



# Automated Vehicle Safety Consortium™ Best Practice

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## Best Practice for First Responder Interactions with Fleet-Managed Automated Driving System-Dedicated Vehicles (ADS-DVs)

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## Rationale

Today's first responders have many well-established procedures to apply to the countless situations they face on the roadways. However, currently there are no common procedures for interacting with Automated Driving System-Dedicated Vehicles (ADS-DVs) where human drivers may not be present to interact with first responders, as well as components/systems not typical on vehicles today. Also, the ADS industry has not, until now, developed a common format to communicate information first responders may need during their interactions with ADS-DVs. While no document can represent a complete list of situations, this best practice provides a framework of recommended procedures and protocols ADS developers and manufacturers can follow to facilitate first responder interactions in multiple use cases. A framework for a First Responder Interaction Plan is also recommended, representing a proactive step in consistently providing information that first responders can use to establish their protocols, procedures and plans for interacting with ADS-DVs. The public will benefit from consistent documented interaction plans and communication of the expected types of interactions, while first responders continue to render timely support and ensure public safety.

## Preface

The Automated Vehicle Safety Consortium™ (AVSC) is an industry program of SAE Industry Technologies Consortia® (SAE ITC) working to quickly publish best practices that will inform and lead to industry-wide standards advancing the safe deployment of automated driving systems (ADSs). The members of this consortium have decades of accumulated experience focused on safe, reliable, and high-quality transportation. They are committed to applying those principles to SAE level 4 and level 5 automated vehicles so that communities, government entities, and the public can be confident that these vehicles will be deployed safely.

The Consortium recognizes the need to establish best practices for the safe operation of ADS-dedicated vehicles (ADS-DVs). These technology-neutral practices are key considerations for safely deploying ADS-DVs on public roads. Members of the AVSC intend to support the published principles and best practices in an effort to establish a suggested level for other industry participants to meet. These best practices will serve as a basis to enhance and expedite the formal industry standards development process through SAE International and other global standards development bodies. Effectively implementing these principles can help inform the development of sound and effective ADS regulations and safety assurance testing protocols that will engender public confidence in the efficacy of ADS-DVs.

Comment and open discussion on the topics are welcome in appropriate industry forums. As discussion unfolds, AVSC documents will be revised as significant information and/or new approaches come to light that would increase public trust.

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## Introduction

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First responders, such as police, firefighters, and emergency medical services personnel, respond to millions of roadway incidents every year [1]. Industry and government organizations recognize the need for new techniques and protocols as automated driving systems (ADSs) assume the driving task and first responder interactions may no longer include human driver interactions. The National Highway Traffic Safety Administration (NHTSA) has published a number of guidance documents related to safe testing and deployment of automated vehicles [2, 3, 4, 5]. Additionally, in 2018, the Crash Avoidance Metrics Partners, LLC's (CAMP's) Automation & Public Safety Common Solutions (APSCS) Consortium published a report, *An Examination of Emergency Response Scenarios for ADS*, which examined first responder interactions across a broad spectrum of scenarios [1]. With this best practice, the AVSC seeks to expand upon and operationalize CAMP's research findings related to emergency response scenarios. Many of the definitions and descriptions of first responder roles, types of interactions, use cases, and insights from CAMP's work are foundational to the recommendations put forth for interacting with ADS-DVs.

The NHTSA guidance and CAMP research apply to vehicles with varying SAE levels of automation. Many of the vehicle types with varying ADS features are currently on public roadways, operating within their operational design domain (ODD)<sup>1</sup>. ADS-DVs with SAE level 4 automation can perform all driving tasks within a specified ODD, including bringing the vehicle to a minimal risk condition, without the need for human intervention. ADS-DVs with SAE level 5 automation are not limited by an ODD, meaning they can complete all driving tasks without geographic<sup>2</sup> or environmental constraint. ADS-DVs with SAE level 4 and level 5 capabilities can perceive their surroundings and place in the world, process what they perceive, and use that information to make decisions about the driving task. ADS-DVs may not have conventional controls found in most vehicles today (i.e., those that can be manipulated by human drivers). [Section 5](#) addresses considerations for these systems that could impact first responder interactions.

A consistent framework for presenting useful information about ADS-DV interaction can help developers and manufacturers prioritize and compile documentation about key processes and technologies. This can help with dialogue between individual developers and first responders as deployments occur and plans are shared with the public safety community.

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<sup>1</sup> An ODD consists of the operating conditions under which a given driving automation system or feature is designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the presence or absence of certain traffic or roadway characteristics (SAE J3016\_201806). For more information on describing an ODD, refer to *AVSC Best Practice for Describing an Operational Design Domain: Conceptual Framework and Lexicon*.

<sup>2</sup> When available, SAE level 5 vehicles may be geographically constrained for legal or regulatory reasons.

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# 1. Scope

This Automated Vehicle Safety Consortium (AVSC) *Best Practice for First Responder Interactions with Fleet-Managed Automated Driving System-Dedicated Vehicles (ADS-DVs)* (AVSC00005202012) **recommends a common approach for describing the interactions and associated protocols for incorporating vital information regarding first responder interactions with SAE level 4 and level 5 fleet operated vehicles into on-going development and deployment plans.**

This best practice provides the following:

1. Definitions of roles associated with emergency situations/processes,
2. Descriptions of expected interactions (use cases) between first responders and ADS-DVs,
3. Recommendations to address first responder and ADS-DV interactions, and
4. Recommends a First Responder Interaction Plan framework.

Procedures and frameworks in this document apply to all first responder types in all jurisdictions<sup>3</sup>.

ADS technology is still evolving and will continue to evolve for many years. First responder interactions with ADS-DVs are expected to mature with further understanding of the operation of ADS-DVs on public roads along with further understanding of the impact on first responder procedures and protocols. This best practice is a proactive step to identify and address key interactions between first responders and fleet-managed ADS-DVs. It addresses a list of interactions [1] important to first responders today and it is expected that the list of common interaction protocols will evolve over time to accommodate changes in technology and the experience gained.

