NCAP LANE DEPARTURE WARNING CONFIRMATION TEST

2013 Honda Accord

DYNAMIC RESEARCH, INC.
355 Van Ness Avenue, STE 200
Torrance, California 90501

27 February 2013

Final Report

Prepared Under Contract No.:DTNH22-08-D-00095

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
Mail Code: NVS-120
1200 New Jersey Avenue SE
Washington, DC 20590
Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-08-D-00095.

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings, and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturer's names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products of manufacturers.

Prepared By: John Lenkeit

Approved By: Nadine Wong

Approval Date: 27 February 2013
OCAS-DRI-LDW-13-008

2. Government Accession No.

3. Recipient’s Catalog No.

4. Title and Subtitle

5. Report Date
27 February 2013

6. Performing Organization Code
DRI

7. Author(s)
John F. Lenkeit, Technical Director  
Brian Kebschull, Principal Engineer

DRI-TM-12-95

9. Performing Organization Name and Address
Dynamic Research, Inc.  
355 Van Ness Ave, STE 200  
Torrance, CA 90501

10. Work Unit No.

11. Contract or Grant No.
DTNH22-08-D-00095

12. Sponsoring Agency Name and Address
U.S. Department of Transportation  
National Highway Traffic Safety Administration  
Office of Crash Avoidance Standards  
1200 New Jersey Avenue, SE,  
West Building, 4th Floor (NVS-120)  
Washington, D.C. 20590

13. Type of Report and Period Covered
Final Test Report  
January –February 2013

NVS-120

15. Supplementary Notes

16. Abstract
These tests were conducted on the subject 2013 Honda Accord in accordance with the specifications of the Office of Crash Avoidance Standards most current Test Procedure in docket NHTSA-2006-26555 to confirm the performance of a lane departure warning system. The vehicle passed the requirements of the test for all three lane marking types and for both directions.

17. Key Words
Lane Departure Warning,  
LDW,  
New Car Assessment Program,  
NCAP

18. Distribution Statement
Copies of this report are available from the following:  
NHTSA Technical Reference Division  
National Highway Traffic Safety Administration  
1200 New Jersey Avenue, SE  
Washington, D.C. 20590

19. Security Classif. (of this report)
Unclassified

20. Security Classif. (of this page)
Unclassified

21. No. of Pages
143

22. Price

---

iii
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. DATA SHEETS</td>
<td>2</td>
</tr>
<tr>
<td>A. Data Sheet 1: Test Summary</td>
<td>3</td>
</tr>
<tr>
<td>B. Data Sheet 2: Vehicle Data</td>
<td>4</td>
</tr>
<tr>
<td>C. Data Sheet 3: Test Conditions</td>
<td>6</td>
</tr>
<tr>
<td>D. Data Sheet 4: Lane Departure Warning System Operation</td>
<td>8</td>
</tr>
<tr>
<td>III. TEST PROCEDURES</td>
<td>11</td>
</tr>
<tr>
<td>A. Test Procedure Overview</td>
<td>11</td>
</tr>
<tr>
<td>B. Lane Delineation Markings</td>
<td>12</td>
</tr>
<tr>
<td>C. Test Validity</td>
<td>15</td>
</tr>
<tr>
<td>D. Pass/Fail Criteria</td>
<td>15</td>
</tr>
<tr>
<td>E. Instrumentation</td>
<td>16</td>
</tr>
<tr>
<td>Appendix A Photographs</td>
<td>A-1</td>
</tr>
<tr>
<td>Appendix B Excerpts from Owner’s Manual</td>
<td>B-1</td>
</tr>
<tr>
<td>Appendix C Run Logs</td>
<td>C-1</td>
</tr>
<tr>
<td>Appendix D Time Histories</td>
<td>D-1</td>
</tr>
</tbody>
</table>
Section I
INTRODUCTION

The purpose of the testing reported herein was to confirm the performance of a Lane Departure Warning (LDW) system installed on a 2013 Honda Accord. The LDW system for this vehicle provides both visual and aural alerts. The vehicle passed the requirements of the test for all three lane marking types and for both directions.

The test procedure is described in detail in the NHTSA Document "LANE DEPARTURE WARNING SYSTEM CONFIRMATION TEST" from March of 2010. Its purpose is to confirm the performance of Lane Departure Warning (LDW) systems installed on light vehicles with gross vehicle weight ratings (GVWR) of up to 10,000 lb. Current LDW technology relies on sensors to recognize a lane delimiting edge line. As such, the test procedures described in the document rely on painted or taped lines or Botts Dots being present on the test course to emulate those found on public roadways. Although it is impossible to predict what technologies could be used by future LDW systems (e.g., magnetic markers, RADAR reflective striping, ultra violet paint, infra red, etc.), it is believed that minor modifications to these procedures, when deemed appropriate, could be used to accommodate the evaluation of alternative or more advanced LDW systems.
Section II
DATA SHEETS
<table>
<thead>
<tr>
<th>Test</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1 – Continuous White Line</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Test 2 – Dashed Yellow Line</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Test 3 – Botts Dots</td>
<td>Pass</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Overall: Pass
TEST VEHICLE INFORMATION

VIN: 1HGCR3F81DA0xxxx

Body Style: Sedan  Color: Silver

Date Received: 1/7/2013  Odometer Reading: 189 mi

Engine: 3.5 L V-6

Transmission: Automatic

Final Drive: FWD

Is the vehicle equipped with:

- ABS  X Yes  ___ No
- Adaptive Cruise Control  ___ Yes  X No
- Collision Mitigating Brake System  ___ Yes  X No

DATA FROM VEHICLE’S CERTIFICATON LABEL

Vehicle manufactured by: Honda of America Manufacturing, Inc

Date of manufacture: 09/12

DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: 215/55 R17

Rear: 215/55 R17

Recommended cold tire pressure: Front: 225 kPa (33 psi)

Rear: 225 kPa (33 psi)
TIRES

Tire manufacturer and model:  

Front tire size:  \textit{215/55 R17}

Rear tire size:  \textit{215/55 R17}

VEHICLE ACCEPTANCE

Verify the following before accepting the vehicle

\begin{itemize}
  \item [\xmark] All options listed on the “window sticker” are present on the test vehicle
  \item [\xmark] Tires and wheel rims are the same as listed.
  \item [\xmark] There are no dents or other interior or exterior flaws.
  \item [\xmark] The vehicle has been properly prepared and is in running condition.
  \item [\xmark] Verify that spare tire, jack, lug wrench, and tool kit (if applicable) is located in the vehicle cargo area.
\end{itemize}
LANE DEPARTURE WARNING
DATA SHEET 3: TEST CONDITIONS (Page 1 of 2)
2013 Honda Accord

GENERAL INFORMATION
Test date: 1/11/2013

AMBIENT CONDITIONS
Air temperature: 7.2 C (45 F)
Wind speed: 3.6 m/s (8.1 mph)

Wind speed ≤ 10 m/s (22 mph)

Tests were not performed during periods of inclement weather. This includes, but is not limited to, rain, snow, hail, fog, smoke, or ash.

