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Intelligent transport systems — Lane keeping assistance systems (LKAS) — Performance requirements and test procedures

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National foreword

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 documents 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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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

Introduction

The main system function of a Lane Keeping Assistance System (LKAS) is to support the driver in keeping the vehicle within the current lane. LKAS acquires information on the position of the vehicle within the lane and, when required, sends commands to actuators to influence the lateral movement of the vehicle. LKAS provides status information to the driver.

Issues such as specific requirements for the detection sensor function and its performance, or the communication links for co-operative solutions, will not be considered here.

Intelligent transport systems — Lane keeping assistance systems (LKAS) — Performance requirements and test procedures

1 Scope

This International Standard contains the basic control strategy, minimum functionality requirements, basic driver interface elements, minimum requirements for diagnostics and reaction to failure, and performance test procedures for Lane Keeping Assistance Systems (LKAS). LKAS provide support for safe lane keeping operations by drivers and do not perform automatic driving nor prevent possible lane departures. The responsibility for the safe operation of the vehicle always remains with the driver. LKAS is intended to operate on highways and equivalent roads. LKAS consist of means for recognizing the location of the vehicle inside its lane and means for influencing lateral vehicle movement. LKAS should react consistently with the driver expectations with respect to the visible lane markings. The support at roadway sections having temporary or irregular lane markings (such as roadwork zones) is not within the scope of this International Standard. This International Standard is applicable to passenger cars, commercial vehicles, and buses.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2575, *Road vehicles — Symbols for controls, indicators and tell-tales*

3 Terms and definitions

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

3.1
subject vehicle
vehicle equipped with LKAS as defined herein

3.2
system states
one of several stages or phases of system operation (see Figure 1)

3.2.1
LKAS off state
system is switched off

3.2.2
LKAS on state
system is switched on

3.2.3
LKAS stand-by state
system is switched on but the activation criteria are not all met

3.2.4
LKAS active state
system is switched on and the activation criteria are met

3.3
lane
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
visible lane marking
delineators intentionally placed on the borderline of the lane that are directly visible to the driver while driving (e.g. not covered by snow, etc.)

3.5
incidental visible road feature
visible patterns on the road surface that were not explicitly intended to delineate the boundaries of the lane, but which are indicative of the position of the lane

Note 1 to entry: These can include such features as pavement seams or edges and curbs.

3.6
lane boundary
borderline of the lane that is determined by a visible lane marking; and in the absence of a visible lane marking, by incidental visible road features or other means such as GPS, magnetic nails, etc

Note 1 to entry: In the case of a visible lane marking, the boundary is at the center thereof.

3.7
time to line crossing
TTLC
calculated time to lane departure

Note 1 to entry: For example, the most simple calculation method of this time (TTLC) is to divide lateral distance (*D*) between the predetermined part of the vehicle and the lane boundary by rate of departure (*V_depart*) of the vehicle relative to the lane. (*TTLC* = *D*/*V_depart*)

3.8
suppression request
driver request or a system feature intended to prevent an LKAS action if an intentional lane departure is detected

3.9
lane keeping actions
actions which the system performs to influence the lateral movement of the subject vehicle with the intention of helping the driver to keep the vehicle within the lane

3.10
rate of departure
V_depart
component of subject vehicle's approach velocity at a right angle to the lane boundary

3.11
visibility
distance at which the illuminance of a non-diffusive beam of white light with a colour temperature of 2 700 K is decreased to 5 % of its original light source illuminance

3.12
automatic driving
system that drives the vehicle without the driver being in the vehicle control loop, e.g. without a hand on the steering wheel or feet on the pedals

3.13
failure
mechanical or electronic malfunction which causes a persistent loss of performance or function

Note 1 to entry: Temporary performance reductions, for example, due to bad weather conditions, bad lane markings, or temporarily occurring sensor blindness, are not considered a failure.

3.14
straight
segment of road which curvature is less than 1/5 000 m

4 Symbols and abbreviated terms

4.1 Symbols

Table 1 — Symbols and meanings

Symbol	Meaning
D	distance between the predetermined part of the vehicle and the lane boundary
LKAS_curvature_rate_max	maximum rate of change of curvature which is allowed for the curve test track
LKAS_curve_time	minimum duration of the curve test after entering the curve
LKAS_Lat_Acel_max	maximum lateral acceleration which is allowed to be induced by a lane keeping action
LKAS_Lat_Jerk_max	maximum lateral jerk which is allowed to be induced by a lane keeping action
LKAS_Offset_max	maximum value by which the outer edges of the tyres of the vehicle are allowed to exceed the lane boundary
V_depart	rate of departure
vmax	LKAS is not required to function if the vehicle speed is larger than *vmax*
vmin	LKAS is not required to function if the vehicle speed is less than *vmin*

