



GOVERNMENT/ INDUSTRY

Digital Summit

February 2-3, 2021

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FMVSS Considerations for Vehicles With Automated Driving Systems: Project Update



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FMVSS Considerations for Vehicles with ADSs

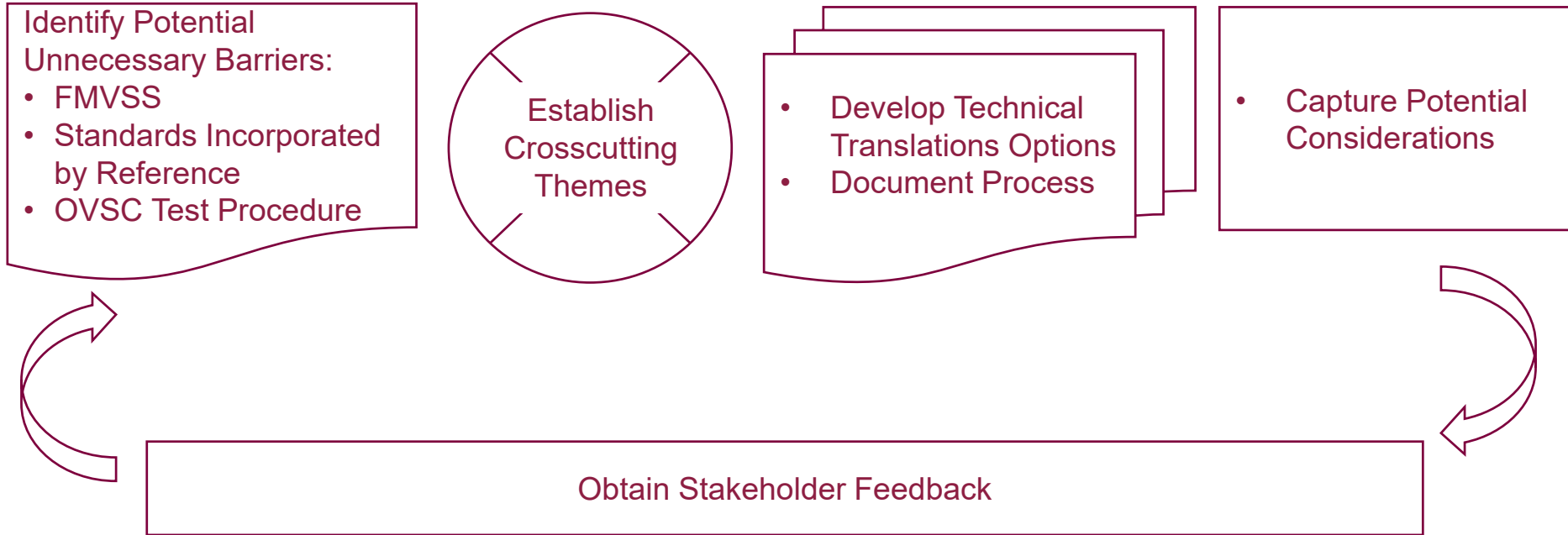
Project Overview:

- NHTSA-sponsored, multi-year project initiated in September 2017
- Identify unnecessary/unintended regulatory barriers to self-certification and compliance verification of innovative vehicle designs with Automated Driving Systems (ADSs)
- 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: Federal Motor Vehicle Safety Standards

Technical Translation Approach



OVSC: Office of Vehicle Safety Compliance

FMVSS Covered in Volume 1 and 2 Research

Focus Areas:

- Address the fundamental crosscutting assumptions (e.g., driver and seating position, service brake application, gear position/selection, and telltales)
- Apply passenger seating position test procedures to the left front outboard seating position (200-series)
- Develop considerations for addressing bidirectional vehicles (100-series)
- Focus on test method development (100-series)

Crash Avoidance

101 Controls and displays	110 Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information	124 Accelerator control systems
102 Transmission shift position sequence, starter interlock, and transmission braking effect	111 Rear visibility	125 Warning devices
103 Windshield defrosting and defogging systems	113 Hood latch system	126 Electronic stability control systems for light vehicles
104 Windshield wiping and washing systems	114 Theft protection and rollover prevention	138 Tire pressure monitoring 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

