126-DRI-10-009
SAFETY COMPLIANCE TESTING FOR FMVSS 126
Electronic Stability Control Systems

General Motors LLC
2010 GMC Acadia
NHTSA No. CA0111

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

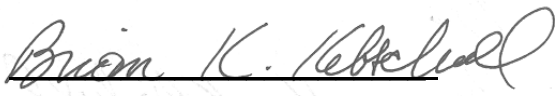
10 November, 2010

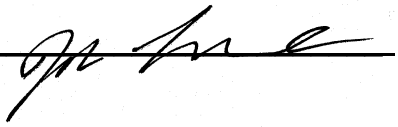
Final Report

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

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
1200 New Jersey Avenue, SE
West Building, 4th Floor (NVS-221)
Washington, DC 20590

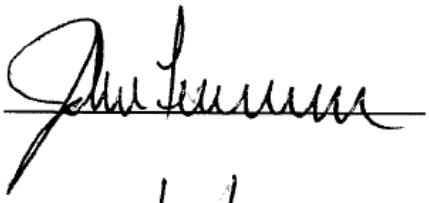
Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-08-D-00098.

Prepared By: 

Approved By: 

Approval Date: 10 November, 2010

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: 

Acceptance Date: 11/16/10

1. Report No. 126-DRI-10-009	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 126 Compliance Testing of 2010 GMC Acadia multipurpose passenger vehicle, NHTSA No. CA0111		5. Report Date 10 November, 2010 6. Performing Organization Code DRI	
7. Author(s) John F. Lenkeit, Technical Director Brian Kebschull, Principal Engineer		8. Performing Organization Report No. DRI-TM-10-10	
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	
12. Sponsoring Agency Name and Address U.S. Department of Transportation 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 5 May,2010 to 10 November, 2010 14. Sponsoring Agency Code NVS-220	
15. Supplementary Notes			
16. Abstract A test was conducted on a 2010 GMC Acadia , NHTSA No. CA0111, 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			
17. Key Words Compliance Testing Safety Engineering FMVSS 126		18. Distribution Statement Copies of this report are available from: NHTSA Technical Information Services (TIS) (NPO 411) 1200 New Jersey Avenue, SE Washington, D.C. 20590 Email: tis@nhtsa.dot.gov FAX: (202) 493-2833	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 62	22.

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1.0 PURPOSE OF COMPLIANCE TEST

The purpose of this test is to determine if the test vehicle, a 2010 GMC Acadia, 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 GMC Acadia 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 GMC Acadia*

NHTSA No. *CA0111* VIN: *1GKLRLED2AJ180906*

Vehicle Type: *MPV* Manufacture Date: *01/10*

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: *2010 GMC Acadia MPV*

NHTSA No. *CA0111* Data Sheet Completion Date: *5/24/2010*

VIN *1GKLRLED2AJ180906* Manufacture Date: *01/10*

GVWR (kg): *2908.0* Front GAWR (kg): *1450.0* Rear GAWR (kg): *1600.0*

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

Odometer reading at time of inspection: *27 miles (43.2 km)*

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front axle: *P255/65 R18* Rear axle: *P255/65 R18*

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

		Front Axle	Rear Axle
	Tire Manufacturer:	*Goodyear*	*Goodyear*
	Tire Model:	*Fortera HL Edition*	*Fortera HL Edition*
	Tire Size:	*P255/65 R18*	*P255/65 R18*
TIN	Left Front:	*4BXM ARDR 0210*	Right Front: *4BXM ARDR 0310*
	Left Rear:	*4BXM ARDR 0210*	Right Rear: *4BXM ARDR 0210*

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: *Standard*
Drive Configuration: _____
Mode: _____
Drive Configuration: _____
Mode: _____

VEHICLE STABILITY SYSTEMS (Check applicable technologies):

List other systems:

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

REMARKS:

RECORDED BY: *P Broen* DATE RECORDED: *5/24/2010*
APPROVED BY: *J Lenkeit* DATE APPROVED: *6/2/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No *CA0111* Data Sheet Completion Date: *5/21/2010*

ESC SYSTEM IDENTIFICATION

Manufacturer/Model *Robert Bosch LLC/Bosch ESP Gen 8*

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)
Brief explanation: *The ESC electronic control unit modulates electrical solenoids that open and close valves within the hydraulic control unit, controlling brake fluid pressure the brake calipers.*

System is capable of determining yaw rate — [X] Yes (Pass) / [ ] No (Fail)
Brief explanation: *Yaw rate is measured by a combination gyroscopic rate sensor/lateral acceleration sensor*

System is capable of monitoring driver steering input — [X] Yes (Pass) / [ ] No (Fail)
Brief explanation: *Driver steering input is measured by a steering wheel angle sensor that is mounted on the steering column.*

System is capable of estimating side slip or side slip derivative — [X] Yes (Pass) / [ ] No (Fail)
Brief explanation: *Side slip and side slip derivative are calculated values within the ESC electronic control unit based on the following sensor inputs: four independent wheel speeds (from the wheel speed sensors mounted at each wheel), yaw rate (from the combination yaw/lateral acceleration sensor mounted underneath the front center console), lateral acceleration (from the combination yaw/lateral acceleration sensor mounted underneath the front center console), and steering wheel angle (from the steering wheel angle sensor mounted on the steering column).*

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. **X** Yes (Pass) ___ No (Fail)

Method used to modify torque: *The ESC electronic control unit sends a signal to the powertrain control module requesting an appropriate percent reduction in engine torque. Torque is modified using a combination of ignition timing and throttle angle.*

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: *14.4 km/h*

System is capable of activation during the following driving phases: **X** Yes (Pass) ___ No (Fail)

- acceleration
- braking
- coasting
- during activation of ABS or traction control

Driving phases during which ESC is capable of activation:
The ESC system is active under driving phases of acceleration, deceleration, coasting, and during activation of ABS or traction control, except if the vehicle is being driven in reverse or if the forward vehicle speed is less than 14.4 km/h.

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: *Joe Kelly* DATE RECORDED: *5/21/2010*
APPROVED BY: *J Lenkeit* DATE APPROVED: *6/2/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No. *CA0111* Data Sheet completion date: *5/21/2010*

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? *Yes*

Telltale Location: *Lower right corner of the instrument panel cluster(Figure 5.6).*

Telltale Color: *Amber*

Telltale symbol or abbreviation used

or **ESC**

	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.

The symbol used is similar to that shown above, but also includes an equilateral triangle around the rear-view silhouette of the vehicle (Figure 5.6). It remains illuminated when there is an ESC malfunction.

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:

This telltale flashes when the ESC system is active.

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? *No*

Is "ESC Off" telltale combined with "ESC Malfunction" telltale utilizing a two part telltale? *NA*

Telltale Location: *NA*

Telltale Color: *NA*

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.

Is telltale part of a common space? *NA*

DATA INDICATES COMPLIANCE *Yes*

(Vehicle is compliant if equipped with a malfunction telltale)

Remarks: *The vehicle has a Driver Information Center (DIC) that can display ESC and other information. The message "SERVICE STABILITRAK" is displayed if there is an ESC malfunction (see owner's manual page 5-41 in Section 7.1). The vehicle Acadia does not have an ESC off control or ESC off telltale.*

RECORDED BY:	*Joe Kelly*	DATE RECORDED:	*5/21/2010*
APPROVED BY:	*Brian Kebschull*	DATE APPROVED:	*6/1/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No. *CA0111* Data Sheet completion date: *6/1/2010*

"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? ___ Yes X No

Type of control or controls provided? (mark all that apply)

- ☐ Dedicated "ESC Off" Control
- ☐ Multi-functional control with an "ESC Off" mode
- ☐ Other (describe) *NA*

Identify each control location, labeling and selectable modes.

First Control: Location *NA*
Labeling
Modes

Second Control: Location
Labeling
Modes

Identify standard or default drive configuration *Standard*

Verify standard or default drive configuration **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 NA ___ 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?

___ Yes ___ No (Fail)

If no, describe how the "Off" control functions

NA

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)
NA		

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_ NA ___ 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 _____

3.0 TEST DATA (CONTD)

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.

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 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.

X NA ____ Yes ____ No (Fail)

DATA INDICATES COMPLIANCE: PASS

Remarks: The 2010 Acadia does not have an ESC off control or ESC off telltale. Vehicle has a button that disables traction control. The symbol on the button is the SLIP icon (car silhouette with slippery lines below it) with a diagonal line through it. When pressed, the ESC/Traction control telltale illuminates, as well as a message in the common area, "Traction Control Off".

RECORDED BY: *Brian Kebschull* DATE RECORDED: *6/1/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED: *6/3/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No. *CA0111* Data Sheet completion date: *6/1/2010*

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

Peak Friction Coefficient (at least 0.9) *0.936*

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

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

Coolant *Yes* *Oil, washer fluid, brake fluid*

Tire Pressures:

Required;	Front Axle	*240*	KPA	Rear Axle	*240*	KPA
Actual;	LF	*240*	KPA	RF	*240*	KPA
	LR	*240*	KPA	RR	*240*	KPA

Vehicle Dimensions:

	Front Track Width	*171.4*	cm	Wheelbase	*302.5*	cm
	Rear Track Width	*170.4*	cm			

Vehicle Weight Ratings: GAWR Front *1450.0* KG GAWR Rear *1600.0* KG

Unloaded Vehicle Weight (UVW):

Front Axle	*1196.5*	KG	Left Front	*592.8*	KG	Right Front	*603.7*	KG
Rear Axle	*950.8*	KG	Left Rear	*489.0*	KG	Right Rear	*461.8*	KG

Total UVW *2147.3* KG

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

Calculated baseline weight (UVW + 73kg) *2220.3* 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	*1222.4* KG	Left front	*610.5* KG	Right front	*611.9* KG
Rear axle	*993.9* KG	Left rear	*507.6* KG	Right rear	*486.3* KG

Total UVW with outriggers *2216.3* KG

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

Front axle	*1300.9* KG	Left front	*645.0* KG	Right front	*655.9* KG
Rear axle	*1058.7* KG	Left rear	*558.8* KG	Right rear	*499.9* KG

