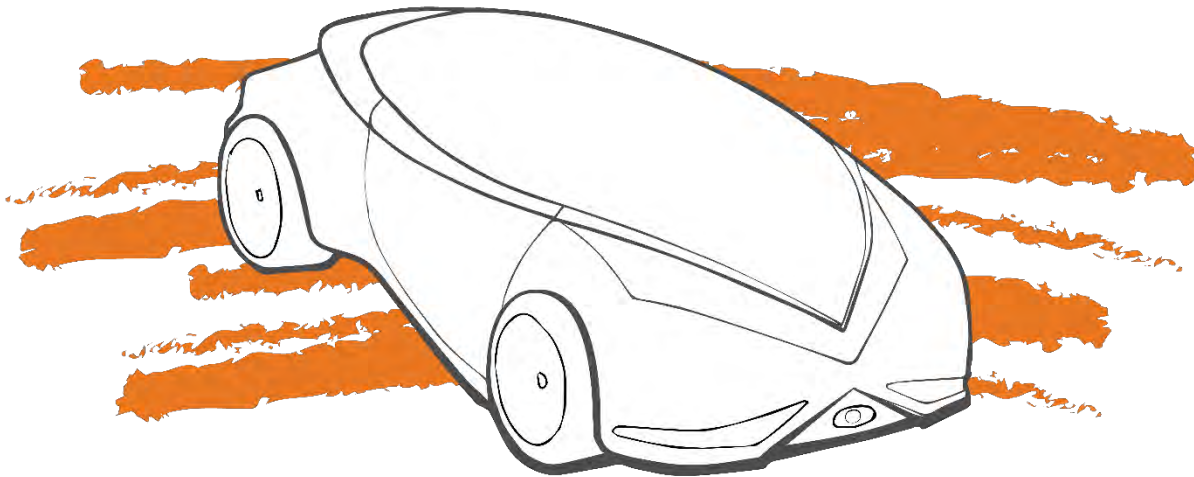


Stakeholder Meeting: FMVSS Considerations for Automated Driving Systems



WiFi Login Information

Network: MediaCntr_Net

Password: OpenHouse2018

Opening Remarks

Lori Summers, Interim Director
Office of Vehicle Crash Avoidance and
Electronic Controls Research, NHTSA

Project Remarks

Ellen Lee

Human Injury Research Division
NHTSA

Project Overview & Scope

Myra Blanco, Director

Center for Public Policy, Partnerships, and Outreach
VTTI

FMVSS Considerations for Automated Driving Systems

Project Overview

Stakeholder Meeting

November 28, 2018



Core Team

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Research Team Members

Industry Group



Research Institutions

Booz | Allen | Hamilton



Test Facilities



Stakeholder/ SME Reviewer Group



Mercedes-Benz



Volkswagen



WAYMO



Project Objectives

- Provide **research findings** that will help NHTSA make informed decisions regarding the **technical translations** of FMVSS and related test procedures.
- Identify **potential regulatory barriers** to the self-certification and compliance verification of innovative new vehicle designs that may appear in vehicles equipped with Automated Driving Systems (ADSs).

Project Scope

- Automated Driving System-Dedicated Vehicle (ADS-DV)
 - Vehicle designed to be operated exclusively by an SAE level 4 or level 5 ADS for all trips, and which is not equipped with manually operated driving controls.
 - Crash avoidance (100-series) considers bidirectionality
 - Crashworthiness/occupant protection (200-series) focus is conventional seating

Out of Scope

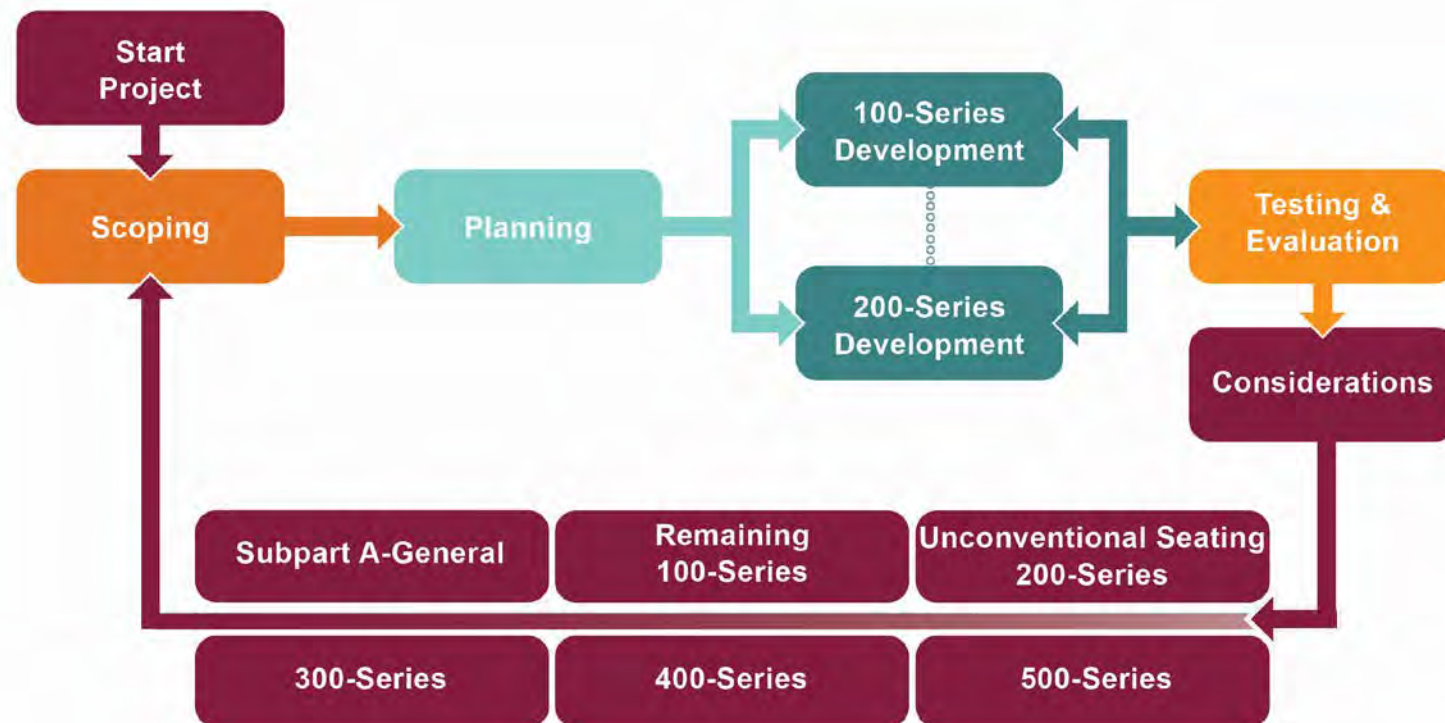
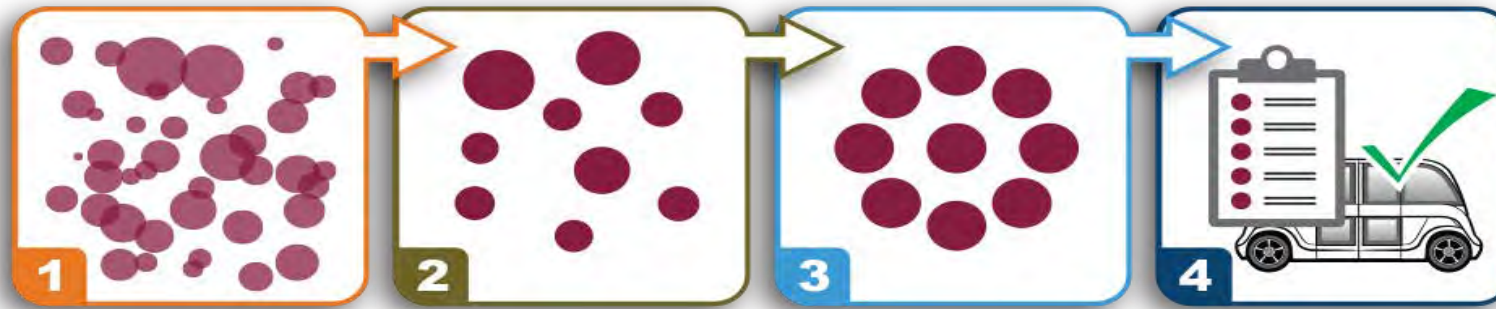
- Level 3 ADS-equipped vehicles (i.e., vehicles equipped with a user interface that permits operation by a human driver)
- ADS performance
- Bidirectionality for crashworthiness/occupant protection (200-series)

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

Approach



Performing Technical Translations

- Potential ADS-DV barriers indicating a need for translations were analyzed at three levels:
 - regulatory language,
 - implementation of test procedures, and
 - cited standards and/or laboratory test procedures incorporated by reference. The references of interest for the third level of analysis are those cited from other organizations or portions of 49 CFR outside of Part 571 – Federal Motor Vehicle Safety Standards.