Protocols or procedures for determining and assigning responsibility, liability, or fault for the ADS-DV and/or passengers are not addressed in this best practice. Also, out-of-scope are vehicle maneuvers involving the dynamic driving task performance, acquisition of crash reconstruction data, first responder interaction with human passengers, parking-related violations, and/or wireless communication protocols.

## 1.1 Purpose

The purpose of this best practice is to improve the public's trust and confidence in ADS-DVs through consistent and documented interactions between trained first responders and ADS-DVs.

<sup>3</sup> Unique considerations for jurisdiction or type of first responder should be addressed in the ODD description section of the interaction plan (Section 6).

This best practice is also intended to provide the means for continued engagement and dialogue between first responders, developers, manufacturers, fleet operators and local communities to promote safe operations and consumer acceptance of fleet-managed ADS-DVs.

These recommendations are intended for use by the technical community (e.g., technology developers, manufacturers, testers) directly and to inform states, other infrastructure owner-operators (IOOs), and the first responder community. Stakeholders can compare the best practices identified in this document against existing procedures and documentation and use the best practices as a guide for establishing new ADS-DV interaction protocols with first responders. States and IOOs can utilize this document as a reference to develop questions to pose to developers and manufacturers operating in their jurisdictions.

AVSC acknowledges there are others involved in emergency situations who are not first responders, and may not be formally trained in or unfamiliar with ADS-DVs. These individuals are encouraged to call emergency services for assistance when arriving on scene.

Finally, the public will benefit from documented interaction plans and consistent communication of the expected types of first responder interactions, while first responders continue to render timely support and ensure public safety.

## 2. References

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### 2.1 Applicable Documents

The following publications were referenced during development of this document. Where appropriate, documents are cited.

#### 2.1.1 SAE Publications

Unless otherwise indicated, the latest issue of SAE publications apply. Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AVSC00002202004	Best Practice for Describing an Operational Design Domain: Conceptual Framework and Lexicon
AVSC00004202009	Best Practice for Data Collection for Automated Driving System-Dedicated Vehicles (ADS-DVs) to Support Event Analysis
SAE J3016_201806	Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles
SAE J2990_201907	Hybrid and EV First and Second Responder Recommended Practice

#### 2.1.2 Other Documents

1. Terry T., Trimble T.E., Blanco M., Fitzgerald K.E., Fitchett V.L. and Chaka M., "An Examination of Emergency Response Scenarios for ADS," Crash Avoidance Metrics Partners LLC, Farmington Hills, MI, 2018, <https://www.campllc.org/publications/>.
2. NHTSA, "Federal Automated Vehicle Policy: Accelerating the next revolution in roadway safety," September 2016. [Online]. Available: <https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016>. [Accessed 19 February 2020].
3. NHTSA, "Automated Driving Systems 2.0: A vision for safety," September 2017. [Online]. Available: [https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0\\_090617\\_v9a\\_tag.pdf](https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf). [Accessed 19 February 2020].

4. NHTSA, "Preparing for the Future of Transportation Automated Vehicles 3.0," October 2018. [Online]. Available: <https://www.transportation.gov/av/3/preparing-future-transportation-automated-vehicles-3>. [Accessed 19 February 2020].
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8. U.S. Fire Administration, "Best Practices for Emergency Vehicle and Roadway Operations Safety in the Emergency Services," 2010. [Online]. Available: [https://www.iaff.org/wp-content/uploads/EVSP/PDF\\_and\\_PP/Best-Practices.pdf](https://www.iaff.org/wp-content/uploads/EVSP/PDF_and_PP/Best-Practices.pdf). [Accessed 2020].
9. "Bureau of Justice Statistics," Office of Justice Programs, [Online]. Available: <https://www.bjs.gov/index.cfm?ty=tdtp&tid=7>. [Accessed 30 December 2019].
10. U.S. Department of Transportation Federal Highway Administration, "Safety Service Patrol Priorities and Best Practices," Federal Highway Administration, Washington, DC, 2017.
11. Automated Vehicle Safety Consortium, "AVSC Best Practice for Passenger-Initiated Emergency Trip Interruption," July 2020. [Online]. Available: <https://avsc.sae-itc.org/principles-03-5471WV-44491AM.html?respondentID=26229746#Read-More>. [Accessed 22 July 2020].
12. NHTSA, "FMVSS 305 Electric-powered vehicles: electrolyte spillage and electrical shock protection," 2018. [Online]. Available: [https://www.ecfr.gov/cgi-bin/text-idx?SID=7d443eb75ceba033fed91e90f816b574&node=s49.6.571\\_1305&rgn=div8](https://www.ecfr.gov/cgi-bin/text-idx?SID=7d443eb75ceba033fed91e90f816b574&node=s49.6.571_1305&rgn=div8). [Accessed 13 March 2020].

## 3. Role Definitions

Interaction is defined as "communication or direct involvement with someone or something" [6]. The following roles have been identified as those most likely to interact with one another in emergency situations involving ADS-DVs.

### 3.1 First Responder Roles

First responders are "emergency personnel who first arrive on the scene of an incident and take action to save lives, protect property, and meet basic human needs. In most incidents, these responders are local police, fire, and emergency medical personnel" [7, p. 494].

First responder roles associated with the "public safety domain" include law enforcement (police), fire and rescue, and emergency medical services [1]. Others who may provide first responder support include those providing roadway response services and towing and recovery services [8].

#### 3.1.1 Law Enforcement/Police

Services or activities of the agencies responsible for maintaining public order and enforcing the law, particularly the activities of prevention, detection, and investigation of crime and the apprehension of criminals [9].

#### 3.1.2 Fire and Rescue

Services dispatched to incidents such as motor vehicle collisions, vehicle fires or other fires in proximity to the roadway, medical emergencies on or near the roadway, and hazardous materials incidents [8].

