



NHTSA

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Update on NHTSA Research Activities and Current Regulatory Agenda related to Automated Driving Systems

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OVERVIEW

- Research
- Regulatory Efforts



Overview of Automated Driving System Research

- Support Updating and Modernizing Regulations
(removing assumption of a driver from current regs)
- System Safety Performance
(tests, test methods, safety performance metrics)
- Functional Safety, ADS Subsystems, Cybersecurity
(safety assurance of vehicle electronics and software)
- Human Factors
(signaling, telltales, disabled user needs)
- Occupant Protection
(alternative cabin configurations)

FMVSS Considerations for Vehicles with ADS

- Multi-year project, initiated in September 2017
- Virginia Tech Transportation Institute (VTTI)
- Identify unnecessary/unintended regulatory barriers to self-certification and compliance verification of innovative vehicle designs with Automated Driving Systems (ADS)
- Focus is on ADS-Dedicated Vehicles (ADS-DVs) that lack manually operated driving controls (e.g., steering wheel, brake pedal)
- Provide technical translation options of FMVSS and related compliance test procedures for ADS-equipped vehicles



FMVSS Considerations for Vehicles with ADS

Phase 1

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

Technical Translation Approach

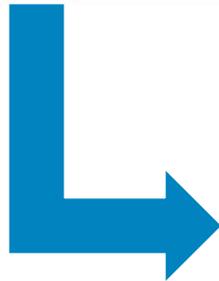
- Detailed evaluation of both regulatory text and Office of Vehicle Safety Compliance (OVSC) test procedure to identify unnecessary barriers
- Develop potential translation options
- Maintain consistency through development of crosscutting themes
- Document FMVSS requirements where a technical translation was evaluated but not performed
- Document potential considerations for technical translation options
- Engage stakeholders for review and feedback

FMVSS No. 126: Electronic Stability Control Systems

- Defines performance criteria for a system's output (the vehicle's yaw and lateral position) in response to a given input (steering wheel angle).
- In the absence of a steering wheel, a means to control the lateral direction of an ADS-equipped vehicle is still required.
- Translation options developed:
 - 1) New definitions for “steering wheel” and “steering wheel angle” based on generic interface with the steering system
 - 2) Inputs into the system via the steering wheel have been translated to refer to equivalent inputs into the steering system
 - 3) Input defined at the road wheel angle (angle of the tires relative to the longitudinal centerline of vehicle).

Vehicle Functionalities and Test Methods

Functionality	101	102	103	104	108	110	111	113	114	118	124	125	126	138	141
Steering control						•	•		•				•	•	•
Speed control (vehicle/engine)			•	•		•	•		•		•		•	•	•
Service brake application						•	•		•				•	•	•
Parking brake							•		•						•
Gear selection		•	•	•		•	•		•				•	•	•
Telltale/warnings/indicators	•	•			•				•		•		•	•	



- Human Control (i.e., external controller)
- Programmed Control
- ADS Normal Operation
- Simulation
- Technical Documentation

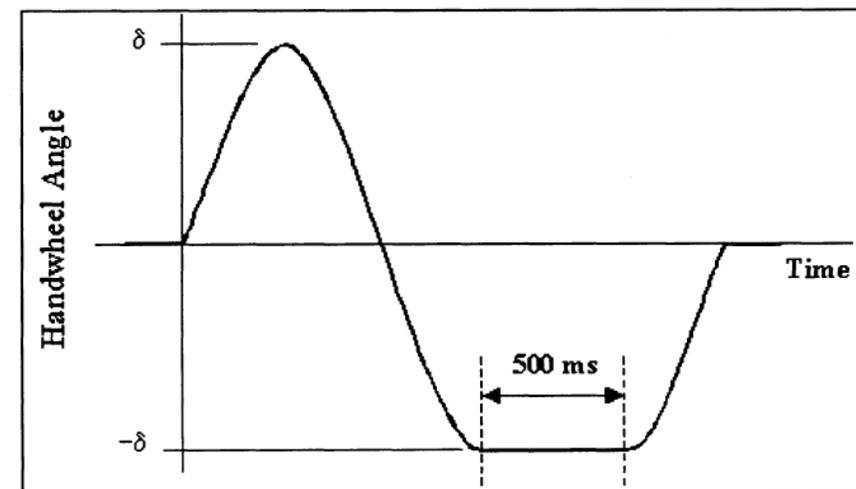
Basic Driving Functionalities: FMVSS No. 114

- (a) Drive the vehicle forward up a 10 percent grade and stop it with the service brakes.
- (b) Apply the parking brake (if present).
- (c) Move the gear selection control to Park
- (d) Note the vehicle position.
- (e) Release the parking brake. Release the service brakes.
- (f) Remove the key.
- (g) Verify that the gear selection control or transmission is locked in Park.
- (h) Verify that the vehicle, at rest, has moved no more than 150 mm from the position noted prior to release of the brakes.