4.2 Abbreviated terms

TTLC time to line crossing

5 Requirements

5.1 Functionality

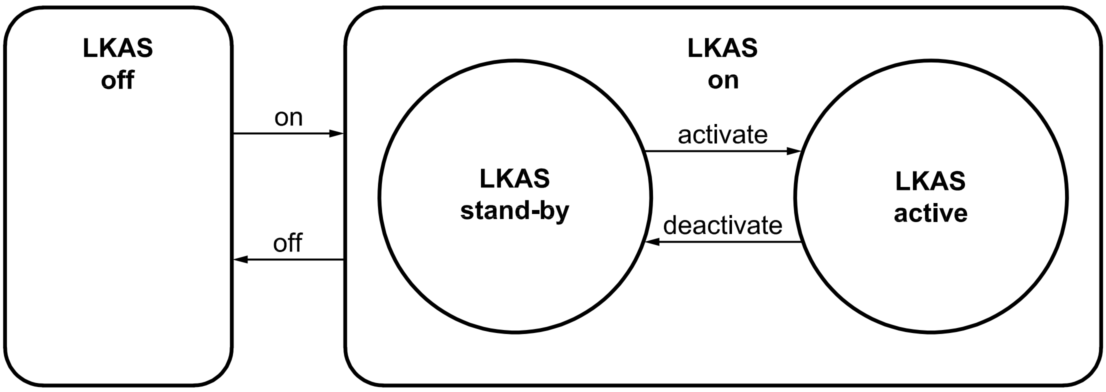


Figure 1 — LKAS states and transitions

LKAS provides support for safe lane keeping operations by drivers and do not perform automatic driving nor prevent possible lane departures. The responsibility for the safe operation of the vehicle always remains with the driver. LKAS shall, as a minimum, provide the following operations and state transitions. The following constitutes the fundamental behaviour of LKAS.

— The transition from LKAS off to LKAS on can be performed by the driver or automatically, e.g. after the ignition is switched on and no system failure has occurred. The transition from LKAS on to LKAS off can be performed by the driver or automatically, for instance after the ignition is switched off or a system failure has occurred.

— LKAS shall be operational for speeds between *vmin* and *vmax*. *vmin* = 20 m/s, *vmax* = 30 m/s, or the maximum possible vehicle speed, whichever is less. It is allowed to be operational in a wider speed range.

— In LKAS stand-by state, the system shall evaluate the activation criteria. LKAS shall not perform any lane keeping actions. One of the activation criteria shall be that the system has determined the position of the vehicle within the lane relative to the visible lane markings of its own lane. It is up to the manufacturer to decide whether it is necessary to detect one or both visible lane markings of the own lane. Other criteria to be selected by the manufacturer can be the type of the lane marking (e.g. solid or dashed), a minimum vehicle speed, driver actions, steering angle, and other vehicle conditions. If all of the selected activation criteria are met, the system shall transition from LKAS stand-by to LKAS active state. This transition can be done automatically or by a driver confirmation.

— In LKAS active state, the system shall evaluate the activation criteria. If any one of the selected activation criteria is not met, the system shall transition from LKAS active to LKAS stand-by state. In the LKAS active state, the system can perform lane keeping actions to influence the lateral movement of the subject vehicle with the intention of helping the driver to keep the vehicle within the lane when an unintended lane departure is likely. A lane keeping action influences the lateral movement of the subject vehicle with respect to the lane in such a way that the TTLC increases compared to the vehicle movement without a lane keeping action (unless the driver overrides the system). The system can detect suppression requests to minimize nuisance lane keeping actions. The suppression request can be issued, e.g. if the driver operates a turn signal.

5.2 Basic driver interface and intervention capabilities

The system shall provide the following controls and intervention capabilities:

5.2.1 Operation elements and system reactions

— The driver shall be provided with means to override the lane keeping action at any time. Such means shall include turning the steering wheel.

— Specific driver actions can be considered as a suppression request.

— The driver shall be provided with the means to transition from LKAS on to LKAS off and to keep the system in the LKAS off state. Such transition shall be possible regardless of whether the system is in the LKAS active or the LKAS stand-by state.

— The driver shall be provided with the means to transition from LKAS off to LKAS on.

— Drivers shall be informed of the conditions that result in LKAS activation and deactivation by the vehicle owner's manual.

5.2.2 Display elements

— The information about whether the LKAS is in LKAS on state shall be accessible to the driver, e.g. in a pull down menu.

— It shall be displayed whether LKAS is in LKAS active state, except if the vehicle is equipped with a combination of systems that assist the driver to keep the vehicle inside the lane, e.g. with lane departure warning system and LKAS. In this case, it shall be displayed whether at least one of the systems is in an active state.

— If LKAS is not available due to a failure, the driver shall be informed.

