International Standard

ISO 17387

Intelligent transport systems — Lane change decision aid systems (LCDAS) — Performance requirements and test procedures

Systèmes de transport intelligents — Systèmes d'aide à la décision de changement de voie (LCDAS) — Exigences de performances et méthodes d'essai

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical CommitteeISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 17387:2008), which has been technically revised.

The main changes are as follows:

— the target vehicle closing speed classification and target vehicle closing speed classification for road curvature have been modified;

— the test procedure for closing vehicle warning function has been modified;

— the blind spot warning test for target vehicle moving laterally has been modified;

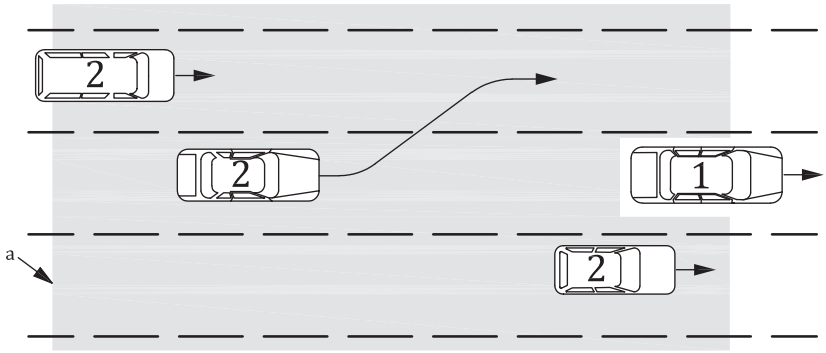
— the definition of the reference point for driver’s eye position has been simplified.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Lane change decision aid systems (LCDAS) warn the driver against collisions that can occur due to a lane change manoeuvre. LCDAS are intended to supplement the vehicle's interior and exterior rear-view mirrors; they are not intended to eliminate the need for such mirrors. LCDAS are intended to detect vehicles in the adjacent lanes to the rear and sides of the subject vehicle (see Figure 1). When the subject vehicle driver indicates the desire to make a lane change, the system evaluates the situation and warns the driver if a lane change is not recommended. The absence of a warning does not guarantee that the driver can safely make a lane change manoeuvre. The system will not take any automatic action to prevent possible collisions. Responsibility for the safe operation of the vehicle remains with the driver.

NOTE Many figures in this document show vehicles on roadways with lane markings. This is not intended to imply that lane marking recognition or lane detection is required for an LCDAS. The lane markings are drawn for reference only.



Key

1 subject vehicle
2 target vehicles
a The shaded area illustrates the concept of one possible system. The actual requirements are given in Clause 5.

Figure 1 — LCDAS concept

Intelligent transport systems — Lane change decision aid systems (LCDAS) — Performance requirements and test procedures

1 Scope

This document specifies system requirements and test methods for lane change decision aid systems (LCDAS). LCDAS are intended to warn the driver of the subject vehicle against potential collisions with vehicles either to the side or to the rear in the adjacent lanes of the subject vehicle and moving in the same direction as the subject vehicle for lane change manoeuvres. This document addresses LCDAS for use on forward-moving cars, vans and straight trucks.

This document does not address LCDAS for use on motorcycles or articulated vehicles such as tractor/trailer combinations and articulated buses.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
subject vehicle
vehicle equipped with the system in question and related to the topic of discussion

3.2
target vehicle
<lane change decision aid systems> any vehicle that is closing in on the subject vehicle from behind, or any vehicle that is located in one of the adjacent zones

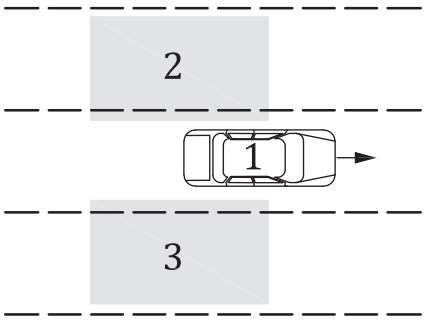
3.3
coverage zone
entire area to be monitored by the lane change decision aid system (LCDAS), consisting of a specific subset of the following zones: left adjacent zone, right adjacent zone, left rear zone and right rear zone

Note 1 to entry: A target vehicle located within the coverage zone will thus be detected by the system.

