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<table>
<thead>
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<tbody>
<tr>
<td>1.</td>
<td>Report No.</td>
<td>126-DRI-10-005</td>
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<td>2.</td>
<td>Government Accession No.</td>
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<td>3.</td>
<td>Recipient's Catalog No.</td>
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<td>4.</td>
<td>Title and Subtitle</td>
<td>Final Report of FMVSS 126 Compliance Testing of 2011 Toyota Sienna multipurpose passenger vehicle, NHTSA No. CB5100</td>
</tr>
<tr>
<td>5.</td>
<td>Report Date</td>
<td>23 November, 2010</td>
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<td>6.</td>
<td>Performing Organization Code</td>
<td>DRI</td>
</tr>
</tbody>
</table>
| 7. | Author(s) | John F. Lenkeit, Technical Director  
Brian Kebschull, Principal Engineer |
| 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-00098 |
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National Highway Traffic Safety Administration Enforcement  
Office of Vehicle Safety Compliance  
1200 New Jersey Avenue, SE,  
West Building, 4th Floor (NVS-221)  
Washington, D.C. 20590 |
| 13. | Type of Report and Period Covered | Final Test Report  
1 April, 2010 to 23 November, 2010 |
| 15. | Supplementary Notes |   |
| 16. | Abstract | A test was conducted on a 2011 Toyota Sienna, NHTSA No. CB5100, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-126-02 for the determination of FMVSS 126 compliance. Test failures identified were as follows: None |
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Safety Engineering  
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</tbody>
</table>
1.0 PURPOSE OF COMPLIANCE TEST

The purpose of this test is to determine if the test vehicle, a 2011 Toyota Sienna, meets the minimum equipment and performance requirements stated in Federal Motor Vehicle Safety Standard (FMVSS) 126, "Electronic Stability Control Systems."

2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS

Testing of the 2011 Toyota Sienna was conducted at Dynamic Research, Inc (DRI) in accordance with NHTSA TP-126-02, dated November 19, 2008.

The vehicle was inspected to ensure it was equipped with an ESC system that:

- Augments vehicle directional stability by applying and adjusting brake torques individually at each wheel to induce a correcting yaw moment to a vehicle;

- Is computer controlled with the computer using a closed-loop algorithm to limit vehicle oversteer and to limit vehicle understeer;

- Has a means to determine the vehicle’s yaw rate and to estimate its side slip or side slip derivative with respect to time;

- Has a means to monitor driver steering inputs;

- Has an algorithm to determine the need, and a means to modify engine torque, as necessary, to assist the driver in maintaining control of the vehicle; and

- Is operational over the full speed range of the vehicle (except at vehicle speeds less than 20 km/h (12.4 mph), when being driven in reverse, or during system initialization).

The vehicle was subjected to a 0.7 Hz Sine with Dwell steering maneuver to ensure that it would meet the stability and responsiveness requirements of the standard as follows:

- At 1.0 second after completion of a required Sine with Dwell steering input, the yaw rate of the vehicle must not exceed 35 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks during the same test run).
2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS (CONTINUED)

- At 1.75 seconds after completion of a required Sine with Dwell steering input, the yaw rate of the vehicle must not exceed 20 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks during the same test run).

- The lateral displacement of the vehicle center of gravity with respect to its initial straight path must be at least 1.83 m (6 feet) (for vehicles with a GVWR of 3,500kg (7,716 lb) or less) when computed 1.07 seconds after the Beginning of Steer (BOS) at the specified steering wheel angles.

System malfunction simulations were executed to verify vehicle could identify and indicate a malfunction.

The vehicle's ESC System appears to meet the performance and equipment requirements as required by FMVSS 126. The test results are summarized on the following summary sheet.
2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS (CONTD)

Data Summary Sheet (Page 1 of 2)

Vehicle: 2011 Toyota Sienna

NHTSA No. CB5100 VIN: 5TDKK3DC6BS010864

Vehicle Type: MPV Manufacture Date: 2/10

Laboratory: Dynamic Research, Inc.

REQUIREMENTS: PASS/FAIL

ESC Equipment and Operational Characteristics (Data Sheet 2)
   The vehicle is to be equipped with an ESC system that meets the equipment and operational characteristics requirements. (S126, S5.1, S5.6) PASS

ESC Malfunction Telltale (Data Sheet 3)
   Vehicle is equipped with a telltale that indicates one or more ESC system malfunctions. (S126, S5.3) PASS

“ESC Off” and other System Controls and Telltale (Data Sheet 3,4)
   Vehicle is equipped with an ESC off telltale indicating the vehicle has been put into a mode that renders the ESC system unable to satisfy the performance requirements of the standard, if such a mode exists. (S5.5.1) PASS

   If provided, off control and other system controls as well as the ESC off telltale meets the operational requirements (S126, S5.4, S5.4.1, S5.4.2, S5.5.4, and S5.5.9) PASS
2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS (CONTD)

Data Summary Sheet (Page 2 of 2)

REQUIREMENTS: PASS/FAIL

Vehicle Lateral Stability (Data Sheet 8)
- Yaw Rate Ratio at 1 second after COS is less than 35% of peak value. (S126, S5.2.1) PASS
- Yaw Rate Ratio at 1.75 seconds after COS is less than 20% of peak value. (S126, S5.2.2) PASS

Vehicle Responsiveness (Data Sheet 8)
- Lateral displacement at 1.07 seconds after BOS is at least 1.83 m (6 feet) for vehicles with a GVWR of 3,500kg (7,716 lb) or less, and 1.52 m (5 feet) for vehicles with a GVWR greater than 3,500 Kg (7,716 lb). (S126, S5.2.3) PASS

ESC Malfunction Warning (Data Sheet 9)
- Warning is provided to driver after malfunction occurrence. (S126, S5.3) PASS
- Malfunction telltale stayed illuminated as long as malfunction existed and must extinguish after malfunction was corrected. (S126, S5.3.7) PASS
3.0 TEST DATA

Data Sheet 1 (Page 1 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

Vehicle: 2011 Toyota Sienna MPV
NHTSA No. CB5100 Data Sheet Completion Date: 4/15/2010
VIN 5TDKK3DC6BS010864 Manufacture Date: 2/10
GVWR (kg): 2715.0 Front GAWR (kg): 1405.0 Rear GAWR (kg): 1405.0
Seating Positions Front: 2 Mid: 3 Rear: 3
Odometer reading at time of inspection: 25 miles (40 km)

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front axle: P235/60 R17 Rear axle: P235/60 R17

INSTALLED TIRE SIZE(S) ON VEHICLE (from tire sidewall)

<table>
<thead>
<tr>
<th>Tire Manufacturer</th>
<th>Front Axle</th>
<th>Rear Axle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firestone</td>
<td>FR710</td>
<td>FR710</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tire Size</th>
<th>Front Axle</th>
<th>Rear Axle</th>
</tr>
</thead>
<tbody>
<tr>
<td>P235/60 R17</td>
<td>P235/60 R17</td>
<td></td>
</tr>
</tbody>
</table>

TIN Left Front: W2OU GKD 0310 Right Front: W2OU GKD 0310
Left Rear: W2OU GKD 0310 Right Rear: W2OU GKD 0310

Are installed tire sizes same as labeled tire sizes? Yes
If no, contact COTR for further guidance

DRIVE CONFIGURATION(S): (mark all that apply)

- [X] Two Wheel Drive (2WD)
- [X] Front Wheel Drive
- [ ] Rear Wheel Drive
- [ ] All Wheel Drive (AWD)
- [ ] Four Wheel Drive Automatic - differential no locked full time (4WD Automatic)
- [ ] Four Wheel Drive (High Gear Locked Differential 4WD HGLD)
- [ ] Four Wheel Drive Low Gear (4WD Low)
- [ ] Other (Describe)
3.0 TEST DATA (CONT'D)

Data Sheet 1 (Page 2 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

DRIVE CONFIGURATIONS AND MODES: (ex. default, performance, off)
(For each of the vehicle's drive configurations identify available operating modes)

<table>
<thead>
<tr>
<th>Drive Configuration:</th>
<th>FWD (Standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode:</td>
<td>Default- ESC on</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive Configuration:</th>
<th>FWD (Standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode:</td>
<td>ESC off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive Configuration:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode:</td>
<td></td>
</tr>
</tbody>
</table>

VEHICLE STABILITY SYSTEMS (Check applicable technologies):
List other systems:

- X ESC
- X Traction Control
- Roll Stability Control
- Active Suspension
- X Electronic Throttle Control
- Active Steering
- X ABS

REMARKS:

RECORDED BY: J Lenkeit       DATE RECORDED: 4/15/2010
APPROVED BY: B Kebschull      DATE APPROVED: 5/3/2010
3.0 TEST DATA (CONTD)

Data Sheet 2 (Page 1 of 2)

ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

Vehicle: **2011 Toyota Sienna MPV**

NHTSA No **CB5100**

Data Sheet Completion Date: **4/15/2010**

ESC SYSTEM IDENTIFICATION

Manufacturer/Model **ADVICS CO., Ltd. 44540-08170**

ESC SYSTEM HARDWARE (Check applicable hardware)

- [x] Electronic Control Unit
- [x] Hydraulic Control Unit
- [x] Wheel Speed Sensors
- [x] Steering Angle Sensor
- [x] Yaw Rate Sensor
- [x] Lateral Acceleration Sensor

List other Components: *Engine Control System, VSC (ESC) Computer, Master Cylinder Pressure Sensor*

ESC OPERATIONAL CHARACTERISTICS

System is capable of generating brake torque at each wheel

List and describe Components: *VSC, (ESC) by way of solenoid valves, controls the fluid pressure generated by the pump and applies it to each wheel cylinder in the following 3 modes: pressure reduction, pressure holding and pressure increase modes. As a result, the tendency to front wheel skid or rear wheel skid is controlled.*

- [x] Yes (Pass)  
- [ ] No (Fail)

System is capable of determining yaw rate

List and describe Components: *Yaw rate sensor to detect yaw rate*

- [x] Yes (Pass)  
- [ ] No (Fail)

System is capable of monitoring driver steering input

List and describe Components: *Steer angle sensor to detect steering angle*

- [x] Yes (Pass)  
- [ ] No (Fail)

System is capable of estimating side slip or side slip derivative

List and describe Components: *Vehicle State Evaluation Module of the VSC software estimates side slip angle based on estimated sideslip derivative. Vehicle side slip derivative is estimated as the difference between the estimated yaw rate and the actual measured yaw rate detected by the yaw sensor. The estimated yaw rate is derived from the measured lateral acceleration and the estimated vehicle speed.*

- [x] Yes (Pass)  
- [ ] No (Fail)
ESC OPERATIONAL CHARACTERISTICS (continued)

System is capable of modifying engine torque during ESC activation. Method used to modify torque: *Throttle control is used to regulate engine output*  
X Yes (Pass)  
__ No (Fail)

System is capable of activation at speeds of 20 km/h (12.4 mph) and higher  
X Yes (Pass)  
__ No (Fail)

Speed system becomes active:  
15 km/h

System is capable of activation during the following driving phases:  
– acceleration  
– braking  
– coasting  
X Yes (Pass)  
__ No (Fail)

Driving phases during which ESC is capable of activation:  
*Acceleration, deceleration, coasting, during activation of the ABS or traction control*

Vehicle manufacturer submitted documentation explaining how the ESC mitigates understeer  
X Yes (Pass)  
__ No (Fail)

DATA INDICATES COMPLIANCE:  
X Yes (Pass)  
__ No (Fail)

REMARKS:

______________________________________________________________________________

RECORDED BY:  
J Lenkeit  
DATE RECORDED: 4/15/2010

APPROVED BY:  
B kebschull  
DATE APPROVED: 5/3/2010
ESC MALFUNCTION AND OFF TELLTALES

Vehicle: 2011 Toyota Sienna MPV

NHTSA No. CB5100 Data Sheet completion date: 4/15/2010

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? Yes

Telltale Location: Instrument panel upper right of speedometer (Figure 5.6)

Telltale Color: Amber

Telltale symbol or abbreviation used

Vehicle uses this symbol

Vehicle uses this abbreviation

Neither symbol or abbreviation is used

If different than identified above, make note of any message, symbol or abbreviation used.

Vehicle is also equipped with a multi-information center which displays "Check VSC System" in event of ESC malfunction (Figure 5.7)

Is telltale part of a common space? No

Is telltale also used to indicate activation of the ESC system? Yes

If yes explain telltale operation during ESC activation:

If the vehicle is in danger of slipping or if any of the drive wheels spins, the slip indicator (shown above) flashes to indicate that the ESC and/or TCS systems are operating
3.0 TEST DATA (CONTD)

Data Sheet 3 (Page 2 of 2)
ESC MALFUNCTION AND OFF TELLTALES

"ESC OFF" Telltale (if provided)

Vehicle is equipped with "ESC OFF" telltale? Yes

Is "ESC Off" telltale combined with "ESC Malfunction" telltale utilizing a two part telltale? No

Telltale Location: Instrument panel. Lower right center of tachometer (Figure 5.8)

Telltale Color: Amber

Telltale symbol or abbreviation used

OR ESC OFF

Vehicle uses this symbol
Vehicle uses this abbreviation
Neither symbol or abbreviation is used

If different than identified above, make note of any message, symbol or abbreviation used.

Is telltale part of a common space? No

DATA INDICATES COMPLIANCE Yes
(Vehicle is compliant if equipped with a malfunction telltale)

Remarks: 

RECORDED BY: John Lenkeit DATE RECORDED: 4/15/2010
APPROVED BY: Brian Kebschull DATE APPROVED: 4/20/2010
3.0 TEST DATA (CONTD)

Data Sheet 4 (Page 1 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

Vehicle: 2011 Toyota Sienna MPV

NHTSA No. CB5100  Data Sheet completion date: 4/16/2010

“ESC OFF” Controls Identification and Operational Check:

Is the vehicle equipped with a control or controls whose purpose is to deactivate the ESC system or place the ESC system in a mode or modes that may no longer satisfy the performance requirements of the standard?  X Yes ___ No

Type of control or controls provided?  
☐ Dedicated “ESC Off” Control
☐ Multi-functional control with an “ESC Off” mode
☐ Other (describe)

Identify each control location, labeling and selectable modes.

First Control:  
Location: Left knee bolster (Figure 5.9)
Labeling: “Slip” symbol + “OFF”
Modes: TCS off, ESC and TCS off, ESC and TCS on

Second Control:
Location: 
Labeling: 
Modes: 

Identify standard or default drive configuration  FWD

Verify standard or default drive configuration selected  X Yes ___ No

Does the “ESC Off” telltale illuminate upon activation of the dedicated ESC off control or selection of the “ESC Off” mode on the multi-function control?  X Yes ___ No (Fail)

Does the “ESC Off” telltale extinguish when the ignition is cycled from “on” (“Run”) to “Lock” or “Off” and then back again to the “On” (“Run”) position?  X Yes ___ No (Fail)

If no, describe how the “Off” control functions

______________________________________________________________________________
3.0 TEST DATA (CONTD)

Data Sheet 4 (Page 2 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

If a multi-function control is provided, cycle through each mode setting on the control and record which modes illuminate the “ESC Off” telltale. Also, for those modes that illuminate the ESC Off” telltale identify if the telltale extinguishes upon cycling the ignition system.

<table>
<thead>
<tr>
<th>Control Mode</th>
<th>&quot;ESC Off&quot; telltale illuminates upon activation of control? (Yes/No)</th>
<th>&quot;ESC Off&quot; telltale extinguishes upon cycling ignition? (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCS Off</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>ESC and TCS off</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For each mode that illuminates the “ESC Off” telltale, did the telltale extinguish when the ignition was cycled from “On” (“Run”) to “Lock” or “Off” and then back again to the “On” (“Run”) position?  

  X  Yes  ___  No

Other System Controls that have an ancillary effect on ESC Operation:

Is the vehicle equipped with any ancillary controls that upon activation may deactivate the ESC system or place the ESC system in a mode or modes that may no longer satisfy the performance requirements of the standard?  

___  Yes  X  No

Ancillary Control:  System  None  
Control Description  
Labeling  

Ancillary Control:  System  
Control Description  
Labeling  

Ancillary Control:  System  
Control Description  
Labeling  

Ancillary Control:  System  
Control Description  
Labeling  

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3.0 TEST DATA (CONT'D)

Data Sheet 4 (Page 3 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

Activate each control listed above and record whether the control illuminates the “ESC Off” telltale. Also, record warnings or messages provided regarding the ESC system.

<table>
<thead>
<tr>
<th>Ancillary Control</th>
<th>Control Activates “ESC Off” Telltale? (Yes/No)</th>
<th>Warnings or Messages Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For those controls that illuminate the “ESC Off” telltale above identify if the “ESC Off” telltale extinguishes upon cycling the ignition system.

<table>
<thead>
<tr>
<th>Ancillary Control</th>
<th>“ESC Off” telltale extinguishes upon cycling ignition? (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

For each ancillary control that illuminates the “ESC Off” telltale, did the telltale extinguish when the ignition is cycled from “On” ("Run") to “Lock” or “Off” and then back again to the “On” ("Run") position? If activating the control places the vehicle into a low-range four-wheel drive configuration designed for low-speed, off-road driving, the ESC system may remain turned off after the ignition has been cycled off and then back on and therefore the “ESC Off” telltale may not extinguish.

