

SAE INTERNATIONAL

CONNECTIVITY, DRIVER ASSISTANCE AND AUTOMATED DRIVING OVERVIEW

Standards Development: Enabling
Technologies, Trends, & Transition

FMCSA - Motor Safety Advisory Committee

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Motivation

- **Safety**
- **Productivity**
- **Environment**
- **Competitiveness**
- **Security**
- **Convenience**
- **Satisfaction**
- ...



SAE Portfolio

PUBLICATIONS

100,000+ collection of technical publications

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TECHNICAL STANDARDS

35,000+ aerospace and ground vehicle standards

MEDIA

Magazines, eNewsletters, custom publishing, Tech Briefs Media Group

MEMBERSHIP

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MEDIA

Magazines, eNewsletters, custom publishing, Tech Briefs Media Group

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SAE Standards Development


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Roll mouse over a committee name to view its scope.
 Click on a committee name to view its fact sheet.

GLOBAL GROUND VEHICLE STANDARDS

For information about the Automotive Technical Committee Meeting Schedule, click here.

For information about the Commercial Vehicle Technical Committee Meeting Schedule, click here.

528 committees
 8,900 members
 2,900 companies
 1,500 meetings

2015 standards
 Issued = 36
 Revised = 123
 Reaffirmed = 30
 Stabilized = 31
 Cancelled = 16

MOTOR VEHICLE COUNCIL

SERVICE DEVELOPMENT STEERING COMMITTEE
 • Service Committee
 • Towability Committee
 • Collision Repair Committee
 • J318 Working Group
 • J355 Review Working Group
 • J371 Working Group
 • Graphics Based Service Information Task Force

AUTOMOTIVE QUALITY AND PROCESS IMPROVEMENT COMMITTEE
 • J2886 DRBM Task Force

CHASSIS SYSTEMS
 • Foundation Brake Steering Committee
 • Brake Committee
 • Brake Linings Standards Committee
 • Brake Drum/Brake Standards Committee
 • Road Test Procedures Standards Committee
 • Brake WMI Standards Committee
 • Hydraulic Brake and Actuation Steering Committee
 • Brake Fluids Standards Committee
 • Automotive Brakes and Steering Hoses Standards Committee
 • Hydraulic Brake Components Standards Committee
 • Vehicle Performance Steering Committee
 • Chassis Control Technical Committee
 • Highway Tire Committee
 • Vehicle Dynamics Standards Committee
 • Wheel Standards Committee
 • Aftermarket Wheel Test Certification Conference Task Force
 • Wheel Finishing Lab Testing Task Force
 • Ball or Wheel-Hub Fatigue Lab Test Task Force

VEHICLE ENGINEERING SYSTEMS
 • Road Vehicle Aerodynamics Forum Committee
 • Interior Climate Control Steering Committee
 • Interior Climate Control HVAC Supplier Committee
 • Interior Climate Control HVAC OEM Committee
 • Interior Climate Control Fluids Committee
 • Glazing Materials Standards Committee
 • Connected Vehicles Steering Committee
 • SPIC (Standardized Short Range Communication) Tech Cnle
 • Cooling Systems Standards Committee
 • J557 - TP - Lab Test Vehicle and Industrial Heat Ex
 • J736-TP - Cng Air Cooler Internal Clean, Leak, Normalcy Lab
 • J339 - Test Method for Measuring Partic. Eng. Cooling Fans
 • J542 TP - Lab Test Veh Ind Heat Ex Thermo/Cyc Dur
 • J548 TP - Lab Test Veh Ind Heat Ex for Dur. Mtg. Ins. Loading
 • Ergonomics Steering Committee
 • Human Accom and Design Decisions SAs Committee
 • Controls and Displays Standards Committee
 • Adaptive Devices Standards Committee
 • Heated Seats Standards Committee
 • Light Duty Vehicle Performance and Economy Metrics Committee
 • Dynamic Modeling and Simulation Committee
 • Odometer and Speedometer Standards Committee
 • Light Vehicle Exterior Sound Level Standards Committee
 • ISO TC45 Acoustics
 • Top Vehicle Trailer Sizing Committee
 • Volatile Organic Compounds
 • Wiper Standards Committee
 • WMI - WMI Technical Committee

