United States House of Representatives

Committee on Energy and Commerce

Subcommittee on Digital Commerce and Consumer Protection

Self-Driving Cars: Levels of Automation Hearing

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Statement of SAE International

S. William Gouse, Director, Federal Program Development

Chairman Latta, Ranking Member Schakowsky, and distinguished members of the subcommittee, SAE International thanks you for the opportunity to submit this statement for the hearing: "Self-Driving Cars: Levels of Automation".

SAE International is a global society founded in 1905 with more than 140,000 engineers, scientists, related technical experts, and students, in over 100 countries, in the aerospace, automotive, motorcycle, commercial, construction, agricultural and specialized vehicles industries. Some notable members were aviation and automotive pioneers Orville Wright, Henry Ford, Amelia Earhart, and Ransom Olds, and celebrities such as Andy Granatelli and Jay Leno. SAE members from government, academia, and industry have testified to this subcommittee at previous hearings.

SAE's core competencies are voluntary consensus standards development with nearly 30,000 experts across the globe contributing to a continually growing standards portfolio of over 10,000 active and 25,000 historical standards used to increase safety, performance, quality, productivity of personal commercial transportation services while optimizing cost of products and product-life cycles. SAE holds

dozens of conferences and symposia, including the Government Industry meeting held in January in conjunction with the Washington Auto Show and our World Congress next month in Detroit. These events, plus other mutually beneficial government/industry academic networking opportunities provide information for the formation of sound public policy positions and affiliated programs, products and services that add value and encourage innovation.

SAE standards are referenced in government procurement documents, recommendations, guidelines, and in regulations issued by the US Department of Transportation (US DOT), US Environmental Protection Agency, US Department of Energy, the National Transportation Safety Board, in regulations in our states, commonwealths, and inhabited territories. In addition, SAE standards are used internationally, in Canada, elsewhere in the Americas, overseas and by the United Nations Economic Commission for Europe. SAE believes that incorporating voluntary consensus standards by reference as directed in the National Technology Transfer Advancement Act and in Office of Management and Budget Circular-A119 improves the efficiency and effectiveness of government (whether a Federal, state, municipal body, or global harmonization activity), saving time and money, while increasing the efficacy of policy, legislation, and/or regulation. This is critical in order to respond to the policy or regulatory needs brought about by rapid technology developments. These developments are progressing significantly faster, potentially orders of magnitude faster, than the regulatory process. In addition, the competitiveness of adopting organizations' products and services is increased in the global marketplace because of the higher quality, value, and customer confidence achieved through conformity with SAE standards.

SAE has several standards published and many documents in development by a variety of car, motorcycle, pedestrian, and truck and bus committees relating to increasing safety and efficiency of transport. While work continues to improve passive safety and crashworthiness of vehicles, the potential

of implementing technological solutions to avoid or reduce the severity of crashes is a major focus of our members' committee activities. These efforts encompass active safety systems, driver assistances systems, cybersecurity, vehicle connectivity and communications, measurement and test devices, vehicle testing including safe on-road testing of automated driving systems, and specific to today's hearing's title, SAE International's standard J3016: Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems.

This Recommended Practice originally published in 2014 and revised last September, and referenced in the Federal Automated Vehicles Policy provides stakeholders including Federal, state, and local/municipal legislators, regulators and policy-makers with a taxonomy describing the full range of levels (SAE 0 through 5) of *driving automation* in on-road *motor vehicles*. This includes functional definitions for advanced levels of *driving automation* and related terms and definitions. This Recommended Practice does not provide specifications, or otherwise impose requirements on, *driving automation systems*. Standardizing levels of *driving automation* and supporting terms serves several purposes, including:

• Clarifying the role of the (human) *driver*, if any, during *driving automation system* engagement.

• Answering questions of scope when it comes to developing laws, policies, regulations, and standards.

• Providing a useful framework for *driving automation* specifications and technical requirements.

• Providing clarity and stability in communications on the topic of *driving automation*, as well as a useful short-hand that saves considerable time and effort.

 This document was developed per the following guiding principles:

• Be descriptive and informative rather than normative.

• Be consistent with current industry practice.

• Be consistent with prior art to the extent practicable.

• Be useful across disciplines, including engineering, law, media, public discourse.

• Be clear and cogent, provide functional definitions and avoid or define ambiguous terms.

SAE International's Levels Of Automated Driving Automation For On-Road Vehicles:

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 *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the *driving mode*-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 *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the *driving mode*-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 *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
3	conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	high Automation	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

SAE has been and will continue to work with states and commonwealths as we learn of their policy, regulatory, and legislative activities regarding both the public on-road testing and the deployment of vehicles with driver assistance and automated driving systems. For example, we have been working the American Association of Motor Vehicle Administrators members and staff, and participate and contribute to their "Automated Vehicles Information Sharing Group". We're also members of the Commonwealth of Pennsylvania's Department of Transportation Autonomous Vehicle Testing Policy Task Force and continue to work with several states regarding policy and regulations for testing of automated driving systems on public roads. SAE staff and members have been involved with efforts in California and Michigan, but many more states, commonwealths, and municipalities in the US are developing policy, regulations and legislation in their departments of transportation, motor vehicle administrations, and legislative bodies.

 SAE was pleased that the US DOT and the National Highway Traffic and Safety Administration (NHTSA) adopted the SAE levels of automation in their September, 2016 "Federal Automated Vehicles Policy". Government entities, media, trade and consumer associations and the transportation/vehicle industry were using SAE levels of automation or the differing NHTSA classification and some, both. This incongruent usage has been one of the difficulties with communicating with stakeholders and harmonizing policy efforts. An ongoing challenge is to expand the use of consistent terms, definitions, and procedures via increasing the awareness of SAE's resources, such as SAE J3016, SAE J3018: Guidelines for Safe On-Road Testing of SAE Level 3, 4, and 5 Prototype Automated Driving Systems (ADS), and other SAE International's enabling standards and recommended practices to all levels and branches of government.

Driver assistance and automated driving systems have the potential to provide substantial benefits to all customers of road transport. SAE International's wealth of knowledge and experience with existing and

developing standards in this area should be used by government, industry and academia to assist in the technology and policy solutions necessary for the adoption of these life and property saving advances.

SAE International thanks the Subcommittee for this opportunity to provide a statement and welcomes questions and requests for additional information.

Supplementing this statement, SAE International submits the following documents for the record:

Surface Vehicle Recommended Practice, SAE J3016, Taxonomy and Definitions for Terms Related to Automated Driving Systems, issued January 2014, revised September 2016.

Automated & Connected Transportation Standards, An infographic from SAE International

Automated Driving, Levels of Driving Automation are Defined in New SAE International Standard J3016

SAE International Global Ground Vehicle Standards Organization Chart