Act and Motor Vehicle Collision Report. The ADS-equipped vehicle collision/incident report should identify if the ADS-equipped vehicle is being operated in autonomous mode or non-autonomous mode.

6.2.4 Transport Canada and jurisdictions should explore additional options to collect and/or link the NCDB collision data with other data sources that may contain the ADS Level vehicle information, including working together to build such data sources where they do not already exist.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 14. Manufacturers should ensure that ADS-equipped vehicles have the capacity to record safety-critical information to support collision investigations.

MOE 15. In the event of a collision or other incident, information recorded by ADS-equipped vehicles should be shared with federal, provincial/territorial, and municipal law enforcement and government agencies in a timely manner to support investigations, including defect and collision investigations.

MOE 16. Manufacturers should monitor international research and best practices to help inform what collision and incident data should be collected by DCMs and how to make the collected data retrievable in a timely manner by those duly authorized.

Benefits of Implementation

Collection of collision and incident data would be beneficial to manufacturers and developers during the developmental process. Once deployed, in addition to manufacturers and developers, law enforcement and other applicable agencies would also benefit from data recorded of the collision event to aid in determining causation.

Challenges to Implementation

Since much of the ADS industry is proprietary, manufacturers may object to part or all of this recommended guideline.

6.3 CRIMINAL ACTIVITY

Background

There are both substantial opportunities and risks presented by automated driving systems. ADS-equipped vehicles have the potential to improve driving safety and make mobility more efficient. New technologies that will be available in ADS-equipped vehicles may also present opportunities to prevent certain vehicle related crimes from being committed, and/or assisting law enforcement in interdicting crimes. These technologies may present an opportunity to aid in the investigation of crimes that have been committed (e.g., such as using data stored in the vehicle DCM) which can help to determine routes taken by the vehicle, among other information.

Conversely, like conventional vehicles, ADS-equipped vehicles may also present possibilities for dual use applications, providing not only a means for legal transportation but also to further criminal enterprises and potentially novel or more efficient means to cause harm to others.

As vehicle connectivity increases, there are also additional threat sources that may emerge. It is important that these vehicles have the appropriate safeguards in place to prevent cyber vulnerabilities. See Section 6.11 – Cybersecurity for Vehicles with ADS below for a more detailed discussion on this issue.

Guidelines for Testing Vehicles

Prior to being authorized to operate a test vehicle, the employees, contractors and other persons designated by the manufacturer or other entities, should satisfy background check requirements as established in policy or regulation by the manufacturer or provincial/territory jurisdiction in which the test is to be conducted.

This may include, but is not limited to, a driver history review and a criminal history check provided that human rights code and privacy obligations are respected, i.e. the driver history and criminal record checks must be reasonable requirements for the proposed ADS testing activity. Careful thought should be given to whether a position really requires a criminal record check, and caution should be taken before making it a requirement. The stigma associated with background checks can be significant, unnecessary, prejudicial and hard to "un-see" or disabuse. For example, a past conviction or record may be a poor predictor of future offences or risk. Cautionary principles for implementing driving or other background checks include that:

- checks should be reasonable and defensible within applicable privacy principles
- the applicant should consent to the specific checks that are being performed
- the checks should be related to the program (e.g., should not check credit history for an activity that does not reasonably require use of credit.)

In the interest of safety, however, it may be advisable to set policy or regulations that prescribe how and when to conduct checks that would identify persons with a poor driving record in recent years, or if they have *relevant* criminal records, and when to place limits on their involvement with testing ADS vehicles up to and including disqualification. This may include prohibition from operating an ADS-equipped vehicle as an agent or contractor of a manufacturer or other entity in a test environment, operation only while supervised, or other measures. The cost of the background check should be the responsibility of the manufacturer or the entity designated to do the testing, not of the jurisdiction.

RECOMMENDATIONS FOR JURISDICTIONS

6.3.1 Jurisdictions should evaluate every test case to determine if it is appropriate for designated Test Users (employees, contractors and other persons) to undergo a police-conducted background check that may include, but is not limited to, a driver history review and a criminal history check (including vulnerable sector background check if the testing is public facing such as an automated shuttle). Subsequent authorization to operate an ADS-equipped test vehicle after a background check is subject to the pass/fail criteria applicable to the test environment as set by jurisdiction in policy or regulation. The cost of the background check should not be borne by the jurisdiction.

6.3.2 It is recommended that jurisdictions should establish provisions, within ADS-equipped vehicle permitting requirements as described in Section 4.2 - Vehicle Permitting and Registration, which disqualify an agent or contractor of a manufacturer or other entity from operating an ADS-equipped vehicle in a test environment if they have a relevant criminal record or a driving history that includes impaired driving, careless driving, or other significant convictions within the past 5 or 10 years.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 17. The manufacturer or other entities should consider requiring the designated Test Users (employees, contractors and other persons) to undergo a background check, including, but not limited to, a driver history review and a criminal record history check, as a condition of operation of an ADS-equipped test vehicle.

MOE 18. The manufacturer or other entities should establish procedures to place limits on or to disqualify an agent or contractor of a manufacturer or other entity who has a relevant criminal record or a criminal code driving violation within the past 5 or 10 years from operating an ADS-equipped vehicle in a test environment.

MOE 19. Manufacturers and other entities should ensure that cybersecurity best practices are incorporated into test vehicles since these vehicles may be operated both in a closed facility and on public roads.

Guidelines for Deployed Vehicles

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

To assist law enforcement in investigating criminal activity where an ADS-equipped test vehicle was implicitly involved as a tool for committing a crime, manufacturers should ensure the ADS leaves an electronic fingerprint that can allow tracing of input data to whomever initiated them. It should also provide additional documentation or assistance in the event of an investigation.

CCMTA recognizes that while privacy of personal information, data ownership and legal liability must be considered, it will also be important to ensure that collision investigators can appropriately identify the origin of all data inputs involved in an ADS-equipped vehicle collision. For example, this information may be critical in resolving insurance claims. Key information for crash investigators is the origin of the command (i.e., driver or ADS), the nature of the command, and when the command was given.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 20. Manufacturers and other entities should provide documentation, and all technical assistance to enforcement agencies, subject to local legislation, to aid any investigation related to how the ADS was used.

Benefits of Implementation

Requiring manufacturers to program software that creates an electronic fingerprint of human/machine interface (HMI) will mitigate the risk of an ADS-equipped vehicle 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 regulatory development may be required to implement the recommended guideline.

There may be challenges related to the costs of implementing the recommended software changes that would create an electronic fingerprint.

There may also be complexities in determining the amount and extent of information sharing that would be appropriate without compromising personal privacy.

6.4 DISTRACTED DRIVING AND FATIGUE

Background

The potential for reducing or eliminating distracted driving is a common topic when discussing ADS-equipped vehicles. The term distraction 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 one or both hands off the steering wheel to manipulate a control, device, or other non-driving-related item.
- **Cognitive distraction:** Tasks that require the driver to avert their mental attention away from the driving task.

The impact of distractions on driving is determined not just by the type of distraction but also the frequency and duration of the task. Because drivers often have a choice regarding when and, depending on vehicle design, how often they will multitask when driving, their exposure to risk is typically within their control. Some research has shown, however, that drivers underestimate the overall risk of various tasks.[18] While drivers may regulate their distractions according to the situation, critical events are often unexpected and a driver's ability to safely react to an emerging risk is impaired by distraction. The longer a driver is inattentive, the more likely they will encounter a situation that requires their attention.

Driver Fatigue

There is evidence from fatigue science and studies in fatigue in transportation that the nature of the driving task has an impact on a driver's vigilance and level of alertness. A monotonous and low demanding driving environment has been shown to generate decreases in brain alertness which in turn can significantly impact a driver's ability to remain vigilant whilst driving. Low vigilance leads to slower reaction time, lack of visual scanning behaviors and loss of situational

18 Overview of the National Highway Traffic Safety Administration's Driver Distraction Program, DOT, HS 811 299, April 2010.

awareness, which in turn significantly impacts traffic safety. If the monotony of the driving task is significant and occurs over a prolonged period of time, it can generate drowsiness, microsleeps and eventual falling asleep at the wheel.

There is evidence that automated driving systems that still require the driver to remain alert and vigilant may also generate task-induced (passive) fatigue.

Accordingly, it is recommended that safe driver distraction and fatigue management practices be applied in the context of deploying ADS-equipped vehicles, especially in situations where drivers are still expected to remain alert and vigilant.

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, and measures taken to limit driver fatigue. An evaluation should also be made as to whether the onboard operator/driver is capable of conducting all the testing activities being undertaken.

RECOMMENDATIONS FOR JURISDICTIONS

6.4.1 Jurisdictions should ensure that all distracting activities are prohibited and measures taken to limit driver fatigue.

6.4.2 Jurisdictions should consider requesting information from testing organizations that evaluates the capacity of the onboard operator/driver to conduct all of their testing activities safely (e.g., without distraction, fatigue, etc.).

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 21. Manufacturers or other entities should outline what the onboard operators/drivers may do while testing any ADS/ADAS on a vehicle.

MOE 22. Manufacturers or other entities should not design information displays that may significantly increase driver distraction.

MOE 23. Manufacturers or other entities should educate test drivers on the effect of task monotony on vigilance and alertness, especially if they are expected to remain alert during the testing.

MOE 24. Manufacturers and other entities should ensure test drivers are provided with frequent breaks to interrupt the monotony (e.g., every 60, 90 minutes).

MOE 25. Manufacturers and other entities should limit the number of hours required for testing, particularly at night and during mid-afternoon to limit test driver fatigue.

MOE 26. Manufacturers and other entities should ensure drivers are medically fit to conduct tests and are not taking medication that can impact vigilance and alertness when conducting tests.

Guidelines for Deployed Vehicles

Jurisdictions should consider at what level of autonomy their distracted driving laws continue to apply. When a vehicle is in automated mode, the user may still need to maintain a level of situational awareness should they need to re-engage with the driving function when prompted by the vehicle. Since the operation of some ADS-equipped vehicles may require no participation by the driver, distracting activities may not be relevant and/or distracted driving laws may not apply.

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

6.4.3 Consider the Level of Automation to which their careless and/or distracted driving laws will apply.

6.4.4 Jurisdictions should stay up-to-date on best practices such as the UN's WP1 resolution for the conduct of non-driving activities in a vehicle when an ADS is engaged.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 27. Manufacturers or other entities 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).

MOE 28. Manufacturers or other entities should minimize distractions in ADS-equipped vehicles.

Benefits of Implementation

A reduction in collisions/incidents caused by driver distraction or driver fatigue.

Challenges to Implementation

Many jurisdictions have laws prohibiting distracted driving. A challenge will be for industry to develop consistent methodologies for systems that allow law enforcement to determine the Level of the ADS and what mode the vehicle is in when they observe a user 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 non-human operation or ADS operation with remote driving assistance. This void presents significant challenges to enforcement of traffic laws and to establishing legal responsibility when ADS-equipped vehicles are involved in motor vehicle collisions 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?

While this may appear to be less of an issue as vehicle technologies approach Level 5, from an enforcement perspective, the issue is still confounding as 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 collision. Traffic tickets or violation notices usually cannot be issued to registered owners or corporate entities and with the exception of parked vehicles, collision 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 the public roads. If a licenced 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 vehicles, with or without a human onboard, are tested on public roads, the permitting process, described in Section 4.1 - Application and Permit for Manufacturers or Other Entities to Test Vehicles on Public Roadways, 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 collisions that may occur during testing should be clearly established in statute. It is recognized, however, that this issue may be further informed and clarified through legal processes relating to determination of responsibility for incidents occurring during testing.

As previously mentioned, 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 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, licenced drivers of Level 0-2 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 vehicles. Although the licenced driver of a Level 3 vehicle may cede control of the DDT to the vehicle under certain circumstances or driving conditions, such vehicle by definition still requires the operator to monitor the DDT and to take control as necessary. A licenced driver, therefore, is still responsible for the safe operation and liable for violations of law during operation of a test vehicle.

For vehicles classified as Level 4 or 5, which may be operated without a licenced driver onboard and where the DDT may be performed independent of human control, new statutes or regulations may be required 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 its 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.

Manufacturers or other entities should design ADS-equipped vehicles with a means of identifying when a vehicle is in automated mode to facilitate effective enforcement of laws such as distracted driving (e.g., so an officer knows if using a hand-held device is legal at the time of observation). Manufacturers or other entities, in collaboration with each other, should determine how best to determine this type of identification (e.g., a signal emitted by the vehicle and detectable by law enforcement).

The AV/CV WG will continue to explore developments on this topic.

RECOMMENDATIONS FOR JURISDICTIONS

6.5.2 Clearly establish legal responsibility for every vehicle operating on public roads.

6.5.3 Take steps to ensure a licenced human driver is prepared and capable of taking control of an ADS Level 3 or 4 vehicle if the vehicle requires a human driver to perform the DDT fallback.

6.5.4 For vehicles classified as Levels 4 or 5, which may be operated without a licenced driver and where the driverless vehicle performs the DDT independent of human input, the registered owner should be responsible for its safe operation (N.B. this issue will continue to be discussed and may evolve over time).

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 29. Manufacturers or other entities should design ADS Level 4 and 5 vehicles with a means of identifying when a vehicle is in automated mode to facilitate effective enforcement of distracted driving behaviours (e.g., so an officer knows if using a hand-held device is legal at the time of observation).

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 up-fitter. The manufacturing industry may oppose these guidelines as unnecessary regulation that may hinder development and public acceptance of technology adoption.

6.6 LAW ENFORCEMENT PROTOCOLS (LEP) FOR LEVEL 4 AND 5 VEHICLES

Background

Level 4 and 5 ADS-equipped vehicles represent unique challenges to law enforcement and other first responders traditionally focused on human behavior, due to 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, or incidents involving a vehicle with no operator present. It should be noted that while some entities may develop a 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.

Guidelines for Testing and Deployment

LEPs are developed by the lead law enforcement agency in the jurisdiction and typically shared with other law enforcement agencies in that jurisdiction. 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 protocols should identify and include the following details:

- The applicable policies of the law enforcement agency(s); and
- Terms used within the document which may be unfamiliar to officers in the field.
- **Specific information from ADS manufacturers/test entities, such as:**
    - How to communicate with an ADS-equipped vehicle fleet support specialist during times of operation;
    - How to safely remove the vehicle from the roadway;
    - How to recognize if the vehicle is in automated mode;
    - How to safely tow the vehicle;
    - How to shut off the power source;

  - Locations where the vehicle will be in operation; and
  - Any additional information the manufacturer deems necessary regarding hazardous conditions or public safety risks.

- **Enforcement guidelines:**
  - How to exchange information with the ADS-equipped vehicle owner;
  - How to issue enforcement documents for ADS traffic violations;
  - How to document a crash;
  - How to remove disabled vehicles; and
  - Any federal, jurisdictional, and local laws and regulations specific to the operation of an ADS-equipped vehicle.

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

6.6.1 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.

6.6.2 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/first responder community. The liaison should review the LEP continually and ensure consistency with:

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

6.6.3 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

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 6.7 – First Responder Safety and Training for more details.

6.7 FIRST RESPONDER SAFETY AND TRAINING

Background

It is essential that law enforcement and other first responders receive specific training regarding the potential hazards they may face and how ADS-equipped vehicles may impact their duties. Those 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 ADS-equipped vehicles that other professions do not. Law enforcement officers may encounter ADS-equipped vehicles during traffic stops or other law enforcement related contacts; however, occupant extrication safety training may be more universally applicable.

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

- silent operation,
- self-initiated or remote ignition,
- high voltage and
- unexpected movement.

In the United States, the National Fire Protection Association (NFPA) developed training programs for both fire service and law enforcement to help them safely respond to crashes involving electric and hybrid electric vehicles. NFPA also

provides ongoing training for the fire service on hazards involving a variety of alternative fuel vehicles. The training focuses on three main functions to render the vehicles safe:

1. the ability of the responder to identify the vehicle (and its propulsion system);
2. immobilize it; and
3. permanently disable it.

The Council of Canadian Fire Marshals Fire Commissioners (CCFMFC) and the National Fire Protection Association (NFPA) signed a licence agreement on May 10, 2016 to deliver an Electric, Hybrid and Fuel Cell Vehicle Safety Training Program for Emergency Responders throughout Canada based on materials originally developed by NFPA for U.S. first responders.

Canadian fire, police, emergency medical services, tow truck operators and other first responders will have access to a variety of relevant materials, including train-the-trainer and in-classroom sessions, resources, and emergency field guides that provide responders with a quick reference on how to handle alternative fuel vehicle (AFV) incidents on-scene. These materials are being made available to career and volunteer firefighters as a result of licence agreements between CCFMFC and NFPA.

Although NFPA training is provided to most fire services in the U.S. and is leveraged in Canada, information has not been well distributed to law enforcement and other responders, resulting in significant vulnerabilities.

Identification of the vehicle at a safe distance is essential and best accomplished through manufacturer labeling (also known as badging) and familiarity with component designs, such as high voltage orange cabling. Immobilization involves knowing how to place the vehicle transmission in park, set parking brakes and if appropriate, chocking the wheels to restrict movement. Disabling techniques involve ensuring the vehicle is turned off, removing potential re-ignition sources, such as proximity keys, from the vicinity of the vehicle and cutting 12-volt power supplies to prevent ignition and depower airbags and seat belt tensioners.

Some or all of these procedures may be applicable to varying degrees to ADS-equipped vehicles. The importance of labeling to assist in vehicle identification is discussed at length in Section 6.1 – Vehicle Identification. Identification strategies that are integrated into the vehicle design will likely be most effective, rather than post-manufacture strategies, such as licence plates that lack

redundancies and can easily be removed or obscured in a collision. Immobilization and disabling issues may be unique to ADS-equipped vehicles, which have the potential for remote or self-initiation of ignition or movement. Immobilizing and disabling ADS-equipped vehicles may require switches, components or functionality designed specifically for this purpose, and these functions should be considered in the development of vehicle systems by the OEMs.