Tests were conducted during daylight hours with good atmospheric visibility (defined as an absence of fog and the ability to see clearly for more than 5000 meters). The tests were not conducted with the vehicle oriented into the sun during very low sun angle conditions, where the sun is oriented 15 degrees or less from horizontal, and camera “washout” or system inoperability results.

VEHICLE PREPARATION
Verify the following:

All non consumable fluids at 100 % capacity: X
Fuel tank is full: X
Tire pressures are set to manufacturer's recommended cold tire pressure: X

Front: 225 kPa (33 psi)
Rear: 225 kPa (33 psi)
## WEIGHT

Weight of vehicle as tested including driver and instrumentation

<table>
<thead>
<tr>
<th>Location</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Front</td>
<td><strong>554.7 kg (1223 lb)</strong></td>
</tr>
<tr>
<td>Left Rear</td>
<td><strong>352.0 kg (776 lb)</strong></td>
</tr>
<tr>
<td>Right Front</td>
<td><strong>526.2 kg (1160 lb)</strong></td>
</tr>
<tr>
<td>Right Rear</td>
<td><strong>320.2 kg (706 lb)</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1753.1 kg (3865 lb)</strong></td>
</tr>
</tbody>
</table>
LANE DEPARTURE WARNING
DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(2013 Honda Accord

How is the Forward Collision Warning presented to the driver?
(Check all that apply)  X Warning light  X Buzzer or audible alarm
  ___ Vibration
  ___ Other

Describe the method by which the driver is alerted. For example, if the warning is a light, where is it located, its color, size, words or symbol, does it flash on and off, etc. If it is a sound, describe if it is constant beep or a repeated beep. If it is a vibration, describe where it is felt (e.g., pedals, steering wheel), the dominant frequency (and possibly magnitude), the type of warning (light, audible, vibration, or combination) etc.

The audible alert consists of a series of repeated beeps whose primary frequency is approximately 800 Hz.

The visual alert consists of a small telltale which flashes repeatedly. The telltale appears on the top right side of the dashboard (above the engine temperature gauge) and illuminates the word "LDW". The telltale appears amber in color.
Is the vehicle equipped with a switch whose purpose is to render LDW inoperable?  

X Yes  

No  

If yes please provide a full description including the switch location and method of operation, any associated instrument panel indicator, etc.

*A LDW on/off switch is located on the lower left side of the dash. When in the "On" position, a green light appears at the top of the switch.*

Is the vehicle equipped with a control whose purpose is to adjust the range setting or otherwise influence the operation of LDW?  

X Yes  

No  

If yes please provide a full description
Are there other driving modes or conditions that render LDW inoperable or reduce its effectiveness?

Yes  X  No

If yes please provide a full description.

- When you drive in bad weather (rain, fog, etc.).
- A heavy load in the rear or modifications to the suspension tilts your vehicle.
- An abnormal tire condition is detected (wrong tire size, flat tire, etc.).
- When the windshield is blocked by dirt, mud, leaves, wet snow, etc.
- When the temperature inside the system is high.
- A sudden change between light and dark such as an entrance or exit of a tunnel.
- You drive into the sunlight (e.g. at dawn or dusk).
- When the windshield is dirty or cloudy.
- When you drive in the shadows of trees, buildings, etc.
- When your vehicle is towing a trailer.
- When you drive on a wet road surface following another vehicle.
  - The camera may perceive the tire tracks in the water as lane lines.
- When there is snow or wheel tracks on the side of the road.
- When the road has many repaired area or an erased lane line.
- When the vehicle is running over painted signs or crosswalk markings.
- When you drive in a lane with specific lane markups (e.g., Bots-dots).
A. Test Procedure Overview

Each LDW test involved one of three lane marking types: solid white lines, dashed yellow lines, or Botts Dots. Lane departures were done both to the left and to the right, and each test condition was repeated five times, as shown in Table 1.

Table 1. – LDW Test Matrix

<table>
<thead>
<tr>
<th>Lane Geometry</th>
<th>Line Type</th>
<th>Departure Direction</th>
<th>Number of Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight</td>
<td>Solid</td>
<td>L</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Dashed</td>
<td>L</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>5</td>
</tr>
<tr>
<td>Botts Dots</td>
<td></td>
<td>L</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>5</td>
</tr>
</tbody>
</table>

Prior to the start of a test series involving a given lane marking type and departure direction combination, the accuracy of the distance to lane marking measurement was verified. This was accomplished by driving the vehicle to the approximate location at which the lane departure would occur and placing the tire at the lane marking edge of interest (i.e., distance to lane marking = 0). The real-time display of distance to the lane marking was then observed to verify that the measured distance was within the tolerance (5 cm). If the measured distance was found to be greater than the tolerance, the instrumentation setup was checked and corrected, if necessary. If the measured distance was found to be within the tolerance, the instrumentation setup was considered appropriate and the test series was begun.

To begin the maneuver, the vehicle was accelerated from rest to a test speed of 72.4 km/h (45 mph), while being driven in a straight line parallel to the lane marking of interest, with the centerline of the vehicle approximately 1.83 m (6.0 ft) from the lane edge (i.e., such that the vehicle would pass through the center of the start gate). The test speed was achieved at least 60 m (200 ft) before the start gate was reached. Striking any start gate cones was not permitted, and any run in which a cone was struck was considered to be invalid. Also, during the initialization and test phases, the test driver avoided using turn
signals and avoided applying any sudden acceleration, sudden steering or sudden braking, and any use of the turn signals, sudden acceleration, sudden steering or sudden braking invalidated the test trial.

Data collection began with the vehicle at least 60 m (200 ft) from the start gate, which was configured using a pair of non-reflective, low-contrast color traffic cones. A second set of cones, placed 6 m (20 ft) longitudinally before the start gate, was used to guide the driver into the start gate. The lateral width between the cone pairs was 20 cm (8 in) greater than the width of the vehicle, and the centerline of each pair was laterally offset from the lane marking by 1.8 m (6 ft).

Once the driver passed the gate, the driver manually input sufficient steering to achieve a lane departure with a target lateral velocity of 0.5 m/s with respect to the lane line. As shown in Fig 1, two additional non-reflective cones were used to guide the driver in making this steering maneuver. Throughout the maneuver the driver modulated the throttle, or used cruise control, as appropriate, such that vehicle speed remained at constant speed. The test was considered complete when the vehicle crossed at least 1 m (3.3 ft) over the lane edge boundary.

