



SURFACE VEHICLE RECOMMENDED PRACTICE

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Naming Methodology for Driving Automation Systems

RATIONALE

Since the 1990s, active safety systems—including driver assistance systems—have been deployed in on-road vehicles. As the number and range of functions associated with driver assistance technologies and, now, driving automation systems—including automated driving systems (ADSs)—increase, it is crucial that users understand what they do and how they typically function. Across vehicle manufacturers, very different names are often given to the same basic vehicle technology. In this regard, a survey conducted by the AAA Traffic Safety Foundation (American Automobile Association, 2019) found 20 different names for adaptive cruise control, 19 for lane keeping assistance, and 19 for blind spot warning features; the same report noted that there is often a mismatch between feature names and feature functionality. While each manufacturer may use unique “branding” or “marketing” names for these systems and features, it is important to promote clear communication about them to prevent misunderstanding, confusion, or misuse. Key to this goal is a need to identify standard public-facing names and corresponding basic definitions that employ user-friendly language for these systems and their features. To support this goal, SAE J3265 integrates a complimentary set of test procedures and evaluation methodologies to provide a systematic process for identifying and evaluating standard names and definitions for driving automation system features and for identifying a “user vocabulary” of standardized terms and descriptions for these systems and features.

INTRODUCTION

The methodology described below was developed through a multi-year effort, supported by SAE International and other organizations, aimed at generating a test approach that would: (1) yield high-quality evaluation data for new and proposed standard names for driving automation system features, (2) provide clear and specific guidance to system developers regarding how they can revise names to improve comprehension and user understanding, and (3) be adopted and performed internationally to support international efforts.

Names and accompanying descriptions of driving automation systems are important because they may be the first piece of information users have about a new feature and may be used by users to infer the purpose, function, and capabilities of the feature. Research has demonstrated that the names given to vehicle technologies influence understanding of their capabilities and limitations. For example, Abraham et al. (2017) conducted a survey in which participants were given the names of 19 driver assistance technologies and then asked to select the division of task responsibility that they would expect to exist between them as the driver and the system. The options presented to the participants roughly corresponded to the driver responsibilities associated with SAE Levels 0 through 5 (refer to SAE J3016). The researchers found that commonly used names for driver assistance technologies, such as “auto,” “pilot,” “assist,” and “cruise,” influenced participants’ expectations about how much support was provided by the automation. Specifically, systems with “cruise” in their names were associated with lower levels of automation, and systems with “assist” in their names appeared to create confusion between whether the driver is assisting the system, or the system is assisting the driver.

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Documents

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Nees (2018) asked research participants to rate 13 different terms that have been used to describe automation in vehicles with respect to the extent to which they perceived the human driver or the automated system to be responsible for each of three driving tasks: steering, accelerating/braking, and monitoring the driving scenario. The results indicated consistent associations between names that included words like “cruise,” “pilot,” and “assist” and the driver’s understanding of their responsibilities.

The Insurance Institute for Highway Safety (IIHS; Teoh, 2019) provided research participants with the names of actual SAE Level 2 driving systems and asked them to indicate which non-driving activities (e.g., talking with a passenger, adjusting the stereo, texting, taking a nap, etc.) from a list they thought would be safe to engage in while the given system was in operation. The results showed that the names of SAE Level 2 driving features clearly influenced drivers’ perceptions of safe non-driving activities while using the system. Although the published research in this area has focused on active safety features, the same dynamic and opportunity for misunderstanding exists regarding the capabilities and limitations of driving automation system features.

While names are not the only factor that influences user expectations and behaviors about driving automation system features—experience, training, and the in-vehicle human-machine interface (HMI) will all clearly play a role—names can impact driving behavior and therefore safety. While some useful efforts have been made in this area (e.g., refer to “Clearing the Confusion,” [adas-nomenclature.pdf](#)), the research makes clear that the industry would benefit from having a robust and systematic methodology for selecting the standard names for driving automation system features that promotes accurate understanding of the feature’s capabilities and limitations.

1. SCOPE

This document describes a systematic and rigorous process to: (1) identify and evaluate standard names and definitions for driving automation system features, and (2) identify a “user vocabulary” of terms and descriptions that [human] drivers use to describe driving automation system features.

