Lane Departure Warning System Performance Test Procedure

1. Scope of Application, etc

This test procedure applies to the "Lane Departure Warning System Performance Test" on the vehicles exclusively used for carrying passengers with riding capacity of less than ten (10) persons and the vehicles used for carrying cargo with gross vehicle weight 2.8 tons or less equipped with the lane departure warning (LDW) systems as part of the tests conducted under the new car assessment program by the National Agency for Automotive Safety and Victim's Aid (hereinafter, the "NASVA").

2. Terms

The terms herein shall mean as follows:

(1) "Lane Departure Warning System (LDW System)" refers to a device that gives warning to the driver of a risk of the vehicle departing from the lane or actual departure by two or more means of the following: visual, audio and tactile. However, for the audio and tactile warning, when the departure direction can be indicated clearly, one means is acceptable.

(2) "Lane Marker" refers to the road painting that indicate boundaries of lanes, based on which the LDW System give warning after judging lane departure.

(3) "Left Departure Test" refers to a test with the test vehicle crossing the Lane Marker on its left.

(4) "Right Departure Test" refers to a test with the test vehicle crossing the Lane Marker on its right.

(5) "Lane Marker Inside Edge" refers to the straight line connecting edges of the Lane Markers that are located closer to the test vehicle before crossing a Lane Marker.

(6) "Distance to Lane Marker" refers to the distance between the outer edge of the contact area of the front tire closer to the Lane Marker (vertical outermost section of the tire) and the Lane Marker Inside Edge (See Figure 1). Taking the Lane Marker Inside Edge as a reference point, the side of the test vehicle before crossing the Lane Marker shall be the negative side.

Figure 1: Distance to Lane Marker (Case of Left Departure Test)
(7) "Lane Marker Approach Speed" refers to the speed at which the outer edge of the contact area of the front tire closer to the Lane Marker moves toward the Lane Marker Inside Edge.

(8) "Test Vehicle Speed" refers to the designated travel speed of the test vehicle during testing.

(9) "Mass at Vehicle Delivery" refers to the condition of the test vehicle fully loaded with the fuel, lubricants, coolants and the like in the engine and fueling system, and equipped with onboard tools, spare tire and standard accessories.

3. Test Conditions

3.1 Provision of Data by Vehicle Manufacturer, etc

Vehicle manufacturers, etc shall provide NASVA with the following data required for test preparations (Attached Table 1).

3.2 Test Vehicle Conditions

Conditions of the test vehicle shall be as follows:

(1) Load Condition: The mass of the test vehicle with one driver and including the measurement equipment, etc shall be the Mass at Vehicle Delivery+200kg of less. Front axle/rear axle weight distribution shall be the same with that of the Mass at Vehicle Delivery (±5%).

(2) Tire: The tires installed at the time of purchase of the test vehicle shall be used. The tire air pressure shall be set, before running (normal temperature) on a level surface, at the value for ordinary run as described in the specification sheet.

(3) Warning Setup: When the warning timing, Lane Marker detection sensitivity and the like can be selected by users, those setup items shall be set to the recommended values declared by the vehicle manufacturer, etc.

3.3 Test Truck

Test Truck shall meet the following requirements:

(1) The Lane Markers installed in the Test Truck shall be dashed lines meeting the following a) through d), and in good condition:
   a) Marker Length (L1): 8.0m
   b) Marker Interval (L2): 12.0m
   c) Marker Width (t): 0.15m
   d) Marker Color: White

(2) The Test Truck shall not have any other road painting or lane lines than the Lane Markers within a scope of 6m around the Lane Markers.

(3) The Test Truck shall be level, dry and paved (by asphalt or concrete), and the color of the road surface other than the Lane Marker shall be uniform (in a color that highlights Lane Markers).

3.3 Weather Conditions

Test shall be performed under the following weather conditions:

(1) Daytime with no rain or snow, with visibility of 1km or more secured;
(2) No shadows of trees, structures or the like on the Lane Markers;
(3) The test vehicle shall not travel in the direction into the sun; and,
(4) Outside temperature between 0°C and 40°C.

3.4 Measurement Items
The items, accuracy/resolution of measurement during testing shall be as described below:
(1) Measurement time: with resolution of 10ms.
(2) Travel Speed: Accuracy of ±0.25% (% of full scale) and resolution of 0.2km/h for the measurement range of 0.1km/h~100km/h.
(3) Distance to Lane Marker: Accuracy of 0.05m and resolution of 0.01m for the measurement range of -1.00m~0.50m.
(4) Yaw Rate: Accuracy of ±2.5% (% of full scale) and resolution of 0.01deg/s in the measurement range of ±10deg/s.
(5) Warning Indication Status: Measurement time delay shall be 10ms or less. However, for the method of visual warning, when it is difficult to measure the warning indication status, it shall be excluded from the measurement items.