VEHICLE SAFETY SYSTEMS
 • Safety and Human Factors Standards Steering Committee
 • Vehicle Sound for Pedestrians
 • VSP/TKA FOR E 3 J289-1
 • J283 In-Vehicle Test Messaging Task Force
 • Visual Behavior and Metrics Committee
 • J296 Pedestrian measures related to UV behavior TF
 • J282 Brake Pad Mounting
 • J283 Process for testing of in-vehicle icons task force
 • J296-05 In-Vehicle Message Priority Task Force
 • J2800 Lane Departure Warning Systems Task Force
 • Lane Keeping Assistance Systems Subcommittee (L3S48)
 • Driver Vehicle Interface Committee
 • J2850 DVI Task Force 3 - MOUE USER INTERFACE
 • J287 DVI Task Force 2 - Hand-free definition
 • DVI Task Force 1 - Research Foundations and Outreach
 • DVI Task Force 4 - Evaluation Approaches, Prioritization and Migration
 • DVI Task Force 5 - Automated Vehicles and IHM
 • Driving Performance Operational Definitions (DIPDO) J2944
 • Adaptive Cruise Control and Forward Collision Warning
 • Driver Alerting Standards Committee

VEHICLE SAFETY SYSTEMS
 • Occupant Protection and Biomechanics Steering Committee
 • Seat Belt Systems Standards Committee
 • Childrest/Childrest Systems Committee
 • Infantile Restraints Committee
 • Impulse Noise TF
 • Rear Seat Belts/Restraints Interaction w/ Children - SM Adults
 • Impact and Roll-over Test Protocol SAs Committee
 • EV Crash Testing Safety Procedures TF
 • Safety Test Instrumentation SAs Committee
 • Human Biomechanics and Simulators Standards Committee
 • CRASH Side Impact Dummy TF
 • Pedestrian Dummy TF
 • Dummy Testing and Equipment Standards Committee
 • Hybrid III Dummy SAs Task Force
 • Calibration and Linearization methods for Potentiometers
 • Hybrid III Dummy Family TF
 • Dummy Abdomen-Pelvis Round Robin
 • Driver Assistance Systems Steering Committee
 • On-Road Automated Vehicle Standards Committee
 • J542 TP - Lab Test Veh Ind Heat Ex Thermo/Cyc Dur
 • J548 TP - Lab Test Veh Ind Heat Ex for Dur. Mtg. Ins. Loading
 • Ergonomics Steering Committee
 • Human Accom and Design Decisions SAs Committee
 • Controls and Displays Standards Committee
 • Adaptive Devices Standards Committee
 • Heated Seats Standards Committee
 • Light Duty Vehicle Performance and Economy Metrics Committee
 • Dynamic Modeling and Simulation Committee
 • Odometer and Speedometer Standards Committee
 • Light Vehicle Exterior Sound Level Standards Committee

CRASH DATA COLLECTION AND ANALYSIS STEERING COMMITTEE
 • Data Collection and Archiving Standards Committee
 • Data Analysis Standards Committee
 • Cross-cutting Issues Standards Committee
Motor Vehicle Fire Investigation Task Force

LIGHTING SYSTEMS
 • Lighting System Steering Committee
 • Lighting Committee Editorial Advisory Group
 • Heavy Duty Lighting Standards Committee
 • Lighting Standard Practices Committee
 • Fuel Cell Reversible Task Force
 • J2388 LED Light Sources Tests and Requirements Task Force
 • Lighting Materials Standards Committee
 • LED Lighting Materials Task Force
 • Lighting Discussion Forum
 • Pedestrian Cooperation Task Force
 • Road Illumination Devices Standards Committee
 • J2383 Headlight Task Force
 • Replaceable Bulb Task Force
 • J2850 LED Road Illumination Devices Task Force
 • Pedestrian Visibility Task Force
 • Performance Based Lighting System Task Force
 • Signaling and Marking Devices SAs Committee
 • J2891 LED Signal Lighting Task Force
 • J287 Daytime Running Lamp Task Force
 • J22 Parking Lamps (Front Position Lamps) Rear Light Modernization and Modernization Task Force

TEST METHODS AND EQUIPMENT SAs COMMITTEE
 • J255 Thermal Test (Dishboard) Task Force
 • EPA/CAD AND Post Production Testing working groups
 • J1370 Protonity Guideline Task Force
 • Highly Accelerated Failure Test Task Force (HAFT)
 • J282 Camera based steering
 • Emergency Warning Lights and Devices Standards Committee
 • EMC Guidelines for Emergency Warning Devices Task Force
 • International Lighting Standards Advisory Group
 • International Cooperation Committee

