126-DRI-10-002

SAFETY COMPLIANCE TESTING FOR FMVSS 126
Electronic Stability Control Systems

New United Motor Manufacturing, Inc.
2010 Toyota Corolla
NHTSA No. CA5107

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

November 22, 2010

Final Report

Prepared Under Contract No.: DTNH22-08-D-00098

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
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Washington, DC 20590

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16. Abstract A test was conducted on a 2010 Toyota Corolla , NHTSA No. CA5107, 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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TABLE OF CONTENTS

SECTION		PAGE
1.0	PURPOSE OF COMPLIANCE TEST	1
2.0	TEST PROCEDURE AND DISCUSSION OF RESULTS	1
3.0	TEST DATA	5
4.0	TEST EQUIPMENT LIST AND CALIBRATION INFORMATION	27
5.0	PHOTOGRAPHS	29
6.0	DATA PLOTS	43
7.0	OTHER DOCUMENTATION	47
	7.1 Owner's Manual Pages	48
	7.2 Vehicle Arrival Condition Report	52
	7.3 Vehicle Completion Condition Report	53
	7.4 Sine with Dwell Test Results	54
	7.5 Slowly Increasing Steer Test Results	55
	7.6 Inertial Sensing System Location Coordinates	56

1.0 PURPOSE OF COMPLIANCE TEST

The purpose of this test is to determine if the test vehicle, a 2010 Toyota Corolla, 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 2010 Toyota Corolla 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: *2010 Toyota Corolla*

NHTSA No. *CA5107* VIN: *1NXBU4EE3AZ280589*

Vehicle Type: *Passenger Car* Manufacture Date: *10/09*

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: *2010 Toyota Corolla Passenger Car*

NHTSA No. *CA5107* Data sheet completion date: *12/7/2009*

VIN *1NXBU4EE3AZ280589* Manufacture Date: *10/09*

GVWR (kg): *1742* Front GAWR (kg): *948* Rear GAWR (kg): *839*

Seating Positions Front: *2* Mid: Rear: *3*

Odometer reading at time of inspection: *14 miles (22.4 km)*

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front Axle: *P195/65 R15* Rear Axle: *P195/65 R15*

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

	Front Axle	Rear Axle
Tire Manufacturer:	*Goodyear*	*Goodyear*
Tire Model:	*Eagle LS2*	*Eagle LS2*
Tire Size:	*P195/65 R15*	*P195/65 R15*

TIN Left Front: *M6O6 011R 4109* Right Front: *M6O6 011R 4109*

Left Rear: *M6O6 011R 4109* Right Rear: *M6O6 011R 4109*

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 (CONTD)

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)

Drive Configuration: *FWD*
Mode: *Default, ESC on*
Drive Configuration: _____
Mode: _____
Drive Configuration: _____
Mode: _____

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: *12/7/2009*
APPROVED BY: *P Broen* DATE APPROVED: *12/8/2009*

3.0 TEST DATA (CONTD)

Data Sheet 2 (Page 1 of 2)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

Vehicle: *2010 Toyota Corolla Passenger Car*

NHTSA No *CA5107* Data Sheet Completion Date: *1/20/2010*

ESC SYSTEM IDENTIFICATION

Manufacturer/Model *Advics Co., Ltd / 44540-02270*

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: _____

ESC OPERATIONAL CHARACTERISTICS

System is capable of generating brake torque at each wheel — [X] Yes (Pass) [ ] No (Fail)
List and describe Components: *Solenoid valves control the fluid pressure generated by the pumps and applies it to the brake calipers/wheel cylinders of each wheel.*

System is capable of determining yaw rate — [X] Yes (Pass) [ ] No (Fail)
List and describe Components: *Yaw rate sensor to detect yaw rate*

System is capable of monitoring driver steering input — [X] Yes (Pass) [ ] No (Fail)
List and describe Components: *Steer angle sensor located on steering column*

System is capable of estimating side slip or side slip derivative — [X] Yes (Pass) [ ] No (Fail)
List and describe Components: *To estimate the vehicle side slip derivative, the VSC system collects wheel speed, lateral acceleration, and yaw rate data. Wheel speed sensors detect each wheel's speed, the acceleration sensor detects lateral acceleration, and the yaw sensor detects the yaw rate. Vehicle speed is estimated from the wheel speed and the estimated yaw rate is calculated by dividing the lateral acceleration by vehicle speed. The estimated vehicle side slip derivative is obtained as the difference between the estimated yaw rate and the actual yaw rate detected by the yaw sensor. The VSC system estimates vehicle side slip by the integration of the estimated vehicle side slip derivative.*

3.0 TEST DATA (CONTD)

Data Sheet 2 (Page 2 of 2)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

ESC OPERATIONAL CHARACTERISTICS (continued)

System is capable of modifying engine torque during ESC activation. Method used to modify torque: *The electronically controlled throttle is modulated to regulate engine output based on an engine output control signal from the skid control ECU to the ECM during traction control or ESC operation.*

X Yes (Pass)
___ No (Fail)

System is capable of activation at speeds of 20 km/h (12.4 mph) and higher

Speed system becomes active: *15 km/h*

X Yes (Pass)
___ No (Fail)

System is capable of activation during the following driving phases:
- acceleration
- braking
- coasting
- during activation of ABS or traction control

X Yes (Pass)
___ No (Fail)

Driving phases during which ESC is capable of activation:
Acceleration, deceleration, coasting, during activation of 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: *1/20/2010*
APPROVED BY: *P Broen* DATE APPROVED: *2/2/2010*

3.0 TEST DATA (CONTD)

Data Sheet 3 (Page 1 of 2)
ESC MALFUNCTION AND OFF TELLTALES

Vehicle: *2010 Toyota Corolla Passenger Car*

NHTSA No. *CA5107* Data sheet completion date: *1/4/10*

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? *Yes*

Telltale Location: *Lower middle of instrument cluster*

Telltale Color: *Amber*

Telltale symbol or abbreviation used

or **ESC**

[X] 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.

When the system detects a malfunction the "slip indicator" symbol, as identified above, illuminates continuously and "VSC off" indicator light flashes on and off.

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:

When ESC is activated the "slip indicator" light flashes and a warning buzzer sounds.

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: Lower middle portion of instrument panel

Telltale Color: *Amber*

Telltale symbol or abbreviation used

or **ESC OFF**

- [ ] Vehicle uses this symbol
- [ ] Vehicle uses this abbreviation
- [x] Neither symbol or abbreviation is used

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

Is telltale part of a common space? *No*

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

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *1/4/10*
APPROVED BY: *J. Lenkeit* DATE APPROVED: *1/20/2009*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 Toyota Corolla Passenger Car*

NHTSA No. *CA5107* Data sheet completion date: *1/13/2010*

"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? (mark all that apply)

- [ ] Dedicated "ESC Off" Control
- [X] Multi-functional control with an "ESC Off" mode
- [ ] Other (describe) *See notes below*

Identify each control location, labeling and selectable modes.

First Control: Location *Lower left of steering column (Figure 5.7)*
Labeling *ESC Symbol plus "Off"*
Modes *Traction control off, Traction control and ESC off, both systems 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.

Control Mode	"ESC Off" telltale illuminates upon activation of control? (Yes/No)	"ESC Off" telltale extinguishes upon cycling ignition? (Yes/No)
Traction Control off	*No*	
TRAC off; ESC off	*Yes*	*Yes*
Both systems on	*No*	

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 ___ NA

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 ___ No **X** NA

Ancillary Control: System _____

Control Description _____

Labeling _____

Ancillary Control: System _____

Control Description _____

Labeling _____

Ancillary Control: System _____

Control Description _____

Labeling _____

3.0 TEST DATA (CONTD)

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

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

Ancillary Control	Control Activates "ESC Off" Telltale? (Yes/No)	Warnings or Messages Provided
None		

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

Ancillary Control	"ESC Off" telltale extinguishes upon cycling ignition? (Yes/No)
None	

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 the control activated 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 **X** NA

DATA INDICATES COMPLIANCE: PASS

Remarks: Push switch once for Traction control off, push and hold to turn off both Traction Control and ESC

RECORDED BY: *B Kebschull* DATE RECORDED: *1/13/2010*
APPROVED BY: *J Lenkeit* DATE APPROVED: *2/2/2010*

