



# NHTSA's FMVSS Considerations for Vehicles with Automated Driving Systems

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SAE Government/Industry Meeting

04.03.2019

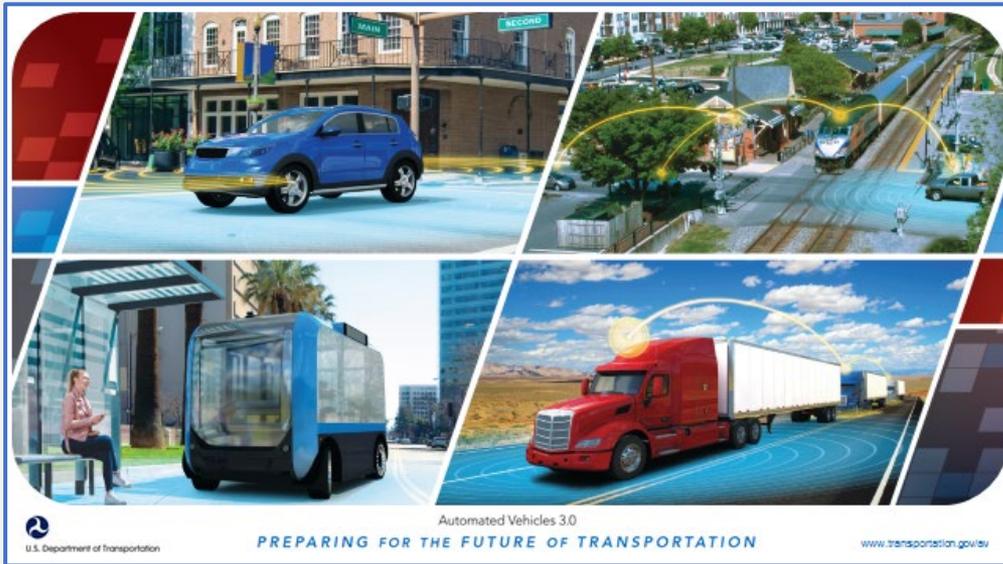
# OVERVIEW

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- Policy (3.0, 2.0)
- Research
- Regulatory Efforts

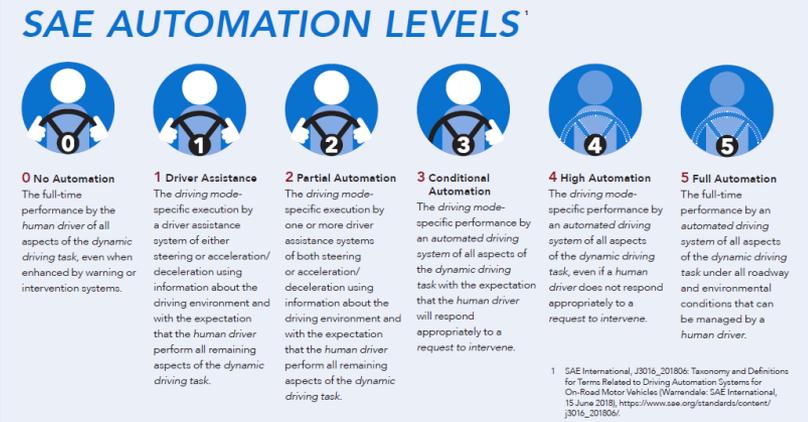
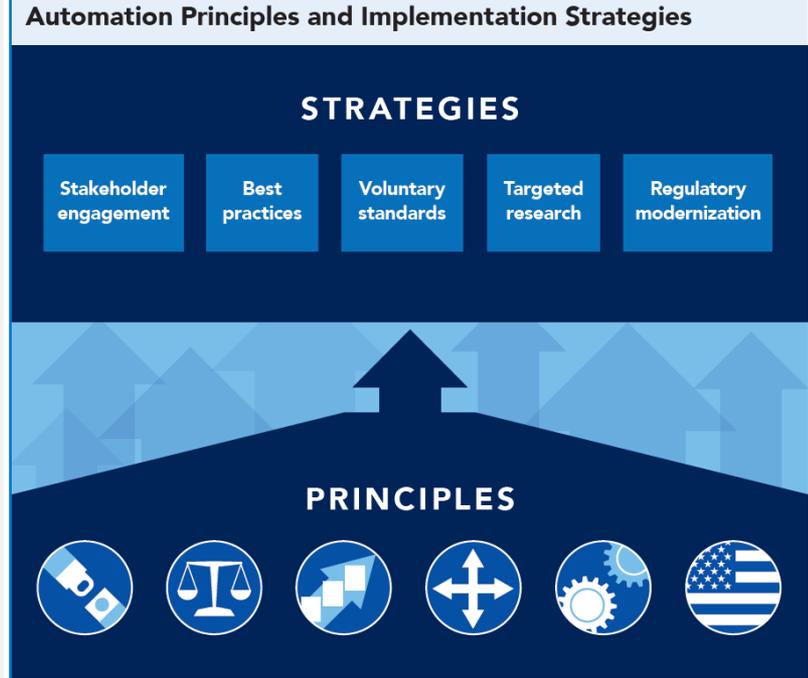