First responder safety information specific to ADS-equipped vehicles should be identified and disseminated prior to public use/deployment.

Guidelines for Testing Vehicles

The ability of first responders to identify an ADS-equipped vehicle is essential to the safe and effective performance of their specific duties. For the safety of 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 – Vehicle Identification). For the safety of vehicle occupants and first responders, manufacturers should ensure ADS-equipped vehicles have safety systems or procedures which allow first responders to immobilize or otherwise disable the vehicle post-collision, 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 tested (see also Section 6.6 - Law Enforcement Protocols for Level 4 and 5 Vehicles). Trial organizations should also inform first responders about the location of trials in their jurisdiction and when trials will take place.

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 design changes. Primary stakeholders to develop and disseminate training may include associations such as CCFMFC with NFPA and the Canadian Association of Chiefs of Police (CACP).

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 which allow first responders to immobilize or otherwise disable the vehicle post-collision 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. Jurisdictions should work with manufacturer consumer training programs to make training available to law enforcement and other first responders at no cost to agencies.

RECOMMENDATIONS FOR JURISDICTIONS

6.7.1 Work with manufacturers' and other entities' consumer training programs to make the ADS training available to first responders at no cost to agencies.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 30. Manufacturers should clearly identify ADS-equipped vehicles for the safety of first responders, based on international best practices.

MOE 31. Manufacturers should ensure ADS-equipped vehicles have safety systems or procedures which allow law enforcement and other first responders to immobilize or otherwise disable the vehicle post-collision, or during certain law enforcement contacts to prevent movement or subsequent ignition of the vehicle.

MOE 32. Manufacturers, 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 collision scenes, the public in or near crash scenes or during other law enforcement contacts with ADS-equipped vehicles.

Challenges to Implementation

Vehicle identification is linked to brand and has been traditionally considered highly proprietary. OEMs may oppose any regulation they perceive impacts the aesthetics of their product.

OEMs may be reluctant to disclose any information relative to vehicles under development, which places the public and first responders at risk if test vehicles are involved in crashes.

Furthermore, some manufacturers and other entities who have identified their test ADS-equipped vehicles have reported incidents of other road users attempting to engage with the vehicles to test their capabilities.

6.8 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 in an ever-changing roadway environment. These hazards include but are not limited to:

- both moving and stopped emergency vehicles;
- emergency workers and other pedestrians manually directing traffic;
- changing traffic patterns or conditions in roadway construction and maintenance zones;
- crash scenes; and
- road debris or other obstructions.

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 ADS-equipped vehicles being operated on public roads, both during testing and deployment, are able to recognize and respond properly to all temporary traffic controls and atypical hazards in the roadway environment. Temporary traffic controls include cone or flare patterns as well as human hand directions and flagging. In addition, vehicles should properly identify, differentiate and respond to both moving and stopped emergency vehicles and hazard vehicles, such as road maintenance vehicles bearing amber lights. Proper responses should include compliance with move-over laws.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 33. Manufacturers should ensure that ADS-equipped vehicles being operated on public roads, both during testing and deployment, are able to recognize and properly respond to all temporary traffic controls and atypical hazards in the roadway environment.

Benefits of Implementation

Vehicles that adequately respond to changing road conditions will increase 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 to violate laws or rules of the road to safely navigate some hazards (e.g., driving on shoulders or disobeying lane markings, signs, etc.). In addition, manual traffic control gestures are not universally consistent and may be performed by professionals or non-professionals alike. Move-over and other traffic laws are not currently uniform among jurisdictions and adherence to these laws may require geographic awareness.

6.9 SYSTEM MISUSE AND ABUSE

Background

Misuse of an ADS 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 due to a lack proper training or the inability of current licencing procedures to capture ADS-equipped vehicles. Misuse can have a major role in determining collision causation, which distinguishes fault and criminal/civil liability. It is the responsibility of law enforcement to determine collision causation whenever possible, but partial or complete automation may make these determinations difficult to discern from other causes or traditional human user errors.

Abuse of an ADS 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 behaviour 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 of ways to perpetrate each.

One issue is whether new laws or regulations are necessary to deter the behaviours or to assist law enforcement in performance of their duties in prevention and/or post 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 whether or not cruise control was active at the time of the offense; and vehicles are widely used in the commission of crimes or to transport goods or proceeds of crimes today. 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. Given the varied end uses of the ADS-equipped vehicle collision/incident data (e.g., for research and/or enforcement purposes), access to the data via a commercially available tool would reduce the burden on the manufacturers and other entities to provide this data and would also show transparency and assist in standardizing the reports.

Guidelines for Testing Vehicles

It could be assumed that it is far less likely that misuse or abuse would occur in a test environment where users are intimately familiar with the vehicle capabilities and use is highly controlled, recorded and researched. Nonetheless, since extensive testing occurs on public roads, it is in the public interest for researchers and developers to consider recording the behavior of the vehicle and the HMI at all times during operation.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 34. Manufacturers or other entities, such as researchers and developers, should monitor international research and best practices to help inform what vehicle and HMI behaviours should be recorded during operation since extensive testing occurs on public roads.

Guidelines for Deployed Vehicles

Manufacturers are encouraged to monitor international research and best practices to help inform what measures should be put in place to prevent misuse and abuse of the ADS-equipped vehicles. This includes considerations of what data should be collected and made available in a timely manner to those authorized to conduct collision and criminal investigations.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 35. For the purposes of supporting collision investigations, manufacturers or other entities, such as researchers and developers, should monitor international research and best practices to help inform what data should be collected and made available in a timely manner to those duly authorized.

MOE 36. Manufacturers and other entities are strongly encouraged to apply international best practices in human factors design procedures to define intended users, user-needs, use environments and interfaces; identify use-related hazards, identify and categorize critical tasks; and should develop and implement misuse mitigation measures and conduct validation testing on real users.

Benefits of Implementation

These recommendations will assist law enforcement and regulating entities in determining collision causation and criminal investigation including, but not limited to, whether system misuse or abuse were involved by providing behavioural information and vehicle performance information in the most serious cases. Users of ADS may be deterred from engaging in misuse or abuse knowing their behaviours are being 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 unwarranted overreach of governmental authority. EDRs have operated and stored data in proprietary formats for proprietary purposes. Manufacturers can be expected to oppose requirements which dictate what information is captured and accessible to the authorized investigator.

6.10 ADHERENCE TO TRAFFIC LAWS

Background

Traffic laws are the purview of provincial and territorial jurisdictions, although local jurisdictions may enact additional traffic and parking laws. While most traffic laws are similar from jurisdiction to jurisdiction, some are jurisdiction specific. For example, although all jurisdictions have laws regarding speed limits, minimum and maximum speed limits may vary significantly between jurisdictions. Similarly, traffic laws relative to vehicle movements commonly referred to as "rules of the road," such as lane changes, left and right-hand turns, yielding right of way, stopping, passing, and movements in regard to traffic control devices and pedestrian crossings, etc., also vary between jurisdictions.

Where speed limits are concerned, it is common knowledge that compliance with those limits is often low, and drivers often adjust their vehicle speed to that of the prevailing flow of traffic. Users frequently even set the vehicle cruise control to speeds that exceed the speed limit. In light of this common practice, there is concern that future consumers of ADS-equipped vehicles may desire similar discretionary control of the maximum operating speed leading manufacturers to develop ADS-equipped vehicles capable of violating speed limits and other traffic laws. This would be legally imprudent and could be unsafe. However, manufacturers should give consideration to emergency circumstances when it may be necessary to perform maneuvers which may otherwise violate traffic laws, such as following the directions of police officers or flaggers to cross double yellow lines or drive on a sidewalk to avoid hazards such as at a collision scene, a flooded road, or road debris.

**Impaired driving, distracted driving and driver fatigue are addressed in other areas of this Guidelines Document.*

Guidelines for Testing and Deployment

Jurisdictions should ensure that all vehicles under their authority are required to adhere to all traffic laws and rules of the road, except in emergency circumstances. Jurisdictions will need to examine their traffic laws to identify laws that may not be relevant or appropriate for ADS-equipped vehicles and amend them as necessary. Examples of these types of laws may include the "stunt-driving" laws in Ontario and Alberta, as well as "safe-distance following" laws in Alberta. In addition, it may be that some of these laws will be appropriate for all SAE Levels of vehicles, or for only certain specific SAE Levels. When such laws are identified, they should be amended as necessary.

In October 2018, the Transportation Research Board (TRB) published a document, NCHRP20-102(07) *Implications of Automation for Motor Vehicle Codes* to assist jurisdictions with updating their motor vehicle traffic laws as ADS technology continues to evolve. Jurisdictions may find this a useful resource.

Additionally, vehicles designed to operate in either automated mode or manual mode should not have the ability to override the ADS settings allowing for violation of traffic laws, without transitioning out of automated mode and into manual mode.

RECOMMENDATIONS FOR JURISDICTIONS

6.10.1 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.

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

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 37. Manufacturers or other entities should ensure users of vehicles designed to operate in either automated mode or non-automated mode do not have the ability to override the ADS settings, without transitioning out of automated mode into non-automated mode, unless faced with an emergency circumstance. It should be noted here that this issue continues to be discussed with international stakeholders. As the discussions evolve, this recommendation may be revised in future iterations of this Guidelines Document.

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 collisions.

Challenges to Implementation

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

6.11 CYBERSECURITY FOR VEHICLES WITH AUTOMATED DRIVING SYSTEMS

Background

The advent of emerging vehicle technologies, including ADS-equipped vehicles, have the potential to enhance safety on Canadian roads, but also pose new cyber security challenges. There is an increasing need to identify, protect and mitigate potential cyber security threats and vulnerabilities in our road transportation system. As such, cyber security must be a priority throughout the entire lifecycle and supply chain of ADS-equipped vehicles, from design to ongoing system development, extending into the aftermarket sector and across the supply chain. In order to mitigate potential adverse consequences, cyber security measures should be designed to protect ADS systems to ensure vehicle safety and protect data privacy (see Section 7.1- Data Collection).

The following are recommendations or resources from leading entities:

- Transport Canada has published a number of guidance and tools designed to support the safe and secure introduction of CAVs, including the **Safety Assessment for Automated Driving Systems in Canada**, which includes strategies used to manage cyber security risks, data and privacy components. In May 2020, Transport Canada published guidelines for vehicle cyber security, which provides a set of technology-neutral guiding principles to support industry in incorporating vehicle cyber security best practices throughout the vehicle lifecycle. The guidance offers best practices on managing cyber security risks (e.g., governance, supply chain) and protecting the entire vehicle ecosystem with appropriate safeguards (e.g., privacy,

training and awareness), as well as how to detect, monitor, respond to, and recover from cyber security events (e.g., security audits, incident response, information sharing).

- NHTSA recommends industry undertake a layered approach to harden ADS-equipped vehicle's 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 Cyber Security Framework which provides detailed guidance and cyber security best practices, allowing for a systematic and comprehensive layered cyber security approach. Though developed initially for critical infrastructure owners and operators, best practices can be applied by the road transportation sector to improve cyber security risk management. The NIST framework specifies five pillars: Identify, Protect, Detect, Respond, and Recover.
- Similarly, industry should review and consider information technology security standards and best practices like the Center for Internet Security's *Critical Security Controls (CIS CSC) for Effective Cyber Defense*.
- The Communication Security Establishment (CSE)'s Canadian Centre for Cyber Security (the Cyber Centre) supports federal departments in addressing cyber security in their respective sectors, including road transportation. The Cyber Centre is the central trusted federal government source of operational cyber security information and advice for government, industry, critical infrastructure owners and operators, as well as the Canadian public. The Cyber Centre is complemented by the Royal Canadian Mounted Police's (RCMP) National Cybercrime Coordination Unit (NC3) who coordinates Canadian law enforcement cybercrime operations. The NC3 has established a national public reporting mechanism for Canadians and businesses to report cybercrime and fraud incidents to law enforcement. As such, cyber incidents may be reported to the Cyber Centre via its Contact Centre, and if an incident is suspected to be criminal in nature, organizations should report incidents to their local law enforcement agency or the RCMP.
- The Auto Information Sharing and Analysis Center (Auto ISAC) serves as a central node for sharing, tracking, and analyzing related intelligence on emerging cyber security risks and creates a forum for collaboration for participating entities to share solutions to potential cyber threats and incidents. As such, stakeholders are encouraged to share intelligence with the Auto-ISAC, with whom incident information may be shared for the benefit of the community.

- Industry should also closely monitor ongoing international efforts to develop global cyber security standards and regulations. For instance, the United Nations World Forum for Harmonization of Vehicle Regulations' (WP.29) Informal Working Group on Cyber Security and Over-the-Air Updates is developing a draft set of technical requirements for vehicle cyber security requirements. In addition, the International Organization for Standardization (ISO) and the Society of Automotive Engineers (SAE) International are developing an automotive cyber security standard (ISO/SAE 21434), which defines common terminology and sets out criteria for cyber security engineering practices throughout the vehicle lifecycle.
- Mobility as a Service (MaaS) operations and other ADS integrators present additional consumer-related cyber and data security considerations that must be considered and addressed.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 38. The automotive industry should use best practices, design principles, and guidance based on or published by TC, NIST, NHTSA, Auto ISAC, and recognized standards-setting bodies such as SAE International standard J3061 Cybersecurity Guidebook for Cyber-Physical Vehicle Systems, as well as ISO/SAE 21434 Road Vehicles – Cyber Security Engineering Standard and ISO/WD PAS 5112 Road Vehicles – Guidelines for Auditing Cybersecurity Engineering.

MOE 39. Organizations are encouraged to report any cyber threats, vulnerabilities, or incidents to the Cyber Centre via its Contact Centre (contact@cyber.gc.ca). Should a cyber incident be suspected to be criminal in nature, incidents should be reported to the local law enforcement agency or the RCMP. Organizations should also report to the Canadian Anti-Fraud Centre (CAFC) at 1-888-495-8501 or www.antifraudcentre.ca if the cyber incident involves fraudulent activity.

Benefits of Implementation

Ensuring cyber security industry best practices are incorporated in ADS design and throughout the entire supply chain and life cycle of the ADS-equipped vehicle, will mitigate incidents and reduce potential exploitation and subsequent risks to public safety, including privacy concerns, as well as national security.

Challenges to Implementation

As cybersecurity threats, attacks, and data security breaches continue to evolve at a rapid pace, meeting that pace of change with effective threat prevention, detection, and mitigation strategies is likely to become increasingly difficult. Ensuring necessary security related system updates are performed in a timely manner is another challenge that must be addressed, as well as identifying the party or entity legally responsible for performing such updates.

References

- Transport Canada Safety Assessment for Automated Driving Systems in Canada (February 2019).
- Transport Canada Canada's Vehicle Cyber Security Guidance (May 2020).
- National Highway Traffic Safety Administration. (2016, October). Cybersecurity Best Practices for Modern Vehicles. (Report No. DOT HS 812 333). Washington, DC.
- National Institute of Standards and Technology.
- Center for Internet Security.
- UNECE Proposal for a new UN Regulation on uniform provisions concerning the approval of vehicles with regards to cyber security and cyber security management system.
- SAE International standard J3061 Cybersecurity Guidebook for Cyber-Physical Vehicle Systems.
- ISO/SAE 21434: Road Vehicles – Cybersecurity Engineering (under development).
- ISO/WD PAS 5112 – Road Vehicles – Guidelines for auditing cybersecurity engineering (under development).

CHAPTER 7

OTHER CONSIDERATIONS

Chapter 7

Other Considerations

This chapter outlines other considerations to address for ADS-equipped vehicles operated on public roadways, including data collection, low-speed automated shuttles, connected vehicles, and platooning. There are 61 recommendations in the following 5 sections. There are 55 recommendations directed to jurisdictions for implementation consideration, while 6 are directed to MOEs.

7.1 DATA COLLECTION

Background

Vehicles equipped with ADAS and ADS rely on the collection and use of data. Many 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 is vital to the evolving technology and improving the systems performing DDTs. Event Data Recorders (EDR's) for instance were integrated into cars in the 1990's and currently are installed in 90 percent of vehicles. They can provide valuable information about the vehicle operation and conditions regarding a traffic incident. On-Board 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 would be the collection of information about geolocation data and driver behaviour 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 or potential harm from misuse must be considered.

Large amounts of data, which may include V2X data (e.g., BSM), are captured by the vehicle DCM. Such information may aid a crash investigation by revealing pre-and post-crash causative factors and actions. This information may include both the driver and automated system actions when the users of ADS-equipped vehicles are prompted to transition into manual mode due to a failure or malfunction of the automated system.

Manufacturers are encouraged to monitor international research and best practices to help inform what data should be collected by DCMs and the

approaches to make the information retrievable by those duly authorized in accordance with laws protecting data privacy.

All businesses operating in Canada must comply with the privacy laws that govern the collection, use, and disclosure of personal information. In the private sector context, the federal Personal Information Protection and Electronic Documents Act (PIPEDA) applies to commercial activities that cross provincial or national borders or that take place wholly within in a province that has not enact legislation that is "substantially similar" to the federal law.[19] Under PIPEDA[20], organizations generally must obtain an individual's consent before processing their personal information (known in legal terms as Personally Identifiable Information or PII). In most cases, an organization must also seek consent before using information for a purpose it did not identify to the individual at the time of originally collecting the information. Organizations must also protect information with appropriate security safeguards and are responsible for notifying individuals of data breaches that create a risk of harm.

Guidelines for Testing Vehicles

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

Many of these features depend on collecting certain data about the driver, the vehicle, and driving habits in order to perform effectively. Some of this data may be collected automatically, and some the driver may choose to provide in order to enable certain functions. For example, in order for the 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.