3.0 TEST DATA (CONTD)

Data Sheet 5 (Page 1 of 3)
TEST TRACK AND VEHICLE DATA

Vehicle: *2010 Toyota Corolla Passenger Car*

NHTSA No. *CA5107* Data sheet completion date: *1/7/2010*

Test Track Requirements: Test surface slope (0-1%): *0.5%*

Peak Friction Coefficient (at least 0.9) *0.96*

Test track data meets requirements: *Yes* If no, explain:

Full Fluid Levels: Fuel *Yes* Other Fluids *Yes* :(specify)

Coolant *Yes* *Washer, brakes*

Tire Pressures:

Required; Front Axle *210* KPA Rear Axle *210* KPA

Actual; LF *210* KPA RF *210* KPA

LR *210* KPA RR *210* KPA

Vehicle Dimensions: Front Track Width *152.1* cm Wheelbase *260.6* cm

Rear Track Width *152.1* cm

Vehicle Weight Ratings: GAWR Front *948* KG GAWR Rear *839* KG

Unloaded Vehicle Weight (UVW):

Front axle *764.0* KG Left Front *386* KG Right Front *378* KG

Rear axle *489.0* KG Left Rear *246* KG Right Rear *243* KG

Total UVW *1253.0* KG

Baseline Weight and Outrigger Selection (only for MPVs, Trucks, Buses)

Calculated baseline weight (UVW + 73kg) *1326.0* KG

Outrigger size required ("Standard" or "Heavy") N/A

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 _____ KG	Left Front _____ KG	Right Front _____ KG
Rear axle _____ KG	Left Rear _____ KG	Right Rear _____ KG

Total UVW with outriggers _____ KG

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

Front axle *834.6* KG	Left Front *440* KG	Right Front *394.6* KG
Rear axle *561.5* KG	Left Rear *282.1* KG	Right Rear *279.4* KG

Vehicle Weight *1396.1* KG

Ballast Required =	[Total UVW with Outriggers (if applicable)]		+ *168*	KG	- [Loaded Weight w/Driver and Instrumentation)]	
=	*1253.0*	KG	+ *168*	KG	- 1396.1	KG

= *25* KG

Total Loaded Vehicle Weight w/Driver and Instrumentation and Ballast

Front axle *846.4* KG	Left Front *441.8* KG	Right Front *404.6* KG
Rear axle *576.5* KG	Left Rear *285.3* KG	Right Rear *291.2* KG

Total UVW *1422.9* 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:

	Center of Gravity				Inertial Sensing System			
x-distance	*41.6*	in	*105.6*	cm	*63.3*	in	*160.8*	cm
y-distance	*-0.7*	in	*-1.7*	cm	*-0.3*	in	*-0.7*	cm
z-distance	*21.8*	in	*55.4*	cm	*12.2*	in	*30.9*	cm
Roof Height					*57.367*	in	*145.7*	cm
Distance between ultrasonic sensors					*85.5*	in	*217.2*	cm

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *1/7/2010*
APPROVED BY: *J Lenkeit* DATE APPROVED: *1/20/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 Toyota Corolla Passenger Car*

NHTSA No. *CA5107*

Measured tire pressure: LF *210* KPA RF *210* KPA

LR *210* KPA RR *210* KPA

Wind Speed *0.90* 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)) *7.3* °C

Brake Conditioning Time: *11:16 AM* Date: *1/7/2010*

56 km/h (35 mph) Brake Stops

Number of stops executed (10 required) *10* Stops

Observed deceleration rate range (.5g target) *0.45 - 0.55* 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 *0.85-0.95* 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

Tire Conditioning series No. 1 Time: *11:30 AM* Date: *1/7/2010*

Measured cold tire pressure LF *229* KPA RF *228* KPA

LR *216* KPA RR *220* KPA

Wind Speed *0.9* 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)) *7.4*°C

30 meter (100 ft) Diameter Circle Maneuver				
Test Run	Steering Direction	Target Lateral Acceleration (g)	Observed Lateral Acceleration (g)	Observed Vehicle Speed (Km/h)
1-3	Clockwise	0.5 – 0.6	*0.5 - 0.6*	*32.8 - 33.6*
4-6	Counterclockwise	0.5 – 0.6	*0.5 - 0.6*	*32 - 33.6*

5-1 Hz Cycle Sinusoidal Steering Maneuver to Determine Steering Wheel Angle for 0.5-0.6 g Lateral Acceleration					
Test Run	Data File	Vehicle Speed Km/h(mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1	2	56 ± 2 (35 ± 1)	*60*	0.5 - 0.6	*0.36*
2		56 ± 2 (35 ± 1)	*(see Remarks)*	0.5 - 0.6	
3		56 ± 2 (35 ± 1)		0.5 - 0.6	
4		56 ± 2 (35 ± 1)		0.5 - 0.6	

Steering wheel angle that corresponds to a peak 0.5-0.6 g lateral acceleration: *90* degrees

10-1 Hz Cycle Sinusoidal Steering Maneuver					
Test Run	Data File	Vehicle Speed Km/h (mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1-3	*3-5*	56 ± 2 (35 ± 1)	*90* (cycles 1-10)	0.5 - 0.6	*0.54*
4	*6*	56 ± 2 (35 ± 1)	*90* (cycles 1-9)	0.5 - 0.6	*0.55*
			180 (cycle10)*	NA	*0.79*

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

3.0 TEST DATA (CONTD)

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

Tire Conditioning series No. 2 Time: *12:10 PM* Date: *1/7/2010*

Measured cold tire pressure LF *227* KPA RF *229* KPA

LR *217* KPA RR 221 KPA

Wind Speed *2.1* 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)) *8.4* °C

30 meter (100 ft) Diameter Circle Maneuver				
Test Run	Steering Direction	Target Lateral Acceleration (g)	Observed Lateral Acceleration (g)	Observed Vehicle Speed (Km/h)
1-3	Clockwise	0.5 - 0.6	*0.5 - 0.6*	*32.8 - 33.6*
4-6	Counterclockwise	0.5 - 0.6	*0.5 - 0.6*	*32.8 - 33.6*

Steering wheel angle that corresponds to a peak 0.5-0.6 g lateral acceleration: *90*

10-1 Hz Cycle Sinusoidal Steering Maneuver					
Test Run	Data File	Vehicle Speed Km/h (mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1-3	*15-17*	56 ± 2 (35 ± 1)	*90* (cycles 1-10)	0.5 - 0.6	*0.54*
4	*18*	56 ± 2 (35 ± 1)	*90* (cycles 1-9)	0.5 - 0.6	*0.55*
			180 (cycle 10)*	NA	*0.79*

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

Remarks: *Confirmation run was not made; proper g level was confirmed in data runs 3-5*

RECORDED BY: *B Kebschull* DATE RECORDED: *1/7/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED: *2/1/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 Toyota Corolla Passenger Car*

NHTSA No. *CA5107*

Measured tire pressure: LF *227* KPA RF *226* KPA

LR *217* KPA RR *222* KPA

Wind Speed *1.1* 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)) *7.7* °C

Selected drive configuration *FWD*

Selected Mode: *Default*

Preliminary Left Steer Maneuver:

Lateral Acceleration measured at 30 degrees steering wheel angle

$a_{y,30degrees}$ = *0.26* g

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

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

δ_{sis} = *63.5* degrees (@.55g)

δ_{sis} = *60* degrees (rounded)

Steering Wheel Angle at Corrected 0.3g Lateral Acceleration:

Maneuver	Initial Steer Direction	Time Clock (5 min max between runs)	Steering Wheel Angle to nearest 0.1° (degrees)	Data Run	Good/NG
1	Left	*11:43 AM*	*-34.2*	*9*	*Good*
2	Left	*11:46 AM*	*-34.3*	*10*	*Good*
3	Left	*11:51 AM*	*-34.5*	*11*	*Good*
4	Left				
5	Left				
1	Right	*11:55AM*	*36*	*12*	*Good*
2	Right	*11:59 AM*	*35.4*	*13*	*Good*
3	Right	*12:03 AM*	*35.8*	*14*	*Good*
4	Right				
5	Right				

3.0 TEST DATA (CONTD)

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

Average Overall Steering Wheel Angle:

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

$\delta_{0.3\ g,\ overall}$ = *35.0* degrees

[to nearest 0.1 degree]

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *1/7/2010*
APPROVED BY: *J Lenkeit* DATE APPROVED: *1/10/2010*