3.4
adjacent zone
zone to the left and right of the subject vehicle

Note 1 to entry: See Figure 2. This figure shows the zone concept only. Actual requirements are given in 5.2.

Note 2 to entry: The adjacent zones are intended to cover the lanes adjacent to the subject vehicle. However, the position and size of the adjacent zones are defined with respect to the subject vehicle and are independent of any lane markings.



Key

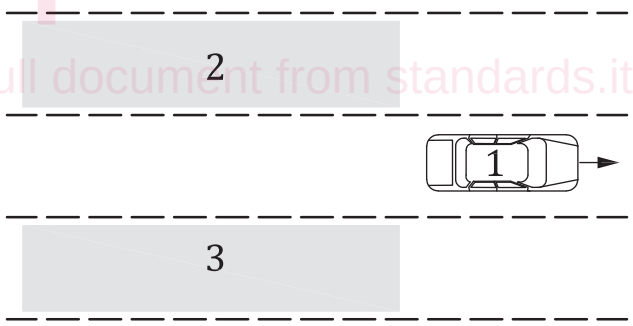
1	subject vehicle
2	left adjacent zone
3	right adjacent zone

Figure 2 — Adjacent zones

3.5
rear zone
zone that is behind and to the sides of the subject vehicle

Note 1 to entry: See Figure 3. This figure shows the zone concept only. Actual requirements are given in 5.2.

Note 2 to entry: The rear zones are intended to cover the lanes adjacent to the subject vehicle. However, the position and size of the rear zones are defined with respect to the subject vehicle and are independent of any lane markings.



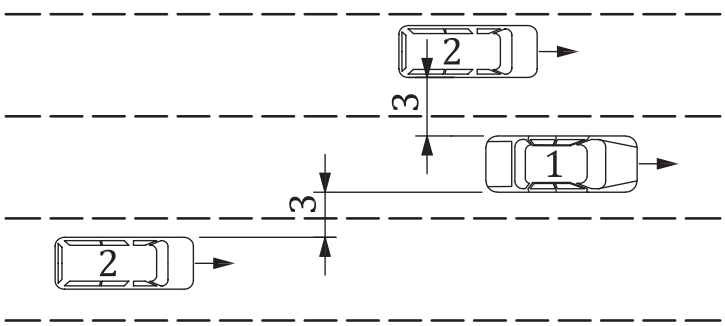
Key

1	subject vehicle
2	left rear zone
3	right rear zone

Figure 3 — Rear zones

3.6
lateral clearance
<of a target vehicle> lateral distance between the side of the subject vehicle and the near side of a target vehicle

Note 1 to entry: See Figure 4.



Key

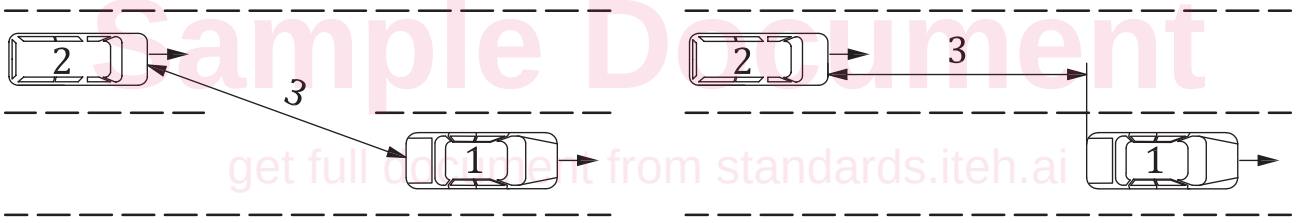
1 subject vehicle
2 target vehicle
3 lateral clearance

Figure 4 — Lateral clearance

3.7
rear clearance
<of a target vehicle> distance between the rear of the subject vehicle and the front of the target vehicle as measured along a straight line, or optionally, as estimated along the target vehicle's estimated path

Note 1 to entry: See Figure 5.