#### 3.1.3 Emergency Medical Services

Services dispatched to roadway incidents when there is a report of the possibility of one or more injured victims on the scene as a result of a fire or collision. They may also be dispatched to medical emergencies occurring on or near the roadway [8].

### 3.1.4 Roadway Response

Services employed by transportation agencies to provide support during heavy traffic periods or continuously (24-hour service) to render assistance to motorists to include basic auto maintenance, first aid, setting up roadway incident scenes, etc., and generally utilize highly visible liveries with warning lights [8]. These type of services may be referred to as Safety Service Patrols, Freeway Service Patrols, Courtesy Patrols, Emergency Response Units, Motorist Assistance Patrols [10], and Road Patrols.

### 3.1.5 Towing and Recovery

Services required when a roadway incident involves a vehicle that has become disabled for any reason and must be removed from the roadway and could be dispatched by the police, a transportation agency, or the ADS fleet operator [8].

## 3.2 ADS-DV Fleet Operator

An entity that manages a fleet of ADS-DVs as well as the services provided by said fleet. NOTE: Fleet operator excludes non-commercially deployed, privately owned vehicles [11]. It supervises and provides technical, operational, emergency, or customer support assistance for ADS-DVs. Fleet operators may engage other organizations to provide supporting services (e.g., dispatch, maintenance, customer service). If contacted by first responders as outlined in the First Responder Interaction Plan, fleet operators may provide direct support to first responders.

## 3.3 Good Samaritan

A Good Samaritan is not a first responder, but a citizen or member of the general public providing aid to a situation; they may or may not have had formal training or experience. A Good Samaritan may have witnessed the incident or been first on the scene, or otherwise been engaged by an official to assist in response to a situation. A Good Samaritan may also be the first to recognize the need for, and to initiate contact with, first responders or required emergency services.

## 4. First Responder and ADS-DV Interaction Use Cases

The number of specific use cases that might require a first response is essentially infinite. A recent study of emergency response scenarios identified over 90 interactions categorized into seven use cases [1]. These use cases are described at a high-level from the first responder's perspective, who may encounter or interact with ADS-DVs during testing or while providing commercial service. Best practice recommendations for ADS developers, manufacturers and fleet operators to address these use cases by interaction type follow in [Section 5. Table 4](#) in [Section 5.4](#) summarizes the linkages between use cases and interaction types.

### 4.1 Responding to an Incident



Responding to an Incident

First responders answering an emergency call must reach the scene as quickly and safely as possible. This may require emergency vehicle operators to navigate through traffic and anticipate the reactions of other motorists [1]. First responders interacting with ADS-DVs in traffic while responding to an incident will need to communicate with or signal ADS-DVs, as they do with other motorists, in order to pass or otherwise proceed without being obstructed.

## 4.2 Securing a Scene



Securing a Scene

First responders securing a scene will gather and report information about an incident, determine if additional resources are required to secure the scene by blocking and diverting traffic, and continually assess the scene and individuals, if present [1]. First responders may need to disable, access, or move an ADS-DV, and must be aware of potential hazards (e.g., electrical power storage, high-voltage wiring and routing, fuel tank location, fuel lines) and unique hazards (i.e., hazards resulting from unexpected vehicle maneuvers or responses) presented by ADS-DVs. First responders should be able to identify an ADS-DV and be able to signal it or influence its behavior by contacting fleet operators or by using temporary traffic control devices (e.g., cones, flares, signs). First responders may also need access to required documentation, such as fleet operations contacts, safety information, and ownership information about the ADS-DV.

## 4.3 Traffic Direction and Control



Traffic Direction & Control

“First responders may need to manually direct traffic in a number of circumstances, such as at special events; during man-made or natural disasters; in adverse weather conditions; during fires, smoke, or fog; at traffic crash scenes; or in cases of damaged or malfunctioning traffic control devices” [1, p. 51]. First responders must be able to signal or otherwise direct an ADS-DV to a specific action or path of movement in accordance with necessary changes in normal traffic flow.

## 4.4 Traffic Stop and Checkpoint



Traffic Stop

Traffic stops generally involve circumstances where police observe a violation and then request a driver to pull over [1]. Checkpoints and roadblocks are similar operations in which multiple vehicles are requested to stop by police and directed manually to the next available officer. Drivers may be required to stop and lower windows, open trunks, or perform other activities [1]. First responders will need to recognize an ADS-DV and signal the vehicle to stop. Once stopped, first responders will need to ensure the ADS-DV remains stationary (unless directed otherwise). They also may need to access required documentation, determine ownership, provide additional direction, and release vehicle(s) after a traffic stop/checkpoint activity is complete.

## 4.5 Parked or Unoccupied ADS-DV



Parked or Unoccupied

It is highly unlikely that a fleet-managed ADS-DV would be abandoned<sup>4</sup>. An unattended vehicle is one that may be powered or “running” without a driver or occupants inside [1]. An ADS-DV that is parked or does not have a human occupant or vehicle operator may appear unattended if it is not actively engaged in a driving task or is not located in a known staging area. To determine the operational status of a parked, unoccupied, or stationary ADS-DV, first responders may need to understand how to safely approach the ADS-DV or contact fleet operators.

## 4.6 Stabilization and Extrication



Stabilization & Extrication

Vehicle stabilization is the process of immobilizing a vehicle to prevent movement to create a secure environment for the first responders to work. Extrication is the process of removing an occupant from a vehicle and involves disentangling the occupant from a damaged vehicle by means of spreading, cutting, or removing vehicle pieces and parts. While extrication is a relatively rare event, it is the most direct contact that fire and rescue units have with vehicles [1]. With an ADS-DV, first responders need to quickly determine if passengers are present, identify potential and unique hazards, disable the ADS-DV, and access the vehicle interior.

## 4.7 Motorist Assist



Motorist Assist

Motorist assistance includes activities such as completing minor repairs, calling a tow agency, or waiting with a vehicle for another responder to provide aid [1]. First responders may need information or instruction on how to safely approach the ADS-DV, disable the vehicle, gain access to the interior, or move the vehicle from the roadway before any emergency services proceed.

