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Intelligent transport systems — Lane departure warning systems — Performance requirements and test procedures

Systèmes intelligents de transport — Systèmes d'avertissement de départ de ruelle — Exigences de performance et méthodes d'essai

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Foreword

ISO (the International Organisation for Standardisation) is a world-wide 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 organisations, 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 standardisation.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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Introduction

Lane Departure Warning Systems (LDWS) are based on fundamental traffic rules. The main focus of LDWS is to help the driver keep the vehicle in the lane on highways and highway-like roads. Accordingly, a warning is issued to alert the driver in case of lane departure caused by, for example, inattention. LDWS are not intended to issue warnings with respect to collisions with other vehicles or control vehicle motions.

Intelligent transport systems — Lane departure warning systems — Performance requirements and test procedures

1 Scope

This standardisation working draft specifies the definition of the system, classification, functions, human machine interface (HMI) and test methods for lane departure warning systems. These are in-vehicle systems that can warn the driver of a lane departure. The subject system, which may utilise optical, electromagnetic, GPS, or other sensor technologies, shall issue a warning consistent with the visible lane markings. The issuance of warnings at sections of highways or highway-like roads having temporary or irregular lane markings such as road work sections is not within the scope. The standard shall apply to passenger cars, commercial vehicles and buses. The system will not take any automatic action to prevent possible lane departures. Responsibility for the safe operation of the vehicle remains with the driver.

2 Keywords

Lane departure, visible lane marking, lane boundary, lane, warning threshold, warning condition, warning line, rate of departure, time to line crossing, false alarm, suppression request.

3 Normative References

The following standards contain provisions that, through reference in this text, constitute provisions of this standardisation draft. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standardisation draft are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid international standards.

There are the following normative references at present:

ISO 1176 “Road vehicles - Masses - Vocabulary and codes”

ISO 2575 “Symbols for control, indicators and telltales” – Corrigendum 1, Amendment 1 and 4

ISO 3833 “Road vehicles – Types – Terms and definitions”

ISO 15005 “Road vehicles - Ergonomic aspects of transport information and control systems – Dialogue management principles and compliance procedures”

ISO/DIS 15006.2 “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”

ISO/PRF TS 16951 “Road vehicles - Criteria for determining priority of TICS and other messages presented to drivers”

ISO 15037-1 "Road vehicles - Vehicle dynamics test methods - Part 1: General conditions for passenger cars"

ISO 15037-2 "Road vehicles – Vehicle dynamics test methods – Part 2: General conditions for heavy vehicles and buses"

4 Definitions

For the purpose of this standardisation draft, the following definitions apply:

4.1 Lane: 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.

4.2 Visible lane marking: Delineators intentionally placed on the borderline of the lane that are directly visible by the driver while driving (e.g. not covered by snow, etc.). (Refer to Annex A for country specific visible lane marking definitions.)

4.3 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. These include such features as pavement seams or edges, kerbs, tracks or ruts left by previous vehicles.

4.4 Lane boundary: The 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, electromagnetic nails, etc. In the case of a visible lane marking, the boundary shall be at the centre thereof.

4.5 Default lane width: A predetermined width given to a lane when a visible lane marking exists only on one side of the lane and no other lane boundaries are detected by the system.

4.6 Departure: The situation in which the outside of one of the front wheels of a vehicle or of the leading part of an articulated vehicle is crossing a specified line. In the case of a 3-wheel vehicle, it is the same except that the wheel is one of the wheels on the axle with the widest track.

4.7 Lane departure: The point of departure across the lane boundary.

4.8 Rate of departure (V): The subject vehicle's approach velocity at a right angle to the lane boundary at the warning issue point.

4.9 Time to line crossing (TTLC): The calculated time to lane departure. 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) of the vehicle relative to the lane. (TTLC = D/V).

4.10 Warning issue point: The measured location or time at which a warning is starts to be issued.

4.11 Warning threshold: The location where the warning shall be issued on the road, which corresponds to a warning trigger point set in the system. In the case of TTLC, this location shifts depending on the rate of departure. The warning threshold shall be placed within the warning threshold placement zone.