The process described in this document includes selection criteria and trade-offs that can be used to select an approach to testing that matches the constraints and objective of a particular evaluation. The data from this process are analyzed to determine users’ name preferences for driving automation system features and what they would expect a specific feature to do, based on the name given to the features. The data generated by this naming methodology can provide guidance regarding the names that may support accurate understanding of the feature’s capabilities and limitations. Although the process described in this document emphasizes the use of large-scale electronic surveys for data collection, an in-person approach to administer the test (either paper-and-pencil or electronic) could be used instead.

NOTE: The development of this SAE Recommended Practice for developing standard names for driving automation system features was greatly aided by a large-scale pilot test that was used to assess and refine the individual test procedures described below. A summary of this pilot test is provided in [Appendix A](#).

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2830	Process for Comprehension Testing of In-Vehicle Symbols
SAE J3016	Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles
SAE J3063	Active Safety Systems Terms and Definitions

Campbell, J.L., Kludt, K., and Kiefer, R.J. (2007). *Evaluation of in-vehicle symbols for an intersection crash avoidance system*. (SAE paper 2007-01-3518). Warrendale, PA: SAE International, DOI: 10.4271/2007-01-3518.

Campbell, J.L., Hoffmeister, D.H., Kiefer, R.J., Selke, D.J., Green, P. and Richman, J.B. (2004). Comprehension testing of active safety symbols (SAE paper. 2004-01-0450). *Proceedings of the SAE 2004 World Congress*. Warrendale, PA: SAE International. (Also published by SAE in SP-1877, *Human Factors in Driving and Telematics, and Seating Comfort*), DOI: 10.4271/2004-01-0450.

Cullinane, B. and Kirn, C. (2012). *Timely comprehension: A methodology for evaluating integration of in-vehicle warnings systems* (SAE paper 2012-01-0100). Warrendale, PA: SAE International, DOI: 10.4271/2012-01-0100.

Green, P. (1979). *Development of pictographic symbols for vehicle controls and displays* (SAE paper #790383). Warrendale, PA: Society of Automotive Engineers, DOI: 10.4271/790383.

Jack, D.D. (1972). *Identification of controls-a study of symbols* (SAE paper 720203)., Warrendale, PA: SAE International, DOI: 10.4271/720203.

Saunby, C.S., Farber, E.I., and DeMello, J. (1988). *Driver understanding and recognition of automotive ISO symbols*. (SAE paper 880056). Warrendale, PA: SAE International, DOI: 10.4271/880056.

2.1.2 Federal Highway Administration Publications

Available from FHWA, 1200 New Jersey Ave., SE, Washington, DC 20590, <https://highways.dot.gov/>.

FHWA-RD-03-065 In-Vehicle Display Icons and Other Information Elements

2.1.3 National Highway Traffic Safety Administration Publications

Available from NHTSA, 1200 New Jersey Ave., SE, Washington, DC 20590, <https://www.nhtsa.gov/>.

NHTSA-2014-0070-0003 Automated Vehicle Research for Enhanced Safety - Final Report

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 Other Publications

Abraham, H., Seppelt, B., Mehler, B., and Reimer, B. (2017). What's in a name: vehicle technology branding and consumer expectations for automation. *Proceedings of the 9th ACM International Conference on Automotive User Interfaces and Interactive Vehicular Applications*, September 24-27, Oldenburg, Germany.

American Automobile Association. (2019). *Advanced driver assistance technology names: AAA's recommendation for common naming of advanced safety systems*. Retrieved from <https://www.aaa.com/AAA/common/AAR/files/ADAS-Technology-Names-Research-Report.pdf>.

Cozby, P.C. (2009). *Methods in Behavioral Research* (10th ed.), New York, NY: McGraw-Hill.

Dewar, R.E., Kline, D.W., and Swanson, A.H. (1994). Age differences in comprehension of traffic sign symbols. *Transportation Research Record* 1456, 1-10.

Easterby, R.S. and Zwaga, H. (1976). *Evaluation of public information symbols, ISO tests: 1975 series* (Report AP 60). Birmingham, UK: Applied Psychology Department, University of Aston at Birmingham.

Nees, M. (2018). Drivers' perceptions of functionality implied by terms used to describe automation in vehicles, *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 62(1), 1893-1897.

