126-DRI-11-009
SAFETY COMPLIANCE TESTING FOR FMVSS 126
Electronic Stability Control Systems

General Motors de Mexico, S. De R.L. DE C.V.
2011 GMC Sierra 1500
NHTSA No. CB0108

DYNAMIC RESEARCH, INC.
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1 December 2011

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

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16. Abstract A test was conducted on a 2011 GMC Sierra 1500 4WD Crew Cab, NHTSA No. CB0108, 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. The vehicle was tested in both two wheel drive and four wheel drive (high) modes. Test failures identified were as follows: None			
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1.0 PURPOSE OF COMPLIANCE TEST

The purpose of this test is to determine if the test vehicle, a 2011 GMC Sierra 1500 4WD Crew Cab, meets the minimum equipment and performance requirements stated in Federal Motor Vehicle Safety Standard (FMVSS) 126, "Electronic Stability Control Systems." The vehicle was tested in both 2WD and 4WD (high) drive configurations.

2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS

Testing of the 2011 GMC Sierra 1500 4WD Crew Cab 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).

- For steering inputs of scalar 5 and greater, 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 3,500 kg (7,716 lb) or less) when computed 1.07 seconds after the Beginning of Steer (BOS) at the specified steering wheel angles.

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

The vehicle's ESC System appears to meet the performance and equipment requirements as required by FMVSS 126. The test results are summarized on the following summary sheet.

2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS (CONTD)

Data Summary Sheet (Page 1 of 2)

Vehicle: *2011 GMC Sierra 1500 4WD (2WD and 4WD High Configurations)*

NHTSA No. *CB0108* VIN: *3GTP2VE33BG386727*

Vehicle Type: *Truck* Manufacture Date: *7/11*

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 3,500 kg (7,716 lb) or less, and 1.52 m (5 feet) for vehicles with a GVWR greater than 3,500 Kg (7,716 lb). (S126, S5.2.3)	***PASS***
ESC Malfunction Warning (Data Sheet 9)	
Warning is provided to driver after malfunction occurrence. (S126. S5.3)	***PASS***
Malfunction telltale stayed illuminated as long as malfunction existed and must extinguish after malfunction was corrected. (S126, S5.3.7)	***PASS***

3.0 TEST DATA

Data Sheet 1 (Page 1 of 2)

TEST VEHICLE INSPECTION AND TEST PREPARATION

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab*

NHTSA No. *CB0108* Data Sheet Completion Date: *9/13/2011*

VIN *3GTP2VE33BG386727* Manufacture Date: *7/11*

GVWR (kg): *3175* Front GAWR (kg): *1792* Rear GAWR (kg): *1792*

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

Odometer reading at time of inspection: *5 miles (8 km)*

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front axle: *P275/55R20* Rear axle: *P275/55R20*

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

		Front Axle	Rear Axle
	Tire Manufacturer:	*Goodyear*	*Goodyear*
	Tire Model:	*Eagle LS-2*	*Eagle LS-2*
	Tire Size:	*P275/55R20*	*P275/55R20*
TIN	Left Front:	*M621 BCER 2611*	Right Front: *M62A BCER 2611*
	Left Rear:	*M621 BCER 2611*	Right Rear: *M62A BCER 2611*

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) [ ] Front Wheel Drive [X] Rear Wheel Drive

[ ] All Wheel Drive (AWD)

[X] Four Wheel Drive Automatic - differential no locked full time (4WD Automatic)

[X] Four Wheel Drive (High Gear Locked Differential 4WD HGLD)

[X] 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:	*2WD*
Modes:	*ESC on (Default), ESC off*
Drive Configuration:	*Auto*
Modes:	*ESC on (Default), ESC off*
Drive Configuration:	*4WD High*
Modes:	*ESC on (Default), ESC off*
Drive Configuration:	*4WD Low*
Mode:	*ESC off*

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:	*9/13/2011*
APPROVED BY:	*B Kebschull*	DATE APPROVED:	*9/13/2011*

3.0 TEST DATA (CONTD)

Data Sheet 2 (Page 1 of 3)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab*

NHTSA No *CB0108* Data Sheet Completion Date: *8/31/2011*

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: *Interface to engine management ECU*

ESC OPERATIONAL CHARACTERISTICS

System is capable of generating brake torque at each wheel — [X] Yes (Pass) [ ] No (Fail)

Brief explanation: *To generate brake torque at each wheel, the ESC electronic control unit modulates electrical solenoids that open and close valves within the hydraulic control unit, which in turn controls brake fluid pressure to the foundation brake calipers located at the four wheels of the vehicle.*

System is capable of determining yaw rate — [X] Yes (Pass) [ ] No (Fail)

Brief explanation: *The component used to determine yaw rate is the yaw/lateral acceleration combination sensor, which is located under the passenger seat on the GMC Sierra. The yaw rate sensor is a gyroscopic device that measures the vehicle's angular velocity around its vertical axis. The signal from the yaw rate sensor is transmitted to the ESC electronic control unit for processing by the ESC control algorithm*

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. The signal from the steering wheel angle sensor is transmitted to the ESC electronic control unit for processing by the ESC control algorithm.*

3.0 TEST DATA (CONTD)

Data Sheet 2 (Page 2 of 3)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

ESC OPERATIONAL CHARACTERISTICS (continued)

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 passenger seat), lateral acceleration (from the combination yaw/lateral acceleration sensor mounted underneath the front passenger seat), and steering wheel angle (from the steering wheel angle sensor mounted on the steering column).*

System is capable of modifying engine torque during ESC activation. — **X** Yes (Pass) / ___ No (Fail)

Method used to modify torque: *During certain vehicle understeer conditions vehicle speed may be reduced by reducing engine torque. In order to reduce engine torque, the ESC electronic control unit sends a signal to the powertrain control module requesting an appropriate percent reduction in engine torque. The powertrain control module provides the requested engine torque reduction using its own control algorithm with actuation that utilizes combinations of spark and throttle.*

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

3.0 TEST DATA (CONTD)

Data Sheet 2 (Page 3 of 3)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

ESC OPERATIONAL CHARACTERISTICS (continued)

Driving phases during which ESC is capable of activation:
Once the system initializes after key-on, 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.
Note that when the driver selects 4-wheel drive low, the ESC system is automatically turned off, the ESC off telltale is illuminated, and 'STABILITRAK OFF' is displayed in the DIC.

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: *8/31/2011*
APPROVED BY: *P Broen* DATE APPROVED: *8/31/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab*

NHTSA No. *CB0108* Data Sheet completion date: *9/13/2011*

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? *Yes*

Telltale Location: *Left side of instrument cluster in the tachometer display*

Telltale Color: *Yellow*

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.

The ESC symbol above is enclosed in a triangle. The ESC symbol with triangle is illuminated and the message "SERVICE STABILITRAK" is displayed in the Driver Information Center (DIC) common display area located in the lower part of the tachometer. (see Figure 5.13)

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:

The "STABILITRAK" symbol (sliding car with triangle) flashes when ESC is activated

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? *Yes but the combined telltale is not a two part telltale utilizing the word "OFF" as shown in the symbol below.*

Telltale Location: *Left side of instrument cluster in the tachometer display*

Telltale Color: *Yellow*

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. *To identify an ESC off condition the ESC malfunction telltale is illuminated and the message "STABILITRAK OFF" is displayed in the Driver Information Center (DIC) common display area located in the lower part of the tachometer. (see Figure 5.13)*

Is telltale part of a common space? *No*

DATA INDICATES COMPLIANCE ***Yes***

(Vehicle is compliant if equipped with a malfunction telltale)

Remarks:

The same sliding car symbol with triangle is used for ESC malfunction and ESC off. When the system is off the ESC malfunction illuminates and the message "Stabilitrak off" is displayed in the common space

RECORDED BY:	*P Broen*	DATE RECORDED:	*9/13/2011*
APPROVED BY:	*B Kebschull*	DATE APPROVED:	*9/13/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab*

NHTSA No. *CB0108* Data Sheet completion date: *9/13/2011*

"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)

Identify each control location, labeling and selectable modes.

First Control:

Location: *In the center of the dashboard (below the navigation display screen).*

Labeling: *ESC symbol and an diagonal line through the symbol (Figure 5.14)*

Modes: *3 modes:*
1. Traction Control and ESC on.
2. Traction control off.
3. Traction control and ESC off

Identify standard or default drive configuration *RWD (2WD)*

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?

____ NA **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?

____ NA **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	*Yes*	*Yes*
Traction Control and ESC Off	*Yes*	*Yes*

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?

___ NA _X_ Yes ___ No

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

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

Ancillary Control: System *4WD Low transfer case selection*
Control Description *Transfer case selector*
Labeling *Selector-symbol with 2 axles, "4" with down arrow (see Figure 5.15)*

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
4WD Low transfer case selection	*Yes*	*"STABILITRAK OFF" and "TRACTION CONTROL OFF" in DIC*

3.0 TEST DATA (CONTD)

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

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)
4WD Low transfer case selection	*No*

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

___ Yes ___X___ No (See remarks) ___ NA

DATA INDICATES COMPLIANCE: PASS

Remarks:

Activating the 4WD Low transfer case selection control placed the vehicle into low-range four-wheel drive configuration designed for low-speed, off–road driving. The ESC system remained turned off after the ignition had been cycled off and then back on and therefore the "ESC Off" telltale did not extinguish. This condition is allowed by FMVSS No. 126 for the 4WD Low drive configuration

RECORDED BY: *B Kebschull* DATE RECORDED: *9/13/2011*
APPROVED BY: *P Broen* DATE APPROVED: *9/13/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (2WD Drive Configuration)*

NHTSA No. *CB0108* Data Sheet completion date: *9/13/2011*

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

Peak Friction Coefficient (at least 0.9) *0.951*

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 *210* kPa Rear Axle *210* kPa

Actual; LF *210* kPa RF *210* kPa

LR *210* kPa RR *210* kPa

Vehicle Dimensions: Front Track Width *172.2* cm Wheelbase *365.3* cm

Rear Track Width *170.2* cm

Vehicle Weight Ratings: GAWR Front *1792* kg GAWR Rear *1792* kg

Unloaded Vehicle Weight (UVW):

Front Axle *1451.5* kg Left Front *740.7* kg Right Front *710.8* kg

Rear Axle *1021.0* kg Left Rear *510.3* kg Right Rear *510.7* kg

Total UVW *2472.5* kg

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

Calculated baseline weight (UVW + 73kg) *2545.5* 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 *1476.0* kg Left front *759.3* kg Right front *716.7* kg

Rear axle *1059.5* kg Left rear *517.5* kg Right rear *542.0* kg

Total UVW with outriggers *2535.5* kg

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

Front axle *1557.2* kg Left front *812.4* kg Right front *744.8* kg

Rear axle *1109.1* kg Left rear *555.7* kg Right rear *553.4* kg

Vehicle Weight *2666.3* kg

Ballast Required =

[Total UVW with Outriggers (if applicable)]		+ *168*	kg	- [Loaded Weight w/Driver and Instrumentation)]	
= *2535.5*	kg	+ *168*	kg	- 2666.3	kg

= *37.2* kg

Total Loaded Vehicle Weight w/Driver and Instrumentation and Ballast

Front axle *1578.1* kg Left front *814.7* kg Right front *763.4* kg

Rear axle *1125.4* kg Left rear *562.9* kg Right rear *562.5* kg

Total UVW *2703.5* 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	*59.9* in	*152.1* cm	*72.3* in	*183.6* cm
y-distance	*-0.6* in	*-1.6* cm	*-1.8* in	*-4.5* cm
z-distance	*28.1* in	*71.3* cm	*28.2* in	*71.5* cm
Roof Height	*73.844* in		*187.6* cm	
Distance between ultrasonic sensors	*85.8* in		*217.8* cm	

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *9/13/2011*
APPROVED BY: *P Broen* DATE APPROVED: *9/13/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (4WD Drive Configuration)*

NHTSA No. *CB0108* Data Sheet completion date: *9/14/2011*

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

Peak Friction Coefficient (at least 0.9) *0.928*

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	*210*	kPa	Rear Axle *210*	kPa
Actual;	LF	*210*	kPa	RF *210*	kPa
	LR	*210*	kPa	RR *210*	kPa

RECORDED BY: *B Kebschull* DATE RECORDED: *9/14/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED: *9/16/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (2WD Drive Configuration)*

NHTSA No. *CB0108*

Measured tire pressure: LF *218* kPa RF *215* kPa

LR *214* kPa RR *215* kPa

Wind Speed *0* 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* °C

Brake Conditioning Time: *8:50:00 AM* Date: *9/13/2011*

56 km/h (35 mph) Brake Stops

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

Observed deceleration range (0.5g 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 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 6)
BRAKE AND TIRE CONDITIONING

Tire Conditioning series No. 1 Time: *9:00:00 AM* Date: *9/13/2011*

Measured cold tire pressure LF *227* kPa RF *227* kPa

LR *223* kPa RR *225* kPa

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

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *28*°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	*0.33*
2	3	56 ± 2 (35 ± 1)	*100*	0.5 - 0.6	*0.55*
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: *100* **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)	*100* (cycles 1-10)	0.5 - 0.6	*0.55*
4	*7*	56 ± 2 (35 ± 1)	*100* (cycles 1-9)	0.5 - 0.6	*0.55*
			200 (cycle10)*	NA	*0.74*

* 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 6)
BRAKE AND TIRE CONDITIONING

Tire Conditioning series No. 2 Time: *10:11:00 AM* Date: *9/13/2011*

Measured cold tire pressure LF *236* kPa RF *236* kPa

LR *228* kPa RR *232* kPa

Wind Speed *0.5* 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)) *29* °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:

100 **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)	*100* (cycles 1-10)	0.5 - 0.6	*0.55*
4	*19*	56 ± 2 (35 ± 1)	*100* (cycles 1-9)	0.5 - 0.6	*0.55*
			200 (cycle 10)*	NA	*0.74*

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

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *9/13/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED: *9/16/2011*

3.0 TEST DATA (CONTD)

Data Sheet 6 (Page 4 of 6)
BRAKE AND TIRE CONDITIONING

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (4WD Drive Configuration)*

NHTSA No. *CB0108*

Measured tire pressure: LF *216* kPa RF *217* kPa

LR *214* kPa RR *215* kPa

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

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *24* °C

Brake Conditioning Time: *8:43:00 AM* Date: *9/14/2011*

56 km/h (35 mph) Brake Stops

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

Observed deceleration range (0.5g 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 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 5 of 6)
BRAKE AND TIRE CONDITIONING

Tire Conditioning series No. 1 Time: *8:53:00 AM* Date: *9/14/2011*

Measured cold tire pressure LF *228* kPa RF *230* kPa

LR *223* kPa RR *226* kPa

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

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *26*°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	*0.33*
2	3	56 ± 2 (35 ± 1)	*100*	0.5 - 0.6	*0.51*
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: *100* **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)	*100* (cycles 1-10)	0.5 - 0.6	*0.51*
4	*7*	56 ± 2 (35 ± 1)	*100* (cycles 1-9)	0.5 - 0.6	*0.51*
			200 (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 6 of 6)
BRAKE AND TIRE CONDITIONING

Tire Conditioning series No. 2 Time: *10:23:00 AM* Date: *9/14/2011*

Measured cold tire pressure LF *234* kPa RF *235* kPa

LR *225* kPa RR *228* kPa

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

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *28* °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:

100 **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)	*100* (cycles 1-10)	0.5 - 0.6	*0.51*
4	*19*	56 ± 2 (35 ± 1)	*100* (cycles 1-9)	0.5 - 0.6	*0.51*
			200 (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: *B Kebschull* DATE RECORDED: *9/14/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED: *9/16/2011*

3.0 TEST DATA (CONTD)

Data Sheet 7 (Page 1 of 4)
SLOWLY INCREASING STEER (SIS) MANEUVER (2WD)