Data collected included vehicle speed, position, and yaw rate. In addition to cone strikes, vehicle speed and yaw rate data were used to identify invalid runs as described in Section C below. Data from trials where speed or yaw rate were outside of the performance specification were not considered valid.

B. Lane Delineation Markings

The Office of Crash Avoidance Standards’ Test Procedure for the confirmation of a lane departure warning system contains a requirement that all lane markings
meet USDOT specifications as described in the Manual on Uniform Traffic Control Devices (MUTCD) and be considered in “very good condition”.

1. Lane Marker Width

The width of the edge line marker was 10 to 15 cm (4 to 6 in). This is considered to be a normal width for longitudinal pavement markings under Section 3A.05 of the MUTCD.

2. Line Marking Color and Reflectivity

Lane marker color and reflectivity met all applicable standards. These standards include those from the International Commission of Illumination (CIE) for color and the American Society for Testing and Materials (ASTM) on lane marker reflectance.

3. Line Styles

The tests described in this document required the use of three lane line configurations: continuous solid white, discontinuous dashed yellow, and discontinuous with raised pavement markers.

- **Continuous White Line**
  A continuous white line is defined as a white line that runs for the entire length of the test course.

- **Dashed Yellow Line**
  As stated in the Manual on Uniform Traffic Control Devices (MUTCD), and as shown in Figure 2, a discontinuous dashed yellow line is defined as by a series of 3 m (10 ft) broken (dashed) yellow line segments, spaced 9.1 m (30 ft) apart.

- **Raised Pavement Marker Line (Botts Dots)**
  California Standard Plans indicates raised pavement markers are commonly used in lieu of painted strips for marking roads in California. Other states, mainly in the southern part of the United States, rely on them as well. These markers may be white or yellow, depending on the specific application, following the same basic colors of their analogous white and yellow painted lines. Following the California 2006 Standard Plans, three types of raised pavement markings are used to form roadway lines. It is believed that these types of roadway markings are the hardest for an LDW sensor system to process. Type A and Type AY are non-reflective circular domes that are approximately 10 cm (4 in) in diameter and approximately 1.8 cm (0.7
in) high. Type C and D are square markings that are retro reflective in two directions measuring approximately 10 x 10 x 5 cm (4 x 4 x 0.5 in), and Type G and H that are the same as C and D only retro reflective in a single direction.

For the tests described in this document, raised pavement markers were set up following California Standard Plan A20A, Detail 4 as shown in Figure 3. Note that in this figure, the squares are Type D yellow reflectors and the circles are yellow Type AY discs.
C. Test Validity

1. Speed

All LDW tests were conducted at 72.4 km/h (45 mph). Test speed was monitored and a test was considered valid if the test speed remained within ± 2 km/h (± 1.2 mph) of the 72.4 km/h (45 mph) target speed. It was required that the speed must remain within this window from the start of the test until any part of the vehicle crossed a lane line by 1 m (3.3 ft) or more.

2. Lateral Velocity

All tests were conducted with a lateral velocity of 0.1 to 0.6 m/s (0.3 to 2.0 ft/s), measured with respect to the lane line at the time of the alert. To assist the test driver in being able to efficiently establish the target lateral velocity, cones were positioned in the manner shown in Figure 1.

3. Yaw Rate

It was required that the magnitude of the vehicle’s yaw rate could not exceed 1.0 deg/sec at any time during lane departure maneuver, from the time the vehicle passes through the start gate to the instant the vehicle has crossed a lane line by 1 m (3.3 ft).

D. Pass/Fail Criteria

The measured test data were used to determine the pass/fail outcome for each trial. The outcome was based on whether the LDW produced an appropriate alert during the maneuver. In the context of this test procedure, a lane departure is said to occur when any part of the two dimensional polygon used to represent the test vehicle breaches the inboard lane line edge (i.e., the edge of the line closed to the vehicle before the departure occurs). In the case of tests performed in this procedure, the front corner of the polygon, defined as the intersection of center of the front wheels (longitudinally) with the outboard edge of the front tire (laterally), crossed the line edge first. So, for example, if the vehicle departed its lane to the left, the left front corner of the polygon would first breach the lane line edge.

For an individual trial to be considered a “pass”:

- Test speed, lateral velocity, and yaw rate validity conditions must be satisfied.
- The LDW alert must not occur when the lateral position of the vehicle
is greater than 0.75 m (2.5 ft) from the lane line edge (i.e., prior to the lane departure).

- The LDW alert must occur before the lane departure exceeds 0.3 m (1.0 ft).

For an overall “Pass” the LDW system must satisfy the pass criteria for 3 of 5 individual trials for each combination of departure direction and lane line type (60 percent), and pass 20 of the 30 trials overall (66 percent).

E. Instrumentation

Table 2 lists the sensors, signal conditioning and data acquisition equipment used for these tests.
### Table 2. Test Instrumentation and Equipment