3.0 TEST DATA (CONTD)

Data Sheet 8 (Page 1 of 3)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS

Vehicle: *2010 Toyota Corolla Passenger Car :*

NHTSA No. *CA5107* Data sheet completion date: *1/7/2010*

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

Selected Drive Configuration: *FWD*

Selected Mode: *Default*

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) *35* degrees

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

Maneuver #	Clock Time (1.5 – 5.0 min max between runs)	Commanded Steering Wheel Angle[1]		Yaw Rates (degrees/sec)			YRR at 1.0 sec after COS [≤ 35%]		YRR at 1.75 sec after COS [≤ 20%]	
		Scalar (* $\delta_{0.3\ g}$)	Angle (degrees)	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0sec}$	$\dot{\psi}_{1.75sec}$	%	Pass/Fail	%	Pass/Fail
1	12:17 PM	1.5	53	12.2	-0.1	-0.2	-0.9	PASS	-1.3	PASS
2	12:21 PM	2	70	16.0	-0.1	-0.1	-0.9	PASS	-0.6	PASS
3	12:24 PM	2.5	88	20.2	-0.1	-0.1	-0.7	PASS	-0.6	PASS
4	12:27PM	3	105	22.2	-0.1	0.0	-0.5	PASS	0.1	PASS
5	12:30 PM	3.5	123	27.0	-0.1	0.0	-0.2	PASS	-0.1	PASS
6	12:33 PM	4	140	32.0	-0.3	-0.1	-0.8	PASS	-0.2	PASS
7	12:37 PM	4.5	158	37.6	-0.4	-0.3	-1.1	PASS	-0.8	PASS
8	12:40 PM	5	175	42.6	-0.5	-0.1	-1.1	PASS	-0.2	PASS
9	12:44PM	5.5	193	47.4	0.0	0.0	0.0	PASS	0.1	PASS
10	12:49 PM	6	210	52.1	-0.4	-0.1	-0.8	PASS	-0.3	PASS
11	12:52PM	6.5	228	54.4	-0.4	-0.2	-0.8	PASS	-0.4	PASS
12	12:55 PM	7	245	57.8	-0.2	0.1	-0.3	PASS	0.2	PASS
13	12:59 PM	7.5	263	60.7	-0.4	-0.1	-0.6	PASS	-0.2	PASS
14	1:03 PM	-	270	63.6	0.4	0.0	0.7	PASS	0.1	PASS

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

3.0 TEST DATA (CONTD)

DATA SHEET 8 (2 of 3)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS

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

Maneuver #	Clock Time (1.5 – 5.0 min max between runs)	Commanded Steering Wheel Angle[1]		Yaw Rates (degrees/sec)			YRR at 1.0 sec after COS [≤ 35%]		YRR at 1.75 sec after COS [≤ 20%]	
		Scalar (* $\delta_{0.3\,g}$)	Angle (degrees)	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0sec}$	$\dot{\psi}_{1.75sec}$	%	Pass/Fail	%	Pass/Fail
1	12:57 PM	1.5	53	-13.3	0.0	0.0	-0.1	PASS	0.0	PASS
2	1:02 PM	2	70	-17.2	0.1	0.1	-0.6	PASS	-0.8	PASS
3	1:06 PM	2.5	88	-21.5	0.0	0.1	-0.2	PASS	-0.5	PASS
4	1:09 PM	3	105	-25.9	0.1	-0.1	-0.3	PASS	0.4	PASS
5	1:12 PM	3.5	123	-27.4	0.0	0.1	-0.1	PASS	-0.3	PASS
6	1:15 PM	4	140	-32.5	0.1	-0.2	-0.3	PASS	0.5	PASS
7	1:18 PM	4.5	158	-37.1	0.1	-0.2	-0.2	PASS	0.6	PASS
8	1:21 PM	5	175	-42.9	0.1	0.0	-0.1	PASS	0.0	PASS
9	1:24 PM	5.5	193	-47.6	0.2	0.1	-0.5	PASS	-0.3	PASS
10	1:28 PM	6	210	-50.9	0.4	0.1	-0.7	PASS	-0.2	PASS
11	1:31 PM	6.5	228	-55.2	0.3	0.0	-0.6	PASS	0.0	PASS
12	1:34 PM	7	245	-60.0	0.0	0.1	0.0	PASS	-0.1	PASS
13	1:38 PM	7.5	263	-63.5	-0.7	-0.1	1.1	PASS	0.1	PASS
14	1:42 PM	-	270	-64.7	-0.4	-0.1	0.6	PASS	0.1	PASS

1. Maneuver execution should continue until a steering wheel angle magnitude factor of $6.5*\delta_{0.3\,g,\,overall}$ or 270 degrees is utilized, whichever is greater provided the calculated $6.5*\delta_{0.3\,g,\,overall}$ is less than or equal to 300 degrees. If $6.5*\delta_{0.3\,g,\,overall}$ is less than 270 degrees maneuver execution should continue by increasing the steering wheel angle magnitude by multiples of $0.5*\delta_{0.3\,g,\,overall}$ 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	☒ No
Tire debeading	☐ Yes	☒ No
Loss of pavement contact of vehicle tires	☐ Yes	☒ No
Did the test driver experience any vehicle loss of control or spinout?	☐ Yes	☒ No

If "Yes" explain the event and consult with the COTR.

3.0 TEST DATA (CONTD)

DATA SHEET 8 (3 of 3)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS

Responsiveness – Lateral Displacement

Maneuver #	Initial Steer Direction	Commanded Steering Wheel Angle (5.0*$\delta_{0.3\ g,\ overall}$ or greater)		Calculated Lateral Displacement[1]	
		Scalar *$\delta_{0.3\ g}$	Angle (degrees)	Distance (m)	Pass/Fail
8	Counter Clockwise	5	175	-3.2	*PASS*
9	Counter Clockwise	5.5	193	-3.3	*PASS*
10	Counter Clockwise	6	210	-3.4	*PASS*
11	Counter Clockwise	6.5	228	-3.5	*PASS*
12	Counter Clockwise	7	245	-3.4	*PASS*
13	Counter Clockwise	7.5	263	-3.5	*PASS*
14	Counter Clockwise	-	270	-3.6	*PASS*
22	Clockwise	5	175	2.9	*PASS*
23	Clockwise	5.5	193	3.1	*PASS*
24	Clockwise	6	210	3.2	*PASS*
25	Clockwise	6.5	228	3.2	*PASS*
26	Clockwise	7	245	3.3	*PASS*
27	Clockwise	7.5	263	3.4	*PASS*
28	Clockwise	-	270	3.3	*PASS*

1. Lateral displacement should be $\geq$ 1.83 m (6 ft) for vehicle with a GVWR of 3,500 kg (7,716 lb) or less; and $\geq$ 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: *P Broen* DATE RECORDED: *1/7/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED: *1/10/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 Toyota Corolla Passenger Car :*

NHTSA No. *CA5107* Data Sheet Completion Date: *1/7/2010*

TEST 1

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Left rear wheel speed sensor disconnected

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.

[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 1 DATA INDICATES COMPLIANCE: ***PASS***

Remarks: With malfunction effected, telltale illuminates immediately when ignition switch turned on. With malfunction eliminated, telltale extinguishes immediately when ignition switch turned on.

RECORDED BY: *B Kebschull* DATE RECORDED: *1/7/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED *1/10/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 Toyota Corolla Passenger Car :*

NHTSA No. *CA5107* Data Sheet Completion Date: *1/22/2010*

TEST 2

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Inertial sensor under driver's seat disconnected

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.

[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: With malfunction affected, telltale illuminates immediately when ignition switch turned on. With malfunction eliminated, telltale extinguishes immediately when ignition is switched on.