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (2WD Drive Configuration)*

NHTSA No. *CB0108*

Measured tire pressure: LF *232* kPa RF *232* kPa

LR *225* kPa RR *229* kPa

Wind Speed *1* m/s

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

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *28* °C

Selected drive configuration *RWD*

Selected Mode: *Default*

Preliminary Left Steer Maneuver:

Lateral Acceleration measured at 30 degrees steering wheel angle

$a_{y,30degrees}$ = *0.25* 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} = *66.0* degrees (@.55g)

δ_{sis} = *70* 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	*9:36*	*-41.2*	*10*	*Good*
2	Left	*9:39*	*-41.1*	*11*	*Good*
3	Left	*9:43*	*-41.8*	*12*	*Good*
4	Left				
5	Left				
1	Right	*9:47*	*39.5*	*13*	*Good*
2	Right	*9:50*	*39.8*	*14*	*Good*
3	Right	*9:54*	*40.1*	*15*	*Good*
4	Right				
5	Right				

3.0 TEST DATA (CONTD)

Data Sheet 7 (Page 2 of 4)
SLOWLY INCREASING STEER (SIS) MANEUVER (2WD)

Average Overall Steering Wheel Angle:

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

$\delta_{0.3\ g,\ overall}$ = *40.6* degrees

[to nearest 0.1 degree]

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *9/13/2011*
APPROVED BY: *P Broen* DATE APPROVED: *9/13/2011*

3.0 TEST DATA (CONTD)

Data Sheet 7 (Page 3 of 4)
SLOWLY INCREASING STEER (SIS) MANEUVER (4WD)

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (4WD Drive Configuration)*

NHTSA No. *CB0108*

Measured tire pressure: LF *231* kPa RF *233* kPa

LR *224* kPa RR *227* kPa

Wind Speed *1* m/s

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

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *27* °C

Selected drive configuration *4WD High*

Selected Mode: *Nominal*

Preliminary Left Steer Maneuver:

Lateral Acceleration measured at 30 degrees steering wheel angle

$a_{y,30degrees}$ = *0.25* 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} = *66.0* degrees (@.55g)

δ_{sis} = *70* 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	*9:56*	*-41.9*	*10*	*Good*
2	Left	*9:59*	*-42.3*	*11*	*Good*
3	Left	*10:02*	*-42.1*	*12*	*Good*
4	Left				
5	Left				
1	Right	*10:05*	*41.6*	*13*	*Good*
2	Right	*10:10*	*41.3*	*14*	*Good*
3	Right	*10:13*	*41.3*	*15*	*Good*
4	Right				
5	Right				

3.0 TEST DATA (CONTD)

Data Sheet 7 (Page 4 of 4)
SLOWLY INCREASING STEER (SIS) MANEUVER (4WD)

Average Overall Steering Wheel Angle:

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

$\delta_{0.3\ g,\ overall}$ = *41.7* degrees

[to nearest 0.1 degree]

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *9/14/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *9/16/2011*

3.0 TEST DATA (CONTD)

Data Sheet 8 (Page 1 of 6)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS (2WD)

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (2WD Drive Configuration)*

NHTSA No. *CB0108* Data sheet completion date: *9/13/2011*

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: *2WD-RWD*

Selected Mode: *Default - ESC on*

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) *40.6* 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
21	10:47	1.5	61	12.19	-0.29	-0.34	-2.34	*PASS*	-2.79	*PASS*
22	10:50	2.0	81	15.65	-0.27	-0.29	-1.76	*PASS*	-1.85	*PASS*
23	10:53	2.5	102	19.27	-0.25	-0.24	-1.31	*PASS*	-1.24	*PASS*
24	10:56	3.0	122	23.15	-0.19	-0.14	-0.81	*PASS*	-0.60	*PASS*
25	10:59	3.5	142	22.86	-0.16	-0.13	-0.68	*PASS*	-0.58	*PASS*
26	11:02	4.0	162	25.74	-0.35	-0.17	-1.38	*PASS*	-0.67	*PASS*
27	11:05	4.5	183	26.27	-0.19	-0.11	-0.73	*PASS*	-0.43	*PASS*
28	11:08	5.0	203	26.09	-0.39	-0.22	-1.50	*PASS*	-0.85	*PASS*
29	11:11	5.5	223	27.94	-0.39	-0.28	-1.38	*PASS*	-1.01	*PASS*
30	11:13	6.0	244	27.72	-0.49	-0.12	-1.78	*PASS*	-0.43	*PASS*
31	11:16	6.5	264	27.76	-0.43	-0.31	-1.54	*PASS*	-1.12	*PASS*
32	11:19	-	270	28.65	-0.12	-0.22	-0.42	*PASS*	-0.78	*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 6)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS (2WD)

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
33	11:22	1.5	61	-12.25	0.08	0.10	-0.66	*PASS*	-0.85	*PASS*
34	11:25	2.0	81	-16.04	0.14	0.12	-0.86	*PASS*	-0.78	*PASS*
35	11:28	2.5	102	-19.57	0.20	0.03	-1.02	*PASS*	-0.16	*PASS*
36	11:31	3.0	122	-23.21	0.15	0.00	-0.65	*PASS*	0.02	*PASS*
37	11:34	3.5	142	-23.53	0.19	0.22	-0.82	*PASS*	-0.95	*PASS*
38	11:37	4.0	162	-24.53	0.31	0.07	-1.25	*PASS*	-0.27	*PASS*
39	11:40	4.5	183	-26.82	0.27	0.20	-1.01	*PASS*	-0.76	*PASS*
40	11:43	5.0	203	-28.07	0.18	-0.07	-0.63	*PASS*	0.23	*PASS*
41	11:46	5.5	223	-27.38	0.43	0.18	-1.58	*PASS*	-0.67	*PASS*
42	11:50	6.0	244	-28.33	0.27	0.04	-0.97	*PASS*	-0.16	*PASS*
43	11:53	6.5	264	-29.27	0.37	0.13	-1.26	*PASS*	-0.44	*PASS*
44	11:56	-	270	-28.48	0.30	0.16	-1.06	*PASS*	-0.55	*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	[X]	Yes	[ ]	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 6)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS (2WD)

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	203	-2.45	*PASS*
29	Counter Clockwise	5.5	223	-2.58	*PASS*
30	Counter Clockwise	6.0	244	-2.53	*PASS*
31	Counter Clockwise	6.5	264	-2.44	*PASS*
32	Counter Clockwise	-	270	-2.52	*PASS*
40	Clockwise	5.0	203	2.41	*PASS*
41	Clockwise	5.5	223	2.39	*PASS*
42	Clockwise	6.0	244	2.40	*PASS*
43	Clockwise	6.5	264	2.46	*PASS*
44	Clockwise	-	270	2.40	*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: *During Run 30 the right front wheel lifted briefly approximately 1 inch from pavement on reversal as determined by visual observation.*

RECORDED BY: *P Broen* DATE RECORDED: *9/13/2011*
APPROVED BY: *B Kebschull* DATE APPROVED: *9/13/2011*

3.0 TEST DATA (CONTD)

Data Sheet 8 (Page 4 of 6)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS (4WD)

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab (4WD Drive Configuration)*

NHTSA No. *CB0108* Data sheet completion date: *9/14/2011*

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: *4WD High*

Selected Mode: *Default - ESC on*

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) *41.7* 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)	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0sec}$	$\dot{\psi}_{1.75sec}$	%	Pass/Fail	%	Pass/Fail
22	10:49	1.5	63	12.53	-0.04	-0.05	-0.34	*PASS*	-0.39	*PASS*
23	10:52	2.0	83	16.06	-0.10	-0.18	-0.61	*PASS*	-1.11	*PASS*
24	10:55	2.5	104	19.29	-0.26	-0.16	-1.32	*PASS*	-0.83	*PASS*
25	10:59	3.0	125	23.09	-0.30	-0.28	-1.28	*PASS*	-1.21	*PASS*
26	11:02	3.5	146	22.67	-0.43	-0.42	-1.88	*PASS*	-1.86	*PASS*
27	11:06	4.0	167	25.36	-0.38	-0.15	-1.51	*PASS*	-0.58	*PASS*
28	11:09	4.5	188	26.48	-0.31	-0.20	-1.16	*PASS*	-0.77	*PASS*
29	11:12	5.0	208	26.43	-0.39	-0.18	-1.48	*PASS*	-0.68	*PASS*
30	11:15	5.5	229	27.52	-0.62	-0.39	-2.26	*PASS*	-1.41	*PASS*
31	11:18	6.0	250	27.69	-0.27	-0.07	-0.96	*PASS*	-0.25	*PASS*
32	11:22	6.5	271	27.46	-0.38	-0.03	-1.38	*PASS*	-0.11	*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 (5 of 6)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS (4WD)

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
33	11:26	1.5	63	-12.29	0.25	0.13	-2.02	*PASS*	-1.02	*PASS*
34	11:30	2.0	83	-16.24	0.24	0.19	-1.45	*PASS*	-1.17	*PASS*
35	11:33	2.5	104	-19.82	0.15	0.28	-0.76	*PASS*	-1.41	*PASS*
36	11:36	3.0	125	-23.09	0.41	0.27	-1.76	*PASS*	-1.18	*PASS*
37	11:39	3.5	146	-24.19	0.41	0.31	-1.71	*PASS*	-1.29	*PASS*
38	11:42	4.0	167	-25.26	0.41	0.23	-1.63	*PASS*	-0.89	*PASS*
39	11:45	4.5	188	-25.81	0.20	0.15	-0.79	*PASS*	-0.59	*PASS*
40	11:48	5.0	208	-27.76	0.34	0.23	-1.22	*PASS*	-0.82	*PASS*
41	11:50	5.5	229	-27.44	0.37	0.18	-1.34	*PASS*	-0.64	*PASS*
42	11:53	6.0	250	-28.74	0.07	-0.14	-0.24	*PASS*	0.48	*PASS*
43	11:56	6.5	271	-28.80	0.05	-0.05	-0.17	*PASS*	0.18	*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 (6 of 6)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS (4WD)

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
29	Counter Clockwise	5.0	208	-2.42	*PASS*
30	Counter Clockwise	5.5	229	-2.47	*PASS*
31	Counter Clockwise	6.0	250	-2.43	*PASS*
32	Counter Clockwise	6.5	271	-2.45	*PASS*
40	Clockwise	5.0	208	2.42	*PASS*
41	Clockwise	5.5	229	2.43	*PASS*
42	Clockwise	6.0	250	2.46	*PASS*
43	Clockwise	6.5	271	2.54	*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: *B Kebschull* DATE RECORDED: *9/14/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED: *9/16/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab*

NHTSA No. *CB0108* Data Sheet Completion Date: *9/13/2011*

TEST 1

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Disconnected left front 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.

X Yes ___ No

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

0 Seconds (must be within 2 minutes) [X] Pass [ ] Fail

TEST 1 DATA INDICATES COMPLIANCE: ***PASS***

Remarks: *Telltale illuminated immediately upon ignition, after sensor was disconnected. In addition, the alternating messages "Service Stabilitrak" and "Service Traction Control" appeared in the common display area in the lower part of the tachometer. The telltale and messages extinguished immediately upon cycling the ignition, after the sensor was reconnected. No driving was required.*

RECORDED BY: *B Kebschull* DATE RECORDED: *9/13/2011*

APPROVED BY: *P Broen* DATE APPROVED *9/13/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 GMC Sierra 1500 4WD Crew Cab*

NHTSA No. *CB0108* Data Sheet Completion Date: *9/13/2011*

TEST 2

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Removed ABS Controller fuse.

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 ± 5 mph) 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 ± 5 mph) 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 sensor was disconnected. In addition, the red "BRAKE" and ABS telltales also illuminated. The telltales extinguished immediately upon cycling the ignition, after the fuse was re-installed. No driving was required.*

RECORDED BY: *B Kebschull* DATE RECORDED: *9/13/2011*

APPROVED BY: *P Broen* DATE APPROVED *9/13/2011*

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:2/22/11 Due: 2/22/12
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: DRI Date: 2/23/11 Due: 2/23/12
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: 3/30/11 Due: 3/30/12
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: 3/8/11 Due: 3/8/12
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: 5/3/11 Due: 5/3/12
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: 2/22/11 Due: 2/21/12
						DOT-NHTSA D3272	By: DRI Date: 2/22/11 Due: 2/22/12

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: 3/29/11 Due: 3/29/12
					SoMat High level Board EHLS	MSHLS.03-3182	By: DRI Date: 3/29/11 Due: 3/29/12
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	Operationally 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; DRI Date: 11/7/10 Due: 11/7/11
Outriggers	No output. Safety Item.	NA	NA	NA	DRI manufactured Aluminum meeting the weight and MOI specifications of Docket 2007-27662-11	NA	NA

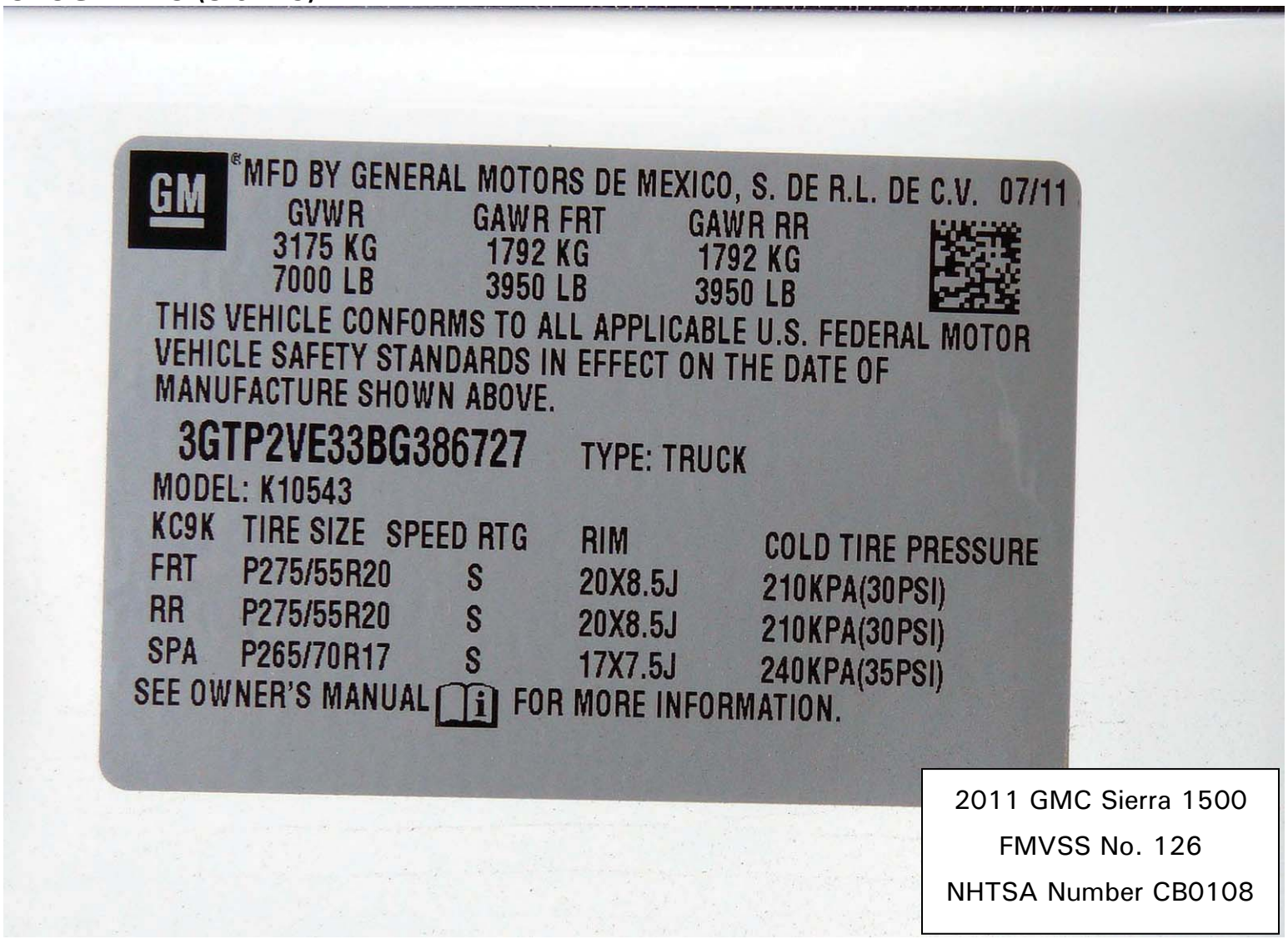
5.0 PHOTOGRAPHS (1 of 15)