4.12 Warning threshold placement zone: The zone between the earliest and the latest warning lines within which the warning threshold shall be placed. There is one warning threshold placement zone around the left lane boundary and one around the right lane boundary.

4.13 Warning condition: A condition in which departure across the warning threshold occurs.

4.14 Repeatability: The ability of a certain percentage of warnings issued by the system to consistently fall within a given range.

4.15 False alarm: An alarm that is issued when the warning conditions have not been fulfilled.

4.16 Earliest warning line: The innermost limit of the warning threshold.

4.17 Latest warning line: The outermost limit of the warning threshold.

4.18 No warning zone: The zone between the two earliest warning lines.

4.19 Suppression request: A driver request or a system feature intended to prevent a lane departure warning if an intended lane departure is detected.

4.20 Lane departure warning: A warning given to the driver in accordance with the lane departure warning condition in the absence of suppression requests.

4.21 System incapable: A state of the system in which it is unable to warn the driver of a lane departure due to temporary conditions.

4.22 Status indication: Indication of the system status (e.g. ON/OFF, failure and incapable).

4.23 Haptic warning: A warning that stimulates the driver's sense of touch, vibration, force and motion (e.g., steering wheel motion, steering wheel vibration, seat and pedal vibrations, etc.).

4.24 Curve cutting: The act of driving to the inner side of a curve, which may lead to an intentional lane departure.

4.25 Visibility: The distance at which the illuminance of a non-diffusive beam of white light with the colour temperature of 2700K is decreased to 5% of its original light source illuminance.

