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(R) Driver-Vehicle Interface Considerations for Lane Keeping Assistance Systems		

RATIONALE

This document was updated to include common naming terminology, revised definitions, and order of definitions to clearly group related areas. Clarification was also added to differentiate lane keeping assistance (LKA) systems as momentary intervention, rather than sustained intervention systems that provide higher levels of driver assistance.

FOREWORD

This SAE Recommended Practice is intended to address the driver-vehicle interface (DVI) aspects of LKA systems as specified by ISO 11270. DVI and human-machine interface (HMI) have been used interchangeably in the existing literature and have the same meaning for the purpose of this document.

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1. SCOPE

The purpose of this document is to provide guidance for the implementation of DVI for momentary intervention-type LKA systems, as defined by ISO 11270.

LKA systems provide driver support for safe lane keeping operations via momentary interventions. LKA systems are SAE Level 0, according to SAE J3016.

LKA systems do not automate any part of the dynamic driving task (DDT) on a sustained basis and are not classified as an integral component of a partial or conditional driving automation system per SAE J3016. The design intent (i.e., purpose) of an LKA system is to address crash scenarios resulting from inadvertent lane or road departures. Drivers can override an LKA system intervention at any time. LKA systems do not guarantee prevention of lane drifts or related crashes. Road and driving environment (e.g., lane line delineation, inclement weather, road curvature, road surface, etc.) as well as vehicle factors (e.g., speed, lateral acceleration, equipment condition, etc.) may affect the operation of the LKA system.

As used in this document, the term “LKA” refers to lateral control driver assistance that automatically intervenes to address a lane departure if the driver either does not signal intent to change lanes (e.g., via turn signal activation) and/or does not initiate corrective steering action to prevent the lane departure. LKA is temporary in nature and distinct from lane centering assistance, which performs sustained steering adjustments to maintain the vehicle’s lateral position within a given lane.

This document addresses DVI parameters for original equipment LKA systems on light-duty vehicles (i.e., passenger cars and light trucks) with a Gross Vehicle Weight Rating of less than 10000 pounds. This document does not apply to the installation of aftermarket LKA systems or those on motorcycles or medium- and heavy-duty vehicles. This document does not address system or operational requirements for LKA systems, which are specified by ISO 11270. The responsibility for the safe operation of the vehicle always remains with the driver.

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 J1050	Describing and Measuring the Driver’s Field of View
SAE J2944	Operational Definitions of Driving Performance Measures and Statistics
SAE J3016	Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles

2.1.2 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 2575	Road vehicles - Symbols for controls, indicators and tell-tales
ISO 11270	Intelligent transport systems - Lane keeping assistance systems (LKAS) - Performance requirements and test procedures
ISO 15006	Road vehicles - Ergonomic aspects of transport information and control systems - Specifications and compliance procedures for in-vehicle auditory presentation
ISO 15008	Road vehicles - Ergonomic aspects of transport information and control systems - Specifications and compliance procedures for in-vehicle visual presentation

3. DEFINITIONS

3.1 DRIVER

For the purposes of this document, “driver” means a human driver.

3.2 SUBJECT VEHICLE

Vehicle equipped with LKA as defined herein.

3.3 ACTIVATION CRITERIA

Operational design conditions required for the LKA systems to function, when enabled or in LKA on state (see 3.7.2).

NOTE: These may include minimum and/or maximum vehicle speeds, detected lane markings, and the absence of system faults.

3.4 LANE (ISO 11270)

The area of roadway that a vehicle would be expected to travel along in the absence of any obstruction without the driver's desire to change the path of travel.

3.4.1 LANE BOUNDARY (ISO 11270)

The borderline of the lane that is determined by visible lane markings and, in the absence of a visible lane marking, by incidental visible road features or other means, such as GPS, magnetic nails, etc.

NOTE: In the case of a visible lane marking, the boundary is at the center thereof.

3.4.2 VISIBLE LANE MARKING (ISO 11270)

Delineators intentionally placed on the borderline of the lane that are directly visible by the LKA system while driving (e.g., not covered by snow, etc.).

3.4.3 INCIDENTAL VISIBLE ROAD FEATURE (ISO 11270)

Visible patterns on the road surface that were not explicitly intended to delineate boundaries of the lane, but which are indicative of position within the lane.

NOTE: These may include such features as pavement seams, edges, or curbs.

3.5 LANE KEEPING ACTIONS (ISO 11270)

Actions which the system performs to influence the lateral movement of the subject vehicle with the intention of helping the driver keep the vehicle within the lane.

3.6 SUPPRESSION REQUEST (ISO 11270)

A driver request or a system feature intended to prevent an LKA action if an intentional lane departure is detected.