Consumers 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.

19 Currently, the provinces of Alberta, British Columbia, and Quebec have enacted "substantially similar" laws.
20 At the time of the publication of this guidance document efforts are underway by Parliament to consider new privacy legislation. Jurisdictions are encouraged to consult www.priv.gc.ca for up-to-date information on privacy legislation in Canada.

It is important for consumers 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 use of data. Consumers may have the right to "opt-out" or request additional information not be gathered, or not be shared. Opting out, however, may also limit the functionality of some of the features available.

It is also important for consumers 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. Consumers should consult the owner's manual and work with the vehicle dealer to reset and remove information from the vehicle system.

RECOMMENDATIONS FOR JURISDICTIONS

7.1.1 Conduct a thorough review of jurisdictional laws pertaining to the collection and dissemination of data. Particular attention should be given to Personally Identifiable Information (PII) and under what circumstances it may appropriately be recorded, maintained and released. In addition, the issue of transparency should be evaluated: what data is permitted to be collected, how the individual is informed about the collection and use of the data and if an affirmative consent should be considered.

7.1.2 Provide information about vehicle data collection resources on the jurisdiction's website to encourage consumers to check with their vehicle manufacturer for information about the collection of data by the systems in their vehicle.

Guidelines for Deployed Vehicles

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

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 40. Comply with the applicable data privacy laws of the jurisdiction in which they are operating.

MOE 41. Ensure that appropriate data management practices are in place to uphold the privacy of occupants and comply with their legal obligations.

MOE 42. Ensure that it has put in place technical and administrative measures to safeguard PII and appropriately respond in the event of a security breach.

MOE 43. Consult the website of the Office of the Privacy Commissioner (OPC), which enforces PIPEDA, for additional guidance on PIPEDA, other privacy laws and best practices.

Benefits of Implementation

It is important to increase awareness of data that is being collected in vehicles, by whom, how it is being used and shared. Consumers 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 it is also stored and can be very valuable to many entities. Consumers may not realize the privacy impact of the collection, storage, retrieval and dissemination of information.

References

The following are recommendations or resources from leading entities:

- NHTSA Data Privacy Webpage https://www.nhtsa.gov/technology-innovation/vehicle-data-privacy.
- *Personal Data in Your Car* Published by the National Automobile Dealers Association https://fpf.org/wp-content/uploads/2017/01/consumerguide.pdf .
- *Data and the Connected Car* Published by the Future Privacy Forum https://fpf.org/wp-content/uploads/2017/06/2017_0627-FPF-Connected-Car-Infographic-Version-1.0.pdf.

7.2 LOW-SPEED AUTOMATED SHUTTLES

Background

A broad variety of automated shuttle concepts have emerged in recent years, some of which are produced by companies who are new entrants to the motor vehicle sector. While the specifications of each vehicle are unique to the manufacturer, typical characteristics include electric powertrains, the capacity to carry approximately 4 to 12 passengers, operational speed ranges of about 5 to 25 km/h, and maximum speeds that may reach up to 60km/h.[21]

Automated shuttles have a number of potential future use cases. Some companies have marketed their automated shuttles as a first/last mile solution to bridge gaps in underserved areas for public transit users. Other use-cases envisioned for automated shuttles include more controlled driving environments such as university campuses, large parking facilities, shopping districts or at airports to transport passengers between terminals.[22] While the technology continues to improve, automated shuttles have unique safety considerations and remain test vehicles capable of operating in specific environments with limited complexity.

Testing automated shuttles presents unique safety considerations due in large part to three characteristics of most trials relating to:

1. **Vehicle design:** Because the automated shuttle's design is often a novel configuration that may not conform to a prescribed vehicle class in the *Motor Vehicle Safety Regulations*, many vehicles may not comply with standards related to occupant protection, crash avoidance and crashworthiness defined in the *Canada Motor Vehicle Safety Standards* (CMVSS).
2. **Types of organizations conducting testing:** Many shuttle manufacturers are marketing their vehicles and partnering with other entities such as municipalities and transportation companies to lead testing operations in different locations across Canada. Close collaboration between trial organizations and shuttle manufacturers is required to ensure the safety of all stakeholders involved in testing activities, as the vehicles and their automated driving systems continue to evolve. Organizations conducting shuttle trials need to have a strong understanding of the vehicle's capabilities and limitations, and plan or adapt operations accordingly.

21 This definition reflects general characteristics of test vehicles observed in the context of trials in North America. Automated shuttles are not a specific class of vehicle defined in Transport Canada's Motor Vehicle Safety Regulations.
22 US Department of Transportation (2018) Low-Speed Automated Shuttles: State of the Practice Final Report.

3. **Inclusion of members of the public in testing activities:** In numerous automated shuttle trials and demonstrations, members of the public are invited to ride in the vehicles as passengers so companies can promote public acceptance of automated technologies, gauge consumer reactions to the vehicle, and test the viability of use cases and potential business models.

Guidelines for Testing

In light of the safety considerations articulated above and other characteristics of shuttle testing, jurisdictions are encouraged to ensure that testing organizations take a graduated approach to testing by introducing new risk or complexity in phases to ensure the safety of their operations. It is also important that jurisdictions ensure trial organizations only test automated shuttles within the parameters of their ODD, in environments which reflect the capabilities and limitations of the technology of the test vehicle.

In 2020, Transport Canada sought stakeholder feedback on best practices for safely testing automated shuttles. Jurisdictions planning to host trials involving automated shuttles are encouraged to consult Transport Canada on potential safety best practices, including the annex on safe shuttle testing in *Guidelines for Testing Automated Driving Systems in Canada: Version 2.0*.

RECOMMENDATIONS FOR JURISDICTIONS

7.2.1 Jurisdictions should implement testing regimes based on the recommendations found in Chapter 4.

7.2.2 Jurisdictions should ensure that shuttle manufacturers supply sufficient information on the capabilities and limitations of the shuttle and technical support and inputs to both the trial organizations and regulators.

7.2.3 Jurisdictions are encouraged to consult Canadian guidance documents, including Transport Canada's Trial Guidelines.

7.2.4 Jurisdictions should ensure that trial organizations employ a graduated approach to testing in their jurisdiction.

7.2.5 Jurisdictions should obtain a detailed definition of the shuttle's ODD as well as documented testing used to validate each ODD including:

a) Road types on which the automated driving system can operate safely
b) Geographic areas
c) Speed range
d) Environmental conditions (daytime/nighttime, weather, etc.)

7.2.6 It is recommended that jurisdictions request a safety assessment report from the shuttle manufacturer based on Transport Canada's safety assessment tool, which is available at https://publications.gc.ca/site/eng/9.864590/publication.html

7.2.7 It is recommended that jurisdictions request that trial organizations develop safety management plans for their testing activities based on a risk assessment of the testing environment, planned operations, and the test vehicles capabilities and limitations. These may include standard operating procedures to be observed throughout the trial, as well as emergency response plans in the event of a collision or other incident.

Guidelines for Deployment

While automated shuttle technology shows great promise to enhance mobility solutions for Canadians, it is too early to discuss the deployment of these vehicles due to their unique safety considerations. Longer term testing is required to obtain a better sense of automated shuttle's capabilities and limitations in Canada.

RECOMMENDATIONS FOR JURISDICTIONS

7.2.8 Jurisdictions should not seek to accommodate on-road deployment of low-speed automated shuttles absent of federal safety standards and a corresponding definition for this vehicle type.

Benefits of Implementation

Testing low-speed automated shuttles offer jurisdictions the opportunity to encourage innovation and explore options for possible future solutions to improve access to mobility within their area. Many of the shuttle prototypes being tested today are electric vehicles, promising an affordable and environmentally-sound transit solution. Automated shuttles will potentially enhance existing transit networks and entice ridership, solve first/last mile mobility issues and overall create a more accessible mobility system. Additionally, a 2019 AAA[23] study found that while the public was still very uncomfortable with the idea of automated vehicles, the public was more accepting of low-speed automated shuttles. By utilizing 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 due to their rapidly changing designs and ADS technology. As a result, jurisdictions may find it difficult to adequately identify these vehicles in their statutes and regulations such that jurisdictions allow for testing and deployment in a technology neutral manner. Testing may also involve organizations who are less familiar with the technology and include members of the public, which creates a higher degree of risk.

7.3 AUTOMATED MICRO UTILITY DEVICES (INCLUDING PERSONAL DELIVERY DEVICES)

Background

The evolution of connected and automated vehicle (CAV) technology and the simultaneous growth of e-commerce has paved the way for the development of automated micro utility devices (MUDs), including personal delivery devices (PDDs). Growing demand for same-day delivery as well as the

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

need for contactless delivery due to the COVID-19 pandemic have accelerated interest in technological solutions in the courier and freight delivery sectors. Automated personal delivery devices (PDDs) are intended to address these challenges by serving as last-mile solutions in the delivery of small to medium-sized goods. MUDs/PDDs do not include drones or other flying devices.

PDDs that are being developed today vary in size and application. Larger robots resembling conventional automated passenger vehicles, may be employed for longer distance on-road deliveries and may fall under the same CAV regulatory regimes that are being adopted by jurisdictions today. Many others are smaller and designed to be primarily operated on sidewalks to transport groceries and small packages to the customer's door and may operate more like pedestrians.

At the same time, automated technology is also being developed and integrated into robots and vehicles that serve other functions in public spaces, such as sidewalk maintenance and waste collection. The term micro utility devices (MUDs) is used in this guideline to encapsulate vehicles that:

- may operate predominantly in a manner which limits interactions with motor vehicles in spaces such as private property, sidewalks, bike lanes or shoulders of roads;
- are not meant for the transport of passengers and may not necessarily have any seating capacity; and
- are task oriented and may be operated or modified primarily to provide services, such as snow plowing, lawn mowing, goods delivery, sidewalk inspection, waste collection etc.

Defining the necessary regulatory tools to support the safe use of MUDs/PDDs is unclear at this time. This is due, in part, to the diversity of designs and use cases for MUDs/PDDs, which continue to rapidly evolve. Although some MUDs intended for use on public roads may meet the definition of existing regulated classes of vehicle, as outlined in *Canada's Motor Vehicle Safety Regulations*, others, such as those intended for use on sidewalks, may not. Similarly, these devices may not fall within the scope of regulations that jurisdictions may have put in place for personal mobility devices (where such regulations exist). In addition, where the MUD/PDD is used in isolation from other road users, regulatory frameworks may not apply. However for MUDs/PDDs that will share spaces with other vehicles or vulnerable road users on sidewalks or roads, lack of widespread testing and usage of these vehicles without consistency across municipalities within a jurisdiction and without appropriate safety oversight could be problematic.

Of the different types of MUDs being developed and tested, PDDs are likely the most widely recognized and regulated. Some American states and cities have regulations in place permitting the operation of automated PDDs. Virginia was the first state in the United States to approve the use of delivery devices, followed by several others including Ohio, Arizona, Florida, Idaho, Utah, Wisconsin, North Carolina and Washington. These jurisdictions generally define where and how the devices may operate, as well as technical minimum vehicle specifications, and many have developed application processes for obtaining permission to test. Cities such as Washington, San Francisco and Austin have also created regulations by passing an ordinance, to specifically authorize the use of sidewalks and crosswalks by automated delivery devices and set parameters on the size, weight, operating speeds, and required oversight parameters for operation.

Jurisdictions should recognize that MUDs/PDDs are being developed, tested and deployed today and that they need to begin preparing in order to mitigate safety risks, especially in terms of interactions between these devices and pedestrians and other road users. The regulation of automated MUDs/PDDs will require collaboration among levels of government as the regulation of urban environments, including sidewalks, is the responsibility of local municipalities. As noted, Federal responsibilities may also be implicated if the vehicle meet the definition of regulated classes of vehicle, as outlined in the *Canada's Motor Vehicle Safety Regulations*, whereas laws respecting traffic safety and vehicle operation are provincial/territorial responsibilities. Municipalities are responsible for establishing and enforcing rules on parking, pedestrian interactions, and accessibility for people living with disabilities.

Guidelines for Testing

Clear guidelines on how MUDs and PDDs should operate would assist all road-users and stakeholders by providing predictable behaviour and further safety efforts. There are many factors to consider as the development of these devices progresses, but the following are considerations regulators should take into account.

Regulators should consider defining these devices in regulations to distinguish them from conventional motor vehicles, with consideration given to size, weight and speed limitations as appropriate for where they will operate and for their intended use.

For example, distinctions between larger versus smaller or lighter delivery devices may be needed to clearly differentiate between the devices and provide guidance on which safety certification and operating parameters should apply. Regulators should mandate that smaller delivery devices operate on sidewalks where they exist, or where sidewalks do not exist and if permitted by municipalities, other spaces such as shoulders of roads or bike trails. They should operate at low speeds and yield to traffic and pedestrians while providing audible and/or visual alert signals within certain proximity to pedestrians, particularly those that are visually impaired, and other road users. Conversely, larger personal delivery devices that may operate at higher speeds could operate on the right side of the roadway, similar to bicycles, travelling in the same direction of vehicular travel.

MUDs such as automated snowplows or devices may require a separate definition and consideration. Automated snowplows or devices may require larger dimensions and weight in order to plow snow or carry salt or salt solutions. Despite its larger size, it may need to operate on sidewalks if its intended use is to plow sidewalks. While limits to dimensions and weight are not provided in this guidance at this time, for safety concerns, regulators should mandate that consideration be given to consider vehicle weights and dimensions, speed and audible and visual alerts to signal the presence of these vehicles in consultation with stakeholders.

If the MUD is not considered a motor vehicle in accordance to local provincial and territorial legislation, which may not require motor vehicle insurance, jurisdictions should nonetheless ensure that adequate insurance is put in place to protect other road users by requiring, for example, general liability insurance.

Given the lack of thorough data on the safety of these devices, jurisdictions are encouraged to consider the potential of a pilot program to allow regulators to monitor, collect and evaluate data to determine long term safety while manufacturers and other entities test their devices in a regulated manner. It is not recommended that jurisdictions issue any type of registration or require applications, however, as MUDs/PDDs are likely to operate predominantly on sidewalks which are within local (municipal) oversight. Instead, it is suggested that jurisdictions support a local registration or application if the local government chooses to do so.

Even if a jurisdiction may not require organizations responsible for automated MUDs/PDDs to apply for a pilot program, the jurisdiction should consider recording and tracking pertinent information, such as company contact

information. This will enable the jurisdiction to provide safety-related information to stakeholders, in the form of statistics on collisions, moving violations, and other incidents involving law enforcement. At a minimum, all devices should have the name and contact information of the testing entity and a unique identifier displayed prominently on its exterior.

To further ensure safety, jurisdictions should require audible and visual alerts (such as reflective flags) to increase conspicuity and awareness of the presence of PDDs especially when in close proximity to pedestrians and other road users. If the MUD/PDD is to be operated at nighttime or under dim lighting conditions, they should be required to display lights that are visible from all sides of the device. When making stops to perform deliveries or other operational activities, measures should be taken to ensure MUDs/PDDs do not impede pedestrians and other sidewalk users from safely entering/exiting crosswalks or entering/exiting buildings. Other safety issues that should be considered include, collision/incident reporting, the type of loads that should be permitted or prohibited, and vehicle oversight parameters such as requiring a remote operator or nearby customer service ambassador or chaperone.

Additionally, as the regulation of MUDs/PDDs involves a collaboration between different levels of government, municipalities should be able to determine whether or not they would like to permit these vehicles to operate in their jurisdiction through an opt-in approach. Jurisdictional law should not pre-empt municipal decision or oversight. Municipalities could create additional rules to complement provincial/territorial requirements to regulate the operation of these vehicles, particularly on sidewalks. Municipalities are in the best position to determine through by-law, where precisely (i.e., which roads, sidewalks, trails) MUDs should be permitted to operate, and how many companies/vehicles should be permitted. This is especially true given that Municipal governments are responsible for road intersection geometry design, traffic signal phase and timing, and roadway/sidewalk maintenance.

Provincial/territorial regulatory programs should also be accompanied by a best practices document, which advises municipalities on developing responsible and safety-oriented programs in their communities. Communications and guidance should also be provided to law enforcement.

RECOMMENDATIONS FOR JURISDICTIONS

7.3.1 Review existing legislative and regulatory framework to understand how MUDs are treated under existing laws, and to what extent municipalities are able to regulate these devices.

7.3.2 Define automated micro utility devices to distinguish them from other vehicle classes, taking into consideration weight/dimensions and speed that are reasonable on sidewalks and/or shoulders in relation to their intended use and other road users that may share those spaces (e.g., pedestrians and/or bicycles).

7.3.3 Provide clear operating parameters where possible. For example, requiring smaller devices to operate on sidewalks where they exist, or where sidewalks do not exist and if permitted by municipalities, other spaces such as shoulders of roads or bike trails. They should also operate under pedestrian rules of the road, such as crossing at designated intersections, travelling at speeds comparable to those of pedestrians, and also to yield to traffic and pedestrians, where possible. Larger devices that may operate at higher speeds could operate on the right side of the roadway, bike lanes, or shoulders, akin to bicycles, travelling in the same direction of vehicular travel.

7.3.4 Require liability insurance, in the form of motor vehicle or general liability, to ensure adequate compensation in case of the device incurring liability.

7.3.5 Registration and applications are not recommended at a jurisdictional level, but jurisdictions should support municipalities if they choose to implement their own registration or application process.

7.3.6 Consider collision/incident reporting requirements and reporting to be directly to the regulating jurisdiction, in addition to the local enforcement agencies.

7.3.7 Require, at a minimum, that all devices have the name and contact information of the owner/operator and a unique identifier to be prominently displayed on its exterior; jurisdictions should consider requiring this information to appear on multiple sides of the vehicles to assist in identification in the event of a collision or other emergency.