<table>
<thead>
<tr>
<th>Type</th>
<th>Output</th>
<th>Range</th>
<th>Accuracy, Other Primary Specs</th>
<th>Mfr, Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tire Pressure Gauge</strong></td>
<td>Vehicle Tire Pressure</td>
<td>0-100 psi 0-690 kPa</td>
<td>0.5 psi 3.45 kPa</td>
<td>Ashcroft, D1005PS</td>
</tr>
<tr>
<td><strong>Platform Scales</strong></td>
<td>Vehicle Total, Wheel, and Axle Load</td>
<td>8000 lb 35.6 kN</td>
<td>±1.0% of applied load</td>
<td>Intercomp, SWII</td>
</tr>
<tr>
<td><strong>Differential Global Positioning System</strong></td>
<td>Position, Velocity</td>
<td>Latitude: ± 90 deg</td>
<td>Horizontal Position: ± 1 cm</td>
<td>Trimble GPS Receiver, 5700 (base station and in-vehicle)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longitude: ± 180 deg</td>
<td>Vertical Position: ± 2 cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Altitude: 0-18 km</td>
<td>Velocity: 0.05 km/h</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Velocity: 0-1000 knots</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multi-Axis Inertial Sensing System</strong></td>
<td>Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles</td>
<td>Latitude: ± 90 deg</td>
<td>Position: ± 2 cm</td>
<td>Oxford Technical Solutions (OXTS), Inertial+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longitude: ± 180 deg</td>
<td>Velocity: 0.05 km/h</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Altitude: 0-18 km</td>
<td>Accel: ≤ 0.01% of full range</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Velocity: 0-1000 knots</td>
<td>Angular Rate: ≤ 0.01% of full range</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accel: ± 0.01 m/s²</td>
<td>Roll/Pitch Angle: ± 0.03 deg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Angular Rate: ± 100 deg/s</td>
<td>Heading Angle: ± 0.1 deg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Angular Disp: ± 180 deg</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Real-Time Calculation of Position and Velocity Relative to Lane Markings (LDW) and POV (FCW)</strong></td>
<td>Distance and Velocity to lane markings (LDW) and POV (FCW)</td>
<td>Lateral Lane Dist: ± 30 m</td>
<td>Lateral Distance to Lane Marking: ± 2 cm</td>
<td>Oxford Technical Solutions (OXTS), RT-Range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lateral Lane Velocity: ± 20 m/sec</td>
<td>Lateral Velocity to Lane Marking: ± 0.02 m/sec</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longitudinal Range to POV: ± 200 m</td>
<td>Longitudinal Range to Lane Marking: ± 3 cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longitudinal Range Rate: ± 50 m/sec</td>
<td>Longitudinal Range Rate: ± 0.02 m/sec</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Output</td>
<td>Range</td>
<td>Accuracy, Other Primary Specs</td>
<td>Mfr, Model</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------</td>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Data Acquisition System</td>
<td>Record Time; Position; Velocity; Distance to lane markings; Headway distance; Closing Velocity; Lateral, Longitudinal, and Vertical Accels; Roll, Yaw, and Pitch Rates; Roll, Yaw and Pitch Angles.</td>
<td>Sufficient to meet or exceed individual sensors</td>
<td>Sound digitized at 10 kHz, all other channels digitized at 100 Hz. Accuracy is sufficient to meet or exceed individual sensors</td>
<td>SoMat, eDaq ECPU processor</td>
</tr>
<tr>
<td></td>
<td>[Includes amplification, anti-aliasing, and analog to digital conversion.]</td>
<td></td>
<td></td>
<td>SoMat, High level Board EHLS</td>
</tr>
<tr>
<td>Microphone</td>
<td>Sound (to measure time at alert)</td>
<td>Max SPL: 139 dB/SPL Frequency Response: 40 Hz – 20 kHz</td>
<td>≤ 3 dB over Freq. Resp. Range</td>
<td>Sennheiser, e614</td>
</tr>
<tr>
<td>Light Sensor</td>
<td>Light intensity (to measure time at alert)</td>
<td>Spectral Bandwidth: 440-800 nm</td>
<td>Rise time &lt; 10 msec</td>
<td>DRI designed and developed Light Sensor</td>
</tr>
<tr>
<td>Accelerometer</td>
<td>Acceleration (to measure time at alert)</td>
<td>± 5g</td>
<td>≤ 3% of full range</td>
<td>Silicon Designs, 2210-005</td>
</tr>
<tr>
<td>Coordinate Measurement Machine</td>
<td>Inertial Sensing System Coordinates</td>
<td>0-8 ft 0-2.4 m</td>
<td>± .0020 in. ± .051 mm (Single point articulation accuracy)</td>
<td>Faro Arm, Fusion</td>
</tr>
</tbody>
</table>
As part of the pre-test instrumentation verification process, the tonal frequency of the audible warning or the vibration frequency of the tactile warning (if present) was determined through use of the PSD (Power Spectral Density) function in Matlab. This was accomplished in order to identify the center frequency around which a band-pass filter was applied to subsequent audible or tactile warning data so that the beginning of such warnings could be programmatically determined. The bandpass filter used for these warning signals was a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 3.

Table 3. Audible and Tactile Warning Filter Parameters

<table>
<thead>
<tr>
<th>Warning Type</th>
<th>Filter Order</th>
<th>Peak-to-Peak Ripple</th>
<th>Minimum Stop Band Attenuation</th>
<th>Pass-Band Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audible</td>
<td>5th</td>
<td>3 dB</td>
<td>60 dB</td>
<td>Identified Center Frequency ± 5%</td>
</tr>
<tr>
<td>Tactile</td>
<td>5th</td>
<td>3 dB</td>
<td>60 dB</td>
<td>Identified Center Frequency ± 20%</td>
</tr>
</tbody>
</table>
APPENDIX A

Photographs
### LIST OF FIGURES

| Figure A1. | Front View of Subject Vehicle | A-3 |
| Figure A2. | Rear View of Subject Vehicle  | A-4 |
| Figure A3. | Window Sticker (Monroney Label) | A-5 |
| Figure A4. | Vehicle Certification Label    | A-6 |
| Figure A5. | DGPS and Inertial Measurement Unit Installed in Subject Vehicle | A-7 |
| Figure A6. | Data Acquisition System Installed in Subject Vehicle | A-8 |
| Figure A7. | Computer Installed in Subject Vehicle | A-9 |
| Figure A8. | Sensors for Visual and Audible Alerts | A-10 |
| Figure A9. | LDW On-Off Switch             | A-11 |
| Figure A10. | LDW Visual Display            | A-12 |
Figure A1. Front View of Subject Vehicle
Figure A2. Rear View of Subject Vehicle
Figure A4. Vehicle Certification Label
Figure A5. DGPS and Inertial Measurement Unit Installed in Subject Vehicle
Figure A6. Data Acquisition System Installed in Subject Vehicle
Figure A7. Computer Installed in Subject Vehicle
Figure A8. Sensors for Visual and Audible Alerts Alert
Figure A9. LDW On-Off Switch
Figure A10. LDW Visual Display
APPENDIX B

Excerpts from Owner’s Manual
Visual Index

- ECON Button ➤ P. 446
- System Indicators ➤ P. 68
- Gauges ➤ P. 89
- Information Display* ➤ P. 90
- Multi-Information Display* ➤ P. 93
- ENGINE START/STOP Button** ➤ P. 132
- Audio/Information Screen ➤ P. 181 ➤ P. 207 ➤ P. 239
- Audio System ➤ P. 180 ➤ P. 203 ➤ P. 236
- Audio with Touch Screen* ➤ P. 204 ➤ P. 237
- Hazard Warning Button
- Heating and Cooling System* ➤ P. 166
- Climate Control System ➤ P. 169
- Rear Window Defogger ➤ P. 142
- Heated Mirror Button* ➤ P. 142
- Navigation System*
  ➤ See Navigation System Manual
- Front Seat Heater Switches* ➤ P. 164
- Ignition Switch* ➤ P. 131
- TPMS (Tire Pressure Monitoring System) Button* ➤ P. 469
- (Vehicle Stability Assist (VSA®) System OFF) Button ➤ P. 465
- Lane Departure Warning (LDW) Button* ➤ P. 462

*1: Models with the smart entry system have an ENGINE START/STOP button instead of an ignition switch.