Yes  No (Fail)  X  NA

DATA INDICATES COMPLIANCE: PASS

Remarks: ESC OFF button is located on the dashboard to the left of steering wheel. Pushing it once briefly turns traction control off ("TRAC OFF" telltale shows at lower left area of IP. ESC is still on). Pushing it and holding it for approximately 3 seconds additionally turns ESC off (both "TRAC OFF" and ESC off telltales illuminate). The system returns to normal mode by briefly pressing the ESC OFF switch in either TCS-OFF or ESC-OFF mode or by cycling the ignition.

RECORDED BY: J Lenkeit DATE RECORDED: 4/16/2010
APPROVED BY: B Kebschull DATE APPROVED: 4/22/2010
### 3.0 TEST DATA (CONTD)

**Data Sheet 5 (Page 1 of 3)**

**TEST TRACK AND VEHICLE DATA**

<table>
<thead>
<tr>
<th>Vehicle: 2011 Toyota Sienna MPV</th>
<th>NHTSA No. CB5100</th>
<th>Data Sheet completion date: 4/23/2010</th>
</tr>
</thead>
</table>

**Test Track Requirements:**
- Test surface slope (0-1%): 0.5%
- Peak Friction Coefficient (at least 0.9): 0.953

Test track data meets requirements: Yes

If no, explain:

<table>
<thead>
<tr>
<th>Full Fluid Levels:</th>
<th>Fuel Yes</th>
<th>Other Fluids Yes (specify)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant Yes</td>
<td>Oil</td>
<td></td>
</tr>
</tbody>
</table>

**Tire Pressures:**

<table>
<thead>
<tr>
<th>Required; Front Axle 240 KPA</th>
<th>Rear Axle 240 KPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual; LF 240 KPA</td>
<td>RF 240 KPA</td>
</tr>
<tr>
<td>LR 240 KPA</td>
<td>RR 240 KPA</td>
</tr>
</tbody>
</table>

**Vehicle Dimensions:**
- Front Track Width 171.5 cm
- Wheelbase 302.9 cm
- Rear Track Width 164.5 cm

**Vehicle Weight Ratings:**
- GAWR Front 1405.0 KG
- GAWR Rear 1405.0 KG

**Unloaded Vehicle Weight (UVW):**
- Front Axle 1116.3 KG
- Left Front 573.3 KG
- Right Front 543.0 KG
- Rear Axle 871.4 KG
- Left Rear 434.1 KG
- Right Rear 437.3 KG
- Total UVW 1987.6 KG

**Baseline Weight and Outrigger Selection** (only for MPVs, Trucks, Buses)
- Calculated baseline weight (UVW + 73kg) 2060.6 KG
- Outrigger size required ("Standard" or "Heavy") Standard

Standard - Baseline weight under 2772 kg (6000 lb)
Heavy - Baseline weight equal to or greater than 2772 kg (6000 lb)
3.0 TEST DATA (CONTD)

Data Sheet 5 (Page 2 of 3)
TEST TRACK AND VEHICLE DATA

UVW with Outriggers: (only for MPVs, Trucks, Buses)

Front axle 1155.8 KG  
Left front 598.3 KG  
Right front 557.5 KG

Rear axle 906.3 KG  
Left rear 445.0 KG  
Right rear 461.3 KG

Total UVW with outriggers 2062.0 KG

Loaded Vehicle Weight w/Driver and Instrumentation (no Ballast)

Front axle 1265.6 KG  
Left front 659.9 KG  
Right front 605.7 KG

Rear axle 959.5 KG  
Left rear 472.1 KG  
Right rear 487.4 KG

Vehicle Weight 2225.1 KG

Ballast Required = \[
\text{[Total UVW with Outriggers (if applicable)]} + 168 \text{ KG} - \text{[Loaded Weight w/Driver and Instrumentation]} \]

= 2062.0 KG + 168 KG - 2225.1 KG

= 4.9 KG

Total Loaded Vehicle Weight w/Driver and Instrumentation and Ballast

Front axle 1266.7 KG  
Left front 659.9 KG  
Right front 606.8 KG

Rear axle 963.4 KG  
Left rear 473.6 KG  
Right rear 489.8 KG

Total UVW 2230.1 KG
3.0 TEST DATA (CONTD)

Data Sheet 5 (Page 3 of 3)

TEST TRACK AND VEHICLE DATA

Center of Gravity and Inertial Sensing System Location at Loaded Vehicle Condition:

x-distance (longitudinal)  Point of reference is the front axle centerline.  
(Positive from front axle toward rear of vehicle.)

y-distance (lateral)  Point of reference is the vehicle centerline.  
(Positive from the center toward the right.)

z-distance (vertical)  Point of reference is the ground plane.  
(Positive from the ground up.)

Locations:

<table>
<thead>
<tr>
<th></th>
<th>Center of Gravity</th>
<th>Inertial Sensing System</th>
</tr>
</thead>
<tbody>
<tr>
<td>x-distance</td>
<td>51.5 in 130.9 cm</td>
<td>60.3 in 153.2 cm</td>
</tr>
<tr>
<td>y-distance</td>
<td>-0.6 in -1.4 cm</td>
<td>-0.3 in -0.9 cm</td>
</tr>
<tr>
<td>z-distance</td>
<td>26.0 in 65.9 cm</td>
<td>20.3 in 51.6 cm</td>
</tr>
<tr>
<td>Roof Height</td>
<td>68.313 in 173.5 cm</td>
<td></td>
</tr>
<tr>
<td>Distance between ultrasonic sensors</td>
<td>90.75 in 230.5 cm</td>
<td></td>
</tr>
</tbody>
</table>

Remarks:

______________________________________________________________________________

RECORDED BY: Brian Kebschull  DATE RECORDED: 4/23/2010
APPROVED BY: J Lenkeit  DATE APPROVED: 5/3/2010
3.0 TEST DATA (CONTD)

Data Sheet 6 (Page 1 of 3)
BRAKE AND TIRE CONDITIONING

Vehicle: 2011 Toyota Sienna MPV
NHTSA No. CB5100

Measured tire pressure: LF 258 KPA RF 259 KPA
LR 254 KPA RR 257 KPA

Wind Speed 1 m/s (10 m/sec (22 mph) max for passenger cars;
5m/sec (11 mph) max for MPVs and trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) 20 °C

Brake Conditioning Time: 9:58:00 AM Date: 4/23/2010

56 km/h (35 mph) Brake Stops

Number of stops executed (10 required) 10 Stops
Observed deceleration rate range (.5g target) .45-.55 g

72 km/h (45 mph) Brake Stops

Number of stops executed (3 required) 3 Stops
Number of stops ABS activated (3 required) 3 Stops
Observed deceleration rate range 0.8-0.9 g

72 km/h (45 mph) Brake Cool Down Period

Duration of cool down period (5 minutes min.) 5 Minutes
3.0 TEST DATA (CONTD)

Data Sheet 6 (Page 2 of 3)

BRAKE AND TIRE CONDITIONING

<table>
<thead>
<tr>
<th>Tire Conditioning series No. 1</th>
<th>Time:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:10:00 AM</td>
<td>4/23/201</td>
<td></td>
</tr>
</tbody>
</table>

Measured cold tire pressure

<table>
<thead>
<tr>
<th>Side</th>
<th>Pressure (KPA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF</td>
<td>267</td>
</tr>
<tr>
<td>RF</td>
<td>266</td>
</tr>
<tr>
<td>LR</td>
<td>261</td>
</tr>
<tr>
<td>RR</td>
<td>264</td>
</tr>
</tbody>
</table>

Wind Speed **0.5** m/s

Ambient Temperature (7°C (45°F) - 40°C (104°F)) **19°C**

5-1 Hz Cycle Sinusoidal Steering Maneuver to Determine Steering Wheel Angle for 0.5-0.6 g Lateral Acceleration

<table>
<thead>
<tr>
<th>Test Run</th>
<th>Data File</th>
<th>Vehicle Speed Km/h(mph)</th>
<th>Steering Wheel Angle (degrees)</th>
<th>Target Peak Lateral Acceleration (g)</th>
<th>Observed Peak Lateral Acceleration (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>56 ± 2 (35 ± 1)</td>
<td>60</td>
<td>0.5 - 0.6</td>
<td>0.29</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>56 ± 2 (35 ± 1)</td>
<td>110</td>
<td>0.5 - 0.6</td>
<td>0.48</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>56 ± 2 (35 ± 1)</td>
<td>120</td>
<td>0.5 - 0.6</td>
<td>0.51</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>56 ± 2 (35 ± 1)</td>
<td></td>
<td>0.5 - 0.6</td>
<td></td>
</tr>
</tbody>
</table>