RECORDED BY: *P Broen* DATE RECORDED: *1/22/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED *1/22/2010*

4.0 TEST EQUIPMENT LIST AND CALIBRATION INFORMATION (1 OF 2)

TABLE 1. TEST INSTRUMENTATION

Type	Output	Range	Resolution	Accuracy	Specifics	Serial Number	Calibration
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	1 psi 6.89 kPa	0.5 psi 3.45 kPa	Ashcroft D1005PS	1039350	By: Innocal Date:1/15/09 Due: 1/15/10
Platform Scales	Vehicle Total, Wheel, and Axle Load	8000 lb 35.6 kN	0.5 lb 2.2 N	±1.0% of applied load	Intercomp Model SWII	24032361	By: Intercomp Date:1/29/09 Due: 1/29/10
Automated Steering Machine with Steering Angle Encoder	Handwheel Angle	±800 deg	0.25 deg	±0.25 deg	Heitz Automotive Testing Model: Sprint 3	60304	By: Heitz Date:1/29/09_ Due: 1/29/10
Multi-Axis Inertial Sensing System	Longitudinal, Lateral, and Vertical Acceleration Roll, Yaw, and Pitch Rate	Accelerometers: ±2 g Angular Rate Sensors: ±100 deg/s	Accelerometers: ≤10 ug Angular Rate Sensors: ≤0.004 deg/s	Accelerometers: ≤0.05% of full range Angular Rate Sensors: 0.05% of full range	BEI Technologies Model: MotionPAK MP-1	0767	By:Systron Donner Date:11/23/09 Due: 11/23/10
Radar Speed Sensor and Dashboard Display	Vehicle Speed	0-125 mph 0-200 km/h	0.009 mph .014 km/h	±0.25% of full scale	A-DAT Corp. Radar Model: DRS-6 Display Model: RD-2	1400.604	By: ADAT Date:1/5/09 Due:1/5/10
Ultrasonic Distance Measuring System	Left and Right Side Vehicle Height	5-24 inches 127-610 mm	0.01 inches .254 mm	±0.25% of maximum distance	Massa Products Corporation Model: M-5000/220	DOT-NHTSA D2646	By: DRI Date:3/16/09 Due: 3/16/10
						DOT-NHTSA D2647	By: DRI Date:3/16/09 Due: 3/16/10

4.0 TEST EQUIPMENT LIST AND CALIBRATION INFORMATION (2 OF 2)

TABLE 1. TEST INSTRUMENTATION (CONTD)

Type	Output	Range	Resolution	Accuracy	Specifics	Serial Number	Calibration
Data Acquisition System [Includes amplification, anti-aliasing, and analog to digital conversion.]	Record Time; Velocity; Distance; Lateral, Longitudinal, and Vertical Accelerations; Roll, Yaw, and Pitch Rates; Steering Wheel Angle.	Sufficient to meet or exceed individual sensors	200 Hz	Sufficient to meet or exceed individual sensors	SoMat eDaq ECPU processor	MSHLB.03-2476	By: Somat Date:1/13/09 Due: 1/14/10
					SoMat High level Board EHLS	MSHLS.03-3182	By: Somat Date:1/14/09 Due: 1/15/10
Load Cell	Vehicle Brake Pedal Force	0-300 lb 0-1.33 kN	1 lb 4.44 N	±0.05% of full scale	Lebow 3663-300	767	By: Davis Date:2/3/09 Due: 2/3/10
Coordinate Measurement Machine	Inertial Sensing System Coordinates	0-8 ft 0-2.4 m	±.0020 in. ±.051 mm	±.0020 in. ±.051 mm (Single point articulation accuracy)	Faro Arm Fusion	UO8-05-08-06636	By: Faro Date: 8/18/09 Due: 8/18/10
Outriggers	No output. Safety Item.	N/A	N/A	N/A	DRI manufactured Aluminum meeting the weight and MOI specifications of Docket 2007-27662-11	N/A	N/A