* Not available on all models
Instrument Panel

Gauges /Information Display* / Multi-Information Display* / System Indicators

System Indicators
- Malfunction Indicator Lamp
- Low Oil Pressure Indicator
- Charging System Indicator
- Vehicle Stability Assist (VSA*) System Indicator
- VSA* OFF Indicator
- Immobilizer System Indicator
- Smart Entry System Indicator
- STARTER SYSTEM U.S.
  - Starter System Indicator
  - Electric Power Steering (EPS) System Indicator
- Washer Level Indicator
- System Message indicator
- Maintenance Minder Indicator

System Indicators
- Security System Alarm Indicator
- Speedometer
- Temperature Gauge
- Tachometer
- Shift Lever Position Indicator
- M (7-speed manual shift mode) Indicator/Shift Indicator

System Indicators
- Lights On Indicator
- High Beam Indicator
- Fog Light Indicator
- Lane Departure Warning (LDW) Indicator

System Indicators
- Turn Signal and Hazard Warning Indicators
- Anti-lock Brake System (ABS) Indicator
- BRAKE
  - Parking Brake and Brake System Indicator (Red)
- BRAKE SYSTEM
  - Brake System Indicator (Amber)
- Door and Trunk Open Indicator
- Low Fuel Indicator
- Seat Belt Reminder Indicator
- Supplemental Restraint System Indicator
- Adaptive Cruise Control (ACC) Indicator
- CRUISE MAIN Indicator
- CRUISE CONTROL Indicator

* Not available on all models
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Name</th>
<th>On/Blinking</th>
<th>Explanation</th>
<th>Message</th>
</tr>
</thead>
</table>
| LDW       |       | • Comes on for a few seconds when you change the power mode to ON, then goes off.  
• Comes on if there is a problem with the LDW system. | **Stays on constantly** - Have the vehicle checked by a dealer. | ![Image] |
|           | Models with information display | • Blinks when your vehicle is too close to the lane lines. The beeper sounds. | **Blinks while driving** - Take appropriate action to keep your vehicle within the lane lines. | — — |
|           |       | • Comes on when the LDW system shuts itself off. | **Stays on** - The temperature inside the LDW camera is too high. The system activates when the temperature inside the camera cools down.  
[LDW Camera P. 463](#) | ![Image] |
|           |       | • Stays on - The area around the camera is blocked by dirt, mud, etc. Stop your vehicle in a safe place, and wipe it off with a soft cloth.  
• Have your vehicle checked by a dealer if the indicator and message come back on after you cleaned the area around the camera.  
[LDW Camera P. 463](#) | ![Image] |

*1: On the left: Models with information display  
On the right: Models with multi-information display

* Not available on all models
## Multi-information Display Warning and Information Messages

### Message

<table>
<thead>
<tr>
<th>Message</th>
<th>Condition</th>
<th>Explanation</th>
</tr>
</thead>
</table>
| ![Battery Charging Problem](image) | • Appears when there is a problem with the sensor on the battery.  
• Appears when the battery is not charging. | • Have your vehicle checked by a dealer.  
[Checking the Battery](#) P. 534  
• Appears along with the battery charging system indicator - Turn off the climate control system and rear defogger to reduce electricity consumption.  
[If the Charging System Indicator Comes On](#) P. 560 |
| ![Battery Charging Problem](image) | • Appears when the starting system has a problem. | • As a temporary measure, press and hold the **ENGINE START/STOP** button for 15 seconds while pressing the brake pedal and manually start the engine. Have the vehicle checked by a dealer. |
| ![ACC (Adaptive Cruise Control)](image) | • Appears for about three seconds when ACC has been automatically canceled. | • You can resume the set speed after the condition that caused ACC to cancel improves. Press the **RES/+** button.  
[ACC (Adaptive Cruise Control)](#) P. 450 |
| ![Brake](image) | • Flashes when the system senses a likely collision with a vehicle in front of you. | • Take appropriate action to prevent a collision (apply the brakes, change lanes, etc.).  
[Forward Collision Warning (FCW)](#) P. 458 |
| ![Lane Departure Warning](image) | • Appears when your vehicle is too close to the traffic lane lines. The beeper sounds. | • Take appropriate action to keep your vehicle within the lane lines.  
[Lane Departure Warning (LDW)](#) P. 462 |

* Not available on all models
Lane Departure Warning (LDW) *

Alerts you when the system detects a possibility of your vehicle unintentionally crossing over left or right side lane markings.

How the System Works

If your vehicle is getting too close to detected left or right side lane markings without a turn signal activated, LDW will give audible and visual alerts.

Models with information display

The beeper sounds and the LDW indicator blinks, letting you know that you need to take appropriate action.

Models with multi-information display

The beeper sounds and the Lane Departure message appears on the multi-information display, letting you know that you need to take appropriate action.

Important Safety Reminder

Like all assistance systems, LDW has limitations. Over-reliance on LDW may result in a collision. It is always your responsibility to keep the vehicle within your driving lane.

LDW only alerts you when lane drift is detected without a turn signal in use. LDW may not detect all lane markings or lane departures; accuracy will vary based on weather, speed and lane marker condition. It is always your responsibility to safely operate the vehicle and avoid collisions.

* Not available on all models
How the System Activates

The system begins to search for lane markings when all the following conditions are met:
- The vehicle is traveling between at 40-90 mph (64-145 km/h).
- The vehicle is on a straight or slightly curved road.
- The turn signals are off.
- The brake pedal is not pressed.

LDW Camera

The camera is located behind the rearview mirror.

LDW On and Off

Press the **LDW** button to turn the system on and off.
- The indicator in the button comes on when the system is on.

How the System Activates

LDW may automatically shut off and the **LDW** indicator comes and stays on.

Indicators P. 79

LDW Camera

Never apply a film or attach any objects to the windshield that could obstruct the LDW camera’s field of vision.

Scratches, nicks, and other damage to the windshield within the LDW camera’s field of vision can cause the system to operate abnormally. If this occurs, we recommend that you replace the windshield with a genuine Honda replacement windshield. Making even minor repairs within the camera’s field of vision or installing an aftermarket replacement windshield may also cause the system to operate abnormally.

After replacing the windshield, have a dealer recalibrate the camera. Proper calibration of the LDW camera is necessary for the system to operate properly.

To help reduce the likelihood that high interior temperatures will cause the camera system to shut off, when parking, find a shady area or face the front of the vehicle away from the sun. Also, do not use a reflective sun shade that can concentrate heat on the camera.

If the **CAMERA HOT** message appears:
- Use the climate control system to cool down the interior and, if necessary, use the defroster mode when windows are fogged.
- Start driving the vehicle to lower the windshield temperature, which cools down the area around the LDW system.

Continued
### LDW Limitations

LDW may not activate or may not recognize lanes, and may activate even when keeping in the middle of a lane under the following conditions.