5.2.3 Symbols

— If symbols are used to identify LKAS function or malfunction, standardized symbols in accordance with ISO 2575 are recommended to be employed.

5.3 Minimum functionality

To cover the main purpose to help the driver to keep the vehicle inside the lane, the LKAS shall pass the test procedure defined in Clause 6.

5.4 Operational limits

The LKAS should be designed in a way that the driver is able to use the LKAS safely in all situations. Therefore, the vehicle actions which are induced by the lane keeping actions shall be limited.

— The magnitude of the lateral acceleration which is induced by the lane keeping action shall not exceed *LKAS_Lat_Acel_max*. Also the moving average over half a second of the lateral jerk should be limited to:

  — LKAS_Lat_Jerk_max.;

  — LKAS_Lat_Acel_max = 3 m/s^2 ;

  — LKAS_Lat_Jerk_max = 5 m/s^3.

— The lane keeping action shall not cause a longitudinal deceleration larger than 3 m/s^2. If the lane keeping action causes a longitudinal deceleration larger than 1,0 m/s^2, this shall not cause a speed reduction more than 5 m/s.

— In case of a transition from LKAS active state to LKAS stand-by state, the lane keeping action shall not end suddenly but shall be faded out smoothly.

— The vehicle owner's manual shall inform the driver that LKAS operation is not guaranteed to be the same as on a dry, flat road if it is under low traction conditions, on roads with lateral bend, super elevation, or adverse weather conditions.

— These operational limit requirements shall be fulfilled under all conditions.

5.5 Failure reactions

— Failures in the LKAS components shall result in immediate notification to the driver and LKAS shall transition to the LKAS off state. The notification shall remain active until the system is switched off.

— The reactivation of the LKAS shall be prohibited until a successful self-test, initiated by either ignition off/on or LKAS-off/on, is accomplished.

Table 2 — Failure reactions while LKAS performs a lane keeping action

	Failure in subsystem	
1	Actuator	LKAS control shall be stopped. If the actuator is still able to finish the current lane keeping action or to fade out smoothly, this is allowed before the LKAS control is stopped completely.
2	Lane recognition system	The lane keeping action shall not be ended suddenly but shall be faded out smoothly.
3	LKAS controller	LKAS control shall be stopped.

6 Performance evaluation test methods

Due to different actuators to realize interventions, e.g. steer torque or steer angle versus single sided braking, it is necessary to define a test, which can be passed by both systems.

6.1 Environmental conditions

— Test location shall be on a flat, dry, and clean asphalt or concrete surface.

— Temperature range shall be between −20 °C and +40 °C.

— The wind speed shall be less than 3 m/s.

— Horizontal visibility range shall be greater than 1 km.

— Visible lane markings of the test location shall be in good condition in accordance with the nationally defined visible lane markings. Also, they shall be marked in accordance with applicable standards for lane marking design and materials.

6.2 Test course conditions

The course shall be long enough to maintain a minimum vehicle speed (of at least 20 m/s) while allowing the vehicle to drift out from the lane at a low rate of departure.

The width of the lane marking shall be in the range of 0,1 m to 0,3 m according to applicable regulations for highway like roads.

The width of the lane relative to the centre of the lane markings shall be in the range of 3,4 m to 3,9 m according to applicable regulations for highway like roads.

6.3 Test vehicle conditions

The test vehicle mass shall be between complete vehicle kerb mass[1)] plus driver and test equipment (combined mass of driver and test equipment shall not exceed 150 kg) and maximum authorized total mass[2)] (Refer to ISO 15037). No alterations shall be made once the test procedure has begun.

6.4 Test system installation and configuration

The LKAS shall be installed and configured in accordance with the instructions provided by the manufacturer. For tests of the LKAS with a user adjustable intervention threshold, each test shall be performed with the intervention threshold set at its latest setting. No alterations to the system shall be made once the test procedure has begun.

1) Includes lubricants, coolant, washer fluid, fuel, spare wheel, fire extinguisher, standard spare parts, chocks, and standard tool-kit.

2) Determined as a maximum by the administrative authority.

6.5 Test procedure

Due to different system concepts, at least one of the test procedures “Procedure on a straight” or “Procedure in a curve” shall be fulfilled.

6.5.1 Parameters recoverable from data record

a) Lateral acceleration

b) Rate of departure

c) Vehicle speed

For all lane keeping actions by LKAS that occur during the test, the above listed data shall be recorded. The data shall be recovered by a device other than the system. The precision of the test device shall be noted in the test report.

6.5.2 Procedure on a straight

The test procedure consists of eight single tests.

The tests shall be conducted on a segment of straight road. The vehicle will travel straight along the segment of straight road at a speed of 20 m/s to 22 m/s. When travelling straight along the segment of straight road, the vehicle can travel either in the centre of the lane, or along the lane marking opposite to the lane marking that will be crossed at the time of lane departure. For example, when lane departure is carried out to the right, the vehicle can be driven along the left-hand lane marking and vice versa.