ELECTRICAL SYSTEMS
 • Vehicle E.E System Diagnostics Steering Committee
 • Vehicle E.E System Diagnostics Standards Committee
 • J2534 Pass-Through Programming Task Force
 • J1962 OBDII Diagnostic Connector TF
 • J1979 Review Task Force
 • J2699 OBDII Related SAE Specification Verification Test
 • J2078 OBDII Scan Tool Task Force
 • J3005 Guidance for Remote OBD Task Force
 • J3030 Electrical Electronic Systems Diagnostics Task Force
 • J202 Diagnostic Trouble Code Task Force
Electrical Distribution Steering Committee
 • Connector Systems Standards Committee
 • Cable Standards Committee
 • Harness Covering Standards Committee
 • Production and Switch Device Committee
 • Functional Safety Committee
 • Brake, Trailer Brake, and Part Brake TF
 • Steering and Suspension Task Force
 • Propulsion and Driveline Task Force
 • Event Data Recorder Committee
Electronic Design Automation Steering Committee
 • Electronic Design Automation Standards Committee
 • Electronic Software Standards Committee
 • Vehicle Architecture For Data Communications Standards
 • GEN2 Task Force
 • Common Ion Transceivers Qualification Requirements TF
 • Vehicle Electrical Power Supply Systems Standards Committee
 • Embedded Software Standards Committee
 • Automotive Electronic Systems Reliability Standards
 • Vehicular Flat Panel Display Standards Committee
 • Electromagnetic Compatibility (EMC) Standards
 • Electromagnetic Immunity (EMI) Task Force
 • Electromagnetic Radiation (EMR) Task Force
Vehicle Electrical System Security Committee
 • Automotive Security Standards and Risk Development TF
 • Vehicle Electrical Hardware Security Task Force

HYBRID-EV STEERING COMMITTEE
 • Fuel Cell Standards Committee
 • Fuel Cell Interface Task Force
 • Fuel Cell Reversible Task Force
 • Hybrid - EV Committee
 • Hybrid Wireless Charging J2254 Task Force
 • Hybrid terminology J755 Task Force
 • Hybrid and EV First and Second Responder Task Force
 • Hybrid Connector J772 Task Force
 • Hybrid Electric Motor Rating Task Force
 • Hybrid Communication and Interoperability Task Force
 • Hybrid Safety J2344 Task Force
 • Hybrid Power Quality J2944 Task Force

SAE IC POWERTRAIN STEERING COMMITTEE
 • Ignition Standards Committee
 • Emissions Standards Committee
 • Engine Power Test Code Committee
 • Filter Test Methods Standards Committee
 • Gasoline Fuel Injection Standards Committee
 • Air Cleaner Test Code Standards Committee
 • Piston and Ring Standards Committee
 • Fuel Systems Standards Committee
 • Drivetrain Standards Committee
 • Belt Drive (Automotive) Systems Committee
 • Automatic Transmission Transaxle Committee
 • Automatic Transmission Friction Standards Committee

VEHICLE BATTERY STANDARDS STEERING COMMITTEE
 • Battery Safety Standards Committee
 • Battery Standards Recycling Committee
 • Small Task Oriented Vehicle Battery Committee
 • Battery Test Equipment Committee
 • Battery Terminology Committee
 • Battery Materials Testing Committee
 • Stand-Stop Battery Committee
 • Secondary Battery Use Committee
 • Battery Field Discharge and Disconnect Committee
 • Battery System Connectors Committee
 • Battery Standards Testing Committee
 • Battery Thermal Management Committee
 • Battery Standards Labeling Committee
 • Battery Transportation Committee
 • Battery Size Standardization Committee
 • Battery Standards Starter Battery Committee
 • Battery Standards Truck and Bus Battery Committee
 • Battery Standards Electric Fuel Gauge Committee
 • Battery Standards Advanced Battery Concepts Committee

GREEN TECHNOLOGY STEERING COMMITTEE
 • Green Racing Committee

TRUCK AND BUS COUNCIL

• Truck and Bus Natural Gas Task Force
 • Truck and Bus Brake and Stability Control Steering Committee
 • Truck and Bus Stability Control Systems Committee
 • Truck and Bus Active Safety Systems Committee
 • Truck and Bus Foundation Brake Committee
 • Truck and Bus Brake Actuator Committee
 • Truck and Bus Brake Supply and Control Components Committee
 • Truck and Bus Hydraulic Brake Committee
 • Air Brake Taring and Tubing Committee
 • Truck and Bus Wheel Committee
Truck and Bus Advanced and Hybrid Powertrain Steering Committee
 • Truck and Bus Hybrid Safety Committee
 • Truck and Bus Hybrid Hybrid Committee
 • Truck and Bus Alternative Fuels Committee
Truck and Bus Body and Occupant Environment Steering Committee
 • Ready-Mix Concrete Truck Safety Committee
 • Truck and Bus Human Factors Committee
 • Truck Cabworkiness Committee
 • Truck and Bus Windshield Wipers and Climate Control Committee
Truck and Bus Total Vehicle Steering Committee
 • Truck and Bus Curtains Committee
 • Truck and Bus Tire Pressure Management Systems Committee
 • Truck and Bus Tire Committee
 • Truck and Bus Aerodynamics and Fuel Economy Committee
Truck and Bus Electrical - Electronic Steering Committee
 • Truck and Bus Event Data Recorder Committee
 • Truck and Bus Electronic Systems Committee
 • Truck and Bus Low Speed Communication Network Committee
 • Truck Cab Control and Communications Network Committee