Programmed Control Example

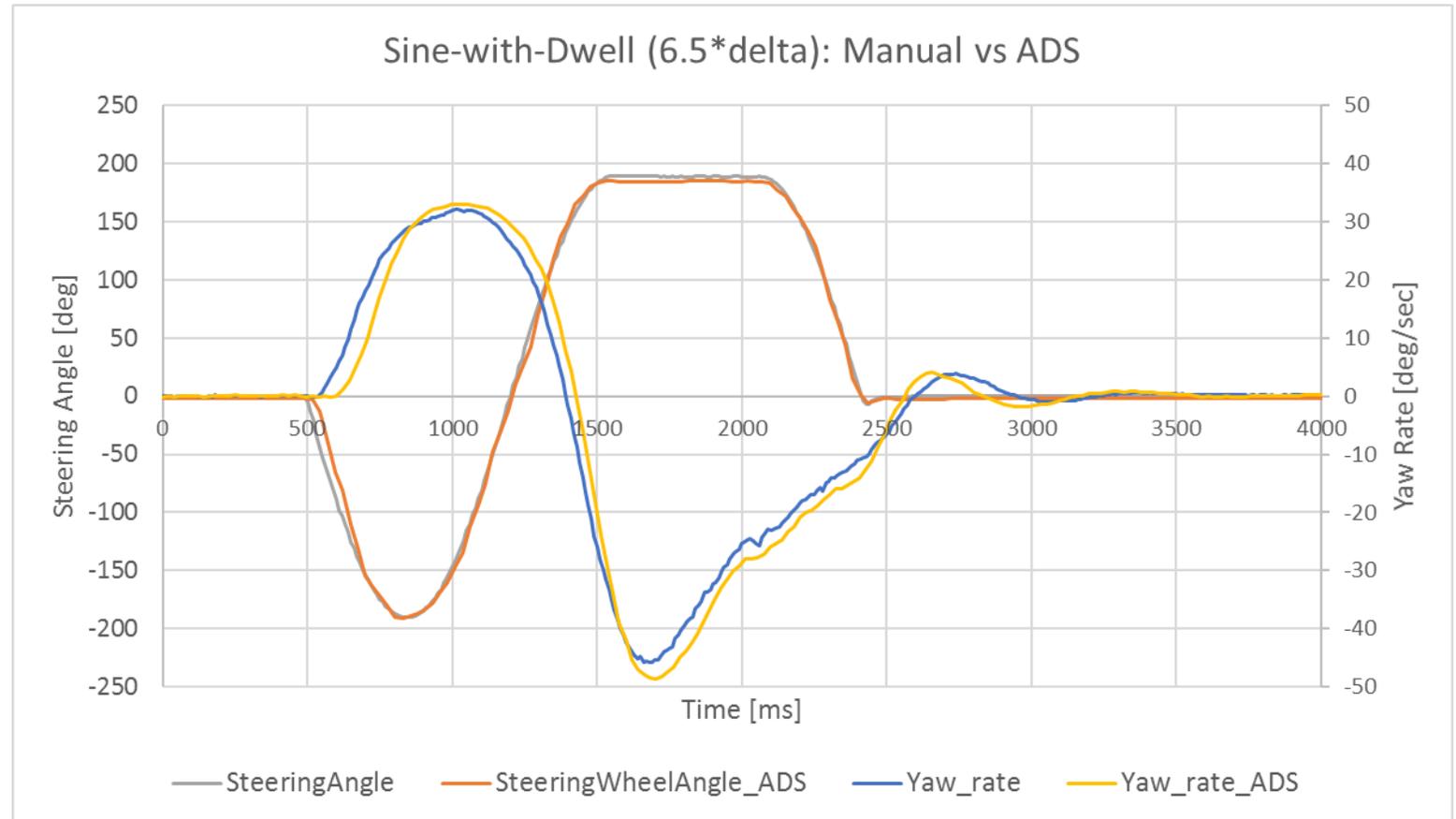
Precise Steering Control: FMVSS No. 126

- Vehicle conditioning
- Vehicle characterization: Slowly increasing steer test
 - Purpose: establish relationship between steered input and lateral acceleration of vehicle for the linear range of the vehicle using controlled input
 - Output: initial conditions for ESC test
- ESC test: Sine with dwell test
 - Purpose: methodically increase steering wheel angle magnitude for double lane change type maneuver at fixed speed to cause ESC to activate
 - Output: vehicle response (yaw rate) during ESC operation