# POLICY



## Preparing for the Future of Transportation (AV 3.0)

- Released October 2018
  - New multimodal safety guidance
  - Clarifies policy and roles
  - Outlines how to work with U.S. DOT as automation technology evolves



# POLICY

## *A Vision for Safety (AV 2.0)*

- Voluntary guidance on design, testing, and safe deployment of ADS remains central to U.S. DOT's Approach.
- Released September 2017.
- Encourages companies to consider and document their approach to 12 safety elements.



- |  |                                     |
|--|-------------------------------------|
| 1. Vehicle Cybersecurity                   | 7. Human Machine Interface          |
| 2. System Safety                           | 8. Crashworthiness                  |
| 3. Operational Design Domain               | 9. Post-Crash ADS Behavior          |
| 4. Object and Event Detection and Response | 10. Data Recording                  |
| 5. Fallback (Minimal Risk Condition)       | 11. Consumer Education and Training |
| 6. Validation Methods                      | 12. Federal, State, and Local Laws  |

### Company VSSA Disclosures

- [Apple](#)
- [AutoX](#)
- [Ford](#)
- [GM](#)
- [Mercedes-Benz/Bosch L4-L5](#)
- [Mercedes Benz L3](#)
- [Navya](#)
- [Nuro](#)
- [Nvidia](#)
- [Starsky Robotics](#)
- [Uber](#)
- [Waymo](#)
- [Zoox](#)

As of 3/29/19

# RESEARCH

1

**Removing  
Regulatory  
Barriers**

2

**ADS System Safety  
Performance;  
Functional Safety;  
Cybersecurity**

3

**Human Factors**

4

**Crashworthiness  
Occupant  
Protection**

# Removing Regulatory Barriers

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## Background: Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles

- Preliminary Report, March 2016
  - <https://rosap.ntl.bts.gov/view/dot/12260>
- Volpe National Transportation Systems Center
  - Identify instances where existing FMVSS may pose challenges to the introduction of automated vehicles.
- Research Objectives
  - Driver scan for explicit or implicit reference to a human driver.
  - Automated vehicle concept scan to identify challenges for a wide range of automated vehicle capabilities and concepts.

# Removing Regulatory Barriers

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## FMVSS Considerations for Vehicles with Automated Driving Systems

- Multi-year project, initiated in September 2017
- Virginia Tech Transportation Institute (VTTI)
- Research Objectives:
  - Provide technical translation options of FMVSS and related compliance test procedures for ADS-equipped vehicles.
  - Identify any regulatory barriers to self-certification and compliance verification of innovative new vehicle designs with ADS.

# FMVSS Considerations for Vehicles with Automated Driving Systems - VTTI

## Phase 1

- 30 FMVSS
- Focus: ADS-DVs without manual controls.

## Approach

- Code the translation category.
- Detailed analysis of regulatory text & compliance test procedures.
- Engage subject matter experts for review.

Crash Avoidance			Crashworthiness & Occupant Protection		
<b>101</b> Controls and displays	<b>110</b> Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information	<b>124</b> Accelerator control systems	<b>201</b> Occupant protection in interior impact	<b>206</b> Door locks and door retention components	<b>216a</b> Roof crush resistance
<b>102</b> Transmission shift position sequence, starter interlock, and transmission braking effect	<b>111</b> Rear visibility	<b>125</b> Warning devices	<b>202a</b> Head restraints	<b>207</b> Seating systems	<b>219</b> Windshield zone intrusion
<b>103</b> Windshield defrosting and defogging systems	<b>113</b> Hood latch system	<b>126</b> Electronic stability control systems for light vehicles	<b>203</b> Impact protection for the driver from the steering control system	<b>208</b> Occupant crash protection	<b>222</b> School bus passenger seating and crash protection
<b>104</b> Windshield wiping and washing systems	<b>114</b> Theft protection and rollaway prevention	<b>138</b> Tire pressure monitoring systems	<b>204</b> Steering control rearward displacement	<b>210</b> Seat belt assembly anchorages	<b>225</b> Child restraint anchorage systems
<b>108</b> Lamps, reflective devices, and associated equipment	<b>118</b> Power-operated window, partition, and roof panel systems	<b>141</b> Minimum Sound Requirements for Hybrid and Electric Vehicles	<b>205</b> Glazing materials	<b>214</b> Side impact protection	<b>226</b> Ejection Mitigation