While maintaining the designated speed with the vehicle smoothly tracking the course so that its posture is stable, the vehicle shall be steered so as to gently depart from the lane at a rate of departure *V_depart* = 0,4 m/s ± 0,2 m/s for eight tests [four to the left (group 1) and four to the right (group 2)]. The tester shall conduct lane departure trials until four trials are achieved within each group according to the rate of departure with respect to the lane marking. The car manufacturer shall specify the minimum duration between two consecutive tests in order to avoid system unavailability e.g. due to misuse prevention measures.

Due to different actuators to realize interventions, it is possible to conduct these tests either with free (hands-off, no external torque applied) steering wheel or fixed steering wheel. These tests shall be passed using either free or fixed steering wheel.

A single test is successful if the outer edges of the tyres of the vehicle do not exceed the lane boundary more than *LKAS_Offset_max*

LKAS_Offset_max = 0,4 m for light vehicles

LKAS_Offset_max = 1,1 m for heavy vehicles

The test procedure is successfully passed if all eight tests are successful.

6.5.3 Procedure in a curve

6.5.3.1 Performing the test

The test procedure consists of two single tests. The vehicle speed shall be between 20 m/s and 22 m/s during the whole test. The tests shall be conducted on a road which is a straight entering a curve. At the straight, the test vehicle shall be adjusted near the middle of the lane such that it moves straight and parallel to the lane with the steering wheel angle being zero. After doing this, the steering wheel shall be set free just before entering the curve. After entering the curve, the test shall last for *LKAS_curve_time* seconds. The test shall be done twice, once entering a left curve and once entering a right curve. A single test is successful if the outer edges of the tyres of the vehicle do not exceed the lane boundary more than

LKAS_Offset_max during the test. The test procedure is successfully passed if both tests in a right and a left curve are successful.

LKAS_curve_time = 5 s

LKAS_Offset_max = 0,4 m for light vehicles

LKAS_Offset_max = 1,1 m for heavy vehicles

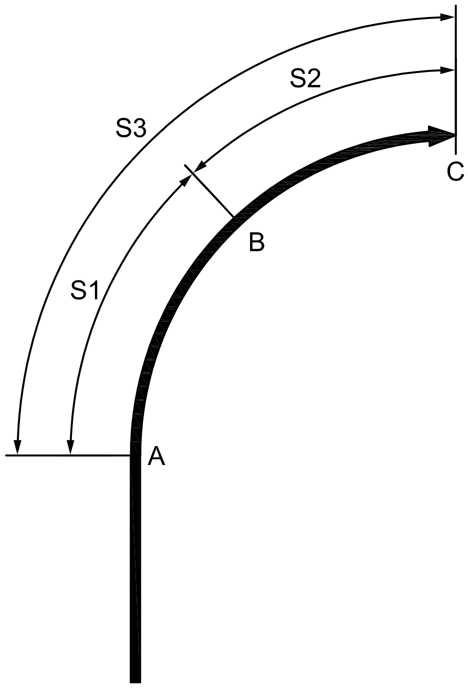
6.5.3.2 Test track

The curve radius is not specified and it is not necessary for the curve radius to be constant during the whole test. During the whole test, the rate of change of curvature should be continuous and should not exceed *LKAS_curvature_rate_max*. The test track shall be shaped, such that, if a vehicle would drive continuously in the middle of the lane, the lateral acceleration would not exceed 1,0 m/s^2. At least for the last second of the test, the test track shall be shaped, such that, if a vehicle would drive continuously in the middle of the lane, the lateral acceleration would be within the range from 0,5 m/s^2 to 1,0 m/s^2.

LKAS_curvature_rate_max = 4×10^{-5} $1/m^2$

Annex A
(informative)

Example for a track for the test procedure in a curve



v	20 m/s
ay	0,5 m/s^2
Radius	$R\ v^2\ /\ ay$ = 800 m, reached at point B
Curvature	$c = 1/R$ = 0,00125 1/m

End of test after 5 s at point C$S3$ = 5 s × v = 100 m

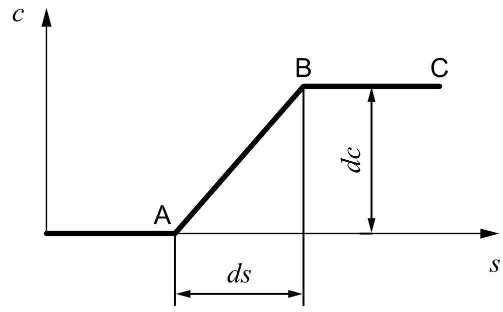
Figure A.1 — Example of a curve test track