Vehicle Weight *2359.6* KG

Ballast Required =

[Total UVW with Outriggers (if applicable)]		+*168*	KG	- [Loaded Weight w/Driver and Instrumentation)]	
= *2216.3*	KG	+*168*	KG	- 2359.6	KG

= *24.7* KG

Total Loaded Vehicle Weight w/Driver and Instrumentation and Ballast

Front axle	*1311.4* KG	Left front	*645.5* KG	Right front	*665.9* KG
Rear axle	*1072.7* KG	Left rear	*563.8* KG	Right rear	*508.9* KG

Total UVW *2384.1* 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:

	Center of Gravity				Inertial Sensing System			
x-distance	*53.6*	in	*136.1*	cm	*74.8*	in	*189.9*	cm
y-distance	*-0.5*	in	*-1.2*	cm	*-0.7*	in	*-1.7*	cm
z-distance	*26.4*	in	*66.9*	cm	*22.7*	in	*57.7*	cm
Roof Height					*69.4*	in	*176.2*	cm
Distance between ultrasonic sensors					*91.8*	in	*233.0*	cm

Remarks:

RECORDED BY: *Peter Broen* DATE RECORDED: *6/1/2010*
APPROVED BY: *Brian Kebschull* DATE APPROVED: *6/1/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No. *CA0111*

Measured tire pressure: LF *249* KPA RF *248* KPA

LR *250* KPA RR *245* KPA

Wind Speed *2.4* 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)) *24.4* °C

Brake Conditioning Time: *11:08:00 AM* Date: *6/1/2010*

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	*0.85-1.00*	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:	*11:21:00 AM*		Date:	*6/1/2010*	
Measured cold tire pressure	LF	*263*	KPA	RF	*263*	KPA
	LR	*266*	KPA	RR	*258*	KPA
Wind Speed *2.5* 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)) *25.4*°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*	*30.4 - 32*
4-6	Counterclockwise	0.5 – 0.6	*0.5-0.6*	*30.4 - 32*

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	*0.38*
2	3	56 ± 2 (35 ± 1)	*90*	0.5 - 0.6	*0.52*
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	*4-6*	56 ± 2 (35 ± 1)	*90* (cycles 1-10)	0.5 - 0.6	*0.52*
4	*7*	56 ± 2 (35 ± 1)	*90* (cycles 1-9)	0.5 - 0.6	*0.52*
			180 (cycle10)*	NA	*0.75*

* 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: *1:30:00 PM* Date: *6/1/2010*

Measured cold tire pressure LF *253* KPA RF *257* KPA

LR *252* KPA RR *241* KPA

Wind Speed *3.1* 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)) *27.2* °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*	*30.4 - 32*
4-6	Counterclockwise	0.5 - 0.6	*0.5-0.6*	*30.4 - 32*

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	*16-18*	56 ± 2 (35 ± 1)	*90* (cycles 1-10)	0.5 - 0.6	*0.52*
4	*19*	56 ± 2 (35 ± 1)	*90* (cycles 1-9)	0.5 - 0.6	*0.52*
			180 (cycle 10)*	NA	*0.75*

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

Remarks:

RECORDED BY: *Brian Kebschull* DATE RECORDED: *6/1/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED: *6/4/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No. *CA0111*

Measured tire pressure: LF *267* KPA RF *261* KPA

LR *268* KPA RR *254* KPA

Wind Speed *1.8* 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)) *25.8* °C

Selected drive configuration *FWD*

Selected Mode: *Default- ESC on*

Preliminary Left Steer Maneuver:

Lateral Acceleration measured at 30 degrees steering wheel angle

$a_{y,30\text{degrees}}$ = *0.29* g

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

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

δ_{sis} = *56.9* 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	*12:09:43 PM*	*-33.8*	*10*	*Good*
2	Left	*12:12:46 PM*	*-32.8*	*11*	*Good*
3	Left	*12:16:30 PM*	*-33.3*	*12*	*Good*
4	Left				
5	Left				
1	Right	*12:20:55 PM*	*32.1*	*13*	*Good*
2	Right	*12:24:27 PM*	*32.1*	*14*	*Good*
3	Right	*12:27:18 PM*	*31.7*	*15*	*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:

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

$\delta_{0.3\,g,\,overall}$ = *32.7* degrees

[to nearest 0.1 degree]

Remarks:

RECORDED BY: *Brian Kebschull* DATE RECORDED: *6/1/2010*
APPROVED BY: *J Lenkeit* DATE APPROVED: *6/3/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No. *CA0111* Data sheet completion date: *6/1/2010*

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- ESC on*

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) *32.7* 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)	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0\,sec}$	$\dot{\psi}_{1.75\,sec}$	%	Pass/Fail	%	Pass/Fail
21	*13:51*	*1.5*	*49*	*12.9*	*-0.3*	*-0.2*	*-1.9*	*Pass*	*-1.5*	*Pass*
22	*13:55*	*2.0*	*65*	*17.0*	*-0.2*	*-0.1*	*-0.9*	*Pass*	*-0.8*	*Pass*
23	*13:59*	*2.5*	*82*	*21.5*	*-0.2*	*-0.4*	*-1.0*	*Pass*	*-1.8*	*Pass*
24	*14:02*	*3.0*	*98*	*25.6*	*0.8*	*-0.1*	*3.3*	*Pass*	*-0.5*	*Pass*
25	*14:05*	*3.5*	*114*	*30.1*	*0.4*	*-0.1*	*1.2*	*Pass*	*-0.2*	*Pass*
26	*14:08*	*4.0*	*131*	*27.7*	*-0.2*	*-0.3*	*-0.5*	*Pass*	*-1.0*	*Pass*
27	*14:11*	*4.5*	*147*	*31.5*	*0.3*	*-0.3*	*1.0*	*Pass*	*-0.8*	*Pass*
28	*14:14*	*5.0*	*164*	*34.8*	*-0.4*	*-0.4*	*-1.1*	*Pass*	*-1.2*	*Pass*
29	*14:17*	*5.5*	*180*	*35.7*	*-0.3*	*-0.3*	*-0.8*	*Pass*	*-0.8*	*Pass*
30	*14:20*	*6.0*	*196*	*39.5*	*-0.3*	*-0.2*	*-0.7*	*Pass*	*-0.5*	*Pass*
31	*14:23*	*6.5*	*213*	*37.1*	*-0.3*	*-0.2*	*-0.9*	*Pass*	*-0.5*	*Pass*
32	*14:27*	*7.0*	*229*	*38.7*	*-0.4*	*-0.3*	*-1.0*	*Pass*	*-0.8*	*Pass*
33	*14:30*	*7.5*	*245*	*39.7*	*-0.5*	*-0.2*	*-1.1*	*Pass*	*-0.5*	*Pass*
34	*14:33*	*8.0*	*262*	*39.8*	*-0.2*	*-0.3*	*-0.5*	*Pass*	*-0.7*	*Pass*
35	*14:36*	*-*	*270*	*39.3*	*-0.4*	*-0.4*	*-0.9*	*Pass*	*-0.9*	*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)	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0\,sec}$	$\dot{\psi}_{1.75\,sec}$	%	Pass/Fail	%	Pass/Fail
36	*14:42*	*1.5*	*49*	*-13.5*	*0.1*	*0.0*	*-0.4*	*Pass*	*-0.2*	*Pass*
37	*14:47*	*2.0*	*65*	*-17.9*	*0.1*	*0.1*	*-0.4*	*Pass*	*-0.4*	*Pass*
38	*14:50*	*2.5*	*82*	*-23.2*	*-0.2*	*-0.2*	*1.0*	*Pass*	*0.7*	*Pass*
39	*14:53*	*3.0*	*98*	*-27.4*	*0.1*	*0.1*	*-0.3*	*Pass*	*-0.2*	*Pass*
40	*14:56*	*3.5*	*114*	*-29.7*	*0.3*	*0.2*	*-0.9*	*Pass*	*-0.6*	*Pass*
41	*14:59*	*4.0*	*131*	*-33.9*	*0.3*	*0.3*	*-0.8*	*Pass*	*-0.8*	*Pass*
42	*15:03*	*4.5*	*147*	*-29.4*	*0.3*	*0.1*	*-0.9*	*Pass*	*-0.4*	*Pass*
43	*15:06*	*5.0*	*164*	*-35.7*	*0.0*	*0.0*	*-0.1*	*Pass*	*-0.1*	*Pass*
44	*15:09*	*5.5*	*180*	*-33.9*	*0.2*	*0.2*	*-0.6*	*Pass*	*-0.5*	*Pass*
45	*15:12*	*6.0*	*196*	*-36.8*	*0.2*	*0.2*	*-0.4*	*Pass*	*-0.5*	*Pass*
46	*15:15*	*6.5*	*213*	*-38.1*	*0.3*	*0.3*	*-0.8*	*Pass*	*-0.9*	*Pass*
47	*15:18*	*7.0*	*229*	*-38.4*	*0.4*	*0.2*	*-1.0*	*Pass*	*-0.5*	*Pass*
48	*15:21*	*7.5*	*245*	*-41.7*	*0.2*	*0.2*	*-0.4*	*Pass*	*-0.5*	*Pass*
49	*15:24*	*8.0*	*262*	*-43.0*	*0.1*	*0.0*	*-0.3*	*Pass*	*0.1*	*Pass*
50	*15:28*	*-*	*270*	*-44.1*	*0.2*	*0.1*	*-0.5*	*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	[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.

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
28	*Counter Clockwise*	*5.0*	*164*	*-2.7*	*PASS*
29	*Counter Clockwise*	*5.5*	*180*	*-2.8*	*PASS*
30	*Counter Clockwise*	*6.0*	*196*	*-2.9*	*PASS*
31	*Counter Clockwise*	*6.5*	*213*	*-2.9*	*PASS*
32	*Counter Clockwise*	*7.0*	*229*	*-2.8*	*PASS*
33	*Counter Clockwise*	*7.5*	*245*	*-2.9*	*PASS*
34	*Counter Clockwise*	*8.0*	*262*	*-2.9*	*PASS*
35	*Counter Clockwise*	*-*	*270*	*-2.9*	*PASS*
43	*Clockwise*	*5.0*	*164*	*2.6*	*PASS*
44	*Clockwise*	*5.5*	*180*	*2.6*	*PASS*
45	*Clockwise*	*6.0*	*196*	*2.6*	*PASS*
46	*Clockwise*	*6.5*	*213*	*2.6*	*PASS*
47	*Clockwise*	*7.0*	*229*	*2.7*	*PASS*
48	*Clockwise*	*7.5*	*245*	*2.8*	*PASS*
49	*Clockwise*	*8.0*	*262*	*2.8*	*PASS*
50	*Clockwise*	*-*	*270*	*2.8*	*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: *Brian Kebschull* DATE RECORDED: *6/1/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED: *6/3/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No. *CA0111* Data Sheet Completion Date: *6/1/2010*

TEST 1

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Disconnected EBCM (electronic brake control module).