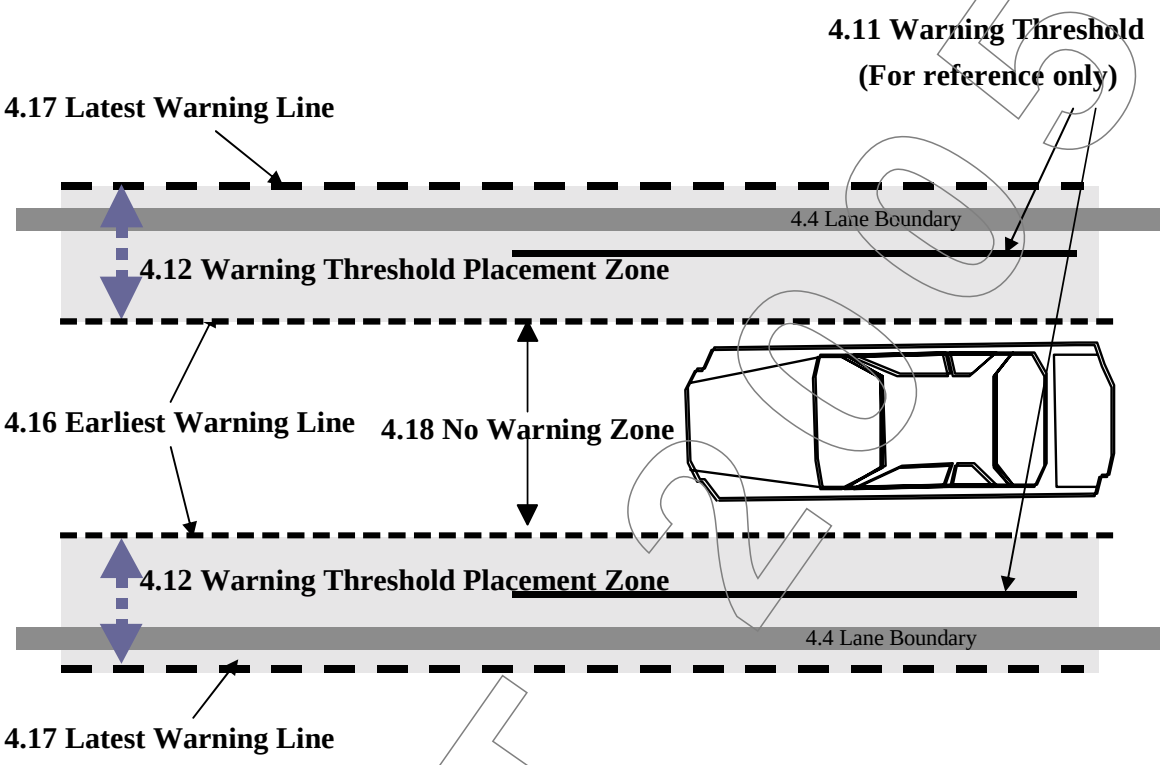


Figure 1 – Concept of Warning Thresholds and Warning Threshold Placement Zones

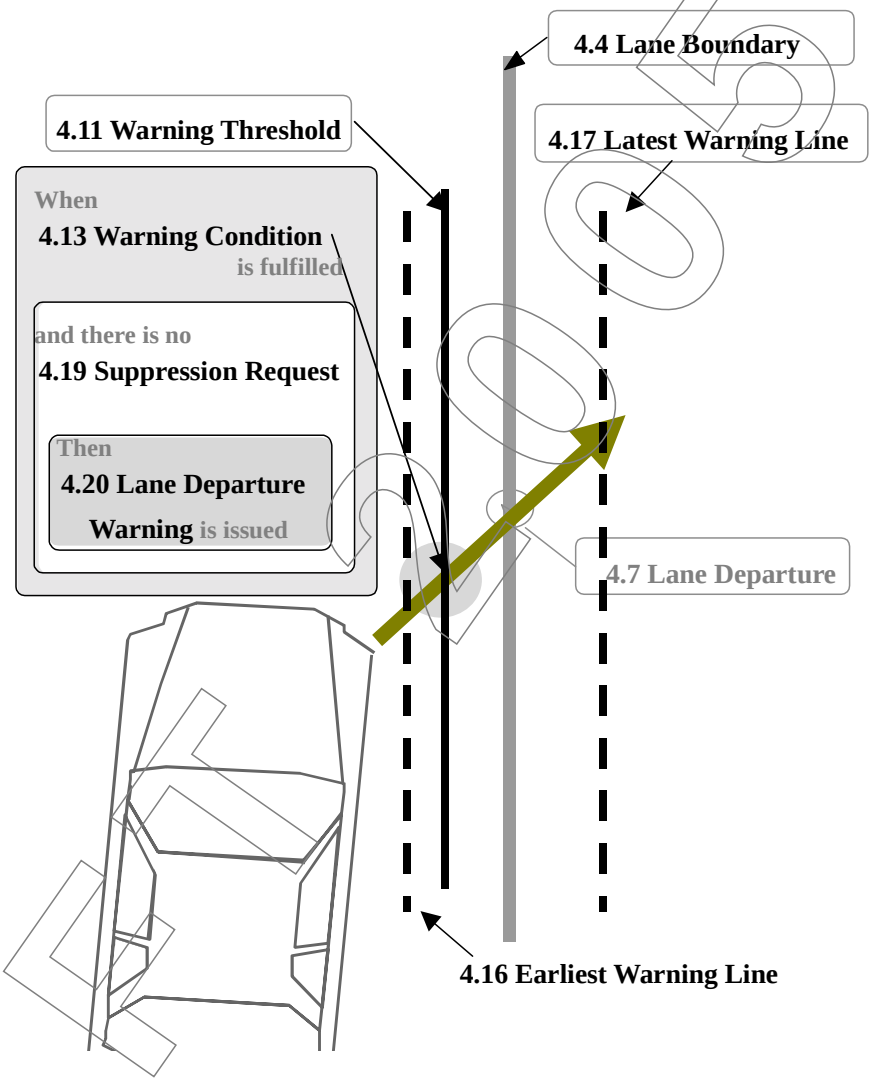


Figure 2 – Illustration of Warning Issue Definitions

5 Specifications and Requirements

5.1 System functions

The functional elements of a lane departure warning system shall be in accordance with Figure 3.

The suppression request, vehicle speed detection, driver preference and other additional functional elements are optional.