FUELS AND LUBRICANTS COUNCIL
 • Fuels and Lubricants TC Engine Lubrication
 • Fuels and Lubricants ECW Task Force
 • Fuels and Lubricants TC Industrial Lubricants
 • Fuels and Lubricants TC 3D/Wetline and Chassis Lubrication
 • Fuel Efficiency Task Force
 • Fuel and Lubricants Tech Task Force
 • Fuel and Lubricants TC 3D Task Force for J306
 • Fuels and Lubricants TC 3D Fuels Committee
 • Fuel and Lubricants TC 3D Fuels Fuel and Blends Task Force
 • Fuels and Lubricants TC 3D Biodiesel Fuel Subcommittee

COOPERATIVE RESEARCH PROJECTS
 • MAC Refrigerant Blends (MRB CSP)
 • Alternative Refrigerants
 • COP1547 Air Refrigerant Assessment
 • COP150 Low GWP Air Refrigerants Assessment
 • High Temperature Battery Study
 • Gage BSR of HPM
 • H2 Fuel Cell Station Breakaways, Hoses, Fittings and Nozzles
 • High Strain Rate Plastics
 • IMAC
 • MAC Equipment Conference
 • IT5 Projects
 • CAESAR
 • Ergonomics
 • Federal Highway (FHWT) Dedicated Short Range Communications (DSRC)
 • Otolitic Trauma
 • Rechargeable Energy Storage Systems (RESS) Safety
 • EV/IEV/HEV Interoperability
 • Truck Cab Anthropometric Study
 • Emergency Vehicle Lighting
 • Vehicle Sound Level for Pedestrians
 • Plastics Suitable for use with H2

MATERIALS, PROCESSES AND PARTS COUNCIL

• Automotive Corrosion and Prevention Committee
 • Cosmetic Corrosion of Automotive Aluminum TF
 • Performance Corrosion Task Force
Acoustical Materials Committee
Committee on Automotive Rubber Specs
Surface Enhancement Committee
Fatigue Design and Eval Executive Advisory Group
 • Internal Properties Committee
 • Structural Analysis Committee
 • Fatigue Lifetime Predictions Committee
 • Road Load Data Acquisition Committee
 • Component Testing and Simulation Committee
Fastener Modeling Committee
 • Train Modeling Task Force
 • Software System Reliability Subcommittee
 • Unmanned Ground Vehicle Reliability Task Force
 • CRP (Condition Based Management) Subcommittee
Non-Hydraulic Hose Committee
Lightweight Vehicle Design Materials and Assembly Technology Committee
Metals Technical Executive Steering Committee
 • Carbon and Alloy Steel Committee
 • Metals Test Procedures Committee
 • Sheet and Strip Steel Committee
 • Draw Temp Ppt of Ferrous Metals Committee
 • Automotive Iron and Steel Castings Committee
Plastics Committee
Hose Clamp Performance and Compatibility Committee
 • Software System Reliability Subcommittee
Vibration Control Committee
Resin and Flexible Plastics Committee
Automotive Adhesives and Sealants Committee
Fluid Conductors and Connectors Tech Steering Committee
 • Hydraulic Tube Fittings Committee
 • Hydraulic Hose and Hose Fittings Committee
 • Hydraulic Tubing Committee
Spline Committee -892
Spring Steering Committee
 • Coil Spring Committee
 • Pneumatic Spring Committee
 • Torsion Bar Springs and Stabilizer Bars Committee