Reason		Technical Translation Type Description
<b>0</b>	Not performed	Translation evaluated but not performed.
<b>1</b>	Translation is straightforward	The translation performed is straightforward.
<b>2</b>	Limited research may be beneficial	Can translate standards or provisions of standards, maintaining current performance levels, with some limited amount of research for NHTSA to conduct compliance verification for both conventional vehicle designs and new vehicle designs associated with Automated Driving System - Dedicated Vehicles (ADS-DVs).

# FMVSS Considerations for Vehicles with Automated Driving Systems - VTTI



## Core Team

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Co-PI & Crash Avoidance Lead

Co-PI & Crashworthiness Lead

### VTTI's FMVSS Expert Group

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Stephen W. Rouhana, Ph.D.  
George Soodoo, M.B.A.  
Kenneth Weinstein, J.D.

### Research Team Members

#### Industry Group



#### Research Institutions

Booz | Allen | Hamilton



#### Test Facilities



## Stakeholder/ SME Reviewer Group



**AUTO ALLIANCE**  
DRIVING INNOVATION™



**Automotive Safety Council**  
Prevent. Protect. Notify.



**DAIMLER**  
Daimler Trucks North America



GlobalAutomakers



Mercedes-Benz



TESLA



Volkswagen



WAYMO



# FMVSS Considerations for Vehicles with Automated Driving Systems - VTTI

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## Crashworthiness Challenges (FMVSS 200-series)

- FMVSS use of the terms: *driver*, *driver's seat*, *driver's designated seating position*, and similar terms.
- FMVSS primarily aimed at driver/front row protection.

## Crash Avoidance Challenges (FMVSS 100-series)

- FMVSS use of a “human” driver using manually-operated driving controls (steering wheel, brakes, etc.).
- FMVSS that specify the “manner in which a vehicle is controlled” required careful review and consistent translation approach.

# FMVSS Considerations for Vehicles with Automated Driving Systems - VTTI

## Crash Avoidance Challenges (FMVSS 100-Series)

- Cross-walk on functionality categories for physical test execution:

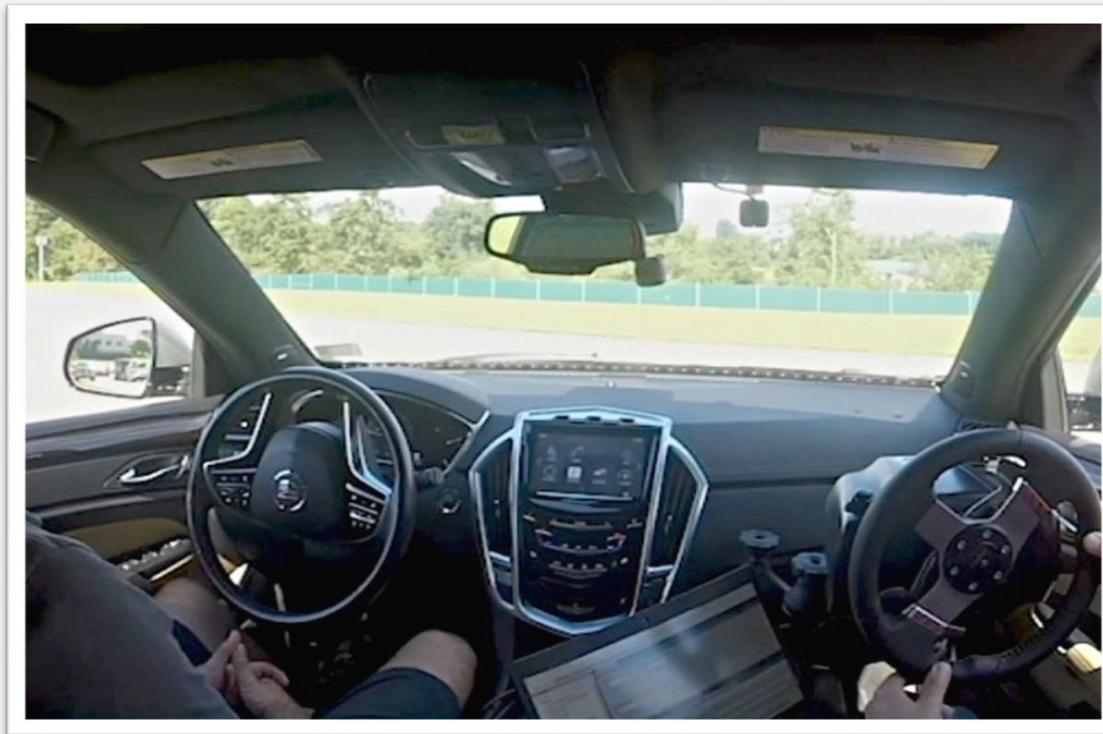
Category	Functionality	102	108	114	118	138	141	101	103	104	110	111	113	124	125	126
Driving Tasks	Steering control			•		•	•				•	•				•
	Speed control (vehicle/engine)			•		•	•		•	•	•	•		•		•
	Service brake application			•		•	•				•	•				•
	Parking brake			•			•					•				
	Gear selection	•		•		•	•		•	•	•	•				•
Vehicle Communications	Telltails/warnings/indicators	•	•	•		•		•						•		•
Key/Ignition Function	Key insertion/removal			•												
	Ignition start/stop	•		•	•	•			•	•	•	•		•		•
	Accessory mode			•	•											
Non-driving Tasks	Door open/close			•	•											
	Non-driving controls		•		•				•	•		•				
Environment Awareness	Visibility							•	•	•		•	•			