Figure 5.1. Front View of Test Vehicle

5.0 PHOTOGRAPHS (2 of 15)

Figure 5.2. Rear View of Test Vehicle

5.0 PHOTOGRAPHS (3 of 15)



2011 GMC Sierra 1500
FMVSS No. 126
NHTSA Number CB0108

Figure 5.3. Vehicle Certification Label

5.0 PHOTOGRAPHS (4 of 15)

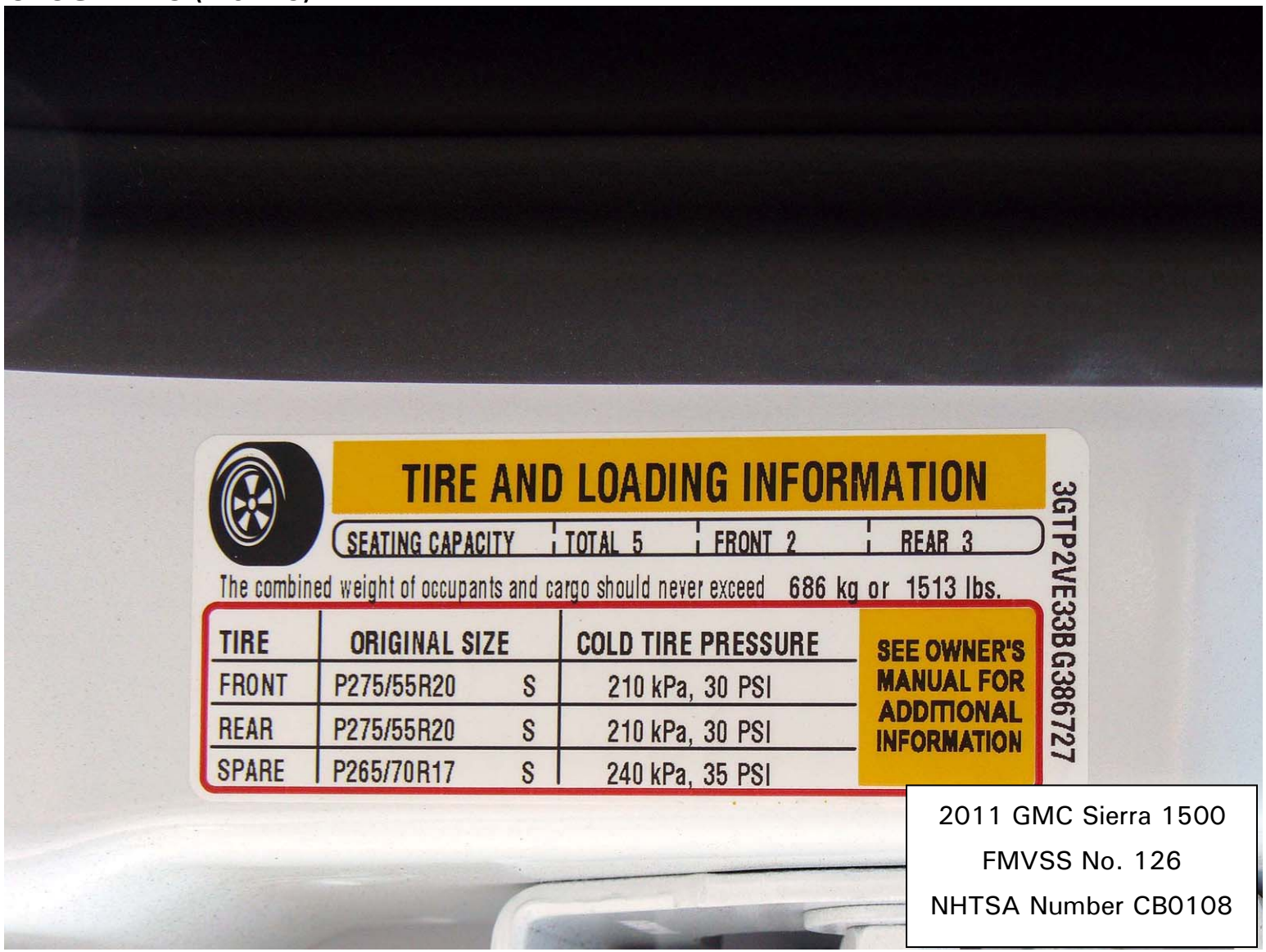


Figure 5.4. Vehicle Placard

5.0 PHOTOGRAPHS (5 of 15)

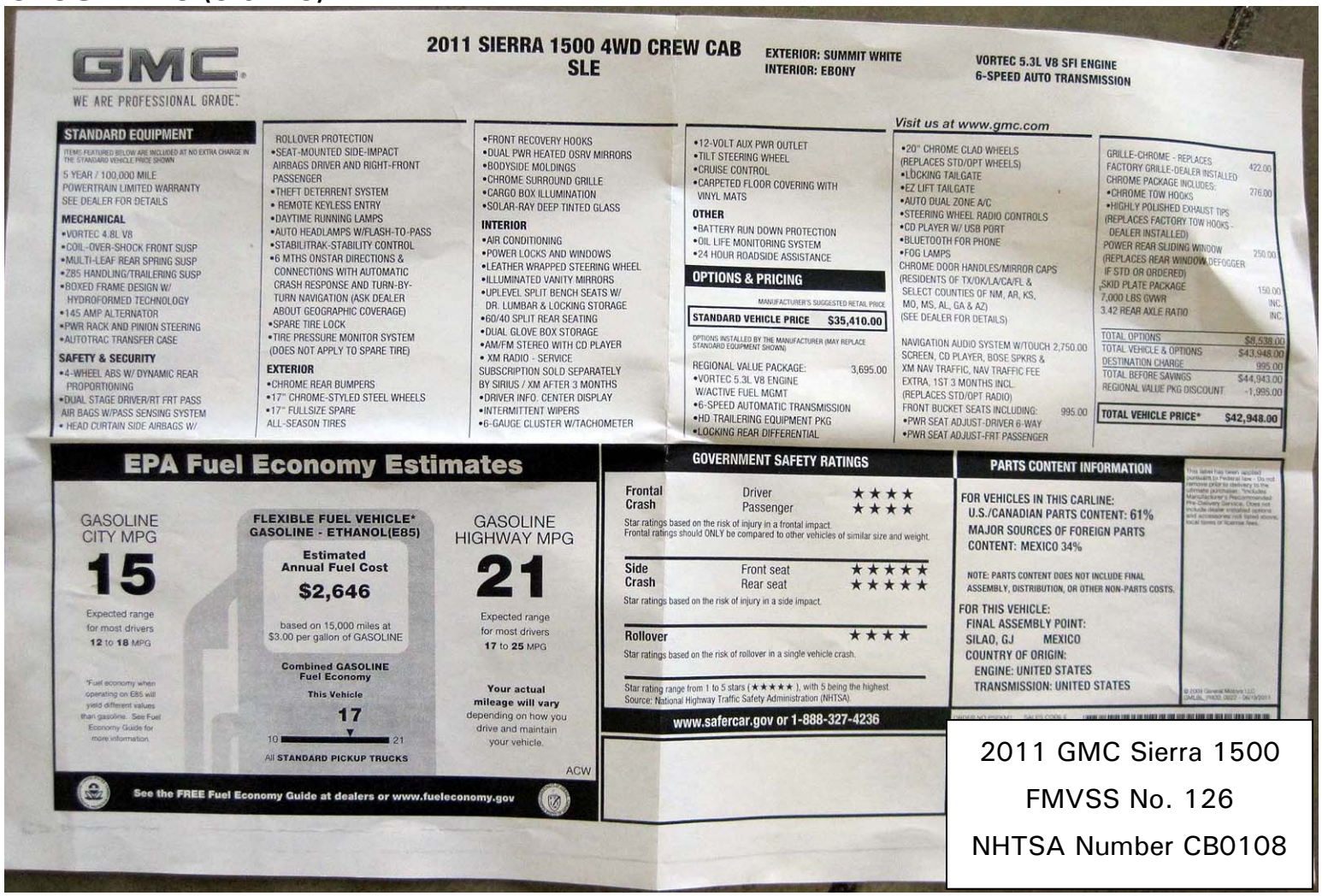


Figure 5.5. Window Sticker (Monroney Label)

5.0 PHOTOGRAPHS (6 of 15)

Figure 5.6. Front View of Vehicle as Tested

5.0 PHOTOGRAPHS (7 of 15)

Figure 5.7. Rear View of Vehicle as Tested

5.0 PHOTOGRAPHS (8 of 15)

Figure 5.8. Ultrasonic Height Sensor Mounted on Side of Vehicle for Determining Body Roll Angle