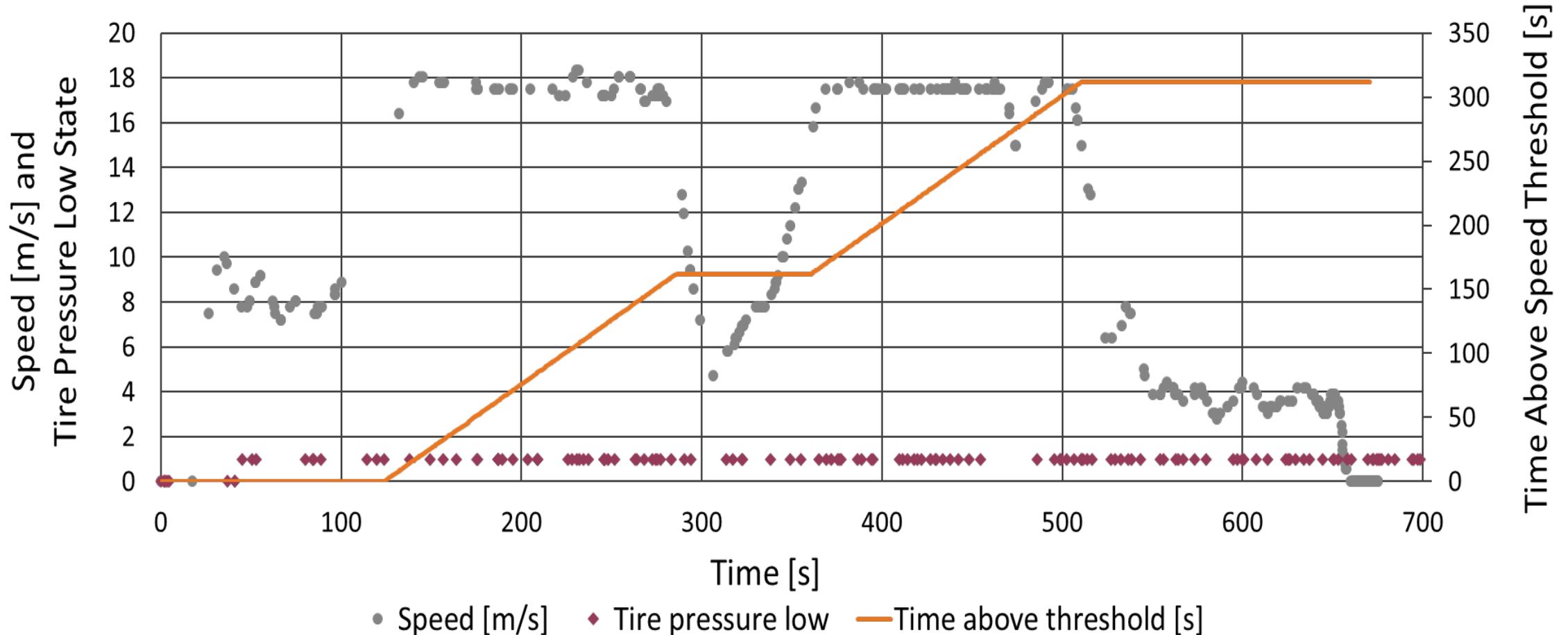
Programmed Control Example

Precise Steering Control: FMVSS No. 126