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>When you drive in bad weather (rain, fog, etc.).</td>
</tr>
<tr>
<td>A heavy load in the rear or modifications to the suspension tilts your vehicle.</td>
</tr>
<tr>
<td>An abnormal tire condition is detected (wrong tire size, flat tire, etc.).</td>
</tr>
<tr>
<td>When the windshield is blocked by dirt, mud, leaves, wet snow, etc.</td>
</tr>
<tr>
<td>When the temperature inside the system is high.</td>
</tr>
<tr>
<td>A sudden change between light and dark such as an entrance or exit of a tunnel.</td>
</tr>
<tr>
<td>You drive into the sunlight (e.g. at dawn or dusk).</td>
</tr>
<tr>
<td>When the windshield is dirty or cloudy.</td>
</tr>
<tr>
<td>When you drive in the shadows of trees, buildings, etc.</td>
</tr>
<tr>
<td>When your vehicle is towing a trailer.</td>
</tr>
<tr>
<td>When you drive on a wet road surface following another vehicle.</td>
</tr>
<tr>
<td>The camera may perceive the tire tracks in the water as lane lines.</td>
</tr>
<tr>
<td>When there is snow or wheel tracks on the side of the road.</td>
</tr>
<tr>
<td>When the road has many repaired area or an erased lane line.</td>
</tr>
<tr>
<td>When the vehicle is running over painted signs or crosswalk markings.</td>
</tr>
<tr>
<td>When you drive in a lane with specific lane markups (e.g., bots-dots).</td>
</tr>
</tbody>
</table>

* Not available on all models
APPENDIX C

Run Log
### Run Lane Marking Type Departure Direction Valid Run? Distance at Visual Alert (ft) Distance at Tactile Alert (ft) Pass/Fail Notes

<table>
<thead>
<tr>
<th>Run</th>
<th>Lane Marking Type</th>
<th>Departure Direction</th>
<th>Valid Run?</th>
<th>Distance at Visual Alert (ft)</th>
<th>Distance at Tactile Alert (ft)</th>
<th>Pass/Fail</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solid</td>
<td>Left</td>
<td>Y</td>
<td>0.23</td>
<td>0.27</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>Hit cone</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.17</td>
<td>0.18</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.25</td>
<td>0.26</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.16</td>
<td>0.16</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.18</td>
<td>0.18</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.1</td>
<td>0.11</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.2</td>
<td>0.18</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Dashed</td>
<td>Right</td>
<td>Y</td>
<td>-0.05</td>
<td>-0.06</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.08</td>
<td>0.06</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.06</td>
<td>-0.07</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>Y</td>
<td>0</td>
<td>-0.01</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.02</td>
<td>0.02</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>Hit cone</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.04</td>
<td>0.07</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>Run</td>
<td>Lane Marking Type</td>
<td>Departure Direction</td>
<td>Valid Run?</td>
<td>Distance at Visual Alert (ft)</td>
<td>Distance at Tactile Alert (ft)</td>
<td>Pass/Fail</td>
<td>Notes</td>
</tr>
<tr>
<td>-----</td>
<td>------------------</td>
<td>---------------------</td>
<td>-----------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>16</td>
<td>Dashed</td>
<td>Right</td>
<td>Y</td>
<td>-0.06</td>
<td>0.02</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Dashed</td>
<td>Left</td>
<td>Y</td>
<td>-0.06</td>
<td>-0.01</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.15</td>
<td>-0.05</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.02</td>
<td>0.05</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.05</td>
<td>0.1</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.15</td>
<td>0.18</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.1</td>
<td>0.13</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.01</td>
<td>0.02</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Solid</td>
<td>Right</td>
<td>Y</td>
<td>-0.11</td>
<td>-0.09</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.18</td>
<td>-0.14</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.02</td>
<td>0.02</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td>Y</td>
<td>0.05</td>
<td>0.07</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.02</td>
<td>-0.02</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td>Yaw rate high</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.08</td>
<td>-0.07</td>
<td>Pass</td>
<td></td>
</tr>
</tbody>
</table>
Subject Vehicle: **2013 Honda Accord**
Date: 1/11/2013

Driver: Nadine Wong

<table>
<thead>
<tr>
<th>Run</th>
<th>Lane Marking Type</th>
<th>Departure Direction</th>
<th>Valid Run?</th>
<th>Distance at Visual Alert (ft)</th>
<th>Distance at Tactile Alert (ft)</th>
<th>Pass/Fail</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Solid</td>
<td>Right</td>
<td>Y</td>
<td>0.07</td>
<td>0.07</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Botts</td>
<td>Right</td>
<td>N</td>
<td>-0.2</td>
<td></td>
<td>Light sensor saturated</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.19</td>
<td>-0.14</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td>yaw rate high</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td>yaw rate high</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td>yaw rate high</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.49</td>
<td>-0.38</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td>yaw rate high</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.4</td>
<td>-0.4</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.38</td>
<td>-0.38</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.36</td>
<td>-0.27</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.35</td>
<td>-0.37</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.3</td>
<td>-0.28</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Botts</td>
<td>Left</td>
<td>N</td>
<td></td>
<td></td>
<td>Light sensor issue</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td>yaw rate high</td>
<td></td>
</tr>
<tr>
<td>Run</td>
<td>Lane Marking Type</td>
<td>Departure Direction</td>
<td>Valid Run?</td>
<td>Distance at Visual Alert (ft)</td>
<td>Distance at Tactile Alert (ft)</td>
<td>Pass/Fail</td>
<td>Notes</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>------------------------------</td>
<td>-----------------------------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>46</td>
<td>Botts</td>
<td>Left</td>
<td>Y</td>
<td>-0.39</td>
<td>-0.29</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>Light sensor issue</td>
</tr>
<tr>
<td>48</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.36</td>
<td>-0.21</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>yaw rate high</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td>Y</td>
<td>-1.74</td>
<td>-0.23</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>yaw rate high</td>
</tr>
<tr>
<td>52</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.41</td>
<td>Pass</td>
<td>No visual warning</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.5</td>
<td>-0.38</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.37</td>
<td>-0.23</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td></td>
<td>Y</td>
<td>-0.4</td>
<td>-0.31</td>
<td>Pass</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