Crashworthiness & Occupant Protection

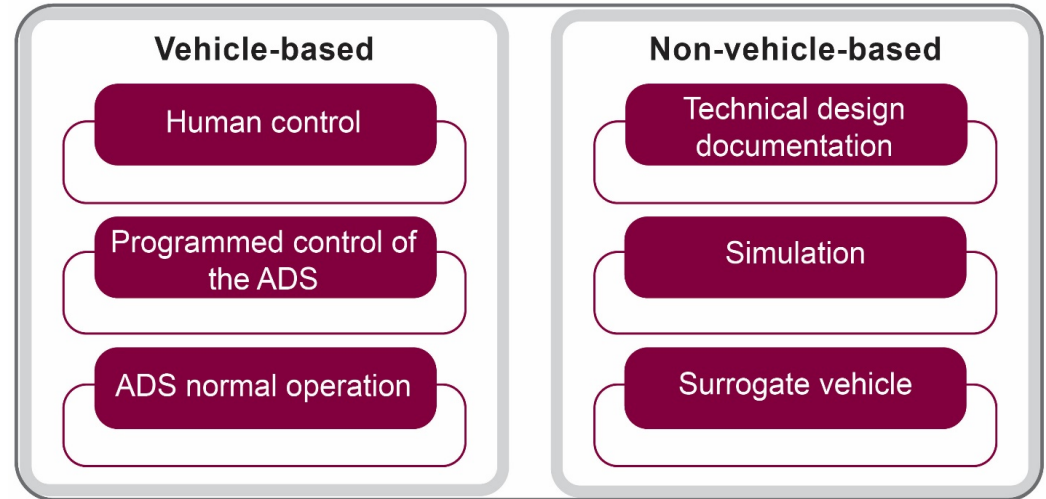
201 Occupant protection in interior impact	206 Door locks and door retention components	216a Roof crush resistance
202a Head restraints	207 Seating systems	219 Windshield zone intrusion
203 Impact protection for the driver from the steering control system	208 Occupant crash protection	222 School bus passenger seating and crash protection
204 Steering control rearward displacement	210 Seat belt assembly anchorages	225 Child restraint anchorage systems
205 Glazing materials	214 Side impact protection	226 Ejection Mitigation

Crash Avoidance Test Methods and Evaluation: Volume 1 and 2

Volumes 1 and 2 explored a range of potential compliance verification test methods for ADS-DVs

Research testing was completed for:

- FMVSS No. 114: Theft Protection and Rollaway Prevention
- FMVSS No. 138: Tire Pressure Monitoring Systems
- FMVSS No. 126: Electronic Stability Control Systems (ESC) for Light Vehicles