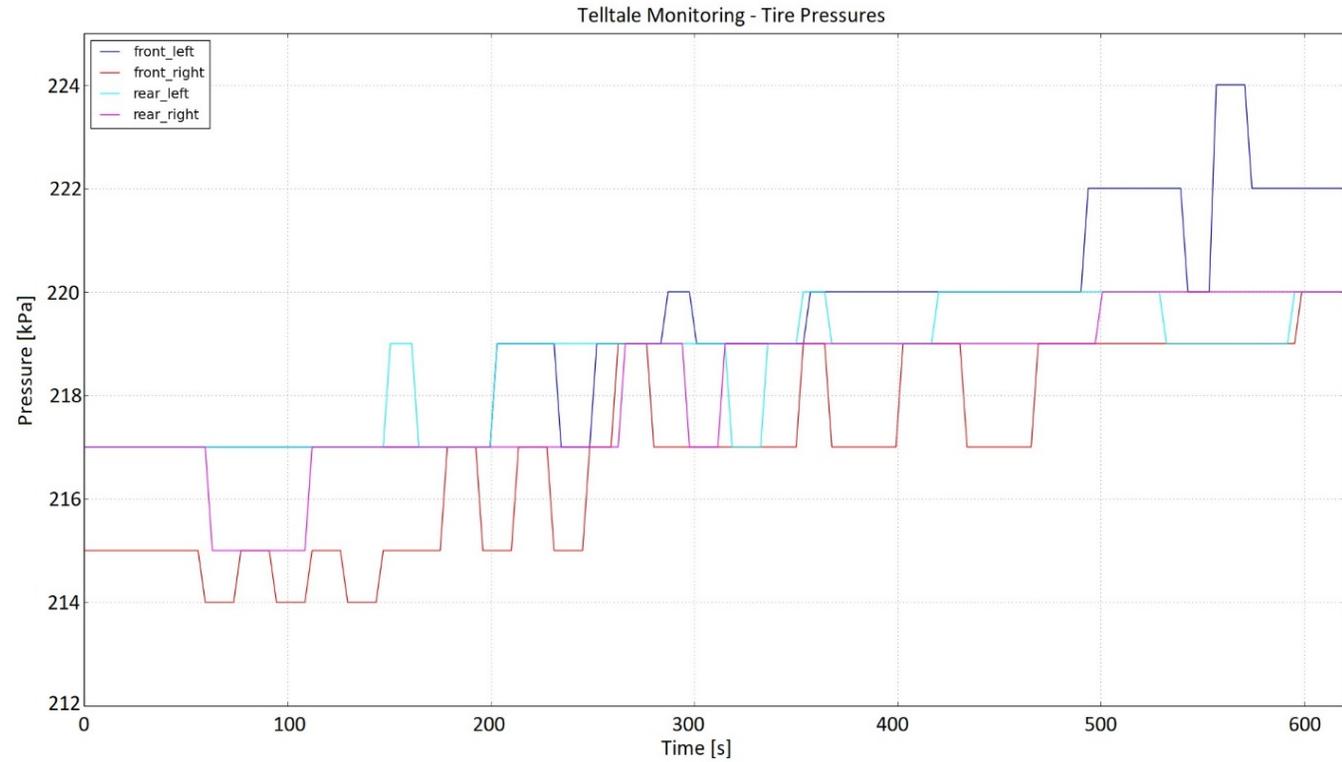
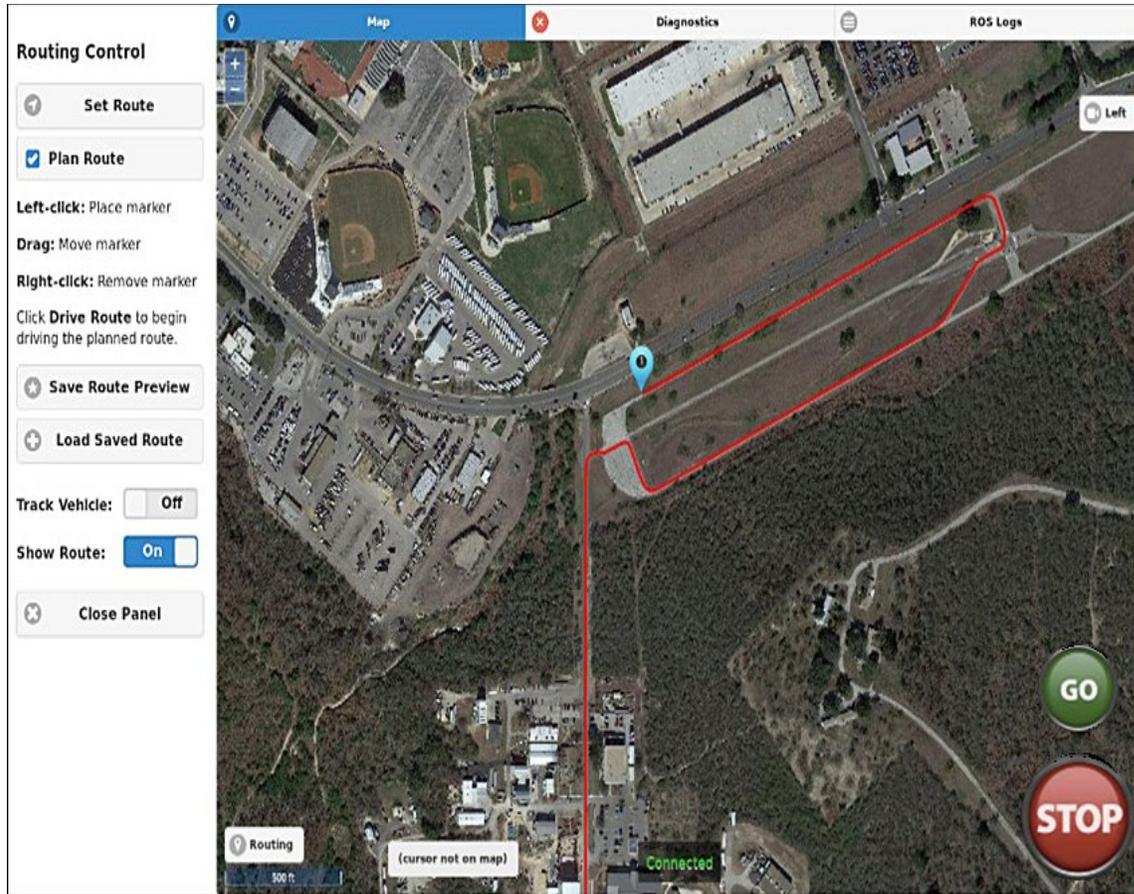
Monitoring Vehicle "State" Example