# 5. First Responder and ADS-DV Interaction Types and Recommendations

There are three general types of interactions anticipated between first responders and ADS-DVs: direct, indirect, and informational [1]. Understanding of the types of interactions between first responders and ADS-DVs is expected to improve as vehicle technologies and architectures evolve. These factors may motivate future reviews and revisions to the types of interactions and recommendations described in this document. Recommendations for developers, manufacturers, and fleet operators are organized according to interaction type.

<sup>4</sup> Although an SAE level 4/level 5 ADS-DV is, by definition, dedicated to driverless operation, situations may arise where human assistance by fleet personnel is needed. Humans may provide remote driving or remote assistance or a human field representative may be dispatched to manually operate a vehicle.

## 5.1 Direct Interactions

Direct interaction **involves physical contact** between a first responder and an ADS-DV; it includes touching the vehicle or using a piece of equipment [1].

Examples of direct interactions include:

- A firefighter checks a vehicle door handle to determine if a vehicle is locked.
- An emergency medical technician enters a vehicle to provide aid to a passenger.
- A tow vehicle operator connects an apparatus to the vehicle.

In addition to the recommendations for direct interactions contained in this section, it may be advisable for first responders to contact fleet operators (in accordance with the First Responder Interaction Plan) for information about the vehicle and situation before proceeding in any of the following circumstances or gaining access to the vehicle.

**TABLE 1** Recommendations for ADS-DV developers, manufacturers, and fleet operators for direct interactions [1] with first responders

First Responder Direct Interaction	Considerations for Direct Interactions	ADS-DV Recommendations
Disable ADS-DV	First responders typically immobilize vehicles by conventional means such as blocking, barricading, chocking wheels, etc., without accessing the interior of the vehicle or communicating with fleet operators.	<ul style="list-style-type: none"> <li>• ADS-DVs should be capable of immobilization or otherwise being kept from physically moving.</li> <li>• Developers and manufacturers should provide instructions in the interaction plans for safely disengaging the drive system, ensuring the ADS-DV will not self-drive, and ensuring safe operations around the vehicle.</li> <li>• Developers and manufacturers should provide first responders a method of contacting ADS-DV fleet operators during hours of anticipated fleet operations to ensure the vehicle is in park and will not self-drive.</li> </ul>
Access ADS- DV Interior	First responders may require access to the interior and compartments of a vehicle in order to complete their task. Traditional and non-traditional access points may be locked when a vehicle is stopped.	<ul style="list-style-type: none"> <li>• ADS-DVs should have access points to the interior and compartments of the vehicle.</li> <li>• If ADS-DVs have non-traditional access points (i.e., marked access panel), these should be clearly identifiable as a means of access in case of emergency. Instructions should be documented in the interaction plans.</li> <li>• Developers and manufacturers should provide a means for unlocking and granting access by either a fleet operator or a passenger (if present and able) to allow the first responder access to the ADS-DV interior.</li> <li>• Developers and manufacturers should document all procedures or guidance for accessing the ADS-DV interior during non-emergency and emergency scenarios in their interaction plans.</li> </ul>
De-Power ADS-DV	ADS-DVs will contain a primary vehicle power source and may include a separate power source for the ADS. Power sources are assumed to be marked per industry standards [12].	<ul style="list-style-type: none"> <li>• ADS-DVs should be capable of being de-powered in accordance with industry guidelines<sup>5</sup>.</li> <li>• Any unique considerations or processes for de-powering an ADS-DV should be documented by developers and manufacturers in the interaction plans.</li> <li>• A fleet operator should be able to assist first responders with information and direction for disengaging all vehicle power supplies.</li> </ul>
Move ADS-DV from Roadway	In certain situations, ADS-DVs may need to be moved around the scene or removed from the roadway to allow the free flow of traffic or to attend to passengers on board. ADS-DVs may not have traditional driver controls.	<ul style="list-style-type: none"> <li>• Developers and manufacturers should document all procedures for moving the ADS-DV around a scene or from a roadway during non-emergency and emergency scenarios in their interaction plans.</li> </ul>

<sup>5</sup> For electric vehicle safety guidelines, refer to *Federal Motor Vehicle Safety Standard (FMVSS) 305: Electric-Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection*. FMVSS 305 S5.4 (electrical safety during normal vehicle operation) contains requirements on markings, service disconnects, protection from electrical shock, and generic electrical isolation. SAE J2344, *Guidelines for Electric Vehicle Safety*, identifies and defines the preferred technical guidelines relating to safety for vehicles that contain high voltage such as electric vehicles. SAE Journal Article 08-07-01-0005, *A Bibliographical Review of Electric Vehicles (xEVs) Standards*, presents an all-inclusive state of the art bibliographical review of all categories of electrified transportation (xEVs) standards.

## 5.2 Indirect Interactions

Indirect interaction [1] involves a first responder influencing an ADS-DV **without coming into physical contact**.

Examples of indirect interactions include:

- An emergency vehicle using lights or sirens while moving through traffic or stationary on or near the roadway.
- A police officer using temporary traffic control devices (e.g., cones, signs, flares) to alter the flow of traffic or cordon off an area.
- An emergency medical technician positioning an ambulance (with or without emergency lights) to block first responders or patients from other vehicles or hazards.