# FMVSS Considerations for Vehicles with Automated Driving Systems - VTTI

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## Crash Avoidance Challenges (FMVSS 100-Series)

### Evaluation of Test Procedure Methods





# FMVSS Considerations for Vehicles with Automated Driving Systems – VTTI

Stakeholder Meetings:  
April 2018 & November 2018

# FMVSS Considerations for Vehicles with Automated Driving Systems - VTTI

## Examples of Cross-cutting Themes in FMVSS

- Use of driver (operator); driver/passenger presence
- Equipment may not be applicable
- Controls, telltales, indicators, and auditory alerts

## Analysis of Information Communicated in Vehicles

Categories	Analysis Questions	Examples
<b>Information Communicated</b>	<b>What is communicated?</b> <b>What type of communication?</b>	Engaged, warning, malfunction, identification
<b>Delivery Method</b>	<b>How is information delivered?</b>	Illumination of a telltale, auditory alert, indicator
<b>Intended For</b>	<b>Whom is the information for?</b>	Driver, non-driving occupants, maintenance entity
<b>Expected Response</b>	<b>What action is expected in response to information?</b>	After a low tire pressure warning is activated, someone is expected to check the tire(s) and take appropriate action

# FMVSS Considerations for Vehicles with Automated Driving Systems - VTTI

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## Next Steps

- Near-term Completion of Volume 1 Report (12 FMVSS)
- Draft Volume 2 Report (18 FMVSS)

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# Regulatory Efforts

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Pilot Program ANPRM  
Notices of Receipt –  
Petitions for  
Temporary Exemption



# Regulatory Efforts

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## Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation

- Advance Notice of Proposed Rulemaking (ANPRM)
  - Published 10.10.18
  - Seeks public comment related to the near-term & long-term challenges of ADS testing, development & eventual deployment.
    - Potential factors to be considered in designing a pilot program;
    - Use of existing statutory provisions and regulations;
    - Additional elements of regulatory relief; and
    - Exemption petition evaluation.
- [Regulations.gov](https://www.regulations.gov): [Docket No. NHTSA-2018-0092](https://www.regulations.gov).

# Regulatory Efforts

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## Petitions for Temporary Exemptions

- 49 Code of Federal Regulations Part 555 Final Rule
  - Published 12.26.18; [Regulations.gov: Docket No. NHTSA-2018-0103](#).
  - Aims to streamline the application & review process for petitions submitted by manufacturers while continuing to prioritize safety for drivers, occupants, and other road users.
  
- Notices of Receipt - Temporary Exemption Petitions
  - Published 03.19.19
  - General Motors, LLC (Zero-Emission Autonomous Vehicle or ZEAV)
    - [Regulations.gov: Docket No. NHTSA-2019-0016](#).
  - Nuro, Inc. (R2X)
    - [Regulations.gov: Docket No. NHTSA-2019-0017](#).



Thank you for your attention.

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