FMVSS No. 138: Tire Pressure Monitoring Systems



ADS Normal Operation Example

FMVSS No. 138: Tire Pressure Monitoring Systems



Next Steps

- Phase 1:
 - Volume 1 Final Report (12 FMVSS)
 - Volume 2 Final Report (18 FMVSS)
- Phase 2:
 - Kicked off July 2019
 - Scope:
 - FMVSS not considered in Phase 1 (e.g., FMVSS 135: Light vehicle brake systems)
 - Refinement of crash avoidance test methods
 - Additional research that stemmed from Phase 1

Regulatory Efforts

- ANPRM: Removing Regulatory Barriers
- Rulemaking Agenda



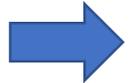
Regulatory Efforts

Removing Regulatory Barriers for Vehicles with Automated Driving Systems

- Advanced Notice of Proposed Rulemaking (ANPRM)
 - Published May 28, 2019
 - Seeks public comment on the near- and long-term challenges of testing and verifying compliance with existing crash avoidance (100-series) FMVSSs for ADS-DVs that lack traditional manual controls
 - Seeks comments on the suitability of various approaches that could be used to address compliance verification challenges
 - 100 comments received from industry, safety advocates, public citizens, etc.
- [Regulations.gov](https://www.regulations.gov): Docket ID: NHTSA-2019-0036

Rulemaking Agenda: Published Fall 2019

- 10 ADS-related actions in published rulemaking agenda
- Proposed Rule Stage:
 - Occupant Protection for Automated Driving Systems
 - This action proposes to amend crashworthiness regulations that may be necessary to facilitate the certification of motor vehicles equipped without driver controls.
 - [Reginfo.gov](https://www.reginfo.gov): RIN: 2127-AM06
 - <https://www.reginfo.gov/public/jsp/EO/eoDashboard.myjsp>
- Prerule Stage:
 - Considerations for Telltales, Indicators, and Warnings in ADS Vehicles
 - This action seeks comments on amending the FMVSS to address the applicability and appropriateness of safety messaging (telltales, indicators, and warnings) in vehicles without conventional driver controls.
 - [Reginfo.gov](https://www.reginfo.gov): RIN: 2127-AM07

- Research ongoing to support removing barriers for ADS-DVs
- Regulatory text  Technical translation options developed
- OVSC test procedures  Multiple test method options investigated