Teoh, E.R. (2019). *What's in a name? Drivers' perceptions of the use of five SAE Level 2 driving automation systems*. Arlington, VA: Insurance Institute for Highway Safety

Wolff, J.S. and Wogalter, M.S. (1998). Comprehension of pictorial symbols: Effect of context and test method. *Human Factors*, 40(2), 173-186.

Zwaga, H. and Easterby, R.S. (1984). Developing effective symbols for public information. In R. Easterby and H. Zwaga (Eds.), *Information design: The design and evaluation of signs and printed material* (pp. 277-297). New York: J. Wiley and Sons.

3. DEFINITIONS

3.1 ACTIVE SAFETY SYSTEMS (SAE J3063)

Vehicle systems that sense and monitor conditions inside and outside the vehicle for the purpose of identifying perceived present and potential dangers to the vehicle, occupants, and/or other road users, and automatically intervene to help avoid or mitigate potential collisions via various methods, including alerts to the driver, vehicle system adjustments, and/or active control of the vehicle subsystems (brakes, throttle, suspension, etc.). Refer to SAE J3063 for further details.

3.2 AUTOMATED DRIVING SYSTEM (ADS) (SAE J3016)

The hardware and software that are collectively capable of performing the entire dynamic driving task (DDT) on a sustained basis, regardless of whether it is limited to a specific operational design domain (ODD); this term is used specifically to describe a Level 3, 4, or 5 driving automation system. Refer to SAE J3016 for further details.

3.3 COMPREHENSION

The degree to which a test participant understands the intended functionality of a candidate feature name.

3.4 COUNTERBALANCING

Using all the possible orders of conditions, or randomly determining the order for each participant to control for order effects (Cozby, 2009).

3.5 CRITICAL CONFUSION

A response to the candidate name undergoing comprehension testing wherein such a response represents a critical misunderstanding that could potentially lead to an unsafe circumstance/incident.

3.6 DRIVING AUTOMATION SYSTEM OR TECHNOLOGY (SAE J3016)

The hardware and software that are collectively capable of performing part or all the DDT on a sustained basis; this term is used generically to describe any system capable of Level 1 to 5 driving automation. Refer to SAE J3016 for further details.

3.7 [HUMAN] DRIVER (SAE J3016)

A user who performs in real time part or all the DDT and/or DDT fallback for a particular vehicle. Refer to SAE J3016 for further details.

3.8 [HUMAN] USER (SAE J3016)

A general term referencing the human role in driving automation. Refer to SAE J3016 for further details.

4. OVERVIEW OF METHODOLOGICAL APPROACHES FOR DEVELOPING NAMES FOR DRIVING AUTOMATION SYSTEM FEATURES

4.1 Matching Test

A matching test is an evaluation technique that measures the perceived association between a stimulus (e.g., names, symbols, display types, control labels) and the features, message, meaning, or activity associated with the stimulus. It can be used to evaluate how well a candidate name for a driving automation system feature will work within a larger set of candidate names and whether the names can be discriminated from one another without confusion. Participants are given a functional description of the feature plus a list of all the candidate names for that feature (plus an equal number of additional, distractor names randomly selected from a list of candidate names for a range of similar and dissimilar features) and asked to select the name that best matches the description. The outcome of the matching test is two measures of effectiveness: the percentage of choices for each candidate name and the degree of confusion among the candidate names.

4.2 Ranking Test

A ranking test (or appropriateness ranking test; refer to FHWA-RD-03-065) is an evaluation technique that provides an ordinal ranking of the perceived appropriateness of a candidate stimulus (e.g., names, symbols, display types, control labels) relative to the features, message, meaning, or activity associated with the stimulus. It can be used to develop a rank ordered list of candidate names for a driving automation system feature from a set of candidate names. In the ranking test, participants are given a description of a feature along with a list of candidate names and are asked to numerically rank order the names with respect to their appropriateness relative to the description. The outcome of the ranking test is typically a mean rank for each candidate name (see note below). The ranking test can also be used to conduct a preliminary screening of candidate names when—for example—it is desired to reduce a large number of candidate names to a smaller, more manageable number of higher-potential candidates names.