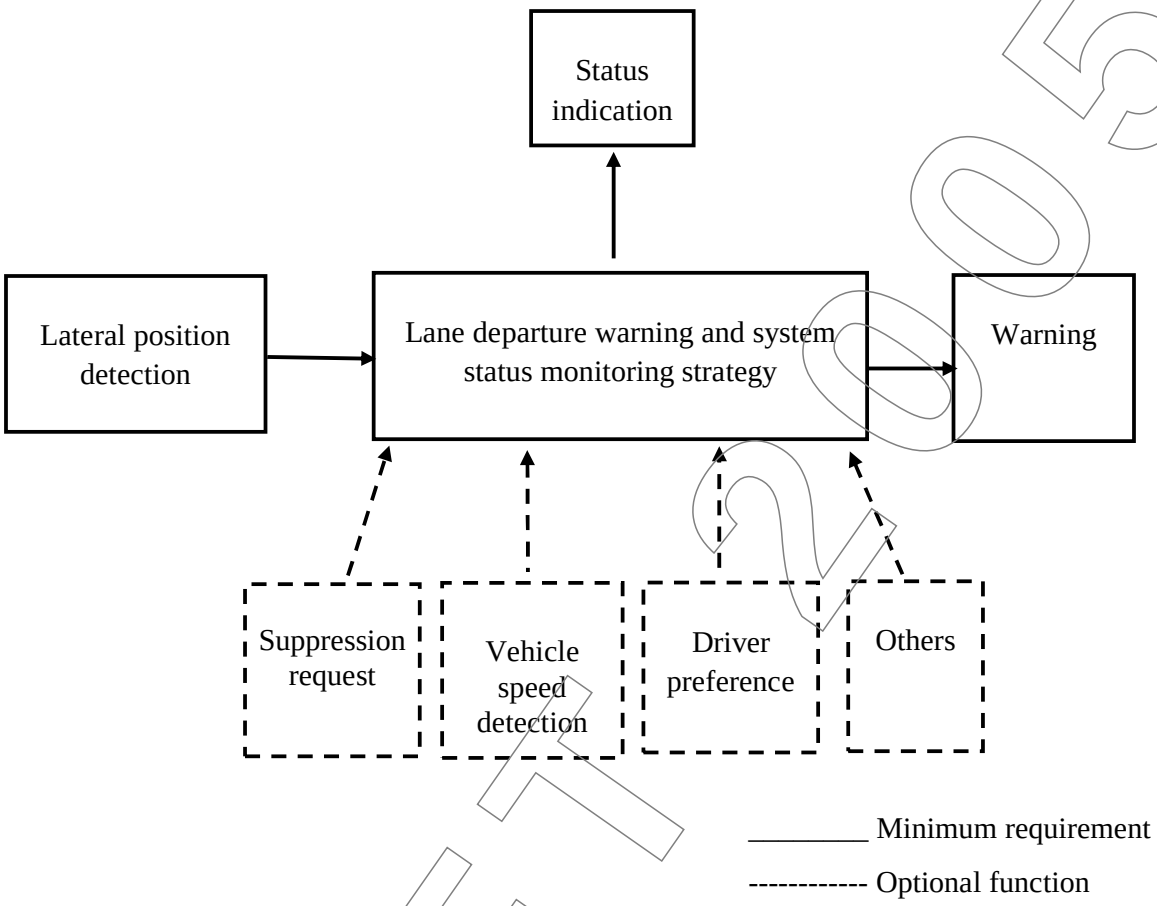


Figure 3 – Functional Elements

5.2 System classification

Lane departure warning systems shall be able to give warning under at least one of the following curvature conditions:

Systems are classified as shown in Table 1.

Table 1: Classification Types

Class	I	II	
Radius of Curvature	≥500m	≥250m	
Operating Speed	≥20m/s	≥17m/s	

5.3 Requirements

5.3.1 Basic requirements

The system shall perform at a minimum the following functions:

1) Monitor system status for: system failure, system incapable and system ON/OFF (if switch is installed) conditions.

2) Indicate system status to the driver.

3) Detect the lateral position of the subject vehicle relative to the lane boundary.

4) Determine if the warning condition is fulfilled.

5) Warn the driver.

5.3.2 Operational requirements

1) The system shall warn the driver when the warning condition is fulfilled.

2) The latest warning line is located at 0.3 m for passenger cars or at 1 m for trucks and buses measured outside from the lane boundary.

3) The earliest warning line is located at maximum of 0.75 m (0 < rate of departure≤ 0.5 m/s), TTLC 1.5 seconds × rate of departure (0.5 < rate of departure≤ 1.0 m/s) and 1.5m (rate of departure > 1.0 m/s) inside the lane boundary (See Fig. 4 and Table 2).