5.0 PHOTOGRAPHS (1 of 14)

Figure 5.1. Front View of Test Vehicle As Delivered

5.0 PHOTOGRAPHS (2 of 14)

Figure 5.2. Rear View of Test Vehicle As Delivered

5.0 PHOTOGRAPHS (3 of 14)

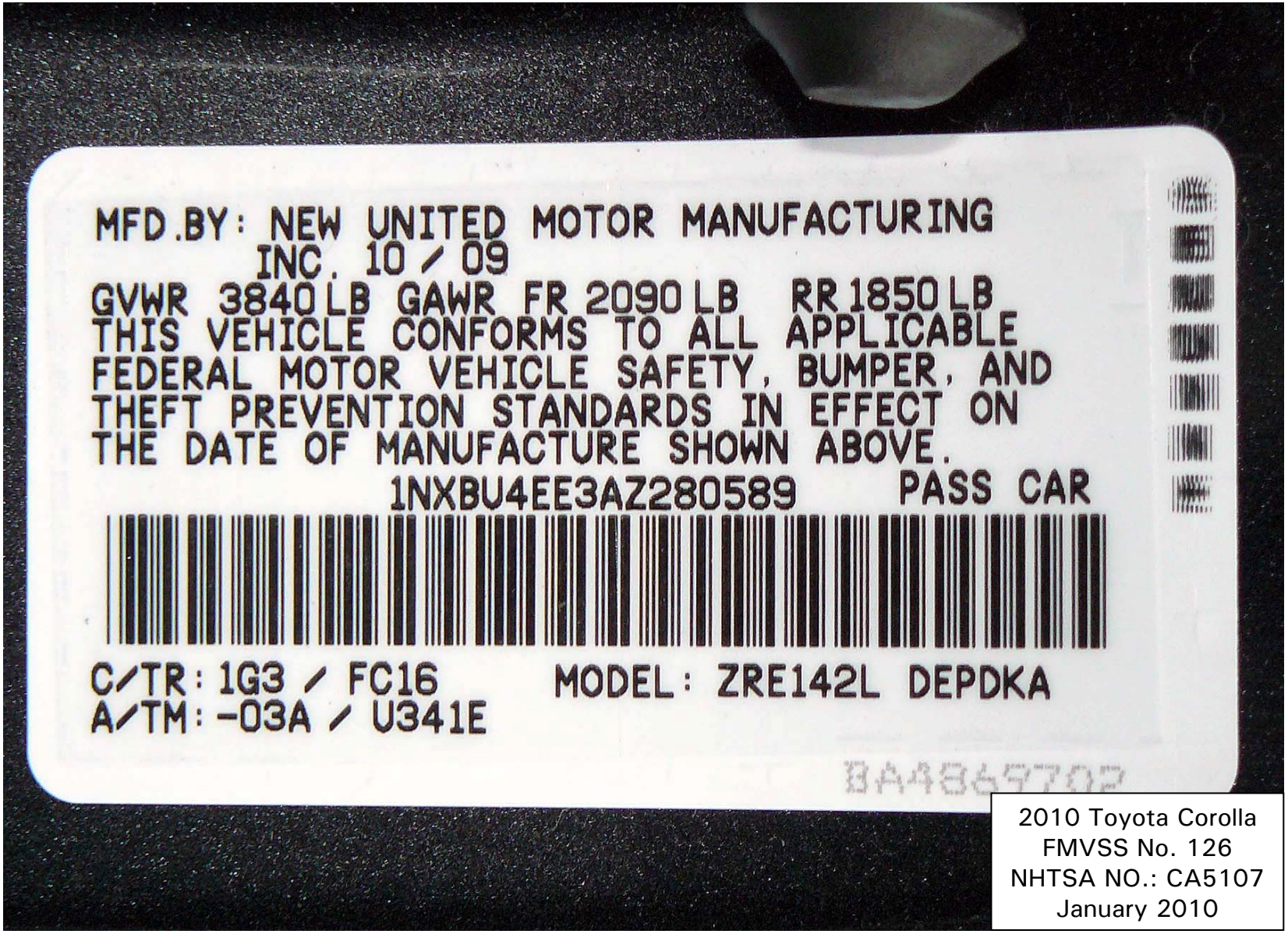


Figure 5.3. Vehicle Certification Label

5.0 PHOTOGRAPHS (4 of 14)

Figure 5.4. Vehicle Placard

5.0 PHOTOGRAPHS (5 of 14)

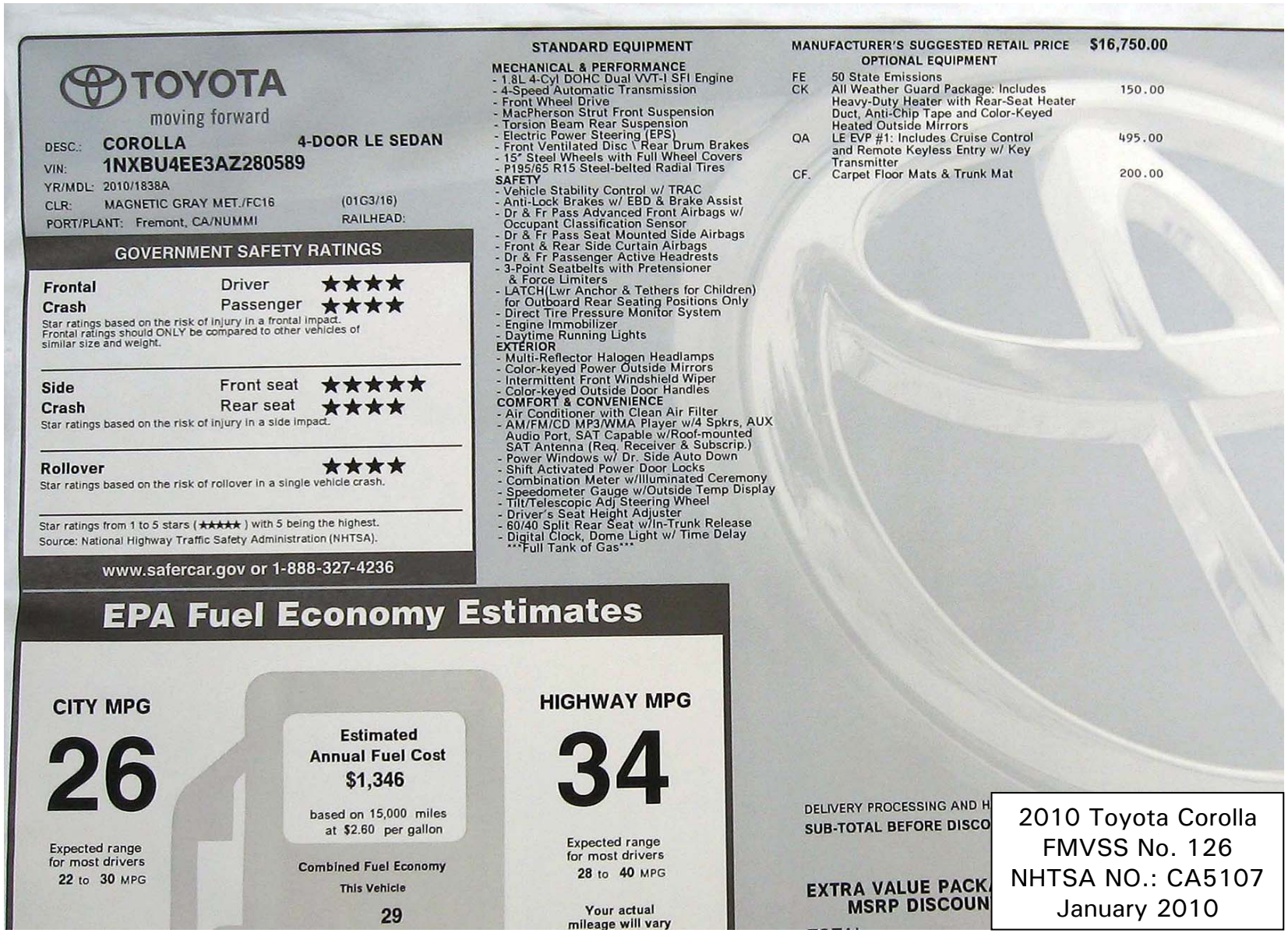


Figure 5.5. Window Sticker (Monroney Label)

5.0 PHOTOGRAPHS (6 of 14)

Figure 5.6. Telltale for ESC Malfunction and ESC Off

5.0 PHOTOGRAPHS (7 of 14)

Figure 5.7. ESC Off Control Switch

5.0 PHOTOGRAPHS (8 of 14)

Figure 5.8. Front View of Vehicle As Tested

5.0 PHOTOGRAPHS (9 of 14)

Figure 5.9. Rear View of Vehicle As Tested

5.0 PHOTOGRAPHS (10 of 14)

Figure 5.10. Ultrasonic Height Sensor Mounted on Left Side of Vehicle for Determining Body Roll Angle

5.0 PHOTOGRAPHS (11 of 14)

Figure 5.11. Rear Mounted Speed Sensor

5.0 PHOTOGRAPHS (12 of 14)

Figure 5.12. Steering Controller and Data Acquisition Computer

5.0 PHOTOGRAPHS (13 of 14)

Figure 5.13. Inertial Measurement Unit Mounted in Vehicle

5.0 PHOTOGRAPHS (14 of 14)

Figure 5.14. Brake Pedal Load Cell

6.0 DATA PLOTS (1 of 4)

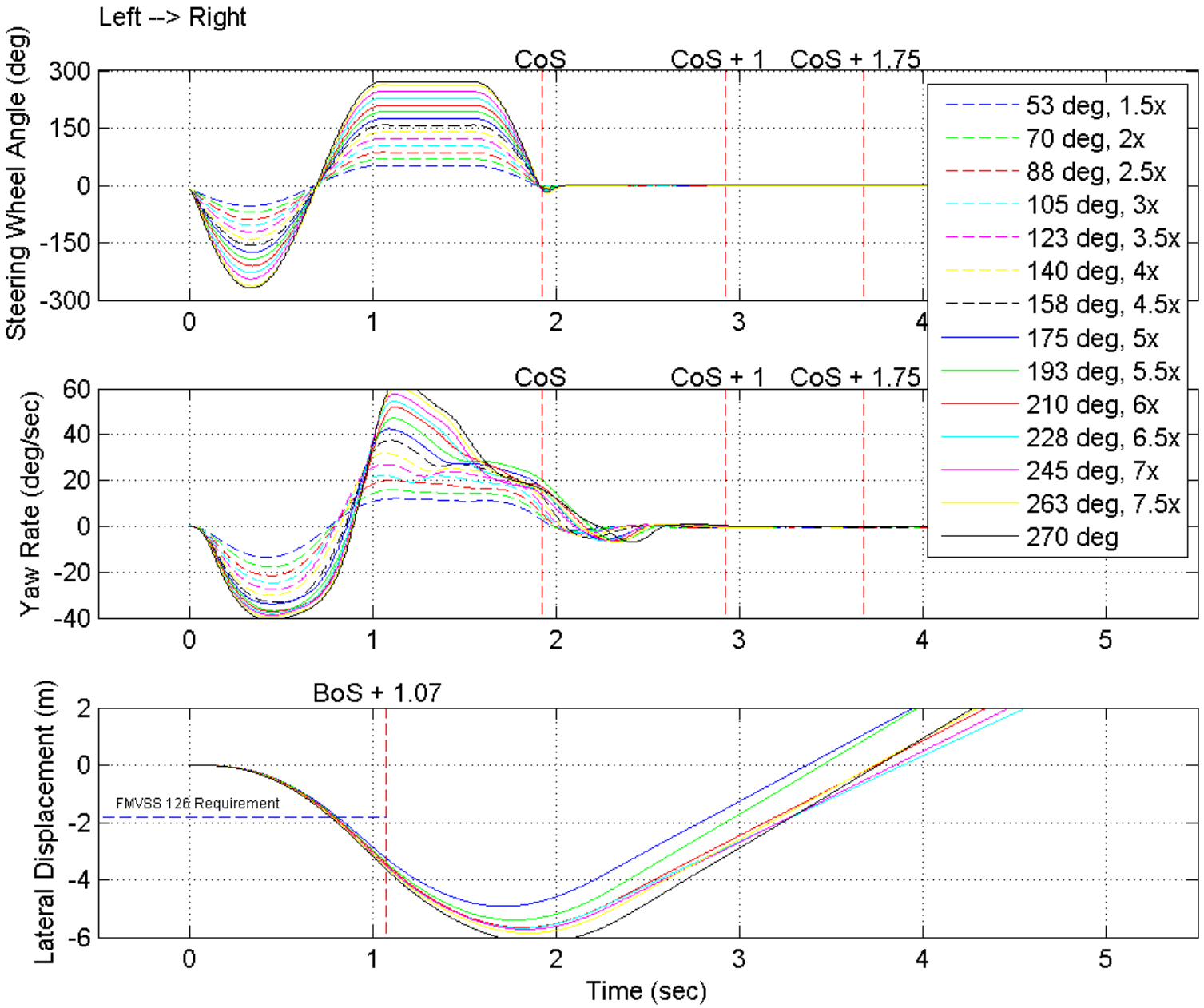


Figure 6.1. Steering Wheel Angle, Yaw Rate and Lateral Displacement for L-R Series