EXAMPLE 1 Curvature rate = $dc/ds = 4 \times 10^{-5}$ 1/m^2

$S1 = c/(dc/ds)$ = 31 m and $S2 = S3 - S1$ = 69 m

EXAMPLE 2 Curvature rate = $dc/ds = 1{,}56 \times 10^{-5}$ 1/m^2

$S1 = c/(dc/ds)$ = 80 m and S2 = $S3 - S1$ = 20 m



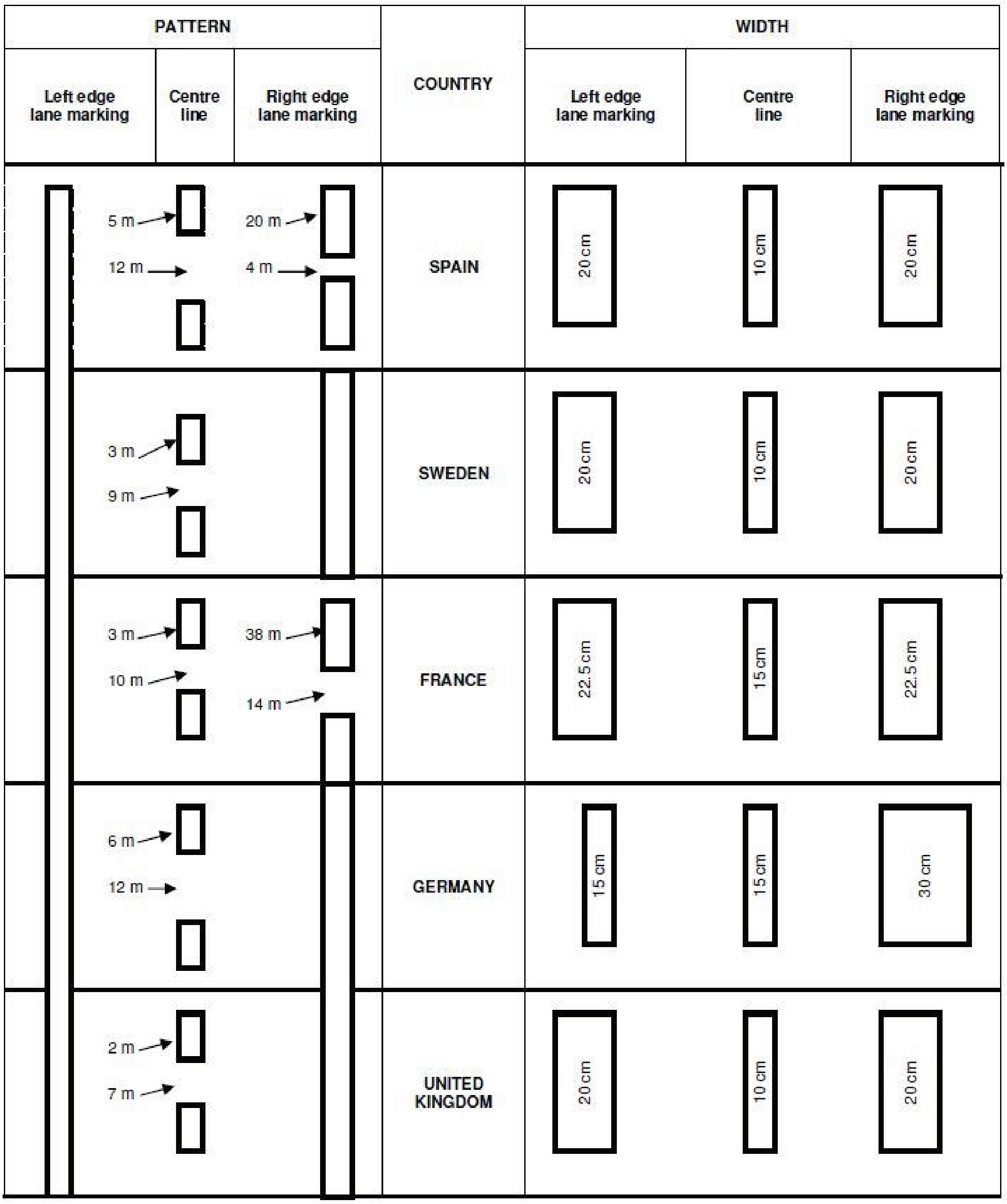
$$\frac{dc}{ds} \leq LKAS\_curvature\_rate\_max$$

Figure A.2 — Curvature of a curve test track

Annex B
(informative)