Steering wheel angle that corresponds to a peak 0.5-0.6 g lateral acceleration: **120** degrees

10-1 Hz Cycle Sinusoidal Steering Maneuver

<table>
<thead>
<tr>
<th>Test Run</th>
<th>Data File</th>
<th>Vehicle Speed Km/h(mph)</th>
<th>Steering Wheel Angle (degrees)</th>
<th>Target Peak Lateral Acceleration (g)</th>
<th>Observed Peak Lateral Acceleration (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>5-7</td>
<td>56 ± 2 (35 ± 1)</td>
<td>120 (cycles 1-10)</td>
<td>0.5 - 0.6</td>
<td>0.51</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>56 ± 2 (35 ± 1)</td>
<td>120 (cycles 1-9)</td>
<td>0.5 - 0.6</td>
<td>0.51</td>
</tr>
</tbody>
</table>

* The steering wheel angle used for cycle 10 should be twice the angle used for cycles 1-9


**3.0 TEST DATA (CONT'D)**

Data Sheet 6 (Page 3 of 3)

BRAKE AND TIRE CONDITIONING

**Tire Conditioning series No. 2**

<table>
<thead>
<tr>
<th>Test Run</th>
<th>Steering Direction</th>
<th>Target Lateral Acceleration (g)</th>
<th>Observed Lateral Acceleration (g)</th>
<th>Observed Vehicle Speed (Km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>Clockwise</td>
<td>0.5 - 0.6</td>
<td>0.5-0.6</td>
<td>32 - 33.6</td>
</tr>
<tr>
<td>4-6</td>
<td>Counterclockwise</td>
<td>0.5 - 0.6</td>
<td>0.5-0.6</td>
<td>32 - 33.6</td>
</tr>
</tbody>
</table>

Steering wheel angle that corresponds to a peak 0.5-0.6 g lateral acceleration:

**120 degrees**

**Remarks:**

**RECORDED BY:** Brian Kebschull **DATE RECORDED:** 4/23/2010

**APPROVED BY:** J Lenkeit **DATE APPROVED:** 5/3/2010
3.0 TEST DATA (CONTD)

Data Sheet 7 (Page 1 of 2)
SLOWLY INCREASING STEER (SIS) MANEUVER

Vehicle: **2011 Toyota Sienna MPV**
NHTSA No. **CB5100**

Measured tire pressure:  

<table>
<thead>
<tr>
<th>Tire</th>
<th>Pressure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LF</td>
<td>272 KPA</td>
<td></td>
</tr>
<tr>
<td>RF</td>
<td>271 KPA</td>
<td></td>
</tr>
<tr>
<td>LR</td>
<td>265 KPA</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>266 KPA</td>
<td></td>
</tr>
</tbody>
</table>

Wind Speed 1 m/s  

(10 m/sec (22 mph) max for passenger cars; 5m/sec (11 mph) max for MPVs and trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) **19 °C**

Selected drive configuration **FWD**

Selected Mode: **Default**

**Preliminary Left Steer Maneuver:**

Lateral Acceleration measured at 30 degrees steering wheel angle  

\[ a_{y,30\text{degrees}} = 0.29 \text{ g} \]

Assuming a linear relationship the following ratio should be used to calculate the steering wheel angle at 0.55g:

\[ \frac{30\text{ degrees}}{a_{y,30\text{degrees}}} = \frac{\delta_{\text{SIS}}}{0.55 \text{ g}} \]

\[ \delta_{\text{SIS}} = \frac{56.9}{56.9} \text{ degrees (@ 0.55g)} \]

\[ \delta_{\text{SIS}} = 60 \text{ degrees (rounded)} \]

**Steering Wheel Angle at Corrected 0.3g Lateral Acceleration:**

<table>
<thead>
<tr>
<th>Maneuver</th>
<th>Initial Steer Direction</th>
<th>Time Clock (5 min max between runs)</th>
<th>Steering Wheel Angle to nearest 0.1° (degrees)</th>
<th>Data Run</th>
<th>Good/NG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left</td>
<td>10:49:11 AM</td>
<td>-33.8</td>
<td>11</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>Left</td>
<td>10:51:00 AM</td>
<td>-33.6</td>
<td>12</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>Left</td>
<td>10:54:04 AM</td>
<td>-33.4</td>
<td>13</td>
<td>Good</td>
</tr>
<tr>
<td>4</td>
<td>Left</td>
<td>10:57:05 AM</td>
<td>-33.8</td>
<td>14</td>
<td>Good</td>
</tr>
<tr>
<td>5</td>
<td>Left</td>
<td>10:59:06 AM</td>
<td>-34.2</td>
<td>15</td>
<td>Good</td>
</tr>
<tr>
<td>6</td>
<td>Right</td>
<td>11:02:07 AM</td>
<td>-34.5</td>
<td>16</td>
<td>Good</td>
</tr>
<tr>
<td>7</td>
<td>Right</td>
<td>11:04:18 AM</td>
<td>-34.5</td>
<td>17</td>
<td>Good</td>
</tr>
<tr>
<td>8</td>
<td>Right</td>
<td>11:06:19 AM</td>
<td>-34.5</td>
<td>18</td>
<td>Good</td>
</tr>
<tr>
<td>9</td>
<td>Right</td>
<td>11:08:20 AM</td>
<td>-34.5</td>
<td>19</td>
<td>Good</td>
</tr>
<tr>
<td>10</td>
<td>Right</td>
<td>11:10:21 AM</td>
<td>-34.5</td>
<td>20</td>
<td>Good</td>
</tr>
<tr>
<td>11</td>
<td>Right</td>
<td>11:12:22 AM</td>
<td>-34.5</td>
<td>21</td>
<td>Good</td>
</tr>
<tr>
<td>12</td>
<td>Right</td>
<td>11:14:23 AM</td>
<td>-34.5</td>
<td>22</td>
<td>Good</td>
</tr>
</tbody>
</table>
3.0 TEST DATA (CONTD)

Data Sheet 7 (Page 2 of 2)
SLOWLY INCREASING STEER (SIS) MANEUVER

Average Overall Steering Wheel Angle:

\[ \delta_{0.3 \text{ g, overall}} = \left( \left| \delta_{0.3 \text{ g, left (1)}} \right| + \left| \delta_{0.3 \text{ g, left (2)}} \right| + \left| \delta_{0.3 \text{ g, left (3)}} \right| + \delta_{0.3 \text{ g, right (1)}} + \delta_{0.3 \text{ g, right (2)}} + \delta_{0.3 \text{ g, right (3)}} \right) / 6 \]

\[ \delta_{0.3 \text{ g, overall}} = 33.9 \text{ degrees} \]
[to nearest 0.1 degree]

Remarks:

RECORDED BY: Brian Kebschull  DATE RECORDED: 4/23/2010
APPROVED BY: J Lenkeit  DATE APPROVED: 5/3/2010
### 3.0 TEST DATA (CONTD)

