

FMVSS Considerations for Vehicles with Automated Driving Systems

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Project Objectives

- Identify unnecessary/unintended regulatory barriers to self-certification and compliance verification of innovative vehicle designs with Automated Driving Systems (ADS)
- Provide technical translation options of FMVSS and related compliance test procedures for ADS-equipped vehicles
- Focus is on ADS-Dedicated Vehicles (ADS-DVs) that lack manually operated driving controls (e.g., steering wheel, brake pedal)

FMVSS of Focus

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

Translation Approach

- Detailed evaluation of both regulatory text and the compliance test procedure to identify unnecessary barriers
- Code the translation type as 0, 1, or 2
- Suggest potential translations of standard text and test procedures
- Document FMVSS requirements where a technical translation was evaluated but not performed
- Document potential considerations for translation options
- Engage subject matter experts for review

Reason		Technical Translation Type Description
0	Not performed	Translation evaluated but not performed.
1	Translation is straightforward	The translation performed is straightforward.
2	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).

Project Team and Stakeholders



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Test Facilities



Stakeholder/ SME Reviewer Group



Translation Approach: Maintaining Consistency

Cross-Cutting Themes

- Driver (operator)
- Equipment may not be available
- Front/rear of vehicle
- Assumes front row is preferred seating
- Dummy positioning
- Controls, Telltales, Indicators and Alerts

Working Definitions

- Driver
- Driver's Designated Seating Position (DSP)
- Manually Operated Driving Controls
- Bidirectional Vehicle

Technical Translation Example:

FMVSS 102: Transmission Shift Position Sequence

S3.1.4.2 Identification of shift positions and of shift position sequence

Regulatory Text	Translation Options		Potential Considerations
<p>...identification of shift positions ... shall be displayed in view of the driver whenever the ignition is in a position in which the engine is capable of operation.</p>	<p>Option 1</p>	<p>...shall be communicated to the driver ...</p>	<p>Eliminates the dependency on a display.</p> <p>Opens the possibility of other communication means to human drivers (e.g., auditory).</p>
	<p>Option 2</p>	<p>...shall be displayed in view of the driver in a vehicle with a transmission shift mechanism intended for operation by a human driver, and shall be communicated to the ADS driver in a vehicle equipped with such a system, whenever...</p>	<p>Separates the human and ADS.</p> <p>If taken out of context, exclusion of "shift" could be ambiguous. "Shift" could be kept as currently stated while keeping the distinction between human and ADS.</p>
	<p>Option 3</p>	<p>...shall be displayed in view of the human driver whenever the ignition is in a position in which the engine is capable of operation.</p>	<p>Only display information for vehicle operated by a human driver.</p>

Test Procedures: Crash Avoidance

- Goal was to investigate the equipment, methods, and/or procedures to perform compliance testing on ADS-DVs
- Evaluate functionalities required to execute compliance test procedures using as many potential test methods as are technically feasible

Category	Functionality	101	102	103	104	108	110	111	113	114	118	124	125	126	138	141
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	•		•	•			•	•							

Test Procedures: Methods

Vehicle-based

Human control

Programmed control of
the ADS

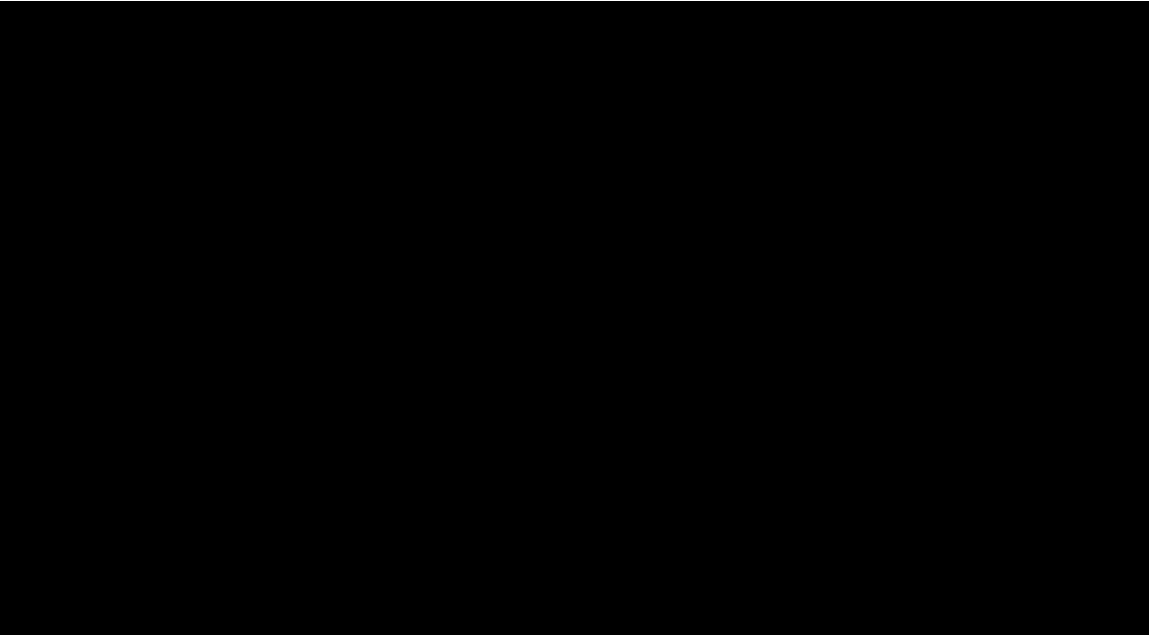
ADS normal operation

Non-vehicle-based

Technical design
documentation

Simulation

Test Procedures: Evaluation Criteria

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- Safety
 - Ease of execution (compared to baseline)
 - Test time
 - Scalability
 - Standardization
 - Cost
 - Gaming Possibility

Test Procedures: Crashworthiness



- Conventional Seating
- Occupant protection from right passenger mirrored to left passenger if no manual controls present
- Focus on seating position (Driver's DSP, Passenger DSP) rather than role (Driver, passenger)

Conclusions

- Unnecessary regulatory barriers identified for 30 FMVSS
- Technical translation options developed to maintain safety and performance standards of each FMVSS
- Multiple test methods established for testing the different functionalities required to execute compliance test procedures for ADS-DVs
- Stakeholder and subject matter expert feedback captured throughout process



NHTSA

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Thank you!

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