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 as specified in section 13.12.B.

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 specified in section 13.12.B

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: *After malfunction was caused, the vehicle could not be started. However, when the key was placed in the accessory position, the ESC malfunction telltale remained on. After the system was restored, the vehicle was able to be started, and the telltale extinguished without any driving required.*

RECORDED BY: *Brian Kebschull* DATE RECORDED: *6/1/2010*

APPROVED BY: *J Lenkeit* DATE APPROVED *6/8/2010*

3.0 TEST DATA (CONTD)

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

Vehicle: *2010 GMC Acadia MPV*

NHTSA No*. CA0111* Data Sheet Completion Date: *6/1/2010*

TEST 2

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Disconnected RF wheel speed sensor.

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 as specified in section 13.12.B.

[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 specified in section 13.12.B

[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 upon ignition, after the malfunction was caused. Also, in common area, various warning messages appeared, including, "Traction Control Off", "Service StabiliTrak", and "Service Traction Control". Telltale extinguished immediately upon ignition, after the system was restored. No driving was required.*

RECORDED BY: *Brian Kebschull* DATE RECORDED: 6/1/2010

APPROVED BY: *J Lenkeit* DATE APPROVED *6/8/2010*

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: DRI Date:2/25/10 Due: 2/25/11
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: American Scale Date: 2/25/10 Due: 2/25/11
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: DRI Date: 2/25/10 Due: 2/25/11
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: DRI Date:3/2/10 Due:3/2/11
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:2/26/10 Due: 2/26/11
						DOT-NHTSA D3272	By: DRI Date:2/26/10 Due: 2/26/11

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: DRI Date:2/9/10 Due: 2/9/11
					SoMat High level Board EHLS	MSHLS.03-3182	By: DRI Date: 2/9/10 Due: 2/9/11
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	Verified by DRI prior to test
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.	NA	NA	NA	DRI manufactured Aluminum meeting the weight and MOI specifications of Docket 2007-27662-11	NA	NA