Note 2 to entry: This definition applies to target vehicles in the rear zones only.



a) On a straight road measured along a straight line

b) On a straight road estimated along target vehicle path

Key

1 subject vehicle
2 target vehicle
3 rear clearance

Figure 5 — Examples of rear clearance

3.8
closing speed
<of a target vehicle> difference between the target vehicle's speed and the subject vehicle's speed

Note 1 to entry: This definition applies to target vehicles in the rear zones only. A positive closing speed indicates that the target vehicle is closing in on the subject vehicle from the rear.

3.9
time to collision
estimated time that it would take a target vehicle to collide with the subject vehicle if the subject vehicle were in the target vehicle's path and the target vehicle's current closing speed were to remain constant

Note 1 to entry: Time to collision can be estimated by dividing a target vehicle's rear clearance by its closing speed. This definition applies to target vehicles in the rear zones only.

3.10
overtaking speed
<of the subject vehicle> difference between the subject vehicle's speed and the target vehicle's speed when the subject vehicle is overtaking the target vehicle

Note 1 to entry: A positive overtaking speed indicates that the subject vehicle is moving faster than the target vehicle.

3.11
blind spot warning function
function that detects the presence of target vehicles in one or more of the adjacent zones and provides a warning to the subject vehicle driver

3.12
closing vehicle warning function
function that detects closing vehicles in one or more of the rear zones and provides a warning to the driver

3.13
lane change warning function
function that combines the blind spot warning function and the closing vehicle warning function

3.14
roadway radius of curvature
horizontal radius of curvature of the road on which the subject vehicle is travelling

3.15
straight road
segment of road for which the curve radius is larger than 5 000 m

3.16
reference point for driver's eye position
reference for the position of driver's eyes in longitudinal direction of the subject vehicle

Note 1 to entry: The reference point is located at the centre of the 95th percentile eyellipse on the x-axis of the subject vehicle.

4 Classification

4.1 Coverage zone classification

4.1.1 General

LCDAS are classified by the minimum required coverage as shown in Table 1. For example, a type I system shall provide coverage of at least the left and right adjacent zones.

Table 1 — Coverage zone classification

Type	Left adjacent zone coverage	Right adjacent zone coverage	Left rear zone coverage	Right rear zone coverage	Function
I	X	X			Blind spot warning
II			X	X	Closing vehicle warning
III	X	X	X	X	Lane change warning

4.1.2 Type I systems

Type I systems provide the blind spot warning function only. Type I systems are intended to warn the subject vehicle driver of target vehicles in the adjacent zones. Type I systems are not required to provide warnings

of target vehicles that are approaching the subject vehicle from the rear. The subject vehicle driver shall be made aware of the limitations of this type of system, at least in the owner's manual. In particular, the owner's manual shall include the following statement: "This system provides support only within a limited area beside the vehicle. The system will not necessarily provide adequate warning for vehicles approaching from the rear."

4.1.3 Type II systems

Type II systems provide the closing vehicle warning function only. These systems are intended to warn the subject vehicle driver of target vehicles that are approaching the subject vehicle from the rear. Since type II systems are not required to provide warnings of target vehicles located adjacent to the subject vehicle, type II systems are recommended for use on vehicles that have side mirrors with a horizontal field of view of at least 45° on both sides of the vehicle. If type II systems are used on other vehicles, the owner's manual should include the following statement: "The driver is required to turn and look into the adjacent area before attempting a lane change." The subject vehicle driver shall be made aware of the limitations of this type of system, at least in the owner's manual. In particular, the owner's manual shall include the following statement: "This system provides no support for the areas adjacent to the subject vehicle. This system will not necessarily provide adequate warning for very fast moving vehicles approaching from the rear and will not necessarily not cover the detection of approaching vehicles in all road curvatures."