National road markings

B.1 General



PATTERN			COUNTRY	WIDTH		
Left edge lane marking	Centre line	Right edge lane marking		Left edge lane marking	Centre line	Right edge lane marking
	2.5 m; 10 m		BELGIUM	30 cm	20 cm	30 cm
	5 m; 10 m		DENMARK	30 cm	15 cm	30 cm
	3 m; 9 m		THE NETHERLANDS	15 cm	10 cm	15 cm
	4.5 m; 7.5 m		ITALY	15 cm	15 cm	15 cm
	4 m; 8 m		IRELAND	15 cm	10 cm	15 cm

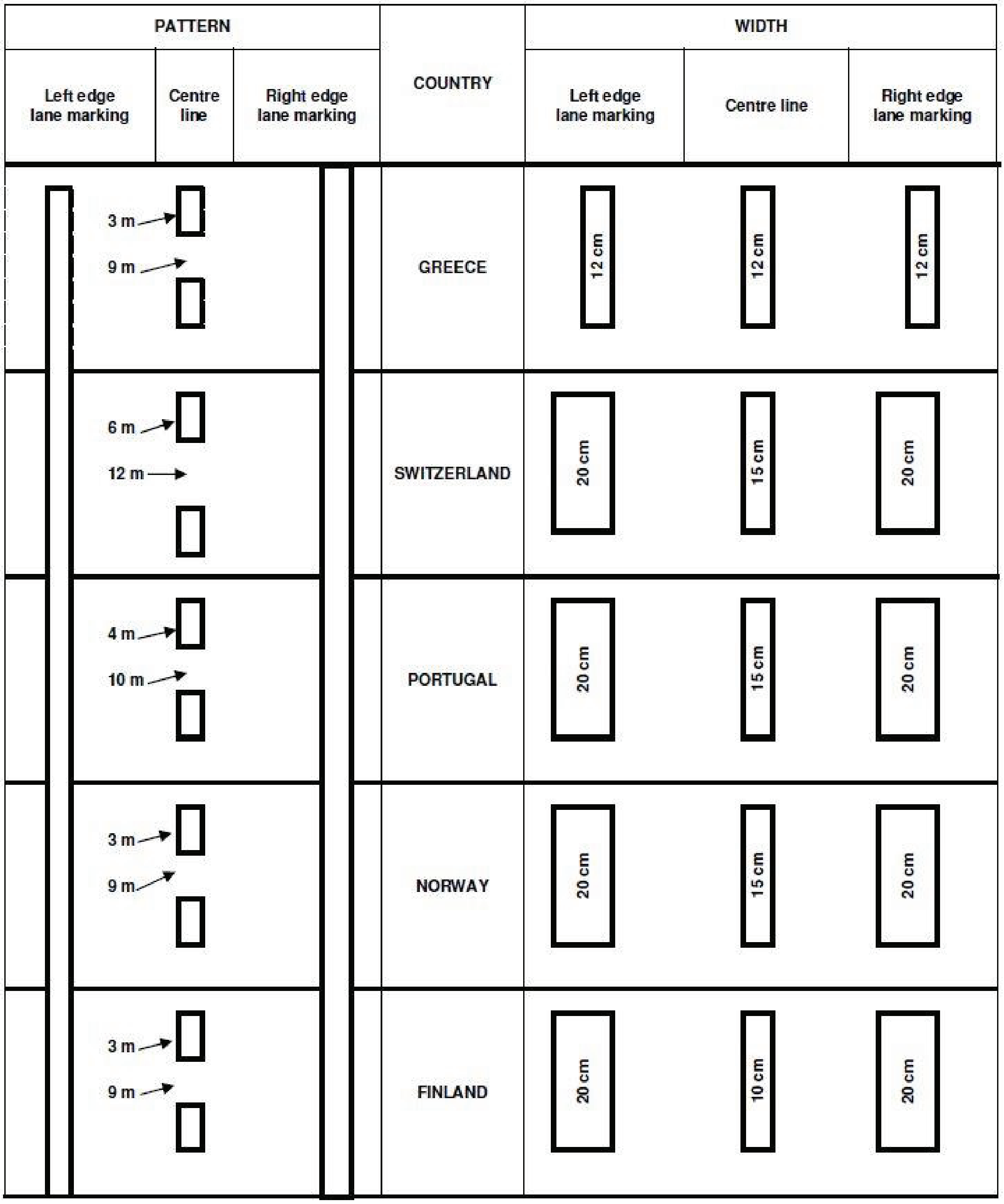


Figure B.1

B.2 China – Lane boundary technology

Lane width should be between 3,0 m to 3,75 m.

Lane boundary width should be 100 mm, 150 mm, or 200 mm wide.

Interrupted marking lines should be:

— 4 m (segment) + 6 m (void) for opposite direction;

— for same direction, 2 m (segment) + 4 m (void) for urban areas;

— 6 m (segment) + 9 m (void) for highway.

Note The information about lane boundaries in China is taken from China national standard GB 5768:1999.