#### Data Sheet 8 (Page 1 of 3)

**VEHICLE LATERAL STABILITY AND RESPONSIVENESS**

**Vehicle:** *2011 Toyota Sienna MPV*

**NHTSA No.:** CB5100  
**Data sheet completion date:** 4/23/2010

<table>
<thead>
<tr>
<th>Maneuver #</th>
<th>Clock Time</th>
<th>Commanded Steering Wheel Angle¹</th>
<th>Yaw Rates (degrees/sec)</th>
<th>YRR at 1.0 sec after COS [&lt; 35%]</th>
<th>YRR at 1.75 sec after COS [&lt; 20%]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scalar (* δ₀.₃ g, overall)</td>
<td>Angle (degrees)</td>
<td>(\dot{\psi})</td>
<td>(\dot{\psi}_{1.0sec})</td>
</tr>
<tr>
<td>23</td>
<td>12:24</td>
<td>1.5</td>
<td>51</td>
<td>13.05</td>
<td>-0.01</td>
</tr>
<tr>
<td>24</td>
<td>12:29</td>
<td>2</td>
<td>68</td>
<td>17.18</td>
<td>0.05</td>
</tr>
<tr>
<td>25</td>
<td>12:32</td>
<td>2.5</td>
<td>85</td>
<td>21.47</td>
<td>0.14</td>
</tr>
<tr>
<td>26</td>
<td>12:34</td>
<td>3</td>
<td>102</td>
<td>24.9</td>
<td>0.18</td>
</tr>
<tr>
<td>27</td>
<td>12:37</td>
<td>3.5</td>
<td>119</td>
<td>26.82</td>
<td>-0.12</td>
</tr>
<tr>
<td>28</td>
<td>12:39</td>
<td>4</td>
<td>136</td>
<td>31.01</td>
<td>-0.23</td>
</tr>
<tr>
<td>29</td>
<td>12:42</td>
<td>4.5</td>
<td>153</td>
<td>37.05</td>
<td>-0.11</td>
</tr>
<tr>
<td>30</td>
<td>12:44</td>
<td>5</td>
<td>170</td>
<td>39.05</td>
<td>0.18</td>
</tr>
<tr>
<td>31</td>
<td>12:47</td>
<td>5.5</td>
<td>186</td>
<td>43.85</td>
<td>-0.88</td>
</tr>
<tr>
<td>32</td>
<td>12:50</td>
<td>6</td>
<td>203</td>
<td>46.92</td>
<td>-0.2</td>
</tr>
<tr>
<td>33</td>
<td>12:53</td>
<td>6.5</td>
<td>220</td>
<td>50.97</td>
<td>0.34</td>
</tr>
<tr>
<td>34</td>
<td>12:56</td>
<td>7</td>
<td>237</td>
<td>53.28</td>
<td>-0.59</td>
</tr>
<tr>
<td>35</td>
<td>12:58</td>
<td>7.5</td>
<td>254</td>
<td>54.8</td>
<td>-0.38</td>
</tr>
<tr>
<td>37</td>
<td>13:05</td>
<td>8</td>
<td>271</td>
<td>56.54</td>
<td>-1.55</td>
</tr>
</tbody>
</table>

1. Maneuver execution should continue until a steering wheel angle magnitude factor of 6.5 * δ₀.₃ g, overall or 270 degrees is utilized, whichever is greater provided the calculated magnitude of 6.5 * δ₀.₃ g, overall is less than or equal to 300 degrees. If 6.5 * δ₀.₃ g, overall is less than 270 degrees maneuver execution should continue by increasing the steering wheel angle magnitude by multiples of 0.5 * δ₀.₃ g, overall without exceeding the 270 degree steering wheel angle.

---

**Tire conditioning completed**  ❑ Yes  ❑ No
**ESC system is enabled**  ❑ Yes  ❑ No
**On track calibration checks have been completed**  ❑ Yes  ❑ No
**On track static data file for each sensor obtained**  ❑ Yes  ❑ No

**Selected Drive Configuration:**  *FWD (Default)*

**Selected Mode:**  *Default*

**Overall steering wheel angle (δ₀.₃ g, overall)**  *33.9* degrees
### DATA SHEET 8 (2 of 3)

**VEHICLE LATERAL STABILITY AND RESPONSIVENESS**

**LATERAL STABILITY TEST SERIES NO. 2 – Clockwise Initial Steer Direction**

<table>
<thead>
<tr>
<th>Maneuver #</th>
<th>Clock Time (1.5 – 5.0 min max between runs)</th>
<th>Commanded Steering Wheel Angle¹</th>
<th>Yaw Rates (degrees/sec)</th>
<th>YRR at 1.0 sec after COS [&lt; 35%]</th>
<th>YRR at 1.75 sec after COS [&lt; 20%]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scalar (* $\delta_{0.3,g}$)</td>
<td>$\psi_{Peak}$</td>
<td>$\psi_{1.0\text{sec}}$</td>
<td>$\psi_{1.75\text{sec}}$</td>
</tr>
<tr>
<td>40</td>
<td>13:17</td>
<td>1.5</td>
<td>-13.48</td>
<td>-0.04</td>
<td>0.1</td>
</tr>
<tr>
<td>41</td>
<td>13:20</td>
<td>2</td>
<td>-17.93</td>
<td>0.01</td>
<td>0.13</td>
</tr>
<tr>
<td>42</td>
<td>13:23</td>
<td>2.5</td>
<td>-22.74</td>
<td>-0.24</td>
<td>-0.05</td>
</tr>
<tr>
<td>43</td>
<td>13:26</td>
<td>3</td>
<td>-25.61</td>
<td>-0.1</td>
<td>0.12</td>
</tr>
<tr>
<td>44</td>
<td>13:29</td>
<td>3.5</td>
<td>-26.5</td>
<td>0.11</td>
<td>-0.04</td>
</tr>
<tr>
<td>45</td>
<td>13:34</td>
<td>4</td>
<td>-31.43</td>
<td>0.12</td>
<td>0.18</td>
</tr>
<tr>
<td>46</td>
<td>13:38</td>
<td>4.5</td>
<td>-36.29</td>
<td>0.21</td>
<td>0.09</td>
</tr>
<tr>
<td>47</td>
<td>13:41</td>
<td>5</td>
<td>-40.52</td>
<td>-0.28</td>
<td>-0.02</td>
</tr>
<tr>
<td>48</td>
<td>13:43</td>
<td>5.5</td>
<td>-43.94</td>
<td>-0.69</td>
<td>0</td>
</tr>
<tr>
<td>49</td>
<td>13:46</td>
<td>6</td>
<td>-48.69</td>
<td>0.86</td>
<td>0.48</td>
</tr>
<tr>
<td>50</td>
<td>13:49</td>
<td>6.5</td>
<td>-50.96</td>
<td>2.24</td>
<td>-0.01</td>
</tr>
<tr>
<td>51</td>
<td>13:51</td>
<td>7</td>
<td>-53.67</td>
<td>0.55</td>
<td>0.09</td>
</tr>
<tr>
<td>52</td>
<td>13:54</td>
<td>7.5</td>
<td>-55.97</td>
<td>2.54</td>
<td>0.19</td>
</tr>
<tr>
<td>53</td>
<td>13:57</td>
<td>8</td>
<td>-56.87</td>
<td>1.26</td>
<td>0.19</td>
</tr>
</tbody>
</table>

1. Maneuver execution should continue until a steering wheel angle magnitude factor of 6.5*$\delta_{0.3\,g\,\text{overall}}$ or 270 degrees is utilized, whichever is greater provided the calculated 6.5*$\delta_{0.3\,g\,\text{overall}}$ is less than or equal to 300 degrees. If 6.5*$\delta_{0.3\,g\,\text{overall}}$ is less than 270 degrees maneuver execution should continue by increasing the steering wheel angle magnitude by multiples of 0.5*$\delta_{0.3\,g\,\text{overall}}$ without exceeding the 270 degree steering wheel angle.

During execution of the Sine with Dwell maneuvers were any of the following events observed?

- Rim-to-pavement contact
  - Yes [x]   No
- Tire debeading
  - Yes [x]   No
- Loss of pavement contact of vehicle tires
  - Yes [x]   No
- Did the test driver experience any vehicle loss of control or spinout?
  - Yes [x]   No

If “Yes” explain the event and consult with the COTR.
- **Responsiveness – Lateral Displacement**

<table>
<thead>
<tr>
<th>Maneuver #</th>
<th>Initial Steer Direction</th>
<th>Commanded Steering Wheel Angle (5.0° or greater)</th>
<th>Calculated Lateral Displacement¹</th>
<th>Distance (m)</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Counter Clockwise</td>
<td>5.0°</td>
<td>-2.85</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Counter Clockwise</td>
<td>5.5°</td>
<td>-2.97</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Counter Clockwise</td>
<td>6.0°</td>
<td>-3.01</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Counter Clockwise</td>
<td>6.5°</td>
<td>-3.06</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Counter Clockwise</td>
<td>7.0°</td>
<td>-3.09</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Counter Clockwise</td>
<td>7.5°</td>
<td>-3.10</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Counter Clockwise</td>
<td>8.0°</td>
<td>-3.11</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Clockwise</td>
<td>5.0°</td>
<td>2.71</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Clockwise</td>
<td>5.5°</td>
<td>2.80</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Clockwise</td>
<td>6.0°</td>
<td>2.87</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Clockwise</td>
<td>6.5°</td>
<td>2.90</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Clockwise</td>
<td>7.0°</td>
<td>2.88</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Clockwise</td>
<td>7.5°</td>
<td>2.89</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Clockwise</td>
<td>8.0°</td>
<td>2.94</td>
<td>PASS</td>
<td></td>
</tr>
</tbody>
</table>

1. Lateral displacement should be ≥ 1.83 m (6 ft) for vehicle with a GVWR of 3,500 kg (7,716 lb) or less; and ≥ 1.52 m (5 ft) for vehicles with GVWR greater than 3,500 kg (7,716 lb).