4.1.4 Type III systems

Type III systems provide the blind spot warning function and the closing vehicle warning function. Type III systems are intended to warn the subject vehicle driver of target vehicles in the adjacent zones and target vehicles which are approaching the subject vehicle from the rear. The subject vehicle driver shall be made aware of the limitations of this type of system, at least in the owner's manual. In particular, the owner's manual shall include the following statement: "This system will not necessarily provide adequate warning for very fast moving vehicles approaching from the rear and will not necessarily cover the detection of approaching vehicles in all road curvatures."

4.2 Target vehicle closing speed classification

LCDAS of types II and III are classified based on the maximum approaching target vehicle closing speed shown in Table 2. A system may belong to more than one of the types listed in Table 2. For example, a highly capable system may meet or exceed the minimum requirements defined individually for types SAV, MAV and FAV.

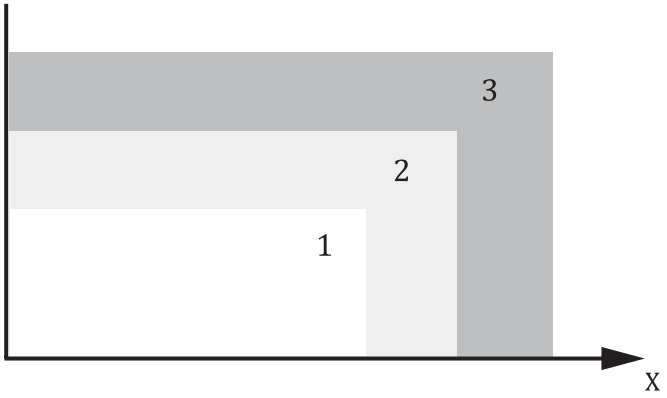
Table 2 — Target vehicle closing speed classification

Type	Maximum target vehicle closing speed m/s
SAV	10
MAV	15
FAV	20

NOTE The maximum target vehicle closing speed has a direct effect on the required sensor range and/or acquisition time. A higher closing speed will require a longer sensor range and/or a shorter acquisition time in order to detect the target vehicle in sufficient time to give the subject vehicle driver adequate warning.

Figure 6 shows the minimum performance of type SAV, MAV and FAV regarding the relative speed between the subject vehicle and the target vehicle. LCDAS of types II and III can be capable of operating on curved roads. There is a relationship between the maximum target vehicle closing speed and the roadway radius of curvature. For a given curve radius and a typical subject vehicle speed, the closing speed of a target vehicle is limited by driving dynamics parameters. In addition, the visibility of the target vehicle can be limited due to the curve radii.

The subject vehicle driver shall be made aware of the limitations of the system, at least in the owner's manual. In particular, the owner's manual shall include the following statement: "This system will not necessarily provide adequate warning on curves."



Key

X	target vehicle closing speed, m/s
1	type SAV - slow
2	type MAV - medium
3	type FAV - fast

Figure 6 — Type SAV, MAV, FAV system minimum performance regarding to target vehicle closing speed

4.3 Optional target vehicle closing speed classification for road curvature

4.3.1 Overview

In addition to the target vehicle closing speed classification (SAV, MAV or FAV) as shown in Figure 6, curvature capability provided by LCDAS can also be provided.

An advanced form of LCDAS may use additional sensor input or may integrate additional environmental information from a map. Such systems can provide the closing vehicle warning function in curvature situations.

For conformity to this optional classification, roadway curvature shall be related to the expectable maximum target vehicle closing speed, shown in Table 3.