Time History Plots
| Figure D1. | Example Time History for Lane Departure Warning Test, Passing | D-9 |
| Figure D2. | Example Time History for Lane Departure Warning Test, Failing, No Warning Issued | D-10 |
| Figure D3. | Example Time History for Lane Departure Warning Test, Invalid Run Due to Subject Vehicle Yaw Rate | D-11 |
| Figure D4. | Time History for Run 1, Solid Line, Left Departure, Audible Warning | D-12 |
| Figure D5. | Time History for Run 1, Solid Line, Left Departure, Visual Warning | D-13 |
| Figure D6. | Time History for Run 3, Solid Line, Left Departure, Audible Warning | D-14 |
| Figure D7. | Time History for Run 3, Solid Line, Left Departure, Visual Warning | D-15 |
| Figure D8. | Time History for Run 4, Solid Line, Left Departure, Audible Warning | D-16 |
| Figure D9. | Time History for Run 4, Solid Line, Left Departure, Visual Warning | D-17 |
| Figure D10. | Time History for Run 5, Solid Line, Left Departure, Audible Warning | D-18 |
| Figure D11. | Time History for Run 5, Solid Line, Left Departure, Visual Warning | D-19 |
| Figure D12. | Time History for Run 6, Solid Line, Left Departure, Audible Warning | D-20 |
| Figure D13. | Time History for Run 6, Solid Line, Left Departure, Visual Warning | D-21 |
| Figure D14. | Time History for Run 7, Solid Line, Left Departure, Audible Warning | D-22 |
| Figure D15. | Time History for Run 7, Solid Line, Left Departure, Visual Warning | D-23 |
| Figure D16. | Time History for Run 8, Solid Line, Left Departure, Audible Warning | D-24 |
| Figure D17. | Time History for Run 8, Solid Line, Left Departure, Visual Warning | D-25 |
| Figure D18. | Time History for Run 9, Dashed Line, Right Departure, Audible Warning | D-26 |
| Figure D19. | Time History for Run 9, Dashed Line, Right Departure, Visual Warning | D-27 |
| Figure D20. | Time History for Run 10, Dashed Line, Right Departure, Audible Warning | D-28 |
| Figure D21. | Time History for Run 10, Dashed Line, Right Departure, Visual Warning | D-29 |
| Figure D22. | Time History for Run 11, Dashed Line, Right Departure, Audible Warning | D-30 |
| Figure D23. | Time History for Run 11, Dashed Line, Right Departure, Visual Warning | D-31 |
Figure D72. Time History for Run 43, Botts Dots, Right Departure, Audible Warning

Figure D73. Time History for Run 43, Botts Dots, Right Departure, Visual Warning

Figure D74. Time History for Run 46, Botts Dots, Left Departure, Audible Warning

Figure D75. Time History for Run 46, Botts Dots, Left Departure, Visual Warning

Figure D76. Time History for Run 48, Botts Dots, Left Departure, Audible Warning

Figure D77. Time History for Run 48, Botts Dots, Left Departure, Visual Warning

Figure D78. Time History for Run 50, Botts Dots, Left Departure, Audible Warning

Figure D79. Time History for Run 50, Botts Dots, Left Departure, Visual Warning

Figure D80. Time History for Run 52, Botts Dots, Left Departure, Audible Warning

Figure D81. Time History for Run 52, Botts Dots, Left Departure, Visual Warning

Figure D82. Time History for Run 53, Botts Dots, Left Departure, Audible Warning

Figure D83. Time History for Run 53, Botts Dots, Left Departure, Visual Warning

Figure D84. Time History for Run 54, Botts Dots, Left Departure, Audible Warning

Figure D85. Time History for Run 54, Botts Dots, Left Departure, Visual Warning

Figure D86. Time History for Run 55, Botts Dots, Left Departure, Audible Warning

Figure D87. Time History for Run 55, Botts Dots, Left Departure, Visual Warning
Description of Time History Plots

A set of time history plots is provided for each valid run in the test series. Each set of plots comprises time varying data from the Subject Vehicle, as well as pass/fail envelopes and thresholds. The following is a description of data types shown in the time history plots, as well as a description of the color code for data envelopes.

Time History Plot Description

Time history figures include the following sub-plots:

- **Event** – indicates timing of warning issued by LDW system. Depending on the type of LDW alert or instrumentation used to measure the alert, this can be any of the following:
  - Filtered and rectified sound signal
  - Filtered and rectified acceleration (e.g., steering wheel vibration)
  - Light sensor signal
  - Discrete on/off value
- **Speed (mph)** – speed of the Subject Vehicle
- **Yaw Rate (deg/sec)** – yaw rate of the Subject Vehicle
- **Dist to Lane Edge (ft)** – lateral distance (in lane coordinates) from the outer front tire bulge to the inside edge of the lane marking of interest for a given test (a positive value indicates the vehicle is completely within the lane while a negative value indicates that the outer front tire bulge has crossed over the inner lane marking edge)
- **Lateral Velocity (ft/sec)** – lateral velocity (in lane coordinates) of the outer front tire bulge
- **Bird’s Eye View** – Indicates the position of the Subject Vehicle with respect to the lane marking of interest for a given test. Green rectangles represent the Subject Vehicle’s position at approximately 2 second intervals, while the yellow rectangle indicates the position of the Subject Vehicle at the time of LDW warning issuance.
Envelopes and Thresholds

Each of the time history plot figures can contain either green or yellow envelopes and/or black threshold lines. These envelopes and thresholds are used to programmatically and visually determine the validity of a given test run. Envelope and threshold exceedances are indicated with either red shading or red asterisks, and red text is placed to the right side of the plot indicating the type of exceedance.

Green envelopes indicate that the time-varying data should not exceed the envelope boundaries at any time within the envelope. Exceedances of a green envelope are indicated by red shading in the area between the measured time-varying data and the envelope boundaries.

Yellow envelopes indicate that the time-varying data should not exceed the envelope only at the right end. Exceedances at the right extent of a yellow envelope are indicated by red asterisks. Data within the boundaries at the right extent of a yellow envelope are indicated by green circles.

Color Codes

Color codes have been adopted to easily identify the types of data, envelopes and thresholds used in the plots.

Color codes can be broken into three categories:
1. Validation envelopes and thresholds
2. Instantaneous samplings
3. Text

1. Validation envelope and threshold color codes:
   • Green envelope = time varying data must be within the envelope at all times in order to be valid
   • Yellow envelope = time varying data must be within limits at right end
   • Black threshold (Solid) = time varying data must not exceed this threshold in order to be valid
   • Black threshold (Dashed) = for reference only – this can include warning level thresholds which are used to determine the timing of the alert

2. Instantaneous sampling color codes:
   • Green circle = passing or valid value at a given moment in time
   • Red asterisk = failing or invalid value at a given moment in time
3. Text color codes:
   - Green = passing or valid value
   - Red = failing or invalid value

   Examples of time history plots (including passing, failing and invalid runs) are shown in Figure D1 through Figure D3. Actual time history data plots for the vehicle under consideration are provided subsequently.
Figure D1. Example Time History for Lane Departure Warning Test, Passing
Figure D2. Example Time History for Lane Departure Warning Test, Failing, No Warning Issued
Figure D3. Example Time History for Lane Departure Warning Test, Invalid Run Due to Subject Vehicle Yaw Rate
Figure D4. Time History for Run 1, Solid Line, Left Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D5. Time History for Run 1, Solid Line, Left Departure, Visual Warning
Figure D6. Time History for Run 3, Solid Line, Left Departure, Audible Warning
Figure D7. Time History for Run 3, Solid Line, Left Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D8. Time History for Run 4, Solid Line, Left Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D9. Time History for Run 4, Solid Line, Left Departure, Visual Warning
Figure D10. Time History for Run 5, Solid Line, Left Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D11. Time History for Run 5, Solid Line, Left Departure, Visual Warning
Figure D12. Time History for Run 6, Solid Line, Left Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D13. Time History for Run 6, Solid Line, Left Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D14. Time History for Run 7, Solid Line, Left Departure, Audible Warning
Figure D15. Time History for Run 7, Solid Line, Left Departure, Visual Warning
Figure D16. Time History for Run 8, Solid Line, Left Departure, Audible Warning
Figure D17. Time History for Run 8, Solid Line, Left Departure, Visual Warning
Figure D18. Time History for Run 9, Dashed Line, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D19. Time History for Run 9, Dashed Line, Right Departure, Visual Warning
Figure D20. Time History for Run 10, Dashed Line, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D21. Time History for Run 10, Dashed Line, Right Departure, Visual Warning
Figure D22. Time History for Run 11, Dashed Line, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
GPS Fix Type: RTK Fixed