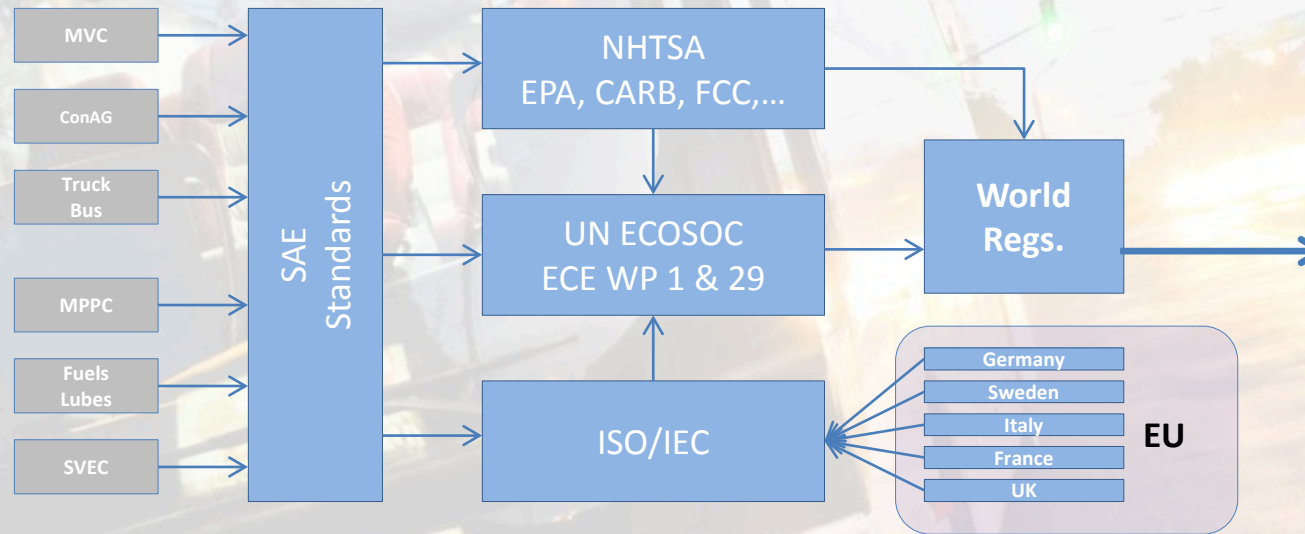
CONSTRUCTION AGRICULTURAL AND PARTS COUNCIL
 • Agricultural Tractor Standards Committee (ATSC)
 • ATSC Test Standards Subcommittee
 • ATSC The Subcommittee
 • ATSC ROPS Subcommittee
Commodity Council Chain Vice Chairs Subcommittee
 • Common Test Technical Steering Committee
 • CTC/CL Hydraulic Systems
 • CTC/CL Electrical Components and Systems
Hum an Factors Technical Advisory Group
 • HF/CL Controls, Visibility, Anthropometrics, Accessibility
 • Component Testing and Simulation Committee
 • HF/CL Machine Displays and Symbols
 • HF/CL Operator Seating and Ride
 • HF/CL Operator Accommodation
Machine Illumination Committee
 • HF/CL Ladders, Crawlers, Scrapers and Mounted Attachments
 • HF/CL Sweeper, Cleaner, and Machinery
 • HF/CL Forestry and Logging Equipment
 • HF/CL CS Excavators
 • HF/CL Roadbuilding Machinery Technical Subcommittee
 • HF/CL Tire and Rim
 • HF/CL Trenching and Horizontal Earthing Machine
Operator Protection Technical Advisory Group
 • HF/CL Personal Protection (General)
 • HF/CL Braking
 • HF/CL Lighting and Sound Committee
 • HF/CL Protective Structure
 • Cranes and Lifting Devices Committee

STANDARDS DERIVATIVE PROGRAMS
 • Aerospace Certification
 • J2246 Software Assessment Repository
 • On Board Diagnostics Database
 • MAC Equipment Conference
 • H-Point Machines
 • WMI/PIN
 • WMC/PIN
 • Wheel Conformance

GROUND VEHICLE STAFF

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FROM SAE STANDARD TO REGULATION TO PRODUCT COMPLIANCE



Product Development



SAE's Global Influence: SAE standards meet all six WTO principles for international standards & NTTA 1996/ OMB Circular A-119

40 SAE references in Canadian regulations

78 SAE references in ISO regulations
27 SAE references in UNECE regulations
25 SAE references in Global Technical Regulations



9 SAE references in Japan's regulations

37 SAE references in Australian regulations

350+ SAE References in US Federal Automotive, Truck & Bus, and Commercial Vehicle related Regulations (~100+ Unique Standards). SAE standards referenced in states and territories.

New Technology in SAE Committees

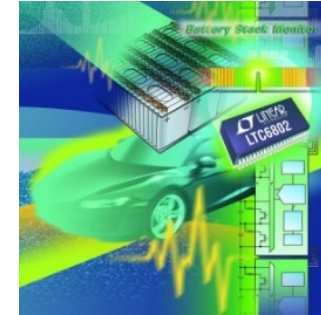


Wireless Charging



Driver Distraction (Driver-Vehicle Interface)