5.0 PHOTOGRAPHS (1 of 14)

Figure 5.1. Front View of Test Vehicle

5.0 PHOTOGRAPHS (2 of 14)

Figure 5.2. Rear View of Test Vehicle

5.0 PHOTOGRAPHS (3 of 14)

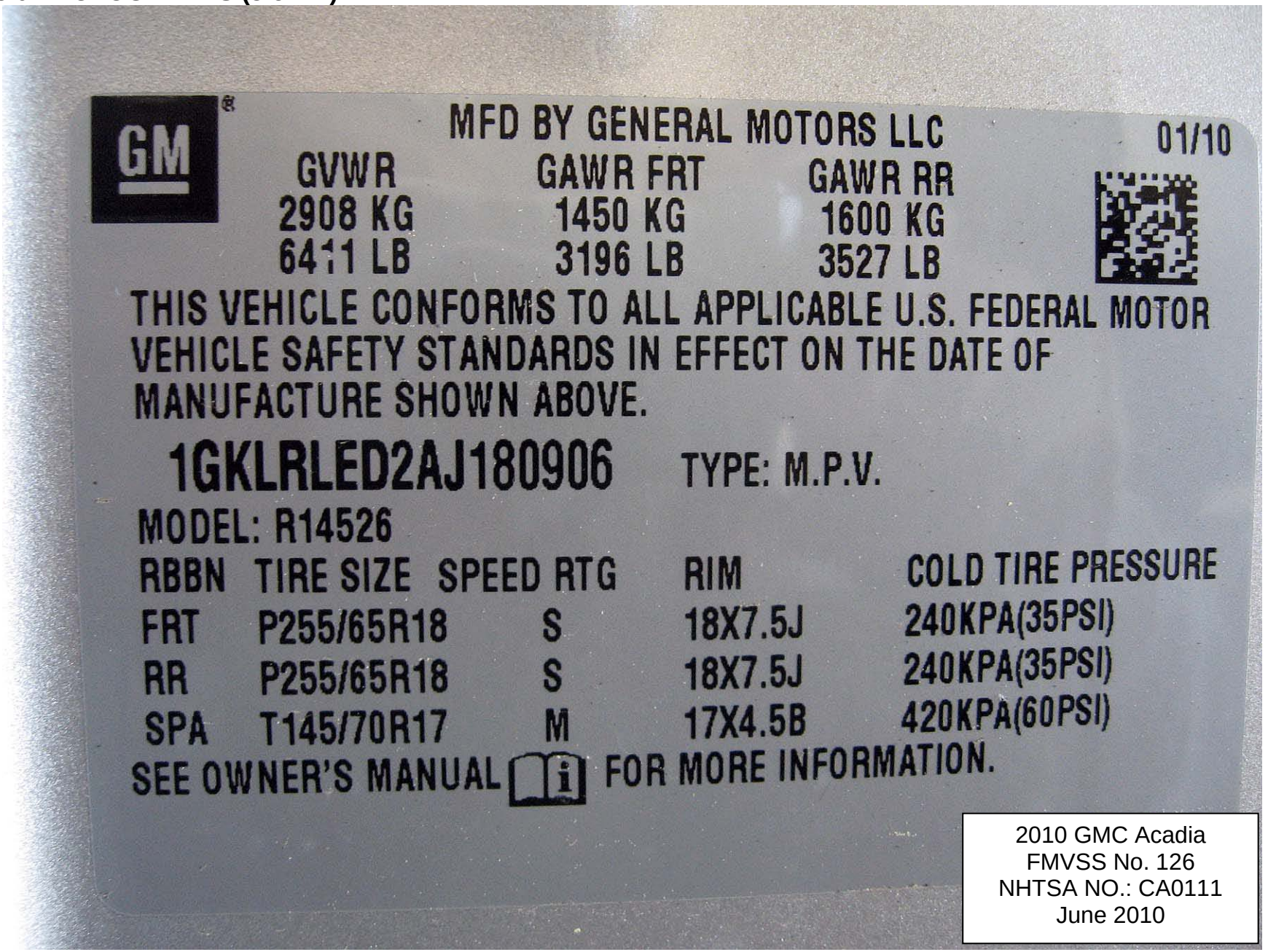


Figure 5.3. Vehicle Certification Label

5.0 PHOTOGRAPHS (4 of 14)

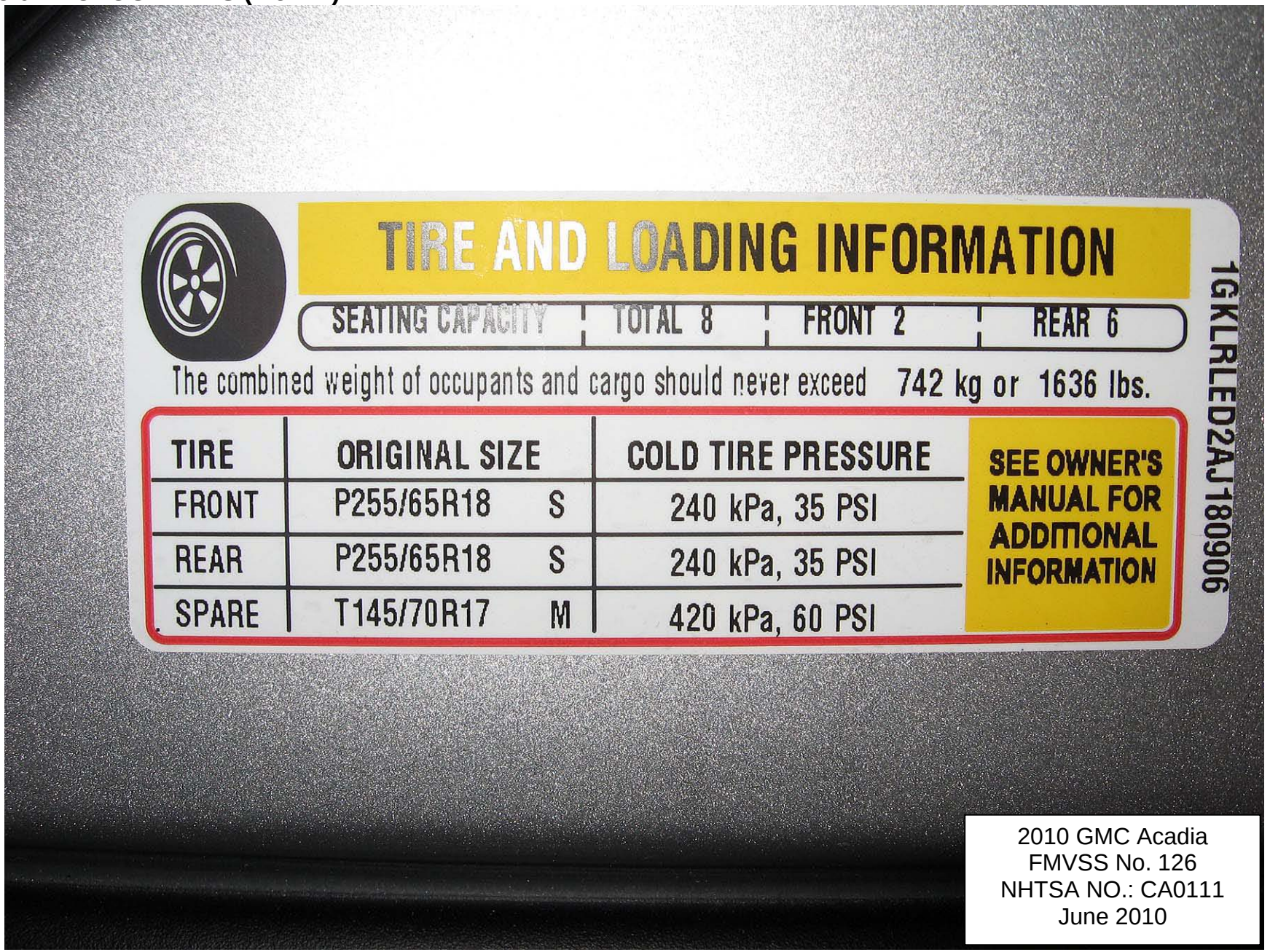


Figure 5.4. Vehicle Placard

5.0 PHOTOGRAPHS (5 of 14)

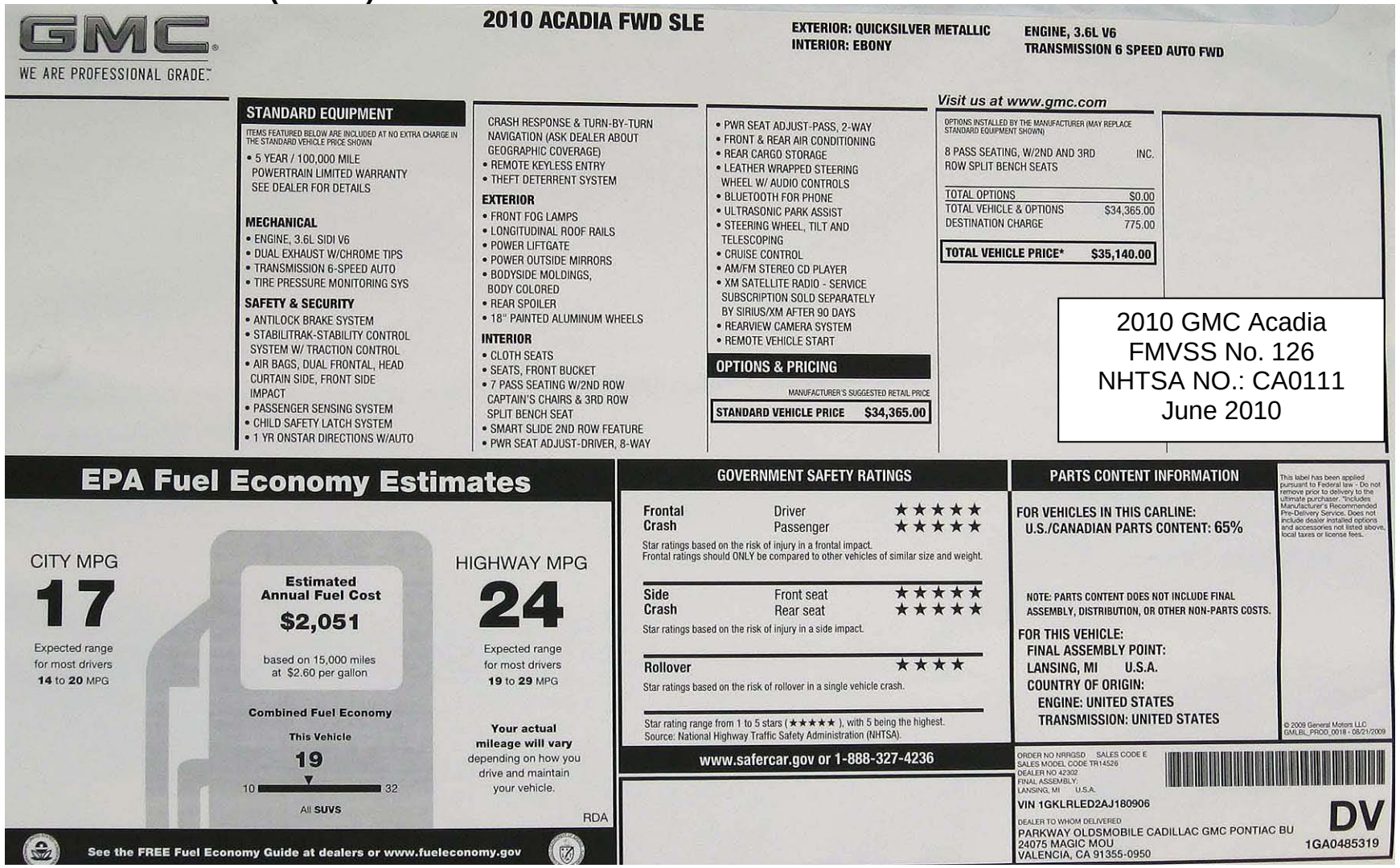


Figure 5.5. Window Sticker (Monroney Label)