Types A, B and C represent the relationship between LCDAS types SAV, MAV and FAV in addition to a minimum roadway curvature:

— type A contains type SAV;

— type B contains type SAV and MAV;

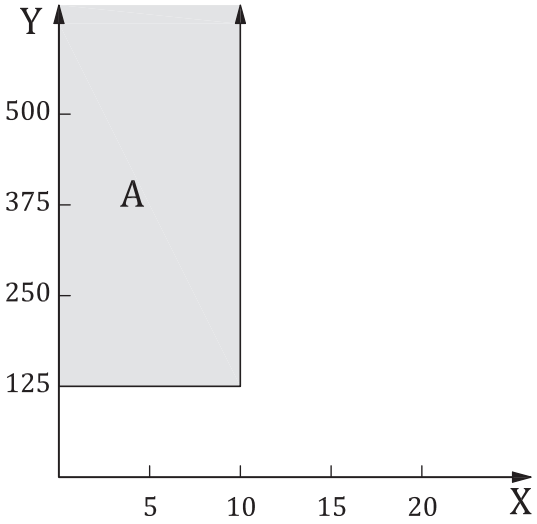
— type C contains type SAV, MAV and FAV.

Table 3 — Target vehicle closing speed classification for road curvature

Type	Maximum target vehicle closing speed m/s	Minimum roadway radius of curvature m
A	10	125
B	15	250
C	20	500

4.3.2 Type A systems

Figure 7 shows the minimum required region of performance with regard to roadway radius of curvature and target vehicle closing speed for a type A system. Type A systems can be capable of operating on curved roads with smaller radii. The subject vehicle driver shall be made aware of the limitations of the system, at least in the owner's manual. In particular, the owner's manual shall include the following statement: "This system will not necessarily provide adequate warning on curves tighter than [X] metres radius," where X is replaced by the tightest curve radius for which the system is designed but not more than 125 m.



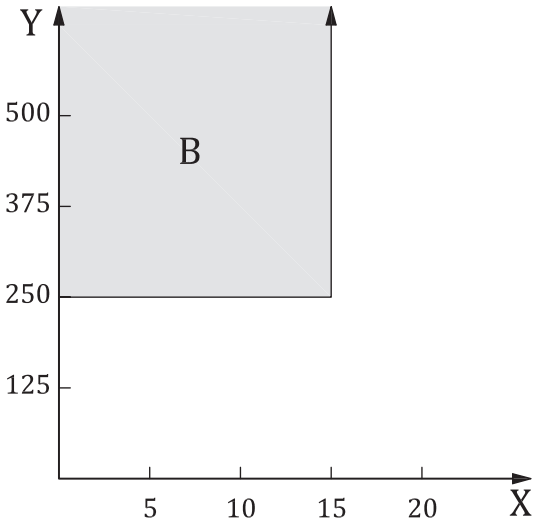
Key

X target vehicle closing speed, m/s
Y roadway radius of curvature, m

Figure 7 — Type A system minimum region of performance

4.3.3 Type B systems

Figure 8 shows the minimum required region of performance with regard to roadway radius of curvature and target vehicle closing speed for a type B system. Type B systems can be capable of operating on curved roads with smaller radii. The subject vehicle driver shall be made aware of the limitations of the system, at least in the owner's manual. In particular, the owner's manual shall include the following statement: "This system will not necessarily provide adequate warning on curves tighter than [X] metres radius" where X is replaced by the tightest curve radius for which the system is designed but not more than 250 m.