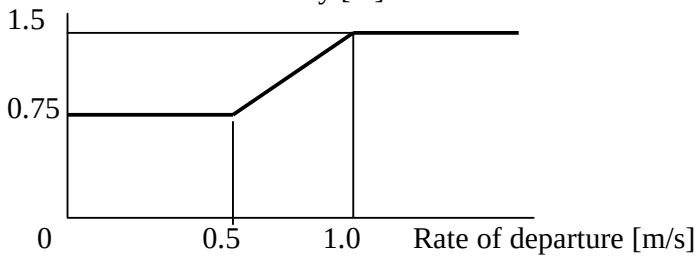


Figure 4 – Earliest Warning Line

Table 2 Earliest Warning Line

Rate of departure (V)	Location inside the lane boundary
0.0 < V ≤ 0.5 m/s	**0.75 m**
0.5 < V ≤ 1.0 m/s	**1.5 s × V m/s**
1.0 m/s < V	**1.5 m**

4) The warning shall be consistently produced around the warning threshold as verified in section 6.5.2.

5) False alarms shall be minimised as verified in section 6.5.2.

6) The system shall be operable at speeds equal to or above 20 m/s for Class I and equal to or above 17 m/s for Class II. The system may operate at lower vehicle speeds.

5.3.3 Human interface requirements

1) Warning presentation

An easily perceivable haptic and/or audible warning shall be provided.

2) Interference with other warnings

Even when a vehicle is equipped with LDWS along with other warning systems such as FVCWS (Forward Vehicle Collision Warning System), the warning shall be clearly distinguishable to the driver by a haptic, audible, or visual modality, or any combination thereof.

3) Indication of the system status

The system status shall be indicated to the driver.

The system status indication shall be easy to understand for the driver.

If a failure is detected during system start-up or operation, or a system incapable is detected during operation, then the driver shall be informed.

Any symbol used to notify the driver shall be a standard symbol. For example, if a symbol is used to indicate that a system incapable condition exists, the symbol shall be the standard symbol for that message.

4) The owner's manual shall describe the minimum vehicle speed at which the system operates, and the conditions for system incapable shall be described.

5.3.4 Optional functions

1) The lane departure warning system may be fitted with a system "on/off" control that can be operated by the driver at all times.

2) The system may detect the suppression request to minimise nuisance warnings. The suppression request is issued, e.g. if the driver operates a turn signal, is braking or is engaged in other high priority maneuvers such as a crash avoidance maneuvers.

3) The system may give an indication to the driver when warnings are suppressed.

4) Subject vehicle speed can be optionally detected for uses including suppression of warnings below the speeds identified in section 5.3.2 (6).

5) On roadways that contain only one lane marking, the system may use a default lane width to establish a virtual lane marking on the opposite side from the visible lane marking to issue warnings, or system incapable may be reported to the driver.

6) The warning threshold may be adjustable within the warning threshold placement zone.

7) While driving in a curve, the system may move the warning threshold farther out, allowing for "curve cutting" behaviour, but the warning threshold shall never be moved beyond the latest warning line.

8) When only haptic and/or audible warnings are used, the warnings may be designed to indicate the direction of the departure (position of sound source, direction of movement, etc.). If the haptic and/or audible warnings are not designed to indicate the direction, a visual cue may be used to supplement the warning.

9) The system may suppress additional warnings to avoid multiple nuisance warnings.

6 Test Method

6.1 Test environment conditions

1) Test location shall be on a flat, dry asphalt or concrete surface.

2) Temperature range shall be 10°C ±30°.

3) 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.

4) Horizontal visibility range shall be greater than 1 km.

6.2 Test course conditions

The test course shall be set to the curvature ± 10% of the smallest value classified in Table 1 for the respective classes. The length of the course shall be long enough to maintain a minimum operating speed (of at least 17m/s or of at least 20m/s), to allow drifting out from the lane at a rate of departure of $0m/s < V \leq 0.8$ m/s.

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 150kg) and maximum authorised total mass[*2]. No alterations 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.