5.0 PHOTOGRAPHS (6 of 14)

Figure 5.6. Telltale for ESC Malfunction

5.0 PHOTOGRAPHS (7 of 14)

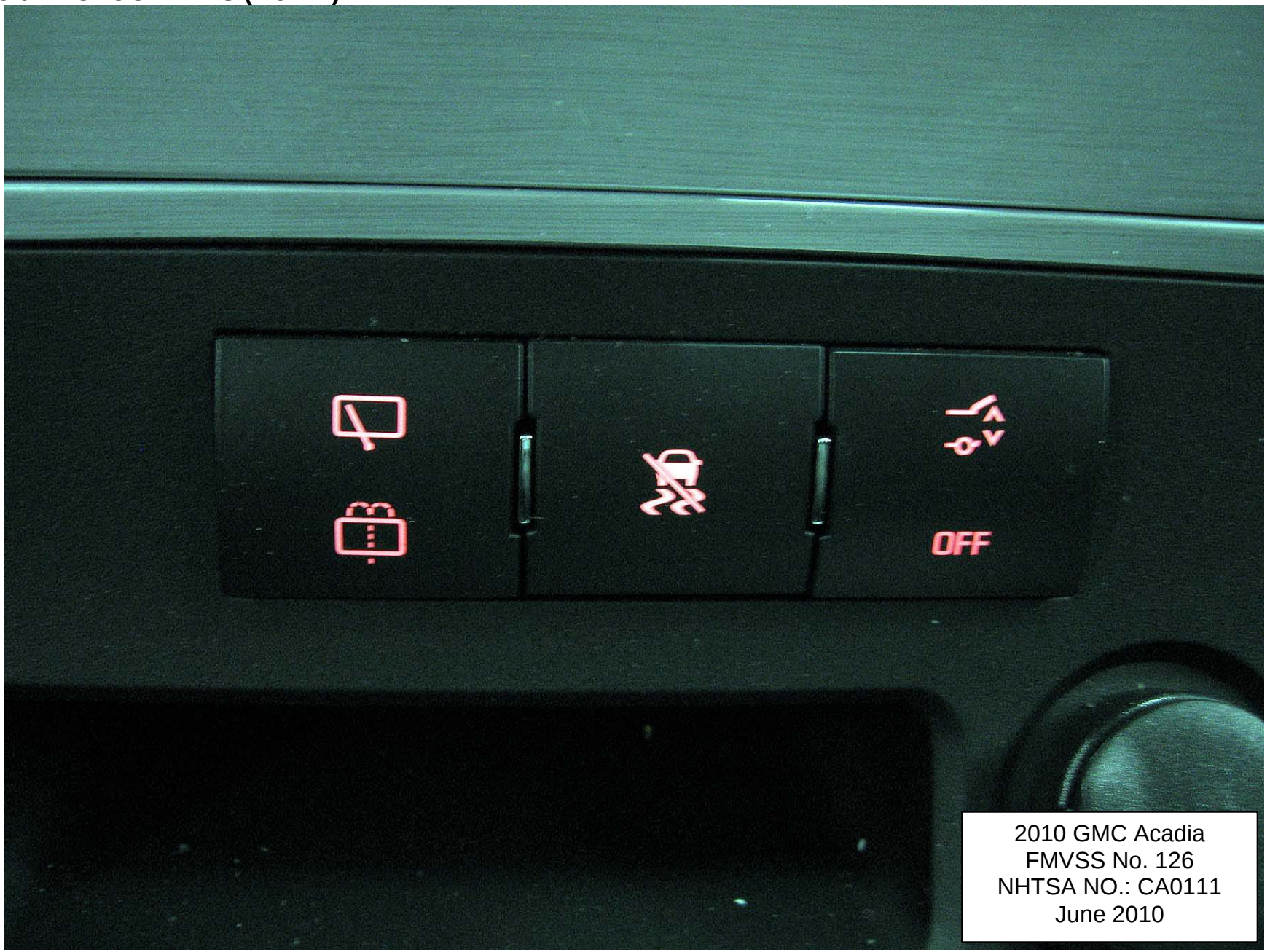


Figure 5.7. TCS Off Control Switch

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

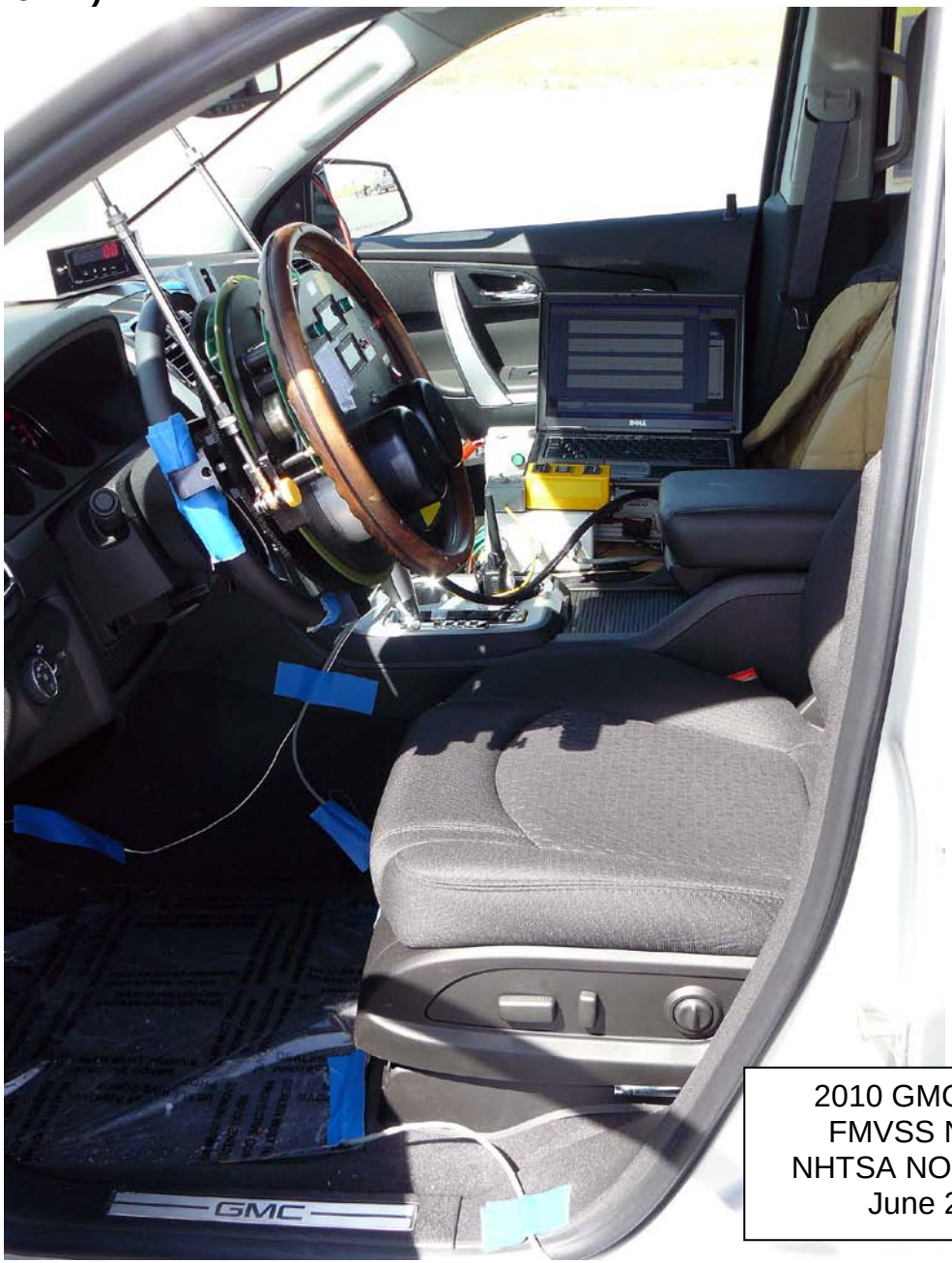
5.0 PHOTOGRAPHS (10 of 14)

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 Outrigger, Mount and Speed Sensor

5.0 PHOTOGRAPHS (12 of 14)



2010 GMC Acadia
FMVSS No. 126
NHTSA NO.: CA0111
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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)

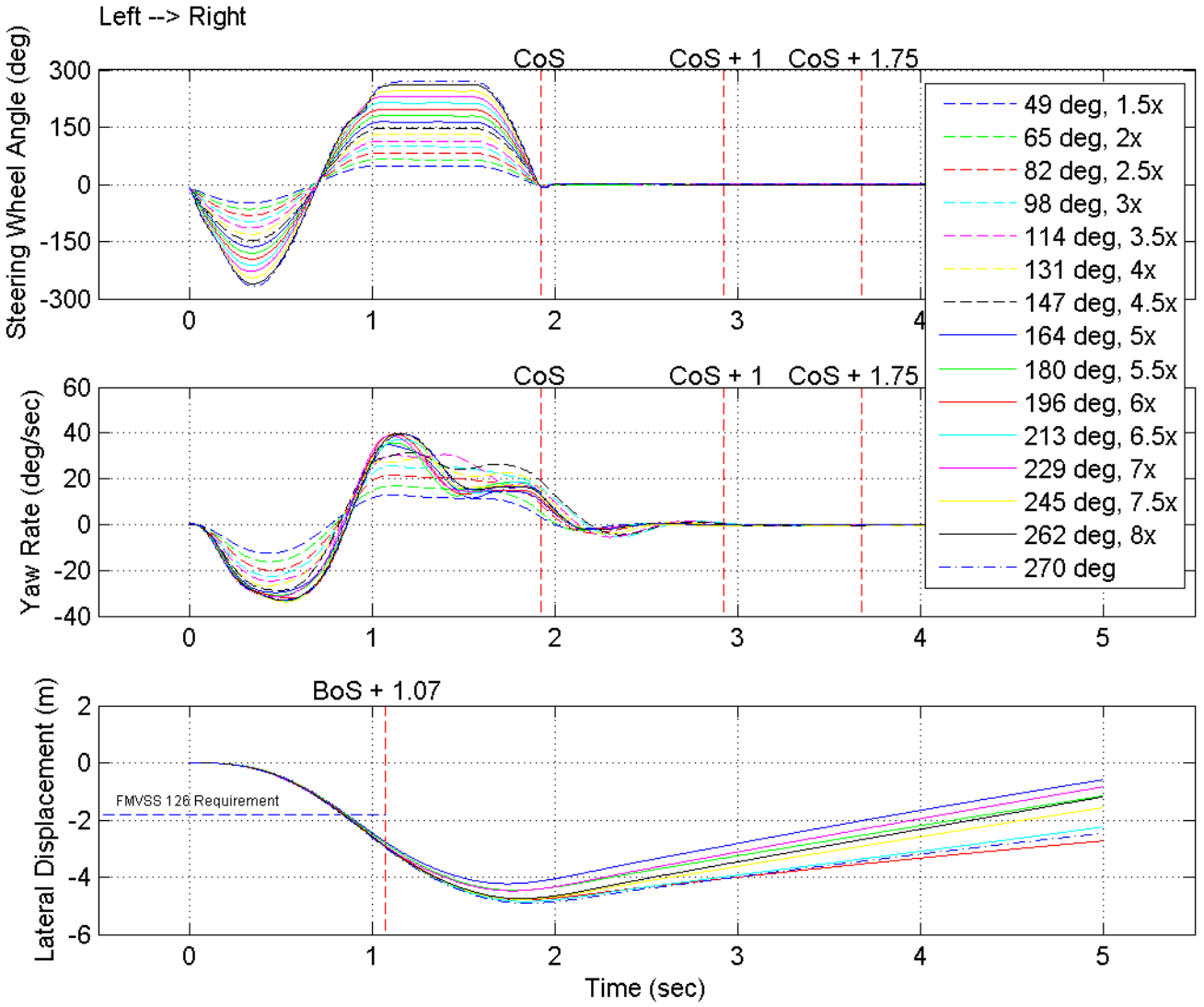

Figure 6.1. Steering Wheel Angle, Yaw Rate and Lateral Displacement for L-R Series

6.0 DATA PLOTS (2 of 4)

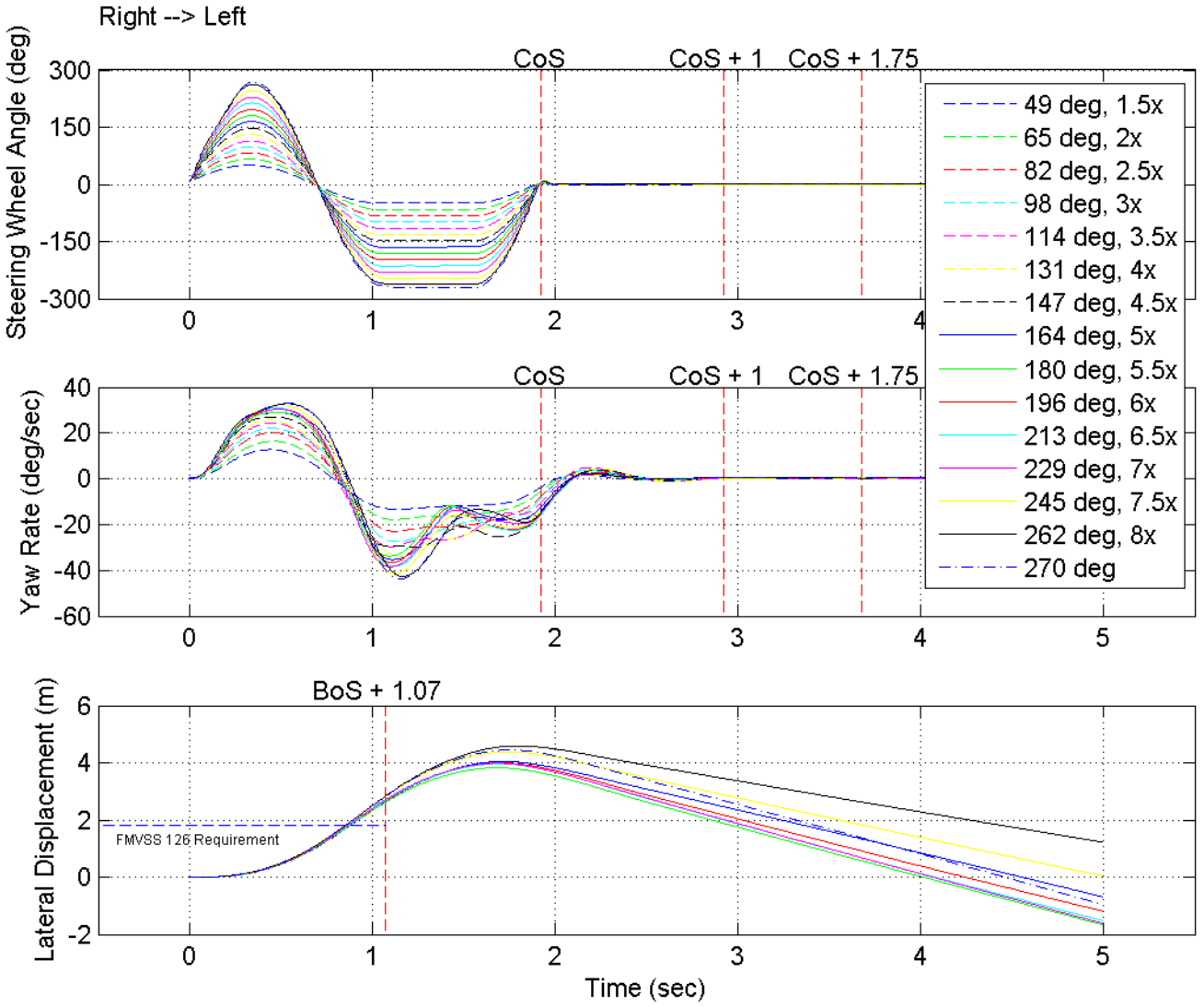

Figure 6.2. Steering Wheel Angle, Yaw Rate and Lateral Displacement for R-L Series