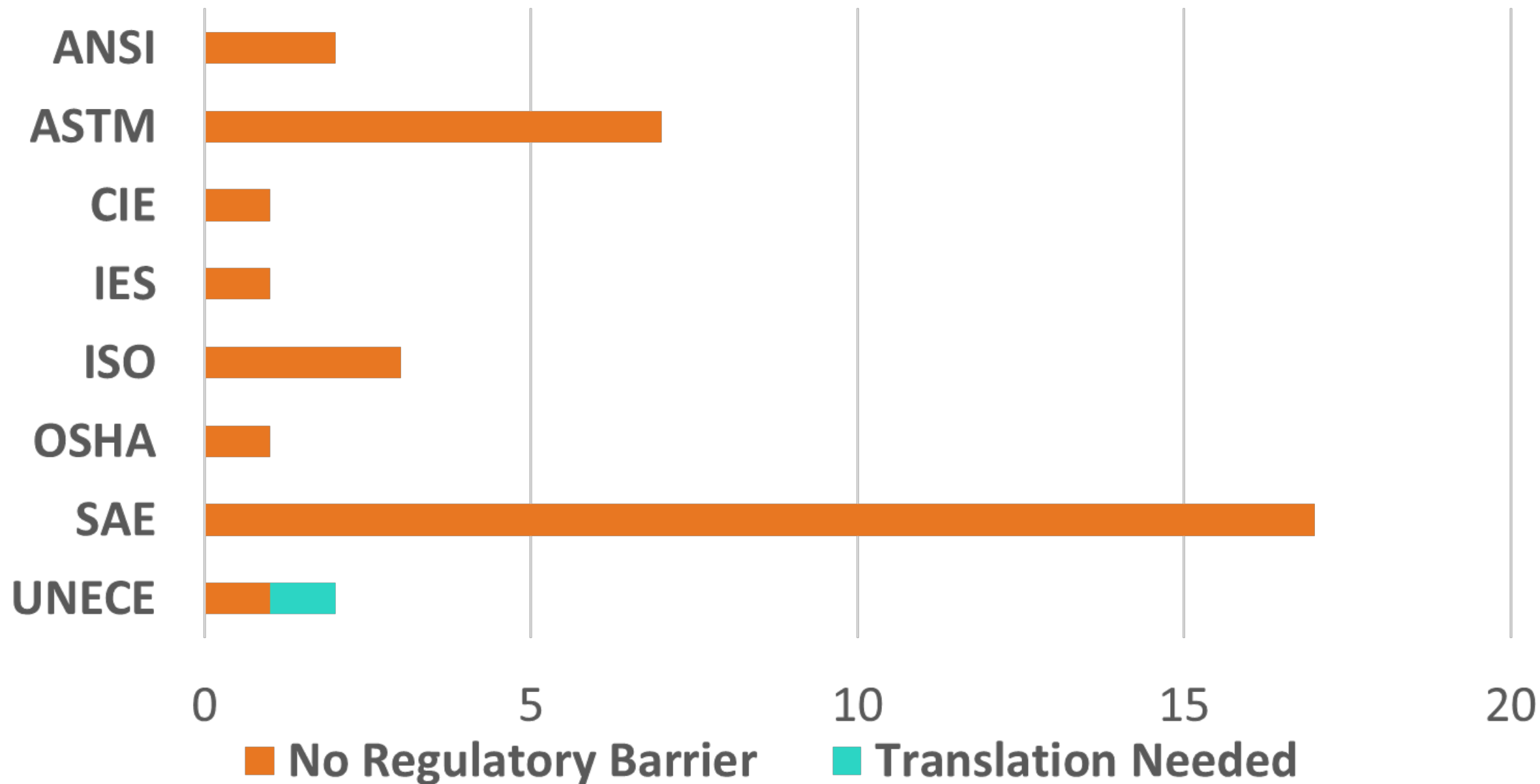
Incorporated Reference Analysis

Referenced Document	Section	Translation Assessment	Standard Status	Regulatory Barrier Identified
SAE J2009_199302 <i>Discharge Forward Lighting System</i>	S5.2, S11.3, S14.7.3.1.2	0—No Barrier	Superseded by SAE J2009_201608	None

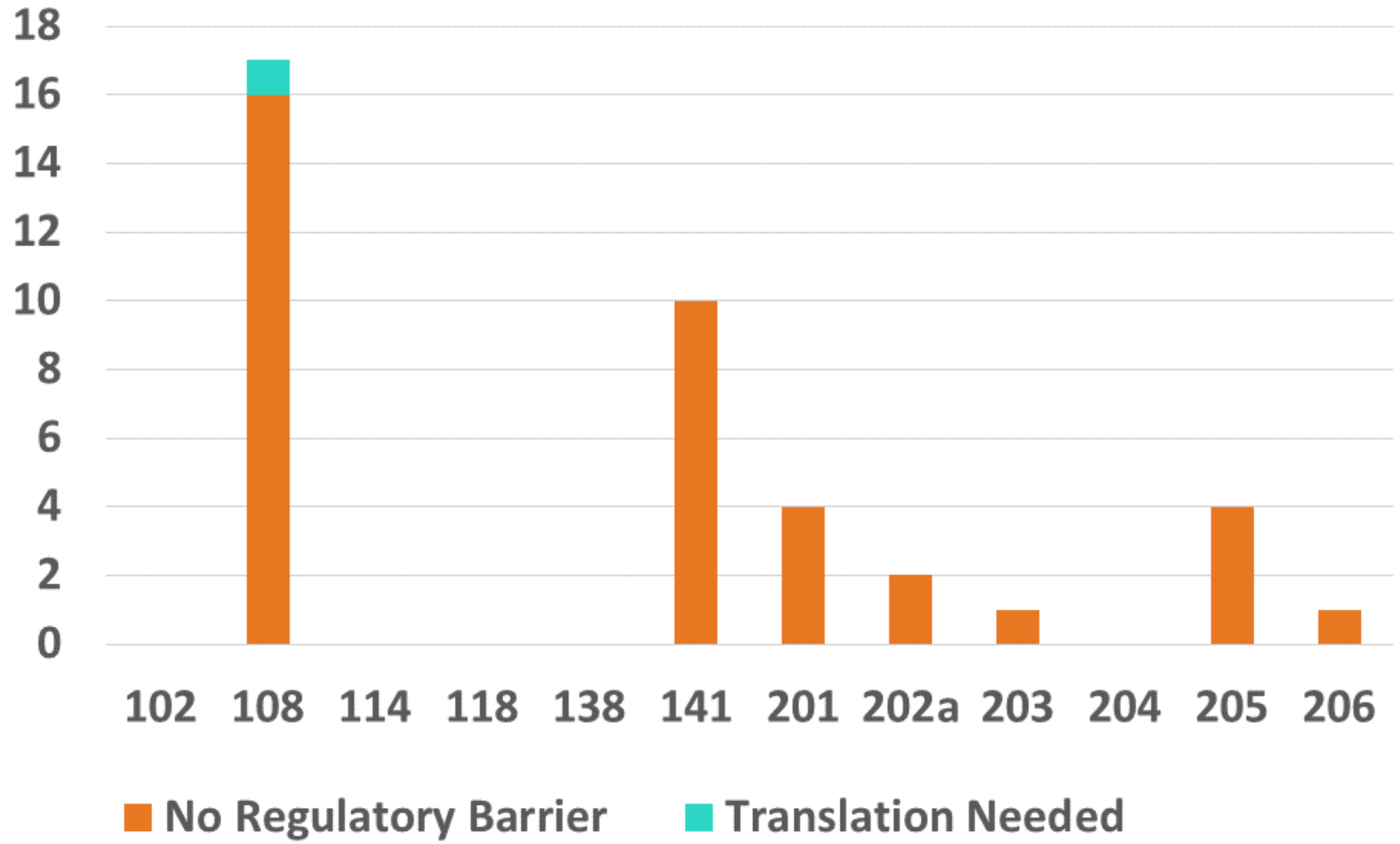
Incorporated Reference Analysis

Referenced Document	Section	Translation Assessment	Standard Status	Regulatory Barrier Identified
<p>Paragraph 5.14 of UNECE Regulation 48 page 17</p> <p><i>Uniform Provisions Concerning the Approval of Vehicles with Regard to the Installation of Lighting and Light-Signalling Devices</i></p>	S12.6	1–Translation is straightforward	Superseded by U.N. Doc. No. E/ECE/324/Rev.1/Add.47/Rev.12-E/ECE/TRANS/505/Rev.1/Add.47/Rev.12, ¶ 5.14 (2017)	Document refers to the switching of the headlamps from the driver's seat. May require translation to account for ADS control and clarification of the driver.