Automotive Electronics System Reliability

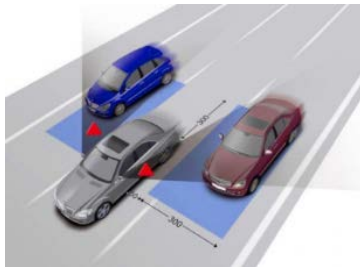


EV/Hybrid/F C Vehicle & Battery

Functional Safety



Automated Driving Systems



Active Safety

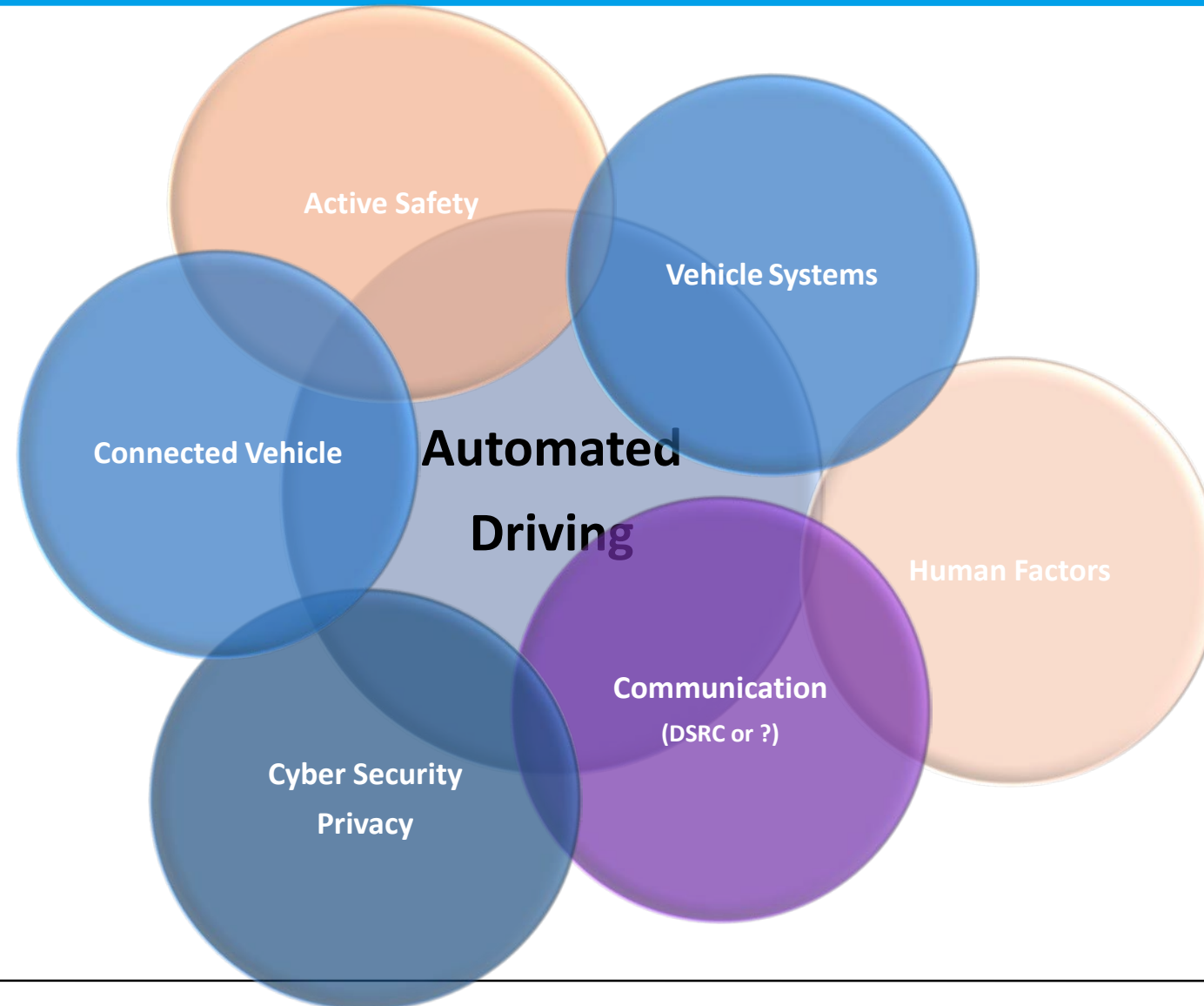


Vehicle Electronics Cyber Security



Intelligent Transportation Systems

Fundamental Relationships & Work at SAE: Automated Driving Systems



Applications



Driving Task / Driver's Tasks



- **Pre-Trip**
- **Roadside**
- **OOS**
- **Incident**
- **P & D (LTL / Cartage)**
- **Maintenance**
- **Diagnostics**
- **Logistics**
- **Vocational**

Architecture Examples:

- **SAE J560**
- **SAE J1939 (&J1587, J1708)**
- **Sensor and Component Developments**
- **ABS**
- **Electronic Engine Controls**
- **Automated Manual Transmissions**
- **Electronically Controlled Braking Systems**
- **Roll Stability Control / Electronic Stability Control Systems**
- **Adaptive Cruise Control (Terrain Function)**
- **Road/Lane Departure Warning Systems**
- **Automatic Emergency Braking**

Evolution or Revolution: Equipment & Societal/Institutional

Established, Traditional, Legacy Suppliers

- **Vehicle Manufacturers**
- **Major Component Suppliers / Strategic Development Partners**
- **Vertically Integrated Divisions**
- **Lower Tier Suppliers**
- **Modifiers / Body/Equipment Installers**
- **Aftermarket / Direct to End User Technology Providers**

New Entrants' / Entrepreneurs' Dynamics (Disrupters)

General Public Perception

Motor Carriers

Law Enforcement

Regulators/Legislators

Special Interest Groups

Evolution or Revolution (continued)

- **Closed**
- **Geofenced**
- **Conservative Domain**
- **Conservative Progression**
- **Regulated**
- **Disruptive**



Recent Studies / Predictions:

- TNO (2016)
- ITF (2015)
- Frisoni et al (2016)
- Underwood (2014)
- PWC (2015)
- KPMG (2015)
- SAFE (2017)
- ...