7.3.8 Require audible alerts and visual warning equipment, such as a flag, to warn other road users of its presence.

7.3.9 Require lighting and other visual warning equipment, such as reflectors.

7.3.10 Consider types of loads that may not be permitted, such as prohibiting dangerous/hazardous goods and livestock.

RECOMMENDATIONS FOR JURISDICTIONS

7.3.11 Consider vehicle oversight parameters if operated remotely, and/or the potential of a nearby human chaperone as required to ensure safety while maintaining situational awareness. Ensure that there are timely and sufficient human interventions for the simultaneous operation of these devices.

7.3.12 Consider creation of a municipal opt-in framework to allow local governments to determine whether to allow the operation of automated micro utility devices within their communities, and to create additional bylaws on their usage (e.g., that govern where devices can be used, which companies are eligible and how many vehicles are permitted).

7.3.13 Require local first responders' input and review of the proposal. First responders must have access to first responders' guidelines, documenting how the system may be disabled in a safe manner.

7.3.14 Require proponents to demonstrate sufficient and timely local infrastructure and human resources to respond to mass-scale system outages.

7.3.15 Review the PDD or MUD for its design, such as elements including Operational Design Domain, Object and Event Detection and Response, Fallback, crashworthiness, post-crash behaviour, and data recording element.

7.3.16 Review how the PDD or MUD will interact with other road users and existing infrastructure (such as traffic conflict point at the intersections, interactions with traffic control devices, interaction with emergency vehicles responding to emergencies, and vehicles with large blind spots like transit buses).

Guidelines for Deployment

MUDs, including PDDs are a new and emerging technology within the AV/CV space. MUDs such as PDDs may be a good potential solution for last-mile deliveries, providing consumer choice and convenience, while others such as automated snowplows, provide municipalities with a low-cost alternative for tasks that may be time and labour intensive. More information and observation through testing and piloting is, however, required before considering full scale deployment.

RECOMMENDATIONS FOR JURISDICTIONS

7.3.17 Jurisdictions should not accommodate full scale deployment of automated micro utility devices before more data is available following testing and piloting.

RECOMMENDATIONS FOR MANUFACTURERS AND OTHER ENTITIES

MOE 44. Manufacturers and other entities, such as operators, should work with government regulators and stakeholders, such as retailers and customers, before testing and deployment of automated micro utility devices.

MOE 45. Manufacturers and other entities, such as operators, should consult advocacy groups such as the CNIB Foundation to minimize impacts to vulnerable road users.

Benefits to Implementation

By establishing a clear regulatory framework for automated micro utility devices, jurisdictions will facilitate collaboration among all stakeholders as they explore options for the safe testing and deployment of these delivery devices. Guidelines will assist municipalities to determine how best to enact rules around these devices in their local communities, while mandating adequate safeguards to ensure that safety remains a top priority. This will ultimately encourage innovation in last-mile delivery solutions that has the potential to reduce traffic congestion, emissions and costs, and bring efficiency and reliability improvements for both businesses and consumers.

Challenges to Implementation

As with any fast-developing field, regulators will need to keep pace with technological advancements, both to ensure road safety and to encourage innovation. More data and observation will be necessary to evaluate issues such as liability, interaction with other road users, and vehicle oversight parameters. Jurisdictions will also need to be nimble to ensure regulations do not stifle development of the evolving designs of these micro utility devices, and ensure emerging concerns are covered, where appropriate.

7.4 CONNECTED VEHICLES

Background

Connected vehicles (CVs) use different types of wireless communications technologies to link electronically to each other and with the various elements and users of the modern surface transportation system (e.g., pedestrians, bicyclists, wheelchairs, roadside infrastructure, transportation management centers, etc.). This takes place on a rapid and continuous basis.

As explained by Transport Canada,

> *"Connected vehicles use different types of wireless technology to communicate with their surroundings. Although the technology can differ between vehicles, most new vehicles sold today have some version of connectivity. Depending on the features it has installed, a connected vehicle may be able to communicate with:*

- *its driver and passengers*
- *roadside assistance services*
- *convenience and entertainment apps*
- *nearby transportation infrastructure like:*
  - *toll booths*
  - *roadways*
  - *traffic lights*
- *other vehicles and road users*

There are many practical uses for connected vehicles. This technology can give the driver and passengers information, provide convenient functions like roadside assistance, and diagnose vehicle issues. Different features may also support navigation, and can recommend nearby restaurants, attractions and entertainment.

Other technologies that are slowly entering the market can improve the efficiency and safety of the transportation system. This includes vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) technologies that can alert drivers of upcoming hazards or provide other useful information. For example, these technologies could:

- *provide warnings about icy road conditions or a traffic accident ahead*
- *alert a driver when a vehicle in front brakes suddenly*
- *notify drivers when a traffic light is about to turn red.*[24]"

24 Refer to Transport Canada's "Understanding connected and automated vehicles" at https://tc.canada.ca/en/road-transportation/innovative-technologies/automated-connected-vehicles/understanding-connected-automated-vehicles#_Whats_a_connected

Potential applications of connected technology are widespread and promise broad benefits related to safety, traffic flow optimization, congestion reduction, and emission reductions.

Connected vehicles may use the information contained in messages received from vehicles, infrastructure, or smart phones to warn a driver of a potential collision. Examples of safety applications currently being tested in pilots are:

- Intersection Movement Assist (IMA): an application that warns the driver when it is not safe to enter an intersection — for example, when something is blocking the driver's view of opposing or crossing traffic. This application only functions when the involved vehicles are each V2V-equipped;
- Pedestrian in Signalized Crosswalk Warning (Transit): an application that warns transit bus operators when pedestrians, within the crosswalk of a signalized intersection, are in the intended path of the bus; and
- Reduced Speed/Work Zone Warning (RSWZ): an application that utilizes roadside equipment to broadcast alerts to drivers warning them to reduce speed, change lanes, or come to a stop within work zones.

Connected vehicles can also communicate with a traffic light to determine when it would turn green, an app on a pedestrian's phone to determine when the person is in the crosswalk and can inform road users of inclement weather or roadway conditions ahead.

Connected and automated technologies can exist independent of each other. While it is not necessary for a vehicle to include both automated and connected features, many experts believe vehicles with both technologies will result in the greatest safety benefits. It is important, therefore, that connected vehicle technologies be considered when developing a jurisdiction's approach to automated vehicles.

In Canada, the federal department of Innovation, Science and Economic Development (ISED) is responsible for setting and enforcing compliance with technical standards and licencing requirements related to wireless technologies integrated in vehicles and roadside infrastructure. These **standards and licencing requirements** are set to minimize harmful interference to radio communication

services and to ensure that Canadians are not overexposed to radiofrequency fields from wireless technologies.

If a trial organization is conducting tests that incorporate the use of wireless technologies to test connectivity capabilities with other vehicles and infrastructure, the trial organization must ensure that their activities comply with all certification and licensing requirements, including procedures administered by ISED. For more information, please see **Radio Standards Specification 252 (RSS-252) — Intelligent Transportation Systems — Dedicated Short Range Communications (DSRC) — On-Board Unit (OBU)** or visit ISED's website at **https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11373.html**

Guidelines for Testing Vehicles

Jurisdictions should require automated vehicles, with or without connected vehicle technologies, to follow the same permitting and registration process (See Section 4.1 – Application Permit for MOEs to Test Vehicles on Public Roadways). Connected vehicles without automated technologies, or with low Levels of Automation (e.g., Levels 0-2) should follow the regular registration process or, if the jurisdiction has one, a registration process specifically for connected vehicles. The deciding factor for permitting and registration should be based on 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 automated vehicles of the same SAE Level.

7.4.2 **j**urisdictions with an ADS-equipped vehicle committee should require the committee members to stay abreast of connected vehicle technologies deployed in their jurisdiction and to inform jurisdiction and local officials involved in connected vehicle technology and infrastructure planning and implementation, including traffic management and operations.

7.4.3 It is recommended that Jurisdictions evaluate the impact of connected vehicle technologies on the existing road transportation and network infrastructure (e.g., connected vehicle's traffic signal prioritization) on the existing traffic pattern prior to approval for testing.

7.4.4 It is recommended that jurisdictions stay engaged on emerging cybersecurity threats via organizations like Automotive Information Sharing and Analysis Center (Auto-ISAC).

Guidelines for Deployed Vehicles

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

RECOMMENDATIONS FOR JURISDICTIONS

7.4.5 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 provided by connected technologies and advanced, non-impaired decision-making by automated technologies. This provides significantly improved situational awareness which can address two of the most basic factors effecting vehicle safety: knowledge of the road environment and driver awareness. Jurisdictions should expect to see significantly more safety improvements by supporting the simultaneous introduction and deployment of connected and automated vehicle technologies.

Challenges to Implementation

While V2X technology has been under development for some 20 years in the U.S.[25], including testing conducted through pilots with thousands of vehicles and roadside units, Canadian experience with this technology is far more limited. Over the last few years, uncertainty in U.S. spectrum allocation (and how that may impact Canadian spectrum regulations) and a lack of industry agreement over base technology, combined with limited funding, have acted as a barrier to many jurisdictions from investing in connected vehicle communications infrastructure.

Overcoming this barrier is both a challenge and an opportunity; the applications that are enabled through connectivity are the same regardless of the underlying communications technology. Jurisdictions that gain experience testing and integrating new equipment into their systems will likely gain an advantage in capturing the safety and efficiency benefits the technology can bring.

25 [1] https://www.gao.gov/assets/660/658709.pdf

7.5 COOPERATIVE TRUCK PLATOONING

Background

While platooning could involve any type of vehicle, most of the emphasis on the development of the technology is currently placed on cooperative truck platooning. Cooperative Truck Platooning (CTP) involves two or more commercial tractor semi-trailer combinations, each equipped with a system which enables them to travel together in close proximity.

Transport Canada's "ecoTECHNOLOGY for Vehicles" program engaged Canada's National Research Council to conduct fuel consumption testing of CTP systems in controlled track conditions, demonstrating fuel consumption and GHG emissions reduction of over 5 percent for a two-truck platoon and over 10 percent for a three-truck platoon (combined fuel savings for all trucks while platooning at highway speed).[26] Transport Canada will undertake further work, including an on-road trial of CTP on Canadian highways, to inform potential safety requirements for CTPS as well as to determine fuel savings and operational limitations in real on-road environments, accounting for affects due to traffic, road geometry, and weather.

In North America, CTP systems are generally classified according to SAE International's *Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems* (J3016). In a Level 1 automated (L1) CTP system, the driver of the lead truck (LT) controls the braking and acceleration of the trucks in the platoon (longitudinal control), while the driver(s) of the following truck(s) (FT) is/are still required to control the lateral movement of their respective vehicle(s). With Level 2 automated (L2) CTP system, the driver of the LT is able control both the lateral and longitudinal movements of the FTs. Current CTP systems are generally designed for highway use only, but some may also be able to operate in low-speed scenarios. Because CTP systems are limited to automation Levels 1 and 2, for the foreseeable future drivers are required in each vehicle.

CTP systems operate using a combination of the following sensors: radar; dedicated short-range communications (DSRC)-based V2V communications, and satellite positioning (GPS, GNSS), among others. L1 CTP systems operate using advanced driver assistance systems (ADAS) such as adaptive cruise control (ACC), cooperative adaptive cruise control (CACC), and automatic emergency braking (AEB), while L2 CTP systems will also include lane-keeping

26 B. McAuliffe, M. Lammert, X.-Y. Lu, S. Shladover, M.-D. Surcel and A. Kailas, "*Influences on Energy Savings of Heavy Trucks Using Cooperative Adaptive Cruise Control*," SAE Technical Paper 2018-01-1181, 2018. This document can be accessed for free from the following webpage: https://www.nrel.gov/docs/fy18osti/70868.pdf

and lane-centering ADAS features. 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. Because aerodynamics are particularly important at higher speeds, platooning is generally considered in highway operations with speeds above 60 km/hr. It is important to note that lateral control remains the responsibility of operators in the following trucks for L1 CTP systems. It is important that drivers maintain ongoing situational awareness and for safely responding to driving and road conditions.

Some of the main safety considerations for CTP include following distance (now called time gap)[27], cut-ins and cyber security. Other safety considerations include driver alertness, distraction and fatigue as well as system performance in adverse weather. As the CTP system assumes more of the dynamic driving task, drivers of FT(s) are at a higher risk of experiencing distraction, inattention or fatigue. Weather is a significant safety factor to consider when engaging in CTP operations as it affects the braking capabilities of trucks in a platoon and may interfere with system sensors.

In order to maximize fuel efficiency, CTP-enabled trucks are required to follow each other closely and at high speeds. A shorter gap between trucks does, however, reduce the available time for a following truck to initiate an emergency braking manoeuvre and increases the chance and severity of a collision. CTP operations on public roads require larger following distances to account for truck variations in braking capabilities due to brake quality, speed, weight, traction, weather, and other factors. It is also recommended that following distances include a safety margin to account for uncertainty regarding real-time braking ability. There appears to be general consensus among stakeholders that air disk brakes (ADB) are preferred for platooning over drum brakes, even though the majority of trucks on the market today use drum brakes. In Canada, most following distances are determined by a following time gap, although some provinces and territories have a set minimum following distance. These minimum standards will have to be followed by platoons depending on the jurisdiction where they operate, unless an exemption is obtained.

Vehicle cut–ins[28] between platooning trucks is another major risk factor when conducting CTP operations. A cut-in occurs when another vehicle from outside a platoon enters the gap between two trucks in the platoon. This may create unsafe following conditions between vehicles and necessitate braking actions by the trucks in the platoon following the cut-in vehicle. Numerous studies have

27 Today's CTPS use time gap rather than fixed distance to account for speed and maintain safe following distances. Time gap is often defined as headway, describing the time interval between two or more vehicles travelling in the same direction along the same route. There are inconsistencies in the literature in how headway is defined. (See P. 4, Transport Canada/National Research Council June 2020 Technical Report entitled: Cooperative Truck Platooning (CPT): Considerations for ON-Road Trails and Pilot Testing in Canada.)

28 Cut-ins often occur during lane changing manoeuvres and when vehicles enter or exit the highway at or near an on-or off-ramp.

indicated that many drivers are comfortable and willing to cut-in between two platooning trucks. The safety systems integrated in the CTP system such as AEB and other sensors can help detect vehicle cut-ins early and engage the brakes of the FT(s) to slow the truck and disengage the platoon to achieve a safe following distance. Platoon drivers must also remain attentive in case they are required to respond to a cut-in and accommodate surrounding traffic where possible.

Finally, cyber threats including on-board computer hacks, service interruptions, and data breaches pose threats to CTP due to connectivity being an integral component of the CTPS. V2V communication systems in CTP operations share safety-critical information wirelessly between platooning trucks to allow simultaneous acceleration and braking, making them critical to maintain safe CTP operations. V2V communications for current CTP systems are conducted over Dedicated Short-Range Communications (DSRC), through the 5.9 gigahertz (GHz) spectrum that is allocated federally in Canada for traffic safety use and are generally designed for security from the start. These V2V communications systems do, however, remain vulnerable to cybersecurity threats and it is important to ensure appropriate security management protocols are in place and respected. Transport Canada has developed **Canada's Vehicle Cybersecurity Guidance**, which provides a set of technology-neutral guiding principles to support industry in strengthening their vehicle cyber resilience. International standards groups have developed and are in the process of developing cybersecurity resources. See Transport Canada's Guidelines for Testing Automated Driving Systems in Canada Version 2.0 for more information.

Currently, some jurisdictions regulate the following distance of vehicles by indicating the minimum number of feet or meters required between vehicles.

Guidelines for Testing Vehicles

While this paper focuses on CTP, platooning does have other use cases. For example, platooning may be used in restricted access areas for military vehicles or for security vehicles monitoring a restricted facility. The focus of this section is on CTP as most of the emphasis on the development of the technology in terms of vehicles operating on public roads is currently placed on truck platooning. To limit safety risks associated with CTP, the following recommendations are provided.

RECOMMENDATIONS FOR JURISDICTIONS

7.5.1 Review and update statutes to enable vehicles that undertake platooning trials to follow at a reasonable and prudent distance.

7.5.2 Require platoon testing entities to submit an application packet for testing as described in Section 4.1 – Application and Permit for MOEs to Test Vehicles on Public Roadways and issue a permit to test once satisfied with the application and other submitted information.

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

7.5.4 Allow testing only on approved limited access highways.

7.5.5 Do not permit platooning for vehicles that are over-weight, over-sized or operating in a long-combination vehicle configuration.

7.5.6 Require disengagement when vehicles enter or exit the highway, or travel in work zones, tunnels, weigh stations, toll plazas, or travel past an incident scene.

7.5.7 Allow testing only on approved routes, with consideration of road geometry, highway ingress/egress, prevailing traffic conditions, etc.

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

7.5.9 Do not allow testing when the roads are snow covered, icy or in reduced visibility.

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

7.5.11 Prohibit carrying dangerous goods, oversize or overweight loads, fluids, loose loads or livestock. Prohibit the transport of members of the general public using such technology.

7.5.12 Require the lead vehicle to be the heaviest vehicle in the platoon.

7.5.13 Do not allow platoons to exceed three tractor and trailer combinations.

7.5.14 Each vehicle combination should be limited to a truck/tractor and one trailer combination unit, i.e., no B-train or long-combination.

7.5.15 Consider requiring an identifier on the outside of the vehicle configurations to indicate when the platoon technology is engaged.

7.5.16 Consider the use of escort vehicles with conspicuous lighting in the front and rear of the platoon during trials, particularly during the early stages of a trial or for experimental platooning systems that have not been subject to significant on-road testing. Measures such as deactivating the platoon in heavier traffic or widening the following distance might also be appropriate alternatives to use in these situations.