Figure D23. Time History for Run 11, Dashed Line, Right Departure, Visual Warning
Figure D24. Time History for Run 12, Dashed Line, Right Departure, Audible Warning
Figure D25. Time History for Run 12, Dashed Line, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D26. Time History for Run 13, Dashed Line, Right Departure, Audible Warning
Figure D27. Time History for Run 13, Dashed Line, Right Departure, Visual Warning
LDW Test
Accord-15

Figure D28. Time History for Run 15, Dashed Line, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
GPS Fix Type: RTK Fixed

Figure D29. Time History for Run 15, Dashed Line, Right Departure, Visual Warning
Figure D30. Time History for Run 16, Dashed Line, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D31. Time History for Run 16, Dashed Line, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D32. Time History for Run 17, Dashed Line, Left Departure, Audible Warning
Figure D33. Time History for Run 17, Dashed Line, Left Departure, Visual Warning
Figure D34. Time History for Run 18, Dashed Line, Left Departure, Audible Warning
Figure D35. Time History for Run 18, Dashed Line, Left Departure, Visual Warning
Figure D36. Time History for Run 19, Dashed Line, Left Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D37. Time History for Run 19, Dashed Line, Left Departure, Visual Warning
Figure D38. Time History for Run 20, Dashed Line, Left Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D39. Time History for Run 20, Dashed Line, Left Departure, Visual Warning
Figure D40. Time History for Run 21, Dashed Line, Left Departure, Audible Warning
Figure D41. Time History for Run 21, Dashed Line, Left Departure, Visual Warning
Figure D42. Time History for Run 22, Dashed Line, Left Departure, Audible Warning
Figure D43. Time History for Run 22, Dashed Line, Left Departure, Visual Warning
Figure D44. Time History for Run 23, Dashed Line, Left Departure, Audible Warning
Figure D45. Time History for Run 23, Dashed Line, Left Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D46. Time History for Run 24, Solid Line, Right Departure, Audible Warning
Figure D47. Time History for Run 24, Solid Line, Right Departure, Visual Warning

LDW Test
Accord-24

Visual Warning

Speed (mph)

Yaw Rate (deg/sec)

Dist to Lane Edge (ft)

Lateral Lane Velocity (ft/sec)

Time (sec)

GPS Fix Type: RTK Fixed
GPS Fix Type: RTK Fixed

Figure D48. Time History for Run 25, Solid Line, Right Departure, Audible Warning
Figure D49. Time History for Run 25, Solid Line, Right Departure, Visual Warning
Figure D50. Time History for Run 26, Solid Line, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D51. Time History for Run 26, Solid Line, Right Departure, Visual Warning.
Figure D52. Time History for Run 27, Solid Line, Right Departure, Audible Warning
Figure D53. Time History for Run 27, Solid Line, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
GPS Fix Type: RTK Fixed

Figure D54. Time History for Run 28, Solid Line, Right Departure, Audible Warning
Figure D55. Time History for Run 28, Solid Line, Right Departure, Visual Warning
Figure D56. Time History for Run 30, Solid Line, Right Departure, Audible Warning
Figure D57. Time History for Run 30, Solid Line, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D58. Time History for Run 31, Solid Line, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D59. Time History for Run 31, Solid Line, Right Departure, Visual Warning
Figure D60. Time History for Run 33, Botts Dots, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D61. Time History for Run 33, Botts Dots, Right Departure, Visual Warning
Figure D62. Time History for Run 37, Botts Dots, Right Departure, Audible Warning
Figure D63. Time History for Run 37, Botts Dots, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D64. Time History for Run 39, Botts Dots, Right Departure, Audible Warning
Figure D65. Time History for Run 39, Botts Dots, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D66. Time History for Run 40, Botts Dots, Right Departure, Audible Warning

LDW Test
Accord-40

GPS Fix Type: RTK Fixed
Figure D67. Time History for Run 40, Botts Dots, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D68. Time History for Run 41, Botts Dots, Right Departure, Audible Warning
**Figure D69. Time History for Run 41, Botts Dots, Right Departure, Visual Warning**

**GPS Fix Type:** RTK Fixed
Figure D70. Time History for Run 42, Botts Dots, Right Departure, Audible Warning
Figure D71. Time History for Run 42, Botts Dots, Right Departure, Visual Warning

GPS Fix Type: RTK Fixed
Figure D72. Time History for Run 43, Botts Dots, Right Departure, Audible Warning

GPS Fix Type: RTK Fixed
GPS Fix Type: RTK Fixed

Figure D73. Time History for Run 43, Botts Dots, Right Departure, Visual Warning
Figure D74. Time History for Run 46, Botts Dots, Left Departure, Audible Warning
Figure D75. Time History for Run 46, Botts Dots, Left Departure, Visual Warning

**GPS Fix Type:** RTK Fixed
GPS Fix Type: RTK Fixed

Figure D76. Time History for Run 48, Botts Dots, Left Departure, Audible Warning
Figure D77. Time History for Run 48, Botts Dots, Left Departure, Visual Warning
Figure D78. Time History for Run 50, Botts Dots, Left Departure, Audible Warning
Figure D79. Time History for Run 50, Botts Dots, Left Departure, Visual Warning
Figure D80. Time History for Run 52, Botts Dots, Left Departure, Audible Warning
Figure D81. Time History for Run 52, Botts Dots, Left Departure, Visual Warning
Figure D82. Time History for Run 53, Botts Dots, Left Departure, Audible Warning
GPS Fix Type: RTK Fixed

Figure D83. Time History for Run 53, Botts Dots, Left Departure, Visual Warning
Figure D84. Time History for Run 54, Botts Dots, Left Departure, Audible Warning

GPS Fix Type: RTK Fixed
Figure D85. Time History for Run 54, Botts Dots, Left Departure, Visual Warning

**GPS Fix Type:** RTK Fixed
Figure D86. Time History for Run 55, Botts Dots, Left Departure, Audible Warning
Figure D87. Time History for Run 55, Botts Dots, Left Departure, Visual Warning