6.0 DATA PLOTS (2 of 4)

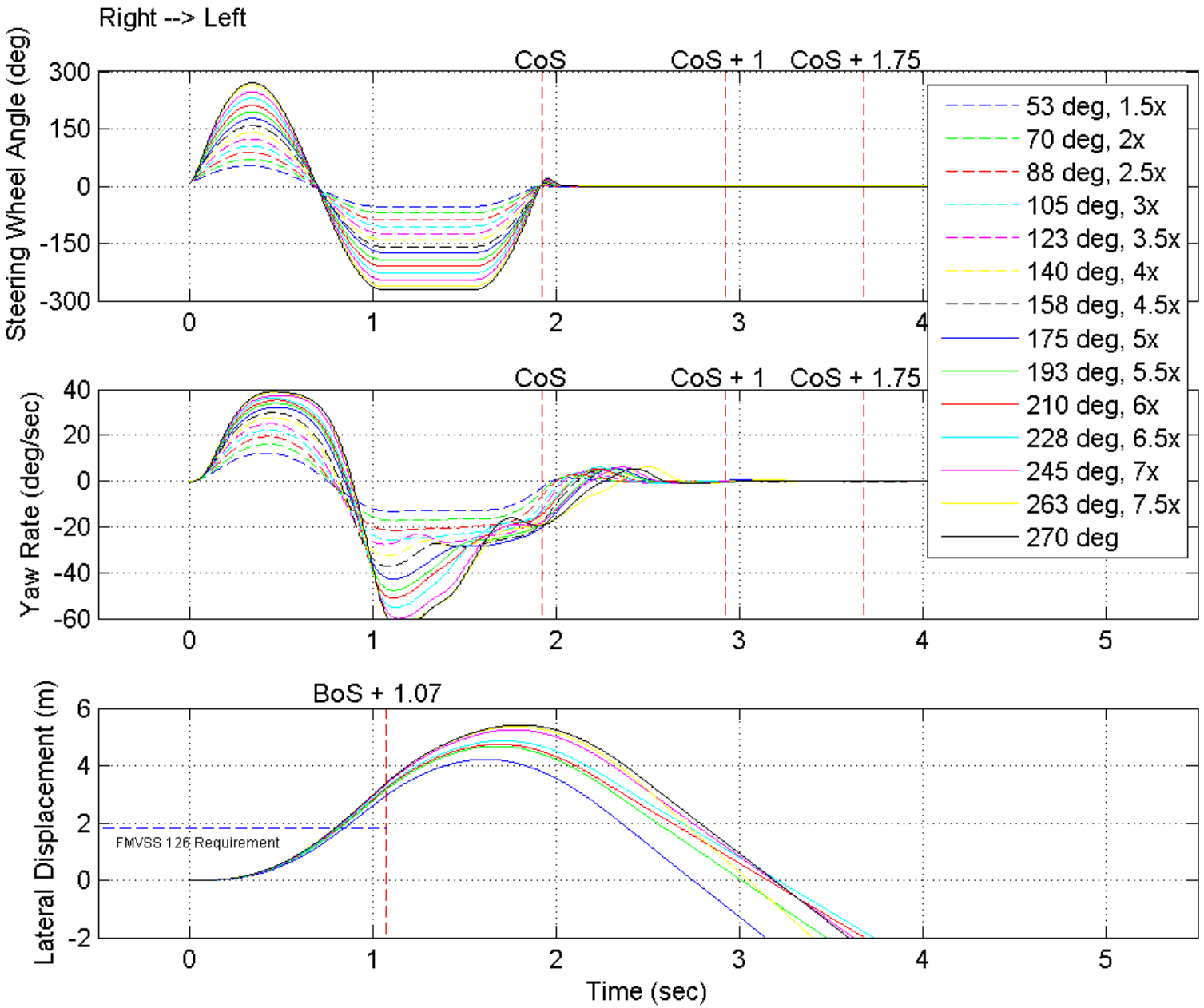


Figure 6.2. Steering Wheel Angle, Yaw Rate and Lateral Displacement for R-L Series