B.3 ITALY - Lane boundary geometry

This is the information we have regarding lane boundary regulations in Italy.

Lane width should be between 2,5 m to 3,75 m for normal lanes and from 2 m to 3,5 m for emergency lanes. However, we have measured lanes of approximately 4 m.

Lane boundaries should be large from 120 mm (generic) to 150 mm (highway) to 250 mm (borders).

Interrupted marking lines should be:

— 3 m (segment) + 3 m (void) for urban areas;

— 3 m (segment) + 4,5 m (void) for extra urban roads;

— 4,5 m (segment) + 7,5 m (void) for highways.

In special cases, other markings are possible.

The data about lane boundary geometry in Italy were taken from the "Manuale della segnaletica stradale", ACINNOVA.

B.4 JAPAN - Lane boundary geometry

Lane width should be between 2,75 m to 3,5 m for generic lanes and from 3,25 m to 3,75 m for highway lanes.

Lane boundaries should be from 100 mm to 150 mm (borders) to 200 mm (centre) wide.

Lane segments and voids for interrupted marking lines should be the same length (between 3 m to 10 m) for centrelines. For borderlines, painted segments should be 3 m to 10 m, and 6 m to 20 m for voids.

B.5 USA - Road markings in the US

Lane width: 2,6 m to 4,2 m

Lane marker width: 120 mm to 250 mm (250 mm for thick border markers)

Double markers, which indicate "no passing zones" on roads with two-way traffic have two parallel painted stripes, each 100 mm wide, with approximately 80 mm between them.

Interrupted markers:

For dashed markers (with voids between dashes), the mean painted dash length is approximately 4 m (±2 m), with a void between dashes of approximately 6 m (±2 m).

Other characteristics:

Pavement marker installation based on California Standard Plans Raised pavement markers can be used in place of painted strips in marking California roads. These markers can be white or yellow, depending on the specific application, following the same logic used to determine whether painted lines are white or yellow.

There are two types of markers: non-reflective circular "dots" and rectangular reflectors.

Dots (D): diameter 100 mm, spherical section with maximum height up to 16 mm above pavement.

Reflectors (R): width 100 mm, length (travel direction) 50 mm to 100 mm, height above pavement 10 mm. Reflective face shall have an area of at least 1 sq in (6,45 sq cm).

These are used in place of painted lines, which are normally 100 mm wide. Where a double-width painted line would be used, two rows of adjacent markers can be used instead.

To represent continuous line (no passing): markers are separated by 1,2 m, arranged in following sequence, repeated continuously: R D D D D D R D D D D D ....

Where dashed lines are used, in areas where passing is permitted, or between lanes of multi-lane highways, the painted stripes can be in either of two configurations, each of which has its equivalent in markers:

— Painted stripe of length 2,1 m, with blank space of 5,2 m, repeated continuously, or markers arranged as: R – 2,4 m – D – 1,2 m – D – 1,2 m – D – 4,8 m – D – 1,2 m – D – 1,2 m – D – 2,4 m – R, also repeated continuously.

— Painted stripe of length 3,65 m, separated by space of 11 m, repeated continuously, or markers arranged as: R – 5,5 m – D – 1,2 m – D – 1,2 m – D – 1,2 m – D – 5,5 m – R, also repeated continuously.

B.6 AUSTRALIA - Lane boundary geometry

Lane widths – 3,5 m desirable, but can range from 2,6 m in turn lanes, 2,8 m on low volume rural roads (with no edge line) and at signallised intersections to 4,5 m on freeway interchange ramps.

Longitudinal lines and their warrants vary between the eight states and territories of Australia. Line widths vary from 80 mm to 200 mm depending on the Annual Average Daily Traffic (AADT) and road type and are predominantly white. Yellow lines are used as an edge line in selected locations but are not currently used for dividing/barrier line.

Edge lines (white)

— Continuous: 80 mm to 200 mm wide

— Broken: 24 m line, 1 m void with reflector (RRPM) placed in the void

Two lane pavements between 5,5 m to 6,8 m wide can be treated with edge lines where special circumstances exist, i.e. poor alignment, fog, and similar conditions.

If lane widths are narrow, the kerb can be painted instead of an edge line or outline (adjacent a median).

Edge lines (yellow)

— Continuous: 80 mm to 200 mm wide no stopping zones/clearways or in areas subject to snow

— Broken: 9 m line, 1 m gap in areas subject to snow

— Broken: 600 mm stripe and 900 mm gap in yellow for restricted parking

— Broken: 3 m line, 3 m gap for part time clearways

Broken or Interrupted markings

— Continuity lines: 1 m line, 3 m void

— Turn lines: 600 mm stripe, 600 mm void

— Special purpose: 9 m line, 3 m void

— Lane lines: 3 m line, 9 m void

— Dividing lines: 3 m line and 9 m void (most common), 9 m line and 3 m void, 6 m line and 6 m void

Barrier lines

— Double two-way: two parallel continuous white lines

— Double one-way: one continuous line parallel to a dividing line 3 m line, 9 m void

Raised Reflective Pavement Markers (RRPMs) – used as part of a simulated lane line (see below) and to augment longitudinal lines. RRPM’s can be placed in the void between lane lines and dividing lines, the void in broken edge lines or either side of a continuous edge line depending on the width of the sealed shoulder.