Incorporated Reference Analysis by FMVSS



Incorporated Reference Analysis by FMVSS



Concept Vehicle Framework

Entry/Egress

Doors
Key/Theft Protection
User Authentication

External Communication

Auditory Indicator
Exterior Illumination
Stop Lamps
Taillamps
Turn Signals
Wireless Intent Communication

Occupant Protection

Child Restraints & Anchorage System
Head Impact Protection
Head Restraints
Inflatable Restraints
Roof Crush
Seat Belts
Seating Configuration
Upper and Lower Extremity Restraints

User Communication

Mounted Displays
Minimal Risk Condition Activation
Portable Device Destination Input
Portable Device User Communication
Portable Device Window/Comfort Input
Safety Relevant Occupant
Communication

Vehicle Control

Accelerator/Brake Pedals
Bidirectional Vehicle Motion
Parking Brake System
Shifter
Speed Limiter
Steering Wheel
Tires

Visibility

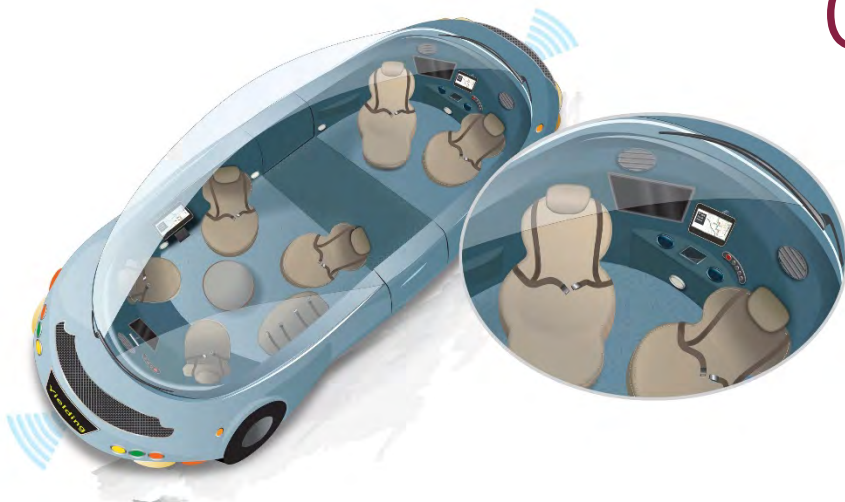
Headlamps
Hood/Trunk
Mirrors
Rear Visibility System
Sun Visor
Window
Window Defog/Defrost
Windshield
Windshield Wiper

■ Category

■ Vehicle Features



First Generation



Revolutionary

Four Research Concept Vehicles



Transitional



Low-Speed

Thank You!

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FMVSS Project Update Crash Avoidance

Presenters - Michelle Chaka, VTTI
Loren Stowe, VTTI

Definitions

Feedback from the April 2018 FMVSS Stakeholder Meeting

Several participants suggested that the project should not create new definitions for ADS-related terms, but rather incorporate definitions from SAE International's Recommended Practice J3016, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles* (SAE International, 2018).

Definitions

Based in part on those suggestions, the project has utilized the definitions in Recommended Practice J3016 for the following terms:

- Automated Driving System (ADS)
- Operational Design Domain (ODD)
- Dynamic Driving Task (DDT)
- Automated Driving System-Dedicated Vehicle (ADS-DV)

Note: The FMVSS technical translation options focused on a particular type of ADS-DV, a vehicle designed to be operated exclusively by an SAE level 4 or level 5 ADS for all trips, and which is not equipped with manually operated driving controls

Driver

As currently specified in 49 CFR § 571.3,

“Driver means the occupant of a motor vehicle seated immediately behind the steering control system.”

Driver

Potential Option 1

- 1) Driver means the occupant of a motor vehicle seated in the driver's designated seating position (DSP); or
- 2) the ADS, for ADS-equipped vehicles when the ADS is engaged. When the ADS is not engaged, the definition in paragraph 1) applies.

Option 1 incorporates the ADS into the definition of "driver."

Potential Option 2

Driver means the occupant of a motor vehicle seated immediately behind manually operated driving controls

Under Option 2, "driver" always refers to a human. The ADS, as defined by SAE International, would perform the driving of an ADS-DV and used independently from "driver".

Designated Seating Position (DSP)

As currently specified in 49 CFR § 571.3,

“DSP means a seat location that has a seating surface width, as described in section 571.10(c), of at least 330 mm (13 inches). . . .” Section 571.10 provides a method for calculating the number of DSPs based primarily on the width of the seat.

The term “DSP” may not need to be translated. However, the FMVSS 200-series standards often employ the term “driver’s DSP” and similar terms, such as “driver’s seat”.

Seating Positions and Driving Controls

The project team evaluated two sets of definition options for seating positions and driving controls. Each set includes a definition of

- driver's DSP,
- manually operated driving controls,
- steering control, and
- passenger DSPs.

Driver's DSP

(Driver's Seat or Driver's Seating Position)

Set 1

Driver's DSP means a DSP immediately behind the manually operated driving controls positioned such that an occupant can operate the manual driving controls, regardless of whether the occupant [or “he or she] is in active control of the vehicle.

Set 2

Driver's DSP means a DSP providing immediate access to the manually operated driving controls.

Manually Operated Driving Controls

Set 1

Manually operated driving controls means the system used by an occupant to manipulate the vehicle's lateral (steering) and/or longitudinal (acceleration and deceleration) motion in real time.

Set 2

Manually operated driving controls means:

- the system used by an occupant for real-time sustained manipulation of the motor vehicle's heading (steering) and speed (accelerator and brake);
- positioned such that they can be used by an occupant;
- regardless of whether the occupant is actively manipulating the vehicle's motion.

Steering Control and Passenger DSPs

The definitions of “steering control” and “passenger DSP” are the same for both Set 1 and Set 2.

Steering control (wheel) means the manually operated driving control used to manipulate the vehicle’s heading.

There are two options for the definition of passenger DSP (passenger seat or passenger seating position)

- A. *Passenger DSP* means any DSP other than the driver’s DSP.
- B. *Passenger DSP* means any DSP other than the driver’s DSP. Specifically, a seating position with stowed manually operated driving controls is a passenger seating position.

Bidirectional Vehicles

Definition

Bidirectional vehicle means an ADS-equipped vehicle without manually operated driving controls that can perform the DDT across an equivalent range of speed and heading control in two opposite directions.



Application

A new subsection (g) of section 571.7, or a new section 571.11 could be added as follows:

Each applicable standard set forth in Subpart B of this Part shall apply to bidirectional vehicles in both directions of travel.

Some of the inherent assumptions in the current standards that are addressed by the 100-series translation options

- a human driver is operating the vehicle
- lateral control of a vehicle is manipulated through a steering wheel
- application of an accelerator pedal is used to accelerate a vehicle
- application of a brake pedal is used to stop a vehicle
- a human driver is seating in the left, front DSP with established visibility sightlines
- illumination of telltales is needed to communicate vehicle conditions to a human “driver”
- a human driver is present to supervise such things as power window operation

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 rollaway 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

FMVSS Crosscutting Themes

Themes	101	102	103	104	108	110	111	113	114	118	124	125	126	138	141
Congressional Mandate							•		•	•				•	•
Controls, Telltales, Indicators, & Alerts	•	•			•				•				•	•	
Driver (Operator)	•	•	•	•	•		•		•		•	•	•	•	
Driver/Passenger Position/Presence	•	•				•		•	•	•			•		
Equipment May Not be Applicable					•		•		•						
Front/Rear of Vehicle			•		•	•	•								•
Service Brake Application		•			•	•			•				•	•	•
Shift Position (Gear, Selects, Reverse)		•	•	•	•		•		•						•
Vehicle Loading Including Test Driver and Instrumentation						•			•				•	•	•
Visibility			•	•	•		•	•							

Crash Avoidance

Translation Options Development Update

Not covered in the April Stakeholder Meeting:
FMVSS Nos. 110 and 126

Updated based on feedback from the April Stakeholder Meeting:
FMVSS No. 108 and 111

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
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Test Method Introduction

- Remove barriers associated with compliance verification
- Identify means and the associated considerations that could be utilized to verify compliance to the FMVSS
- Basic premise – there is something associated with the vehicle that may precludes verification of compliance as performed today

Possible Test Methods Being Evaluated

Vehicle based

Human control

Programmed control
of the ADS

ADS normal operation

Non-vehicle based

Technical Design
Documentation

Simulation

Identified Vehicle Functionalities

Theme	Functionality
Driving Task	Steering control
	Speed control (veh/eng)
	Service brake application
	Parking brake
	Gear selection
Vehicle Comm.	Telltales/ warnings/ indicators

Theme	Functionality
Key/Ignition Function	Key insertion/removal
	Ignition start/stop
	Accessory mode
Non-driving Tasks	Door open/close
	Non-driving controls
Environmental Awareness	Visibility

Classification for Purposes of Compliance Verification

FMVSS No.	Test Procedure	Specific Sequence	Driving Task	Test Methods*	FMVSS No.	Test Procedure	Specific Sequence	Driving Task	Test Methods*
101	No	No	No	n/a	114	Yes	Yes	Yes	HC, P, D
102	No	No	No	HC, D	118	Yes	Yes	No	HC, D, ADS(?)
103	Yes	No	Yes	HC, P, D	124	No	n/a	n/a	HC, P
104	Yes	No	Yes	HC, P, D	125	Yes	No	No	n/a
108	Yes	No	No	n/a	126	Yes	Yes	Yes	HC(?), P, ADS(?), S
110	Yes	No	Yes	HC, P, ADS(?)	138	Yes	No	Yes	HC, P, ADS, D
111	Yes	No	Yes	HC, P, ADS, D	141	Yes	Yes	Yes	HC, P, ADS, D
113	No	n/a	n/a	n/a					

* HC = human control; P = programmed; ADS = normal ADS operation; S = simulation;
D = documentation; n/a = current verification method may be adequate; (?) = may be possible

Test Functionalities for Purposes of Compliance Verification

Category	Functionality
Basic Driving	Steering control
	Speed control
	Service brake application
	Parking brake
	Gear selection
Vehicle State	Telltale/ warnings/ indicators/non-driving controls