6.4 Test system installation and configuration

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

6.5 Test procedure

6.5.1 Parameters recoverable from data record

a) Warning issue point (temporal and/or spatial)

b) Rate of departure

c) Vehicle speed

All warnings that occur during the test 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

Three types of tests must be carried out: a test for warning generation in a curve according to curve classification (Warning generation test), a test for repeatability on a straight course (Repeatability test) and a test for false alarms (False alarm test).

Test a) Warning generation test

The start location within the lane shall be in approximately the centre of the lane.

After the vehicle has entered the course and is smoothly tracking it so that the posture of the vehicle is stable, the vehicle shall gently drift off inside and outside of the course while taking a curve according to curve classification at a speed of 20 to 22 m/s for Class I, and 17 to 19 m/s for Class II. The vehicle shall depart once to both the right and left sides for both ranges of rate of departure of 0 to 0.4 m/s and 0.4 to 0.8 m/s on a curve to the right and a curve to the left, for a total of 8 departures as shown in Table 3 and Fig. 5.

Table 3

		Right Curve		Left Curve	
		Left Departure	Right Departure	Left Departure	Right Departure
Rate of Departure	0.0 – 0.4 m/s	One Trial	One Trial	One Trial	One Trial
	0.4 – 0.8 m/s	One Trial	One Trial	One Trial	One Trial

Test b) Repeatability test

The repeatability test 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 to 22 m/s for Class I, and 17 to 19 m/s for Classes II. When travelling straight along the segment of straight road, the vehicle may 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, as shown in Fig. 6. While maintaining the designated speed according to the class 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 (between $0.1 < X1 \pm 0.05 \leq 0.3$ m/s) for 8 tests (4 to the left (Group 1) and 4 to the right (Group 2)), and at rate of departure (between $0.6 < X2 \pm 0.05 \leq 0.8$ m/s) for another 8 tests (4 to the left (Group 3) and 4 to the right (Group 4)), such that a total of 16 tests are conducted. X1 and X2 are selected by the manufacturer. The tester shall conduct lane departure trials until four trials are achieved within each group according to the rate of departure tolerance given in Table 4.

Table 4

		Departure Direction	
		Left	Right
Rate of Departure	$0.1 < X1 \pm 0.05 \leq 0.3$ m/s	Group 1 Four Trials	Group 2 Four Trials
	$0.6 < X2 \pm 0.05 \leq 0.8$ m/s	Group 3 Four Trials	Group 4 Four Trials

Test c) False alarm test

The system shall produce no warnings while driving within the no warning zone for a total distance of 1000 m on a straight course (to be done either in one 1000 m stretch or two 500 m stretches).

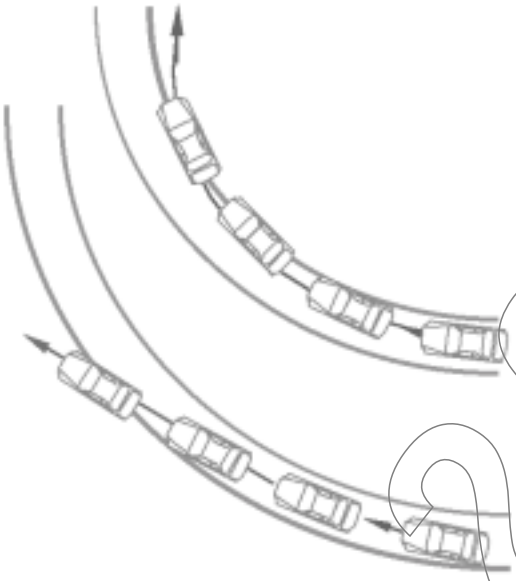


Figure 5 – Method of How To Carry Out Warning Generation Test

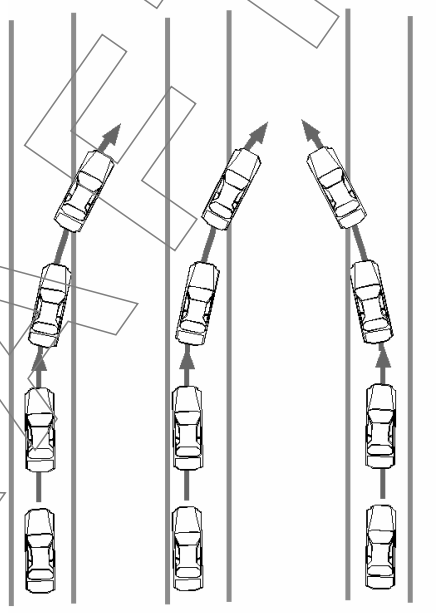


Figure 6 – Method of How to Carry Out Repeatability Test

6.6 Criteria for passing the tests

Test a) Warning generation test

The system shall provide warnings prior to crossing the latest warning line but not before crossing the earliest warning line for each test case.