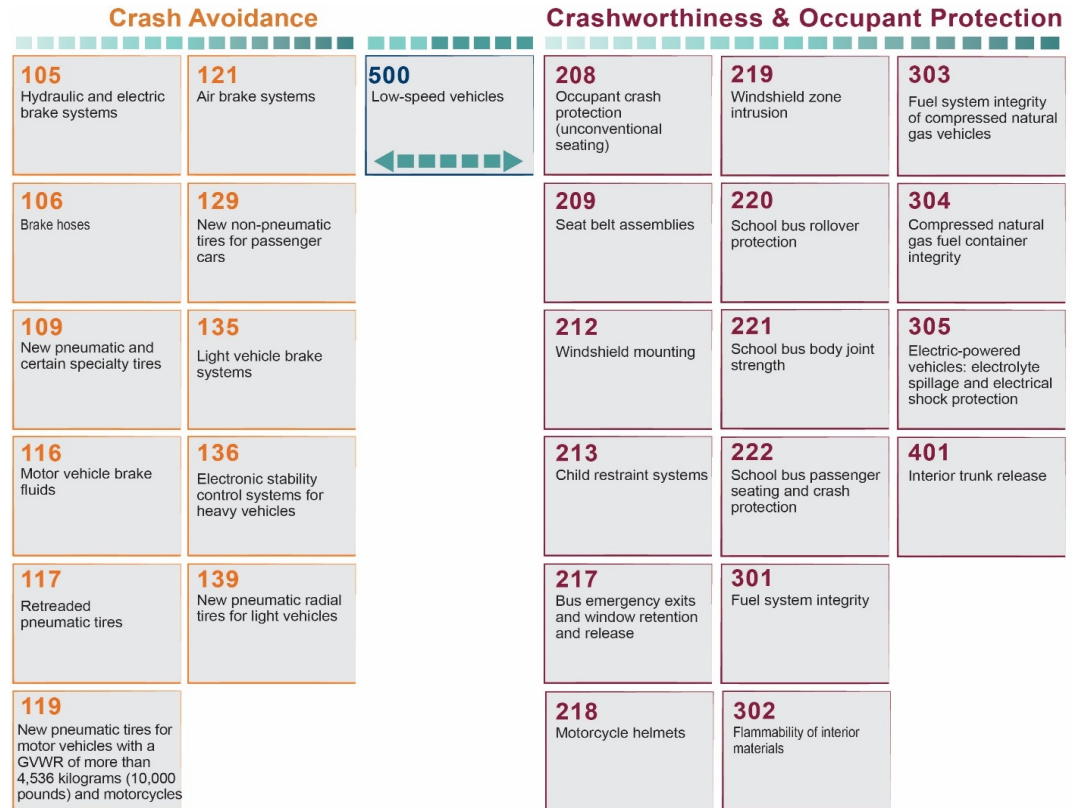


Test Method Considerations

FMVSS Covered in Volume 3

Focus Areas:

- Braking and heavy truck electronic stability control (ESC) standards
- Low-speed vehicles standard
- 300-series standards (post-crash)
- Unconventional seating considerations for occupant crash protection (FMVSS No. 208)



Unconventional Seating Technical Translation Scope: Volume 3

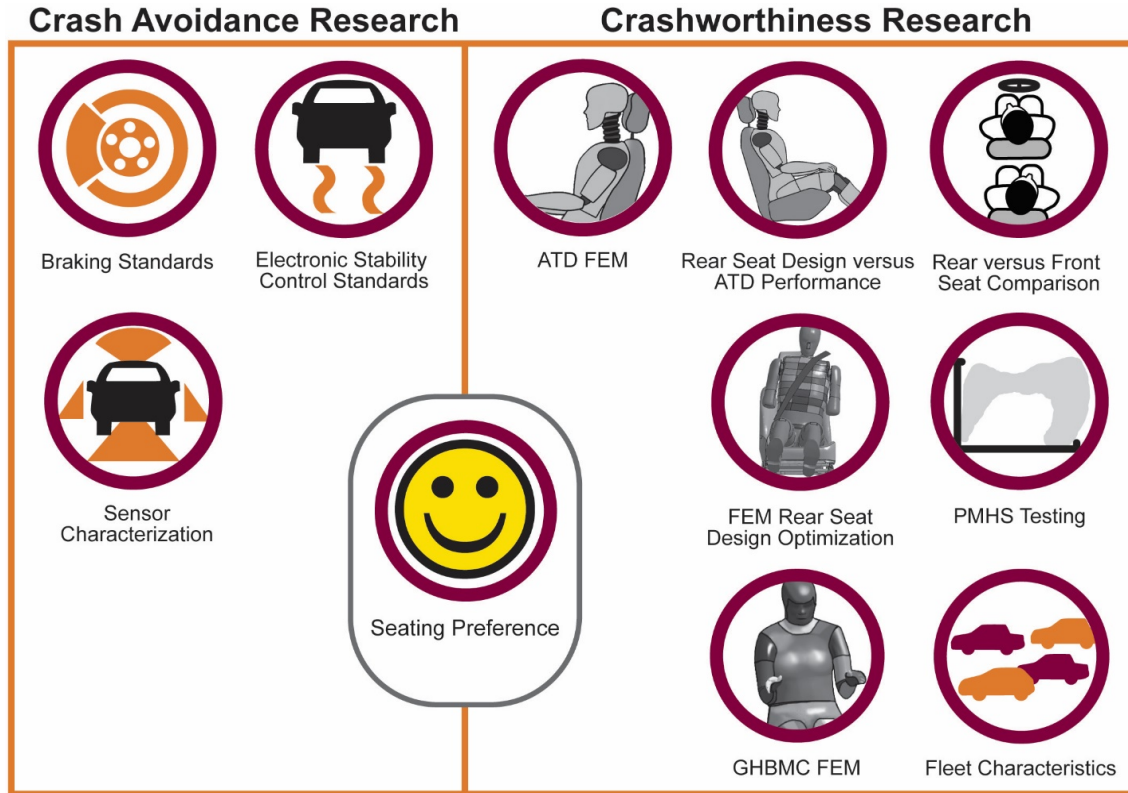
Stationary face-to-face designated seating positions were selected for initial technical translation of FMVSS No. 208 analysis:

- Maximizes use of conventional restraint systems
- Aligns with current research initiatives
- Offers the least amount of complexity



Unconventional Seating Illustration

Beyond Volume 3: Ongoing Research



Braking and ESC Standards

- Conduct FMVSS No. 135 evaluation of human (surrogate) and programmed control test methods and identify unique considerations:
 - Test requirements that may not be applicable to an ADS or may be outside the way the vehicle is designed to operate
 - What the ADS can't do and why not
- Evaluate alternate steering control inputs (e.g., road wheel angle) for test execution identified in FMVSS No. 126 Volume 2 technical translation options
- Assess implementation suitability of findings from FMVSS Nos. 135 and 126 for heavy vehicles (FMVSS Nos. 121 and 136)



Braking Standards



Electronic Stability Control Standards



Sensor Characterization

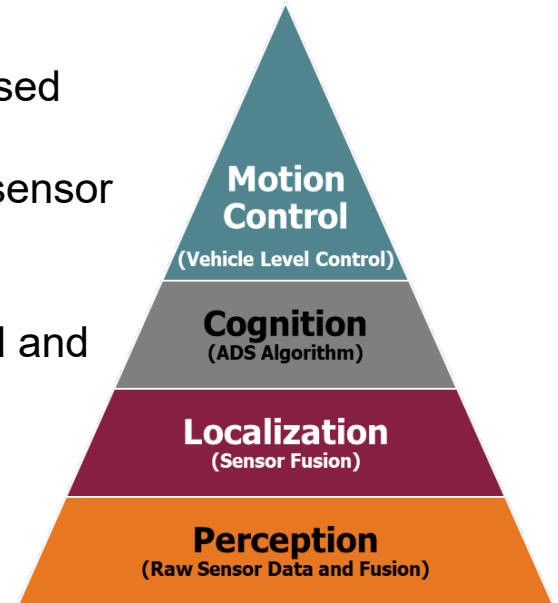


Sensor
Characterization



Explore sensor capabilities and evaluate and characterize critical sensor attributes by:

- 1) Surveying test procedures and measures used by industry
- 2) Identifying potential gaps in characterizing sensor performance
- 3) Measuring sensor performance
- 4) Evaluating methods to characterize nominal and degraded sensor performance for ADS applications



ADS Control Architecture

Occupant Protection and Crashworthiness

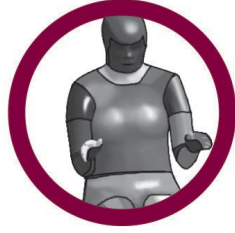
- Front seat bias was found to be a key consideration during the review of FMVSS No. 208 in Volume 2
- Research was initiated to explore the potential issues for future translations of crashworthiness regulations for occupants seated anywhere other than in the front row of an ADS-DV
- There are seven related areas that examine the expected incidence and outcomes of rear-seated occupants in an ADS-DV with conventional (forward-facing) seats including:
 - Developing dummy positioning procedures for rear-seated ATDs
 - Assessing candidate injury criteria for rear-seated occupants (PMHS testing)
 - Evaluating ATD performance for rear-seated occupants (sled testing and GHBMCM FEM)



ATD FEM



Rear Seat Design versus
ATD Performance



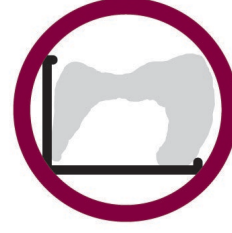
GHBMCM FEM



Rear versus Front
Seat Comparison



FEM Rear Seat
Design Optimization



PMHS Testing



Fleet Characteristics

Seat Preference



Explore occupants' **preferred seating** positions in an ADS-DV

Examine the prevalence of **seat belt use** in an ADS-DV

Consider how FMVSS **information** could be **communicated to occupants** and study if the information is understood



Seating Preference



Thank You

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- **Volume 1 Publication:**
https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/ads-dv_fmvs_vol1-042320-v8-tag.pdf

Contract No., DTNH2214D00328L
Task Order, DTNH2217F00177