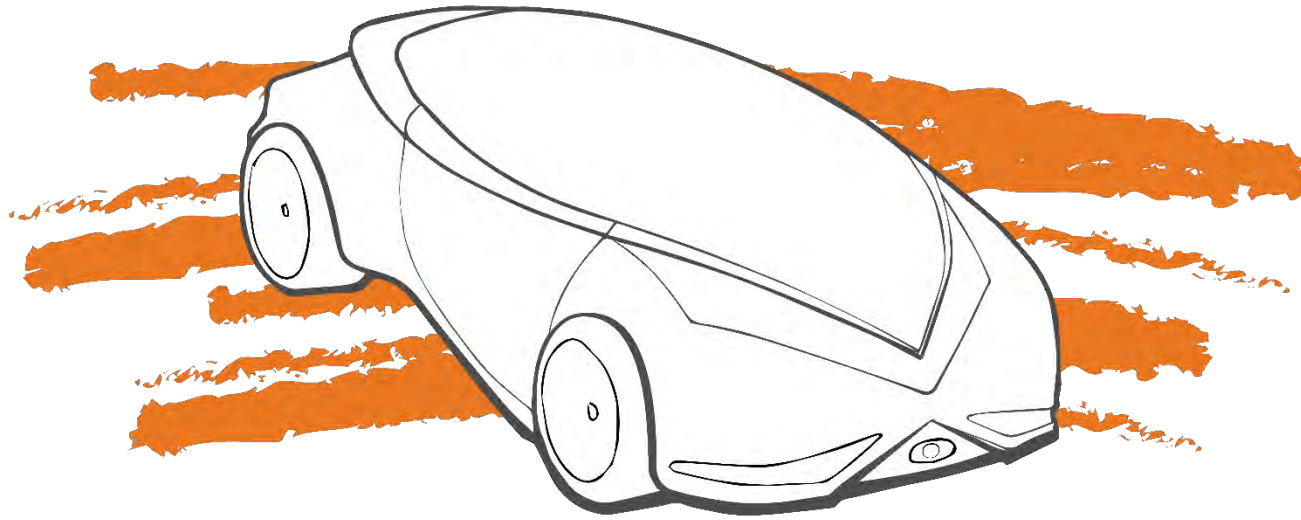
Category	Functionality
Accurate and Precise Control	Steering
	Speed
	Brake
Engine Idle	Engine speed
Visibility	Mirrors/camera

Functionality Based Test Matrix (Example)

Description		Comment	Output Record/display	Steering control general specific		Speed control (veh./eng.) general specific		Service brake general specific		Parking brake	Gear state	Ignition on/off
Theme Driving Task	Position vehicle at starting location	Manual control										
	Apply service brake	Assumes key in system						•				
	Start engine	Undefined sequence						•			•	•
	Shift transmission to drive		Transmission state								•	
	Release service brake		Brake state					•				
	Navigate to specified location and stop	Requires steering and braking control	Position tolerance x/y=1.5m	•	opt.	•	opt.	•			•	
	Apply parking brake		Parking brake state							•		
	Shift transmission to park		Transmission state								•	
	Release service brake		Brake state					•				
	Disengage parking brake	Shows control of service brake independent of ADS normal control	Parking brake state							•		
	Turn off engine		Parking brake state									•

Test Method Execution

Thank You



FMVSS Project Update Crash Avoidance

Stakeholder Meeting – Draft Project Status Update

Crashworthiness and Occupant Protection Update

FMVSS 200-Series Research Tasks

Warren N. Hardy

Research Objectives

- To support a potential translation of FMVSS No. 208 that would extend the standard to occupants seated behind the front seat.
- To help delineate the boundaries of potential issues to be encountered as a result of occupants being seated other than in the front row of ADS-DVs.
- To provide a framework for efficient decision-making going forward.

Research Rationale

- FMVSS 208 and New Car Assessment Program (NCAP) frontal tests do not include the evaluation of safety for rear seat occupants.
- The risk of injury in frontal collisions is higher for rear seat occupants than for front seat occupants, especially in newer vehicles and for older occupants.
- Occupants of ADS-DVs are likely to select a non-front-row seat, particularly in a rideshare environment, which could have considerable negative effect on injuries.
- For many novel seating arrangements, the second or rear row will contain the forward-most front-facing seats.

Research Specific Aims

- Answer the question, “What are the expected injury incidence and outcomes of rear-seated occupants in an ADS-DV with conventional (forward-facing) seats?”
- Evaluate/adapt candidate dummy positioning procedures for rear-seated ATDs for FMVSS 208 frontal crash testing.
- Assess candidate injury criteria for rear-seated occupants for FMVSS 208 frontal crash testing.
- Compare ATD and ATD FE model performance for rear-seated occupants for FMVSS 208 frontal crash testing.

Research Approach Overview

The five primary components of the research approach are

- 1) REAL-WORLD PROBLEM SCOPING
- 2) PLATFORM AND ATD MODELING AND VEHICLE SELECTION
- 3) TEST BUCK PREPARATION
- 4) ATD SLED TESTING
- 5) ANALYSIS AND RECOMMENDATION

PART 1: Real-World Problem Scoping

1.1 Quantify Rear-Seated Passenger Injury Incidence and Risk

Literature review

NASS/CDS/GES/FARS 2010-2015 study

1.2 Assess ADS-DV Occupant Seating Preference

Literature review

Industry partner consultation

1.3 Select Late-Model Vehicles Spanning a Range of Rear-Seat Safety Performance

Survey NCAP boneyard inventories

Select sedans, SUV/crossovers, and Minivans for inspection

Examine vehicles' package characteristics, restraint geometry, seatbelt routing

Establish a subset of vehicles for further examination via finite element modeling

PART 1: Real-World Problem Scoping

1.3 Select Late-Model Vehicles Spanning a Range of Potential Rear-Seat Safety Performance

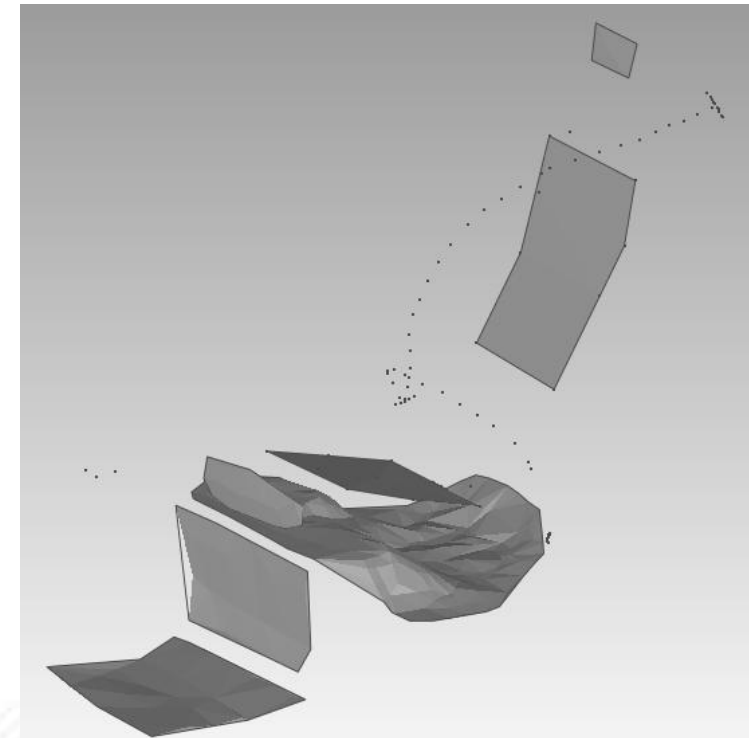


PART 1: Real-World Problem Scoping

1.3 Select Late-Model Vehicles Spanning a Range of Potential Rear-Seat Safety Performance

Down selection of approximately 10 vehicles for FE modeling

- Anchor location/spacing, retractor and D ring location
- Belt routing: seat and occupant interaction
- Floor pan topology
- Seat pan topology
- Retractor characteristics
- Seat stiffness and height
- Objective assessment of submarining potential
- Objective assessment of crash performance



PART 1: Real-World Problem Scoping

1.3 Select Late-Model Vehicles Spanning a Range of Potential Rear-Seat Safety Performance

Down selection of 5-7 vehicles for sled testing

- ATD modeling output of FMVSS No. 208 IARVs
- Lower neck loads and moments
- Lumbar or T12 loads and moments
- Lap belt submarining by the pelvis and shoulder belt escape by the shoulder and/or torso: provisional IARVs for the abdomen will be computed
Fmax (kN), Cmax (%), Fmax*Cmax (kN), Peak Penetration (mm),
Penetration Speed (m/s), Vmax*Cmax (m/s), and Peak V*C (m/s) - Seatbelt load will be used to approximate force on the abdomen
- Evaluation of existing FMVSS 208 requirements, submarining, compression