Test b) Repeatability test

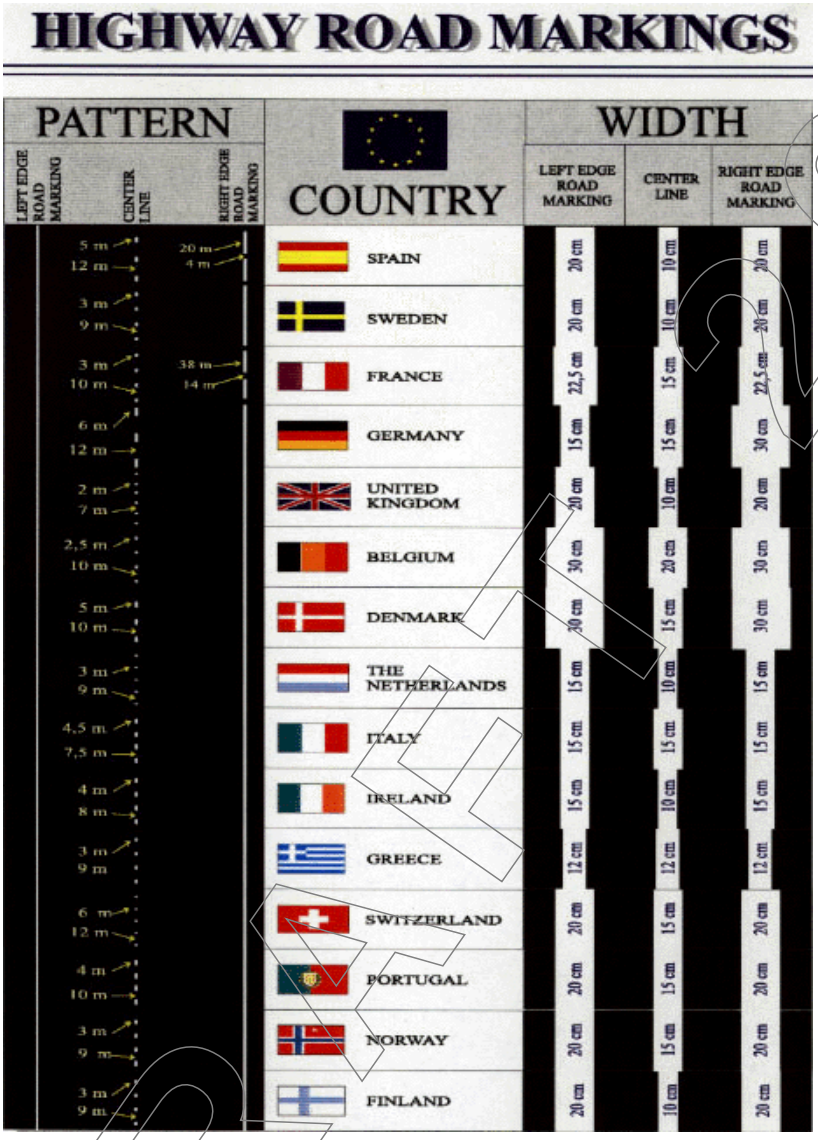
The system shall provide warnings within a zone having a width of 30 cm for each test group. No warnings shall be issued outside of the warning threshold placement zone. If a particular test group includes more than four trials within the required speed tolerance band, then only the first four trials that are within the required speed tolerance band shall be considered.

Test c) False alarm test

No warnings shall occur between the two earliest warning lines.