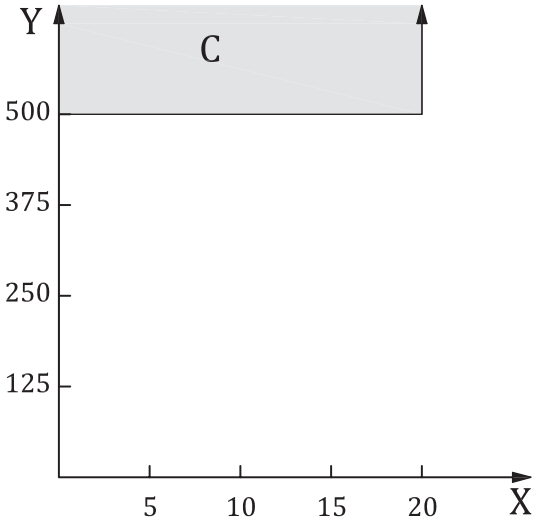
Key

X	target vehicle closing speed, m/s
Y	roadway radius of curvature, m

Figure 8 — Type B system minimum region of performance

4.3.4 Type C systems

Figure 9 shows the minimum required region of performance with regard to roadway radius of curvature and target vehicle closing speed for a type C system. Type C systems can be capable of operating on curved roads with smaller radii. The subject vehicle driver shall be made aware of the limitations of the system, at least in the owner's manual. In particular, the owner's manual shall include the following statement: "This system will not necessarily provide adequate warning on curves tighter than [X] metres radius" where X is replaced by the tightest curve radius for which the system is designed but not more than 500 m.



Key

X	target vehicle closing speed, m/s
Y	roadway radius of curvature, m

Figure 9 — Type C system minimum region of performance

5 Functional requirements

5.1 LCDAS state diagram

5.1.1 General

At a minimum, the LCDAS shall operate according to the state diagram in Figure 10.

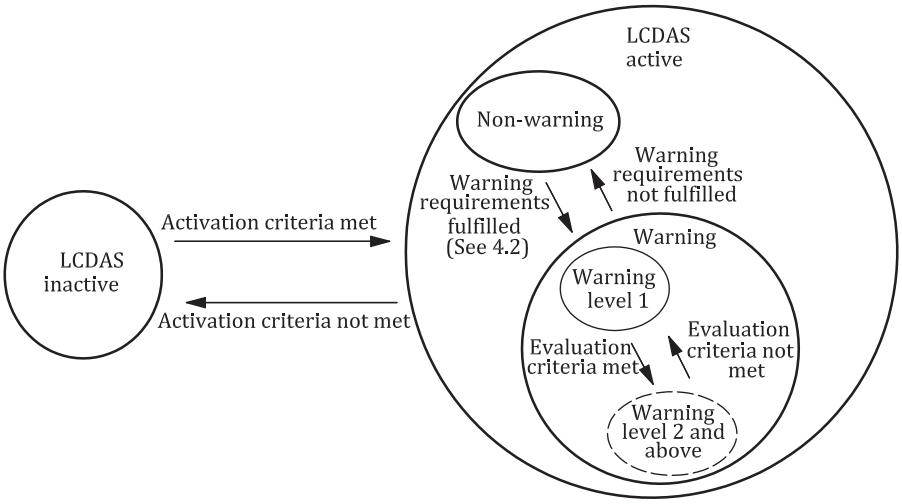


Figure 10 — LCDAS state diagram

5.1.2 LCDAS inactive state

In the LCDAS inactive state the system shall give no warnings to the driver. This state may be a power off state or a ready state. In a ready state the system can detect target vehicles, but shall not issue warnings because the activation criteria are not met.

5.1.3 Activation criteria

5.1.3.1 General

When activated, the LCDAS shall transition from the LCDAS inactive state to the LCDAS active state. Several activation criteria may be used at the same time. Potential activation criteria include but are not limited to those described in the following subclauses.

5.1.3.2 Continuous activation

The system may be active continuously (whenever the subject vehicle's ignition is on).

5.1.3.3 Manual switch activation

The system may be activated manually, e.g. by a toggle switch, a tip switch or a menu-based user interface.

5.1.3.4 Turn signal activation

The system may be activated based on the subject vehicle turn signal status. For instance, if the left turn signal is on, the system may be activated on the left side of the subject vehicle, while remaining inactive on the right side of the subject vehicle.