5.0 PHOTOGRAPHS (9 of 15)

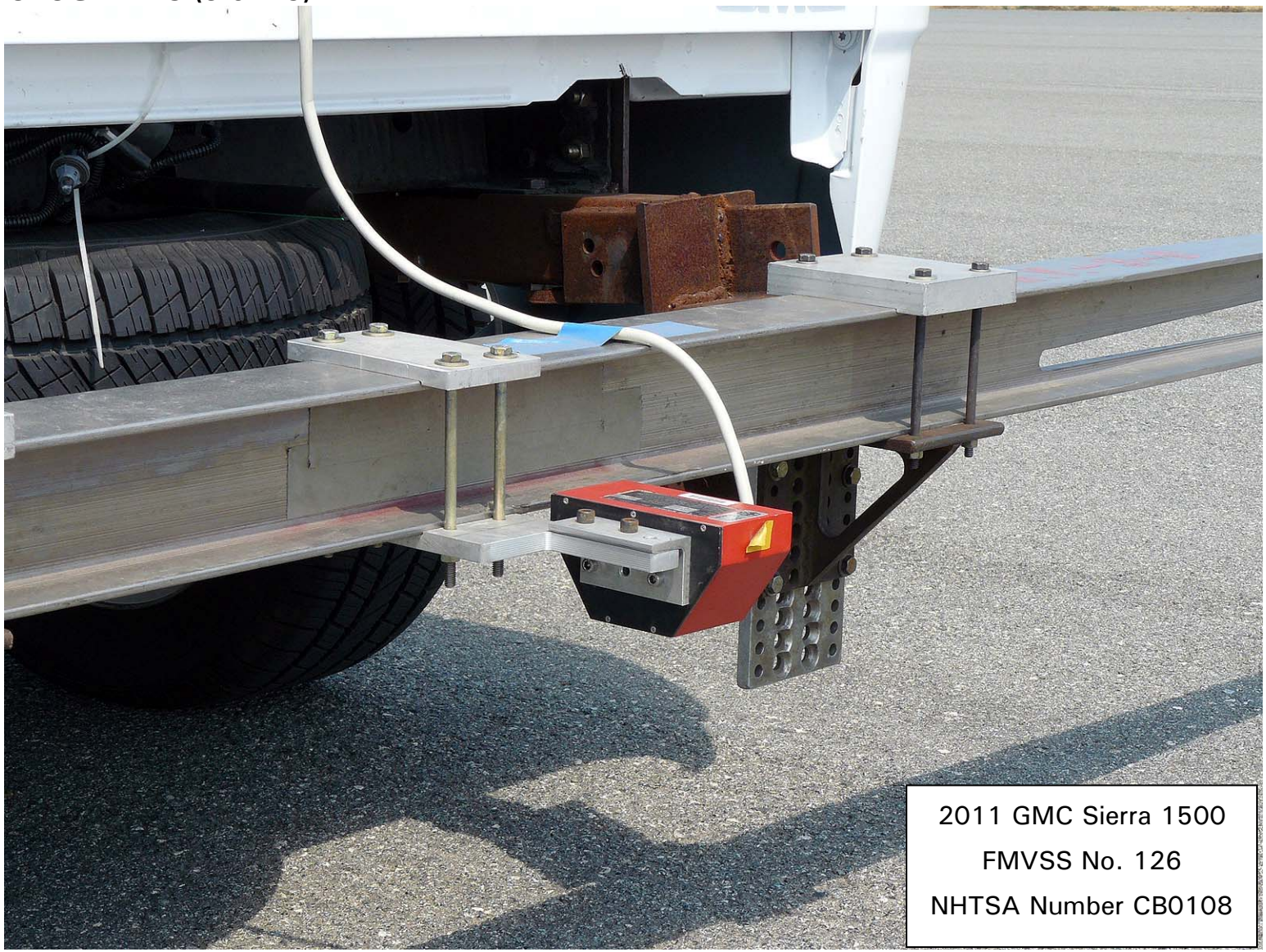


Figure 5.9. Rear Mounted Speed Sensor

5.0 PHOTOGRAPHS (10 of 15)

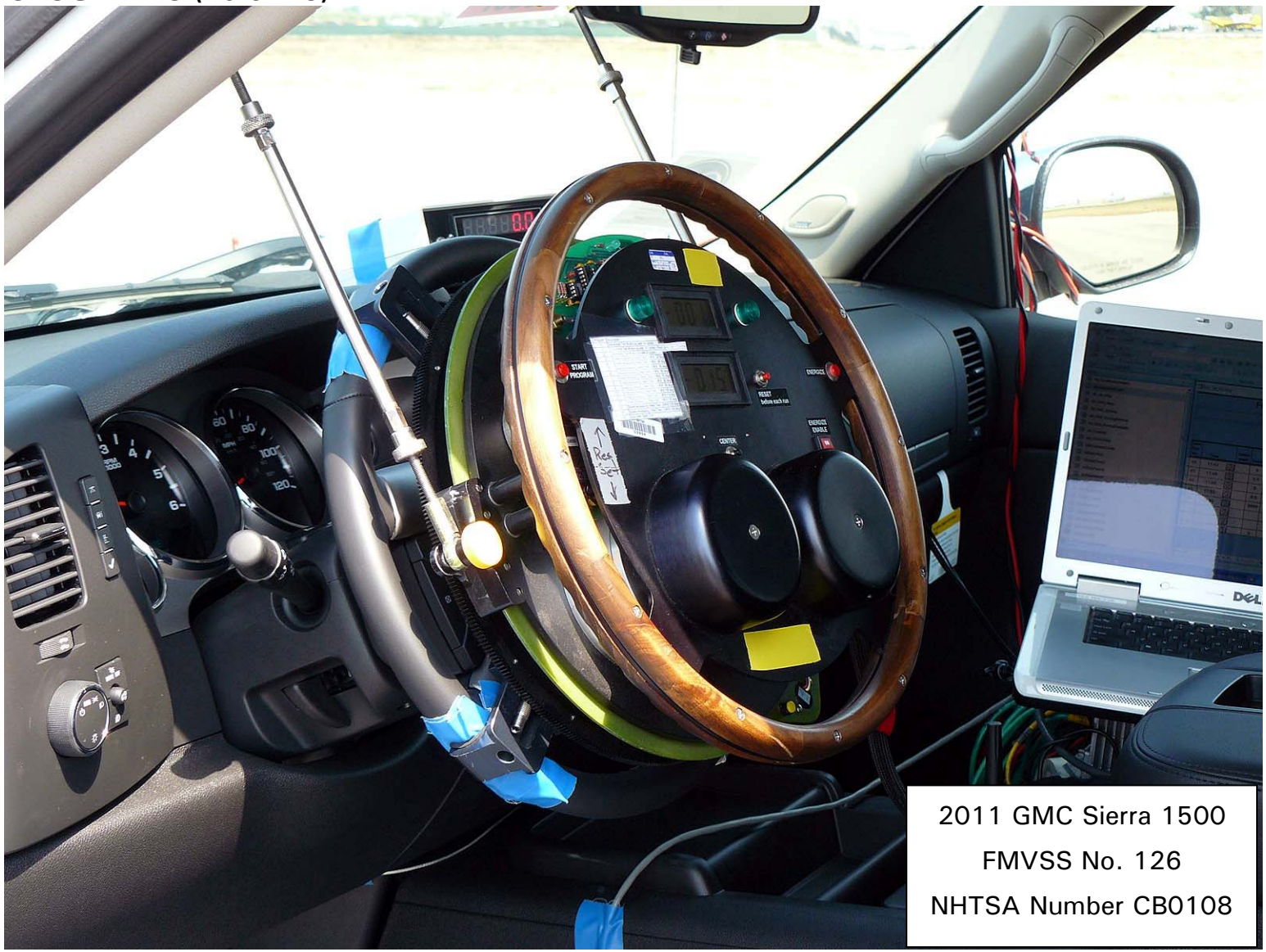


Figure 5.10. Steering Controller and Data Acquisition Computer

5.0 PHOTOGRAPHS (11 of 15)

Figure 5.11. Inertial Measurement Unit Mounted in Vehicle

5.0 PHOTOGRAPHS (12 of 15)

Figure 5.12. Brake Pedal Load Cell

5.0 PHOTOGRAPHS (13 of 15)

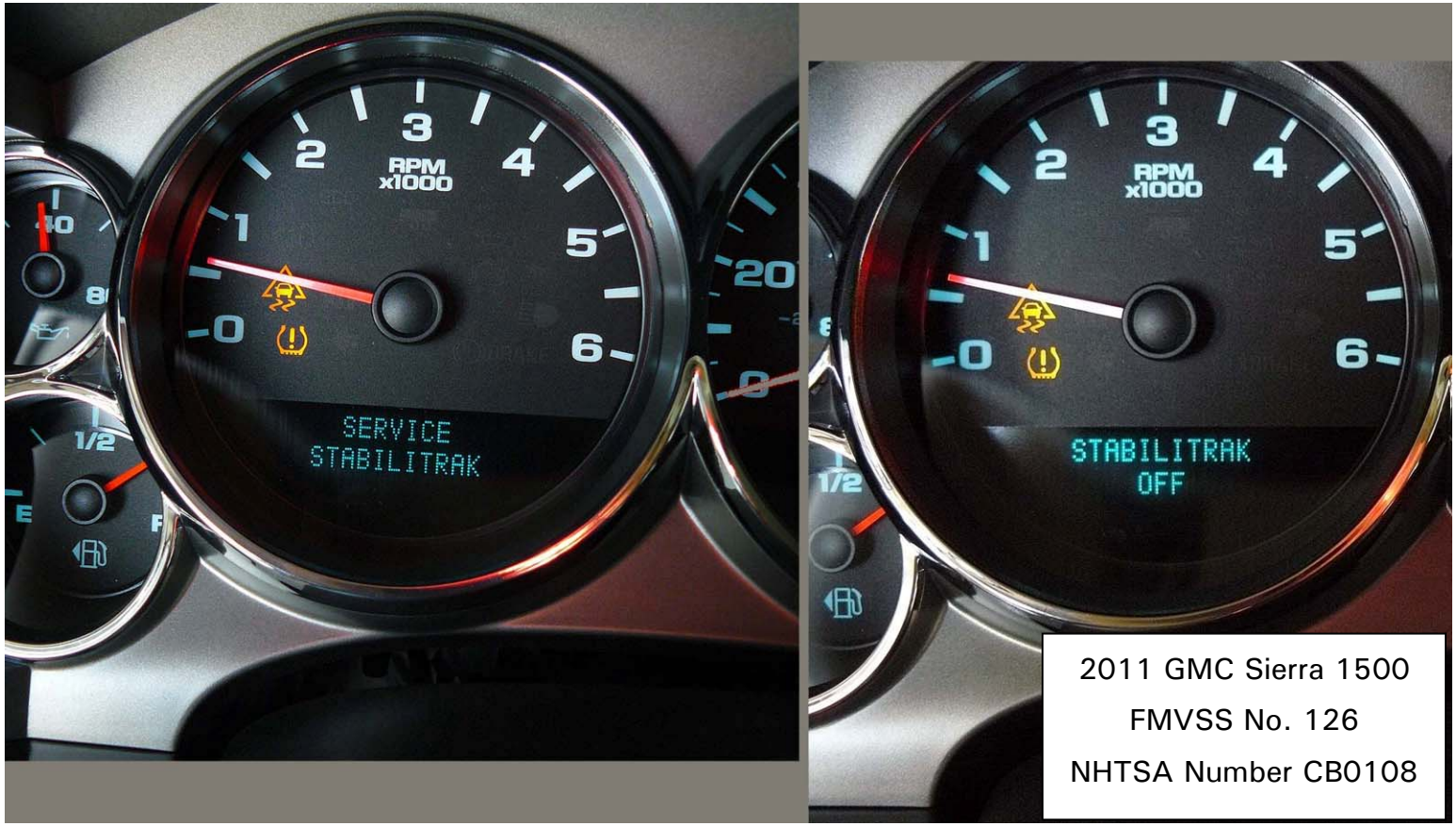


Figure 5.13. Telltale and Messages for ESC Malfunction and ESC Off

5.0 PHOTOGRAPHS (14 of 15)

Figure 5.14. ESC Off Control Switch

5.0 PHOTOGRAPHS(15 of 15)

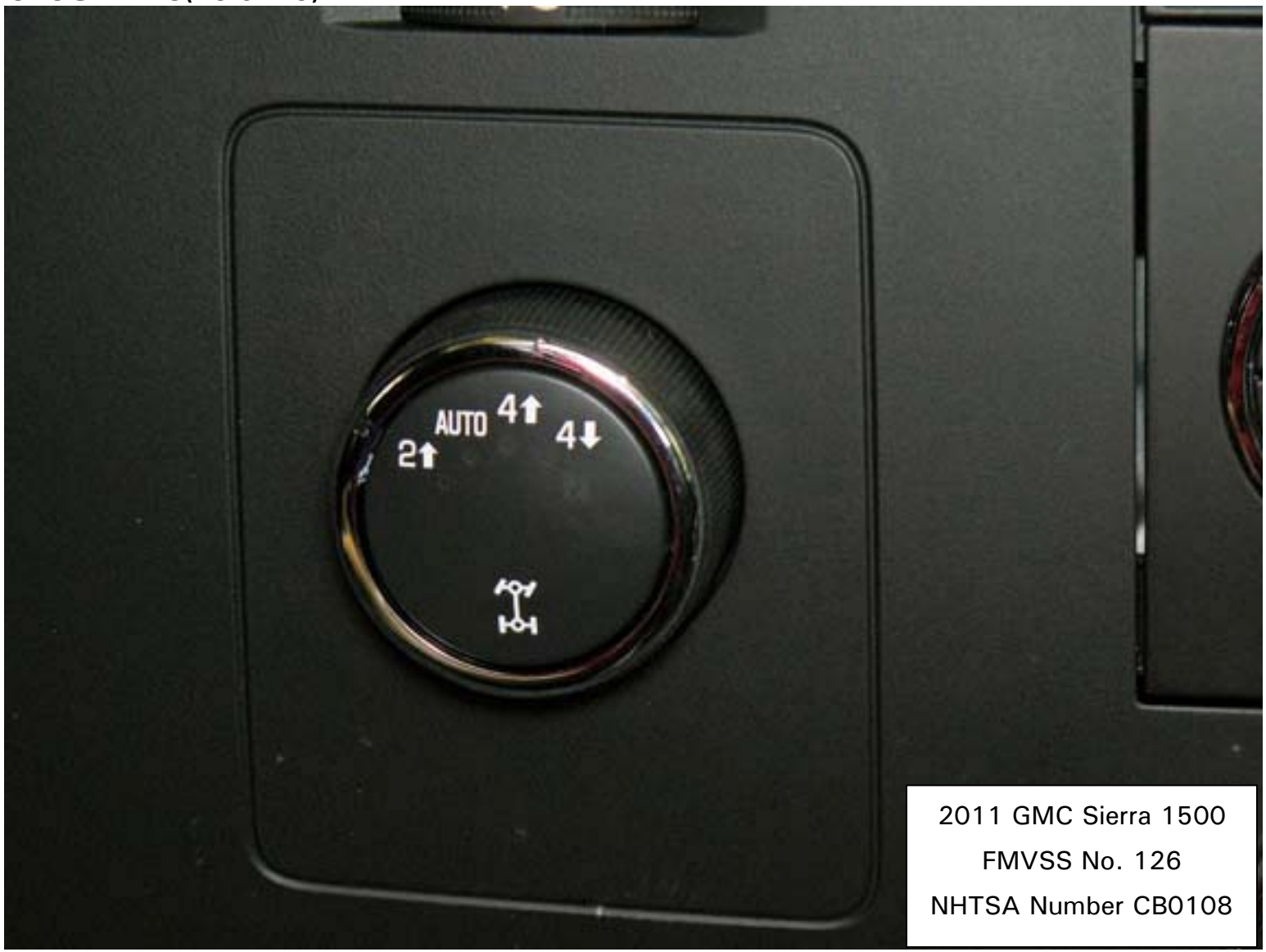


Figure 5.15. Transfer Case Configuration Select Switch

6.0 DATA PLOTS (1 of 8)

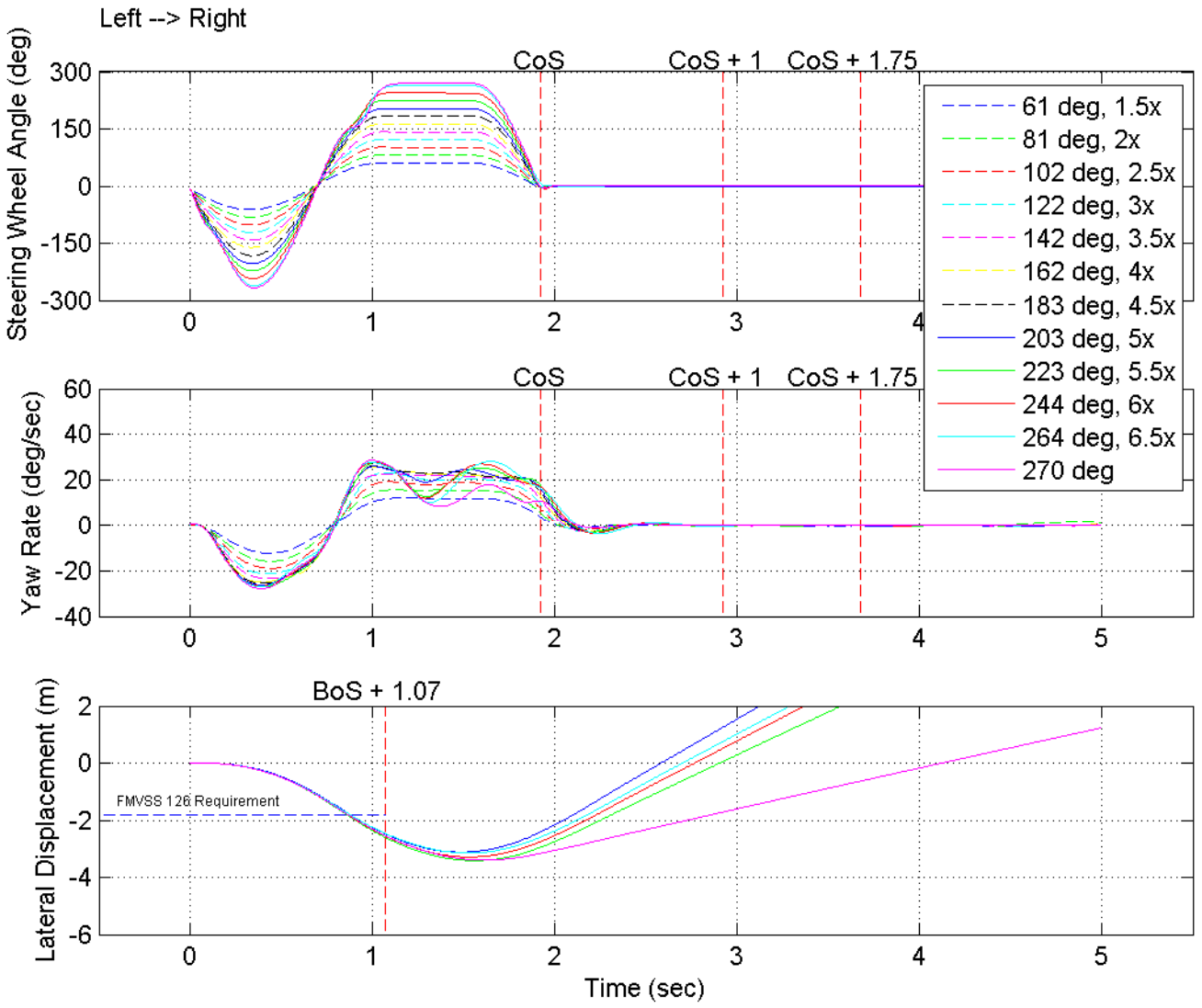


Figure 6.1. Steering Wheel Angle, Yaw Rate and Lateral Displacement for L-R Series (2WD Configuration)

6.0 DATA PLOTS (2 of 8)

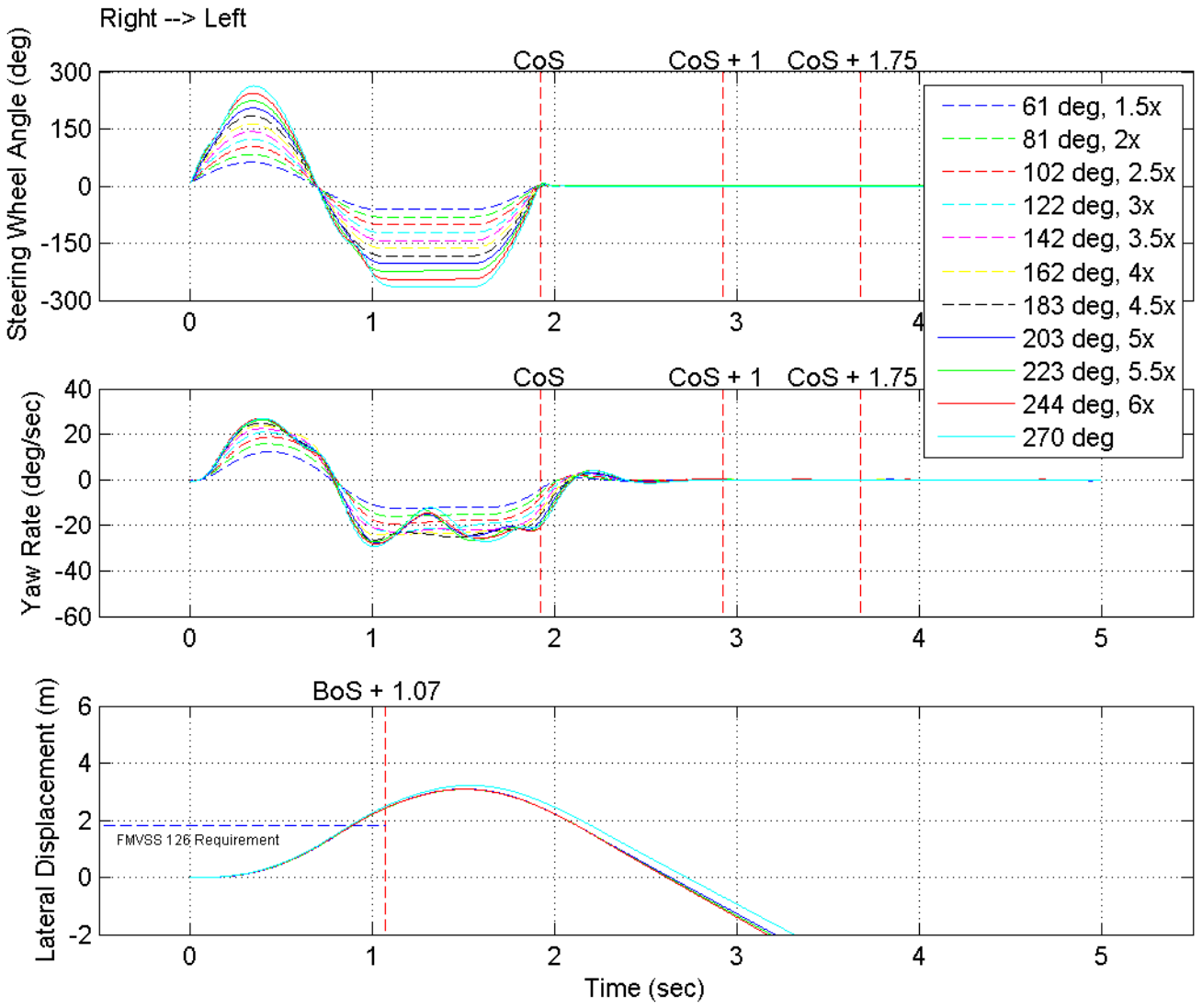


Figure 6.2. Steering Wheel Angle, Yaw Rate and Lateral Displacement for R-L Series (2WD Configuration)