Published and Works In Progress

Terms and Definitions

- Taxonomy & Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems
- Operational Definitions of Driving Performance Measures & Statistics
- Definition of Hand-Free Operation of a Person to Person Wireless Communication System or Device
- Automated Vehicles Definitions: Key Terms Related to Human Interaction with Automated Driving Systems
- Active Safety Systems Sensors

Vehicle & System Performance Requirements

- DSRC Common Performance Requirements
- On-Board System Requirements for V2V Safety Communications
- Performance Requirements for Cooperative Adaptive Cruise Control and Platooning
- Performance Requirements for Safety Communications to Vulnerable Road Users
- Automatic Emergency Braking Test Methods and Performance Assessment
- Adaptive Cruise Control Operating Characteristics and User Interface
- Recommended Practice for Pas-Thru Vehicle Programming
- Automated Driving Reference Architecture

Interoperability (V2V, V2I, V2X)

- Dedicated Short Range Communication (DSRC) Message Set Dictionary
- On-Board System Requirements for V2V Safety Communications
- DSRC Requirements for V2V Safety Awareness
- Candidate Improvements to DSRC Using Systems Engineering Methods
- Mobile Device Application
- Road Side Equipment for I2V and V2I
- Performance Requirements for Safety Communications to Vulnerable Road Users
- Recommended Practices for MAP/SPaT Message Development
- Recommended Practices for Signal Preemption Message Development
- Recommended Practice for Pass-Through Vehicle Programming
- Automated Driving Reference Architecture

SAE J3016 Standards for Automated Driving



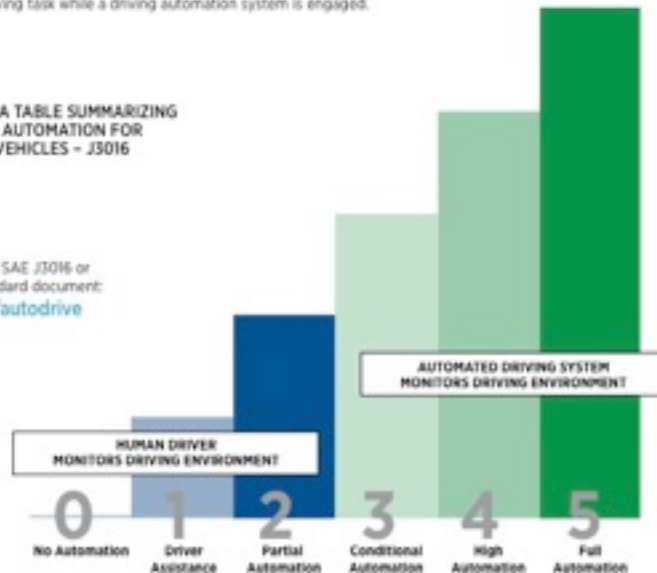
AUTOMATED DRIVING LEVELS OF DRIVING AUTOMATION ARE DEFINED IN NEW SAE INTERNATIONAL STANDARD J3016

With the goal of providing common terminology for automated driving, SAE International's new standard J3016: **Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems**, delivers a harmonized classification system and supporting definitions that:

- Identify six levels of driving automation from "no automation" to "full automation".
- Base definitions and levels on functional aspects of technology.
- Describe categorical distinctions for a step-wise progression through the levels.
- Are consistent with current industry practice.
- Eliminate confusion and are useful across numerous disciplines (engineering, legal, media, and public discourse).
- Educate a wider community by clarifying for each level what role (if any) drivers have in performing the dynamic driving task while a driving automation system is engaged.

▶ **CLICK OVER FOR A TABLE SUMMARIZING
LEVELS OF AUTOMATION FOR
ON-ROAD VEHICLES - J3016**

Learn more about SAE J3016 or
purchase the standard document:
www.sae.org/autodrive



SUMMARY OF SAE INTERNATIONAL'S LEVELS OF DRIVING AUTOMATION FOR ON-ROAD VEHICLES

Issued January 2014, **SAE International's J3016** provides a common taxonomy and definitions for automated driving in order to simplify communication and facilitate collaboration within technical and policy domains. It defines more than a **dozen key terms**, including those italicized below, and provides **full descriptions and examples** for each level.

The report's **six levels of driving automation** span from *no automation* to *full automation*. A **key distinction** is between level 2, where the *human driver* performs part of the *dynamic driving task*, and level 3, where the *automated driving system* performs the entire *dynamic driving task*.