Simulated lane line – RRPMs and Non-reflective Raised Pavement Markers (NRPMs) used as an alternative to the 3m painted line and 9m void in the order RRPM NRPM NRPM NRPM, 9m void (and repeat).

Sources:

Australian Standard 1742.2-2009 Manual of Uniform Traffic Control Devices Part 2: Traffic Control devices for general use

AUSTROADS Guide to Traffic Mangement Part 10: Traffic Control and Communication Devices

AUSTROADS Guide to Road Design Part 3: Geometric Design

Various state published pavement marking standards (e.g RMS-NSW, VicRoads, Qld Main Roads, SA DPTI)

B.7 NETHERLANDS - Road markings in the Netherlands

Road markings are:

— length markings

— cross markings

— other markings like:

  — arrow markings

  — expel markings

  — angle areas

  — symbols and traffic markings

The traffic area (carriageway and traffic lanes) is bounded by length markings which generally trends parallel to the axis of the road. Length markings can occur as a uninterrupted or interrupted (broken) line and can be divided into edge lines and centre or separation lines. Dependent on the position of the marking, the width of the line differs. For interrupted marking lines, the length of segments and voids depends on the meaning of the marking. For a centreline, a combination of an uninterrupted and/or broken line (spaced out equal to the width of the line) is possible.

The requirements for the marking width and the lane width can be split up in two: freeways and non-freeways.

Freeways or motorways

— 120 km/h-roads:

  — lane width (separation lines included and edge lines excluded): 3,50 m

  — edge line 0,20 m wide

  — separation line 0,15 m wide

In special cases other lane widths are possible.

Rural roads (non-freeways)

- 60 km/h-roads:
  - lane width (markings excluded): 2,75 m
  - width of edge line and centre of separation line: 0,10 m
- 80 km/h-roads:
  - lane width (markings excluded): 3,10 m
  - edge line 0,15 m wide
  - centre of separation line 0,10 m wide
- 100 km/h-roads:
  - lane width (markings excluded): 3,25 m
  - edge line 0,15 m wide
  - centre of separation line 0,10 m wide

In special cases other lane widths are possible.

B.8 CANADA - Highway markings

The following information on pavement markings was taken from the Manual of Uniform Traffic Control Devices for Canada (1998):

- Normal width line is 100 mm to 150 mm wide.
- Wide line is nearly twice the width of a normal line.
- Double line consists of two normal lines.
- Dashed line is formed by shorter segments and gaps in the ratio of 1:1. These are typically 0,5 m to 3,0 m each.

Lane lines are broken white lines normally with segments and gaps in a 1:2 ratio. A recommended pattern is 3,0 m line segments with 6,0 m gaps. On high-speed roads such as freeways, a segment to gap ratio of 1:3 (3,0 m segment, 9,0 m gap) can be used.

On urban streets, the lane width defined by lane lines normally should not be less than 3,1 m, but widths as narrow as 2,8 m have been used. Widths should increase on sharply curved sections of urban streets.

Pavement edge lines are continuous solid lines placed on the pavement of the travelled lane as close as practicable to the travelled lane. A white line is used to the right and a yellow line is used to the left of the travelled lane.

The following information on lane width guidelines was taken from the Canadian Geometric Design Guide (1999).

- widths for two-lane rural roads (≤80 km/h) 3,0 m to 3,7 m, and (>80 km/h) 3,3 m to 3,7 m;
- multilane rural roadways (<100 km/h) 3,5 m to 3,7 m, and (≥100 km/h) 3,7 m;
- urban freeways, major arterials, and industrial/commercial collector roadways 3,7 m;
- minor arterials, residential collectors, and local industrial/commercial roadways 3,5 m. to 3,7 m.

— local residential roadways 3,0 m to 3,7 m.

B.9 KOREA – Lane width and road markings

Lane width: 2,75 m –3,50 m.

Lane marker width should be from 100 mm to 150 mm wide for both borders and centre.

Lane segments and voids for interrupted marking lines should be between 3 m to 10 m. The guidelines include

— urban collectors and arterials: 3 m painted, 5 m void,

— rural arterials: 5 m painted, 8 m void, and

— freeways and expressways: 10 m painted and 10 m void.

Bibliography

[1] GB 5768:1999, *Road traffic signs and markings*

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