NOTE: Rank order data are on an ordinal scale that ranks the candidate names in order of magnitude but does not reveal the magnitude of the differences between them. An interval scale, on the other hand, allows statements about how much difference there is between two names. It may not be desirable to use rank orders alone to make final decisions among candidate names; procedures for converting rank order data to an interval scale of perceived appropriateness are provided in FHWA-RD-03-065 (refer to Tutorial 1).

4.3 Comprehension Test

A comprehension test is an open-ended evaluation technique that provides a means to determine which of a number of candidate stimuli (e.g., names, symbols, display types, control labels) are best understood when: a stimulus is presented to research participants, the context of the presentation or use of the stimulus is specified, and participants are asked to describe the features, message, meaning, or activity associated with the stimulus. It can be used to evaluate which of several candidate names for a driving automation system feature are best understood by participants. Participants are presented with a candidate name and asked to provide system features, functionality, or behaviors that best describe the name. Candidate names are tested individually, as the focus is on testing absolute comprehension/recognition for individual names, not to test confusability across names (as it might be in the matching test). The outcome of the comprehension test is an absolute measure of comprehension expressed as a percentage of correct responses.

4.4 Rating Test

A rating test is a direct evaluation technique that provides a means to determine the perceived effectiveness of candidate stimuli (e.g., names, symbols, display types, control labels) relative to the features, message, meaning, or activity associated with the stimulus. It can be used to resolve ambiguities found with other methods or to add additional information to the overall analysis. After initial testing (i.e., some mix of matching, ranking, or comprehension testing; see [4.5](#)) is complete, participants can rate all the candidate system names for a particular description in terms of the degree to which they think each name communicates the description given for a driving automation system feature (see [Appendix B](#)).

4.5 Comparison of the Matching Test, the Ranking Test, and the Comprehension Test

The matching test, ranking test, and comprehension test each have some advantages and disadvantages relevant to identifying descriptive and effective names for driving automation system features, as summarized in [Table 1](#).

Table 1 - Advantages and disadvantages of the matching test, ranking test, and the comprehension test

	Matching Test	Ranking Test	Comprehension Test
Advantages	(1) Easy to administer and score. (2) Provides both: number of correct choices for a name, and degree of confusion among names.	(1) Easy to administer and score. (2) Provides a rapid and low-cost method to quickly reduce a large number of candidate names to a more manageable set.	Provides a direct measure of absolute comprehension or understanding (Name → driving automation system functionality).
Disadvantages	(1) Requires developing a set of plausible alternatives. (2) Does not provide an absolute measure of comprehension or understanding.	(1) Does not readily provide the magnitude of the differences between ranked names (i.e., no interval scale without conversions). (2) Does not provide an absolute measure of comprehension or understanding.	Difficult and time-consuming to: (1) Set-up (requires plausible “name” alternatives for a function/feature and scores for range of answers) (2) Score the responses (involves judgements that are subject to intra- and inter-rater scoring variability)

4.6 General Methodological Recommendations

Given the objectives of this “naming methodology” procedure, the basic steps associated with the matching test, the ranking test, and the comprehension test, as well as considerations of the relevant advantages and disadvantages of these approaches, it is recommended to use some mix of all three approaches, with the exact sequence and selection of tests determined by specific circumstances, including: the time and resources available for the research, the nature of the feature under consideration, the number of candidate names available, and the possible consequences of a poorly named feature.

For example, it may be beneficial to:

1. Initially conduct a matching test and a ranking test to identify names for features followed by a comprehension test if the results of a matching test (and/or a ranking test) do not provide a clear outcome,
2. Conduct a ranking test first to “downselect” a large number of candidate names to a smaller set that can move forward for further testing (e.g., a matching test and/or a comprehension test),
3. Conduct both a matching test and a ranking test and compare/combine results to select a name.

In general, although the comprehension test takes more time and resources to complete, the use of a comprehension test as part of the process is recommended as it provides the most direct measure of absolute comprehension and understanding. Initial outcomes that suggest that a comprehension test may be needed include:

1. Candidate names with the same or very similar scores on the matching test, indicating ambiguity or confusion across candidate names,
2. Situations where the results of a combined matching test and ranking test are contradictory or otherwise irreconcilable, or
3. A situation where the score for even the highest-scoring name on a matching test may be low enough to cast uncertainty on the overall outcome.

5. BASIC PROCESS STEPS

[Figure 1](#) summarizes the recommended approach to developing names for features.