6.0 DATA PLOTS (3 of 4)

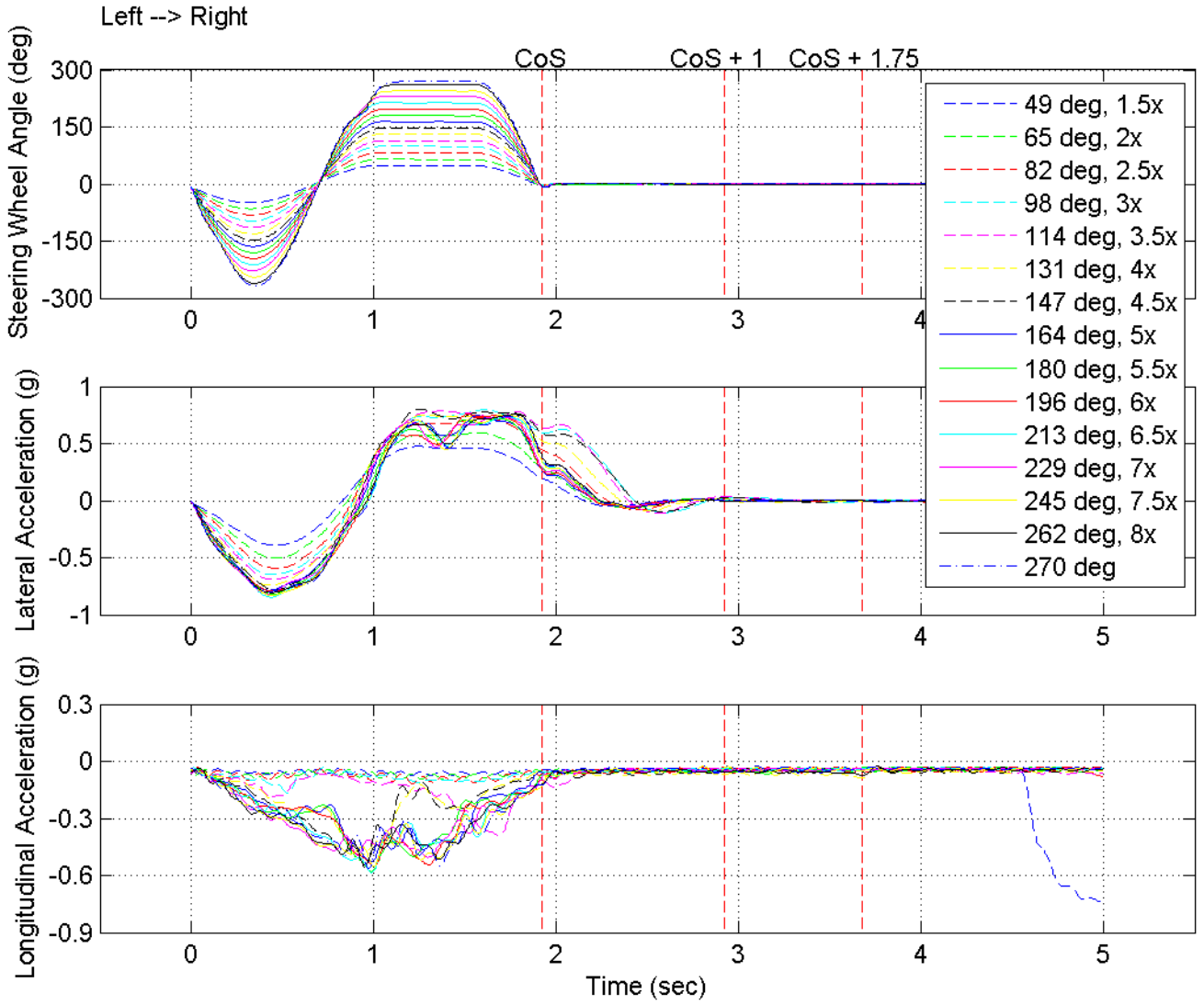

Figure 6.3. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for L-R Series

6.0 DATA PLOTS (4 of 4)

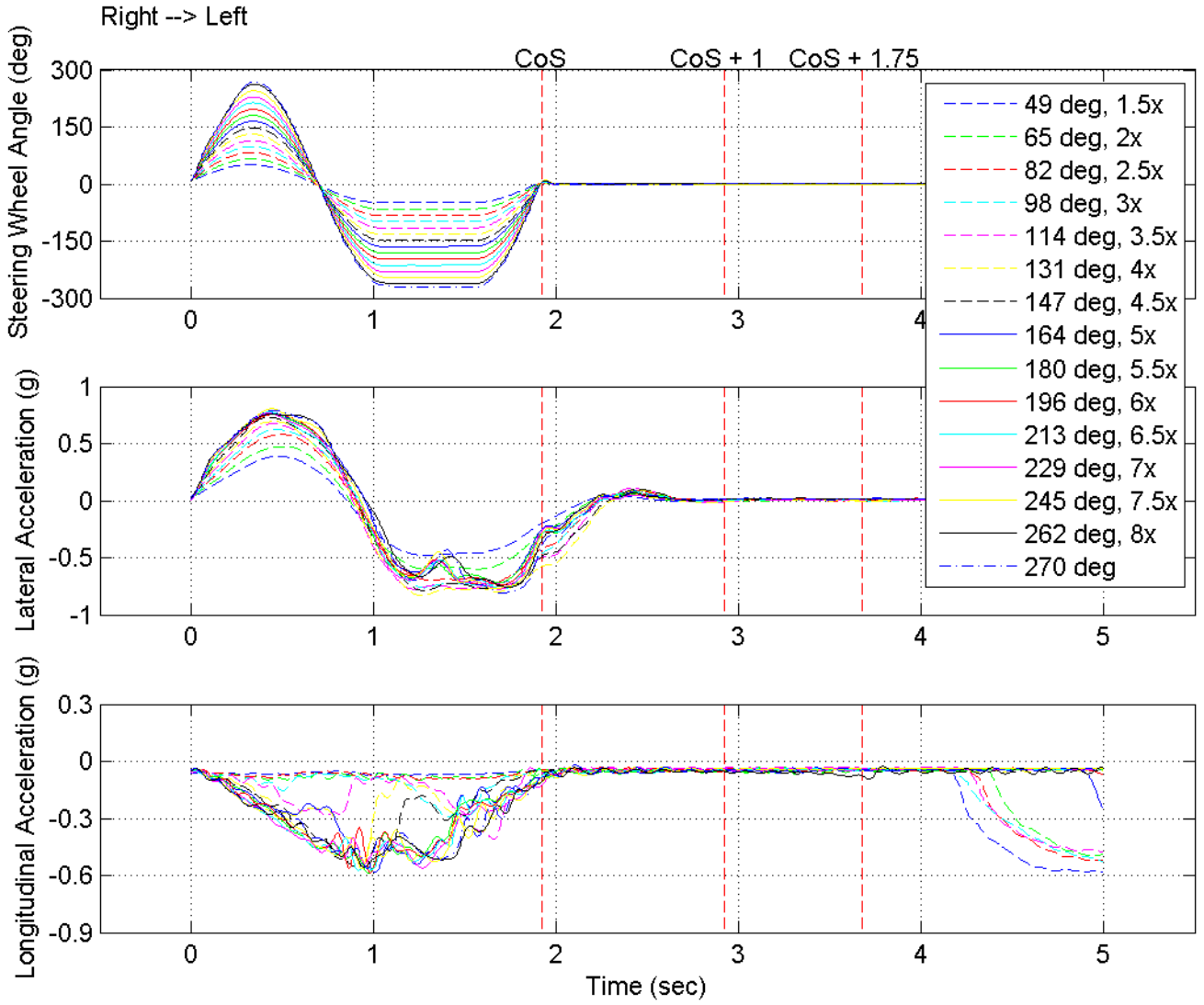

Figure 6.4. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for R-L Series

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

Performance and Maintenance

StabiliTrak®

The traction control system limits wheel spin and the StabiliTrak system assists with directional control of the vehicle in difficult driving conditions. Both systems turn on automatically every time the vehicle is started.

- To turn off the traction control part of StabiliTrak, press and release located on the instrument panel below the climate controls. illuminates and the appropriate DIC message is displayed. See *Vehicle Messages on page 5-36*.
- The StabiliTrak system remains on.

For more information, see *StabiliTrak System on page 9-30*.

Tire Pressure Monitor

This vehicle may have a Tire Pressure Monitor System (TPMS).

The Tire Pressure Monitor System alerts you when a significant reduction in pressure occurs in one or more of your vehicle's tires by illuminating the low tire pressure warning light on the instrument cluster. If the warning light comes on, stop as soon as possible and inflate the tires to the recommended pressure shown on the tire loading information label located on the driver side center pillar (B pillar). See *Vehicle Load Limits on page 9-12*. The warning light will remain on until the tire pressure is corrected.

You may notice during cooler conditions that the low tire pressure warning light will appear when the vehicle is first started and then turn off as you drive. This may be an early indicator that your tire pressures are getting low and the tires need to be inflated to the proper pressure.

Note: The Tire Pressure Monitor System can alert you about low tire pressure, but it does not replace normal monthly tire maintenance. It is the driver's responsibility to maintain correct tire pressures.

See *Tire Pressure Monitor System on page 10-44* and *Tire Pressure Monitor Operation on page 10-46*.

Tire Sealant and Compressor Kit

This vehicle may come with a jack and spare tire or a tire sealant and compressor kit. The kit can be used to seal small punctures in the tread area of the tire.

7.1 OWNER'S MANUAL PAGES

StabiliTrak® Indicator Light

This light comes on briefly while starting the engine. If it does not, have the vehicle serviced by your dealer/retailer. If the system is working normally the indicator light goes off.

If it stays on, or comes on while driving, there could be a problem with the StabiliTrak system and the vehicle might need service. When this warning light is on, the system is off and will not limit wheel spin.

This light flashes when the StabiliTrak system is active.

See *StabiliTrak System on page 9-30* for more information.

Engine Coolant Temperature Warning Light

The engine coolant temperature warning light comes on briefly when the engine is started.