RECOMMENDATIONS FOR JURISDICTIONS

7.5.17 Ensure platoons are equipped with appropriate signage to advise other motorists of their presence.

7.5.18 Require all drivers to hold an appropriately endorsed and valid commercial driver licence (CDL).

7.5.19 Require all drivers to receive appropriate training provided by the testing entity, including appropriate fault injection and traffic scenarios (e.g., cut-ins) training..

7.5.20 Drivers must comply with all applicable jurisdictional regulations.

7.5.21 A driver must be in each vehicle, seated in the driver's seat, prepared to take over control of the vehicle at any time.

7.5.22 In the event of a loss of communication or a CTPS failure, drivers would need to increase the following distance within the platoon in a controlled manner until the platoon as a whole achieves stable following distances.

7.5.23 At this time, jurisdictions should not consider extending the hours of service for drivers (or operators), even if these people are just monitoring the safe operation of the motor vehicle.

Guidelines for Deployed Vehicles.

At this time, 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

Law makers and jurisdiction regulators and the general public may not have sufficient understanding of platooning and may, thus, need to be educated on issues in this domain to understand the benefits and risks. Jurisdictional laws may need to be updated. A process should be established to permit platoon testing.

Interjurisdictional will require prior approval from all implicated jurisdictions travelled.

References

The following are recommendations or resources from leading entities:

- National Research Council of Canada Technical Report "Cooperative Truck Platooning (CTP): Considerations for On-Road Trials and Pilot Testing in Canada", June 2020.
- Ontario: http://www.mto.gov.on.ca/english/trucks/cooperative-truck-platooning-conditions.shtml.
- Pennsylvania Department of Transportation: https://www.penndot.gov/ProjectAndPrograms/ResearchandTesting/Autonomous%20_Vehicles/Pages/Platooning.aspx.
- US Department of Transportation: https://rosap.ntl.bts.gov/view/dot/1038.
- Volpe Center: https://www.volpe.dot.gov/news/how-automated-car-platoon-works.

CHAPTER 8

NEXT STEPS

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 last several years by CCMTA members, the AV/CV WG and material provided by AAMVA. It is also important to highlight that these Guidelines have drawn from and complement those found in the national trial guidelines, "*Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations*", released in 2018 and developed under the leadership of Transport Canada and in collaboration with CCMTA.

Because the technology is rapidly evolving, it is critical for the CCMTA to continue to work in collaboration with stakeholders, learn and share their expertise for the collective benefit of members and the community as a whole.

To advance their knowledge of the progression of ADAS and ADS-equipped vehicle technology, CCMTA will continue to work closely with government entities, industry and research stakeholders. In addition, CCMTA will maintain close contact with jurisdictional government officials; and national associations supporting transportation agencies, such as the Policy and Planning Support Committee (PPSC) of the Council of Deputy Ministers of Transportation and Highway Safety. CCMTA will work closely with Transport Canada as it moves forward on future iterations of the guidelines for trial organizations and it will also continue to partner and collaborate with AAMVA to ensure consistency and understand the impacts on government programs and responsibilities on both sides of the border.

CCMTA will continue to work with manufacturers and other stakeholders to discuss the Guidelines and current and emerging factors that the recommendations address. CCMTA will participate in conferences, seminars and other fora focused on technology and public policy as required. It is recommended that CCMTA members of the AV/CV WG continue to play a role in supporting jurisdictions to understand ADAS and ADS-equipped vehicle technology and its impact on government programs. They are well placed to provide assistance to jurisdictions with the implementation of the guidelines identified in this report as well as Transport Canada's *Guidelines for Testing Automated Driving Systems in Canada Version 2.0*.

The Guidelines will be a living document and revisions will be made as new vehicle technology and information emerges. They will continue to address MTA and law enforcement concerns related to ADAS and ADS-equipped vehicle testing and deployment. Future updates are expected to include subjects such as heavy-commercial vehicles, and other emerging issues that have progressed

far enough in their research, development and deployment to warrant new guidelines and recommendations. CCMTA will work with and coordinate ADS-equipped vehicle initiatives through their partnerships with Transport Canada.

The CCMTA is committed to keeping pace with the evolution of vehicle technology, providing timely information, and sharing their expertise.

APPENDICES

Appendix A

Acronyms

- Advanced Driver-Assistance Systems (ADAS)
- American Association of Motor Vehicle Administrators (AAMVA)
- American Driver and Traffic Safety Association (ADTSEA)
- Auto Information Sharing and Analysis Center (Auto ISAC)
- Automated Driving System (ADS)
- Automated licence plate readers (ALPR)
- Automated Vehicles (AV)
- Automated vehicle testing (AVT)
- Canadian Association of Chiefs of Police (CACP)
- Canadian Council of Motor Transport Administrators (CCMTA)
- Center for Internet Security's Critical Security Controls (CIS CSC)
- Central Processing Unit (CPU)
- Commercial Driver's Licence Information System (CDLIS)
- Commercial Motor Vehicle Safety Standards (CMVSS)
- Data Collection Mechanisms (DCM)
- Department of Motor Vehicles (DMV)
- Department of Transportation (DOT)
- Driving School Association of the Americas (DSAA)
- Electric and hydrogen fueled vehicles (xEVs)
- Event data recorder (EDR)
- Emergency Medical Services (EMS)
- Federal Motor Vehicle Safety Standards (FMVSS)
- Global positioning system (GPS)
- International Driver Examiner Certification (IDEC)
- International Organization for Standardization (ISO)
- Law Enforcement Protocol (LEP)
- Law Enforcement Interaction Plan (LEIP)
- Manufacturer's Certificate of Origin (MCO)
- Manufacturers and other entities (MOE)
- Manufacturer's Statement of Origin (MSO)
- Model Minimum Uniform Crash Criteria (MMUCC)
- Motor Transport Administrator (MTA)
- National Fire Protection Association (NFPA)
- National Highway Traffic Safety Administration (NHTSA)
- Non-commercial Model Driver Testing System (NMDTS)
- Object and Event Detection and Response (OEDR)
- Original Equipment Manufacturer (OEM)
- Rear-view video systems (RVS)
- Society of Automotive Engineers International (SAE)
- Test Maintenance Subcommittee (TMS)
- Transportation Research Board (TRB)
- United States Department of Transportation (USDOT)
- Vehicle Identification Number (VIN)

Appendix B

Summary of Recommendations for Jurisdictions

The following is a summary of the recommended jurisdictional guidelines for the: governance, safe testing, deployment, and law enforcement and transportation safety considerations of ADS vehicles.

These guidelines are intended to ensure a framework of consistent regulation and oversight of ADS vehicles throughout the jurisdictions. Jurisdictions are not required to follow these guidelines. The guidelines are provided for those jurisdictions that choose to regulate ADS vehicles.

Recommendations

Chapter 3. Guidelines for the Governance of Testing and Deployment of ADS Vehicles

3.1 GOVERNANCE

3.1.1 Establish an ADS Committee to address ADS-equipped vehicle testing and deployment. The Committee should include members from a broad range of governmental and private sector stakeholders having interest in and/or responsibilities related to ADS.

3.1.2 Identify a Lead Agency to manage the ADS Committee and its work. The ADS Committee should develop strategies for addressing testing and deployment of ADS-equipped vehicles in their jurisdiction, balancing the protection of road safety with enabling technological innovation.

3.1.3 Jurisdictions should review their laws, regulations and rules regarding vehicle operation to:

a) Support the testing and deployment of ADS-equipped vehicles on public roads; and

b) Ensure that they do not create unnecessary barriers to the testing, deployment and operation of ADS-equipped vehicles in Canada. *(modified)*

3.1.4 Jurisdictions that regulate the testing of ADS-equipped vehicles are encouraged to take necessary steps to establish statutory authority and to consult the document *Testing Highly Automated Vehicles in Canada Version 2.0* published by Transport Canada in collaboration with CCMTA in 2021 as a minimum baseline to frame the regulations. ***(modified)***

3.1.5 Jurisdictions should encourage their regulating bodies and legislators to engage in regular reviews of ADS technologies and to engage with industry to stay current with advancements. This will help officials recognize when laws, rules and policies are either outdated or proposed prematurely.

3.1.6 The lead agency should designate an AV lead staff member. **(new)**

3.1.7 The motor vehicle agency should also designate an AV lead staff person, if that 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. **(new)**

3.2 VEHICLES WITH ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) (new)

3.2.1. Use consistent terminology to describe ADAS technology in vehicles as international standards continue to be developed. **(new)**

Chapter 4. Guidelines for the Testing of ADS Vehicles

Vehicle Credentialing Considerations

4.1 APPLICATION AND PERMIT FOR MANUFACTURERS OR OTHER ENTITIES TO TEST VEHICLES ON PUBLIC ROADWAYS (new)

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. ***(modified)***

4.1.2 Establish a test permit application process including for approval or denial for ADS-equipped vehicles that does not create unnecessary barriers for manufacturers or other entities and requires the completion or attachment of the information listed in Section 4.1's Guidelines above. ***(modified)***

4.1.3 Jurisdictions may consider creating a single umbrella application for test permits for any number of identically equipped vehicles. **(new)**

4.1.4 Require test permit/approval 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 those jurisdictions where manufacturer or other entity-owned vehicles are required to be individually registered. *(modified)*

4.1.5 Require test permits/approvals to be carried in the test vehicle while present on public roadways within their jurisdiction or until or unless an electronic process has been created by jurisdictions which will allow permit information to be made readily available to law enforcement. *(modified)*

4.1.6 Jurisdictions should not utilize regulations developed for testing for deployed vehicles since these vehicles will be subject to the *Canada Motor Vehicle Safety Standards* (CMVSS) and other potential federal safety guidance. *(modified)*

Actions on Permit Process **(new)**

4.2.1 Develop provisions for suspension/revocation/fining of any permit holder to test on public roads if permit holders violate permit conditions and reporting such actions to the jurisdiction's lead law enforcement agency. **(new)**

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. **(new)**

4.2.3 Establish a process for reporting traffic law violations to the permit issuing agency. **(new)**

4.2.4 Have an appeal process from any action taken against a manufacturer or other entity. **(new)**

4.3 VEHICLE PERMITTING AND REGISTRATION

4.3.1 Record and maintain test vehicle information in the vehicle record through the normal registration process, through a registration exception process unique to ADS-equipped vehicles or recording vital information in the database without registering. **(new)**

4.3.2 Establish uniform language that will benefit law enforcement, the MTA and other stakeholders for testing ADS-equipped vehicles. Use the acronyms and terms such as "ADS" for "*Automated Driving System*", and "ADS-equipped vehicle" on the vehicle registration record.

4.3.3 Place a notation on the permit, registration certificate, approval and/or electronic record, if applicable, by means of an ADS flag and the ADS Level in an additional corresponding field for the ADS Level.

4.3.4 Recognize the permit issued by another jurisdiction for purposes of testing.

4.3.5 Jurisdictions should not begin the process of registering test vehicles if the jurisdiction does not already require this protocol for other technology testing scenarios (e.g., alternate fuel test vehicles).

4.3.6 Test vehicles that have entered Canada through a temporary importation declaration will not be permitted to permanently stay in Canada except as provided for in the Motor Vehicle Safety Regulations (e.g., donation as approved by the Minister). Vehicles should be plated through a means that allows the jurisdiction to prevent the transfer of ownership of the vehicle unless it receives approval for permanent importation into Canada. ***(modified)***

4.3.7 If the jurisdiction does issue a registration record/credential, it should consider placing an "Altered" or "A" status on vehicles not equipped with automated technologies by the OEM but have aftermarket automated components.

4.3.8 Require manufacturers and other entities to notify the jurisdiction in the case of:

a) any change to the SAE Level of the vehicle or vehicles being tested; or

b) the addition of another vehicle or vehicles to the testing program.

In the case of such notification, the manufacturers and other entities should be required to provide details on these vehicles to be tested.

4.3.9 When changes to the SAE Level have been made or additional vehicles are added to the testing program, the jurisdiction should promptly update its records accordingly, and issue a new permit for the test vehicle or vehicles reflecting the changes/additions made.

4.4 LICENCE PLATES **(new)**

4.4.1 Jurisdictions should not require a special licence plate for ADS-equipped vehicles. If a jurisdiction does, however, choose to require a special licence plate for ADS-equipped vehicles, the jurisdiction may consider adopting the administrative, design and manufacturing specifications contained in the *AAMVA License Plate Standard*. **(new)**

4.4.2 Jurisdictions are also encouraged to monitor international research and best practices as they evolve, to help inform approaches for appropriately identifying ADS-equipped test vehicles through licence plates or other means. **(new)**

4.5 FINANCIAL RESPONSIBILITY

4.5.1 Require all ADS-equipped vehicles permitted for on road testing to have a minimum of $5 million in liability insurance, in the form and manner required by the MTA authority or other relevant agency.

4.5.2 Jurisdictions should consider requiring additional liability insurance, beyond the $5 million minimum, for vehicles with a large seating capacity (e.g., for 8 or more passengers).

4.5.3 For the testing of driverless ADS-equipped vehicles, jurisdictions should consider including a requirement that stipulates, as part of the application process, that

(a) testing entities must accept full liability/responsibility for damages caused by their vehicles or drivers, and

(b) their insurers must agree to respond to damage claims whether the driver or vehicle is deemed to be at fault.

4.6 COMPLIANCE OF ADS TRIAL VEHICLES WITH THE MOTOR VEHICLE SAFETY ACT (MVSA)

4.6.1 Consider requiring manufacturers or other entities that seek to conduct trials for ADS-equipped vehicles within their jurisdictions to confirm compliance with the MVSA including federal importation requirements. Consider requiring manufacturers or other entities that seek to conduct trials for ADS-equipped vehicles within their jurisdictions to confirm compliance with the MVSA including the submission of any declarations that may be applicable as per Section 7(1)(a) of the MVSA and Section 5.1(1) of the MVSR as applicable. *(modified)*

4.6.2 As noted in section 4.1, as part of their trial permitting process, jurisdictions are encouraged to ask for the submission of a Safety Assessment report from the ADS-developer based on Transport Canada's published tool: Safety Assessment for Automated Driving Systems in Canada (2019). Jurisdictions are encouraged to consult with Transport Canada when reviewing the information they receive and to share a copy of the safety assessment. **(new)**

4.7 PERIODIC MOTOR VEHICLE INSPECTIONS (new)

4.7.1 Do not impose safety inspection requirements to verify the safety of ADAS and ADS technology, for vehicles being tested under AV pilot programs. **(new)**

Driver Licencing Considerations

4.8 DRIVER AND PASSENGER ROLES DEFINED

4.8.1 Utilize the SAE International definitions provided in the Preface.

May need a similar recommendation to 5.8.2 here for the testing situation

4.9 DRIVER LICENCE REQUIREMENTS FOR TESTING BY MANUFACTURERS AND OTHER ENTITIES

4.9.1 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.

4.9.2 Require the test driver to have the appropriate and valid class of licence associated with the particular vehicle being tested (e.g., Class 5 licence to test a passenger vehicle).

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

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

4.9.5 Consider allowing testing of driverless or remote operations of ADS-equipped vehicles, provided that the manufacturer can demonstrate that the ADS can operate safely and achieve a minimal risk condition based on results from previous testing. Other risks associated with remote driving should also be accounted for by the trial organization (see Section 4.10 - Remote Test Driver below). *(modified)*

4.9.6 Take steps to ensure their motor vehicle laws allow for the manufacturer testing of ADS Levels 4 and 5 vehicles without a licenced driver.

4.10 REMOTE TEST DRIVER (new)

4.10.1 Define remote driver in the jurisdiction's statutes by adopting the SAE definition and review the SAE 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. **(new)**

4.10.2 Require the testing entity to agree in writing that a remote driver would be subject to an operator fitness evaluation by law enforcement if there is an incident or collision. **(new)**

4.10.3 Clarify in law that all laws applicable to drivers, apply to remote drivers. **(new)**

4.10.4 Review licence 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 corrective lenses, hearing devices, and accommodations for missing limbs. **(new)**

4.10.5 Driver licence program staff and law enforcement need to understand remote driving and be well versed in responding to inquiries. **(new)**

4.10.6 Require manufacturers and other entities, testing vehicles using a remote driver to notify the jurisdiction's lead AV agency, comply with all other testing requirements and to provide the names and driver licence information for all remote drivers. **(new)**

4.10.7 Be physically located in the same jurisdiction as the vehicle they are driving. **(new)**

4.10.8 Require documentation from the manufacturers and other entities that remote drivers have been trained to safety operate the vehicle remotely. Evidence that other risks associated with remote driving (e.g., signal loss/latency, other human factors considerations etc.) have been sufficiently addressed and validated through previous testing in the vehicle's ODD, should also be provided. **(new)**

4.10.9 Require Remote Test Drivers to:

a) Comply with all federal and jurisdictional laws unless otherwise exempt.

b) Hold the class of licence issued by the jurisdiction in which the vehicle is being operated for the vehicle they are driving.

c) Be physically located in the same jurisdiction as the vehicle they are driving.

d) Inform their employer immediately of any moving violations.

e) Not be impaired or distracted. They must be fit to drive.

f) Only remotely drive one vehicle at a time.

g) Be at a specific location and not driving remotely from another vehicle.