6.0 DATA PLOTS (3 of 8)

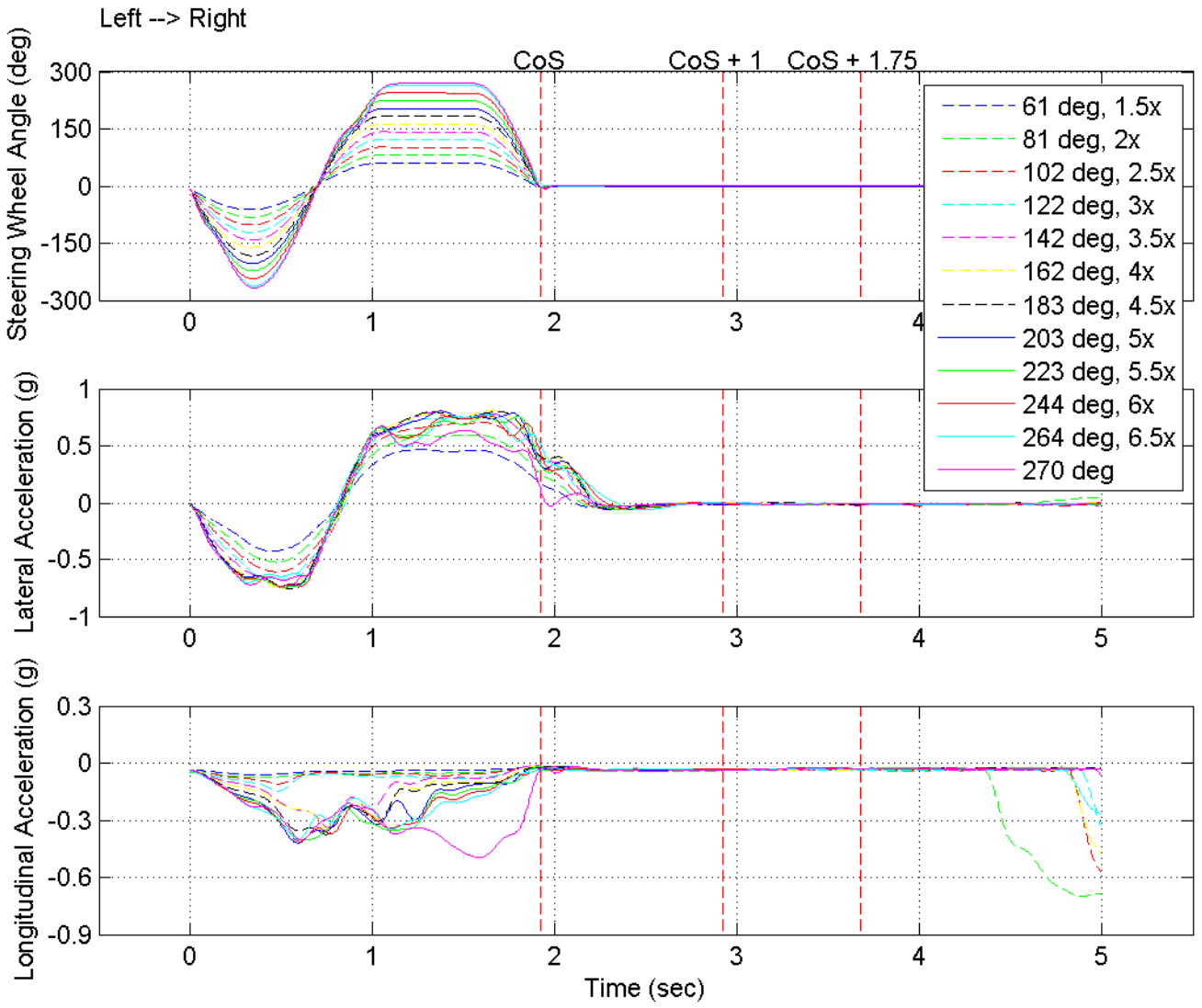


Figure 6.3. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for L-R Series (2WD Configuration)

6.0 DATA PLOTS (4 of 8)

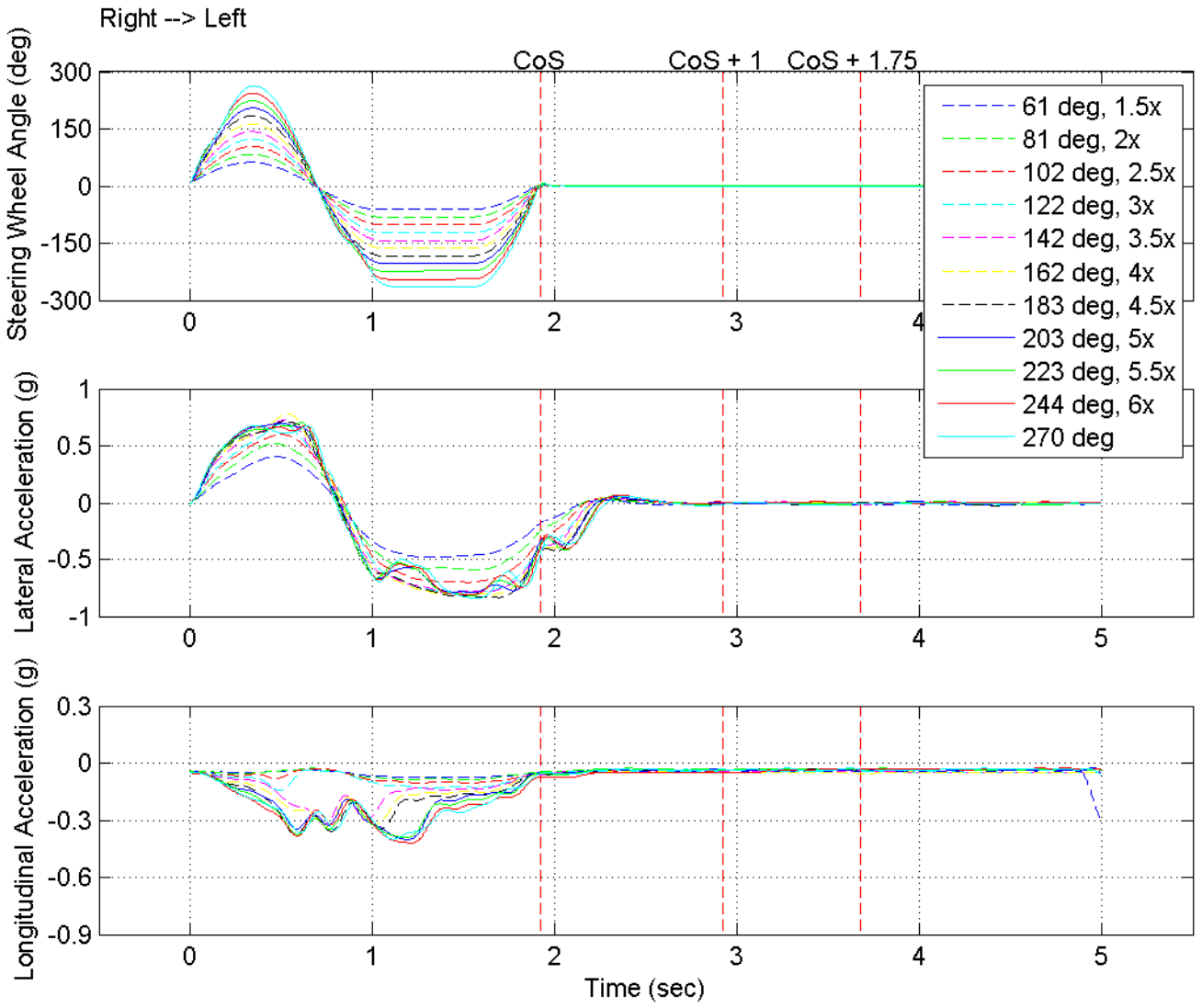


Figure 6.4. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for R-L Series (2WD Configuration)

6.0 DATA PLOTS (5 of 8)

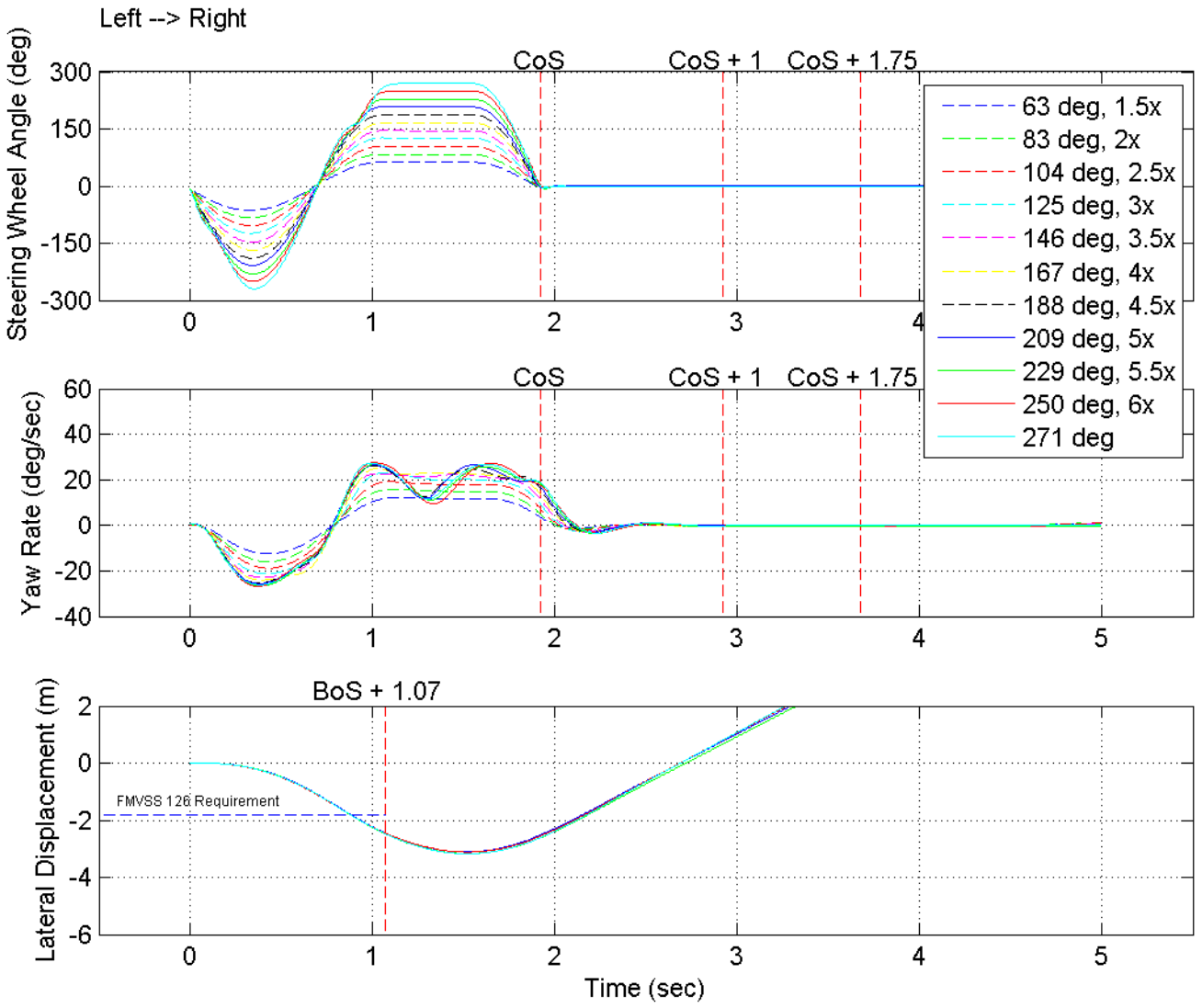


Figure 6.5. Steering Wheel Angle, Yaw Rate and Lateral Displacement for L-R Series (4WD Configuration)

6.0 DATA PLOTS (6 of 8)

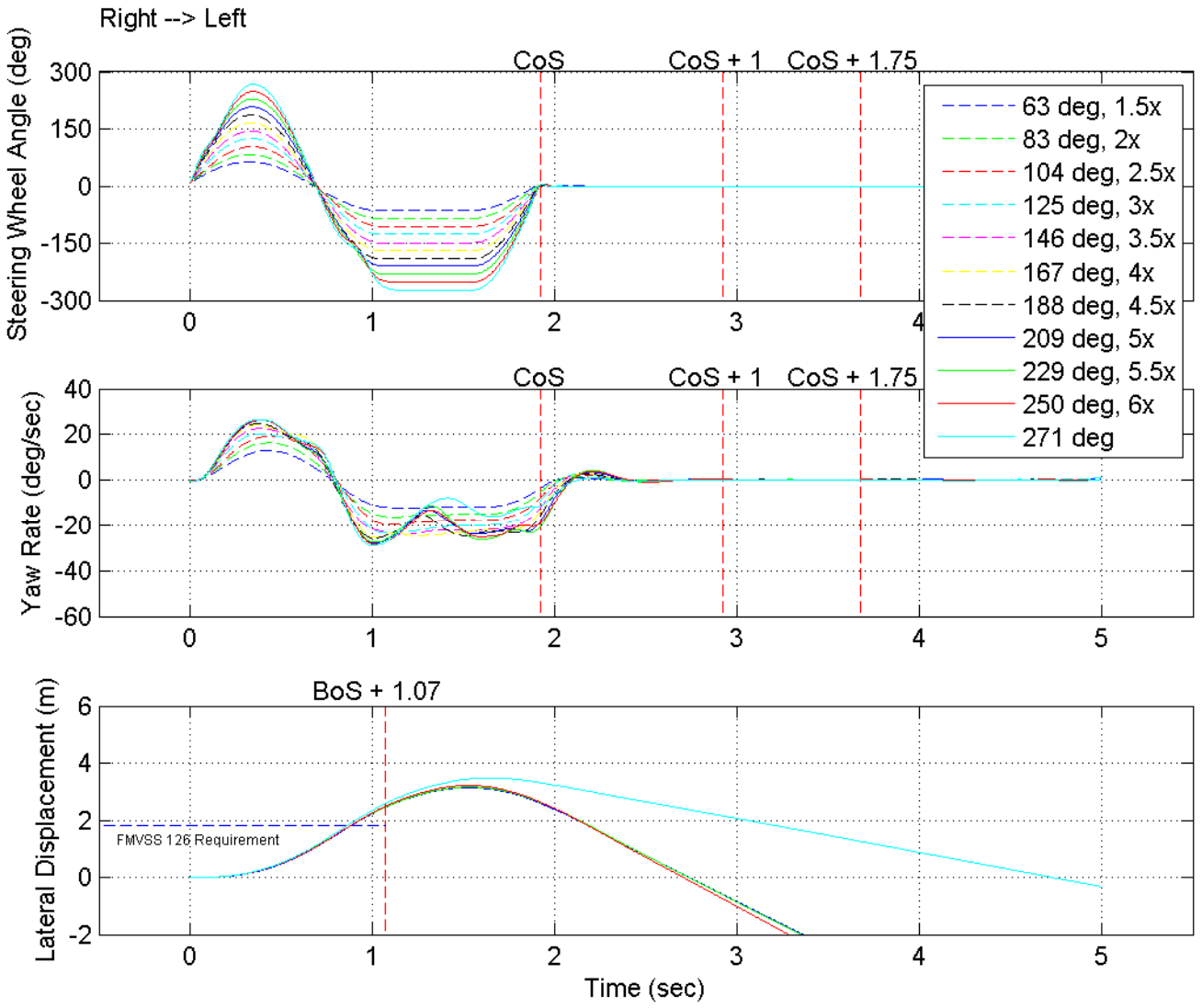


Figure 6.6. Steering Wheel Angle, Yaw Rate and Lateral Displacement for R-L Series (4WD Configuration)