4. Test Procedure
4.1 Test Preparation
(1) Test Vehicle Speed Setup: The Test Vehicle Speed shall be 60km/h. However, when the designed speed range for the activation of the LDW System as declared by the vehicle manufacturer, etc is higher than 60km/h, the Test Vehicle Speed may be changed to 70km/h.
(2) Test Truck Setup: Pylons will be placed as guide for running during testing. In case of a Left Departure Test, they shall be placed in positions to the Lane Marker of the Test Truck as shown in Figure 2. Further, in case of a Right Departure Test, the pylon positions shall be in contrast to the Lane Marker with the Left Departure Test.
If the overall width of the test vehicle is over 1.8m Pylon setting of 3.5m from lane maker shall be widen.(10cm from the one side of the overall width)
4.2 Test

(1) Running Procedure: In the Test Truck set up in section 4.1, the test vehicle shall be run at the Test Vehicle Speed (60km/h or 70km/h), and cross the Lane Maker in a trajectory of passing near the pylon. In that process, maintain the neutral position of the steering wheel as much as possible. During running, the directional indicator should not be operated, and sudden acceleration/deceleration or sudden steering should not be performed.

(2) Transmission: For the test vehicles with automatic transmission, select D. For vehicles with manual transmission, select the highest gear where the RPM will be at least 1500 at the test speed.

(3) Number of Tests: Tests shall be conducted 5 times each for the Left Departure Test and the Right Departure Test. Further, when any of the following a) through d) is found in confirmation of the tests results of section 4.3, the test shall be deemed invalid (foul) and shall not be counted in the number of tests.

a) When the Travel Speed of the measurement section is less than the Test Vehicle Speed or exceeds the Test Vehicle Speed+3.0km/h;

b) When the Lane Marker Approach Speed in the Measurement Section is less than 0.1m/s or exceeds 0.6m/s;

c) When the Yaw Rate in the Measurement Section exceeds 1.00°/s (absolute figure regardless of direction); or,

d) When the measurement results cannot be obtained as required due to failure of malfunction of the measuring equipment, or when it is judged that there is obviously an error.

4.3 Confirmation of Test Results and Recording

(1) Measurement Section: The Measurement Section shall start at a point where the Distance to Lane Marker becomes 1.00m or less and end at a point where either the Warning Indication began or the Distance to Lane Marker became -0.50m or less, whichever is earlier.

(2) Warning Indication Start Position: Within the Measurement Section, read the Distance to Lane
Marker, in unit of 0.01m, as of the point where the Warning Indication began (in case of two warnings, when both indications began), and record the figure in the applicable column of Attached Table 2. Further, when the Warning is not indicated, the Warning Indication Start Position column should be entered with “None”.

(3) Travel Speed: Within the Measurement Section, read the highest and lowest Travel Speeds in unit of 0.1km/h, and record the figure in the applicable column of Attached Table 2.

(4) Lane Marker Approach Speed: Use the following formula to obtain the Lane Marker Approach Speed within the Measurement Section in unit of 0.01m/s, and record the figure in the applicable column of Attached Table 2.

\[ V_{lat} = \frac{1.0 - P_{\text{end}}} {T_{\text{end}} - T_{\text{start}}} \]

Here, \( V_{lat} \) is Lane Marker Approach Speed (unit: m/s)
\( P_{\text{end}} \) is Warning Indication Start Position (when Warning is indicated)
-0.5 (when Warning is not indicated)
\( T_{\text{start}} \) is Measurement Section Start Time (unit: s)
\( T_{\text{end}} \) is Measurement Section End Time (unit: s)

(5) Yaw Rate: Within the Measurement Section, read the highest Yaw Rate absolute figure in unit of 0.01°/s, and record the figure in the applicable column of Attached Table 2. Further, be sure to use the result after eliminating the high-frequency component at cutoff frequency of 10Hz.

5. Sorting Out of Test Results

5.1 Environmental Conditions, etc during Testing

Test date, environmental conditions during testing, the test vehicle specification and the like shall be recorded in Attached Table 1.

5.2 Test Results

When the Warning Indication Start Positions recorded in Attached Table 2 fall between -0.30m and 0.75m 4 times or more in the Left Departure Test and 4 times or more in the Right Departure Test, it shall be rated “Pass”, and in other cases, “Fail”, and record the rating in the applicable column of Attached Table 2.
Attached Table 1: LDW System Performance Test Conditions and Test Vehicle Specification

[To be filled in by Vehicle Manufacturer, etc]

1. Test Vehicle Specification

(1) Model/type:

(2) Installed tire

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(3) Test Vehicle Load Distribution

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2. Declaration by Vehicle Manufacturer, etc

✓ Test vehicle speed: 60km/h / 70km/h

✓ Warning indication method: Audio / Tactile / Visual

✓ Recommended setup (detection range, warning timing, etc):

✓ Test results at the vehicle manufacturer, etc: The vehicle manufacturer or importer shall attach the test results at the vehicle manufacturer, etc in a form equivalent to the Attached Table 2, as necessary.
Attached Table 2: Test Vehicle Specification and Test Results

[To be filled by Testing Institute]

Test date: yy mm dd  Test site: _______  Tested by: _______

1. Environmental Conditions
   Start time:_______  End time:_______
   Weather:_______  Temperature:_______

2. Test Vehicle Specification
   (1)Model/type:________________________________________________________

   (2)Installed tire

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### 3. Test Results

#### (1) Left Departure Test

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<th>Warning Indication Position (m)</th>
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#### (2) Right Departure Test

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