6.0 DATA PLOTS (3 of 4)

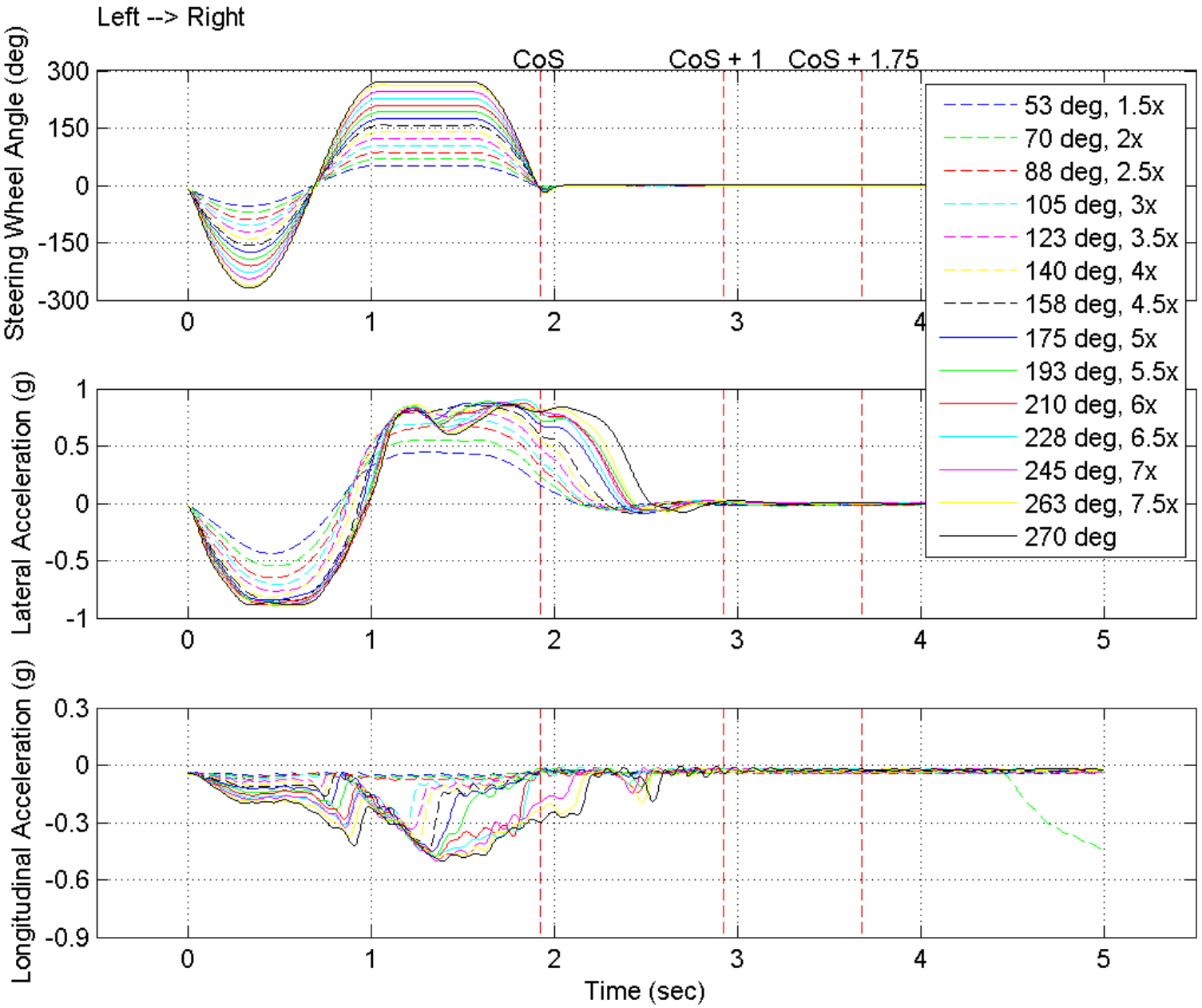


Figure 6.3. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for L-R Series

6.0 DATA PLOTS (4 of 4)

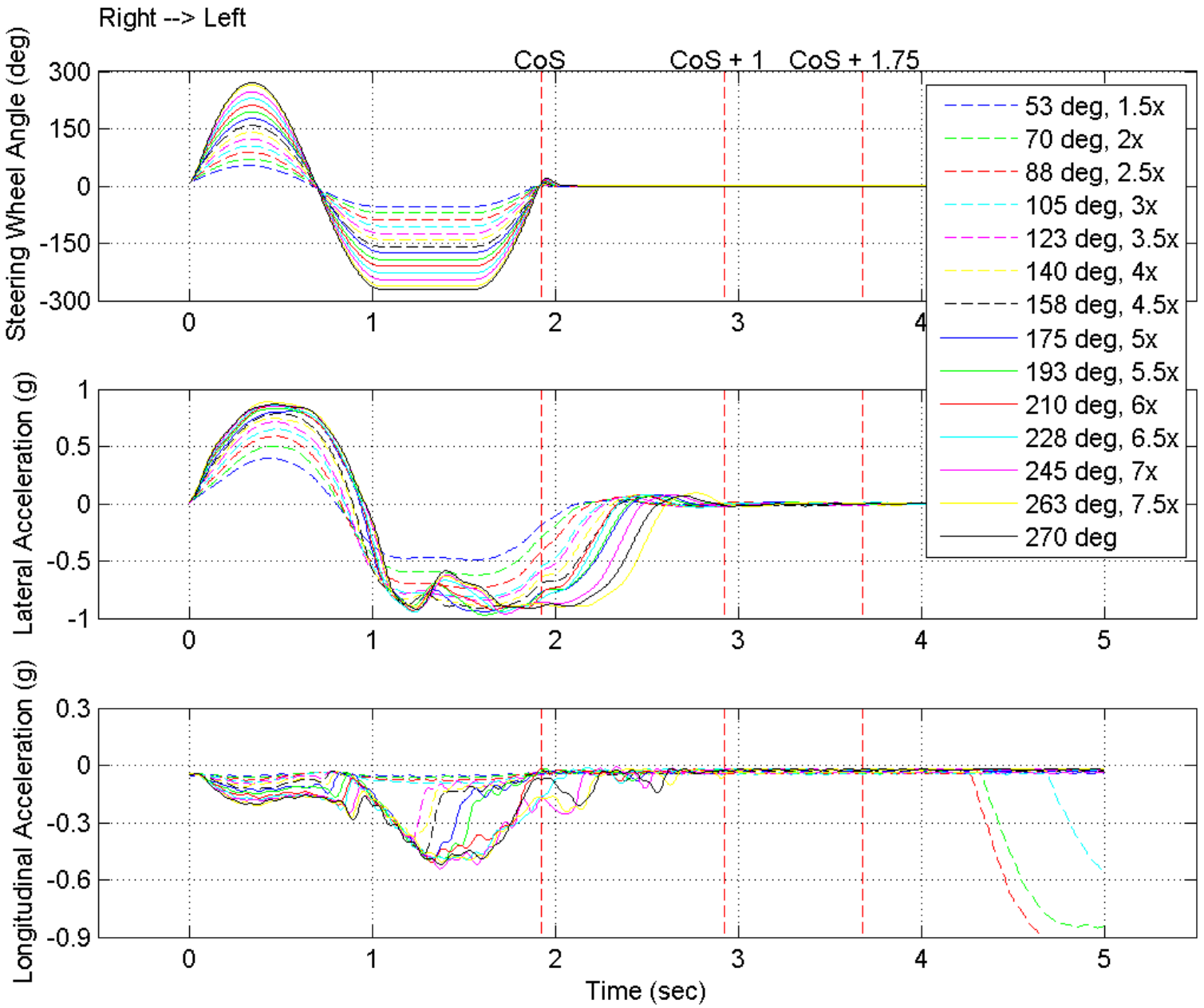


Figure 6.4. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for R-L Series

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

7.1 OWNER'S MANUAL PAGES

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) (if equipped)**

  Helps the driver to control skidding when swerving suddenly or turning on slippery road surfaces.

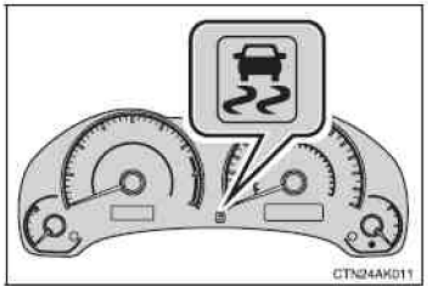
- **TRAC (Traction Control) (if equipped)**

  Maintains drive power and prevents the front wheels from spinning when starting the vehicle or accelerating on slippery roads.

- **EPS (Electric Power Steering)**

  Employs an electric motor to reduce the amount of effort needed to turn the steering wheel.

When VSC and TRAC are operating



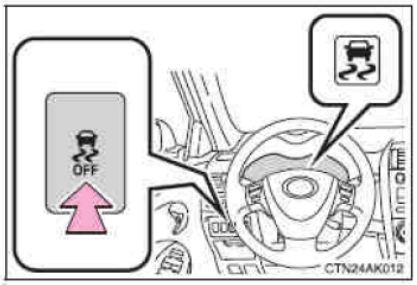
If the vehicle is in danger of slipping or the front wheels spin, the indicator flashes to indicate that VSC/TRAC have been engaged.

A buzzer (intermittent) sounds to indicate that VSC is operating.

To disable TRAC and/or VSC

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 TRAC

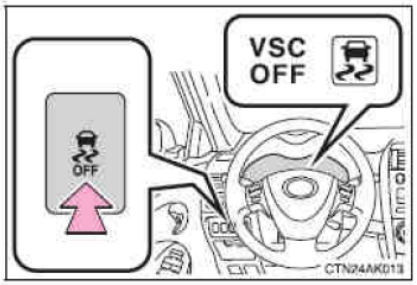


Quickly push and release the button to turn off TRAC.

The slip indicator light should come on.

Push the button again to turn the system back on.

Turning off TRAC and VSC



Push and hold the button while the vehicle is stopped to turn off TRAC and VSC.

The slip indicator light and "VSC OFF" indicator light should come on.

Push the button again to turn the system back on.

Automatic reactivation of TRAC and VSC

Turning the "ENGINE START STOP" switch or the engine switch OFF after turning off the TRAC and VSC systems will automatically re-enable them.

Automatic TRAC reactivation

If only the TRAC system is turned off, the TRAC system will turn on when vehicle speed increases.

Automatic TRAC and VSC reactivation

If the TRAC and VSC systems are turned off, the systems will not turn on even when vehicle speed increases.

Sounds and vibrations caused by ABS, brake assist, 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.

If the "VSC OFF" indicator light flashes

There is a malfunction in the TRAC and VSC systems. Contact your Toyota dealer and have your Toyota inspected.

EPS operation sound

When the steering wheel operates, a motor sound (whirring sound) may be heard.
This does not indicate a malfunction.

Reduced effectiveness of EPS

The effectiveness of EPS 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 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 the wet or slick road.

CAUTION

Stopping distance when ABS is operating on the wet or slick roads

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 uneven roads

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.

When VSC is activated

The slip indicator light flashes and a warning buzzer sounds. Always drive carefully. Reckless driving may cause an accident. Exercise particular care when the indicator light flashes and a buzzer sounds.

When TRAC and VSC are off

Be especially careful and drive at a speed appropriate to the road conditions. As these are systems to ensure vehicle stability and driving force, do not turn off TRAC and VSC unless necessary.

Replacing tires

Make sure that all tires are of the same 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 VSC system will not function correctly if different tires are fitted 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.

7.2 VEHICLE ARRIVAL CONDITION REPORT

CONTRACT NO.: DTNH22-08-D-00098
DATE:

From: *Competitive Vehicle Services* Purpose ☒ Initial Receipt
☐ Received via Transfer
To: *Dynamic Research, Inc* ☐ Present Vehicle Condition

Vehicle VIN: *1NXBU4EE3AZ280589* NHTSA NO.: *CA5107*

Model Year: *2010* Odometer Reading: *14* *Miles*
Make *Toyota* Body Style: *Passenger Car*
Model: *Corolla* Body Color: *Gray*
Manufacture Date: *10/09* Dealer: *Competitive Vehicle Services*
GVWR (kg/lb) *1742 (3840)* 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: *No extra key*

RECORDED BY: *J Lenkeit* DATE RECORDED: *12/7/2009*

APPROVED BY: *P Broen* DATE APPROVED: *12/7/2009*

7.3 VEHICLE COMPLETION CONDITION REPORT

CONTRACT NO.: DTNH22-08-D-00098
DATE: 1/22/2010

Vehicle VIN: *1NXBU4EE3AZ280589* NHTSA NO.: *CA5107*

Model Year: *2010* Odometer Reading: *57* *Miles*
Make: *Toyota* Body Style: *Passenger Car*
Model: *Corolla* Body Color: Gray
Manufacture Date: Dealer: *Competitive Vehicle Services*
GVWR (kg/lb) *1742 (3840)* Price: *Leased*

LIST OF FMVSS TESTS PERFORMED BY THIS LAB: 126

☒ THERE ARE NO DENTS OR OTHER INTERIOR OR EXTERIOR FLAWS

☒ THE VEHICLE HAS BEEN PROPERLY MAINTAINED 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

REMARKS:

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

None

Explanation for equipment removal:

Test Vehicle Condition: *As delivered, new*

RECORDED BY: *J Lenkeit* DATE RECORDED: *1/22/2010*

APPROVED BY: *B Kebschull* DATE APPROVED: *2/1/2010*

7.4 SINE WITH DWELL TEST RESULTS

2010 Toyota Corolla Passenger Car
NHTSA No. *CA5107*
Date of Test *1/7/2010*
Date Created *1/7/2010*

File	SWA @ 5deg Ct	MES	Time @ 5deg	COS	Time @ COS	MOS	Time @ MOS	YRR1	YR1	YRR 1 Ct	YRR 175	YR17 5	YRR1 75 Ct	2nd Yaw Peak	2nd Yaw Peak Ct	Lat Disp	Lat. Acc. 1.07 s	1st SWA Peak	1st SWA Peak Ct	2nd SWA Mean
	(deg)	(mph)	(s)		(s)		(sec)	(%)	(deg/s)		(%)	(deg/s)		(deg/s)		(ft)	(g)	(deg)		(deg)
20	710	49.9	3.5	1091	5.4	847	4.2	-0.9	-0.1	1291	-1.3	-0.2	1441	12.2	936	-4.2	0.4	52.9	775	52.8
21	708	50.0	3.5	1090	5.4	847	4.2	-0.9	-0.1	1290	-0.6	-0.1	1440	16.0	929	-5.6	0.5	69.9	775	69.8
22	708	50.1	3.5	1090	5.4	847	4.2	-0.7	-0.1	1290	-0.6	-0.1	1440	20.2	928	-6.8	0.6	87.7	775	87.7
23	707	50.1	3.5	1090	5.4	846	4.2	-0.5	-0.1	1290	0.1	0.0	1440	22.2	919	-7.6	0.6	104.6	775	104.5
24	707	50.2	3.5	1090	5.4	846	4.2	-0.2	-0.1	1290	-0.1	0.0	1440	27.0	922	-8.7	0.6	122.7	775	122.7
25	707	49.9	3.5	1090	5.4	846	4.2	-0.8	-0.3	1290	-0.2	-0.1	1440	32.0	921	-9.4	0.7	139.7	775	139.6
26	706	50.1	3.5	1090	5.4	846	4.2	-1.1	-0.4	1290	-0.8	-0.3	1440	37.6	925	-10.2	0.6	157.8	775	157.6
27	706	50.0	3.5	1090	5.4	846	4.2	-1.1	-0.5	1290	-0.2	-0.1	1440	42.6	925	-10.5	0.7	174.9	775	174.7
28	706	50.1	3.5	1090	5.4	846	4.2	0.0	0.0	1290	0.1	0.0	1440	47.4	930	-11.0	0.5	192.9	775	192.6
29	707	50.4	3.5	1090	5.4	847	4.2	-0.8	-0.4	1290	-0.3	-0.1	1440	52.1	932	-11.2	0.5	210.1	775	209.6
30	707	49.9	3.5	1090	5.4	847	4.2	-0.8	-0.4	1290	-0.4	-0.2	1440	54.4	931	-11.3	0.5	228.2	775	227.7
31	706	50.1	3.5	1090	5.4	847	4.2	-0.3	-0.2	1290	0.2	0.1	1440	57.8	932	-11.3	0.5	245.2	775	244.7
32	706	50.1	3.5	1090	5.4	847	4.2	-0.6	-0.4	1290	-0.2	-0.1	1440	60.7	934	-11.5	0.5	263.2	775	262.5
33	706	50.2	3.5	1090	5.4	847	4.2	0.7	0.4	1290	0.1	0.0	1440	63.6	936	-11.7	0.4	270.0	775	269.5
34	710	50.2	3.5	1091	5.4	847	4.2	-0.1	0.0	1291	0.0	0.0	1441	-13.3	931	3.9	-0.4	53.6	775	53.5
35	708	50.1	3.5	1090	5.4	846	4.2	-0.6	0.1	1290	-0.8	0.1	1440	-17.2	932	5.1	-0.5	70.5	775	70.5
36	708	50.2	3.5	1090	5.4	847	4.2	-0.2	0.0	1290	-0.5	0.1	1440	-21.5	930	6.1	-0.6	88.5	775	88.3
37	707	50.1	3.5	1090	5.4	846	4.2	-0.3	0.1	1290	0.4	-0.1	1440	-25.9	930	7.0	-0.7	105.2	775	105.2
38	706	50.2	3.5	1090	5.4	846	4.2	-0.1	0.0	1290	-0.3	0.1	1440	-27.4	920	7.9	-0.7	123.4	775	123.4
39	706	50.0	3.5	1090	5.4	846	4.2	-0.3	0.1	1290	0.5	-0.2	1440	-32.5	922	8.5	-0.7	140.4	775	140.4
40	706	49.8	3.5	1090	5.4	846	4.2	-0.2	0.1	1290	0.6	-0.2	1440	-37.1	924	9.0	-0.7	158.5	775	158.4
41	706	50.6	3.5	1089	5.4	846	4.2	-0.1	0.1	1289	0.0	0.0	1439	-42.9	929	9.6	-0.7	175.6	775	175.4
42	706	50.3	3.5	1090	5.4	847	4.2	-0.5	0.2	1290	-0.3	0.1	1440	-47.6	930	10.2	-0.7	193.7	775	193.2
43	706	50.1	3.5	1089	5.4	846	4.2	-0.7	0.4	1289	-0.2	0.1	1439	-50.9	929	10.4	-0.7	210.7	775	210.3
44	706	50.2	3.5	1090	5.4	847	4.2	-0.6	0.3	1290	0.0	0.0	1440	-55.2	931	10.6	-0.7	228.9	775	228.4
45	706	50.2	3.5	1090	5.4	847	4.2	0.0	0.0	1290	-0.1	0.1	1440	-60.0	935	10.9	-0.6	246.1	775	245.2
46	706	50.2	3.5	1090	5.4	847	4.2	1.1	-0.7	1290	0.1	-0.1	1440	-63.5	935	11.0	-0.6	264.0	775	263.0
47	706	50.2	3.5	1090	5.4	847	4.2	0.6	-0.4	1290	0.1	-0.1	1440	-64.7	937	11.0	-0.5	270.8	775	270.1

7.5 SLOWLY INCREASING STEER TEST RESULTS

2010 Toyota Corolla Passenger Car
NHTSA No. *CA5107*
Date of Test *1/7/2010*
Date Created *1/7/2010*

File	EventPt	DOS	MES	Mean SPD	AYcount_3	THETAENCF_3	AYCG_CD2_3	r_squared	ZeroBegin	ZeroEnd
			(mph)	(mph)		(deg)	(g)			
9	700	1	49.17	49.57	1215	-34.21	-0.2981	0.9978	500	700
10	700	1	49.40	49.65	1215	-34.26	-0.3050	0.9985	500	700
11	679	1	49.81	50.06	1218	-34.45	-0.3101	0.9941	479	679
12	700	0	49.68	49.98	1236	36.00	0.3000	0.9971	500	700
13	700	0	50.01	50.13	1227	35.36	0.3038	0.9986	500	700
14	700	0	49.80	49.89	1234	35.84	0.2970	0.9979	500	700
				Averages		35	0.3023			

Scalars	Steering Angles (deg)
1.5	53
2.0	70
2.5	88
3.0	105
3.5	123
4.0	140
4.5	158
5.0	175

Scalars	Steering Angles (deg)
5.5	193
6.0	210
6.5	228
7.0	245
7.5	263
-	270
8.0	280

7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES

Vehicle: **2010 Toyota Corolla Passenger Car** NHTSA No.: CA5107

Wheelbase: 102.4 Inches Faro Arm S/N: U08-05-08-06636

Measurement date: 12/23/2009 Certification date: 8/18/2009

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

	Ref X	Ref Y	Ref Z
M_PLANE001_Ground_Plane	-	-	0.000
M_Line_Y_Axis	2.430	-3.381	0.000
M_Point_48_Ref	0.000	0.000	-
M_CIRCLE001_I_Left_Rear_Wheel_Axle	-28.844	14.173	-11.856-
M_Point_IMU_side	10.235	46.183	-12.167
M_Point_ROOF	-		-57.367
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	10.235	47.708	-12.167

Measurment 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 meaurements:
   - 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

	Ref X	Ref Y	Ref Z
Motion_PAK_Location in S7D (Matlab program) coordinate system	**63.321**	**-0.292**	**12.167**

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).