6.0 DATA PLOTS (7 of 8)

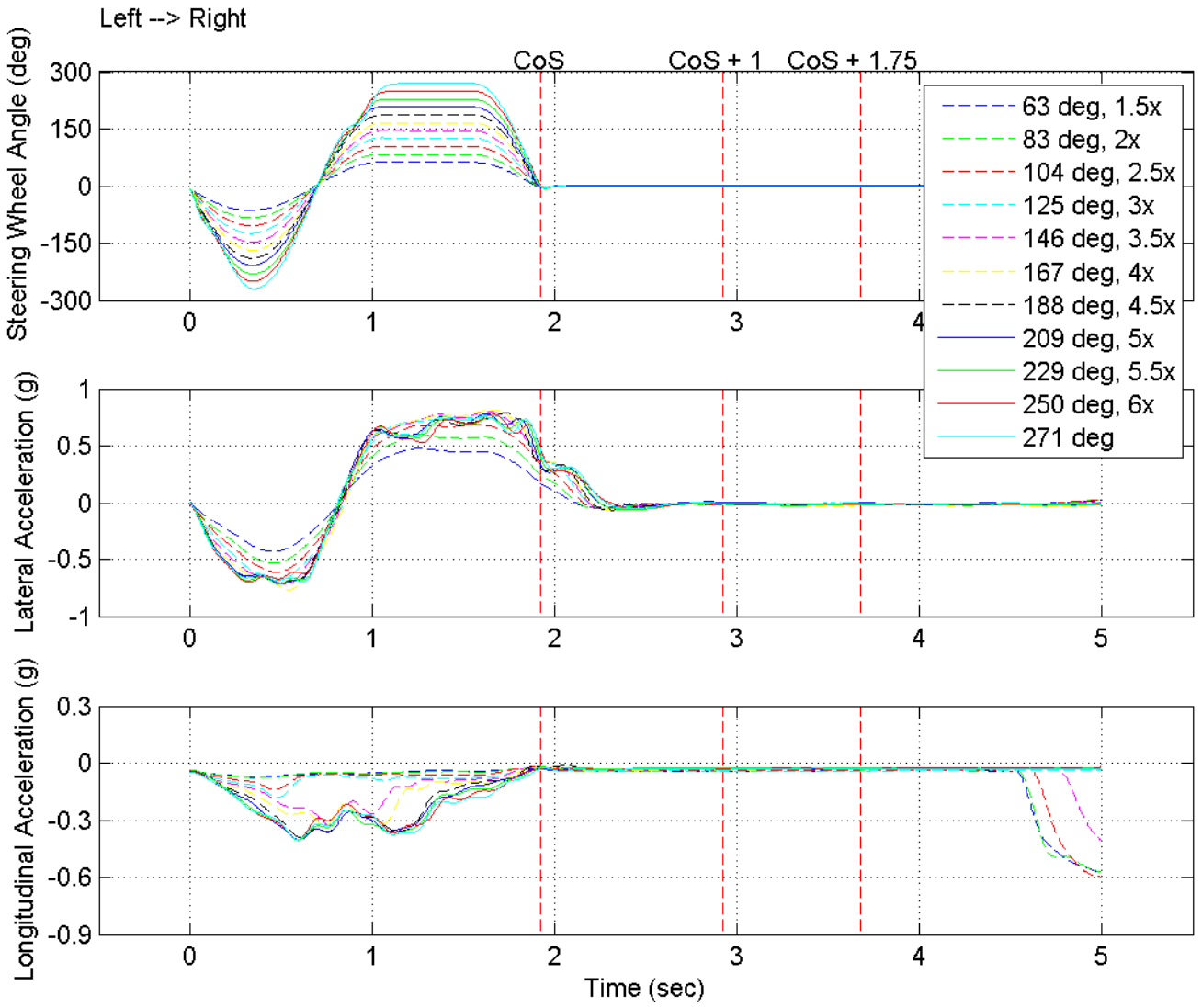


Figure 6.7. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for L-R Series (4WD Configuration)

6.0 DATA PLOTS (8 of 8)

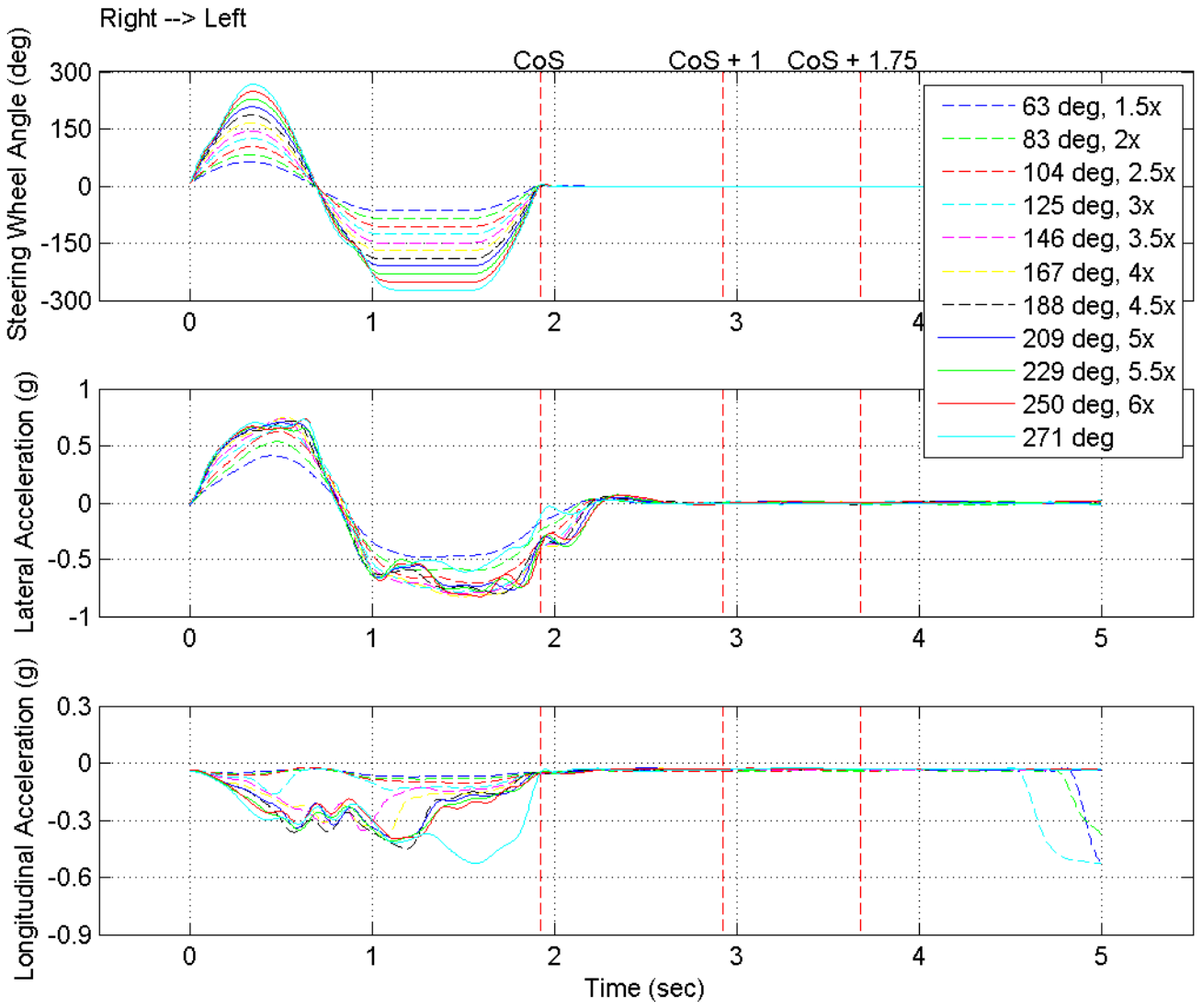


Figure 6.8. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for R-L Series (4WD Configuration)

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

Vehicle Symbol Chart

Here are some additional symbols that may be found on the vehicle and what they mean. For more information on the symbol, refer to the Index.

: Adjustable Pedals

: Airbag Readiness Light

: Air Conditioning

: Antilock Brake System (ABS)

: Audio Steering Wheel Controls or OnStar®

: Brake System Warning Light

: Charging System

: Cruise Control

: Engine Coolant Temperature

: Exterior Lamps

: Fog Lamps

: Fuel Gauge

: Fuses

: Headlamp High/Low-Beam Changer

: LATCH System Child Restraints

: Malfunction Indicator Lamp

: Oil Pressure

: Outside Power Foldaway Mirrors

: Power

: Remote Vehicle Start

: Safety Belt Reminders

: Tire Pressure Monitor

: Tow/Haul Mode

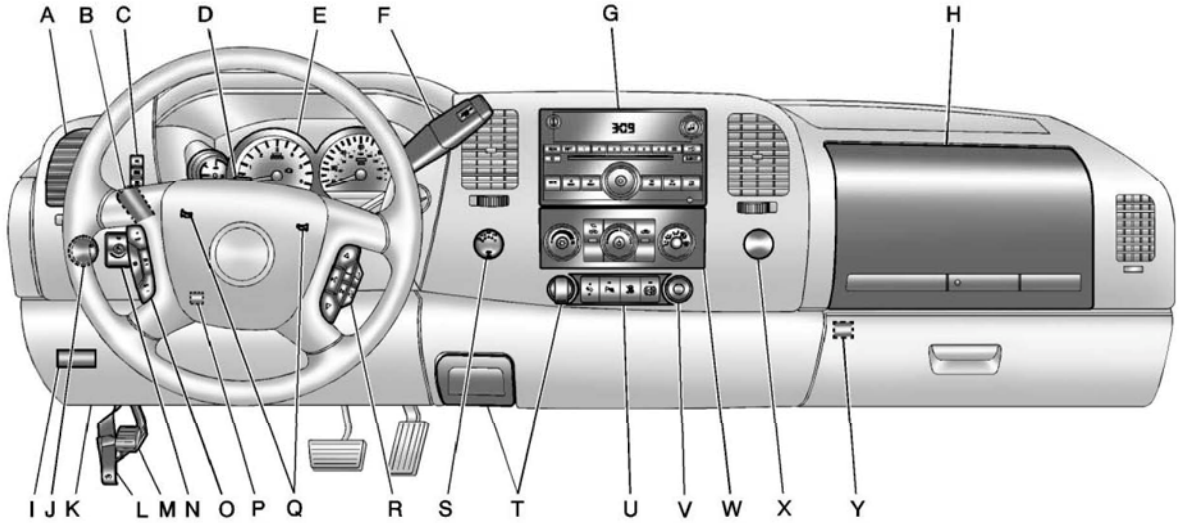
: Traction Control

: Windshield Washer Fluid

7.1 OWNER'S MANUAL PAGES

Instrument Panel

Instrument Panel (Base/Uplevel Version)



7.1 OWNER'S MANUAL PAGES

A. *Air Vents on page 8-11.*

B. *Turn and Lane-Change Signals on page 6-6.*

Windshield Wiper/Washer on page 5-5.

C. Driver Information Center (DIC) Buttons. See *Driver Information Center (DIC) on page 5-33.*

D. *Hazard Warning Flashers on page 6-5.*

E. *Instrument Cluster on page 5-13.*

F. Shift Lever. See *Automatic Transmission on page 9-46.*

Tow/Haul Selector Button (If Equipped). See *Tow/Haul Mode on page 9-51.*

Range Selection Mode (Allison Transmission and Hydra-Matic® 6-Speed Button (If Equipped). See *Manual Mode on page 9-50.*

G. *Infotainment on page 7-1.*

H. *Instrument Panel Storage on page 4-1.*

I. Integrated Trailer Brake Controller (If Equipped). See *Trailer Towing on page 9-95.*

J. *Exterior Lamp Controls on page 6-1.*

K. Data Link Connector (DLC) (Out of View). See *Malfunction Indicator Lamp on page 5-25.*

L. *Hood on page 10-5.*

M. *Parking Brake on page 9-69.*

N. *Dome Lamps on page 6-8.*

Fog Lamps on page 6-6 (If Equipped).

O. *Cruise Control on page 9-73.*

P. *Steering Wheel Adjustment on page 5-2.*

Q. *Horn on page 5-5.*

R. *Steering Wheel Controls on page 5-3* (If Equipped).

S. Automatic Transfer Case Control (If Equipped). See *Four-Wheel Drive on page 10-34.*

T. Ashtray (If Equipped). See *Ashtrays on page 5-12* and *Cigarette Lighter on page 5-11.*

U. *StabiliTrak® System on page 9-70* (If Equipped).

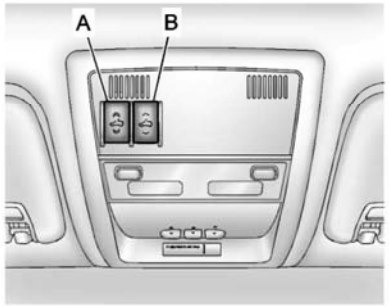
Ultrasonic Parking Assist on page 9-76 (If Equipped).

Pedal Adjust Button (If Equipped). See *Adjustable Throttle and Brake Pedal on page 9-35.*

Exhaust Brake (If Equipped). See "Brakes" in the Duramax Diesel Supplement.

The sunroof also has a roller sunshade that can be used to block the rays of the sun. To open the sunshade, press and unlatch it, and roll it back. To close, pull it forward and latch it into the closed position.

Crew Cab



A. Open or Close

B. Vent

There are two sunroof switches located in the overhead console above the rearview mirror.

Vent: From the closed position, press the rear of the passenger side switch (B) to vent the sunroof.

Manual-Open/Manual-Close: To open the sunroof, press and hold the rear of the driver side switch (A) until the sunroof reaches the desired position. Press and hold the front of the driver side switch to close it.

Express-Open/Express-Close: To express-open the sunroof, fully press and release the rear of the driver side switch (B) until the sunroof reaches the desired position. To express-close the sunroof, fully press and release the front of the driver side switch. Press the switch again to stop it.

The sunroof also has a sunshade that you can pull forward to block the rays of the sun. The sunshade must be opened and closed manually.