If it does not, have the vehicle serviced by your dealer/retailer. If the system is working normally the indicator light then goes off.

If the light comes on and stays on while driving, the vehicle may have a problem with the cooling system.

Stop the vehicle and turn off the engine to avoid damage to the engine. A warning chime sounds when this light is on.

See *Engine Overheating on page 10-18* for more information.

Tire Pressure Light

For vehicles with a tire pressure monitoring system, this light comes on briefly when the engine is started. It provides information about tire pressures and the Tire Pressure Monitoring System.

7.1 OWNER'S MANUAL PAGES

HUD Display on the Vehicle Windshield

The HUD information appears as an image focused out toward the front of the vehicle.

When the ignition key is turned to ON/RUN, the HUD will display an introductory message for a short time, until the HUD is ready.

The following indicator lights come on the instrument panel when activated and also appear on the HUD:

- Turn Signal Indicators
- High-Beam Indicator Symbol

The HUD temporarily displays CHECK GAGES and ICE POSSIBLE when these messages are on the DIC trip computer.

The HUD also displays the following messages on vehicles with these systems, when they are active:

- TRACTION CONTROL ACTIVE
- STABILITRAK ACTIVE

Notice: **If you try to use the HUD image as a parking aid, you may misjudge the distance and damage your vehicle. Do not use the HUD image as a parking aid.**

When the HUD is on, the speedometer reading is continually displayed. The current radio station or CD track number will display for a short period of time after the radio or CD track status changes. This happens whenever radio information is changed. The speedometer size is reduced when radio, CD information, warnings, or turn-by-turn navigation information are displayed on the HUD.

The HUD control is located to the right of the steering wheel.

Press the set/reset button or the trip odometer reset stem to acknowledge this message and clear it from the DIC display. For more information see *Ultrasonic Parking Assist on page 9-35*.

SERVICE PARK ASSIST

If your vehicle has the Ultrasonic Rear Parking Assist (URPA) system, this message displays if there is a problem with the URPA system. Do not use this system to help you park. See *Ultrasonic Parking Assist on page 9-35* for more information. See your dealer/retailer for service.

Ride Control System Messages

SERVICE STABILITRAK

This message displays if there is a problem with the StabiliTrak® system. If this message appears, try to reset the system. Stop; turn off the engine for at least 15 seconds; then start the engine again. If this message still comes on, it means there is a problem. See your dealer/retailer for service. The vehicle is safe to drive, however, you do not have the benefit of StabiliTrak, so reduce your speed and drive accordingly.

SERVICE TRACTION CONTROL

This message displays when there is a problem with the Traction Control System (TCS). When this message is displayed, the system will not limit wheel spin. Adjust your driving accordingly. See your dealer/retailer for service. See *StabiliTrak System on page 9-30* for more information.

TRACTION CONTROL OFF

This message displays when the Traction Control System (TCS) is turned off. Adjust your driving accordingly. See *StabiliTrak System on page 9-30* for more information. This message clears itself after 10 seconds.

Airbag System Messages

SERVICE AIR BAG

This message displays if there is a problem with the airbag system. Have your dealer/retailer inspect the system for problems. See *Airbag Readiness Light on page 5-15* and *Airbag System on page 3-32* for more information.

Anti-Theft Alarm System Messages

SERVICE THEFT DETERRENT SYSTEM

This message displays when there is a problem with the theft-deterrent system. The vehicle may or may not restart so you may want to take the vehicle to your dealer/retailer before turning off the engine. See *Immobilizer Operation on page 2-14* for more information.

Medical research shows that alcohol in a person's system can make crash injuries worse, especially injuries to the brain, spinal cord, or heart. This means that when anyone who has been drinking — driver or passenger — is in a crash, that person's chance of being killed or permanently disabled is higher than if the person had not been drinking.

Control of a Vehicle

The following three systems help to control the vehicle while driving — brakes, steering, and accelerator. At times, as when driving on snow or ice, it is easy to ask more of those control systems than the tires and road can provide. Meaning, you can lose control of the vehicle. See *StabiliTrak System on page 9-30*.

Adding non-dealer/non-retailer accessories can affect vehicle performance. See *Accessories and Modifications on page 10-3*.

Braking

See *Brake System Warning Light on page 5-19*.

Braking action involves perception time and reaction time. Deciding to push the brake pedal is perception time. Actually doing it is reaction time.

Average reaction time is about three-fourths of a second. But that is only an average. It might be less with one driver and as long as two or three seconds or more with another. Age, physical condition, alertness, coordination, and eyesight all play a part. So do alcohol, drugs, and frustration. But even in three-fourths of a second, a vehicle moving at 100 km/h (60 mph) travels 20 m (66 ft). That could be a lot of distance in an emergency, so keeping enough space between the vehicle and others is important.

And, of course, actual stopping distances vary greatly with the surface of the road, whether it is pavement or gravel; the condition of the road, whether it is wet, dry, or icy; tire tread; the condition of the brakes; the weight of the vehicle; and the amount of brake force applied.

Avoid needless heavy braking. Some people drive in spurts — heavy acceleration followed by heavy braking — rather than keeping pace with traffic. This is a mistake. The brakes might not have time to cool between hard stops. The brakes will wear out much faster with a lot of heavy braking. Keeping pace with the traffic and allowing realistic following distances eliminates a lot of unnecessary braking. That means better braking and longer brake life.

7.1 OWNER'S MANUAL PAGES

Brake Assist

This vehicle has a brake assist feature designed to assist the driver in stopping or decreasing vehicle speed in emergency driving conditions. This feature uses the stability system hydraulic brake control module to supplement the power brake system under conditions where the driver has quickly and forcefully applied the brake pedal in an attempt to quickly stop or slow down the vehicle. The stability system hydraulic brake control module increases brake pressure at each corner of the vehicle until the ABS activates. Minor brake pedal pulsations or pedal movement during this time is normal and the driver should continue to apply the brake pedal as the driving situation dictates. The brake assist feature will automatically disengage when the brake pedal is released or brake pedal pressure is quickly decreased.

Ride Control Systems

StabiliTrak System

The vehicle has the StabiliTrak system which combines antilock brake, traction and stability control systems and helps the driver maintain directional control of the vehicle in most driving conditions.

When you first start the vehicle and begin to drive away, the system performs several diagnostic checks to ensure there are no problems. The system may be heard or felt while it is working. This is normal and does not mean there is a problem with the vehicle. The system should initialize before the vehicle reaches 32 km/h (20 mph). In some cases, it may take approximately 3.2 km (2 miles) of driving before the system initializes.

If the system fails to turn on or activate, the StabiliTrak light along with one of the following messages will be displayed on the Driver Information Center (DIC): TRACTION CONTROL OFF, SERVICE TRACTION CONTROL, SERVICE STABILITRAK. If these conditions are observed, turn the vehicle off, wait 15 seconds, and then turn it back on again to reset the system. If any of these messages still appear on the Driver Information Center (DIC), the vehicle should be taken in for service. For more information on the DIC messages, see *Driver Information Center (DIC) (With DIC Buttons) on page 5-24* or *Driver Information Center (DIC) (Without DIC Buttons) on page 5-29*.

The StabiliTrak light will flash on the instrument panel cluster when the system is both on and activated.

The system may be heard or felt while it is working; this is normal.

The traction control disable button is located on the instrument panel below the climate controls.

The traction control part of StabiliTrak can be turned off by pressing and releasing the traction control disable button.

Traction control can be turned on by pressing and releasing the traction control disable button if not automatically shut off for any other reason.

When the traction control system is turned off, the StabiliTrak light and the appropriate traction control off message will be displayed on the DIC to warn the driver. The vehicle will still have brake-traction control when traction control is off, but will not be able to use the engine speed management system. See "Traction Control Operation" next for more information.

When the traction control system has been turned off, system noises may be heard and felt as a result of the brake-traction control working.

It is recommended to leave the system on for normal driving conditions, but it may be necessary to turn the system off if the vehicle is stuck in sand, mud, ice or snow, and you want to "rock" the vehicle to attempt to free it. It may also be necessary to turn off the system when driving in extreme off-road conditions where high wheel spin is required. See *If the Vehicle is Stuck on page 9-11*.

Traction Control Operation

The traction control system is part of the StabiliTrak system. Traction control limits wheel spin by reducing engine power to the wheels (engine speed management) and by applying brakes to each individual wheel (brake-traction control) as necessary.

The traction control system is enabled automatically when the vehicle is started. It will activate and the StabiliTrak light will flash if it senses that any of the wheels are spinning or beginning to lose traction while driving.

If traction control is turned off, only the brake-traction control portion of traction control will work. The engine speed management will be disabled. In this mode, engine power is not reduced automatically and the driven wheels can spin more freely. This can cause the brake-traction control to activate constantly.

Notice: **If the wheel(s) of one axle is allowed to spin excessively while the StabiliTrak, ABS and brake warning lights and any relevant DIC messages are displayed, the transfer case could be damaged. The repairs would not be covered by the vehicle warranty. Reduce engine power and do not spin the wheel(s) excessively while these lights and messages are displayed.**

The traction control system may activate on dry or rough roads or under conditions such as heavy acceleration while turning or abrupt upshifts/downshifts of the transmission. When this happens, a reduction in acceleration may be noticed, or a noise or vibration may be heard. This is normal.

If cruise control is being used when the system activates, the StabiliTrak light will flash and cruise control will automatically disengage. Cruise control may be reengaged when road conditions allow. See *Cruise Control on page 9-32*.

StabiliTrak may also turn off automatically if it determines that a problem exists with the system. If the problem does not clear itself after restarting the vehicle, see your dealer/retailer for service.

Cruise Control

With cruise control, a speed of about 40 km/h (25 mph) or more can be maintained without keeping your foot on the accelerator. Cruise control does not work at speeds below about 40 km/h (25 mph).

When the brakes are applied, the cruise control is disengaged.

⚠ WARNING

Cruise control can be dangerous where you cannot drive safely at a steady speed. So, do not use the cruise control on winding roads or in heavy traffic.

Cruise control can be dangerous on slippery roads. On such roads, fast changes in tire traction can cause excessive wheel slip, and you could lose control. Do not use cruise control on slippery roads.