PART 2: Platform and ATD Modeling, and Vehicle Selection

2.1 Development of Simplified Vehicle Models

2.2 Simulation of Vehicle-Specific Frontal NCAP and Reduced-Energy Tests using ATD Models

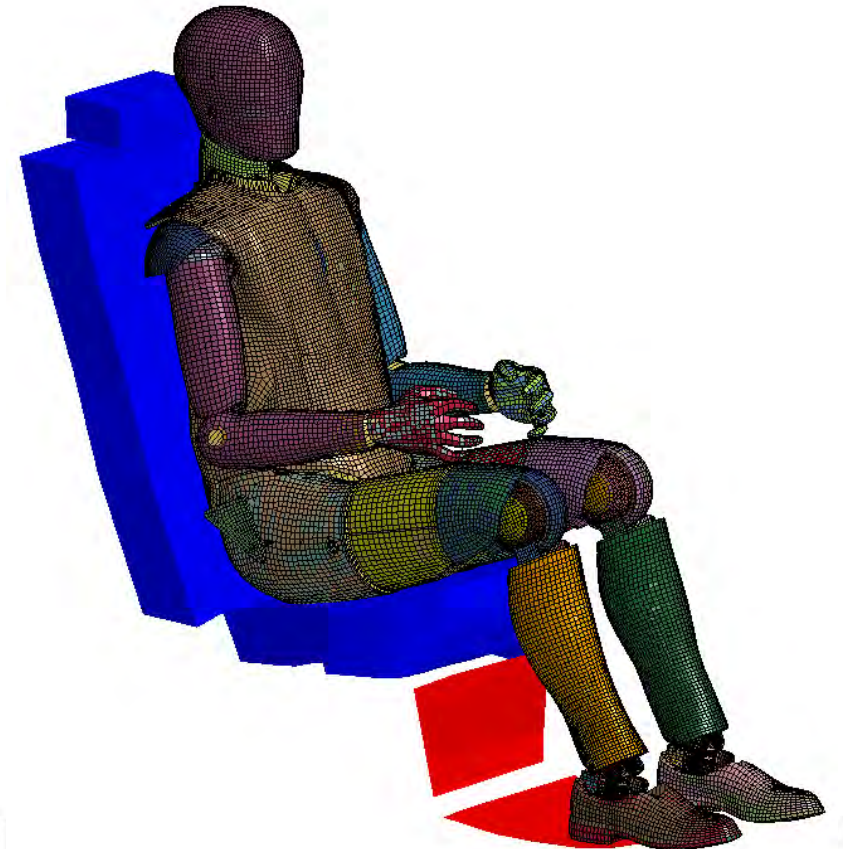
2.3 Assessment of the Relative Safety Performance of Simulated Vehicles

2.4 Selection of Vehicles to be used in Sled Testing

PART 2: Platform and ATD Modeling, and Vehicle Selection

2.1 Development of Simplified Vehicle Models

- Humanetics Hybrid III and THOR models
- Surfaces and points used to create vehicle elements
- Metal surfaces modeled as rigid structures
- Soft surfaces used to create mesh boundaries
- Soft materials modeled using material properties derived from stiffness information
- Belts and pretensioners modeled using generic components



PART 3: Test Buck (5-7) Preparation



PART 4: ATD Sled Testing

4.1 Determine ATD Positioning Procedures for Seating behind the First Row

4.2 Establish Methods to Assess Submarining in the ATDs

4.3 Conduct Paired ATD Sled Tests using up to Seven Vehicle Bucks and Two Speeds

4.4 Assess Relative Vehicle Platform Safety Performance for Rear Seats

- Evaluate metrics
- Compare ATDs to FE
- Summarize findings

Part 5: Analysis and Recommendation

- One-half of the vehicles have been selected
- FE modeling continues
- Testing to start December 2018

Contact: Warren N. Hardy (whardy@vt.edu)



Crashworthiness and Occupant Protection Update

FMVSS 200-Series Language Translation

Joshua G. McNeil

Translation Strategy

Foundation of Translation Strategy for 200-series are the Section 571.3 definitions:

- Driver Designated Seating Position
- Manually Operated Driving Controls
- Steering Control
- Passenger Designated Seating Position

Translations for all 200-Series standards have been provided

New definitions in Section 571.3 for Driver Designated Seating Position and associated terms greatly simplify translations

Test Procedure: Current translation of FMVSS 200-series involves mirroring the passenger/right side testing to the left side when there are no controls

- No additional test procedure development for translations

Translation Strategy

- FMVSS do not require a driver's DSP
 - Only exception – S.1 of FMVSS No. 207, which will be removed in mid-term research
- Several FMVSS specify requirements if a Driver's DSP is present as steering controls at Driver's DSP may increase crash injury risk for occupant seated at this location.
 - Manufacturers can choose whether to have a Driver's DSP
 - If there is a Driver's DSP, vehicles must meet FMVSS requirements for Driver's DSP (e.g., FMVSS Nos. 203 and 204)
 - If there is no Driver's DSP, these FMVSS requirements would not apply
- This approach greatly simplifies translations

200-Series Crosscutting Themes

Themes	201	202a	203	204	205	206	207	208	210	214	216a	219	222	225	226
Assumes Front Row is Preferred Seating Position	•	•	•	•		•		•		•					
Controls, Telltales, Indicators, and Alerts						•		•							•
Driver (Operator)	•	•	•		•	•	•	•		•	•		•	•	•
Driver/Passenger Position/Presence	•	•				•	•	•		•	•		•	•	•
Dummy Positioning	•	•						•		•					
Equipment May Not Be Applicable			•	•											
Front/Rear of Vehicle	•	•				•	•	•		•	•	•	•	•	•
Congressional Mandate								•							

Potential Considerations

Consideration 1: Some translation options would modify the requirement for non-ADS-equipped vehicles as well as ADS-equipped vehicles.

Example: Definition of “A-Pillar” in FMVSS No. 201, Occupant Protection in Interior Impact

- Current definition: “any pillar that is entirely forward of a transverse vertical plane passing through the seating reference point of the driver's seat”
- One translation option is to revise this to read “...passing through the seating reference point of any front passenger seat”
- May have little effect on how manufacturers comply with FMVSS 201 standard. However, the change would affect both conventional vehicles and ADS-DVs

Potential Considerations

Consideration 2: Some specific landmarks for FMVSS 200-series crash test dummy positioning may not exist in an ADS-DV, such as the center of the steering wheel.

Approach: Ensure that these driver-centric dummy positioning procedures only apply if there is a driver's DSP.

- For vehicles without a driver's DSP, the procedure would involve mirroring the dummy positioning at the front right DSP to the positioning at the front left DSP.

Potential Considerations

Consideration 3: Translation of requirements for telltales

Example: FMVSS No. 206 specifies a requirement that the driver be notified if a limited number of specified doors (side doors with rear-mounted hinges and certain sliding side doors) are unlatched.

- If there is no human driver, the question arises as to who should be notified if one of the doors covered by this requirement is not properly latched.
- Stakeholders raised the issue of what action(s) should be taken by the ADS in an ADS-DV in response to such a warning.

Potential Considerations

Consideration 4: The apparent front seat bias of some FMVSS (i.e., the fact that air bags are required for front outboard DSPs but not for the rear seats) will be considered in mid-term research, but also appears in FMVSS No. 201 rigid pole crash test which only tests a dummy positioned in the front seat.

- Front and rear seat occupancy rates may change in ADS-equipped vehicles.
- If front and rear seat occupancy rates are found to substantially change with the advent of ADS-DVs, crash testing requirements may need to be revisited for conventional seating.
- If front and rear seat occupancy rates remain similar between vehicles with and without ADS, translation of front/rear references for ADS-equipped vehicles with conventional, forward-facing seating is straightforward, but could be revisited in FMVSS 200-series translations for rear-facing seating configurations.

FMVSS No. 201: Occupant Protection in Interior Impact

Purpose: Reduce risk of injury in impacts with interior components

Translation Strategy

Reframe regulatory language in terms of DSPs rather than occupant roles (e.g., “driver” or “passenger”)

Translate vehicle landmarks from “driver” or “passenger” to “left” or “right”

- Another translation is “driver’s seat” to “any front seat,” though this would modify the definitions for conventional vehicles as well as ADS-equipped vehicles
- Some options omit sun visors in some cases. Omitting this requirement for ADS-DVs will require further translation for these vehicles in other standards that reference sun visors, such as FMVSS No. 208, which requires warning labels to appear on the visor or on the dashboard.

FMVSS No. 201: Occupant Protection in Interior Impact

Test Procedure

Translation Strategy: Reframe the regulatory language in terms of DSPs rather than occupant roles, such as a “driver” or “passenger”

The dummy positioning for FMVSS No. 201 dynamic pole test involves mirroring the passenger/right side testing to the left side when there are no controls. No additional test procedure development for translation.

Stakeholder and Subject Matter Expert (SME) Review Input

Consensus was that conventional seating should be considered first.

The candidate definition of driver’s DSP was well-received (simpler translations were preferred).

FMVSS No. 206: Door Locks and Door Retention Components

Purpose: Prevent inadvertent door opening during operation by notifying driver. Would allow driver to prevent operation without latching all doors.

Translation Strategy

Reframe regulatory language in terms of DSPs rather than occupant roles (e.g., “driver” or “passenger”)

Translate vehicle landmarks from terms such as “driver” or “passenger” side to “left” or “right” side

FMVSS No. 206 specifies that the driver be notified if side doors with rear-mounted hinges (or certain sliding side doors) are unlatched. Possible actions:

- Options considered included notifying the left front outboard seat, any front row seat, or any designated passenger seating positions if the driver’s DSP is not occupied, and only communicating the information to the ADS.