See *Sunroof (Extended Cab) on page 2-21* or *Sunroof (Crew Cab) on page 2-22*.

Performance and Maintenance

StabiliTrak® System

If equipped, the vehicle has a traction control system that limits wheel spin and the StabiliTrak system that 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 traction control, press and release on the instrument panel. illuminates and the appropriate DIC message displays. See *Ride Control System Messages on page 5-47*.

7.1 OWNER'S MANUAL PAGES

- To turn off both traction control and StabiliTrak, press and hold until illuminates and the appropriate DIC message displays. See *Ride Control System Messages on page 5-47*.
- Press and release again to turn on both systems.

For more information, see *StabiliTrak® System on page 9-70*.

Tire Pressure Monitor

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

The TPMS warning light alerts you to a significant loss in pressure of one of the vehicle's tires.

If the warning light comes on, stop as soon as possible and inflate the tires to the recommended pressure shown on the Tire and Loading Information label. See *Vehicle Load Limits on page 9-25*. The warning light will remain on until the tire pressure is corrected.

During cooler conditions, the low tire pressure warning light may appear when the vehicle is first started and then turn off. This may be an early indicator that the tire pressures are getting low and the tires need to be inflated to the proper pressure.

The TPMS 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 10-68*.

Engine Oil Life System

The engine oil life system calculates engine oil life based on vehicle use and, on most vehicles, displays a DIC message when it is necessary to change the engine oil and filter. The oil life system should be reset to 100% only following an oil change.

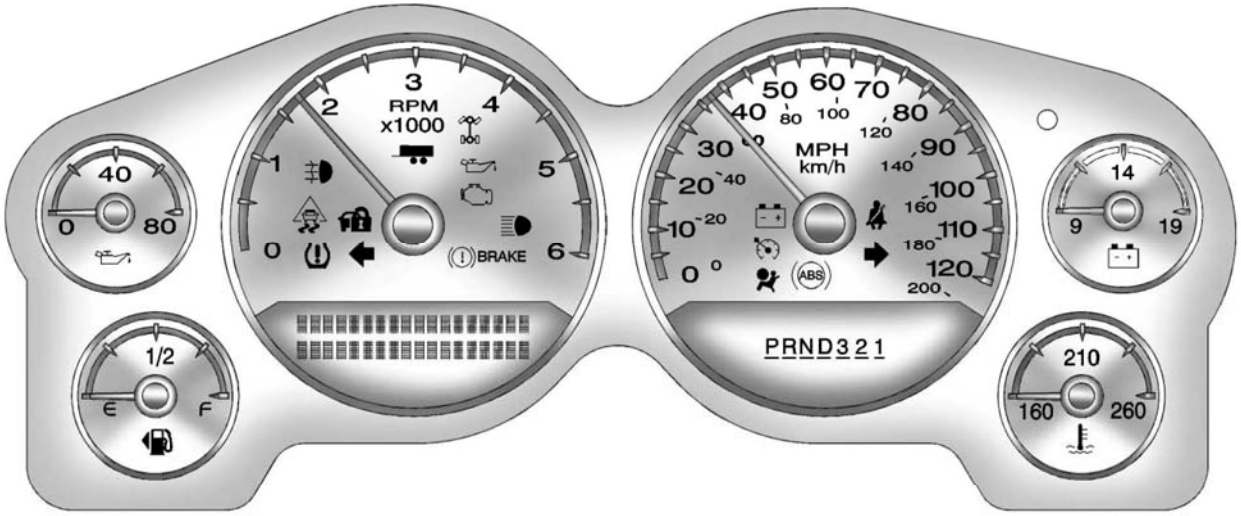
Resetting the Oil Life System

To reset the Engine Oil Life System on most vehicles:

1. Display OIL LIFE REMAINING on the DIC. If the vehicle does not have DIC buttons, the vehicle must be in P (Park) to access this display.
2. Press and hold the SET/RESET button on the DIC, or the trip odometer reset stem if the vehicle does not have DIC buttons, for more than five seconds. The oil life will change to 100%.

7.1 OWNER'S MANUAL PAGES

Instrument Cluster



English Light Duty Premium Shown. Metric, Uplevel, Base, Heavy Duty Similar.

StabiliTrak® Indicator Light

For vehicles with the StabiliTrak system, this light comes on briefly while starting the engine.

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

If the light comes on and stays 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 StabiliTrak system is off and does not limit wheel spin.

The light flashes if the system is active and is working to assist the driver with directional control of the vehicle in difficult driving conditions.

See *StabiliTrak® System on page 9-70* for more information.

If the vehicle is a hybrid, see the hybrid supplement for more information.

Tire Pressure Light

For vehicles with the Tire Pressure Monitor System (TPMS), this light comes on briefly when the engine is started. It provides information about tire pressures and the TPMS.

When the Light is On Steady

This indicates that one or more of the tires are significantly underinflated.

A tire pressure message can accompany the light. See *Tire Messages on page 5-49* for more information. Stop as soon as possible, and inflate the tires to the pressure value shown on the Tire and Loading Information label. See *Tire Pressure on page 10-66* for more information.

When the Light Flashes First and Then is On Steady

This indicates that there may be a problem with the Tire Pressure Monitor System. The light flashes for about a minute and stays on steady for the remainder of the ignition cycle. This sequence repeats with every ignition cycle. See *Tire Pressure Monitor Operation on page 10-69* for more information.

7.1 OWNER'S MANUAL PAGES

SERVICE PARK ASSIST

If the 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 9-76* for more information. See your dealer for service.

Ride Control System Messages

SERVICE STABILITRAK

If the vehicle has StabiliTrak and this message displays, it means there may be a problem with the StabiliTrak system. If you see this message, 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. You should see your dealer 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

If the vehicle has StabiliTrak, this message displays when there is a problem with the Traction Control System (TCS). When this message displays, the system will not limit wheel spin. Adjust your driving accordingly. See your dealer for service. See *StabiliTrak® System on page 9-70* for more information.

STABILITRAK OFF

If the vehicle has StabiliTrak, this message displays when you turn off StabiliTrak, or when the stability control has been automatically disabled. To limit wheel spin and realize the full benefits of the stability enhancement system, you should normally leave StabiliTrak on. However, you should turn StabiliTrak off if your vehicle gets stuck in sand, mud, ice, or snow and you want to rock your vehicle to attempt to free it, or if you are driving in extreme off-road conditions and require more wheel spin. See *If the Vehicle is Stuck on page 9-23*. To turn the StabiliTrak system on or off, see *StabiliTrak® System on page 9-70*.

There are several conditions that can cause this message to appear.

- If the vehicle is overheating, which could occur if StabiliTrak activates continuously for an extended period of time.
- If the brake system warning light is on. See *Brake System Warning Light on page 5-27*.
- If the stability system takes longer than usual to complete its diagnostic checks due to driving conditions.
- If an engine or vehicle related problem has been detected and the vehicle needs service. See your dealer.
- If the vehicle is shifted into 4LO.

The message turns off as soon as the conditions that caused the message to be displayed are no longer present.

TRACTION CONTROL OFF

If the vehicle has StabiliTrak, this message displays when the Traction Control System (TCS) is turned off. Adjust your driving accordingly. See *StabiliTrak® System on page 9-70* for more information.

Airbag System Messages

SERVICE AIR BAG

This message displays if there is a problem with the airbag system. Have your dealer inspect the system for problems. See *Airbag Readiness Light on page 5-20* and *Airbag System on page 3-29* 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 before turning off the engine. See *Immobilizer Operation on page 2-13* for more information.

Starting the Vehicle Messages

FAST IDLE ON

If your vehicle has this feature, this message displays when the fast idle feature is on. See *Fast Idle System on page 9-39* for more information.

Drive Systems

Four-Wheel Drive

If the vehicle has Four-Wheel Drive, you can send the engine's driving power to all four wheels for extra traction. To get the most satisfaction out of Four-Wheel Drive, you must be familiar with its operation. Read the following before using Four-Wheel Drive. See the appropriate text for the transfer case in the vehicle.

Notice: **Driving on clean, dry pavement in Four-Wheel Drive High or Four-Wheel Drive Low for an extended period of time may cause premature wear on the vehicle's powertrain. Do not drive on clean, dry pavement in Four-Wheel Drive High or Four-Wheel Drive Low for extended periods of time.**

While driving on clean dry pavement and during tight turns, you may experience vibration in the steering system.

If the vehicle has StabiliTrak®, shifting into Four-Wheel Drive Low will turn Traction Control and StabiliTrak off. See *StabiliTrak® System on page 9-70*.

Front Axle

The front axle engages and disengages automatically when you shift the transfer case. Some delay for the axle to engage or disengage is normal.

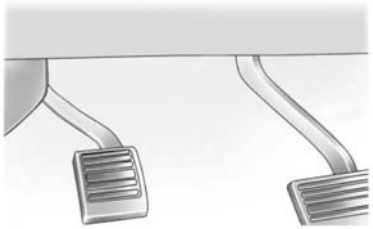
Manual Transfer Case

The transfer case shift lever is on the floor to the right of the driver. Use this lever to shift into and out of Four-Wheel Drive.

Braking in Emergencies

ABS allows the driver to steer and brake at the same time. In many emergencies, steering can help more than even the very best braking.

Parking Brake



Set the parking brake by holding the regular brake pedal down, then pushing down the parking brake pedal.

If the ignition is on, the brake system warning light will come on. See *Brake System Warning Light on page 5-27*.

Notice: **Driving with the parking brake on can overheat the brake system and cause premature wear or damage to brake system parts. Make sure that the parking brake is fully released and the brake warning light is off before driving.**

To release the parking brake, hold the regular brake pedal down, then push down momentarily on the parking brake pedal until you feel the pedal release. Slowly pull your foot up off the parking brake pedal. If the parking brake is not released when you begin to drive, the brake system warning light will flash and a chime will sound warning you that the parking brake is still on.

If you are towing a trailer and are parking on a hill, see *Driving Characteristics and Towing Tips on page 9-91*.

Brake Assist (Except With 4.3L V6 Engine)

If this vehicle has StabiliTrak®, it also 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.

7.1 OWNER'S MANUAL PAGES

Minor brake pedal pulsation 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.

Hill Start Assist (HSA)

2500 and 3500 series vehicles with StabiliTrak have a Hill Start Assist (HSA) feature, which may be useful when the vehicle is stopped on a grade. This feature is designed to prevent the vehicle from rolling, either forward or rearward, during vehicle drive off. After the driver completely stops and holds the vehicle in a complete standstill on a grade, HSA will be automatically activated. During the transition period between when the driver releases the brake pedal and starts to accelerate to drive off on a grade, HSA holds the braking pressure for a maximum of two seconds to ensure that there is no rolling. The brakes will automatically release when the accelerator pedal is applied within the two-second window. If the vehicle is equipped with the Integrated Trailer Brake Control (ITBC) system, HSA may also apply the trailer brakes. It will not activate if the vehicle is in a drive gear and facing downhill or if the vehicle is facing uphill and in R (Reverse). There may be situations on minor hills (less than 5% grade) with a loaded vehicle or while pulling a trailer where HSA will not activate.

Ride Control Systems

StabiliTrak® System

The vehicle may have a vehicle stability enhancement system called StabiliTrak®. It is an advanced computer-controlled system that assists the driver with directional control of the vehicle in difficult driving conditions.

StabiliTrak activates when the computer senses a discrepancy between the intended path and the direction the vehicle is actually traveling. StabiliTrak selectively applies braking pressure at any one of the vehicle's brakes to assist the driver with keeping the vehicle on the intended path.

7.1 OWNER'S MANUAL PAGES

When the vehicle is started and begins to move, the system performs several diagnostic checks to insure 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 mi) of driving before the system initializes.

If cruise control is being used when StabiliTrak activates, the cruise control automatically disengages. The cruise control can be re-engaged when road conditions allow. See *Cruise Control on page 9-73* for more information.

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, STABILITRAK OFF, SERVICE STABILITRAK. If these DIC messages appear, make sure the StabiliTrak system has not been turned off using the StabiliTrak on/off button. Then turn the vehicle off, wait 15 seconds, and turn it back on again to reset the system. If any of these messages still appear on the DIC, the vehicle should be taken in for service. For more information on the DIC messages, see *Ride Control System Messages on page 5-47*.

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 System (TCS) part of StabiliTrak can be turned off by pressing and releasing the StabiliTrak button. To disable both TCS and StabiliTrak, press and hold until illuminates and the appropriate DIC message displays.

TCS and StabiliTrak can be turned on by pressing and releasing the StabiliTrak button if they are not automatically shut off for any other reason.

7.1 OWNER'S MANUAL PAGES

When TCS or StabiliTrak is turned off, the StabiliTrak light and the appropriate 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 still be heard as a result of the brake-traction control coming on.

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 9-23*.

When the transfer case is in 4LO, the stability system is automatically disabled, the StabiliTrak light comes on, and the STABILITRAK OFF message will appear on the DIC. Both traction control and StabiliTrak are automatically disabled in this condition.

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, 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 9-73*.

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 for service.

2500 and 3500 series vehicles with StabiliTrak have a Trailer Sway Control (TSC) feature. See *Trailer Sway Control (TSC) on page 9-124*.

2500 and 3500 series vehicles with StabiliTrak have a Hill Start Assist (HSA) feature. See *Hill Start Assist (HSA) on page 9-70*.

Adding non-dealer accessories can affect the vehicle's performance. See *Accessories and Modifications on page 10-3*.

Locking Rear Axle

Vehicles with a locking rear axle can give more traction on snow, mud, ice, sand, or gravel. It works like a standard axle most of the time, but when traction is low, this feature will allow the rear wheel with the most traction to move the vehicle.

Cruise Control

⚠ 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.

For vehicles 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).

7.1 OWNER'S MANUAL PAGES

Integrated Trailer Brake Control System

The vehicle may have an Integrated Trailer Brake Control (ITBC) system for electric trailer brakes.

This symbol is located on the Trailer Brake Control Panel on vehicles with an Integrated Trailer Brake Control system. The power output to the trailer brakes is based on the amount of brake pressure being applied by the vehicle's brake system. This available power output to the trailer brakes can be adjusted to a wide range of trailering situations.

The ITBC system is integrated with the vehicle's brake, antilock brake, and StabiliTrak (if equipped) systems. In trailering conditions that cause the vehicle's antilock brake or StabiliTrak systems to activate, power sent to the trailer's brakes will be automatically adjusted to minimize trailer wheel lock-up. This does not imply that the trailer has StabiliTrak.

2500 and 3500 series vehicles with StabiliTrak have a Trailer Sway Control (TSC) feature. See *Trailer Sway Control (TSC) on page 9-124*.

2500 and 3500 series vehicles with StabiliTrak have a Hill Start Assist (HSA) feature. See *Hill Start Assist (HSA) on page 9-70*.

If the vehicle's brake, antilock brake, or StabiliTrak systems are not functioning properly, the ITBC system may not be fully functional or may not function at all. Make sure all of these systems are fully operational to ensure full functionality of the ITBC system.

The ITBC system is powered through the vehicle's electrical system. Turning the ignition off will also turn off the ITBC system. The ITBC system is fully functional only when the ignition is in ON or in RUN.

The ITBC system can only be used with trailers with electric brakes.

⚠ WARNING

Connecting a trailer that is not compatible with the ITBC system may result in reduced or complete loss of trailer braking. There may be an increase in stopping distance or trailer instability which could result in personal injury or damage to the vehicle, trailer, or other property. An aftermarket controller may be available for use with trailers with surge, air, or electric-over-hydraulic trailer brake systems. To determine the type of brakes on the trailer and the availability of controllers, check with your trailer manufacturer or dealer.

7.1 OWNER'S MANUAL PAGES

SERVICE TRAILER BRAKE SYSTEM: This message will be displayed when there is a problem with the ITBC system. If this message persists over multiple ignition cycles, there is a problem with the ITBC system. Take the vehicle to an authorized GM dealer to have the ITBC system diagnosed and repaired.