**TABLE 2** Recommendations for ADS-DV developers, manufacturers and fleet operators for indirect interactions [1] with first responders

First Responder Indirect Interaction	Considerations for Indirect Interaction	ADS-DV Recommendations
Communicate with ADS-DV	Relevant communications include the ability to detect and react to emergency vehicles, equipment, and personnel. ADS-operated vehicles may vary in their ability to respond to traditional methods of human communication (e.g., hand gestures, body language, eye contact, whistles, flashlights, batons). In some cases, interaction with a fleet operator may be required.	<ul style="list-style-type: none"> <li>• ADS-DVs should be able to detect and comply with identifiable and customary first responder instructions either independently or through communications with a fleet operator.</li> <li>• ADS-DVs should be capable of detecting and reacting to emergency vehicles, if they are identifiable by the customary features possessed by those vehicles, such as flashing lights and sirens. This may include yielding the right of way, contacting fleet operators, or otherwise complying with local traffic laws.</li> <li>• ADS-DVs should detect and react appropriately to emergency equipment such as temporary traffic control devices and stationary emergency vehicles.</li> <li>• ADS-DVs should detect and respond appropriately to first responders in the roadway.</li> <li>• Developers and manufacturers should coordinate communication protocols with first responders and contact fleet operators.</li> <li>• An ADS-DV that is directed to pull over by a first responder (e.g., a traffic stop) should be placed into a non-motive state until it has been released by the attending first responder personnel.</li> <li>• Developers and manufacturers should develop methods for releasing an ADS-DV (e.g., after a traffic stop). These methods should be described in the interaction plans.</li> <li>• Developers and manufacturers should document instructions for communicating with an ADS-DV and contacting fleet operators in interaction plans.</li> </ul>
Approach ADS-DV	A first responder's approach to vehicles involved in an incident and interaction with fleet operators and passengers is a key step across multiple use cases.	<ul style="list-style-type: none"> <li>• First responders should be able to contact fleet operators before they approach an ADS-DV.</li> <li>• Procedures for approaching an ADS-DV should be documented in the interaction plans.</li> </ul>

## 5.3 Informational Interactions

Informational interaction [1] (which may or may not require physical contact) between a first responder and an ADS-DV occurs **when information must be obtained from or about a vehicle** by the first responder.

Examples of informational interactions include:

- A police officer scans or otherwise enters a license plate number into a vehicle registration system to determine ownership and other relevant information about the vehicle.
- A firefighter observes hazard or other warning decals or tags during extrication or other manipulation of vehicle parts.
- A first responder visually determines if there are passengers in the vehicle as they approach.

**TABLE 3** Recommendations for ADS-DV developers, manufacturers, and fleet operators for informational interactions [1] with first responders

First Responder Informational Interaction	Considerations for Informational Interaction	ADS-DV Recommendations
Identify ADS-DV	Depending on the developer/manufacturer, an ADS-DV may be identified by a distinctive shape, unique vehicle platform, or by the addition of external sensors and/or other hardware. Placement of these external sensors and hardware may vary between developers/manufacturers or vehicle platforms. Furthermore, there may be other contextual clues for identifying an ADS-DV, which may include absence of traditional driving controls or even lack of occupants.	<ul style="list-style-type: none"> <li>Developers and manufacturers should document a description and location of any distinguishing features, along with any specific contextual cues, that would help distinguish an ADS-DV from a conventional vehicle in the interaction plans.</li> </ul>
Access Required Documentation	State and local laws mandate copies of required documentation be present in the vehicle, such as vehicle registration and proof of insurance. In addition, physical documentation and information associated with registration, insurance, or other fleet information may also be provided through the license plate or by contacting fleet operators.	<ul style="list-style-type: none"> <li>ADS-DVs will comply with applicable laws pertaining to documentation of registration, insurance, and other information.</li> <li>Specific guidance for obtaining required documentation from fleet operators, or describing how to locate and access required documentation should be documented by developers and manufacturers in the interaction plans.</li> </ul>
Identify ADS-DV Owner	First responders need to identify ownership as part of their notification and investigation process. Fleet-operated ADS-DVs may present unique challenges for determining ownership of a vehicle.	<ul style="list-style-type: none"> <li>ADS-DV developers/manufacturers may need to coordinate with local authorities to determine unique requirements for establishing ownership and allowable means for communicating ownership to first responders.</li> <li>Instructions for first responders to identify the ADS-DV owner should be documented by developers and manufacturers and included in the interaction plans.</li> </ul>
Identify ADS-Related Hazards	First responders will need to be aware of potential hazards (e.g., electrical power storage, high-voltage wiring and routing, fuel tank location, fuel lines) and unique hazards (i.e., hazards which may result from unexpected vehicle maneuvers or responses presented by ADS-DVs).	<ul style="list-style-type: none"> <li>Potential hazards (e.g., electrical power storage, high-voltage wiring and routing, fuel tank location, fuel lines) should be labeled per industry standards.<sup>6</sup></li> <li>Developers and manufacturers should document information regarding ADS-DV unique potential hazards in the interaction plans.</li> <li>If contacted by first responders, fleet operators should be prepared to provide additional information about hazards associated with the ADS system or base vehicle.</li> </ul>
Determine Presence of Passengers	Depending on the platform and use case, ADS-DVs may transport goods or people, or they may be empty (e.g., repositioning themselves, waiting to be called to service). ADS-DV visibility into the interior of the vehicle will vary by developer and manufacturer in accordance with laws and regulations. First responders need to determine the presence and number of passengers.	<ul style="list-style-type: none"> <li>ADS-DVs should allow first responders a means to determine the presence and number of passengers (i.e., visual inspection or other means).</li> <li>Fleet operators should assist first responders with available information regarding the presence and number of passengers as allowable by law.</li> </ul>
ADS-DV Data Integrity	ADS-DV data recording is important to crash reconstruction, system performance investigations, and event analysis to identify lessons learned to enable industry-wide improvements in automated driving systems (ADS) safety. <sup>7</sup> Though an ADS can collect data from many different sources, this data is protected and only accessible by the appropriate first responder agency via due process. ADS-DV data is not directly accessible by first responders prior to arriving on the scene, while securing the scene, or as part of post-incident investigation.	<ul style="list-style-type: none"> <li>Developers and manufacturers should take “privacy by design” into consideration and should take into account the various privacy protections as set forth by the applicable laws.<sup>8</sup></li> <li>Developers and manufacturers should establish procedures for protecting ADS data integrity during first responder interactions.</li> </ul>
Contact ADS-DV Fleet Operator	First responders may need to contact fleet operators to obtain information relevant to a situation.	<ul style="list-style-type: none"> <li>Developers and manufacturers should document instructions for contacting and coordinating with fleet operators in their interaction plans.</li> <li>Fleet operators should ensure availability during the anticipated hours of operation for contact by first responders.</li> </ul>

<sup>6</sup> For hazard labeling see SAE Standards: SAE J3108, *xEV Labels to Assist First and Second Responders, and Others* and SAE J2936, *SAE Electrical Energy Storage Device Labeling Recommended Practice*.