FMVSS No. 206: Door Locks and Door Retention Components

Test Procedure

Reframe regulatory language in terms of DSPs rather than occupant roles (e.g., “driver” or “passenger”)

Translate vehicle landmarks from terms such as “driver” or “passenger” side to “left” or “right” side

Stakeholder and SME Review Input

Strong differences of opinion on telltales among stakeholders and SME reviewers. With regard to the question, “Are telltales just to make the driver aware, or is there the expectation of safety?” there were two positions with little agreement:

- Position 1: Just make the driver aware of the issue (e.g., a door is unlatched)
- Position 2: There is a need to assure that someone or something takes action in response to the information conveyed by the telltale

FMVSS No. 208: Occupant Crash Protection

Purpose: Reduce both the frequency and severity of injuries sustained in impacts/crashes by specifying crashworthiness requirements in terms of forces and accelerations measured in test crashes

Translation Strategy

Several references to driver and passenger seat

- Translate to any front outboard seat

FMVSS No. 208 requires a readiness indicator for the occupant protection system which is clearly visible from the driver's DSP.

- Translation options include visible from any front outboard seat, any DSP
- Feedback: For non-ADS-equipped vehicles, leave as is. For ADS-equipped vehicles, translate to all front outboard seats

FMVSS No. 208: Occupant Crash Protection

Test Procedure

Translations of the test procedures are not necessary, since they do not distinguish between the two front outboard seating positions

Stakeholder and SME Review Input

Airbag warning label on the sun visors will require a new location if vehicles are no longer required to have sun visors

Seat belt warning should be provided to all occupants

Unbelted tests should be removed from FMVSS No. 208

Seatbelt interlocks will become necessary for ADS-DVs where there is no driver responsible for seat belt usage. This will be especially true where children could ride an ADS-DV without adults. Therefore, seatbelt interlocks should be researched further and required for ADS-DVs. With a reliable and defeat-free interlock, unbelted tests will not be required.

FMVSS No. 214: Side Impact Protection

Purpose: Reduce both the frequency and severity of injuries sustained in side impacts/crashes by specifying strength requirements for side doors, limiting the measured forces, deflections and accelerations, etc.

Translation Strategy

Reframe the regulatory language in terms of DSPs rather than occupant roles (e.g., “driver” and “passenger” to “any front outboard”)

Translate vehicle landmarks from terms such as “driver” or “passenger” side to “left” or “right” side, respectively

Include statements such as “if present” to exclude ADS-DVs without manual steering controls

FMVSS No. 214: Side Impact Protection

Test Procedure

Translate landmarks from “driver” or “passenger” to “left” or “right” (e.g., driver air bag)

Reframe regulatory language in terms of DSPs rather than occupant roles (e.g., “driver” or “passenger”)

State “if present” to exclude ADS-DVs without manual steering controls

Stakeholder and SME Review Input

Agreed with translation of driver’s and passenger seats to front outboard seats.

ADS-DV may change the traditional occupancy positions such that more adults may sit in the rear. Research should be conducted to identify if applying the pole requirements to the rear rows, if justified.

If the traditional “driver’s” seat no longer has controls, the test may require a 5th percentile female dummy in the front seat.

FMVSS No. 216a: Roof Crush Resistance

Purpose: Reduce both the frequency and severity of injuries sustained by roof crush in rollovers

Translation Strategy (including test procedures)

Translate vehicle landmarks from terms such as “driver” or “passenger” to “left” or “right” (e.g., driver and passenger sill in S7.1 translated to left and right sill)

Reframe the regulatory language in terms of DSPs rather than occupant roles, e.g., “driver” or “passenger”

Stakeholder and SME Review Input

Sensors and housings could be included as non-structural components to remove in S7.1 (Currently states “Remove roof racks or other non-structural components”)

FMVSS No. 226: Ejection Mitigation

Purpose: Reduce the likelihood of occupant ejection through side windows during rollovers or side impacts

Translation Strategy

Reframe regulatory language in terms of DSPs rather than occupant roles (e.g., driver's compartment)

FMVSS No. 226 specifies a readiness indicator for the monitoring system be visible from the driver's designated seating position. Possible actions:

- Visible to driver's DSP, and any DSP if driver's DSP is not occupied or present
- Visible to driver's DSP, and any front DSP if the driver's DSP is not occupied or present
- Visible to the front left outboard designated seating position
- Visible to driver's DSP. For vehicles without a driver's DSP, the indicator shall monitor its own readiness and shall provide an input to the ADS indicating the underlying condition.

FMVSS No. 226: Ejection Mitigation

Potential Considerations

Some indicator options expand applicability or may not ensure the warning will be received by any occupant

Stakeholder and SME Review Input

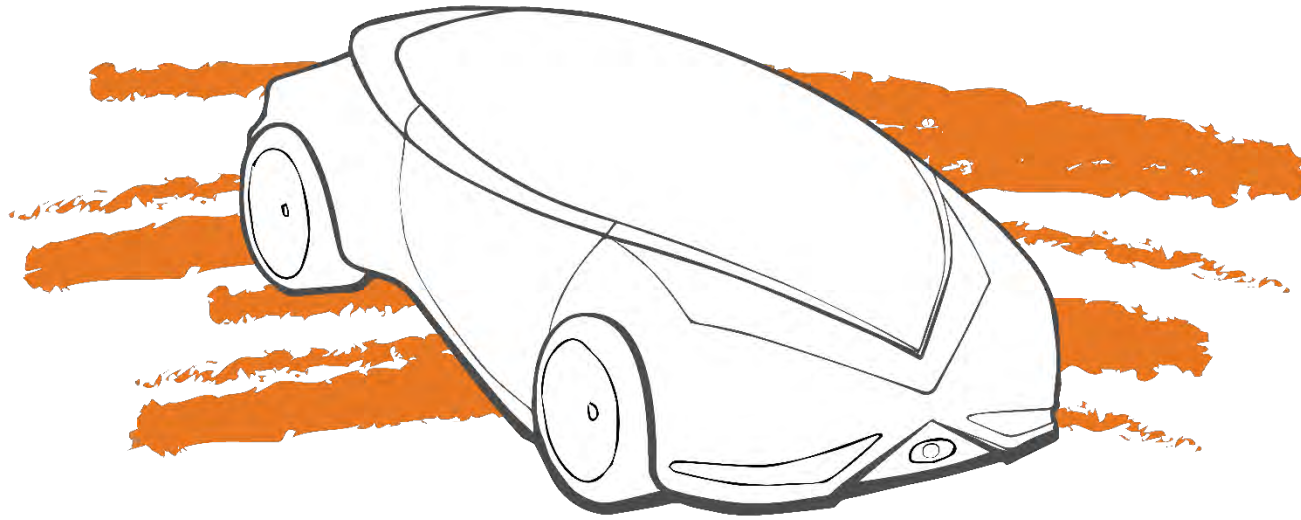
Discussions for what information should be displayed to occupants and what information is available to service technicians, etc.

Questions



Contact: Joshua G. McNeil (jgmcneil@vt.edu)

Thank You



FMVSS Project Update Crashworthiness/Occupant Protection

Analysis of Regulatory Information Communicated in an ADS-DV

Presenter - Michelle Chaka, VTTI

Analysis of Regulatory Information Communicated in an ADS-DV

Telltales, indicators, and audible alerts are designed to convey information to the driver and, in rare instances, to other occupants of a vehicle.

- A number of standards require telltales, indicators, and/or alerts, and some of the standards specify performance requirements for those features.
- FMVSS No. 101, “Controls and Displays,” specifies requirements for location, identification, color, and illumination of motor vehicle controls, telltales and indicators.”
- These requirements are intended to assist the driver; e.g., S5.1.2 specifies:

“The telltales and indicators listed in Table 1 and Table 2 must be located so that, when activated, they are visible to a driver”

Analysis of Regulatory Information Communicated in an ADS-DV

Objective

- identify standards that require telltales, indicators, or alerts;
- determine the “expected response” of a driver and/or occupant(s) to these features today;
- present options for translations; and
- identify the consideration associated with the translation options.

Analysis of Regulatory Information Communicated in an ADS-DV

Development of Translation Options

- An analysis of the expected response to each of the telldates, indicators, and alerts was conducted using
 - regulatory text,
 - regulatory history, and
 - NHTSA interpretations.
- When no FMVSS-related source was found, language from owner's manuals and/or common sense was considered.