These levels are **descriptive** rather than normative and **technical** rather than legal. They imply **no particular order** of market introduction. Elements indicate **minimum** rather than maximum system capabilities for each level. A particular vehicle may have multiple driving automation features such that it could operate at **different levels** depending upon the feature(s) that are engaged.

System refers to the driver assistance system, combination of driver assistance systems, or *automated driving system*. **Excluded** are **warning and momentary intervention systems**, which do not automate any part of the *dynamic driving task* on a sustained basis and therefore do not change the *human driver's* role in performing the *dynamic driving task*.

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

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Key definitions in J3016 include (among others):

Dynamic driving task includes the operational (steering, braking, accelerating, monitoring the vehicle and roadway) and tactical (responding to events, determining when to change lanes, turn, use signals, etc.) aspects of the driving task, but not the strategic (determining destinations and waypoints) aspect of the driving task.

Driving mode is a type of driving scenario with characteristic *dynamic driving task* requirements (e.g., expressway merging, high speed cruising, low speed traffic jam, closed-campus operations, etc.).

Request to intervene is notification by the *automated driving system* to a *human driver* that s/he should promptly begin or resume performance of the *dynamic driving task*.

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P141661

Published and Works in Progress: Safety (sample)

Functional Safety

Safety and Reliability

Active Safety

Safety & Human Factors

**Other Safety /
Crosscutting**

Functional Safety

Safety and Reliability

Active Safety

Safety & Human Factors

**Other Safety /
Crosscutting**

Advanced Driver Assistance Systems & Levels of Automation

- **Active Safety Systems Sensors**
- **Automatic Emergency Braking Test Methods & Performance Assessment**
- **Specifications of Pedestrian Mannequins for Vehicle Pedestrian Detection Systems**
- **Truck & Bus Lane Departure Warning Systems Test Procedure**
- **Truck & Bus Forward Collision Warning & Mitigation Vehicle Test Procedure**
- **Recommended Practice for Braking, Stability, & Control Performance Test Procedure of Air-Brake-Equipped Trucks**
- **Taxonomy & Definitions for Terms related to On-Road Motor Vehicle Automated driving Systems**
- **Test Target Correlation**

Functional Safety

Safety and Reliability

Active Safety

Safety & Human Factors

Other Safety / Crosscutting

Advanced Driver Assistance Systems & Levels of Automation

- Active Safety Systems Sensors
- Automatic Emergency Braking Test Methods & Performance Assessment
- Specifications of Pedestrian Mannequins for Vehicle Pedestrian Detection Systems
- Truck & Bus Lane Departure Warning Systems Test Procedure
- Truck & Bus Forward Collision Warning & Mitigation Vehicle Test Procedure
- Recommended Practice for Braking, Stability, & Control Performance Test Procedure of Air-Brake-Equipped Trucks
- Taxonomy & Definitions for Terms related to On-Road Motor Vehicle Automated driving Systems
- Test Target Correlation

Other Safety

- Truck & Bus Automated Commercial Vehicle
- Uniform Pavement Markings for Machine Vision Systems
- Adaptive Driving Beam System
- Guidelines for Safe On-Road Testing of Automated Driving Systems
- Identifying Automated Driving System Dedicated Vehicles (ADS-DV) User Issues for Persons With Disabilities

Privacy

- **Data Collection, Retention, Ownership & Access**
- **Pedestrian Protection EDR Parameters**
- **Permanently or Semi-Permanently Installed Diagnostic Communication Devices**

Security

- **Cybersecurity Recommended Practice for Cyber-Physical Vehicle Systems**
- **Requirements for Hardware Protected Security for Ground Vehicle Applications**
- **OBD II Telematics, Vehicle Health Management, Data Access**
- **Vulnerabilities & Cyber Threat Analysis**
- **Over the Air Updates**
- **Automotive Networks of Connected Systems, Sensors & Physical Objects**

SAE Cybersecurity Standards

SAE J3061 “Cybersecurity Guidebook for Cyber-Physical Automotive Systems”

Scope:

- Consistent with Process Framework for ISO 26262 Functional Safety Standard
- Contains automotive cybersecurity framework and processes
- Evaluates Threat Analysis and Risk Assessment (TARA) methods
- Simple approach to allow effective implementation across the automotive industry
- Contains elements of existing industry security standards
- Definitions, Acronyms, and sample templates provided

SAE J3101: “Requirements for Hardware-Protected Security for Ground Vehicle Applications”

Scope:

Define a common set of requirements for security to be implemented in hardware for ground vehicles to facilitate security enhanced applications, developing expectations for necessary functionality to achieve an ideal system for hardware protection for ground vehicle applications, including examples, but not explicitly detailing implementation requirements.

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Thank you

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