**DATA INDICATES COMPLIANCE:** ☑ PASS ☐ FAIL

**Remarks:**

---

**RECORDED BY:** B Kebschull  **DATE RECORDED:** 4/23/2010

**APPROVED BY:** J Lenkeit  **DATE APPROVED:** 5/3/2010
3.0 TEST DATA (CONTD)

Data Sheet 9 (Page 1 of 2)
MALFUNCTION WARNING TESTS

Vehicle: 2011 Toyota Sienna MPV
NHTSA No. CB5100 Date Sheet Completion Date: 4/23/2010

TEST 1

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Disconnect brake light switch

MALFUNCTION TELLTALE ILLUMINATION:
Telltale illuminates and remains illuminated after ignition locking system is activated and if necessary the vehicle is driven at least 2 minutes.

[ ] Yes [ ] No

Time for telltale to illuminate after ignition system is activated and vehicle speed of 48 ± 8 km/h (30 ± 5mph) is reached.

[ ] Pass [ ] Fail

0 Seconds (must be within 2 minutes)

ESC SYSTEM RESTORATION
Telltale extinguishes after ignition locking system is activated and if necessary the vehicle is driven at least 2 minutes.

[ ] Yes [ ] No

Time for telltale to extinguish after ignition system is activated and vehicle speed of 48 ± 8 km/h (30 ± 5mph) is reached.

[ ] Pass [ ] Fail

0 Seconds (must be within 2 minutes)

TEST 1 DATA INDICATES COMPLIANCE: PASS

Remarks: Telltale takes approximately 3 seconds to illuminate after ignition on (no driving was required). ABS telltale also illuminated. After switch was re-connected, telltale extinguished approximately 3 seconds after ignition on.

RECORDED BY: Brian Kebschull DATE RECORDED: 4/23/2010
APPROVED BY: J Lenkeit DATE APPROVED: 5/3/2010
3.0 TEST DATA (CONTD)

Data Sheet 9 (Page 2 of 2)
MALFUNCTION WARNING TESTS

Vehicle: **2011 Toyota Sienna MPV**
NHTSA No. **CB5100**
Data Sheet Completion Date: **4/23/2010**

<table>
<thead>
<tr>
<th>TEST 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MALFUNCTION SIMULATION: Describe method of malfunction simulation</td>
</tr>
<tr>
<td>Disconnected steering wheel angle sensor</td>
</tr>
</tbody>
</table>

| MALFUNCTION TELLTALE ILLUMINATION: |
| Telltale illuminates and remains illuminated after ignition locking system is activated and if necessary the vehicle is driven at least 2 minutes. |
| x Yes | No |
| Time for telltale to illuminate after ignition system is activated and vehicle speed of 48 ± 8 km/h (30 ± 5mph) is reached. |
| 0 Seconds (must be within 2 minutes) | x Pass | Fail |

| ESC SYSTEM RESTORATION |
| Telltale extinguishes after ignition locking system is activated and if necessary the vehicle is driven at least 2 minutes as. |
| x Yes | No |
| Time for telltale to extinguish after ignition system is activated and vehicle speed of 48 ± 8 km/h (30 ± 5mph) is reached. |
| 0 Seconds (must be within 2 minutes) | x Pass | Fail |

| TEST 2 DATA INDICATES COMPLIANCE: | PASS |
| Remarks: Telltale illuminated immediately after ignition on (no driving was required). After switch was re-connected, telltale extinguished immediately after ignition on. |
| RECORDED BY: **Brian Kebschull** | DATE RECORDED: **4/23/2010** |
| APPROVED BY: **J Lenkeit** | DATE APPROVED **5/3/2010** |
# 4.0 TEST EQUIPMENT LIST AND CALIBRATION INFORMATION (1 OF 2)

## TABLE 1. TEST INSTRUMENTATION

<table>
<thead>
<tr>
<th>Type</th>
<th>Output</th>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
<th>Specifics</th>
<th>Serial Number</th>
<th>Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tire Pressure Gauge</td>
<td>Vehicle Tire Pressure</td>
<td>0-100 psi 0-690 kPa</td>
<td>1 psi 6.89 kPa</td>
<td>0.5 psi 3.45 kPa</td>
<td>Ashcroft D1005PS</td>
<td>1039350</td>
<td>By: DRI Date: 2/25/10 Due: 2/25/11</td>
</tr>
<tr>
<td>Platform Scales</td>
<td>Vehicle Total, Wheel, and Axle Load</td>
<td>8000 lb 35.6 kN</td>
<td>0.5 lb 2.2 N</td>
<td>± 1.0% of applied load</td>
<td>Intercomp Model SWII</td>
<td>24032361</td>
<td>By: American Scale Date: 2/25/10 Due: 2/25/11</td>
</tr>
<tr>
<td>Automated Steering Machine with Steering Angle Encoder</td>
<td>Handwheel Angle</td>
<td>± 800 deg</td>
<td>0.25 deg</td>
<td>± 0.25 deg</td>
<td>Heitz Automotive Testing Model: Sprint 3</td>
<td>60304</td>
<td>By: DRI Date: 2/25/10 Due: 2/25/11</td>
</tr>
<tr>
<td>Multi-Axis Inertial Sensing System</td>
<td>Longitudinal, Lateral, and Vertical Acceleration Roll, Yaw, and Pitch Rate</td>
<td>Accelerometer s: ± 2 g Angular Rate Sensors: ± 100 deg/s</td>
<td>Accelerometers: ± 0.05° of full range Angular Rate Sensors: 0.05% of full range</td>
<td>BEI Technologies Model: MotionPAK MP-1</td>
<td>0767</td>
<td>By: Systron Donner Date: 11/23/09 Due: 11/23/10</td>
<td></td>
</tr>
<tr>
<td>Radar Speed Sensor and Dashboard Display</td>
<td>Vehicle Speed</td>
<td>0-125 mph 0-200 km/h</td>
<td>0.009 mph .014 km/h</td>
<td>± 0.25% of full scale</td>
<td>A-DAT Corp. Radar Model: DRS-6 Display Model: RD-2</td>
<td>1400.604</td>
<td>By: DRI Date: 3/2/10 Due: 3/2/11</td>
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<tr>
<td>Ultrasonic Distance Measuring System</td>
<td>Left and Right Side Vehicle Height</td>
<td>5-24 inches 127-610 mm</td>
<td>0.01 inches .254 mm</td>
<td>± 0.25% of maximum distance</td>
<td>Massa Products Corporation Model: M-5000/220</td>
<td>DOT-NHTSA D2646</td>
<td>By: DRI Date: 2/26/10 Due: 2/26/11</td>
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<td></td>
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<td>DOT-NHTSA D3272</td>
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## 4.0 TEST EQUIPMENT LIST AND CALIBRATION INFORMATION (2 OF 2)

### TABLE 1. TEST INSTRUMENTATION (CONTD)

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<thead>
<tr>
<th>Type</th>
<th>Output</th>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
<th>Specifics</th>
<th>Serial Number</th>
<th>Calibration</th>
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</thead>
<tbody>
<tr>
<td>Data Acquisition System</td>
<td>Record Time; Velocity; Distance; Lateral, Longitudinal, and Vertical Accelerations; Roll, Yaw, and Pitch Rates; Steering Wheel Angle.</td>
<td>Sufficient to meet or exceed individual sensors</td>
<td>200 Hz</td>
<td>Sufficient to meet or exceed individual sensors</td>
<td>SoMat eDaq ECPU processor</td>
<td>MSHLB.03-2476</td>
<td>By: DRI Date: 2/9/10 Due: 2/9/11</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SoMat High level Board EHLS</td>
<td>MSHLS.03-3182</td>
<td>By: DRI Date: 2/9/10 Due: 2/9/11</td>
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<tr>
<td>Load Cell</td>
<td>Vehicle Brake Pedal Force</td>
<td>0-300 lb 0-1.33 kN</td>
<td>1 lb 4.44 N</td>
<td>±0.05% of full scale</td>
<td>Lebow 3663-300</td>
<td>767</td>
<td>Functionally verified by DRI prior to testing</td>
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<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</td>
<td>Faro Arm Fusion</td>
<td>UO8-05-08-06636</td>
<td>By: Faro Date: 8/18/09 Due: 8/18/10</td>
<td></td>
</tr>
<tr>
<td>Outriggers</td>
<td>No output. Safety Item.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>DRI manufactured Aluminum meeting the weight and MOI specifications of Docket 2007-27662-11</td>
<td>N/A</td>
<td>N/A</td>
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</tbody>
</table>
Figure 5.1. Front View of Test Vehicle
Figure 5.2. Rear View of Test Vehicle
Figure 5.3. Vehicle Certification Label
<table>
<thead>
<tr>
<th>TIRE PNEU</th>
<th>SIZE DIMENSIONS</th>
<th>COLD TIRE PRESSURE PRESSION DES PNEUS À FROID</th>
<th>SEE OWNER’S MANUAL FOR ADDITIONAL INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRONT AVANT</td>
<td>P235/60R17</td>
<td>240 kPa, 35 PSI</td>
<td>VOIR LE MANUEL DE L’USAGER POUR PLUS DE RENSEIGNEMENTS</td>
</tr>
<tr>
<td>REAR ARRIÈRE</td>
<td>P235/60R17</td>
<td>240 kPa, 35 PSI</td>
<td></td>
</tr>
<tr>
<td>SPARE DE SECOURS</td>
<td>T155/80R17</td>
<td>420 kPa, 60 PSI</td>
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</tbody>
</table>

The combined weight of occupants and cargo should never exceed 695 kg or 1535 lbs.