Analysis of Regulatory Information Communicated in an ADS-DV

Information Communicated:

- **what is communicated; what type of communication**
- Ex: engaged, warning, malfunction, identification

Delivery Method

- **how information is delivered**
- Ex.: illumination of a telltale, auditory alert, indicator

Intended For

- **whom the information is for**
- Ex.: driver, non-driving occupants, maintenance entity

Expected Response

- **action expected in response to information**
- Ex.: after a low tire pressure warning is activated, someone is expected to check the tire(s) and take appropriate action

Analysis of Regulatory Information Communicated in an ADS-DV

FMVSS	Component	Information Communicated	Delivery Method				Intended For			Expected Response (after receiving the information)	Considerations			
			Symbol	Telltale	Auditory Alert	Indicator	Human Driver	Passengers	Maintenance Entity		ADS	Occupant(s)	Maintenance Entity	Observations
108	High Beam	Identification and status	X	X			X			Proper control high beam operation	?	-	-	Indicator reminds the human driver of their selection. However, occupants may want to see the exterior environment. This is beyond the current regulatory scope.
108	Turn Signal Pilot Indicator	Identification and status	X	X	X		X			Confirm proper turn signal operation	X	-	-	Indicator reminds the human driver of his or her turn signal selection. Occupants may want to know the future direction of the vehicle. However, this is beyond the project scope.
108	Turn Signal Pilot Indicator	Lamp Failure	X		X	X	X		X	Check for burned out bulb and replace if necessary	X	?	?	Assuring that failed turn signal bulbs are replaced is beyond the project scope.

Analysis of Regulatory Information Communicated in an ADS-DV

FMVSS	Component	Information Communicated	Delivery Method				Intended For			Expected Response (after receiving the information)	Considerations			
			Symbol	Telltale	Auditory Alert	Indicator	Human Driver	Passengers	Maintenance Entity		ADS	Occupant(s)	Maintenance Entity	Observations
108	Vehicular Hazard Warning Pilot Indicator	Identification and status	X	X	X		X			Confirm proper operation of the vehicular hazard warning signal	X	?	?	Non-driving occupants may want to be able to activate the vehicular hazard warning signal. Under current FMVSS No. 108, the control must be operable by the driver. However, in many vehicles, all front seat occupants can activate the hazard warning signal.
108	Light Activation	Identification	X				X			Verify proper lighting system operation	?	-	-	Indicator reminds the human driver of his or her selection.

Analysis of Regulatory Information Communicated in an ADS-DV

Potential options for translation of provisions that specify to whom or where a telltale, indicator, or alert is directed in ADS-DVs

1. To the ADS only
2. To the ADS and an occupant compartment maintenance panel
3. To the ADS and provide per the current standard location
4. To the ADS and other DSP(s) as specified by the vehicle manufacturer
5. To the ADS and all DSPs
6. To the occupants per the current standard location and not to the ADS
7. To the occupants as specified by the vehicle manufacturer
8. To all DSPs and not to the ADS
9. To no entity: not communicated to the ADS or occupants (e.g., human driver reminders)

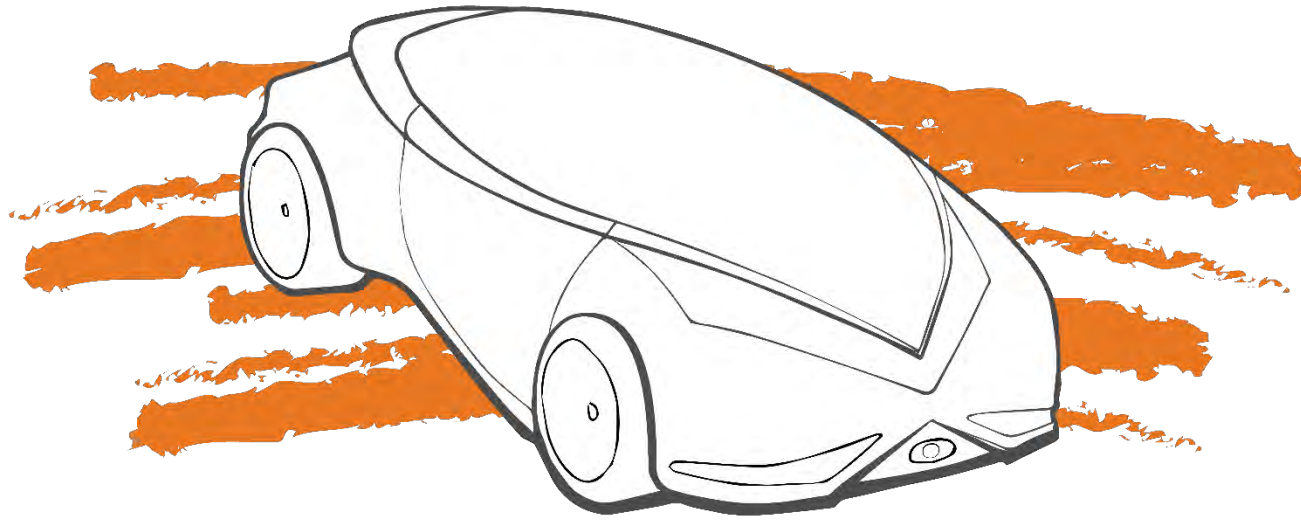
Analysis of Regulatory Information Communicated in an ADS-DV

Not all of the options were applied in the translation of each standard; selections were made based on the standard's safety purpose along with the results of the four areas of research identified earlier.

Example

- Option 1 (To the ADS only) was not used in the translation of the passenger air bag deactivation light
- FMVSS No. 208 provides that the telltale, “Shall be visible and recognizable to a driver and right front passenger during night and day when the occupants have adapted to the ambient light roadway conditions” (S19.2.2 (e))

Thank You



Analysis of Regulatory Information Communicated in an ADS-DV

ADS-DV Implications of Passenger Seating (H-point) and Vision (Eyellipse)

Presenter - Larry Smythe,
Nissan Technical Center NA

Outline

1. Overview
2. J826:201011 H-pt Background
3. SAE J941:2010 Eyellipse Background
4. Automated Vehicle Passenger Seating & Vision
5. Passenger Control Icons & Information Displays
6. Summary

Overview

Today's discussion primarily focuses on the SAE tools and procedures for understanding Passenger Seat H-pt (SAE J941:201003) and Vision (SAE J941:2010) for....

- Passenger Fixed Seats
- Passenger Minimum Fore / Aft Adjustment Seats
- Measurement Considerations for Passenger Controls and Information Displays

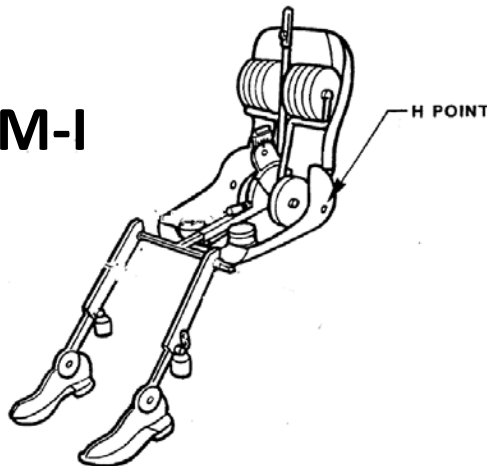
J826:201011 H-pt Background

SAE J826:2010 This SAE Standard defines passenger compartment dimensions using a deflected seat as described in SAE J1100:200911.

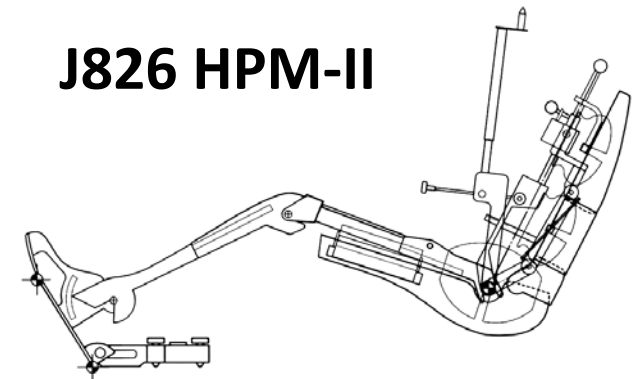
- Intended applications are seated driver or occupant accommodation spaces and DO NOT measure or indicate occupant capabilities or comfort.

SAE J826:201011 establishes Driver H-pt (Driver / Occupant Hip Trochanter). This is the origin point for many SAE workspace tools such as SAE J941 Eyellipse.

J826 HPM-I



J826 HPM-II



SAE J941:2010 Eyellipse Background

SAE J941:2010 was originally created to describe *Driver's Eye Locations* with fore / aft seat adjustments less than 133mm or greater than 133mm.

Fixed seat Eyellipses (passenger seats) apply to seated positions with no H-point or torso angle adjustment and the Eyellipse centroid is located relative to the fixed seat H-point (SgRP).

The only vehicle factor affecting location of the fixed seat Eyellipse is the torso angle; A40 and other seat adjustments are assumed fixed at the manufacturer's design specifications.

However

Automated Vehicle Passenger Seating and Vision

Passenger Seats with Limited H-Point Adjustment

From J941 MAR2010, p.24:

“If a 2nd or succeeding row seat has fore/aft H-point adjustment, with a back angle that is either fixed or adjustable, *there are no field data available on which to base a procedure for selecting or locating an eyellipse (Fixed Seat)*. Until such data are available, select the 95% fixed seat eyellipse, locate it from the manufacturer’s SgRP and torso angle, and then sweep the eyellipse along the range of normal riding fore/aft seat adjustment. The swept volume defines the range of rider eye locations. If the manufacturer’s SgRP or torso angle is unknown, use the rearmost, lowest normal riding position and a torso angle of 25 degrees.”