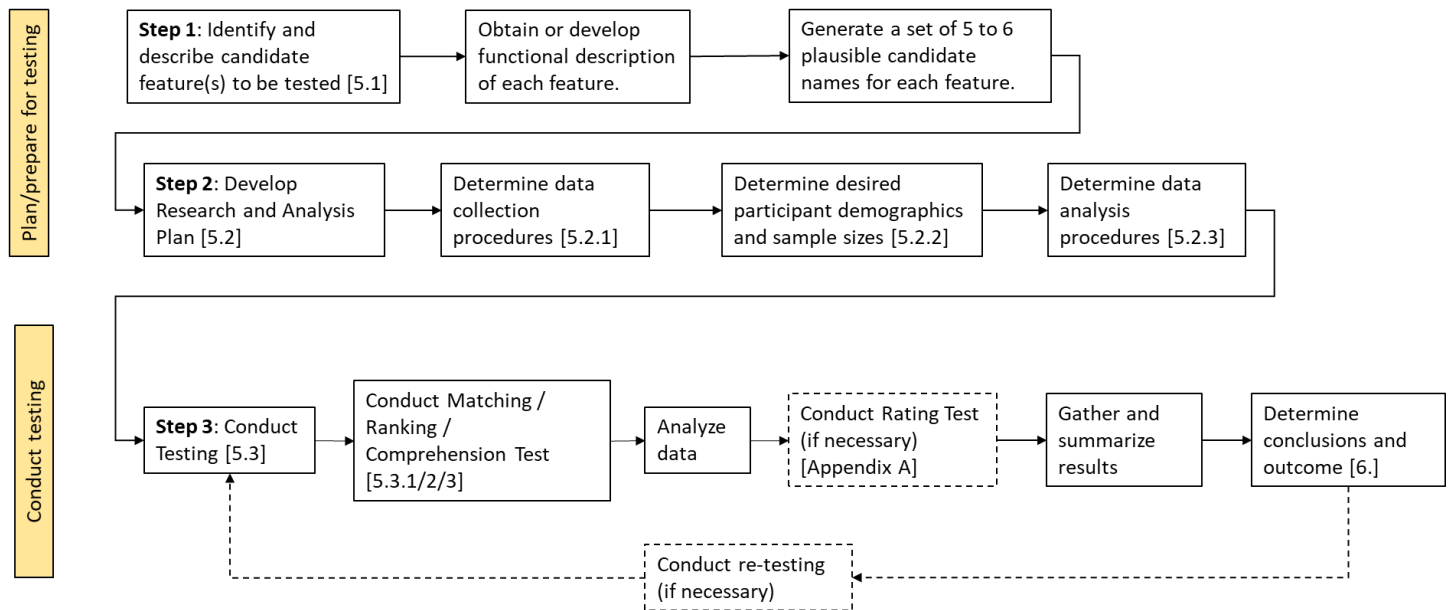


Figure 1 - Overview of the recommended approach to developing names for driving automation system features

Below, we provide the individual steps recommended for implementing the naming methodology process.

5.1 Step 1: Identify and Describe the Driving Automation System Features to be Tested

The types of naming tests described in Section 4 are generally performed on features that will be newly developed for market introduction. Conducting the test requires obtaining or developing functional descriptions of the feature(s) to be tested as a first step in the research. Some features may be described in public forums, or may be available through corporate promotional literature, non-technical media, professional conferences, technical journals, and standardization organizations. Broader availability of descriptions would likely allow more organizations to perform naming tests on a given feature. Consider reaching out to other companies and other SAE/ISO/etc. committees for potential examples of feature information.

Due to proprietary concerns, information for some features may only be known within a given developer's organization. In this case, the naming tests would likely be performed within the developer's organization, with potential assistance from another organization(s) under contract. However, more detailed feature information may be available for the tests.

Independent of the source for a given candidate feature, the testing requires a functional description of the feature. Since a functional description is determined by how a feature is designed, a useful description could be obtained or gleaned from technical sources. NHTSA-2014-0070-0003 is a useful source document that provides helpful examples of feature descriptions. The description(s) should cover aspects such as, but not limited to:

- The feature's purpose (i.e., parking, freeway travel, urban travel, etc.).
- Limits on the conditions in which the feature operates.
- Actions needed by a human, if any, when the feature is operating.