Le poids total des occupants et du chargement ne doit jamais dépasser 695 kg ou 1535 lbs.

Figure 5.4. Vehicle Placard
5.0 PHOTOGRAPHS (5 of 16)

Figure 5.5. Window Sticker (Monroney Label)
Figure 5.6. Telltale for ESC Malfunction
Figure 5.7. ESC Malfunction Warning on Information Center
Figure 5.8. Telltale for ESC Off
Figure 5.9. ESC Off Control Switch
Figure 5.10. Front View of Vehicle As-Tested
Figure 5.11. Rear View of Vehicle As-Tested

2011 Toyota Sienna
FMVSS No. 126
NHTSA NO.: CB5100
April 2010
Figure 5.12. Ultrasonic Height Sensor Mounted on Left Side of Vehicle for Determining Body Roll Angle
Figure 5.13. Rear Outrigger, Mount and Speed Sensor
Figure 5.14. Steering Controller and Data Acquisition Computer
Figure 5.15. Inertial Measurement Unit Mounted in Vehicle
Figure 5.16. Brake Pedal Load Cell

2011 Toyota Sienna
FMVSS No. 126
NHTSA NO.: CB5100
April 2010
Figure 6.1. Steering Wheel Angle, Yaw Rate and Lateral Displacement for L-R Series
Figure 6.2. Steering Wheel Angle, Yaw Rate and Lateral Displacement for R-L Series
Figure 6.3. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for L-R Series
Figure 6.4. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for R-L Series
7.0 OTHER DOCUMENTATION

7.1 OWNER’S MANUAL PAGES
7.2 VEHICLE ARRIVAL CONDITION REPORT
7.3 VEHICLE COMPLETION CONDITION REPORT
7.4 SINE WITH DWELL TEST RESULTS
7.5 SLOWLY INCREASING STEER TEST RESULTS
7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES
2-2. Instrument cluster and information display

<table>
<thead>
<tr>
<th>*1, 2</th>
<th>Slip indicator</th>
<th>Shift position indicators</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(→P. 300, 305)</td>
<td>(→P. 223)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>*1</th>
<th>VSC OFF indicator</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(→P. 301)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>*1</th>
<th>Eco Driving Indicator Light</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(if equipped)</td>
</tr>
</tbody>
</table>

| *1, 3 | “TRAC OFF” indicator  |
|-------| (→P. 301)           |

| *1, 3 | “PCS” warning  |
|-------| (→P. 307)        |

*1: These lights turn on when the “ENGINE START/STOP” switch is turned to IGNITION ON mode (vehicles with a smart key system) or the engine switch is turned to the “ON” position (vehicles without a smart key system) to indicate that a system check is being performed. They will turn off after the engine is started, or after a few seconds. There may be a malfunction in a system if a light does not come on, or if the lights do not turn off. Have the vehicle inspected by your Toyota dealer.

*2: The light flashes to indicate that the system is operating.

*3: The light flashes faster than usual to indicate that the system is operating.
2.4. Using other driving systems

**Driving assist systems**

To help enhance driving safety and performance, the following systems operate automatically in response to various driving situations. Be aware, however, that these systems are supplementary and should not be relied upon too heavily when operating the vehicle.

- **ABS (Anti-lock Brake System)**
  Helps to prevent wheel lock when the brakes are applied suddenly, or if the brakes are applied while driving on a slippery road surface.

- **Brake assist**
  Generates an increased level of braking force after the brake pedal is depressed, when the system detects a panic stop situation.

- **VSC (Vehicle Stability Control)**
  Helps the driver to control skidding when swerving suddenly or turning on slippery road surfaces.

- **Enhanced VSC (Enhanced Vehicle Stability Control)**
  Provides cooperative control of the ABS, TRAC, VSC and EPS. Helps to maintain directional stability when swerving on slippery road surfaces by controlling steering performance.

- **TRAC (Traction Control)**
  Helps to maintain drive power and prevent the drive wheels from spinning when starting the vehicle or accelerating on slippery roads.

- **Hill-start assist control (if equipped)**
  →P. 305

- **EPS (Electric Power Steering)**
  Employs an electric motor to reduce the amount of effort needed to turn the steering wheel.
2-4. Using other driving systems

- **Active Torque Control 4WD (AWD models only)**
  Automatically switches from front-wheel drive to AWD (All-Wheel Drive) according to driving conditions, helping to ensure reliable handling and stability. Examples of conditions where the system will switch to AWD are when cornering, going uphill, starting off or accelerating, and when the road surface is slippery due to snow or rain etc.

- **VDIM (Vehicle Dynamics Integrated Management) (if equipped)**
  Provides integrated control of the ABS, brake assist, TRAC, VSC, hill-start assist control, and EPS systems.
  Helps to maintain vehicle stability when swerving on slippery road surfaces by controlling the brakes and engine output.

- **PCS (Pre-Collision System) (if equipped)**
  → P. 307

---

**When the Enhanced VSC/TRAC systems are operating**

If the vehicle is in danger of slipping or if any of the drive wheels spins, the slip indicator light flashes to indicate that the Enhanced VSC/TRAC systems are operating.
Disabling TRAC and VSC system

If the vehicle gets stuck in fresh snow or mud, TRAC and VSC may reduce power from the engine to the wheels. You may need to turn the system off to enable you to rock the vehicle in order to free it.

- **Turning off the TRAC system only**
  
  To turn the TRAC system off, quickly press and release the button.
  
  The TRAC OFF indicator light will come on.
  
  Push the button again to turn the system back on.

- **Turning off both TRAC and VSC systems**
  
  To turn the TRAC and VSC systems off, press and hold the button for more than 3 seconds while the vehicle is stopped.
  
  The TRAC OFF indicator light and VSC OFF indicator light will come on.
  
  Press the button again to turn the systems back on.
2-4. Using other driving systems

- Sounds and vibrations caused by ABS, brake assist, Enhanced VSC, and TRAC
  - A sound may be heard from the engine compartment when the engine is started or just after the vehicle begins to move. This sound does not indicate that a malfunction has occurred in any of these systems.
  - Any of the following conditions may occur when the above systems are operating. None of these indicates that a malfunction has occurred.
    - Vibrations may be felt through the vehicle body and steering.
    - A motor sound may be heard after the vehicle comes to a stop.
    - The brake pedal may pulsate slightly after ABS is activated.
    - The brake pedal may move down slightly after ABS is activated.

- EPS operation sound
  - When the steering wheel is operated, a motor sound (whirring sound) may be heard. This does not indicate a malfunction.

- Reactivation of the TRAC and VSC systems after turning off the engine
  - Turning off the engine after turning off the TRAC and VSC systems will automatically reactivate them.

- Reactivation of the TRAC system linked to vehicle speed
  - When only the TRAC system is turned off, the TRAC system will turn on when vehicle speed increases. However, when both TRAC and VSC systems are turned off, the systems will not turn on even when vehicle speed increases.
Reduced effectiveness of the EPS system

The effectiveness of the EPS system is reduced to prevent the system from overheating when there is frequent steering input over an extended period of time. The steering wheel may feel heavy as a result. Should this occur, refrain from excessive steering input or stop the vehicle and turn the engine off. The EPS system should return to normal within 10 minutes.