Automated Vehicle Passenger Seating and Vision

Fixed Seat Eyellipse **Without**
Fore / Aft Seat Track Movement

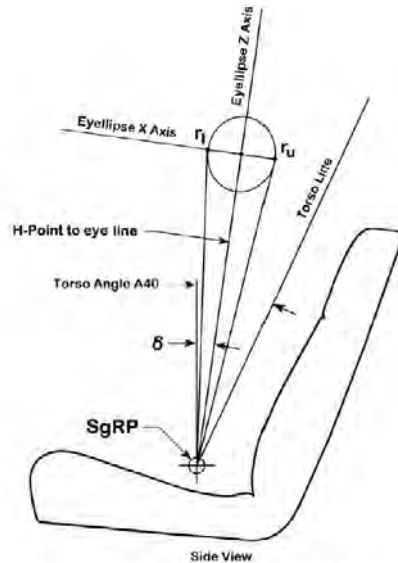


FIGURE C1 - FIXED SEAT EYELIPSE SIDE VIEW, (X, Z) AXIS AND AXIS ANGLE, δ

Fixed Seat Eyellipse **With Minimum**
Fore / Aft Seat Track Movement
Possible Solution **Intended Method**

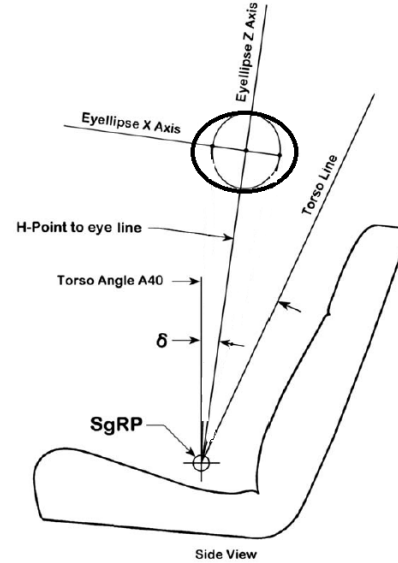


FIGURE C1 - FIXED SEAT EYELIPSE SIDE VIEW, (X, Z) AXIS AND AXIS ANGLE, δ

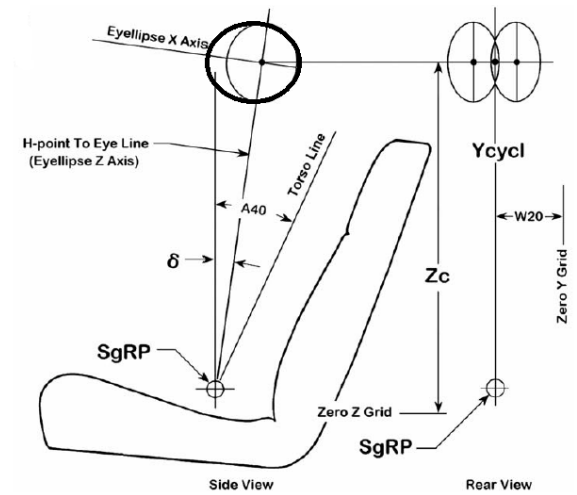


FIGURE B1 - FIXED SEAT EYELIPSE SIDE VIEW AXIS ANGLE AND CENTROID LOCATION

J941 does not define which one, or if both, of these solutions is correct

Unanswered Question

- SAE J941 is clear for Fixed Seats. However, as Seat Track Travel Increases and height adjustments are provided, the Passenger Seat Eyellipse probably starts to resemble the Driver's Eyellipse.

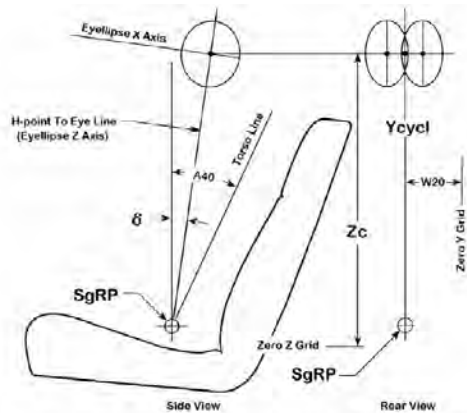


FIGURE B1 - FIXED SEAT EYELIPSE SIDE VIEW AXIS ANGLE AND CENTROID LOCATION

Passenger Fixed Seat

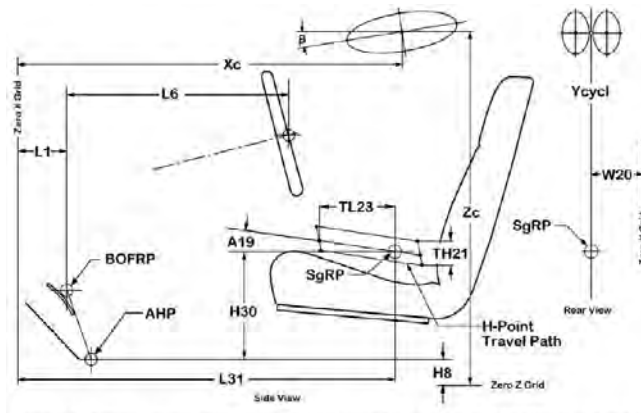


FIGURE 5 - EYELIPSE PACKAGE FACTORS, SIDE VIEW AXIS ANGLE, AND CENTROID LOCATION

Driver Adjustable Seat

Conclusion: New Definitions and Measurement Methods to locate the H-pt and Eyellipse for Passenger Seats with more than 'Minimum' Fore / Aft Adjustment are required

Passenger Control Icons and Information Displays

Readability Measurement Method Considerations

SAE and ISO Vision measurements are based on Driver's Adjustable Seat and Passenger Fixed Seat Eyellipse (SAE J941:201003 and ISO 4513:2010)

- The Eyellipse and associated SAE & ISO standards provide common measurement methods for vision attributes such as graphic sizes as a function of viewing distance and viewing angle.
- Measures that use the Eyellipse include, but are not limited to, projected and emitted graphics color contrast, Head-up Display fields of view, display readability in the presence of glare, and display luminance.

Passenger Control Icons and Information Displays

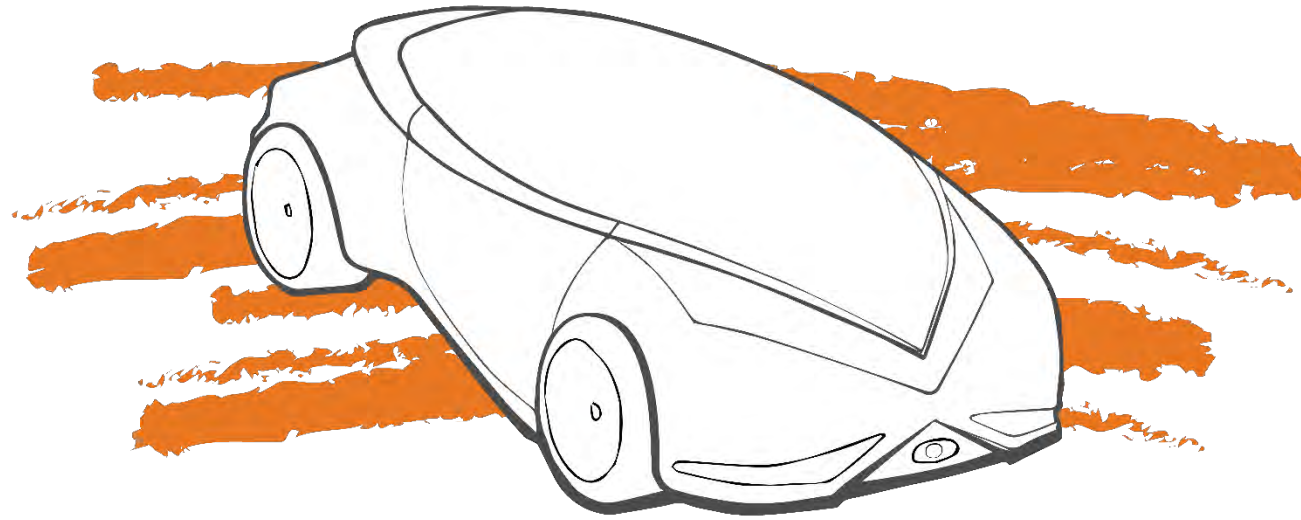
Current SAE and ISO Graphics, Telltales and Display Readability standards are primarily for drivers, but may be applicable for automated vehicle applications. Examples are...

- SAE J1050 FEB2009_Describing and Measuring the Driver's Field of View
- SAE J1757-1:200704_Standard Metrology for Vehicular Displays
- SAE 1757-2:201811_Standard - Optical Performance for HUD Vehicular Display
- ISO 15008:2017_Road vehicles -- Ergonomic aspects of transport information and control systems -- Specifications and test procedures for in-vehicle visual presentation

Summary

- Existing SAE and ISO vision standards provide a solid basis to measure readability of automated vehicle passenger control icons and information displays.
- The Passenger Seat Eyellipse for seats with greater than 'Minimum' Fore / Aft adjustment may require new definitions and measurement methods.

Thank You



Analysis of Regulatory Information Communicated to the ADS-DV

ADS-DV Testing Perspectives

Moderator: Myra Blanco, VTTI

Panelists:

- **Shaun Kildare**, Advocates for Highway and Auto Safety
- **Anne Marie Lewis**, Auto Alliance
- **Douglas Campbell**, Automotive Safety Council
- **Paul Scullion**, Global Automakers
- **Alex Epstein**, National Safety Council