<sup>7</sup> Considerations for data collection for event reconstruction is addressed in the AVSC *Best Practice for Data Collection for Automated Driving System-Dedicated Vehicles (ADS-DVs) to Support Event Analysis*. It can also serve as part of the foundation for future discussions on sharing of data and lessons learned for industry-wide learning.

<sup>8</sup> Examples of existing privacy statutes are Texas Transportation Code § 547.615. Recording Devices, California Consumer Privacy Act (CCPA), and General Data Protection Regulation (GDPR).

## 5.4 Linking Use Cases to Interactions

[Table 4](#) summarizes the linkages between each use case and each specific interaction organized by interaction type. [Table 4](#) provides an easy reference to align the use cases described in [Section 4](#) with the interaction types described in [Section 5](#). Recommendations align to interactions listed within each interaction type.

**TABLE 4** Interaction themes by interaction type [1] and use case

Use Case	Direct Interaction (5.1)	Indirect Interaction (5.2)	Informational Interaction (5.3)
<b>Responding to an Incident (4.1)</b>		<ul style="list-style-type: none"> <li>Communicate with ADS-DV<sup>9</sup></li> </ul>	<ul style="list-style-type: none"> <li>Contact ADS-DV fleet operator</li> </ul>
<b>Securing a Scene (4.2)</b>	<ul style="list-style-type: none"> <li>Disable ADS-DV</li> <li>Access ADS-DV interior</li> <li>Move ADS-DV from roadway</li> </ul>	<ul style="list-style-type: none"> <li>Communicate with ADS-DV</li> <li>Approach ADS-DV</li> </ul>	<ul style="list-style-type: none"> <li>Identify ADS-DV</li> <li>Identify ADS-DV owner</li> <li>Access required documentation</li> <li>Identify ADS-related hazards</li> <li>Determine presence of passengers</li> <li>ADS-DV data integrity</li> <li>Contact ADS-DV fleet operator</li> </ul>
<b>Traffic Direction and Control (4.3)</b>		<ul style="list-style-type: none"> <li>Communicate with ADS-DV</li> </ul>	<ul style="list-style-type: none"> <li>Identify ADS-DV</li> <li>Contact ADS-DV fleet operator</li> </ul>
<b>Traffic Stop and Checkpoint (4.4)</b>		<ul style="list-style-type: none"> <li>Communicate with ADS-DV</li> <li>Approach ADS-DV</li> </ul>	<ul style="list-style-type: none"> <li>Identify ADS-DV</li> <li>Identify ADS-DV owner</li> <li>Access required documentation</li> <li>ADS-DV Data</li> <li>Contact ADS-DV fleet operator</li> </ul>
<b>Parked or Unoccupied ADS-DV (4.5)</b>	<ul style="list-style-type: none"> <li>Disable ADS-DV</li> <li>Move ADS-DV from roadway</li> <li>Access ADS-DV interior</li> <li>De-power ADS-DV</li> </ul>	<ul style="list-style-type: none"> <li>Approach ADS-DV</li> <li>Communicate with ADS-DV</li> </ul>	<ul style="list-style-type: none"> <li>Identify ADS-DV</li> <li>Identify ADS-related hazards</li> <li>Determine presence of passengers</li> <li>Contact ADS-DV fleet operator</li> </ul>
<b>Stabilization and Extrication (4.6)</b>	<ul style="list-style-type: none"> <li>Disable ADS-DVs</li> <li>De-power ADS-DV</li> <li>Access ADS-DV interior</li> </ul>	<ul style="list-style-type: none"> <li>Approach ADS-DV</li> </ul>	<ul style="list-style-type: none"> <li>Identify ADS-related hazards</li> <li>Determine presence of passengers</li> </ul>
<b>Motorist Assist (4.7)</b>	<ul style="list-style-type: none"> <li>Disable ADS-DV</li> <li>De-power ADS-DV</li> <li>Access ADS-DV interior</li> <li>Move ADS-DV from roadway</li> </ul>	<ul style="list-style-type: none"> <li>Approach ADS-DV</li> <li>Communicate with ADS-DV</li> </ul>	<ul style="list-style-type: none"> <li>Identify ADS-DV</li> <li>Access required documentation</li> <li>Identify ADS-related hazards</li> <li>Determine presence of passengers</li> <li>Contact ADS-DV fleet operator</li> </ul>

## 6. Interaction Plan Framework

**ADS developers and/or manufacturers should have or develop a First Responder Interaction Plan.** ADS-DV deployments should be accompanied by documentation providing all the necessary information first responders might need to safely interact with the vehicle. The plan may include detailed documentation procedures, content about ADS platforms and systems, and specific instructions for the operating design domain where ADS-DVs are tested and deployed. A minimum set of interaction plan elements is recommended in [Section 6.1.1](#). In addition to written instructions or descriptions for each element, developers and manufacturers are encouraged to include diagrams, graphics, videos, or other appropriate means detailing procedural steps or other considerations.

<sup>9</sup> Communicating with an ADS-DV may require contacting and coordinating with fleet operators.

The interaction plan framework consists of three aspects, all of which contribute to safe interactions:

1. Develop an interaction plan, including a minimum set of key elements,
2. Publish and maintain an interaction plan, and
3. Provide ADS content to support first responder training development.

States and IOOs can utilize this framework as a reference to develop questions to pose to developers and manufacturers operating in their jurisdictions.