7.2 VEHICLE ARRIVAL CONDITION REPORT

CONTRACT NO.: DTNH22-08-D-00098
DATE: *5/5/2010*

From: *Automotive Allies*

To: Dynamic Research, Inc

Purpose ☒ Initial Receipt
☐ Received via Transfer
☐ Present Vehicle Condition

Vehicle VIN: *1GKLRLED2AJ180906* NHTSA NO.: *CA0111*
Model Year: *2010* Odometer Reading: *27* Miles
Make *GMC* Body Style: *MPV*
Model: *Acadia* Body Color: *Silver*
Manufacture Date: *01/10* Dealer: *Automotive Allies*
GVWR (kg/lb) *2908/6411* 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: *5/5/2010*

APPROVED BY: *B Broen* DATE APPROVED: *5/6/2010*

7.3 VEHICLE COMPLETION CONDITION REPORT

CONTRACT NO.: *DTNH22-08-D-00098*
DATE: *6/8/2010*

Vehicle VIN: *1GKLRLED2AJ180906* NHTSA NO.: *CA0111*
Model Year: *2010* Odometer Reading: *81* Miles
Make: *GMC* Body Style: *MPV*
Model: *Acadia* Body Color: *Silver*
Manufacture Date: *01/10* Dealer: *Automotive Allies*
GVWR (kg/lb) *2908 (6411)* 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:

Explanation for equipment removal:

Test Vehicle Condition: *As delivered except that steering wheel has slight damage, to be repaired at DRI expense*

RECORDED BY: *J Lenkeit* DATE RECORDED: *6/8/2010*

APPROVED BY: *P Broen* DATE APPROVED: *6/9/2010*

7.4 SINE WITH DWELL TEST RESULTS

2010 GMC Acadia MPV
NHTSA No.: CA0111
Date of Test : 6/1/2010
Date Created: 6/2/2010

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

File	SWA @ 5deg Ct	MES	Time @ 5deg	COS	Time @ COS	MOS	Time @ MOS	YRR1	YR1	YRR1 Ct	YRR1 75	YR175	YRR17 5 Ct	2nd Yaw Peak	2nd Yaw Peak Ct	Lat Disp	Lat. Acc. 1.07s	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)
21	710	50.25	3.54	1090	5.45	847	4.23	-1.92	-0.25	1290	-1.52	-0.20	1440	12.88	933	-3.96	0.37	49.17	775	48.90
22	709	50.08	3.54	1090	5.45	847	4.23	-0.86	-0.15	1290	-0.82	-0.14	1440	16.95	934	-5.00	0.44	65.13	775	64.84
23	708	50.43	3.53	1090	5.44	846	4.23	-0.99	-0.21	1290	-1.84	-0.40	1440	21.49	930	-6.27	0.48	82.07	775	81.85
24	707	50.30	3.53	1090	5.44	847	4.23	3.27	0.84	1290	-0.46	-0.12	1440	25.55	929	-7.06	0.52	98.14	775	97.82
25	707	50.43	3.53	1090	5.44	846	4.23	1.17	0.35	1290	-0.17	-0.05	1440	30.10	933	-7.77	0.53	114.11	775	113.65
26	707	50.29	3.53	1090	5.44	846	4.23	-0.54	-0.15	1290	-1.02	-0.28	1440	27.66	918	-8.14	0.51	131.15	775	130.79
27	706	50.23	3.53	1090	5.44	847	4.23	1.01	0.32	1290	-0.78	-0.25	1440	31.52	947	-8.64	0.53	147.26	775	146.72
28	706	50.18	3.52	1090	5.44	846	4.23	-1.10	-0.38	1290	-1.15	-0.40	1440	34.80	924	-8.94	0.50	164.25	775	163.70
29	706	50.33	3.52	1090	5.44	847	4.23	-0.80	-0.28	1290	-0.81	-0.29	1440	35.73	931	-9.14	0.46	180.15	775	179.80
30	706	50.35	3.52	1090	5.44	846	4.23	-0.72	-0.28	1290	-0.50	-0.20	1440	39.52	932	-9.38	0.43	196.14	775	195.68
31	706	50.32	3.52	1090	5.44	847	4.23	-0.85	-0.31	1290	-0.51	-0.19	1440	37.13	938	-9.55	0.39	212.92	775	212.68
32	706	50.25	3.52	1090	5.44	847	4.23	-1.01	-0.39	1290	-0.76	-0.29	1440	38.69	928	-9.33	0.50	228.99	775	228.62
33	706	50.22	3.52	1090	5.44	847	4.23	-1.14	-0.45	1290	-0.52	-0.21	1440	39.66	939	-9.56	0.43	244.67	776	244.91
34	706	50.21	3.52	1090	5.44	847	4.23	-0.53	-0.21	1290	-0.70	-0.28	1440	39.79	937	-9.49	0.39	261.23	776	261.72
35	706	50.35	3.52	1090	5.44	847	4.23	-0.88	-0.35	1290	-0.91	-0.36	1440	39.25	941	-9.61	0.39	268.49	777	269.76

7.4 SINE WITH DWELL TEST RESULTS

2010 GMC Acadia MPV
NHTSA No.: CA0111
Date of Test : 6/1/2010
Date Created: 6/2/2010

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

File	SWA @ 5deg Ct	MES	Time @ 5deg	COS	Time @ COS	MOS	Time @ MOS	YRR1	YR1	YRR1 Ct	YRR1 75	YR175	YRR17 5 Ct	2nd Yaw Peak	2nd Yaw Peak Ct	Lat Disp	Lat. Acc. 1.07s	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)
36	710	50.30	3.54	1090	5.45	847	4.23	-0.39	0.05	1290	-0.17	0.02	1440	-13.46	939	3.92	-0.36	49.91	775	49.58
37	708	50.16	3.54	1090	5.44	847	4.23	-0.44	0.08	1290	-0.38	0.07	1440	-17.94	933	4.95	-0.42	65.86	775	65.56
38	708	50.12	3.53	1090	5.44	847	4.23	0.96	-0.22	1290	0.67	-0.16	1440	-23.24	934	5.95	-0.47	82.76	775	82.52
39	707	50.39	3.53	1090	5.44	847	4.23	-0.33	0.09	1290	-0.22	0.06	1440	-27.44	934	6.79	-0.50	98.82	775	98.51
40	707	50.20	3.53	1090	5.44	847	4.23	-0.87	0.26	1290	-0.63	0.19	1440	-29.67	928	7.18	-0.57	114.71	775	114.42
41	706	50.37	3.52	1090	5.44	846	4.23	-0.80	0.27	1290	-0.82	0.28	1440	-33.89	939	7.68	-0.53	131.80	775	131.54
42	706	50.37	3.52	1090	5.44	847	4.23	-0.87	0.26	1290	-0.37	0.11	1440	-29.44	924	8.04	-0.49	147.82	775	147.51
43	706	50.30	3.52	1090	5.45	847	4.23	-0.08	0.03	1290	-0.12	0.04	1440	-35.72	930	8.53	-0.45	164.79	775	164.60
44	706	50.40	3.52	1090	5.44	847	4.23	-0.63	0.21	1290	-0.50	0.17	1440	-33.92	926	8.47	-0.53	180.88	775	180.40
45	706	50.43	3.52	1090	5.44	847	4.23	-0.40	0.15	1290	-0.49	0.18	1440	-36.78	928	8.63	-0.47	196.70	775	196.37
46	706	50.25	3.52	1090	5.44	847	4.23	-0.83	0.32	1290	-0.89	0.34	1440	-38.14	932	8.67	-0.50	213.71	775	213.25
47	706	50.40	3.52	1090	5.44	847	4.23	-0.95	0.36	1290	-0.48	0.18	1440	-38.37	927	8.76	-0.53	229.76	775	229.40
48	706	50.53	3.52	1090	5.44	847	4.23	-0.40	0.17	1290	-0.53	0.22	1440	-41.66	931	9.16	-0.43	245.44	776	245.57
49	706	50.18	3.52	1090	5.45	847	4.23	-0.28	0.12	1290	0.06	-0.03	1440	-43.02	941	9.17	-0.32	261.93	776	262.40
50	706	50.48	3.52	1090	5.45	847	4.23	-0.53	0.23	1290	-0.11	0.05	1440	-44.11	937	9.14	-0.39	268.82	777	270.44

7.5 SLOWLY INCREASING STEER TEST RESULTS

2010 GMC Acadia MPV
NHTSA No.: CA0111
Date of Test: 6/1/2010
Date Created: 6/1/2010

File	EventPt	DOS	MES (mph)	Mean SPD (mph)	AYcount_3	THETAENCF_3 (deg)	AYCG_CD2_3 (g)	r_squared	ZeroBegin	ZeroEnd
10	700	1	49.73	49.70	1206	-33.76	-0.30	1.00	500	700
11	716	1	50.93	50.60	1191	-32.83	-0.30	0.99	516	716
12	656	1	50.04	49.99	1201	-33.31	-0.31	1.00	456	656
13	700	0	50.08	49.92	1178	32.14	0.30	1.00	500	700
14	700	0	49.51	49.95	1180	32.14	0.30	1.00	500	700
15	693	0	49.69	49.83	1173	31.73	0.30	1.00	493	693

Averages

Scalars	Steering Angles (deg)
1.5	49
2.0	65
2.5	82
3.0	98
3.5	114
4.0	131
4.5	147
5.0	164

Scalars	Steering Angles (deg)
5.5	180
6.0	196
6.5	213
7.0	229
7.5	245
8.0	262
	270

7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES

Vehicle: **2010 GMC Acadia MPV** NHTSA No.: CA0111

Wheelbase: 119.1 Inches Faro Arm S/N: U08-05-08-06636

Measurement date: 5/17/2010 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	-1.734	-3.274	0.000
M_Point_48_Ref	0.000	0.000	-
M_CIRCLE001_I_Left_Rear_Wheel_Axle	-37.554	9.672	-14.819
M_Point_IMU_side	6.763	45.788	22.734
M_Point_ROOF	-	-	-69.352
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	6.763	47.313	22.734

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

	Ref X	Ref Y	Ref Z
Motion_PAK_Location in S7D (Matlab program) coordinate system	**74.783**	**-0.687**	**22.734**

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).