Annex A (informative)

A1 National road markings



China – Lane boundary technology

Lane width should be between 3.0 and 3.75 m.
Lane boundary width should be 10, 15 or 20 cm 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 ‘Road traffic signs and markings’.

ITALY - Lane boundary geometry

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

Lane width should be between 2.5 to 3.75 m for normal lanes and from 2 to 3.5 for emergency lanes. However, we have measured lanes of approximately 4 m.

Lane boundaries should be large from 12 (generic) to 15 (highway) to 25 cm (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.

JAPAN - Lane boundary geometry

Lane width should be between 2.75 to 3.5 m for generic lanes and from 3.25 to 3.75 m for highway lanes.

Lane boundaries should be from 10 to 15 (borders) to 20 (centre) cm wide.

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

USA - Road Markings in the US

Lane width: 2.6 – 4.2m

Lane marker width: 12cm – 25cm (25cm for thick border markers).

Double markers, which indicate “no passing zones” on roads with two-way traffic, have two parallel painted stripes, each 10cm wide, with approximately 8cm between them.

Interrupted markers:

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

Other characteristics:

Pavement Marker Installation
Based on California Standard Plans

Raised pavement markers may be used in place of painted strips in marking California roads. These markers may 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 10 cm, spherical section with maximum height up to 1.6 cm above pavement.

Reflectors (R): Width 10 cm, length (travel direction) 5 to 10 cm, height above pavement 1 cm. Reflective face must have an area of at least 1 square inch (6.45 sq. cm.).

These are used in place of painted lines, which are normally 10 cm wide. Where a double-width painted line would be used, two rows of adjacent markers may 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 may be in either of two configurations, each of which has its equivalent in markers:

(a) Painted stripe of length 2.1 m, with blank space of 5.2 m, repeated continuously, or markers arranged as: R – 2.4m – D – 1.2m – D – 1.2m – D – 4.8m – D – 1.2m – D – 1.2m – D – 2.4m – R, also repeated continuously.
(b) Painted stripe of length 3.65 m, separated by space of 11 m, repeated continuously, or markers arranged as: R – 5.5m – D – 1.2m – D – 1.2m – D – 1.2m – D – 5.5m – R, also repeated continuously.

AUSTRALIA - Lane boundary Geometry

Lane widths of 3.7 metres on freeways and 3.5 metres on rural roads are common.
The national guidelines state that lane widths should not be less than 3 m, but at traffic signals, or in other special circumstances, the width may be reduced to 2.8 m.

Edge Lines

The guidelines for the use of edge lines are:

- Edge lines are always marked on urban and rural freeways and on other rural arterial roads where the shoulder is partly or fully sealed.
- Edge lines may be marked to supplement lane or separation lines on pavements 6.8m or more in width. Two lane pavements between 6.8 and 5.5 m wide may be treated with edge lines where special circumstances exist, i.e. poor alignment, fog and similar conditions.
- Continuous edge lining can be justified on rural roads generally where the AADT is 2000vpd or greater. In high rainfall areas (greater than 1000mm annual rainfall) or where the road is subject to fog or wet days for significant periods, edge line marking may be justified at 1000 or more AADT.

- Edge lines may be provided where truck volumes on rural roads exceed 2000vpd.
- Edge lines may be marked on urban arterial roads where street lighting is of low standard and extra delineation at the kerb line is required (in some cases it is preferable to paint the kerb face rather than mark the edge line).

Line dimensions

Broken or interrupted lane lines should be 3 m with a 9m void and 80 mm wide for roads other than freeways. Edge lines are continuous and 80 - 120 mm wide.
Broken separation lines for a 2 lane road should be 3 m with a 9 m void and 80 - 100 mm wide.
Broken separation lines for a multilane road should be 6 m with a 6 m void and 150 mm wide.

Source: AUSTROADS Guide to Traffic Engineering Practice Part 8, 1988.

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 an 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.

CANADA-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 10 cm to 15 cm 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) may 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.

KOREA – Lane Width and Road Markings

Lane width: 2.75 -3.50m.

Lane marker width should be from 10 to 15cm wide for both borders and centre.

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

Urban collectors and arterials: 3.0m painted, 5.0m void

Rural arterials: 5.0m painted, 8.0m void

Freeways and expressways: 10.0m painted and 10.0m void