## 6.1 Develop an Interaction Plan

**ADS developers and/or manufacturers should develop a First Responder Interaction Plan. Input from first responders should be considered wherever possible and applicable.** All plans should be developed to meet the needs of first responders in an operational design domain (ODD)<sup>10</sup>. Efforts should be made to address the concerns of local authorities and first responder stakeholders during planning and throughout operations. Ideally, developers and manufacturers should develop interaction plans using a collaborative process with the first responders and emergency services community.

### 6.1.1 Minimum Set of Interaction Plan Elements

**ADS developers and/or manufacturers should include a minimum set of key elements in their interaction plans.** Recommended elements were derived from research [1], state requirements, developer and manufacturer guides, and on-road ADS experiences. An interaction plan is not limited to these elements and should be developed to best meet the requirements of first responders that may interact with ADS-DVs during the deployment. Many of the key elements relate to recommendations in [Section 5](#).

**6.1.1.1 Introduction.** Describe and provide background on the process used to develop the plan, how the information is organized, the stakeholders included in creating the plan, and the review/update process and schedule.

**6.1.1.2 Description of the ODD.** Provide a description of the ODD elements in which the ADS-DVs will operate, utilizing the elements of *AVSC Best Practice for Describing an Operational Design Domain: Conceptual Framework and Lexicon*. At a minimum, the ODD description should include the following elements:

- Geographical area description, including applicable limitations
- Road types, e.g., divided roads, one-way streets, highways
- Speed range
- Weather condition
- Time of day

Any updates to the described ODD, determined by manufacturers and developers to materially alter first responder interactions with the ADS-DV should prompt a revision to the interaction plan.

All other related documents or support materials related to the ODD should be referenced in the plan and available for first responders to review in planning for and supporting ADS-DV deployments.

**6.1.1.3 Fleet Operations.** Describe the roles and responsibilities, type(s) of services provided, and hours of fleet operations and processes used to verify a valid first responder request and prevent unauthorized access, misuse, and abuse. See [Table 3](#).

**6.1.1.4 Identifying ADS-DVs.** Provide a description, pictures, diagrams, or other means to identify the ADS-DVs. See [Table 3](#).

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<sup>10</sup> Although wireless communications are out of scope for this document, developers and manufacturers should address vehicle-to-everything (V2X) technologies or infrastructure if relevant to the ODD. If applicable, a description of the capability, procedures, and other information should be included in the discussion with relevant elements.

**6.1.1.5 Contact Information.** Describe the location of, or methods for determining, contact information to reach fleet operations. Contact information should be accessible under all conditions, i.e., no access to the interior of the vehicle. Consider including alternative contact methods in addition to accessing vehicle interior. See [Table 3](#).

**6.1.1.6 Disabling ADS-DV.** Provide instructions to safely approach the ADS-DV and how to determine the vehicle's mode (i.e., automated). Provide instructions for immobilizing the ADS-DV. Emphasis should be placed on special instructions or additional steps required to disable or immobilize the ADS-DV beyond traditional first responder stabilization procedures. Provide instructions for safely disengaging the drive system, ensuring the ADS will not operate the vehicle, and ensuring the vehicle is safe for first responders to operate around it. See [Table 1](#).

**6.1.1.7 Accessing Required Documentation.** Provide instructions for accessing vehicle information, such as owner information, vehicle registration, and proof of insurance. See [Table 3](#).

**6.1.1.8 De-Powering ADS-DV.** Describe the vehicle's electrical power source(s) and instructions for safely disconnecting or otherwise disabling electrical power on the vehicle. See [Table 1](#).

**6.1.1.9 Moving ADS-DV from Roadway.** Provide instructions that enable first responders to act independently or in concert with fleet operations to drive or otherwise safely remove the ADS-DV from the active portion of the roadway. Include instructions for first responders to move the ADS-DV from the roadway if they are unable to contact fleet operations. See [Table 1](#).

**6.1.1.10 Determining Presence of Passengers.** Describe the means for determining the presence of passengers and how first responders may assist them with exiting the vehicle. See [Table 3](#).

**6.1.1.11 Extricating Passengers.** Describe any special considerations for extricating passengers from the ADS-DV. Include appropriate and inappropriate cut points or cut zones in the vehicle body/structure. Include potential hazards which may be unfamiliar to first responders. Highlight any steps or procedures that differ from traditional vehicles when extricating a passenger from the ADS-DV. See [Table 1](#) and [Table 3](#).

**6.1.1.12 Firefighting on or Around ADS-DV.** Describe any unique hazards or other special considerations for extinguishing fires on or around the vehicle. See [Table 3](#).

**6.1.1.13 Safe Towing ADS-DV.** Provide instructions for coordinating with fleet operators and safety considerations for first responders needing to tow the ADS-DV from the roadway. Include instructions for first responders to tow the ADS-DV if they are unable to contact fleet operations. See [Table 1](#).

**6.1.1.14 Releasing ADS-DV.** Describe how to release the ADS-DV after the vehicle has been signaled and pulled over (e.g., traffic stop). See [Table 2](#).

**6.1.1.15 ADS-DV Data Integrity.** Describe the process to maintain ADS data integrity during first responder interactions. See [Table 3](#).

**6.1.1.16 Other Considerations.** Any special considerations for first responder activities (e.g., jurisdictional boundaries, unique statutes) could be included in the interaction plan in this section. Describe other interaction procedures and considerations not addressed in this best practice that may be specific to the ODD or identified during stakeholder engagement activities, such as V2X communications.

## 6.2 Publish and Maintain an Interaction Plan

**ADS developers and/or manufacturers should publish and distribute their interaction plans.** Publication and distribution should be accomplished through an appropriate media and method for relevant stakeholders (e.g., internet website address, printed materials, presentations, app).

Interaction plans should be updated as technologies, operational conditions, use cases, regulatory guidance, or related considerations which may result in a material change in first responder interactions with ADS-DVs. Subsequent changes need to be communicated expeditiously to the first responder community.