If either the CHECK TRAILER WIRING or SERVICE TRAILER BRAKE SYSTEM message is displayed while driving the vehicle, power is no longer available to the trailer brakes. When traffic conditions allow, carefully pull the vehicle over to the side of the road and turn the ignition off. Check the wiring connection to the trailer and turn the ignition back on. If either of these messages continues, either the vehicle or trailer needs service.

An authorized GM dealer may be able to diagnose and repair problems with the trailer. However, any diagnosis and repair of the trailer is not covered under the vehicle warranty. Please contact your trailer dealer for assistance with trailer repairs and trailer warranty information.

Trailer Sway Control (TSC)

Trailer Sway Control (TSC)

2500 and 3500 series vehicles with StabiliTrak have a Trailer Sway Control (TSC) feature. If the vehicle is towing a trailer and the system detects that the trailer is swaying, the vehicle's brakes are applied without the driver pressing the brake pedal. If the vehicle is equipped with the Integrated Trailer Brake Control (ITBC) system, StabiliTrak may also apply the trailer brakes. The TCS/StabiliTrak warning light will flash on the instrument panel cluster to notify the driver to reduce speed. If the trailer continues to sway, StabiliTrak will reduce engine torque to help slow the vehicle.

Adding non-dealer accessories can affect the vehicle's performance. See *Accessories and Modifications on page 10-3* for more information.

7.2 VEHICLE ARRIVAL CONDITION REPORT

CONTRACT NO.: *DTNH22-08-D-00098*
DATE: *8/26/2011*

From: *Automotive Allies*

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

To: *Dynamic Research, Inc*

Vehicle VIN: *3GTP2VE33BG386727* NHTSA NO.: *CB0108*
Model Year: *2011* Odometer Reading: *5* Miles
Make *GMC* Body Style: *Truck*
Model: *Sierra 1500* Body Color: *White*
Manufacture Date: *7/11* Dealer: *Automotive Allies*
GVWR (kg/lb) *3175/7000* 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: *8/26/2011*

APPROVED BY: *P Broen* DATE APPROVED: *8/26/2011*

7.3 VEHICLE COMPLETION CONDITION REPORT

CONTRACT NO.: *DTNH22-08-D-00098*
DATE: *9/27/2011*

Vehicle VIN: *3GTP2VE33BG386727* NHTSA NO.: *CB0108*
Model Year: *2011* Odometer Reading: *79* Miles
Make: *GMC* Body Style: *Truck*
Model: *Sierra 1500* Body Color: *White*
Manufacture Date: *7/11* Dealer: *Automotive Allies*
GVWR (kg/lb) *3175 (7000)* 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, like-new

RECORDED BY: *J Lenkeit* DATE RECORDED: *9/27/2011*

APPROVED BY: *P Broen* DATE APPROVED: *9/27/2011*

7.4 SINE WITH DWELL TEST RESULTS

2011 GMC Sierra 1500 4WD Crew Cab (2WD Drive Configuration)

NHTSA No.: *CB0108*
Date of Test : *9/13/2011*
Date Created: *9/14/11*

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	YRR 1 Ct	YRR 175	YR175	YRR17 5 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)
21	709	50.07	3.536	1091	5.446	847	4.226	-2.34	-0.29	1291	-2.79	-0.34	1441	12.19	945	-4.12	0.41	61.30	775	60.95
22	708	50.21	3.532	1091	5.446	847	4.226	-1.76	-0.27	1291	-1.85	-0.29	1441	15.65	934	-5.18	0.49	81.16	775	80.93
23	707	50.40	3.527	1090	5.445	846	4.225	-1.31	-0.25	1290	-1.24	-0.24	1440	19.27	925	-6.23	0.57	102.00	775	101.81
24	707	50.39	3.526	1090	5.445	847	4.226	-0.81	-0.19	1290	-0.60	-0.14	1440	23.15	923	-7.14	0.62	122.06	775	121.99
25	706	50.47	3.524	1090	5.445	846	4.225	-0.68	-0.16	1290	-0.58	-0.13	1440	22.86	932	-7.61	0.62	142.15	775	141.85
26	706	50.13	3.523	1090	5.444	847	4.226	-1.38	-0.35	1290	-0.67	-0.17	1440	25.74	911	-8.24	0.64	162.17	775	161.86
27	706	50.21	3.522	1090	5.444	846	4.225	-0.73	-0.19	1290	-0.43	-0.11	1440	26.27	910	-8.05	0.63	183.16	775	182.87
28	706	50.23	3.523	1090	5.444	847	4.226	-1.50	-0.39	1290	-0.85	-0.22	1440	26.09	909	-8.04	0.63	203.16	775	202.66
29	706	50.19	3.523	1090	5.445	847	4.226	-1.38	-0.39	1290	-1.01	-0.28	1440	27.94	912	-8.45	0.65	223.05	775	222.72
30	706	50.34	3.523	1091	5.449	847	4.227	-1.78	-0.49	1291	-0.43	-0.12	1441	27.72	909	-8.29	0.66	243.88	776	243.71
31	706	50.11	3.524	1097	5.480	847	4.228	-1.54	-0.43	1297	-1.12	-0.31	1447	27.76	906	-7.99	0.66	262.28	777	263.63
32	706	50.39	3.523	1091	5.449	847	4.228	-0.42	-0.12	1291	-0.78	-0.22	1441	28.65	906	-8.26	0.67	267.86	778	269.55

7.4 SINE WITH DWELL TEST RESULTS

2011 GMC Sierra 1500 4WD Crew Cab (2WD Drive Configuration)

NHTSA No.: *CB0108*
Date of Test : *9/13/2011*
Date Created: *9/14/11*

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	YRR 1 Ct	YRR 175	YR175	YRR17 5 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)
33	709	50.16	3.536	1090	5.445	847	4.227	-0.66	0.08	1290	-0.85	0.10	1440	-12.25	953	4.15	-0.39	61.91	775	61.64
34	708	49.99	3.531	1090	5.445	847	4.227	-0.86	0.14	1290	-0.78	0.12	1440	-16.04	931	5.24	-0.49	81.91	775	81.53
35	707	50.18	3.527	1090	5.444	847	4.226	-1.02	0.20	1290	-0.16	0.03	1440	-19.57	934	6.28	-0.56	102.77	775	102.38
36	706	50.23	3.525	1090	5.444	847	4.226	-0.65	0.15	1290	0.02	0.00	1440	-23.21	934	6.91	-0.61	122.93	775	122.44
37	706	50.09	3.522	1090	5.444	846	4.225	-0.82	0.19	1290	-0.95	0.22	1440	-23.53	939	7.46	-0.62	142.86	775	142.40
38	706	50.18	3.522	1090	5.444	847	4.226	-1.25	0.31	1290	-0.27	0.07	1440	-24.53	911	7.76	-0.64	162.95	775	162.34
39	706	50.10	3.522	1090	5.444	847	4.226	-1.01	0.27	1290	-0.76	0.20	1440	-26.82	909	7.67	-0.62	184.02	775	183.30
40	706	50.05	3.521	1090	5.443	847	4.226	-0.63	0.18	1290	0.23	-0.07	1440	-28.07	913	7.90	-0.65	204.02	775	202.95
41	706	50.35	3.522	1090	5.444	847	4.227	-1.58	0.43	1290	-0.67	0.18	1440	-27.38	910	7.84	-0.62	223.86	775	222.95
42	706	50.36	3.522	1091	5.446	847	4.227	-0.97	0.27	1291	-0.16	0.04	1441	-28.33	911	7.87	-0.66	244.50	776	244.11
43	706	50.17	3.523	1091	5.449	847	4.229	-1.26	0.37	1291	-0.44	0.13	1441	-29.27	909	8.07	-0.66	263.27	777	264.06
44	706	49.92	3.523	1091	5.448	847	4.229	-1.06	0.30	1291	-0.55	0.16	1441	-28.48	910	7.88	-0.68	268.75	778	270.05

7.4 SINE WITH DWELL TEST RESULTS

2011 GMC Sierra 1500 4WD Crew Cab (4WD Drive Configuration)

NHTSA No.: *CB0108*

Date of Test : *9/14/2011*

Date Created: *9/14/2011*

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	YRR 1 Ct	YRR 175	YR175	YRR17 5 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)
22	709	50.11	3.536	1091	5.446	847	4.226	-0.34	-0.04	1291	-0.39	-0.05	1441	12.53	939	-4.07	0.40	63.33	775	63.01
23	708	50.31	3.531	1090	5.445	846	4.225	-0.61	-0.10	1290	-1.11	-0.18	1440	16.06	934	-5.24	0.49	83.28	775	82.98
24	707	50.11	3.527	1090	5.445	846	4.225	-1.32	-0.26	1290	-0.83	-0.16	1440	19.29	928	-6.21	0.55	104.10	775	103.84
25	706	50.20	3.525	1090	5.444	846	4.225	-1.28	-0.30	1290	-1.21	-0.28	1440	23.09	921	-7.07	0.63	125.25	775	124.94
26	706	50.13	3.524	1090	5.444	846	4.225	-1.88	-0.43	1290	-1.86	-0.42	1440	22.67	911	-7.50	0.62	146.25	775	145.91
27	706	50.39	3.523	1090	5.444	847	4.226	-1.51	-0.38	1290	-0.58	-0.15	1440	25.36	911	-7.82	0.64	167.22	775	166.84
28	706	50.36	3.523	1090	5.445	847	4.226	-1.16	-0.31	1290	-0.77	-0.20	1440	26.48	909	-7.86	0.64	188.18	775	187.76
29	706	50.44	3.523	1090	5.445	847	4.226	-1.48	-0.39	1290	-0.68	-0.18	1440	26.43	909	-7.93	0.63	208.10	775	207.60
30	706	50.51	3.522	1091	5.447	847	4.226	-2.26	-0.62	1291	-1.41	-0.39	1441	27.52	911	-8.10	0.66	229.11	775	228.60
31	706	50.26	3.523	1094	5.462	847	4.227	-0.96	-0.27	1294	-0.25	-0.07	1444	27.69	909	-7.96	0.67	249.64	776	249.61
32	706	50.16	3.523	1092	5.453	847	4.227	-1.38	-0.38	1292	-0.11	-0.03	1442	27.46	905	-8.03	0.62	268.77	778	270.41

7.4 SINE WITH DWELL TEST RESULTS

2011 GMC Sierra 1500 4WD Crew Cab (4WD Drive Configuration)

NHTSA No.: *CB0108*

Date of Test : *9/14/2011*

Date Created: *9/14/2011*

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	YRR 1 Ct	YRR 175	YR175	YRR17 5 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)
33	709	50.11	3.536	1090	5.445	847	4.226	-2.02	0.25	1290	-1.02	0.13	1440	-12.29	941	4.22	-0.40	63.87	775	63.75
34	707	50.34	3.530	1090	5.444	846	4.225	-1.45	0.24	1290	-1.17	0.19	1440	-16.24	932	5.34	-0.49	83.90	775	83.60
35	707	50.39	3.526	1091	5.450	848	4.232	-0.76	0.15	1291	-1.41	0.28	1441	-19.82	928	6.32	-0.56	104.71	776	104.43
36	706	50.48	3.524	1090	5.444	847	4.226	-1.76	0.41	1290	-1.18	0.27	1440	-23.09	922	7.02	-0.60	125.91	775	125.63
37	706	50.34	3.522	1090	5.444	846	4.225	-1.71	0.41	1290	-1.29	0.31	1440	-24.19	939	7.51	-0.63	146.95	775	146.58
38	706	50.14	3.522	1090	5.444	847	4.226	-1.63	0.41	1290	-0.89	0.23	1440	-25.26	911	7.88	-0.64	168.02	775	167.41
39	706	50.23	3.522	1090	5.444	847	4.226	-0.79	0.20	1290	-0.59	0.15	1440	-25.81	910	7.76	-0.63	188.98	775	188.19
40	706	50.45	3.522	1090	5.444	847	4.226	-1.22	0.34	1290	-0.82	0.23	1440	-27.76	910	7.94	-0.64	208.88	775	208.05
41	706	50.17	3.522	1090	5.445	847	4.227	-1.34	0.37	1290	-0.64	0.18	1440	-27.44	910	7.97	-0.63	229.58	775	229.12
42	706	50.42	3.522	1091	5.447	847	4.228	-0.24	0.07	1291	0.48	-0.14	1441	-28.74	911	8.06	-0.68	250.16	776	250.12
43	706	50.19	3.523	1091	5.446	847	4.229	-0.17	0.05	1291	0.18	-0.05	1441	-28.80	909	8.34	-0.65	269.59	778	270.86

7.5 SLOWLY INCREASING STEER TEST RESULTS

2011 GMC Sierra 1500 4WD Crew Cab (2WD Drive Configuration)

NHTSA No.: *CB0108*

Date of Test: *9/13/2011*

Date Created: *9/13/11*

File	EventPt	DOS	MES (mph)	Mean SPD (mph)	AYcount_3	THETAENCF_3 (deg)	AYCG_CD2_3 (g)	r_squared	ZeroBegin	ZeroEnd
10	700	1	49.633	49.741	1316	-41.237	-0.297	0.994	500	700
11	703	1	49.526	49.835	1314	-41.056	-0.299	0.998	503	703
12	705	1	49.853	50.012	1324	-41.831	-0.303	0.998	505	705
13	717	0	49.777	49.980	1290	39.499	0.293	0.998	517	717
14	700	0	49.566	49.738	1294	39.822	0.299	0.998	500	700
15	700	0	49.835	49.831	1298	40.102	0.296	0.998	500	700
					Averages	40.591	0.298			

Scalars	Steering Angles (deg)
1.5	61
2.0	81
2.5	102
3.0	122
3.5	142
4.0	162
4.5	183
5.0	203

Scalars	Steering Angles (deg)
5.5	223
6.0	244
6.7	264

7.5 SLOWLY INCREASING STEER TEST RESULTS

2011 GMC Sierra 1500 4WD Crew Cab (4WD Drive Configuration)

NHTSA No.: *CB0108*

Date of Test: *9/14/2011*

Date Created: *9/14/2011*

File	EventPt	DOS	MES (mph)	Mean SPD (mph)	AYcount_3	THETAENCF_3 (deg)	AYCG_CD2_3 (g)	r_squared	ZeroBegin	ZeroEnd
10	709	1	49.644	49.798	1326	-41.927	-0.310	0.996	509	709
11	716	1	49.801	49.905	1330	-42.270	-0.304	0.996	516	716
12	700	1	49.444	49.858	1328	-42.106	-0.298	0.994	500	700
13	697	0	49.409	49.756	1319	41.552	0.301	0.997	497	697
14	711	0	49.777	49.801	1315	41.286	0.303	0.995	511	711
15	697	0	49.774	49.773	1316	41.262	0.297	0.996	497	697
					Averages	41.724	0.302			

Scalars	Steering Angles (deg)
1.5	63
2.0	83
2.5	104
3.0	125
3.5	146
4.0	167
4.5	188
5.0	209

Scalars	Steering Angles (deg)
5.5	229
6.0	250
6.5	271

7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES

Vehicle: **2011 GMC Sierra 1500 4WD Crew Cab** NHTSA No.: CB0108

Wheelbase: 143.8 Inches Faro Arm S/N: U08-05-08-06636

Measurement date: 9/9/2011 Certification date: 11/7/10

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	2.438		0.000
M_Point_48_Ref	0.000	0.000	-
M_CIRCLE001_I_Left_Rear_Wheel_Axle	-52.191	8.521	-15.210
M_Point_IMU_side	19.327	44.694	-28.163
M_Point_ROOF	-	-	-73.844
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	19.327	46.219	-28.163

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	**72.282**	**-1.781**	**28.163**

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).