3.7 LKA ACTIVE STATE

System is enabled, or switched on, and the activation criteria are met.

NOTE: The active state includes the following sub-states:

- LKA intervening - System is exerting one or more vehicle control functions (e.g., steering, braking, drive torque).
- LKA overridden - System intervention is temporarily suspended or overcome by a driver action (e.g., steering).
- LKA suppressed - While activation criteria are met, system intervention is temporarily suspended due to driver request or a system feature intended to prevent an LKA action (e.g., turn signal, automatic lane change, etc.).

3.7.1 LKA OFF STATE (ISO 11270)

System is switched off. The system is not available for use in this state.

3.7.2 LKA ON STATE (ISO 11270)

System is switched on. The system is available for use in this state. The on state reflects either the active or stand-by state.

3.7.3 LKA STAND-BY STATE (ISO 11270)

System is enabled, or switched on, but the activation criteria are not all met.

3.7.4 SYSTEM STATES (ISO 11270)

One of several stages or phases of system operation (refer to Figure 1 from ISO 11270).

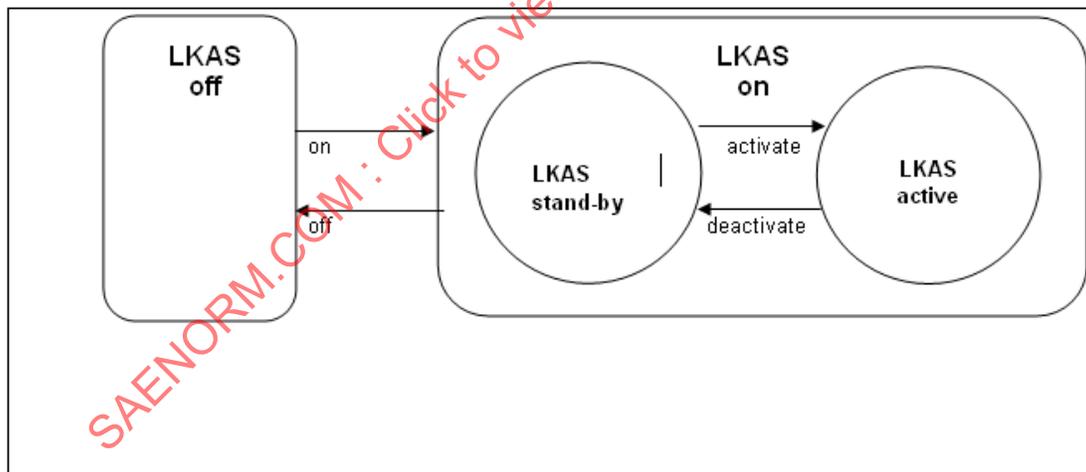


Figure 1 - LKA states and transitions

4. ABBREVIATIONS

ISO International Standards Organization

LKA lane keeping assistance

5. SYMBOLS

5.1 Where a symbol is used in place of words to refer to an LKA system (e.g., system indicator, display, or owner's manual), refer to ISO 2575 for guidance (see Figure 2, symbol K25 from ISO 2575).



Figure 2 - ISO 2575, symbol K25

6. REQUIREMENTS

6.1 Operational Characteristics

6.1.1 Warning and Assistance Functions

An LKA system may provide warnings in addition to momentary lateral interventions. These functions may be provided concurrently or sequentially, depending on the system strategy and operating condition.

6.1.1.1 Driver Override of Assistance Function

The driver shall be able to override a lane keeping action at any time. The driver shall be able to override the lane keeping action at least by turning the steering wheel. Other driver actions could also be considered as overriding (e.g., hard braking).

NOTE: Systems may or may not provide explicit feedback to the driver indicating an override event.

6.1.1.2 Suppression Request

A lane keeping action may be suppressed under specified conditions, such as turn signal activation or intervention by another safety system (e.g., electronic stability control). Suppression based on turn signal activation may be cancelled if the turn signal remains activated for a prolonged period of time.

NOTE: Systems may or may not provide explicit feedback to the driver indicating a suppression event.

6.2 System State and State Indication

The transition from LKA off to LKA on, or vice versa, can be performed manually by the driver or automatically by the LKA system. When the LKA is on, it may be in either the active or the stand-by state.

EXAMPLE 1: LKA may automatically transition to off state (i.e., unavailable) if a malfunction occurs.

EXAMPLE 2: LKA may automatically transition to on state upon vehicle restart, even if turned off manually by the driver during the previous trip.

EXAMPLE 3: Driver turns off LKA through vehicle settings or other controls.