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

i) If the vehicle is involved in a collision, report it immediately to the appropriate law enforcement in the jurisdiction in which the vehicle is located. **(new)**

4.10.10 Require Test Vehicle Owners to:

a) Post the responsible party's name and contact information within a remotely operated vehicle.

b) Verify remote test drivers' driving records at least annually. **(new)**

4.11 TRAINING MOTOR TRANSPORT ADMINISTRATOR STAFF FOR ADAS AND ADS-EQUIPPED VEHICLES (new)

4.11.1 MTA senior managers should be aware that ADS-equipped vehicles are being tested and should be aware of their jurisdiction's approach to testing. **(new)**

4.11.2 MTA staff responsible for approving the testing proposals need to have wholistic understanding of the test vehicles (including the risks involved), and its impact to the road users and traffic pattern. **(new)**

4.11.3 MTA staff responsible for approving test proposals are encouraged to stay up-to- date for testings in other jurisdictions. **(new)**

Chapter 5. Guidelines for the Deployment of ADS-Equipped Vehicles

Vehicle Credentialing Considerations

5.1 VEHICLE PERMITS FOR DEPLOYED ADS VEHICLES

No recommendations for Jurisdictions.

5.2 VEHICLE REGISTRATION

5.2.1 Establish uniform language that will benefit law enforcement, the MTA and other stakeholders for ADS-equipped vehicles. Use "Automated Driving System" on the vehicle registration record. This uniform language should include the use of the acronyms and terms such as "ADS" for "Automated Driving System", and "ADS vehicle". ***(modified)***

5.2.2 Establish a field on the registration and electronic record by means of an ADS flag that indicates the motor vehicle is ADS-equipped and by indicating the motor vehicle's ADS capability Level. ***(modified)***

5.2.3 For vehicles not originally equipped with automated technologies by the OEM but have added aftermarket automated components, place an "Altered" or "A" status in the field in addition to the ADS Flag and ADS Level. ***(modified)***

5.2.4 If a jurisdiction receives a notification from a manufacturer or other entity (as in MOE 3 or 7), it should update its records, accordingly, and issue a new registration for the vehicle reflecting the change in ADS Level.

5.3 LICENCE PLATES

5.3.1 At this time, it is too early to recommend that a jurisdiction require a special licence plate for ADS-equipped vehicles. If a jurisdiction does choose to require a special licence plate for ADS-equipped vehicles, however, the jurisdiction should adopt the administrative, design and manufacturing specifications contained in the *AAMVA License Plate Standard*. ***(modified)***

5.4 LEVEL OF AUTOMATION ON NEW VEHICLE INFORMATION STATEMENT (NVIS)

5.4.1 Jurisdictions should consider changes to their vehicle registry systems so that they can begin recording vehicle Levels of Automation when the information becomes available on NVIS forms.

5.5 MANDATORY LIABILITY INSURANCE (new)

5.5.1 While it is still premature to provide specific insurance liability recommendations to jurisdictions, it is not too early for jurisdictions to start considering the new challenges described above when establishing minimum insurance liability on deployed ADS-equipped vehicles. **(new)**

5.5.2 Consider whether the owner, manufacturer, after market installer or some other person or entity will be the required insured with responsibility for liability insurance. **(new)**

5.5.3 Consider when a public or semi-public entity has purchased a vehicle for use by consumers, irrespective of whether the consumers are paying for that use. **(new)**

5.5.4 Consider liability insurance requirements for commercial vehicles not covered by the federal regulations that are distinctive from rates for personal/private vehicles. **(new)**

5.6 COMPLIANCE OF DEPLOYED ADS VEHICLES WITH THE MOTOR VEHICLE SAFETY ACT (MVSA)

5.6.1 Require all ADS-equipped vehicles, available to the public, to conform to all applicable Canada Motor Vehicle Safety Standards, unless specifically exempted by Transport Canada. *(modified)*

5.7 PERIODIC MOTOR VEHICLE INSPECTIONS (new)

5.7.1 Integrate ADAS and ADS-equipped technology maintenance requirements into inspection programs after federal safety standards have been developed; minimum program requirements should reflect federal safety standards where possible. At that point, establish a committee or task force to lead and explore integrating AV technology into jurisdiction's inspection programs. **(new)**

5.7.2 Jurisdictions should continue to work closely with manufacturers and other entities to understand mechanisms for verifying the safety and functionality of ADAS and ADS-equipped technology components, and how safety might be discerned in the future. **(new)**

Driver Licencing Considerations

5.8 DRIVER AND PASSENGER ROLES DEFINED

5.8.1 Utilize the SAE International definitions provided in the Preface.

5.8.2 Take steps to ensure motor vehicle laws allow for the operation of Level 4 and 5 ADS-equipped vehicles without a driver if the vehicle cannot be operated in non-automated mode. *(modified)*

5.9 DRIVER TRAINING FOR CONSUMERS FOR DEPLOYED VEHICLES

5.9.1 Promote consumer training on the use of ADAS and ADS-equipped vehicle functions.

5.9.2 Consider conducting public awareness campaigns to support safe consumer use of emerging vehicle technologies as they enter the market. **(new)**

5.9.3 Encourage communication between dealers and consumers including, but not limited to, acknowledgement of the sections in the vehicle "owner's manual" that relate to the ADAS and ADS-equipped vehicle functions. The owner's manual and/or other consumer education resources should contain easy to understand information for the consumer. *(modified)*

5.9.4 Encourage manufacturers, dealers and insurance companies to provide incentives for consumers to receive proper training on the use of ADAS and ADS-equipped vehicle functions.

5.10 TRAINING MOTOR TRANSPORT ADMINISTRATOR STAFF FOR ADAS AND ADS-EQUIPPED VEHICLES (new)

5.10.1 Provide general training to MTA staff on vehicle technologies, including what the technology does and how it works. AAMVA's *Testing Drivers in Vehicles with Advanced Driver-Assistance Systems* resource guide, published in 2019, could be utilized. **(new)**

5.10.2 Require all definitions and language on ADAS and ADS-equipped vehicles provided to MTA staff to be taken from SAE or CCMTA's guidelines for consistency. **(new)**

5.10.3 Begin to expose staff to vehicle technology by incorporating some general education about vehicles in staff meetings. This could include showing videos and pictures of vehicles equipped with ADAS and ADS. **(new)**

5.11 TRAINING MOTOR TRANSPORT ADMINISTRATOR EXAMINERS ON ADAS AND ADS-EQUIPPED VEHICLES (new)

5.11.1 Provide training to driver licence examiners on vehicle technologies including the operation of ADAS and ADS vehicles.

5.11.2 Align with future iterations of AAMVA's International Driver Examiner Certification model training materials that include ADAS and ADS vehicles. Changes to the driver licence examiner training requirements would need to be considered by CCMTA for possible inclusion in NSC 2 and 3, to continue alignment with AAMVA. *(modified)*

5.12 TRAINING FOR DRIVER EDUCATORS AND CONSIDERATIONS FOR DRIVER EDUCATION AND DRIVER TRAINING PROGRAMS (new)

5.12.1 Require driver education curricula to contain information on ADAS and ADS-equipped vehicles and to provide behind-the-wheel instruction using this technology. *(modified)*

5.12.2 Require all definitions and language on ADAS and ADS-equipped vehicles provided in driver education to be taken from SAE or CCMTA guidelines for consistency. **(new)**

5.12.3 Establish standards for the conduct and training of driver educators and private instructors for the training of drivers on the use of ADAS and ADS-equipped vehicles.

5.13 DRIVER LICENCE SKILLS TESTING WITH VEHICLE TECHNOLOGIES

Recommendations for Jurisdictions

5.13.1 Include ADAS and ADS information on vehicle technologies in the jurisdiction's driver's manual, when provided by the AAMVA TMS, as appropriate.

5.13.2 Include questions addressing ADAS and ADS in the jurisdictional knowledge test, when provided by the AAMVA TMS, as appropriate.

5.13.3 Jurisdictions should not allow the applicant to utilize convenience technologies, such as the parking assist feature, for off-road skills tests or parking maneuvers during the road test. For example, the applicant should be required to demonstrate the ability to park the vehicle.

5.13.4 Allow the applicant to utilize safety critical technologies for skills tests or parking maneuvers during the road test. These technologies, such as backup or other cameras should not be disengaged for off-road testing.

5.13.5 Jurisdictions should not require applicants to deactivate safety critical technologies during the testing process.

5.14 ENDORSEMENTS AND RESTRICTIONS FOR DEPLOYED VEHICLES

5.14.1 Jurisdictions should not establish endorsements and/or restrictions on the driver licence at this time, specifically for ADS-equipped vehicles. *(modified)*

5.14.2 Review laws and regulations related to a passenger of a motor vehicle, such as unsupervised children, or persons with physical or mental disabilities and adopt appropriate laws and regulations to ensure safety at each Level of Automation.

Chapter 6: Law Enforcement and Transportation Safety Considerations

6.1 VEHICLE IDENTIFICATION (new)

6.1.1 There is growing recognition that it will be important for other road users to be able to visually identify ADS-equipped vehicles. Special licence plates and requiring labels on the body of the vehicle are just some means of identification. Other innovative options may emerge as ADS technology continues to evolve (e.g., special lighting systems etc.). **(new)**

6.1.2 At this stage in ADS technologies' development, it may be too early to determine what approach will be most effective. Further research and collaboration with industry and the international road safety community are recommended to identify best practices as ADS technology continues to develop. Jurisdictions should seek to align any future statutory requirements pertaining to ADS identification based on international best practices. **(new)**

6.2 COLLISION/INCIDENT REPORTING

For Testing of Vehicles

6.2.1 Jurisdictions should require ADS-equipped vehicle manufacturers or other test entities to:

a) submit a periodic disengagement report to the MTA with sufficient information for regulators. Jurisdictions may require the testing plans to be altered by trial organizations if the cause of the disengagement is recurring; **(new)**

b) provide to jurisdictions, within 24 hours of the collision or as otherwise required under provincial/territorial law or regulations, a preliminary report on the incident and any relevant information that the manufacturer may be able to share at the time, regarding potential causes of the collision;

c) postpone immediately any testing activities involving any of the persons or vehicles involved until further direction is provided from the MTA or relevant agency; and

d) provide to the jurisdiction a summary analysis of the incident in order to expand the amount of ADS data and research. **(new)**

For Deployment of Vehicles

6.2.2 Transport Canada should explore options to update the National Collision Database Dictionary (NCDB2) to support the identification and collection of ADS Level vehicle information in Canada. Canadian jurisdictions should adopt the NCDB2 or its successor, as soon as practicable.

6.2.3 Jurisdictions should develop and standardize the reporting process to document ADS collisions/incidents beyond the Provincial Highway Traffic Act and Motor Vehicle Collision Report. The ADS-equipped vehicle collision/incident report should identify if the ADS-equipped vehicle is being operated in autonomous mode or non-autonomous mode.

6.2.4 Transport Canada and jurisdictions should explore additional options to collect and/or link the NCDB collision data with other data sources that may contain the ADS Level vehicle information, including working together to build such data sources where they do not already exist.

6.3 CRIMINAL ACTIVITY

For Testing of Vehicles

6.3.1 Jurisdictions should evaluate every test case to determine if it is appropriate for designated Test Users (employees, contractors and other persons) to undergo a police-conducted background check that may include, but is not limited to, a driver history review and a criminal history check (including vulnerable sector background check if the testing is public facing such as an automated shuttle). Subsequent authorization to operate an ADS-equipped test vehicle after a background check is subject to the pass/fail criteria applicable to the test environment as set by jurisdiction in policy or regulation. The cost of the background check should not be borne by the jurisdiction.

6.3.2 It is recommended that jurisdictions should establish provisions, within ADS-equipped vehicle permitting requirements as described in Section 4.2 - Vehicle Permitting and Registration, which disqualify an agent or contractor of a manufacturer or other entity from operating an ADS-equipped vehicle in a test environment if they have a relevant criminal record or a driving history that includes impaired driving, careless driving, or other significant convictions within the past 5 or 10 years.

6.4 DISTRACTED DRIVING AND FATIGUE

For Testing of Vehicles

6.4.1 Jurisdictions should ensure that all distracting activities are prohibited and measures taken to limit driver fatigue. **(new)**

6.4.2 Jurisdictions should consider requesting information from testing organizations that evaluates the capacity of the onboard operator/driver to conduct all of their testing activities safely (e.g., without distraction, fatigue, etc.). **(new)**

For Deployment of Vehicles

6.4.3 Consider the Level of Automation to which their careless and/or distracted driving laws will apply. **(new)**

6.4.4 Jurisdictions should stay up-to-date on best practices such as the UN's WP1 resolution for the conduct of non-driving activities in a vehicle when an ADS is engaged. **(new)**

6.5 ESTABLISHING OPERATIONAL RESPONSIBILITY AND LAW ENFORCEMENT IMPLICATIONS

For Testing of Vehicles

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.

For Deployment of Vehicles

6.5.2 Clearly establish legal responsibility for every vehicle operating on public roads.

6.5.3 Take steps to ensure a licenced human driver is prepared and capable of taking control of an ADS Level 3 or 4 vehicle if the vehicle requires a human driver to perform the DDT fallback.

6.5.4 For vehicles classified as Levels 4 or 5, which may be operated without a licenced driver and where the driverless vehicle performs the DDT independent of human input, the registered owner should be responsible for its safe operation (N.B. this issue will continue to be discussed and may evolve over time).

6.6 LAW ENFORCEMENT PROTOCOLS (LEP) FOR LEVEL 4 AND 5 VEHICLES **(new)**

For Testing and Deployment of Vehicles

6.6.1. 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. **(new)**

6.6.2. 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/first responder community. The liaison should review the LEP continually and ensure consistency with:

- Jurisdictional laws and regulations,
- Recommendations from the manufacturer and
- Enforcement guidelines. **(new)**

6.6.3. Ensure the LEP and LEIP are available to law enforcement officers and first responders with or without an internet connection. **(new)**

6.7 FIRST RESPONDER SAFETY AND TRAINING *(modified)*

For Testing and Deployment of Vehicles

6.7.1 Work with manufacturers' and other entities' consumer training programs to make the ADS training available to first responders at no cost to agencies.

6.8 VEHICLE RESPONSE TO EMERGENCY VEHICLES, MANUAL TRAFFIC CONTROLS AND ATYPICAL ROAD CONDITIONS

No recommendations for Jurisdictions.

6.9 SYSTEM MISUSE AND ABUSE

No recommendations for Jurisdictions.

6.10 ADHERENCE TO TRAFFIC LAWS

For Testing and Deployment of Vehicles

6.10.1 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. *(modified)*

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

6.11 CYBERSECURITY FOR VEHICLES WITH AUTOMATED DRIVING SYSTEMS (new)

No recommendations for Jurisdictions.

Chapter 7. Other Considerations (all new)

7.1 DATA COLLECTION (all new)

For Testing of Vehicles

7.1.1 Conduct a thorough review of jurisdictional laws pertaining to the collection and dissemination of data. Particular attention should be given to Personally Identifiable Information (PII) and under what circumstances it may appropriately be recorded, maintained and released. In addition, the issue of transparency should be evaluated: what data is permitted to be collected, how the individual is informed about the collection and use of the data and if an affirmative consent should be considered.

7.1.2 Provide information about vehicle data collection resources on the jurisdiction's website to encourage consumers to check with their vehicle manufacturer for information about the collection of data by the systems in their vehicle.

For Deployment of Vehicles

No recommendations for Jurisdictions.

7.2 LOW-SPEED AUTOMATED SHUTTLES (all new)

For Testing of Vehicles

7.2.1 Jurisdictions should implement testing regimes based on the recommendations found in Chapter 4.

7.2.2 Jurisdictions should ensure that shuttle manufacturers supply sufficient information on the capabilities and limitations of the shuttle and technical support and inputs to both the trial organizations and regulators.

7.2.3 Jurisdictions are encouraged to consult Canadian guidance documents, including Transport Canada's Trial Guidelines.

7.2.4 Jurisdictions should ensure that trial organizations employ a graduated approach to testing in their jurisdiction.

7.2.5 Jurisdictions should obtain a detailed definition of the shuttle's ODD as well as documented testing used to validate each ODD including:

a) Road types on which the automated driving system can operate safely

b) Geographic areas

c) Speed range

d) Environmental conditions (daytime/nighttime, weather, etc.)

7.2.6 It is recommended that jurisdictions request a safety assessment report from the shuttle manufacturer based on Transport Canada's safety assessment tool, which is available at https://publications.gc.ca/site/eng/9.864590/publication.html.

7.2.7 It is recommended that jurisdictions request that trial organizations develop safety management plans for their testing activities based on a risk assessment of the testing environment, planned operations, and the test vehicles capabilities and limitations. These may include standard operating procedures to be observed throughout the trial, as well as emergency response plans in the event of a collision or other incident.

For Deployment of Vehicles

7.2.8 Jurisdictions should not seek to accommodate on-road deployment of low-speed automated shuttles absent of federal safety standards and a corresponding definition for this vehicle type.

7.3 AUTOMATED MICRO UTILITY DEVICES (INCLUDING PERSONAL DELIVERY DEVICES) (all new)

For Testing of Vehicles

7.3.1 Review existing legislative and regulatory framework to understand how MUDs are treated under existing laws, and to what extent municipalities are able to regulate these devices.

7.3.2 Define automated micro utility devices to distinguish them from other vehicle classes, taking into consideration weight/dimensions and speed that are reasonable on sidewalks and/or shoulders in relation to their intended use and other road users that may share those spaces (e.g., pedestrians and/or bicycles).

7.3.3 Provide clear operating parameters where possible. For example, requiring smaller devices to operate on sidewalks where they exist, or where sidewalks do not exist and if permitted by municipalities, other spaces such as shoulders of roads or bike trails. They should also operate under pedestrian rules of the road, such as crossing at designated intersections, travelling at speeds comparable to those of pedestrians, and also to yield to traffic and pedestrians, where possible. Larger devices that may operate at higher speeds could operate on the right side of the roadway, bike lanes, or shoulders, akin to bicycles, travelling in the same direction of vehicular travel.

7.3.4 Require liability insurance, in the form of motor vehicle or general liability, to ensure adequate compensation in case of the device incurring liability.