CAUTION

- **ABS does not operate effectively when**
  - Tires with inadequate gripping ability are used (such as excessively worn tires on a snow covered road).
  - The vehicle hydroplanes while driving at high speed on wet or slick roads.
- **Stopping distance when ABS is operating will exceed that of normal conditions**
  The ABS is not designed to shorten the vehicle's stopping distance. Always maintain a safe distance from the vehicle in front of you in the following situations.
  - When driving on dirt, gravel or snow-covered roads
  - When driving with tire chains
  - When driving over bumps in the road
  - When driving over roads with potholes or roads with uneven surfaces
- **TRAC may not operate effectively when**
  Directional control and power may not be achievable while driving on slippery road surfaces, even if the TRAC system is operating. Do not drive the vehicle in conditions where stability and power may be lost.
2.4. Using other driving systems

**CAUTION**

- **When Enhanced VSC is activated**
  The slip indicator light flashes. Always drive carefully. Reckless driving may cause an accident. Exercise particular care when the indicator light flashes.
- **When TRAC and VSC systems are turned off**
  Be especially careful and drive at a speed appropriate to the road conditions. As these are the systems to ensure vehicle stability and driving force, do not turn the TRAC and VSC systems off unless necessary.
- **Replacing tires**
  Make sure that all tires are of the specified size, brand, tread pattern and total load capacity. In addition, make sure that the tires are inflated to the recommended tire pressure level.
  The ABS and Enhanced VSC systems will not function correctly if different tires are installed on the vehicle.
  Contact your Toyota dealer for further information when replacing tires or wheels.
- **Handling of tires and suspension**
  Using tires with any kind of problem or modifying the suspension will affect the driving assist systems, and may cause the system to malfunction.
- **Active Torque Control 4WD system**
  - The AWD system of this vehicle is intended to ensure driving stability on normal roads. It is not designed for use in demanding situations such as rally driving.
  - Take care when driving on slippery road surfaces.
7.2 VEHICLE ARRIVAL CONDITION REPORT

CONTRACT NO.: DTNH22-08-D-00098
DATE: 4/1/2010

From: Automotive Allies  Purpose: Initial Receipt
Received via Transfer

To: Dynamic Research, Inc  Present Vehicle Condition

Vehicle  VIN: 5TDKK3DC6BS010864  NHTSA NO.: CB5100
Model Year: 2011  Odometer Reading: 25 Miles
Make: Toyota  Body Style: MPV
Model: Sienna  Body Color: White
Manufacture Date: 2/10  Dealer: Automotive Allies
GVWR (kg/lb) 2715/5995  Price: Leased

☒ All options listed on the "Window Sticker" are present on the test vehicle
☒ Tires and wheel rims are new and the same as listed
☒ There are no dents or other interior or exterior flaws
☒ The vehicle has been properly prepared and is in running condition
☒ The glove box contains an owner’s manual, warranty document, consumer
information, and extra set of keys
☒ Proper fuel filler cap is supplied on the test vehicle
☒ Place vehicle in storage area
☒ Inspect the vehicle’s interior and exterior, including all windows, seats, doors,
etc., to confirm that each system is complete and functional per the
manufacturer’s specifications. Any damage, misadjustment, or other unusual
condition that could influence the test program or test results shall be
recorded. Report any abnormal condition to the NHTSA COTR before beginning
any test.

NOTES:

RECORDED BY: J Lenkeit  DATE RECORDED: 4/1/2010
APPROVED BY: B Kebschull  DATE APPROVED: 4/2/2010
### 7.3 VEHICLE COMPLETION CONDITION REPORT

**CONTRACT NO.:** DNHT22-08-D-00098  
**DATE:** 5/5/10

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<thead>
<tr>
<th>Vehicle</th>
<th>VIN: 5TDKK3DC6BS010864</th>
<th>NHTSA NO.: CB5100</th>
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</thead>
<tbody>
<tr>
<td>Model Year</td>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>Make:</td>
<td>Toyota</td>
<td></td>
</tr>
<tr>
<td>Model:</td>
<td>Sienna</td>
<td></td>
</tr>
<tr>
<td>Manufacture Date:</td>
<td>2/10</td>
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<tr>
<td>GVWR (kg/lb):</td>
<td>2715 (5995)</td>
<td></td>
</tr>
<tr>
<td>Price:</td>
<td>Leased</td>
<td></td>
</tr>
</tbody>
</table>

**Odometer Reading:** 70 Miles  
**Body Style:** MPV  
**Body Color:** White  
**Dealer:** Automotive Allies

**LIST OF FMVSS TESTS PERFORMED BY THIS LAB:** 126

- [X] THERE ARE NO DENTS OR OTHER INTERIOR OR EXTERIOR FLAWS
- [X] THE VEHICLE HAS BEEN PROPERLY MAINTAINED AND IS IN RUNNING CONDITION
- [X] THE GLOVE BOX CONTAINS AN OWNER'S MANUAL, WARRANTY DOCUMENT, CONSUMER INFORMATION, AND EXTRA SET OF KEYS
- [X] PROPER FUEL FILLER CAP IS SUPPLIED ON THE TEST VEHICLE

**REMARKS:**

Equipment that is no longer on the test vehicle as noted on Vehicle Arrival Condition Report:

Explanation for equipment removal:

Test Vehicle Condition:

**RECORDED BY:** J Lenkeit  
**DATE RECORDED:** 5/5/10

**APPROVED BY:** Brian Kebschull  
**DATE APPROVED:** 5/5/10
### 7.4 SINE WITH DWELL TEST RESULTS

**2011 Toyota Sienna MPV**

NHTSA No.: CB5100

**Date of Test:** 4/23/2010

**Date Created:**

---

#### Lateral Stability Test Series No. 1 – Counterclockwise Initial Steer Direction

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<th>File</th>
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<th>MES</th>
<th>Time @ 5deg</th>
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<th>Time @ COS</th>
<th>MO S</th>
<th>Time @ MOS</th>
<th>YRR1</th>
<th>YR1</th>
<th>YRR 175</th>
<th>YRR175</th>
<th>2nd Yaw Peak</th>
<th>2nd Yaw Peak Ct</th>
<th>Lat Disp</th>
<th>Lat. Acc. 1.07 s</th>
<th>1st SWA Peak</th>
<th>1st SWA Peak Ct</th>
<th>2nd SWA Mean</th>
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<td>(%)</td>
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### 7.4 SINE WITH DWELL TEST RESULTS

2011 Toyota Sienna MPV

NHTSA No.: CB5100

Date of Test: 4/23/2010

Date Created: 4/23/2010

**Lateral Stability Test Series No. 2 – Clockwise Initial Steer Direction**

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### 7.5 SLOWLY INCREASING STEER TEST RESULTS

2011 Toyota Sienna MPV  
NHTSA No.: **CB5100**  
Date of Test: **4/23/2010**  
Date Created: **4/23/2010**

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Averages  
**33.9**  
**0.3014**
7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES

Vehicle: 2011 Toyota Sienna MPV
Wheelbase: 119.25 Inches
Measurement date: 4/7/2010

CMM Measurements
Coordinate system: SAE (X,Y,Z positive forward, to the right, and downward, respectively)
Origin defined at 48" point on lateral arm of measurement fixture, projected onto the ground plane

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Motion Pak reference point taken from mid height of unit left side

Motion Pak Width = 3.05" => 1/2 W = 1.525
Motion_PAK_Location = 21.426 47.665 -20.316

Measurement Notes:
1. The Faro arm is positioned just to the left of the vehicle, near the rear door.
2. A "centerline jig" is used in the Faro arm measurement. The jig consists of a long beam with a 4 ft lateral arm that is perpendicular to the beam. The jig is placed on the ground underneath the vehicle with the long beam positioned along the centerline of the vehicle, such that the lateral arm extends to the left, slightly forward of the left rear tire. The lateral arm has a marked indentation point which is located 48.00" from the edge of the centerline beam.
3. The Faro arm is used to make the following measurements:
   - Three points on the ground, which establishes the ground plane.
   - Two points along the lateral arm, and projected onto the ground plane. This establishes the y axis.
   - One point at the 48 inch reference point on the lateral arm. This establishes the origin.
   - Three points on the left rear wheel or wheel cover. The Faro arm then computes the center point of the wheel.
   - One point to establish the height of the highest point on the roof of the vehicle.

Coordinate Measurements Calculated for S7D (Matlab Program)
Coordinate system: X,Y,Z positive rearward, to the right, and upward, respectively
Origin defined as follows: X axis: front axle, Y axis: vehicle centerline, Z axis: ground plane

<table>
<thead>
<tr>
<th>Ref X</th>
<th>Ref Y</th>
<th>Ref Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion_PAK_Location in S7D (Matlab program) coordinate system</td>
<td>60.324</td>
<td>-0.335</td>
</tr>
</tbody>
</table>

Calculation Notes:
1. X axis value is the difference between the wheelbase and the calculated distance from the rear axle centerline to the IMU (the value must be positive and less than the wheelbase).
2. Y axis value is -48.00 (the Y axis offset of the measurement origin in the S7D coordinate system) plus the measured Y axis value (a negative value indicates the IMU is to the left of the vehicle centerline, and a positive value indicates it is to the right)
3. Z axis value is from the ground plane up to the center of the IMU (value must be positive).