## 6.3 ADS Content to Support First Responder Training Development

ADS developers and manufacturers should collaborate, as needed, with first responders as they operationalize protocols and procedures in their jurisdictions. **ADS developers and/or manufacturers should provide ADS platform and system content to assist first responders in the development of training materials.** [Section 6.1.1](#) includes the minimum set of ADS content that should be available to first responders. ADS platform and system content may be available or administered via web-based tools, written media, or in-person/classroom sessions. Recommendations or assistance with training should reference information in the interaction plan and may be directly linked as appropriate.

## 7. Summary

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As more first responders are required to interact with ADS-DVs, the need for common procedures and training increases. This best practice outlines key roles, interaction types, and use cases associated with first responder interactions with ADS-DVs. Recommendations for ADS manufacturers and developers are provided to promote safe interactions. This best practice contains a recommended format for a First Responder Interaction Plan, with a minimum set of key elements to be included. It also provides considerations for developing, distributing, and maintaining an interaction plan that will inform, educate, and communicate important information to first responders.

## 8. About Automated Vehicle Safety Consortium™

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The objective of the Automated Vehicle Safety Consortium™ is to provide a safety framework around which automated vehicle technology can responsibly evolve in advance of the broad use of commercialized vehicles. The consortium will leverage the expertise of its current and future members and engage government and industry groups to establish safety principles and best practices. These technology-neutral principles are key considerations for deploying SAE level 4 and level 5 automated vehicles on public roads.

### **AVSC Vision:**

Public acceptance of SAE level 4 and level 5 automated driving systems as a safe and beneficial component of transportation through industry consensus.

### **AVSC Mission:**

The mission of the Automated Vehicle Safety Consortium™ (AVSC) is to quickly establish safety principles, common terminology, and best safety practices, leading to standards to engender public confidence in the safe operation of SAE level 4 and level 5 light-duty passenger and cargo on-road vehicles ahead of their widespread deployment.

The AVSC will:

- Develop and prioritize a roadmap of pre-competitive topics;
- Establish working groups to address each of the topics;
- Engage the expertise of external stakeholders;
- Share output/information with the global community;
- Initially focus on fleet service applications.

## 9. Contact Information

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To learn more about the Automated Vehicle Safety Consortium™, please visit <https://avsc.sae-itc.org>.

Contact: [AVSCinfo@sae-itc.org](mailto:AVSCinfo@sae-itc.org)

## 10. Acknowledgements

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The Automated Vehicle Safety Consortium™ would like to acknowledge the contributions of the member organizations during the development of this document.

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## 11. Abbreviations

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ADS - Automated Driving System

ADS-DV - Automated Driving System-Dedicated Vehicles

APSCS - Automation and Public Safety Common Solutions

AVSC - Automated Vehicle Safety Consortium™

CAMP - Crash Avoidance Metrics Partnership, LLC

DV - Dedicated Vehicles

FR - Fire and Rescue

GS - Good Samaritan

IOO - Infrastructure Owner-Operator

NHTSA - National Highway Traffic Safety Administration

ODD - Operational Design Domain

RR - Roadway Response

SPaT - Signal, Phase, and Timing

SAE ITC - SAE Industry Technologies Consortia®

TR - Towing and Recovery

V2X - Vehicle-to-Everything

## Appendix A. Best Practice Quick Look

*First Responder Interactions with Fleet-Managed Automated Driving System-Dedicated Vehicles (ADS-DVs)*

**Role definitions (3.0).** Common definitions for roles associated with first responders and others.

**First responder and ADS-DV interaction use cases (4.0).** Use case descriptions provided as context for first responder interactions.

**First responder and ADS-DV interaction types and recommendations (5.0).** Three general types of interactions are anticipated between first responders and ADS-DVs. [Table 4](#) summarizes linkages between use cases and interaction types.

- **Direct interaction (5.1).** Involves physical contact between a first responder and an ADS-DV. Recommendations for direct interactions include in [Table 1](#).
- **Indirect interaction (5.2).** Involves a first responder influencing an ADS-DV without coming into physical contact. Recommendations for indirect interactions included in [Table 2](#).
- **Informational interaction (5.3).** Interaction between a first responder and an ADS-DV occurs when information must be obtained from or about a vehicle by the first responder. Recommendations for informational interactions included in [Table 3](#).
- **Linking use cases to interaction types (5.4).** [Table 4](#) summarizes interaction use cases described in [Section 4](#) with the interaction types described in [Section 5](#).

**Interaction Plan Framework (6.0).** Framework for developing, publishing, and communicating an interaction plan. **ADS developers and manufacturers should have a first responder interaction plan.**

- **Develop an interaction plan (6.1).** ADS developers and manufacturers should develop an interaction plan, including input from first responders wherever possible and applicable.
  - **Minimum set of interaction plan elements (6.1.1).** Developers and manufacturers should include a minimal set of key elements in their interaction plans.
    - Introduction ([6.1.1.1](#))
    - Description of ODD ([6.1.1.2](#))
    - Fleet operations ([6.1.1.3](#))
    - Identifying ADS-DVs ([6.1.1.4](#))
    - Contact information ([6.1.1.5](#))
    - Disabling ADS-DV ([6.1.1.6](#))
    - Accessing required information ([6.1.1.7](#))
    - De-powering ADS-DV ([6.1.1.8](#))
    - Moving ADS-DV from roadway ([6.1.1.9](#))
    - Determining presence of passengers ([6.1.1.10](#))
    - Extricating passengers ([6.1.1.11](#))
    - Firefighting on or around ADS-DVs ([6.1.1.12](#))
    - Safe towing ADS-DV ([6.1.1.13](#))
    - Releasing ADS-DV ([6.1.1.14](#))
    - ADS-DV data integrity ([6.1.1.15](#))
    - Other considerations ([6.1.1.16](#))
- **Publish and maintain an interaction plan (6.2).** ADS developers and manufacturers should publish and distribute their interaction plans. Interaction plans should be updated when material changes affecting ADS-DV and first responder interactions occur.
- **Training in support of an interaction plan (6.3).** ADS developers and manufacturers should provide ADS platform and system content to assist first responders in the development of training materials.