7.3.5 Registration and applications are not recommended at a jurisdictional level, but jurisdictions should support municipalities if they choose to implement their own registration or application process.

7.3.6 Consider collision/incident reporting requirements and reporting to be directly to the regulating jurisdiction, in addition to the local enforcement agencies.

7.3.7 Require, at a minimum, that all devices have the name and contact information of the owner/operator and a unique identifier to be prominently displayed on its exterior; jurisdictions should consider requiring this information to appear on multiple sides of the vehicles to assist in identification in the event of a collision or other emergency.

7.3.8 Require audible alerts and visual warning equipment, such as a flag, to warn other road users of its presence.

7.3.9 Require lighting and other visual warning equipment, such as reflectors.

7.3.10 Consider types of loads that may not be permitted, such as prohibiting dangerous/hazardous goods and livestock.

7.3.11 Consider vehicle oversight parameters if operated remotely, and/or the potential of a nearby human chaperone as required to ensure safety while maintaining situational awareness. Ensure that there are timely and sufficient human interventions for the simultaneous operation of these devices.

7.3.12 Consider creation of a municipal opt-in framework to allow local governments to determine whether to allow the operation of automated micro utility devices within their communities, and to create additional bylaws on their usage (e.g., that govern where devices can be used, which companies are eligible and how many vehicles are permitted).

7.3.13 Require local first responders' input and review of the proposal. First responders must have access to first responders' guidelines, documenting how the system may be disabled in a safe manner.

7.3.14 Require proponents to demonstrate sufficient and timely local infrastructure and human resources to respond to mass-scale system outages.

7.3.15 Review the PDD or MUD for its design, such as elements including Operational Design Domain, Object and Event Detection and Response, Fallback, crashworthiness, post-crash behaviour, and data recording element.

7.3.16 Review how the PDD or MUD will interact with other road users and existing infrastructure (such as traffic conflict point at the intersections, interactions with traffic control devices, interaction with emergency vehicles responding to emergencies, and vehicles with large blind spots like transit buses).

For Deployed Automated Micro Utility Devices (including Personal Delivery Devices)

7.3.17 Jurisdictions should not accommodate full scale deployment of automated micro utility devices before more data is available following testing and piloting.

CONNECTED VEHICLES (all new)

For Testing of Vehicles

7.4.1 Jurisdictions should require vehicles with connected and automated technologies to follow the permitting and registration process for automated vehicles 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 their jurisdiction and to inform jurisdiction and local officials involved in connected vehicle technology infrastructure planning and implementation, including traffic management and operations.

7.4.3 It is recommended that jurisdictions evaluate the impact of connected vehicle technologies on the existing road transportation and network infrastructure (e.g., connected vehicle's traffic signal prioritization) on the existing traffic pattern prior to approval for testing.

7.4.4 It is recommended that jurisdictions stay engaged on emerging cybersecurity threats via organizations like Automotive Information Sharing and Analysis Center (Auto-ISAC).

For Deployment of Vehicles

7.4.5 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.

7.5 COOPERATIVE TRUCK PLATOONING (all new)

For Testing of Vehicles

7.5.1 Review and update statutes to enable vehicles that undertake platooning trials to follow at a reasonable and prudent distance.

7.5.2 Require platoon testing entities to submit an application packet for testing as described in Section 4.1 – Application and Permit for MOEs to Test Vehicles on Public Roadways and issue a permit to test once satisfied with the application and other submitted information.

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

7.5.4 Allow testing only on approved limited access highways.

7.5.5 Do not permit platooning for vehicles that are over-weight, over-sized or operating in a long-combination vehicle configuration.

7.5.6 Require disengagement when vehicles enter or exit the highway, or travel in work zones, tunnels, weigh stations, toll plazas, or travel past an incident scene.

7.5.7 Allow testing only on approved routes, with consideration of road geometry, highway ingress/egress, prevailing traffic conditions, etc.

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

7.5.9 Do not allow testing when the roads are snow covered, icy or in reduced visibility.

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

7.5.11 Prohibit carrying dangerous goods, oversize or overweight loads, fluids, loose loads or livestock. Prohibit the transport of members of the general public using such technology.

7.5.12 Require the lead vehicle to be the heaviest vehicle in the platoon.

7.5.13 Do not allow platoons to exceed three tractor and trailer combinations.

7.5.14 Each vehicle combination should be limited to a truck/tractor and one trailer combination unit, i.e., no B-train or long-combination.

7.5.15 Consider requiring an identifier on the outside of the vehicle configurations to indicate when the platoon technology is engaged.

7.5.16 Consider the use of escort vehicles with conspicuous lighting in the front and rear of the platoon during trials, particularly during the early stages of a trial or for experimental platooning systems that have not been subject to significant on-road testing. Measures such as deactivating the platoon in heavier traffic or widening the following distance might also be appropriate alternatives to use in these situations.

7.5.17 Ensure platoons are equipped with appropriate signage to advise other motorists of their presence.

7.5.18 Require all drivers to hold an appropriately endorsed and valid commercial driver licence (CDL).

7.5.19 Require all drivers to receive appropriate training provided by the testing entity, including appropriate fault injection and traffic scenarios (e.g., cut-ins) training.

7.5.20 Drivers must comply with all applicable jurisdictional regulations.

7.5.21 A driver must be in each vehicle, seated in the driver's seat, prepared to take over control of the vehicle at any time.

7.5.22 In the event of a loss of communication or a CTPS failure, drivers would need to increase the following distance within the platoon in a controlled manner until the platoon as a whole achieves stable following distances.

7.5.23 At this time, jurisidictions should not consider extending hours of service for drivers (or operators) even if these people are just monitoring the safe operation of the motor vehicle.

For Deployment Vehicles

At this time, it is premature to provide guidance for deployed vehicles.

Appendix C

Summary of Recommendations for Manufacturers and Other Entities (MOEs)

Manufacturers or other entities are not required to follow these recommendations, however, CCMTA and its members offer them to manufacturers and other entities to ensure the safe testing and deployment of ADS vehicles. These guidelines come from the recommendations provided in Chapters 3, 4 and 5 of the Guidelines Document.

Chapter 3. Considerations for the Governance of Testing and Deployment of ADS

3.1 GOVERNANCE

MOE 1. Manufacturers and other entities should interact cooperatively with and respond to jurisdictional ADS Committee questions and requests.

3.2 ADVANCED DRIVER-ASSISTANCE SYSTEMS (ADAS) (new)

MOE 2. Manufacturers and other entities should adopt consistent terminology to describe ADAS technology in vehicles. **(new)**

Chapter 4. Guidelines for the Testing of ADS Vehicles

Vehicle Credentialing Considerations

4.1 APPLICATION AND PERMIT FOR MANUFACTURERS OR OTHER ENTITIES TO TEST VEHICLES ON PUBLIC ROADWAYS

No recommendations for MOEs.

4.2 ACTIONS ON PERMITS AND AUTHORIZATION PROCESS (new)

No recommendations for MOEs.

4.3 VEHICLE PERMITTING/AUTHORIZATION AND REGISTRATION

MOE 3. Testing entities should be required to notify the jurisdiction of any change in the SAE Level of vehicles being tested and/or the addition of any vehicles to the testing program.

4.4 LICENCE PLATES (new)

No recommendations for MOEs.

4.5 FINANCIAL RESPONSIBILITY

No recommendations for MOEs.

4.6 COMPLIANCE OF ADS TRIAL VEHICLES WITH THE MOTOR VEHICLE SAFETY ACT (MVSA)

No recommendations for MOEs.

4.7 PERIODIC MOTOR VEHICLE INSPECTIONS (new)

MOE 4. Manufacturers and other entities should ensure all technology being tested on public roads is safe. **(new)**

4.8 DRIVER AND PASSENGER ROLES DEFINED

MOE 5. Manufacturers and other entities should utilize the SAE International definitions provided in the Preface.

4.9 DRIVER LICENCE REQUIREMENTS FOR TESTING BY MANUFACTURERS AND OTHER ENTITIES

MOE 6. Manufacturers and other entities should complete a background check and provide/ensure appropriate training for ADS test drivers. See Section 6.3 Criminal Activity on background checks. Manufacturers are in the best position to determine what is "appropriate" training. As further guidance on this question, MOE's may wish to consider the information on "driver training" provided in the SAE J3018.

4.10 REMOTE TEST DRIVER (new)

No recommendations for MOEs.

4.11 TRAINING MOTOR TRANSPORT ADMINISTRATOR STAFF FOR ADAS AND ADS-EQUIPPED VEHICLES (new)

No recommendations for MOEs.

Chapter 5. Deployment of ADS Vehicles

Vehicle Credentialing Considerations

5.1 VEHICLE PERMITS FOR DEPLOYED ADS VEHICLES

No recommendations for MOEs.

5.2 VEHICLE REGISTRATION

MOE 7. Manufacturers and other entities should notify the jurisdiction of any subsequent change in the ADS Level of the vehicles.

5.3 LICENCE PLATES

No recommendations for MOEs.

5.4 ADS INFORMATION ON NEW VEHICLE INFORMATION STATEMENT (NVIS)

MOE 8. Various levels of government and private industry should continue to collaborate and cooperate in meeting identification goals for ADS-equipped vehicles entering the marketplace, including exploring potential updates to the NVIS. ***(modified)***

5.5 MANDATORY LIABILITY INSURANCE **(new)**

MOE 9. Manufacturers should be aware of the potential liability that may arise if issuance and installation of firmware to update the operating systems of the ADS are not done in a timely manner by the vehicle owner. Every effort should be made to encourage vehicle owners to install the new update as soon as possible after issuance. In addition, manufacturers should take appropriate steps to ensure that firmware, sensors and hardware of the ADS are maintained to the manufacturers' specifications. **(new)**

5.6 COMPLIANCE OF DEPLOYED ADS-EQUIPPED VEHICLES WITH THE MOTOR VEHICLE SAFETY ACT (MVSA) **(new)**

No recommendations for MOEs.

5.7 PERIODIC MOTOR VEHICLE INSPECTIONS (new)

No recommendations for MOEs.

Driver Licencing Considerations

5.8 DRIVER AND PASSENGER ROLES DEFINED

MOE 10. Manufacturers and other entities should utilize the SAE International definitions provided in the Preface.

5.9 DRIVER TRAINING FOR CONSUMERS FOR DEPLOYED VEHICLES

MOE 11. Manufacturers should take steps to make training available to licenced drivers to ensure they understand the functionality of the vehicle and are prepared to operate it properly. Manufacturers and Other Entities should consider implementing learning tools, such as online/in-person/in-vehicle tutorials and training programs. **(new)**

5.10 TRAINING MOTOR TRANSPORT ADMINISTRATOR STAFF FOR ADAS AND ADS-EQUIPPED VEHICLES (new)

No recommendations for MOEs.

5.11 TRAINING MOTOR TRANSPORT ADMINISTRATOR EXAMINERS ON ADAS AND ADS-EQUIPPED VEHICLES

No recommendations for MOEs.

5.12 TRAINING FOR DRIVER EDUCATORS AND CONSIDERATIONS FOR DRIVER EDUCATION AND DRIVER TRAINING PROGRAMS (new)

No recommendations for MOEs.

5.13 DRIVER LICENCE SKILLS TESTING WITH VEHICLE TECHNOLOGIES

MOE 12. Manufacturers that develop an ADS-equipped vehicle that can be fully operated by a human or fully operated by an ADS should consider taking steps to prevent the ADS to be engaged in error. The working group is concerned that a passenger in a dual-mode ADS-equipped vehicle who does not have a driver's licence could engage the mode that requires a human driver to intervene. **(new)**

5.14 ENDORSEMENTS AND RESTRICTIONS FOR DEPLOYED VEHICLES

No recommendations for MOEs.

Chapter 6. Law Enforcement and Transportation Safety Considerations

6.1 VEHICLE IDENTIFICATION

MOE 13. Manufacturers should develop international consensus standards for a system of external facing permanent labeling and/or other means of visual identification of ADS-equipped vehicles. **(new)**

6.2 COLLISION/INCIDENT REPORTING

For Testing of Vehicles

No recommendations for MOEs.

For Deployment of Vehicles

MOE 14. Manufacturers should ensure that ADS-equipped vehicles have the capacity to record safety-critical information to support collision investigations. *(modified)*

MOE 15. In the event of a collision or other incident, information recorded by ADS-equipped vehicles should be shared with federal, provincial/territorial, and municipal law enforcement and government agencies in a timely manner to support investigations, including defect and collision investigations. *(modified)*

MOE 16. Manufacturers should monitor international research and best practices to help inform what collision and incident data should be collected by DCMs and how to make the collected data retrievable in a timely manner by those duly authorized. *(modified)*

6.3 CRIMINAL ACTIVITY

For Testing of Vehicles

MOE 17. The manufacturer or other entities should consider requiring the designated Test Users (employees, contractors and other persons) to undergo a background check, including, but not limited to, a driver history review and a criminal record history check, as a condition of operation of an ADS-equipped test vehicle. *(modified)*

MOE 18. The manufacturer or other entities should establish procedures to place limits on or to disqualify an agent or contractor of a manufacturer or other entity who has a relevant criminal record or a criminal code driving violation within the past 5 or 10 years from operating an ADS-equipped vehicle in a test environment. *(modified)*

MOE 19. Manufacturers and other entities should ensure that cybersecurity best practices are incorporated into test vehicles since these vehicles may be operated both in a closed facility and on public roads.

For Deployment of Vehicles

MOE 20. Manufacturers and other entities should provide documentation, and all technical assistance to enforcement agencies, subject to local legislation, to aid any investigation related to how the ADS was used. *(modified)*

6.4 DISTRACTED DRIVING AND FATIGUE

For Testing of Vehicles

MOE 21. Manufacturers or other entities should outline what the onboard operators/drivers may do while testing any ADS/ADAS on a vehicle. *(modified)*

MOE 22. Manufacturers or other entities should not design ADS information displays that may significantly increase driver distraction.

MOE 23. Manufacturers or other entities should educate test drivers on the effect of task monotony on vigilance and alertness, especially if they are expected to remain alert during the testing.

MOE 24. Manufacturers and other entities should ensure test drivers are provided with frequent breaks to interrupt the monotony (e.g., every 60, 90 minutes).

MOE 25. Manufacturers and other entities should limit the number of hours required for testing, particularly at night and during mid-afternoon to limit test driver fatigue.

MOE 26. Manufacturers and other entities should ensure drivers are medically fit to conduct tests and are not taking medication that can impact vigilance and alertness when conducting tests.

For Deployment of Vehicles

MOE 27. Manufacturers or other entities 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 (i.e., so an officer knows if using a hand-held device is legal at the time of observation). **(new)**

MOE 28. Manufacturers or other entities should minimize distractions in ADS-equipped vehicles. **(new)**

6.5 ESTABLISHING OPERATIONAL RESPONSIBILITY AND LAW ENFORCEMENT IMPLICATIONS

For Testing of Vehicles

No recommendations for MOEs.

For Deployment of Vehicles

MOE 29. Manufacturers or other entities should design ADS Level 4 and 5 vehicles with a means of identifying when a vehicle is in automated mode to facilitate effective enforcement of distracted driving behaviours (e.g., so an officer knows if using a hand-held device is legal at the time of observation).

6.6 LAW ENFORCEMENT PROTOCOLS (LEP) FOR LEVEL 4 AND 5 VEHICLES

No recommendations for MOEs.

6.7 FIRST RESPONDER SAFETY AND TRAINING

For Testing and Deployment of Vehicles

MOE 30. Manufacturers should clearly identify ADS-equipped vehicles for the safety of first responders, based on international best practices. **(new)**

MOE 31. Manufacturers should ensure ADS-equipped vehicles have safety systems or procedures which allow law enforcement and other first responders to immobilize or otherwise disable the vehicle post-collision, or during certain law enforcement contacts to prevent movement or subsequent ignition of the vehicle. *(modified)*

MOE 32. Manufacturers, 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. *(modified)*

6.8 VEHICLE RESPONSE TO EMERGENCY VEHICLES, MANUAL TRAFFIC CONTROLS AND ATYPICAL ROAD CONDITIONS

For Testing and Deployment of Vehicles

MOE 33. Manufacturers should ensure that ADS-equipped vehicles being operated on public roads, both during testing and deployment, are able to recognize and properly respond to all temporary traffic controls and atypical hazards in the roadway environment.

6.9 SYSTEM MISUSE AND ABUSE

For Testing of Vehicles

MOE 34. Manufacturers or other entities, such as researchers and developers, should monitor international research and best practices to help inform what vehicle and HMI behaviours should be recorded during operation since extensive testing occurs on public roads. **(new)**

For Deployment of Vehicles

MOE 35. For the purposes of supporting collision investigations, manufacturers or other entities, such as researchers and developers, should monitor international research and best practices to help inform what data should be collected and made available in a timely manner to those duly authorized.

MOE 36. Manufacturers and other entities are strongly encouraged to apply international best practices in human factors design procedures to define intended users, user-needs, use environments and interfaces; identify use-related hazards, identify and categorize critical tasks; and should develop and implement misuse mitigation measures and conduct validation testing on real users.

6.10 ADHERENCE TO TRAFFIC LAWS

For Testing and Deployment of Vehicles

MOE 37. Manufacturers or other entities should ensure users of vehicles designed to operate in either automated mode or non-automated mode do not have the ability to override the ADS settings, without transitioning out of automated mode into non-automated mode, unless faced with an emergency circumstance. It should be noted here that this issue continues to be discussed with international stakeholders. As the discussions evolve, this recommendation may be revised in future iterations of this Guidelines Document.

6.11 CYBERSECURITY FOR VEHICLES WITH AUTOMATED DRIVING SYSTEMS (new)

MOE 38. The automotive industry should use best practices, design principles, and guidance based on or published by TC, NIST, NHTSA, Auto ISAC, and recognized standards-setting bodies such as SAE International standard J3061 Cybersecurity Guidebook for Cyber-Physical Vehicle Systems, as well as ISO/SAE 21434 Road Vehicles – Cyber Security Engineering Standard and ISO/WD PAS 5112 Road Vehicles – Guidelines for Auditing Cybersecurity Engineering. **(new)**

MOE 39. Organizations are encouraged to report any cyber threats, vulnerabilities, or incidents to the Cyber Centre via its Contact Centre (contact@cyber.gc.ca). Should a cyber incident be suspected to be criminal in nature, incidents should be reported to the local law enforcement agency or the RCMP. Organizations should also report to the Canadian Anti-Fraud Centre (CAFC) at 1-888-495-8501 or www.antifraudcentre.ca if the cyber incident involves fraudulent activity. **(new)**

Chapter 7. Other Considerations (all new)

7.1 DATA COLLECTION (all new)

For Testing of Vehicles

No recommendations for MOEs.

For Deployment of Vehicles

MOE 40. Comply with the applicable data privacy laws of the jurisdiction in which they are operating.

MOE 41. Ensure that appropriate data management practices are in place to uphold the privacy of occupants and comply with their legal obligations.

MOE 42. Ensure that it has put in place technical and administrative measures to safeguard PII and appropriately respond in the event of a security breach.

MOE 43. Consult the website of the Office of the Privacy Commissioner (OPC), which enforces PIPEDA, for additional guidance on PIPEDA, other privacy laws and best practices.

7.2 LOW-SPEED AUTOMATED SHUTTLES (all new)

For Testing and Deployment

No recommendations for MOEs.

7.3 MICRO UTILITY DEVICES AND AUTOMATED PERSONAL DELIVERY DEVICES (all new)

For Testing of Vehicles

No recommendations for MOEs.

For Deployment of Vehicles

MOE 44. Manufacturers and other entities, such as operators, should work with government regulators and stakeholders, such as retailers and customers, before testing and deployment of automated micro utility devices.

MOE 45. Manufacturers and other entities, such as operators, should consult advocacy groups such as the CNIB Foundation to minimize impacts to vulnerable road users.

7.4 CONNECTED VEHICLES (all new)

No recommendations for MOEs.

7.5 COOPERATIVE TRUCK PLATOONING (all new)

No recommendations for MOEs.

Appendix D

Select Definitions from SAE J3016 including Notes and Examples

Definitions adopted from SAE J3016 Standard[1] [2]

Automated Driving System (ADS): the hardware and software that are collectively capable of performing the entire *Dynamic Driving Task (DDT)*, on a sustained basis, regardless of whether it is limited to a specific *Operational Design Domain (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, while the former term should not. *(J3016 Section 3.2)*

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).

> **NOTE 1:** In contrast to previous versions of [J3016], which specified that an *ADS-DV* was limited to Levels 4 and 5, this revised definition of an *ADS-DV* also allows for the possibility of a Level 3 ADS-DV if the *remote fallback-ready user* can be receptive to both ADS-issued requests to intervene and to evident DDT performance-relevant *system failures* in the *vehicle*. Once either of these conditions occurs, the remote fallback-ready user begins to perform the *DDT fallback* in (virtually) real time using wireless means. (See also 3.24 and 3.22.)
>
> **NOTE 2:** An *ADS-DV* might be designed without *user* interfaces designed to be operable by an in-*vehicle driver*, such as braking, accelerating, steering, and transmission gear selection input devices, or it might be designed so that these devices are inoperative under routine/normal *operating* conditions.
>
> **NOTE 3:** *ADS-DVs* might be *operated* temporarily by a human *driver*: (1) to manage transient deviations from the *ODD*, (2) to address a *system failure*, or (3) while in a marshalling yard before or after being repaired/serviced or *dispatched*.

1 This 2nd Edition of the Guidelines uses the April 2021 revised version of SAE J3016. SAE J3016 is, however, a standard that will continue to evolve over time. Changes will be made in an iterative fashion. In order to ensure readers of this document have the latest version of this standard, CCMTA suggests visiting the following website: https://www.sae.org/standards/content/j3016_201401/

2 Note to the reader: SAE uses italics to highlight defined terms in J3016. As such, the italics are reproduced here.

EXAMPLE 1: A Level 4 *ADS-DV* designed to *operate* exclusively within a corporate campus where it picks up and discharges passengers along a specific route specified by the *ADS-DV dispatcher*.

EXAMPLE 2: A Level 4 *ADS-DV* designed to *operate* exclusively within a geographically prescribed central business district where it delivers supplies using roads (but not necessarily routes) specified by the *ADS-DV dispatcher*.

EXAMPLE 3: A Level 5 *ADS-DV* capable of *operating* on all mapped roads in the US that are navigable by a human *driver*. The user simply inputs a destination, and the *ADS-DV* automatically navigates to that destination. *(SAE J3016 Section 3.32.3)*

ADS-equipped Vehicle: a vehicle equipped with an *Automated Driving System (ADS)*.

ADS-equipped Dual-Mode Vehicle: 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*.

NOTE 1: When *operated* by the *ADS*, *dual-mode vehicles* enable *driverless operation*, although a human *driver* could also be present in the *driver's* seat.

NOTE 2: An *ADS subtrip feature* that is usable during only part of a *trip*, such as a *feature* designed to perform the complete *DDT* during traffic jams on freeways, would not be sufficient to classify its host *vehicle* as a *dual-mode vehicle* because it would not be capable of *driverless operation* for a complete *trip*.

NOTE 3: A *vehicle* equipped with a Level 5 *feature* in which at any time the *driver* can choose to engage the *feature*, or can choose to *operate the vehicle* manually, would be classified as a *dual-mode vehicle. (SAE J3016 Section 3.32.2)*

Driver:

- **[Human] Driver:** A *user* who performs in real-time part or all of the *Dynamic Driving Task (DDT)* and/or *DDT fallback* for a particular vehicle.

  NOTE: This definition of "driver" does not include a robotic test device designed to exercise steering, braking and acceleration during certain dynamic test maneuvers. *(SAE J3016 Section 3.31.1)*

- **In-vehicle Driver** a *driver* who manually exercises in-*vehicle* braking, accelerating, steering, and transmission gear selection input devices in order to operate a vehicle.

NOTE 1: an in-*vehicle driver* is seated in what is normally referred to as "the *driver's* seat" in automotive contexts, which is a unique seating position that makes in-*vehicle* input devices (steering wheel, brake and accelerator pedals, gear shift) accessible to a human *driver*.

NOTE 2: "*Conventional driver*" is an acceptable synonym for in-*vehicle driver.*

NOTE 3: In a conventional or *dual-mode vehicle* equipped with a *driving automation system*, an in-*vehicle driver*, who may be a *passenger* or a *fallback-ready user* during ADS engagement, may assume or resume performance of part or all of the *DDT* from the *driving automation system* during a given trip. *(SAE J3016 Section 3.31.1.1)*

- **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.

  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 (see J3016 section 3.31.4)*, although a *driverless operation dispatcher* may become a *remote driver* if s/he has the means to operate the vehicle remotely.

  NOTE 3: A r*emote 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 his/her head lamps to encourage overtaking, or a pedestrian using a dedicated short-range communication (DSRC) system to announce his/her 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 s/he is 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 in order 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 r*emote 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. *(SAE J3016 Section 3.31.1.2)*

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).

NOTE 1: Some *driving automation systems* (or the *vehicles* equipped with them) may have a means to change longitudinal *vehicle* motion control between forward and reverse.

NOTE 2: For simplification and to provide a useful shorthand term, subtasks (3) and (4) are referred to collectively as *object and event detection and response (OEDR) (see 3.19).*

NOTE 3: In this document, reference is made to "complete(ing) the *DDT*". This means fully performing all of the subtasks of the *DDT*, whether that role is fulfilled by the (human) driver, by the driving automation system, or by a combination of both. *(J3016 Section 10)*

Dynamic Driving Task (DDT) Fallback: the response by the *user* or by an ADS 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 *ODD exit*, or the response by an ADS to achieve minimal risk condition, given the same circumstances.

NOTE 1: The *DDT* and the *DDT fallback* are distinct functions, and the capability to perform one does not necessarily entail the ability to perform the other. Thus, a Level 3 *ADS*, which is capable of performing the entire *DDT* within its *ODD*, may not be capable of performing the *DDT fallback* in all situations that require it and thus will issue a request to intervene to the *DDT fallback-ready user* when necessary.

NOTE 2: Some Level 3 *features* may be designed to automatically perform the fallback and achieve a *minimal risk condition* in some circumstances, such as when an obstacle-free, adjacent shoulder is present, but not in others, such as when no such road shoulder is available. The assignment of Level 3 therefore does not restrict the ADS from automatically achieving the minimal risk condition, but it cannot guarantee automated achievement of *minimal risk condition* in all cases within its *ODD*. Moreover, automated *minimal risk condition* achievement in some, but not all, circumstances that demand it does not constitute Level 4 functionality.

NOTE 3: At Level 3, an *ADS* is capable of continuing to perform the *DDT* for at least several seconds after providing the *fallback-ready user* with a request to intervene. The *DDT fallback-ready user* is then expected to resume manual vehicle operation, or to achieve a minimal risk condition if s/he determines it to be necessary.

NOTE 4: At Levels 4 and 5, the *ADS* must be capable of performing the *DDT fallback* and achieving a minimal risk condition. Level 4 and 5 *ADS*-equipped *vehicles* that are designed to also accommodate *operation* by a *driver* (whether in-*vehicle* or remote) may allow a user to perform the *DDT fallback*, when circumstances allow this to be done safely, if s/he chooses to do so. However, a Level 4 or 5 *ADS* need not be designed to allow a *user* to perform *DDT fallback* and, indeed, may be designed to disallow it in order to reduce crash risk (more information is provided on this point in *SAE J3016 Section 8.9*).

NOTE 5: While a Level 4 or 5 *ADS* is performing the *DDT fallback*, it may be limited by design in speed and/or range of lateral and/or longitudinal vehicle motion control (i.e., it may enter so-called “limp-home mode”).

NOTE 6: While performing *DDT fallback*, an *ADS* may operate temporarily outside of its *ODD* (see definition of *ODD NOTE 1*).

EXAMPLE 1: A Level 1 adaptive cruise control (ACC) *feature* experiences a *system failure* that causes the feature to stop performing its intended function. The human *driver* performs the *DDT fallback* by resuming performance of the complete DDT.

EXAMPLE 2: A Level 3 *ADS* feature that performs the entire *DDT* during traffic jams on freeways is not able to do so when it encounters a crash scene and therefore issues a request to intervene to the *DDT fallback-ready user*. S/he responds by taking over performance of the entire *DDT* in order to maneuver around the crash scene. (Note that in this example, a *minimal risk condition* is not needed or achieved.)

EXAMPLE 3: A Level 4 *ADS*-dedicated vehicle (*ADS-DV*) that performs the entire *DDT* within a geo-fenced city center experiences a *DDT* performance-relevant *system failure*. In response, the *ADS-DV* performs the *DDT fallback* by turning on the hazard flashers, maneuvering the *vehicle* to the road shoulder and parking it, before automatically summoning emergency assistance. (Note that in this example, the *ADS-DV* automatically achieves a *minimal risk condition*.) (*SAE J3016 Section 3.12*)

(Human) User: a general term referencing the human role in driving automation.

NOTE 1: The following five terms (1- *driver*, 2- *passenger*, 3- *DDT fallback-ready user*, 4-*driverless operation dispatcher*, and 5 -r*emote assistant*) describe categories of (human) *users*.

NOTE 2: These human categories define roles that do not overlap and may be performed in varying sequences during a given *trip*. (*SAE J3016 Section 3.31*)

Minimal Risk Condition: a stable, stopped condition to which a user or an *ADS* may bring a *vehicle* after performing the *DDT fallback* in order to reduce the risk of a collision when a given *trip* cannot or should not be continued.

NOTE 1: At Levels 1 and 2, the *in-vehicle driver* is expected to achieve a *minimal risk condition* as needed.

NOTE 2: At Level 3, given a *DDT* performance-relevant *system failure* in the *ADS* or *vehicle*, the *DDT fallback-ready user* is expected to achieve a *minimal risk condition* when s/he determines that it is necessary, or to otherwise perform the *DDT* if the *vehicle* is operable.

NOTE 3: At Levels 4 and 5, the *ADS* is capable of automatically achieving a *minimal risk condition* when necessary (i.e., due to *ODD* exit, if applicable,

or due to a *DDT* performance-relevant *system failure* in the *ADS* or vehicle). The characteristics of automated achievement of a *minimal risk condition* at Levels 4 and 5 will vary according to the type and extent of the *system failure*, the *ODD* (if any) for the *ADS feature* in question, and the particular operating conditions when the *system failure* or *ODD* exit occurs. It may entail automatically bringing the vehicle to a stop within its current travel path, or it may entail a more extensive maneuver designed to remove the *vehicle* from an active lane of traffic and/or to automatically return the *vehicle* to a dispatching facility.

EXAMPLE 1: A Level 4 *ADS feature* designed to operate a *vehicle* at high speeds on freeways experiences a *DDT* performance-relevant system failure and automatically removes the *vehicle* from active lanes of traffic before coming to a stop.

EXAMPLE 2: A *vehicle* in which a Level 4 *ADS* is installed experiences a DDT performance-relevant *system failure* in its primary electrical power system. The *ADS* utilizes a backup power source in order to achieve a *minimal risk condition*. *(SAE J3016 Section 3.16)*

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 *DDT fallback*). *(SAE J3016 Section 3.19)*

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.

NOTE 1: The term "drive" is not used in this document, however, in many cases it could be used correctly in lieu of "*operate*".

NOTE 2: Although use of the term *operate/operating/operation* implies the existence of a *vehicle* "operator," this term is not defined or used in this document, which otherwise provides very specific terms and definitions for the various types of *ADS*-equipped *vehicle users*.

NOTE 3: Terms such as "drive," "operate," "driver," and "operator" may have legal meanings that are different from their technical meanings, as contained in this document. *(SAE J3016 Section 3.20)*

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.

NOTE 1: While Level 3 and 4 *ADS features/vehicles* are designed to *operate* exclusively within their respective ODDs, some ODD conditions are subject to rapid change during on-road *operation* (e.g., inclement weather, obscured lane lines). Such transient changes in the operating environment do not necessarily represent an "*ODD* exit," as the *ADS* determines when such a change in conditions requires *fallback* performance (whether by the *fallback-ready user* or *ADS*).

EXAMPLE 1: Level 1 ACC *driver support feature* is designed to provide longitudinal *vehicle* motion control support to the *driver* on fully access-controlled freeways under fair weather conditions.

EXAMPLE 2: An *ADS feature* is designed to operate a *vehicle* only on fully access-controlled freeways in low-speed traffic, under fair weather conditions and optimal road maintenance conditions (e.g., good lane markings and not under construction).

EXAMPLE 3: An *ADS-dedicated vehicle* is designed to operate only within a geographically defined military base, and only during daylight at speeds not to exceed 25 mph.

EXAMPLE 4: An *ADS-dedicated commercial truck* is designed to pick up parts from a geo-fenced sea port and deliver them via a specific route to a distribution center located 30 miles away. The vehicle's *ODD* is limited to day-time operation within the specified sea port and the specific roads that constitute the prescribed route between the sea port and the distribution center.

EXAMPLE 5: A Level 3 *ADS* highway *feature* with an *ODD* requirement of clearly visible lane lines encounters a short stretch of roadway with obscured lane lines. The *ADS feature* is able to compensate for brief periods of faded or missing lane markings through other means (e.g., sensor fusion, digital map, lead *vehicle* following) and continues to *operate the vehicle* for a brief period before the lane lines again become clearly visible. A short while later, the lane lines again become obscured and remain so for longer duration, causing the *ADS feature* to issue a *request to intervene* to the *fallback-ready user*.
(SAE J3016 Section 3.21)

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

EXAMPLE 1: The person seated in the *driver's* seat of a vehicle equipped with a Level 4 *ADS feature* designed to automate high-speed *vehicle operation* on access-controlled freeways is a passenger while this Level 4 feature is engaged. This same person, however, is a driver before engaging this Level 4 *ADS feature* and again after disengaging the *feature* in order to exit the controlled access freeway.

EXAMPLE 2: The *in-vehicle users* of an *ADS-DV* shuttle on a university campus are *passengers*.

EXAMPLE 3: The *in-vehicle users* of a Level 5 *ADS*-equipped *dual-mode vehicle* are *passengers* whenever the Level 5 ADS is engaged.
(SAE Section 3.31.2)

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.

NOTE 1: A receptive remote fallback-ready user becomes a remote driver when s/he performs 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.
(SAE J3016 Section 3.24)

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.

NOTE: "… it may be possible for a *passenger* in a Level 4 or 5 *ADS-operated vehicle* to also resume manual *operation* of the *vehicle* under certain conditions, provided that the *vehicle* and *feature* are designed for this (e.g., a *dual-mode vehicle* or a *conventional vehicle* with a Level 4 *sub-*

trip feature). However, even when alerted by the *ADS* to take over *vehicle operation*, a passenger of such a *vehicle* is not required to do so to ensure competent operation, as Level 4 and 5 *ADS features/vehicles* are capable of automatically achieving a *minimal risk condition* when necessary. Thus, such an alert to a *passenger* of a Level 4 or 5 *ADS-operated vehicle* is not a "request to intervene" as defined herein for Level 3 *ADS-equipped vehicles*. *(SAE J3016 Section 3.25)*

Trip: The traversal of an entire travel pathway by a vehicle from the point of origin to a destination.

NOTE: Performance of the *DDT* during a given *trip* may be accomplished in whole or in part by a *driver, driving automation system* or both.
(SAE J3016 3.29)

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